

DRUŠTVO GENETIČARA SRBIJE
SOCIETY OF GENETICISTS OF SERBIA

PRVI SIMPOZIJUM ZA OPLEMENJIVANJE ORGANIZAMA SA
MEĐUNARODNIM UČEŠĆEM
THE FIRST SYMPOSIUM ON THE BREEDING OF ORGANISMS
- WITH INTERNATIONAL PARTICIPATION -
Vrnjačka Banja, 8 - 11 November 1995

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abstracts



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ABSTRAKTI

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Organizacioni odbor

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BIOMETRIJSKI KONCEPT U IZUČAVANJU HETEROZISA

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Većina postojećih teorija o heterozisu može se svrstati u dve, međusobno suprotstavljene grupe. Jedna, genetičku osnovu heterozisa zasniva na pojavi superdominacije, a druga na dominaciji poželjnih gena koji kontrolišu ekspresiju određenog kvantitativnog svojstva. Do danas nema opšte prihvatljivog modela, međutim noviji teorijski i eksperimentalni rezultati, uglavnom engleskih autora, favorizuju teoriju disperzne dominacije. Biometrijski koncept heterozisa čini se pogodnim za njeno tumačenje, bez obzira da li se radi o međupopulacijskom ili međulinijskom F1 potomstvu. Kod međupopulacijskog ukrštanja (po- drazumevajući Hardy-Weinber equilibrium roditelja), koristeći standardnu simboliku Falconer-a, prosečna vrednost potomstva iznosila bi $F_1 = a(pp' - qq') + d(pq + qp')$, a efekat heterozisa $h = a [pp' - qq' - (1/2)(p - q + p' - q')] + d [(pq' + qp') - (pq - p'q')] = d(p - p')^2$; (ako je $p + q = p' + q' = 1$). Navedena relacija jasno pokazuje da je $h = f(d)$, te da je za svako $h > 0$, vrednost $d > 0$. Kod F1 potomstva dva homozigotna roditelja (gde se pozitivni heterozis izražava u odnosu na boljeg roditelja P1), koristeći simboliku Mather-a, očekivana vrednost heterozisa (h) u odnosu na procenjenu (F1-P1), može se izraziti formulama: $h = [h] - [d]$, (kao razlika dominantnog i aditivnog efekta gena), ili $h = ([h] + [1]) - ([d] + [i])$, (u slučaju prisustva dvogenske epistaze). Podrazumevajući odgovarajuće algebarske odnose za vrednost $h > 0$, jasno je da će efekat heterozisa biti utoliko veći, ukoliko je vrednost [h], odnosno ([h] + [01]) veća u odnosu na vrednost [d], odnosno ([d] + [i]). U radu će biti diskutovani i složeniji modeli biometrijskog koncepta heterozisa.

THE BIOMETRICAL CONCEPT IN STUDIES OF HETEROSIS

The majority of existing theories on heterosis could be classified into two, mutually opposite groups. The first they founds the genetic basic of heterosis on super dominance, and the second one on the dominance of favourable genes responsible for the expresses of a certain quantitative trait. Although a generally accepted model has not yet been introduced recent theoretical and experimental results, obtained mostly by English authors, favour the theory of dispersion dominance. The biometrical concept of heterosis seems to be suitable for its explanation, regardless of interpopulation or interline F1 progeny. The average value; of progenies in interpopulation crosses (following *Hardy- Weinberg* parental equilibrium) using standard *Falconer's* symbolic, would amount to $F_1 = a(pp' - qq') + d(pq + qp')$, while the effect of heterosis would be $h = a [pp' - qq' - (1/2)(p - q + p' - q')] + d [(pq' + qp') - (pq - p'q')] = d(p - p')^2$ if $p + q = p' + q' = 1$. The presented relation clearly shows that $h = f(d)$, so for each $h > 0$ the value of d is $d > 0$. The expected value of heterosis in F1 progenies of two homozygous parents in relation to the estimated (F1 - P1) (where positive heterosis is expressed in relation to the better parent P1), using *Mather's* symbolic, could be expressed by formulas: $h = [h] - [d]$, (as the difference between the dominant and additive gene effect), or $h = ([h] + [1]) - ([d] + [i])$, (in the case of digenic epistasis). After using appropriate algebraic ratios for the value $h > 0$, it is clear that the effect of heterosis will be

higher if the value of [h], *i.e.* of ([h] + [1]) is higher than the value of [d], *i.e.* of ([d] + [i]). Some more complex models of the biometrical concept of heterosis will also be discussed in this paper.

FIZIOLOŠKE OSNOVE SELEKCIJE PŠENICE NA EFIKASNOST ISHRANE AZOTOM

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U ovom radu analiziraju se osnove za stvaranje sorata pšenice efikasni u ishrani azotom, tj. sorata skromnih u zahtevima prema azotnim đubrivima. Efikasnost ishrane azotom meri se povećanjem prinosa po jedinici azota đubriva. Efikasnost đubrenja azotom (EFN) realizuje se kroz usvajanje azota iz đubriva (AN) i njegovo iskorišćavanje u biljci (UN) u formiranju prinosa i predstavlja njihov proizvod:

$$EFN = EAN \times EUN = \frac{AN}{Nf} \times \frac{Yg}{AN} = \frac{Yg}{Nf}$$

Na osnovu ove relacije prinos se može definisati kao proizvod iz akumulacije i iskorišćavanja azota u biljci: $Yg = AN \times EUN$ (FEN). Isti prinosi se mogu dobiti slaganjem visokih vrednosti jednog i niskih vrednosti drugog, ili osrednjih vrednosti oba pokazatelja. Objedinjavanjem visokih vrednosti oba parametra u novom genotipu, bez narušavanja balansa fizioloških procesa, može se ostvariti dalje povećanje prinosa i efikasnosti đubrenja azotom. Širok dijapazon variranja ovih parametara ukazuje da selekcija u ovom pogledu ima perspektive. Analize pokazuju da se usvajanje azota iz đubriva pšenicom može povećati sa sadašnjih 50% na 75% a iskorišćavanje sa sadašnjih 40 na 50 kg zrna na kilogram azota biljke. To bi omogućilo da se količine azotnih đubriva u proizvodnji pšenice smanje na polovinu. Pored ova dva pomenuta parametra koji nepotrebno utiču i određuju nivo efikasnosti ishrane pšenice azotom analizirani su i drugi parametri koji posredno ili neposredno utiču na usvajanje i iskorišćavanje azota u biljci. Analize su obuhvatile: biološki i poljoprivredni prinos; masa, aktivnost i dužina trajanja aktivnosti korenovog sistema; koncentracija azota u biljci; aktivnost fermenta metabolizma azota u biljci; akumulacija azota u biljci u periodu do i posle oplodnje; žetveni indeks azota; fertilizacija azota vegetativnih organa zrnom u reprodukcijom periodu. Za uspešnije vođenje selekcije pšenice u ovom pogledu neophodno je poznavanje genetskih osnova ovih procesa. Pošto su usvajanja azota iz đubriva i njegovo iskorišćavanje u biljci prostorno i vremenski odvojeni procesi, pretpostavlja se da ove procese kontrolišu dva odvojena genetska sistema. Za sada su ti sistemi malo ispitani.

PHYSIOLOGICAL BASES OF WHEAT SELECTION FOR NITROGEN NUTRITION EFFICIENCY

This paper analyzes the bases for the establishment of what varieties efficient in nitrogen nutrition, *i.e.* varieties with modest requirements of nitrogenous fertilizers. The efficiency of nitrogen nutrition is assessed by the increase of the yield per unit of fertilizer nitrogen. The efficiency of fertilizing with nitrogen (EFN) is realized through the accumulation of nitrogen from fertilizers (AN) and its utilization (UN) by the plant in the formation of yield, *i.e.* it is their product:

$$EFN = EAN \times EUN = \frac{AN}{Nf} \times \frac{Yg}{AN} = \frac{Yg}{Nf}$$

Based on this relation, the yield can be defined as the product of nitrogen accumulation and utilization in the plant: $Yg = AN \times EUN$ (FEN). The same yields can be obtained by the addition of high values of one and low values of another, or moderate values of both parameters. By uniting the high values of both parameters in the new genotypes, without the disturbance of the balance of physiological processes, a further increase of the yield and efficiency of nitrogenous fertilizers can be realized. The wide range of variation of these parameters indicates that the selection is promising in this respect. The analyses show that the absorption of nitrogen by wheat can be increased from the present 50 % to 75 %, and the utilization from the present 40 to 50 kg of grain per kilogram of plant nitrogen. This would enable the cutting of the amounts of nitrogenous fertilizers in wheat production by half. In addition to the above two parameters which directly affect and determine the level of efficiency of nitrogenous fertilizers; several other parameters have also been analyzed, which directly or indirectly affect the accumulation and utilization of nitrogen in the plant. The analyses included: biological and agricultural yield; mass, activity and duration of root activity; nitrogen concentration in the plant; activity of enzymes of nitrogen metabolism in the plant; accumulation of nitrogen in the plant in the period before and after fertilization; harvest index of nitrogen; re-utilization of nitrogen in the vegetative organs by the grain in the reproduction period. If wheat selection in this respect is to be more successful, it is necessary to know the genetic bases of these processes. As nitrogen accumulation from fertilizers and its utilization in the plant are processes separated in space and time, it is supposed that these processes are controlled by two separate genetic systems. Up to now, these systems have been insufficiently investigated.

**PETNAEST GODINA REKURENTNE SELEKCIJE NA POVEĆAN SADRŽAJ ULJA U ZRNU
KUKURUZA (*Zea mays* L.)**

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U Institutu za kukuruz – Zemun Polje, rad na rekurentnoj selekciji kukuruza na povećan sadržaj ulja u zrnu započeo je 1980. godine stvaranjem sintetičkih populacija DS7u i YuSSSu koje međusobno čine heterotičan par. U radu su izučavani odgovori populacija na masovnu selekciju, inbriding depresija, heterozis i korelacioni odnosi između važnijih agronomskih osobina ove dve visokouljane populacije kukuruza. Pored toga, izučavane su i promene u frekvenciji aditivnih i dominantnih alela koje su se desile kao posledica dejstva rekurentne selekcije na povećan sadržaj ulja u zrnu, kao i efekat genetičkog drifta u populacijama. Kao statističko-biometrijske metode obrade podataka korišćeni su analiza varijanse za TRIPPLE LATTICE dizajn, regresiona analiza po Eberhartu-u (1964) i model Smith-a (1979a; 1979b i 1983) koji je omogućio da se ukupan odgovor na selekciju razdvoji na efekte zbog delovanja aditivnih i dominantnih alela, izuče promene u frekvenciji alela i odredi efekat genetičkog drifta i njegovo učešće u odgovoru populacija na selekciju. Rezultati istraživanja su potvrdili efikasnost masovne, fenotipske, rekurentne selekcije na povećan sadržaj ulja u zrnu u obe ispitivane populacije *per se* i u interpopulacijskim ukrštanjima. Ustanovljeni direktni odgovori ovih populacija *per se* na selekciju bili su 15.13 % ciklus⁻¹ za populaciju DS7u, odnosno 12.80 % ciklus⁻¹ za populaciju YuSSSu, a indirektan odgovor izmeren u interpopulacijskom ukrštanju bio je 14.35 % ciklus⁻¹. S povećanjem sadržaja ulja u zrnu menjale su se i druge agronomске osobine ovih populacija. Prinos zrna je kod DS7u populacije opadao s porastom sadržaja ulja u zrnu, a kod populacije YuSSSu je rastao kroz cikluse selekcije. Genetički drift nije bio važan kod DS7u populacije, za osobinu sadržaj ulja u zrnu, dok je kod YuSSSu populacije njegovo prisustvo uslovalo povećanje ove osobine. Kod obe populacije genetički drift je delovao u pravcu smanjenja prinosa zrna. Obe populacije mogu se koristiti kao izvor za dobijanje inbred linija sa povećanim sadržajem ulja u zrnu, dobrim prinosom i drugim agronomski važnim osobinama. Njihovim ukrštanjem bi se dobili prinosni visokouljani hibridi.

**FIFTEEN YEARS OF THE RECURRENT SELECTION FOR A HIGH OIL CONTENT IN MAIZE
(*Zea mays* L.)**

In the Maize Research Institute - Zemun Polje, the selection program for a high oil content in maize started in 1980 by establishing the synthetic maize populations, DS7u and YuSSSu. The purpose of this experiment was to study population responses to phenotypic, mass selection, inbreeding depression, heterosis and correlations among important agronomic traits of two high oil maize populations mutually forming a heterotic pair. Also, changes in additive and dominant allele frequencies, caused by the recurrent selection for a high oil content, as well as genetic drifts in populations were observed. Statistical and biometric data analysis included the

analysis of variance of the *TRIPLE LATTICE* design, regression analysis according to Eberhart (1964) and the model proposed by Smith (1979a; 1979b and 1983). This model allows the separation of selection effects due to additive and dominant alleles, from the total response. Investigation of changes in allele frequencies and determination of genetic drift effects and their contribution to the population response to selection. Obtained results proved the efficiency of mass, phenotypic, recurrent selection for a high grain oil content for both investigated populations *per se* and in interpopulation crosses. The observed direct responses to selection in populations *per se* were 15.13 % cycle⁻¹ and 12.80 % cycle⁻¹ for DS7u and YuSSSu populations, respectively. While the indirect response measured in interpopulation crosses was 14.35 % cycle⁻¹. Other agronomic traits of these populations changed simultaneously with the increase of the oil content. The grain yield decreased in the DS7u population, and increased in the YuSSSu population, simultaneously with the oil content increase, during selection cycles. The genetic drift was not important in the DS7u population, while it caused an increase of the oil content in the YuSSSu population. The genetic drift in both populations caused a grain yield reduction. Both populations could be used as a source for the development of inbred lines with a high oil content, high grain yield and other important agronomic traits. Yielding, high-oil hybrids could be derived from a cross of these inbreds.

MOLEKULARNI MARKERI I NJIHOVA UPOTREBA U QTL ANALIZI

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Pojava molekularnih markera (posebno RFLP i PCR siritetisanih) kao proba za genomsku DNK, unela je revoluciju u genetičku analizu gajenih biljaka i dala ne samo genetičarima nego i fiziolozima, agronomima i selekcionarima, korisno, novo oruđe za identifikaciju i izolaciju gena koji determinišu agronomski značajne osobine. Danas je dostupan širok spektar molekularnih markera koji imaju svoje prednosti i nedostatke, zavisno od opreme kojom se raspolaže i genetičkog materijala koji treba analizirati. Genetička mapa molekularnih markera omogućuje da se selekcija određenih osobina vrši daleko efikasnije nego što je to ranije bilo moguće. Konstrukcija ovih mapa kao i razvijene statističke metode su omogućile identifikaciju lokusa za kvantitativna svojstva. Ne samo da se na ovaj način određuje kompleksnost genetičke kontrole bilo koje od osobina koja se određuje, nego se poređenjem stepena preklapanja intervala pouzdanosti QTL, može ispitati verovatnoća da su osobine plejotropski vezane. Biohemičari i molekularni biolozi mogu da odrede značaj specifičnog produkta gena u determinisanju fenotipa biljke koristeći pristup preko gena, kandidata. Tako, cDNK probe za gene sa poznatom funkcijom, mogu biti mapirane a QTL analiza će pokazati da li je gen lociran unutar intervala pouzdanosti QTL za posmatranu osobinu. Alternativna metoda za ispitivanje značaja određenih gena u ekspresiji osobina je korišćenje grupnih uzoraka: populacije biljaka koje su selekcionisane da se razlikuju u ekspresiji određene osobine. Razlike u frekvenciji alela među grupama, koje su identifikovane hibridizacijom sa cDNK poznate funkcije ukazuju na regione genoma gde su locirani geni od važnosti za datu osobinu. Primeri ove metode biće prikazani u radu.

MOLECULAR MARKERS AND THEIR USE IN QTL ANALYSIS

The advent of molecular markers (particularly RFLP and PCR-derived) for use as probes for genomic DNA has revolutionized the genetic analysis of crop plants and provided not only geneticists, but also physiologists, agronomists and breeders with valuable new tools to identify and tag traits of agronomic importance. A wide range of molecular markers is now available, and these have advantages and disadvantages depending on the facilities available and genetic stock, to be examined. For the breeder, a genetic map saturated with molecular markers allows selection for certain characters to be carried out much more efficiently and effectively than was possible previously. High density maps allow the location of all major genes regulating the expression of a particular trait to be determined, and statistical methods have been developed to allow quantitative trait loci (QTL) for the trait to be identified. Not only does this allow the complexity of the genetic control of any trait to be determined, but by comparing the extent to which confidence intervals of QTL for different traits overlap it is possible to examine the likelihood that traits are pleiotropically linked. The biochemists and molecular biologists can use the candidate gene approach to determine the likely importance of a specific gene product in

determining the plant phenotype. Thus, cDNA probes to known function genes can be mapped and QTL analysis will show whether the gene is located within the confidence intervals of QTL for traits of interest. An alternative method for testing the importance of particular genes in trait expression is using bulked segregants: populations of plants selected to differ in expression of a particular trait. Differences in allele frequency between the two bulks, identified by hybridization with known-function cDNAs, indicate the regions of the genome where genes important in determining the trait are located. Examples of these techniques will be given.

UTICAJ TEMPERATURE NA METABOLIZAM CEREALIJA

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U radu će se govoriti o uticaju niske temperature na pšenicu, ječam i kukuruz. U toku su istraživanja uticaja niske temperature na proces sazrevanja rRNK kod sorti ječma i pšenice sa različitim stepenima otpornosti na mraz. Utvrđeno je da niska temperatura izaziva i kvantitativne i kvalitativne promene rRNK. Kod sorata sa slabom otpornošću na mraz, utvrđeno je da poslednji prekursori stabilne citoplazmatske rRNK akumuliraju, što pokazuje da je proces inhibiran. Ovi rezultati treba da posluže kao osnova za elaboriranje metoda selekcije. Izvršena su detaljna istraživanja sinteze poliamina tokom dugotrajnih tretmana niskim temperaturama sorata pšenice i hromozomskih supstitucionih linija, različitih stepena otpornosti na mraz. Rezultati pokazuju da alternativni način biosinteze poliamina, koji je prisutan samo kod viših biljaka, igra važnu ulogu u metabolizmu koji se odvija pri niskim temperaturama. Pored putrescina, niske temperature takođe indukuju sintezu agmatina. Detaljno su ispitane kvantitativne promene izvesnih jedinjenja koje sadrže N (putrescin - agmatin, prolin i glicin - betain) tokom istraživanja tolerancije niskih temperatura kod kukuruza i istraživana je korelacija između akumulacije ovih jedinjenja i osetljivosti na niske temperature datog genotipa kukuruza. U ovim eksperimentima korišćene su linije kukuruza koje su bile selekcionisane na osnovu osetljivosti na nisku temperaturu. Utvrđeno je da su sva tri jedinjenja, mada u različitom stepenu, pogodna za karakterizaciju osetljivosti na mraz različitih linija kukuruza. Separacija poliamina i prolina vršena je pomoću metoda HPLC, dok je glicin-betain identifikovan putem gasne hromatografije.

EFFECT OF TEMPERATURE ON THE METABOLISM OF CEREALS

I would like to discuss the effect of cold temperatures on wheat, barley and maize. Investigations are underway on the effect of cold temperatures on the rRNA maturation process in barley and wheat varieties with different degrees of frost resistance. It has been found that low temperature causes both quantitative and qualitative changes in rRNA processing. In varieties with poor frost resistance the last precursors of the stable cytoplasmic rRNAs are found to accumulate, demonstrating that the process is inhibited. These results could serve as the basis for the elaboration of a selection method. Detailed studies have been made on the synthesis of polyamines during long-term low temperature treatment in wheat varieties and eluosome substitution lines with various degrees of frost resistance. The results indicate that the alternative pathway of polyamine biosynthesis, present only in higher plants plays an important role in the metabolism taking place at low temperatures. In addition to putrescine, the low temperature induced synthesis of agmatine can also be demonstrated. Quantitative changes in certain N-containing compounds (putrescine- agmatine, proline and glycinebetaine) have been examined in detail during the cold tolerance process of maize, and correlations have been sought between the accumulation of these compounds and the low temperature sensitivity of the given maize genotype.

Maize lines selected by breeders on the basis of their response to low temperatures were used in the experiments. It was found that all three N-containing compounds were suitable, through to different extents, for characterising the cold tolerance of maize lines. The HPLC method was used to separate polyamines and proline, while glycine-betaine was identified using gas chromatography.

GENETSKA TRANSFORMACIJA HEKSAPLOIDNE PŠENICE PUTEM BOMBARDOVANJA ČESTICAMA MLADIH ZIGOTA I HAPLOIDNIH EMBRIONA IZ MIKROSPORA

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Genetska modifikacija biljaka korišćenjem *in vitro* kulture i metode transformacije otvorila je put za proučavanje procesa regulacije gena i za uvođenje strane DNK u biljni genom vrsta značajnih za poljoprivredu. Kod različitih vrsta biljaka, zaštita od insekata, virusa i herbicida dokumentovana je posle transfera gena, uglavnom kod dikotiledona, pomoću *Agrobacterium* transformacije. Nažalost, kod agronomski značajnih žitarica, ovaj sistem transformacije nije moguć, pa je stoga genetska manipulacija ovim vrstama još uvek teška. Ipak, pokazalo se da su dva metoda transformacije uspešna za dobijanje fertilnih transgenskih biljaka iz pšenice: direktni genski transfer u izolovani protoplast i metod mikroprojektilskog bombardovanja. Kod transformacije protoplasta, osnovni problem izgleda da nije kod DNK, već kod osnivanja kultura dugoročne regenerativne suspenzije, iz kojih se transgenske biljke efikasno povraćaju. Međutim, genski transfer pomoću mikroprojektila sposoban je da prevaziđe ova ograničenja direktnim dejstvom na tkiva ili ćelije koje se lako mogu dobiti i manipulirati *in vitro*. Sistem reproduktivne transformacije heksaploidne pšenice usavršen je tokom poslednjih nekoliko godina u našoj laboratoriji, putem bombardovanja česticama mladog zigota i haploidnih embriona. Bombardovanje česticama vršeno je azotom pod visokim pritiskom iz pištolja (proizvedenim u Mađarskoj pod nazivom Gene Booster). Biljni materijal je bombardovan sa plazmidom pDBI koji sadrži β -glukuronidaz gen (*uidA*) pod kontrolom actin-1 promoterom iz pirinča, i selektivnim marker genom bar (phosphinotricin acetyl- transferase) pod kontrolom CaMV 35S promotor. Haploidni i zigotni embrioni provereni su na enzimsku aktivnost histohemijskom GUS probom. Nedelju dana posle bombardovanja, regeneracija je sprovedena na 5 mg/l Basta (Glufosinate-ammonium) koji sadrži mediju za utvrđivanje klijavih transgenskih biljaka. Haploidni i diploidni regenerantni izdvojeni su na vodenim rastvorom biljke Basta. Molekularne analize su ukazale na prisustvo introdukovanih stranih gena u genomsku DNK i marker geni su utvrđeni kod većine regeneranata. Potomci su još uvek pod istraživanjima. Ova istraživanja su delimično potpomognuta mađarskim Fondom za naučnoistraživački rad (OTKA) No. T6009.

GENETIC TRANSFORMATION OF HEXAPLOID WHEAT VIA PARTICLE BOMBARDMENT OF YOUNG ZYGOTIC AND MICROSPORE DERIVED EMBRYOS

The genetic modification of plants used *in vitro* cultures and transformation techniques has opened the way to studying the processes of gene regulation, metabolic pathways and the introduction of foreign DNA of agronomic interest into the plant genome. In various plant species, protection against insects, viruses and herbicides has been documented after gene transfer, mostly in dicotyledonous plants using the *Agrobacterium*-mediated transformation. Unfortunately the *Agrobacterium*-mediated transformation system cannot be used, for

agro- nomically important cereals, therefore, the genetic manipulation of these species is still difficult. Nevertheless, two alternative transformation techniques have proved to be successful in obtaining fertile transgenic plants from wheat: the direct gene transfer into isolated protoplast and the method of microprojectile bombardment. In the case of protoplast transformation the fundamental problem does not seem to be the delivery of DNA, but the establishment of long term regenerative suspension cultures, from which transgenic plants can be recovered efficiently. However, microprojectile-mediated gene transfer has the potential to overcome these limitations by directly targeting tissues or cells which can easily be obtained and manipulated *in vitro*. A reproducible transformation system for hexaploid wheat was developed during the last few years in our laboratory based on particle bombardment of young zygotic and microspore originating haploid embryos. Particle bombardment was carried out using a high pressure nitrogen driven particle gun (Made in Hungary, registered as a *Gene Booster*). The plant material was bombarded with the plasmid *pDBI* containing the (β -glucuronidase gene (*uidA*) under control of the actin-1 promoter of rice, and the selectable marker gene bar (phosphinotricin acetyltransferase) under control of the CaMV 35S promoter. Haploid and zygotic embryos were screened for the enzyme activity by the histochemical GUS assay, 1 week after bombardment regeneration was carried out on a 5 mg/l Basta (Glufosinate-ammonium) containing media for the detection of putative transgenic plants. The haploid and diploid regenerants were sprayed with an aqueous solution of the herbicide Basta. The molecular analysis indicated the presence of the introduced foreign genes in the genomic DNA and the marker genes were found in most of the regenerants. The offspring are presently under investigation. This work was partly supported by the Hungarian Scientific Research Fund (OTKA) No. T6009.

DOSTIGNUĆA I ELEMENTI OPLEMENJIVANJA ŽIVOTINJA

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Počeci oplemenjivanja životinja u bliskoj su vezi s domestikacijom divljih vrsta, i početkom razvoja poljoprivrede pre oko 12000 godina. Bilo je to u stvari odabiranje boljih životinja, koje su lakše preživljavale dotične uslove, a potom onih koje su proizvodile više mleka, mesa, jaja, ili onih životinja, koje su imale bolje krzno, s ciljem da se osigura više hrane za stanovništvo organizovano umesto putem lova i ribolova. Oplemenjivanje životinja u smislu stvaranja novih linija i rasa i unapređenjem postojećih je novijeg datuma. Naša zemlja nije toliko kasnila, u na primer, pogledu uvođenja matične knjige, potrebne evidencije i testova, već se kasnilo u pripremi najnovijih dostignuća. Najznačajniji razlozi su, može se reći, oskudna teoretska znanja u školama i među proizvođačima u oblasti genetike i oplemenjivanja životinja, što je opet posledica izolovanosti struke i neefikasna organizacija proizvođača stočarske proizvodnje, a posebno pogrešne koncepcije države prema stočarstvu. Danas je u razvijenim zemljama oplemenjivanje životinja na visokom nivou, uključujući i našu ali samo u državnom sektoru proizvodnje. Privatni sektor koji čini većinu stočarske proizvodnje nije organizovan stručno, zaostao je najvećim delom nedoslednom privrednom politikom države i oskudnim nivoom znanja odgajivača i proizvođača, posebno iz oblasti genetike i oplemenjivanja. Genetski napredak kod vodećih vrsta životinja (goveda, kokoši, svinja, ovaca...) u odnosu na prirodne populacije, unapređen je za 3–4 puta, dok je kod riba, na primer, neznatno poboljšanje. Tendencije daljih promena, u odnosu na genetski limit, realne su.

ACHIEVEMENTS AND ELEMENTS OF ANIMAL BREEDING

The beginning of animal breeding is closely related to the domestication of wild species and the development of agriculture 12.000 years ago. Exactly, it was the selection of better animals, that survived more easily the environmental conditions they lived in, and then of those that produced more milk, eggs, meat or those with better fur, with the aim to provide more food instead of hunting and fishing. The development of lines and breeds is of a recent date in animal breeding. Our country is not behind regarding the herd book, necessary evidence and tests, but it is late in the application of these achievements. The most important reasons are pure theoretical knowledge at schools and among producers in the field of genetics and animal breeding, and that is of course the result of the isolation of this branch and inefficient organization of stock production breeders, and especially wrong state programmes concerning stock production. In more developed countries animal breeding is at a high level today including our country, but strategy only the state production level. Private farms which have the greatest part in stock production are not organized of a professional level. They are behind at a bad state strategy and a poor level of producers knowledge especially in the field of genetics and animal breeding. Genetic achievements in breeding animal species (cattle, pigs, poultry,...) in relation to natural (original)

populations have made considerable progress, 3-4 times, yet with fish hardly any progress has been made. There exist realistic tendencies for further achievements regarding the genetic limit.

GERMPLAZMA U OPLEMENJIVANJU SUNCOKRETA I ŠEĆERNE REPE U NAREDNIH DESET GODINA

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Suncokret (*Helianthus annuus* L.) spada među 4 najvažnije uljane kulture u svetu. Kod nas je glavna uljana kultura. Genetička varijabilnost je dosta uska, a posebno u pogledu gena koji uslovljavaju otpornost prema bolestima. Divergentnost je delimično povećana korišćenjem divljih vrsta putem interspecijes hibridizacije. U narednom periodu povećanje genetičke varijabilnosti biće nastavljeno daljim korišćenjem divljih vrsta. Rod *Helianthus* ima 49 vrsta i

19 podvrsta sa 12 godišnjih i 37 višegodišnjih vrsta i bogatom varijabilnošću unutar svake vrste, odnosno podvrste. Ova varijabilnost pruža veliku mogućnost za povećanje genetičke varijabilnosti u narednih deset godina. Interspecies hibridizacija je često otežana usled različitog broja hromozoma. (2n, 4n, 6n) kod divljih vrsta i prisustva inkompatibilnosti. Iz ovih razloga prevazilaženje problema može se postići primenom novih metoda biotehnologije. Obogaćenje genetičke varijabilnosti suncokreta na bazi divljih vrsta biće usmereno na otpornost prema bolestima, insektima, kvalitet ulja i otpornost prema stresu (suši). Povećanje genetičke varijabilnosti pored interspecijes biće i korišćenjem intergenus hibridizacije. Sadašnja kolekcija u Institutu u Novom Sadu od preko 5000 inbred linija i preko 1000 populacija divljih vrsta su garant za uspešan rad u oplemenjivanju suncokreta u narednom periodu. Šećerna repa *Beta vulgaris* L. ima zavidan broj srodnika u četiri sekcije *Vulgares*, *Patelares*, *Corollinae* i *Nane* koji u zavisnosti od genetičke udaljenosti, broja hromozoma i mogućnosti ukrštanja mogu vrlo korisno da posluže kao izvori u stvaranju nove genetičke varijabilnosti kao što je otpornost prema suši, zaslanjenost zemljišta ili druge neophodne osobine koje ne poseduje šećerna repa, a koje se u datom momentu ili budućnosti mogu pokazati kao vrlo korisne. Brzi progres u biotehnologiji i genetičkom inženjeringu ukazuju da su barijere koje su sada prisutne u ukrštanjima između različitih vrsta sekcije Beta u budućnosti predstavljati marginalni problem u oplemenjivanju.

GERMPLASM IN BREEDING SUNFLOWERS AND SUGAR BEET IN THE FOLLOWING TEN YEARS

Sunflower (*Helianthus annuus* L.) belongs to 4 most important oil crops in the world. In our country, it is the main oil crop. Its genetic variability is rather narrow particularly regarding genes that control the resistance to diseases. The divergence is partially increased by using wild species through interspecific hybridization. In the following period, genetic variability will further be increased using wild species. The genus *Helianthus* has 49

species and 19 subspecies, 12 annual and 37 perennial species with a rich variability within each species or subspecies. Such a variability represents a great possibility for increasing genetic variability for the next ten years. Interspecific hybridization is frequently impeded due to a different number of chromosomes ($2n$, $4n$ and $6n$) in wild species and incompatibility. All these problems can be solved by applying new biotechnological methods. Increasing the genetic variability in sunflower on the basis of wild species will be directed to improving the resistance to diseases, oil quality and stress tolerance. Genetic variability will be also improved by applying intergenus hybridization. The collection in the Institute of Field and Vegetable Crops in Novi Sad which contains over 5000 inbred lines and over 1000 populations of wild species guarantees successful work in sunflower breeding. Sugar beet (*Beta vulgaris* L.) has a large number of relatives divided into four sections: Vulgares, Patellares, Corollinae and nane. Depending on the genetic closeness, number of chromosomes and crossing possibility, all these can be useful as a source for a new genetic variability such as tolerance to drought, high salt concentration in the soil or other traits that sugar beet does not possess and which may be very useful either now or in the future. Rapid progress in biotechnology and genetic engineering indicates that the obstacles that presently exist when crossing different species of the section Beta will represent a marginal problem in future breeding.

GERMPLAZMA U OPLEMENJIVANJU SOJE U NAREDNIH DESET GODINA

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Soja pripada rodu *Glycine* koji se sastoji iz dva podroda. Podrod *Glycine* Willd čine sedam divljih višegodišnjih vrsta. Podrodu *Soja* (Moench) F.J. Herm, pripadaju jednogodišnja divlja vrsta *Glycine soja* Sieb. & Zucc. (ranije *G. ussuriensis*) i gajena vrsta *Glycine max* (L.). Merrill. Dosadašnji pokušaji intraspecies i interspecies hibridizacije su doprineli rasvetljavanju filogenetskih, citoloških i biohemijskih veza među vrstama, ali još nisu omogućili korišćenje divljih vrsta kao izvora genetske varijabilnosti u oplemenjivačkim programima soje. Do sada gajene sorte nastale su isključivo ukrštanjem genotipova u okviru vrste *G. max*. Mnoge zemlje u svetu imaju manje ili veće kolekcije genotipova soje, karakterističnih za određeni region. Najkompletnija kolekcija germplazme soje, koja se sastoji od introdukovanih i oplemenjivanih sorti kao i nekih divljih srodnika nalazi se u SAD, Urbana, Illinois. Ista naučna ustanova ima i genetsku kolekciju podeljenu u četiri kategorije: kolekciju tipova, kolekciju izolinija, kolekciju vezanih svojstava i citološku kolekciju. Svake godine se nove linije, interesantne za bilo koju od ovih kategorija prijavljuju genetskom komitetu i uključuju u kolekciju, a njihove karakteristike objavljuju u Soybean Genetics Newsletter. U našoj zemlji postoji kolekcija sorti i manjeg broja linija sa poznatim genima. Pošto kolekcija germplazme i genetska kolekcija stoje na raspolaganju svim zainteresovanim naučnim ustanovama moguće je u naše oplemenjivačke programe uključiti i neke od ovih linija.

GERMPLASM IN SOYBEAN BREEDING IN THE NEXT TEN YEARS

Soybean belongs to the genus *Glycine* consisting of two subgenera. There are seven wild perennial varieties in the subgenus *Glycine* Willd. Wild species *Glycine soja* Sieb & Zucc belong to the subgenus *Soja* (Moench) (former *G. ussuriensis*) and the cultivated variety *Glycine max* (L.) Merrill F.J. Herm is the one for which intraspecies and interspecies hybridization have thrown some light on phylogenetic, cytological and biochemical relationships among species, but still have not made possible the use of wild species as sources of genetic variability in soybean breeding programs. Up to now, all cultivated varieties have originated from crosses of genotypes belonging to *G. max* species only. Many countries in the World have smaller or bigger collections of soybean genotypes typical for certain regions. The most complete collection of soybean genotypes, consisting of introduced and cultivated varieties, as well as, some wild soybean relatives, is placed in U.S.A., Urbana, Ill. The Soybean Genetic Collection is divided into four categories: type collection, isolate collection, linkage collection, cytological collection. They are regularly published in the Soybean Genetics Newsletter. In our country there exists a collection of varieties and a smaller number of lines with known genes. Since germplasm collection and genetic collection are at the disposal of all concerned scientific institutions, it is possible to include some of these lines in our breeding programs, as well.

GENETICALLY MANIPULATED RESISTANCE TO VIRAL FUNGAL AND BACTERIAL DISEASES IN TOBACCO

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Tobacco is one of the most important industrial crops for Bulgaria. A number of pathogens: viruses, bacteria and fungi cause serious losses in tobacco production. In addition to classical breeding approaches plant biotechnology techniques provide novel tools to create resistance to various pathogens. In our study two different approaches have been demonstrated to successfully produce tobacco varieties resistant to economically important diseases: Genetic transformation to introduce pathogen derived genes. The concept for nonconventional protection proposed by Sanford and Johnson (1985) based on the mechanisms of host - pathogen interaction provided the ground to engineer pathogen resistance. The idea is to interfere with and disrupt the pathogenic process by expressing in the host, pathogen genes coding molecules essential for the pathogen. Using this approach by *Agrobacterium* mediated transformation we introduced genes conferring resistance to TSWV (the viral nucleoprotein NP gene) and *Pseudomonas syringae p.v. tabaci* (bacterial tabtoxin resistance ttr gene) in a number of widespread Bulgarian tobacco cultivars. The introduction and expression of the nucleocapsid gene from the Bulgarian isolate of TEWL-L3 strain in tobacco plants conferred high level of protection against the homologous strain and a serologically close isolate of the virus which was tested both under controlled and field conditions. High level of resistance to *Pseudomonas syringae p.v. tabaci* have been obtained in transgenic tobacco plants expressing the ttr gene which proved that the detoxifying enzyme encoded by the transgene provides efficient protection. The resistance to TSWV and *Pseudomonas syringae p.v. tabaci* in transgenic tobacco plants is stable and inherited in next generations. Non-segregating lines resistant to each TSWV and *Pseudomonas syringae p.v. tabaci* have been selected for a number of economically important tobacco cultivars. Selection for resistance against pathogen-derived toxins. The effects of *Phytophthora parasitica* Dast var. *nicotlanae* (Breda de Haan) Tucker (Ppn) race 0 culture filtrate (CF) on direct organogenesis of tobacco stem explants was evaluated using five tobacco haploid lines, which were selected based on their field reaction to Ppn (race 0). The culture filtrate used in different concentrations in MS medium suppressed bud formation from stem explants of susceptible tobacco cultivars more than those from resistant tobacco cultivars. The lowest concentration of CF (2%) stimulated bud formation in tobacco stem explants from both susceptible and resistant cultivars compared to the controls without CF. Twenty percent CF is suitable for screening *in vitro* Ppn resistance of tobacco cultivars at stem explants level. The selection scheme for resistance to Ppn CF and for increased resistance to Ppii was established. *In vitro* selected lines of five tobacco cultivars were tested for resistance to block shank up to F₂ generations.

OČUVANJE I KORIŠĆENJE GENETIČKE VARIJABILNOSTI GAJENIH I KORIŠĆENIH BILJNIH VRSTA JUGOSLAVIJE

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Sa stanovišta oplemenjivanja i selekcije biljaka genetička varijabilnost predstavlja neophodni, polazni uslov. Ovom aspektu korišćenja genetičkih resursa posvećeno je dosta pažnje i u nauci i u politici. Drugi aspekti brige o genetičkoj varijabilnosti je očuvanje biološke divergentnosti kroz pitanja fleksibilnosti vrste. Očuvanje genetičke varijabilnosti gajenih i korišćenih biljnih vrsta, po raznim osnovama, spada u nadležnosti mnogih činilaca društva; Države, jer je osnov vođenja politike u upravljanju prirodnim bogatstvom – biljnim genofondom i jer predstavlja element nacionalne bezbednosti; Nauke, jer predstavlja blago koje ni iz daleka nije proučeno u oba segmenta – konzerviranja i korišćenja: Privrede, jer se na rezultatima čuvanja, a naročito korišćenja temelje neke veoma važne grane; Pojedinaca koji su izabrali biljku kao objekt istraživanja menjanja i korišćenja. Otuda se čini važnom koordinirana aktivnost svih činilaca u društvu. Aktivnosti pojedinačnih činilaca u prošlosti nisu dale zadovoljavajuće rezultate. Korišćenje genetičke varijabilnosti u užem selekcionarskom smislu, predstavlja, brigu genetičara - oplemenjivača biljaka. Da li će se pravilno koristiti i održavati, zavisi od selekcionarskih ciljeva i ambicija. Prirodna je želja selekcionara da za što kraće vreme stvore što više novih sorata poželjnih svojstava, ali je nedopustiva politika selekcionih instituta da zbog komercijalnih rezultata zapostave „naučno oplemenjivanje” koje podrazumeva sve aspekte proučavanja i stvaranja polaznog materijala za selekciju. Korišćenje genetičkih resursa u širem smislu reči podrazumeva i dostup genetičkim resursima, kako domaćih tako isto i stranih korisnika. Mnoga pitanja od: kolekcionisanja, čuvanja, dokumentacije i korišćenja, predmet su međunarodnih konvencija i poduhvata, koje je Jugoslavija potpisala. Izgradnja banke biljnih gena i rad na formiranju genofonda za potrebe banke fundirani su na važećim međunarodnim normama. Održavanje i korišćenje genetičke varijabilnosti, na adekvatan način nije moguće bez formiranja nacionalnog programa kao strateškog projekta visokog stepena prioriteta.

CONSERVATION AND UTILIZATION OF THE GENETIC VARIABILITY OF PLANTS SPECIES CULTIVATED AND USED IN YUGOSLAVIA

From the standpoint of plant breeding and selection, genetic variability is the necessary starting condition. Sufficient attention for this aspect of the use of genetic resources has been paid both in science and in politics. Other aspects concerning genetic variability are the conservation of biological diversity through species flexibility. The conservation of the genetic variability of cultivated and utilized plant species comes within the competence of many factors in society: the state, because it is the basis of the policy of natural resource management; science, because it is a treasure which has not been sufficiently studied in both segments - conservation and utilization; economy, because some of its very important branches are based on the results of

conservation, and especially utilization, individuals, who have chosen to investigate plants. Consequently, the coordinated activity of all the factor in society is important. The activities of individual factors in the past did not produce satisfactory results. The application of genetic variability in its narrower sense, i.e. selection, is the concern of geneticists - plant breeders. The aims and ambitions of selectionists affect its correct utilization and maintenance. It is the natural desire of selectionists to create as many new varieties as possible with desired properties, but the policy of selection institutes is inadmissible, i.e. to neglect „scientific breeding" which includes all the aspects of research and the creation of basic material for selection because of commercial results. The use of genetic resources in *sensu lato* involves the availability of genetic resources to both domestic and foreign users. Many issues of the collection, conservation, documentation, and utilization are the subject of international conventions and projects signed by Yugoslavia. The construction of a plant gene bank and the work on the formation of a gene pool for the needs of the bank are based on current international norms. An adequate method of conservation and utilization of the genetic variability is not possible without a national program, i.e. a strategic project with a high priority.

HETEROZIS I PROIZVODNJA HIBRIDNOG SEMENA ŠUMSKOG DRVEĆA

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Genetički zakoni koji su u osnovi heterozisa su jedinstveni, ali karakter nasleđivanja i metodi istraživanja kod drveća su različiti. Izučavanje heterozisa drveća obuhvata: (1) evidentiranje i proučavanje efekta heterozisa; (2) unapređenje metoda izbora roditeljskih stabala, i (3) tehnologiju masovne proizvodnje. Do danas ostvarene hibridne kombinacije sa odlikama heterozisa ukazuju: da heterozis karakteriše manje-više sve ekonomski značajne vrste drveća, i da ostvareni nivoi heterozisa nisu maksimalni. Izbor roditeljskih stabala treba osetno usporiti i zasnovati na što više eksperimentalnih podataka. Kod izbora roditeljskih stabala kombinaciona sposobnost, koja je genetički determinisana, zauzima vodeće mesto. Za procenu kombinacione sposobnosti koriste se: linije polusrodnika i linije punih srodnika. Komercijalna proizvodnja hibridnog semena zasnovana je na specijalizovanim semenskim plantažama i obuhvata 4 etape: osnivanje eksperimentalnih semenskih plantaža, testiranje hibridnih kombinacija od slobodnog oprašivanja na roditeljskim i intermerijernim staništima, testiranje potomstva punih srodnika, i osnivanje komercionalnih, biparentalnih (linijskih ili dvoklonalnih) semenskih plantaža od roditeljskih stabala sa najboljom opštom i specifičnom kombinacionom sposobnošću. Hibridna sorta je osnovni faktor unapređenja u šumarstvu, jer predstavlja kapacitet koji tek treba iskoristiti. Unapređenje tehnologije masovne proizvodnje hibridnog semena neophodno je ostvariti kroz stalnu povezanost naučnih istraživanja i proizvodnje drveta u šumskim kulturama i plantažama. Neophodno je što više interakcije u proizvodnji hibridnog šumskog semena, ekonomije i tržišta.

HETEROSIS AND THE PRODUCTION OF HYBRID SEEDS OF FOREST TREES

The genetical laws which are the basis of heterosis are uniform, but for trees, the character of heritability and the methods of research are different. The study of heterosis in trees includes: (1) recording and studying heterosis effects, (2) enhancement of the method of parent tree selection, and (3) technology of mass production. So far hybrid combinations with heterosis characteristics indicate: that heterosis characterizes \pm all major economical tree species, and that the obtained levels of heterosis are not the maximum. The selection of parent trees should be noticeably slowed down and based on more experimental data.. In the selection of parent trees, the combining ability, which is genetically determined, holds the leading position. The combining ability is evaluated by half-sib and full-sib lines. The commercial production of hybrid seeds is based on specialized seed orchards, which include four stages: the establishment of experimental seed orchards, testing of hybrid combinations of open pollination on parent and intermediary sites, testing of full-sib progenies, and the establishment of commercial, hi-parental (line and biclonal) seed orchards of parent trees with the best general and specific combining ability. A hybrid variety is the basic factor of forestry enhancement, because it

represents a capacity still to be exploited. The improvement of the mass production technology of hybrid seeds should be based on the permanent cooperation of scientific research and timber production in forest plantations. The interaction of the production of forest hybrid seeds, economy and market should be increased.

HETEROTIČNI EFEKTI U OPLEMENJIVANJU TOPOLA

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Rezultati dugoročnih istraživanja i rada na oplemenjivanju omogućili su stvaranje i korišćenje u praksi sorti topola s visokim genetskim proizvodnim potencijalima. Genetskom dobiti u pogledu skoro svih svojstava značajnih za kultivisanje (adaptivnost, bujnost rasta, otpornost na oboljenja, kvalitet drveta) daleko su nadmašena svojstva polaznih populacija, odnosno genotipova. Dvodomost i anemofilija uslovljavaju veliku heterozigotnost prirodnih populacija, odnosno selekcionisanih roditeljskih parova u većini svojstava, usled čega se očekuje i manje povećanje heterozigotnosti potomstava u odnosu na roditelje. Zbog toga, kao i zbog dugog reproduktivnog i proizvodnog ciklusa i izražene sposobnosti vegetativne reprodukcije kod ekonomski najvažnijih vrsta, su oplemenjivači topola uglavnom usmereni na klonsku selekciju već u ranim fazama onotogeneze intersekcijjskih, interspecies i intraspecies potomstava umesto dugoročnijeg testiranja prostih vrednosti njihovih svojstava. To su osnovni razlozi što su nedovoljno proučene pojave heterozisa kod topola i što su u literaturi oskudni podaci o konstatovanom heterozisu, kao „nadmoći” F1 generacije nad roditeljima. Međutim, neki rezultati vlastitih i stranih proučavanja, koji su prikazani u ovom radu, ukazuju na mogućnost korišćenja heterozisa u oplemenjivanju topola. To su u prvom redu odnosi na pojave povećane bujnosti rasta i manje osetljivosti na oboljenja kao heterotičnih efekata kod nekih interspecies hibrida. Najizrazitiji primeri takvih heterotičnih efekata su kod hibrida evroazijskih i američkih jasika, i kod nekih hibrida crnih i balzamastih topola.

HETEROTIC EFFECTS IN POPLAR BREEDING

The results of long-term research and work on poplar breeding enabled the creation and utilization of poplar varieties with high genetic production potentials. The characteristics of the initial populations, i.e. genotypes, have been surpassed by the genetic gain in almost all the properties significant for cultivation (adaptability, luxurious growth, resistance to diseases, wood quality). Dioecy and anemophily condition a high heterozygosity of natural populations, i.e. selected parents, in most characteristics, due to which a small increase of the heterozygosity of the progeny is expected compared to parents. Due to this and also the long reproductive and production cycle and the marked ability of vegetative reproduction of major economical species, poplar breeders have mainly been directed to clone selection already in early stages of ontogeny of intersectional, inter-species, and intra-species progenies, instead of long-term testing of the average values of their properties. These are the main reasons why poplar heterosis has been insufficiently studied, and also why there are few reference data on the observed heterosis, i.e. the superiority of F1 generation over the parents. However, some results of our own or foreign research, which have been presented in this paper, point to the possibility of the application of heterosis in poplar breeding. This refers first of all to the increased growth vigor

and lower susceptibility to diseases, which are heterotic effects in some inter-species hybrids. The most expressed examples of such heterotic effects occur in the hybrids of Euroasian and American aspens, and in some hybrids of black and balsam poplars.

OPLEMENJIVANJE VOĆAKA I VINOVE LOZE

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Intraspecijes hibridizacija je najznačajniji put stvaranja novih sorti voćaka u jabuke, kruške, šljive, trešnje, višnje, kajsije, breskve, jagode i maline. Intraspecijes hibridizacija kod pomenutih vrsta korišćena je samo u radu na stvaranju otpornih sorti na ekonomski značajne parazite. Kod leske taj rad ubuhvata i stvaranje sorti koje ne daju izdanke. Selekcijom iz populacije oraha, vinogradarske breskve, mečije leske i drena izdvojen je veći broj sorti i selekcija pogodnih za stonu upotrebu ili kao podloge. Kultura tkiva i genetski inženjering u značajnoj menji dopunjuju konvencionalno oplemenjivanje voćaka. Stvaranje novih genetičkih kapaciteta vinove loze danas ima za cilj pre svega povećanje otpornosti prema biotičkim i abiotičkim faktorima. Gajenjem rezistentnih genotipova na gljivične bolesti povećava se sigurnost i ekonomičnost proizvodnje a značajno se doprinosi očuvanju životne sredine i zdravlja ljudi.

FRUIT AND GRAPE BREEDING

Intraspecies hybridization is the main method used in apple, pear, plum, sweet and sour cherry, apricot, peach, strawberry and raspberry fruit breeding. Intraspecies hybridization of these species is used only in breeding programmes for disease resistance. In Turkish filbert intraspecies hybridization opened the possibility for creating new suckerless varieties. A number of new varieties and a perspective rootstock selection were created by selection from the natural walnut, vineyard peach, hazelnut and dogwood populations. Tissue culture and genetic engineering significantly contribute to conventional fruit breeding. The main goal of grape breeding is increasing the resistance to biotic and abiotic factors. The introduction of new fungal disease resistant varieties enhances the security, economy of the production and environmental protection.

OPLEMENJIVANJE BILJAKA I GENETIČKA SLABOST

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Kada se prouče svi do sada poznati slučajevi epidemija biljnih bolesti dolazi se do zaključka da su se epidemije dogodile onda kada su uslovi uniformno osetljivi prema nekom parazitu i kada su vremenske prilike bile povoljne za razvoj bolesti. Genetička uniformnost može imati različite forme. Stranooplodne biljke poseduju veću genetičku rezistentnost od samooplodnih biljaka i biljaka koje se vegetativno razmnožavaju. Uniformnost jednog useva je hitan preduslov genetičke ranjivosti. Za pojavu epidemije potrebno je da se ispune sva tri uslova iz trougla bolesti - osetljiva biljka domaćin na širokom prostoru, virulentni, agresivni parazit i povoljni uslovi sredine, uglavnom povoljne vremenske prilike za razvoj bolesti. Kad se govori o uniformnosti ne misli se samo na zasnivanje proizvodnje na širem prostoru sa samo jednim genetički uniformnim kultivarom, već i na situacije kad je zastupljen veći broj kultivara koji u sebi sadrže jedan isti gen ili jednu istu citoplazmu. Svaki program selekcije, u principu, vodi sužavanju genetičke osnove gajenih biljaka. Istaknuto je da je genetička raznovrsnost glavna brana genetičkoj ranjivosti gajenih biljaka. Na osnovu onoga što se danas zna o genetičkoj uniformnosti i ranjivosti useva, o uzrocima i uslovima pojave epidemija bolesti na biljkama, o genetici biljke domaćina i parazita, kao i o fiziološkim mehanizmima rezistentnosti, predložena je i diskutovana određena strategija u oplemenjivanju biljaka kako bi se umanjio rizik od epidemija bolesti. Istaknuto je da uniformnost useva ima i dobrih i loših strana. Pozitivna strana uniformnosti ima prevagu nad njenim lošim stranama. Rizik od uniformnosti, mada ponekad i katastrofalan, ipak je kratkotrajan, dok su koristi stalne.

PLANT BREEDING AND GENETIC VULNERABILITY

When all the previously known cases of plant diseases have been studied, it is concluded that epidemics occur at times when the conditions are uniformly vulnerable to a parasite and when the weather is favorable for disease development. The genetic uniformity can have different forms. Outbreeding plants have a greater genetic resistance than self-fertilized plants and vegetatively propagated plants. The uniformity of a crop is an essential condition of genetic vulnerability. All three conditions from the disease triangle must be satisfied for an epidemic to occur - a vulnerable host plant over a wide area, a virulent, aggressive parasite, and favorable environment conditions, mainly favorable weather conditions for the development of the disease. Uniformity does not mean only the establishment of production over a wide area with only one genetically uniform cultivar, but also the situations when there are numerous cultivars containing the same gene or the same cytoplasm. Each selection program, in principle, leads to the narrowing of the genetic basis of cultivated plants. It should be emphasized that genetic diversity is the main barrier to genetic vulnerability of cultivated plants. Based on the present knowledge of genetic uniformity and vulnerability of crops, the causes and conditions of plant disease epidemics, a strategy of plant breeding has been proposed and discussed regarding

the genetics of host plants and parasites, as well as physiological mechanisms of resistance, in order to decrease the risk of disease epidemics. It has been emphasized that crop uniformity has its good and bad sides. The positive side of uniformity dominates over the negative side. A uniformity risk, although sometimes catastrophic, is temporary, while the benefits are permanent.

NOVE TEHNOLOGIJE U OPLEMENJIVANJU BILJAKA – KORIST I RIZIK

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Razvojem nove biotehnologije (tehnologije rekombinantne DNK i kulture ćelija i tkiva), stvoreni su uslovi za identifikaciju, izolovanje i manipulacije gena koji kontrolišu određene osobine viših biljaka. Iznalaženjem optimalnih sistema za unošenje stranih gena u genom biljaka izbegnuti su problemi inkompatibilnosti u seksualnom razmnožavanju različitih biljnih vrsta. Stvoreni su uslovi za korišćenje divljih biljnih vrsta kao izvora gena koji kontrolišu otpornost / tolerantnost biljaka prema nepovoljnim biotičkim i abiotičkim faktorima spoljne sredine. Uklonjena je evolucionarna barijera između organizama tako da je moguće gen koji kontroliše željenu osobinu izolovati iz mikroorganizama ili iz animalnih sistema i integrisati u genom biljaka. Na taj način je moguće dobiti transgene biljke poboljšanog kvaliteta prinosa ili rezistentne / tolerantne prema različitim bolestima ili nepovoljnim uslovima gajenja kao što su nepovoljne temperature, zaslanjenost zemljišta itd. Pored istraživanja usmerenih na dobijanje transgenih biljaka kao izvora hrane poboljšanog kvaliteta sve su intenzivnija istraživanja mogućnosti dobijanja transgenih biljaka koje će biti sposobne da sintetišu komponente kao što su prirodni poliestri npr. Dobijene su transgene biljke pamuka koje sintetišu pamuk sa osobinama poliestra. Pored toga vrlo intenzivno se vrše genetičke manipulacije u cilju konstrukcije transgenih biljaka kao izvora novih vakcina. Sistem je dosta jednostavan kada se vrše manipulacije osobina koje su pod kontrolom jednog gena. Istovremeno integracija pojedinačnih gena ne može značajno da poveća ukupnu vrednost biljaka, jer se većina najvažnijih osobina gajenih biljaka, prinos biomase npr., nalaze pod kontrolom više gena (poligenске osobine). Integracija stranog gena u genom biljaka se odvija po sistemu slučaja tako da je moguće izazvati represiju / depresiju endogene aktivnosti gena što može da ima pozitivne / negativne efekte na aktivnost biljnog genoma u celini. Pored mogućnosti izmene strukture i funkcije genoma viših biljaka, korišćenjem tehnologije rekombinantne DNK i kulture ćelija i tkiva moguća je identifikacija postojećih i konstrukcija novih genetičkih marketa od značaja u zaštiti intelektualne svojine i autorskih prava u procesu oplemenjivanja biljaka.

NEW TECHNOLOGIES IN PLANT BREEDING - BENEFITS AND RISKS

Through the development and application of new technologies like recombinant DNA technology, cell and tissue culture it is possible to identify, isolate and manipulate gene/genes controlling desired plant traits. By developing methods for gene transfer (direct or through the identification or construction of optimal vector systems) problems emerging from the sexual incompatibility of different plant species could be avoided. There is the possibility of using wild plant relatives or wild plant species as a genetic pool for the genes controlling

plant resistance / tolerance to different stress conditions (of biotic as well as abiotic origin). An evolution barrier could also be avoided and genes from a particular microorganism or animal genome could be cloned and transferred into the plant protoplasts, cell or tissue culture or the whole plant organism, resulting in transgenic plants. In this way it is possible to obtain new, genetically manipulated, plants of improved quality or resistant / tolerant to different diseases or unfavorable temperatures, soil salinity and other growth conditions. Besides focusing on improving the quality of food plants increasing attention is paid to creating plants that can provide a wide array of nonfood, nonfeed materials. There already exist cotton plants producing fibers with a polyester like compound in normal hollow fiber cores. Besides that intensive experiments on exploring transgenic plants as a new vaccine source are conducted. The system is relatively simple when monogenic traits are manipulated. At the same time single gene integration can not contribute to the improvement of the total plant value because the most important traits, yield for example, have a polygenic character. Foreign gene integration is a random process and could cause repression / derepression of the host genome by inducing positive as well as negative effects on the genome structure and expression. An obvious benefit of the application of new technologies is the identification of already existing or the creation of new genetic markers which could be successfully used in the intellectual property and plant breeders rights protection.

NOVA DOSTIGNUĆA U PROUČAVANJU MOLEKULARNE BAZE HETEROZIS

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Originalna koncepcija heterozisa bila je rezultat proučavanja na feotipsko-morfološkom nivou, međutim uskoro su usledili biohemijski podaci, pošto je pronalaskom elektroforeze olakšano prikupljanje podataka koji se odnose na enzimsku varijabilnost. Međutim, veliki broj ograničenja obima polimorfizma u novijim studijama omogućio je unapređenje linkidž mapa sa visokom rezolucijom koja se koristi za lociranje i manipulaciju sa QTL. Kada je dovoljan broj takvih neutralnih markera upotrebljen za merenje genetske udaljenosti kod velikog broja srodnika kukuruza, zabeležena je veoma visoka korelacija između roditeljske genetske srodnosti i hibridnog karaktera. Na isti način, identifikovan je relativno mali broj QTL rasprostranjenih u genomu kukuruza, što ukazuje na izraženu superdominantnost koratrole heterozisa. Postavljena je hipoteza da isti QTL mogu da kodiraju regularne proteine, pošto su ovi proteini sposobni da kontrolišu veliki opseg drugih strukturnih gena, čiji je efekat potreban za izražavanje složenih kriterijuma, kao što su prinos i bujnost prinosa. Do sada je identifikovano nekoliko takvih proteina: svi su složeni proteini sa hetero- polimerima i ispoljavaju znatno različite aktivnosti u poređenju sa prostim polimerima, što je u skladu sa jasno izraženom superdominacijom QTL, potvrđenom u dosadašnjim analizama. Pored toga, parametri koji potiču iz varijabilnosti ekspresije genoma, procenjeni kroz proučavanje polimorfizma u okviru individualnih proteina ili mRNK, pokazali su signifikantnu korelaciju ovih pokazatelja i hibridne bujnosti. Ova korelacija potvrđuje zaključak da QTL kontrolišu lokuse i količinu mRNA ili proteina sintetizovanih iz strukturnih gena i ističe se značaj i regularnih proteina (i njihovih gena) i strukturnih gena za kompleksan karakter heterozisa.

RECENT DEVELOPMENTS IN STUDYING THE MOLECULAR BASIS OF HETEROZIS

While the original concept of heterosis resulted from studies at the phenotypic morphological level, they were soon followed by biochemical data with the advent of electrophoresis and the consequent ease of accumulation of data related to isozyme variability. However, the large numbers of restriction fragment length polymorphisms from more recent studies have allowed the development of linkage maps with a high degree of resolution useful in locating and manipulating quantitative trait loci (QTL). When substantial numbers of such neutral markers were used to measure genetic distance in large numbers of maize inbreds very significant correlations were recorded between the parental genetic distance and hybrid performance. Through the same approach, a relatively small number of QTLs dispersed through the maize genome were identified which show a clear overdominance expression controlling heterosis. The hypothesis was made that some QTLs could code for regulatory proteins since these proteins are able to control a vast array of other structural genes, the products

of which are necessary for the expression of complicated characters such as yield and heterosis for yield. The few such proteins identified thus far were all multimeric proteins with the heteropolymers exhibiting significantly different activities in comparison with the homopolymers, that is in compliance with the clear overdominance manifestation of the few QTLs analyzed so far. In addition, parameters derived from the variability of genome expression assessed throughout studies or polymorphisms in the amounts of individual proteins or mRNAs showed numerous significant correlations between these indices and hybrid vigor. These correlations supported the conclusion the QTLs could be loci controlling the amount of mRNAs or proteins synthesized from a number of structural genes and stress the significance of both the regulatory proteins (and their genes) and the structural genes, being regulated, in manifestation of complicated characters, such as heterosis.

GENETIČKE OSNOVE I EVOLUCIONI SMISAO POLNOG RAZMNOŽAVANJA

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Životni ciklus eukariota obuhvata dva različita ciklusa: (1) vegetativni ciklus rastenja i reprodukcije, i (2) seksualni ciklus fuzije i restitucije. Kod kompleksnih višecelijskih formi, kao što je većina biljaka i životinja, ti ciklusi su obično spojeni zbog, po pravilu, postojanja povezanosti seksa i reprodukcije. Postojanje polnog razmnožavanja, kao evolutivno mlađeg oblika reprodukcije, još uvek predstavlja, u određenom stepenu kontraverzu evolucione biologije iz razloga što je seksualna reprodukcija jedina karakteristika živih organizama koja pre favorizuje preživljavanje grupe nego jedinke. Stoga razmatranje genetičke osnove i evolutivnog smisla seksa predstavlja vrlo aktuelnu temu s različitih fundamentalnih i aplikativnih aspekata. Genetička osnova determinacije pola može se sagledati na funkcionalnom i organizacionom nivou. U heterogametnom polu Y hromozom nema homologog para pa je morao da egzistira u hemizigotnoj formi. Jedini X hromozom kod heterogametnog pola je u aktivnom stanju, dok se kod homeogametnog pola, jedan X hromozom random inaktivira. U toku rekombinacije u mejozi X i Y hromozom razmenjuju određenu količinu genetskih informacija, jer je distalni deo Yg skoro potpuno homolog sa kratkim krakom X hromozoma. Ovi regioni ne podležu inaktivaciji, a u toku mejoze izvrše crossing-over i do 20-30 puta češće nego normalni hromozomi. Prema tome, seksualni identitet jedne individue je završni produkt celog lanca događaja, od genetskog statusa, preko hormonskog i morfološkog pola pa sve do uticaja okoline u kojoj individua živi. Najveća varijabilnost polnog dimorfizma se sreće kod viših biljaka, a generativno razmnožavanje je uslovljeno diferencijacijom polova koja je kod većine Familija po tipu 2A+XY i obuhvata diecke biljke, monoecijske sa hermafroditnim cvetovima ili sa razdvojenim muškim i ženskim cvetovima. Ispitivanje čestine rasprostranjenja pojedinih tipova polnih mehanizama kod cvetnica, pokazala su da se dvodomost (diecija) sreće retko i da obuhvata oko 5% udaljenih Familija, dok je kod 75% porodica evidentirana po koja dvodoma vrsta. Morfološka i funkcionala varijabilnost polova kod biljaka je velika, tako da su opšti biološki i evolutivni mehanizmi koji se ostvaruju putem generativnog razmnožavanja u sličnom obimu promenljivi kao što su to morfološke i fiziološke karakteristike individue. Unutar i međuindividualna promenljivost u građi i rasporedu reproduktivnih organa kod biljaka uslovlili su seksualnu reprodukciju puteni autbridinga, inbridinga i uniparentalno, kao i veliki broj mehanizama adaptacija koji stimulišu ili inhibiraju jedan od ovih tipova polnog razmnožavanja. Pri generativnoj reprodukciji evidentirana je izražena varijabilnost u građi, funkciji i rasporedu reproduktivnih organa, što je od bitnog značaja pri unapređenju metoda oplemenjivanja biljaka selekcijom i hibridizacijom.

GENETIC BASIS AND EVOLUTIONARY SENSE OF SEXUAL REPRODUCTION

The eucariotic life cycle includes two different cycles: (1) the vegetative cycle of growing and reproduction, and (2) the sexual cycle of fusion and restitution. In complex multicellular forms, such as most plants and animals, these cycles are usually united due to, as a rule, interrelated sex and reproduction. Sexual reproduction, as the evolutionary younger form of reproduction, still represents, to a certain degree, a counterversion of evolution biology, because sexual reproduction is the only characteristic of living organisms which favors the survival of the group more than that of an individual. Consequently, the study of the genetic basis and the evolutionary sense of sex represents a very current topic from different fundamental and application aspects. The genetic basis of sex determination can be observed both from functional and organization levels. In the heterogametic sex, the Y chromosome does not have a homologous pair, so it has to exist in a hemizygous form. The only X chromosome in the heterogametic sex is in an active state, whereas in the homeogametic sex, one X chromosome is randomly inactivated. During recombination in meiosis, X and Y chromosomes exchange some genetic information, because the distal part of Y is almost completely homologous, with a short X chromosome portion. These regions are not subject to inactivation, and during meiosis they perform crossings-over up to 20-30 times more often than normal chromosomes. Consequently, the sexual identity of an individual is the final product of a whole chain of events, from the genetic status, through the hormone and morphologic sex, till the effects of the environment. The greatest variability of sexual dimorphism is encountered in higher plants, and the generative reproduction is conditioned by sex differentiation, which is in most families of the type $2A+XY$ and it includes dioecious plants, monoecious with hermaphroditic flowers or with separate male and female flowers. A study of the frequency of the distribution of certain types of sexual mechanisms in flowering plants, shows that dioecy is rare and that it includes about 5% of distant families, whereas in 75% families a few dioecious species were recorded. The morphological and functional variability of sexes in plants is great, so that general biological and evolution mechanisms realized by generative reproduction are variable to a similar degree as the morphological and physiological characteristics of individuals. Inter and intra individual variability of the structure and arrangement of reproductive organs in plants are the condition of sexual reproduction by outbreeding, inbreeding and uniparental, as well as a great number of adaptation mechanisms which stimulate or inhibit one of the above types of sexual reproduction. In generative reproduction, an expressive variability of structure, function and arrangement of reproductive organs occurs which is essential for the advancement of plant breeding methods of selection and hybridization.

KORELACIJE PRINOSA I KOMPONENTI PRINOSA KOD DVE SINTETIČKE POPULACIJE KUKURUZA SA RAZLIČITIM SADRŽAJEM ABSCISINSKE KISELINE (ABA)

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Abcisinska kiselina (ABA) je biljni hormon koji ima uticaj na rast i razviće biljke, sličan efektima stresa suše. Povećanje akumulacije ABA pomaže biljci da se adaptira na uslove suše, ali je teško predvideti kako visok ili nizak sadržaj ABA u listu utiče na prinos i njegove komponente. Za ispitivanje uticaja sadržaja ABA u listu kukuruza, korišćeni su genotipovi koji se razlikuju samo u kapacitetu za akumulaciju ovog hormona, da bi se proučile posledice genetičkog variranja na prinos i druge agronomske karakteristike. Od inbred linija, Polj-1 7 (s visokim) i F-2 (s niskim kapacitetom za akumulaciju ABA), stvorene su dve sintetičke populacije koje se u poljskim uslovima razlikuju u ovoj osobini oko 2-3 puta. Pored upoređivanja prosečnih vrednosti, rađena je i korelaciona analiza sledećih osobina: prinosa zrna, mase 1000 zrna, broja redova zrna, broja zrna u redu i sadržala ABA u listu. Za sve komponente prinosa, utvrđena je značajna, srednje jaka i jaka zavisnost sa prinosom zrna (naročito kod biljaka iz populacije sa visokim kapacitetom za akumulaciju ABA). Pored toga, utvrđena je negativna i slaba korelacija sadržaja ABA u listu i prinosa i komponenti prinosa kod biljaka iz populacije sa visokim kapacitetom za akumulaciju ABA, dok je kod biljaka iz druge populacije ta zavisnost bila srednje jaka i visoko značajna. Za detaljnija ispitivanja planira se korišćenje QTL-analize (quantitative trait loci) odvojeno za prino i sadržaj ABA u uslovima jačeg stresa suše, u kojima će se adaptivni efekat različitog kapaciteta za akumulaciju ABA više ispoljiti.

CORRELATIONS BETWEEN YIELD AND YIELD COMPONENTS IN TWO COMPOSITE POPULATIONS DIFFERING IN ABSCISIC ACID CONTENT

Abcisic acid is a plant hormone which affect plant growth and development, similar to drought stress. Increase in abscisic acid accumulation helps the plant to adapt to a drought environment, but it is difficult to predict the effects of a high or low ABA content in leaves on the yield and yield components. To examine the consequences of genetic variation in the leaf ABA content on yield and other agronomic characteristics in maize, we have used genotypes selected for differences in the leaf ABA content. Two synthetic populations differing 2-3 times in this trait were created from the cross of 2 inbred lines: Polj-17 (high ABA parent) and F-2 (low ABA parent) and used in field experiments for comparisons of yield and yield components. Beside comparisons of means of investigated traits, a correlative analysis was made for the following traits: kernel yield, mass of 1000 kernels, number of kernel rows, number of kernels in the row, leaf ABA content. A significant positive correlation with yield was obtained for all yield components, especially in the population

with a high leaf ABA content. In the same population a negative correlation (slightly significant) was found for the leaf ABA content and yield and yield components, while in the plants from other populations this correlation was positive and significant. For more detailed investigations the use of QTL-analysis (quantitative trait loci) was planned under more severe stress conditions where adaptive effects of a high ABA content may be expressed.

PRILOG ISPITIVANJU MOLEKULARNE OSNOVE HETEROZISA KOD KUKURUZA

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Iako je fenomen heterozisa najviše iskorišćen u oplemenjivanju kukuruza do sada se veoma malo zna o njegovoj molekularnoj osnovi. Jedan od mogućih pristupa izučavanja heterozisa je proučavanje strukture i funkcije biljnog genoma korišćenjem molekularnih markera. Molekularni markeri obuhvataju proteinske (izozimi, proteinski kompleks u različitim tkivima) i DNK markere. U našim istraživanjima ispitan je polimorfizam izozima i polimorfizam u solima rastvorljivih proteina klice samooplodnih linija, njihovih F1 hibrida kao i segregirajuće generacije kombinacija koje su ispoljile najveći i najmanji heterotični efekat. Veličina heterotičnog efekata za sva ispitana svojstva u F1 hibridima izračunata je u odnosu na prosečnog roditelja. Dobijeni rezultati su pokazali da u

samooplodnim linijama i hibridima postoji polimorfizam nekoliko enzimatskih sistema. Iz

klice linija i hibrida izolovani su u solima rastvorljivi proteini (albumini i globulini) i razdvojeni elektroforezom na poliakrilamidnom gelu. Svi ispitani genotipovi su imali karakterističnu proteinsku sliku. Najveći broj proteinskih frakcija u hibridima je nasleđen od oba roditelja aui se javljaju i frakcije nasleđene samo od jednog roditelja kao i frakcije specifične za hibrid. U toku su dalja ispitivanja strukture i funkcije genoma kukuruza i utvrđivanja uloge pojedinačnih gena-regiona genoma u ekspresiji heterozisa.

A CONTRIBUTION TO THE STUDY OF THE MOLECULAR BASIS OF HETEROSIS IN MAIZE

In spite of fact that heterosis is used the most in maizee production very little is known- about the molecular basis of heterosis. The development and use of molecular markers provide more genetic information about the structure and function of the plant genome and at the same time give more details on the molecular mechanisms included in the heterotic effect expression. Molecular markers include proteins (isozyme, protein complex of embryonic and other tissue) and DNA markers. Izozyme and salt soluble proteinn polymorphism of inbred lines, F1 hybrids and the segregating generation has been invstigated in the hybrid combination ezspressing a high/low heterotic effect. The estimates of heterosis in the crosses were, expressed on the basis.s of the midparent. The polymophism of several enzymatic systems in the tissue of inbred lines and hybrids was determined. Salt soluble - proteins were isolated from scutella and embryo tissue and separated into numerous components by PAGE. Distinctive differences between genotypes were determined. Most protein fractions detected in hybrids are inherited from both parents; some fractions are inherited only from one parent and some are hybrid specific. Further studies of the molecular basis and role of the inbred lines genome contribution to the expression of heterotic effects in maize are in progress.

**IDENTIFIKACIJA DONORA POŽELJNIH ALELA ZA PIRNOS I ZAPREMINU KOKIČAVOSTI
KOD KUKURUZA KOKIČARA (*Zea mays L. everta*)**

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Dobijanje novih hibrida kukuruza uopšte, pa i kukuruza kokičara, najvećim delom se vrši popavkom jedne od roditeljskih komponenti. U tom smislu se postavlja pitanje izbora donora poželjnih alela za osobine od interesa. Kod kukuruza kokičara se pored prinosa zrna velika pažnja poklanja zapremini kokičavosti, kao najvažnijem pokazatelju kvaliteta. Mnogi eksperimentalni hibridi visokog prinosa bivaju odbačeni zbog nedovoljne zapremine kokičavosti. Negativna korelacija prinosa i zapremine kokičavosti otežava dobijanje hibrida visokog prinosa i zapremine kokičavosti. U ovom radu je izvršena ocena 2 komercijalne inbred linije kao nosilaca poželjnih alela za popravku prinosa i zapremine kokičavosti hibrida ZPK18xSg1533.

**IDENTIFICATION OF DONORS OF FAVOURABLE ALLELES FOR THE GRAIN YIELD AND
POPPING VOLUME IN POPCORN (*Zea mays L. everta*)**

The development of new maize hybrids, including popcorn hybrids as well, is mostly done by improving one of the parental components. Therefore, the selection of a donor of favourable alleles for the traits of interest is very important. Besides grain yield, great attention is paid to the popping volume of popcorn; as it is, the most important parameter of quality. Many experimental high yielding hybrids have been rejected due to an insufficient popping volume. The negative correlation between the grain yield and popping volume makes the development of hybrids with both high a yield and popping volume difficult. The evaluation of two commercial inbred lines as donors of favourable alleles for the improvement of the grain yield and popping volume of the hybrid ZPK18xSg1533 was performed in this study.

KORELACIJE I „PATH” KOEFICIJENT ANALIZA ZA STAY GREEN KUKURUZA (*Zea mays* L.)

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Proučavane su fenotipske korelacije između stay-greena, sadržaja vode u stablu, sadržaja vode u listu, broja dana do svilanja i sadržaja vode i zrna kod dve sintetičke populacije kukuruza (NS 103 i NS 140). Eksperimentalni podaci obrađeni su analizom varijanse i kovarijanse Nested dizajna p0 Random modelu. Iz odnosa kovarijansi i odgovarajućih varijansi, izračunate su fenotipske korelacije između svih svojstava koje su poslužile za izvođenje „path” koeficijent analize. Primenjen je metod inverznih simetričnih korelacionih matrica (Edwards, 1979), u kojem je stay green predstavljao zavisno, a ostala svojstva nezavisno promenljive varijable. Utvrđene su visokosignifikantne fenotipske korelacije između stay-greena i svih proučavanih svojstava; u obe populacije, a najkonzistentnija korelaciona veza ustanovljena je između stay-greena i sadržaja vode u listu ($r_{f} = 0,788^{**}$; $r_{f} = 0,833^{**}$). Vrednosti direktnih uticaja nezavisno promenljivih na zavisno promenljivu značajno su se razlikovale od vrednosti korelacionih koeficijenata. Naj snažniji direktni uticaj na stay green osobinu utvrđen je za sadržaj vode u listu u obe populacije ($P_{y2} = 0,601^{**}$; $P_{y2} = 0,591^{**}$), što ukazuje na mogućnost korišćenja ovog svojstva kao jednog od pouzdanih pokazatelja stay-greena. Direktni uticaji sadržaja vode u stablu i sadržaja vode u zrnu bili su znatno slabiji nego što bi se moglo zaključiti samo na osnovu koeficijenata korelacije. Zbog toga je poželjna primena „path” koeficijent analize kao preciznijeg metoda za sagledavanje odnosa između svojstava. Vrlo slab i nesignifikantan direktni uticaj na zavisno promenljivu utvrđen je za broj dana do svilanja ($P_{y4} = 0,063$; $P_{y4} = -0,0005$) što ukazuje da je moguće selekcionisati stay green genotipove bez obzira na dužinu vegetacije.

CORRELATIONS AND PATH COEFFICIENT ANALYSIS FOR STAY GREEN IN MAIZE (*Zea mays* L.)

Two synthetic maize populations (NS 103 and NS 140) were studied for: phenotypic correlations between stay green, water content in stem, water content in leaf, number of days before silking and water content in grain. Analysis of the variance and covariance of the Nested design-Random model were used for the processing of experiment data. Phenotypic correlations between all traits that were used for path coefficient analysis were calculated from the relationship of covariances and corresponding variances. The method of inverse symmetric correlation matrices (Edwards, 1979) was applied in which stay green represented a dependent and other traits independent variables. Highly significant phenotypic correlations were found between stay green and all studied traits in both populations, while the most consistent correlation was found between stay green and the water

content in leaves ($r_f = 0,788^{**}$; $r_f = 0,833^{**}$). The values of direct effects of independent variables on the dependent variable significantly differed from the values of correlation coefficients. The strongest direct effect on the stay green trait was found for the water content in leaves in both populations ($P_{y2} = 0,601:k *$; $p_{y2} = 0,591^{**}$) which indicates the possibility of applying this trait as one of the reliable indicators of stay green. The direct effects of the water content in stem and water content in grain were weaker than was expected on the basis of correlation coefficients. Therefore, the application of path coefficient analysis is desirable as a precise method for determining relationships between traits. A very weak and nonsignificant direct effect on the dependent variable was found for the number of days before silking ($p_{y4} = 0,063$; $p_{y4} = - 0,0005$) which indicates that stay green genotypes can be selected regardless of the length of the growing period.

PROMENE MORFOLOŠKIH OSOBINA U BSSS POPULACIJAMA KUKURUZA PUTEM REKURENTNE SELEKCIJE

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Rekurentna selekcije poboljšava osobine populacije povećanjem frekvencije poželjnih alela. Kod kukuruza (*Zea mays* L.) očekuje se da visoka frekvencija poželjnih alela u populaciji ima uticaj na poboljšanje osobina inbred linija i hibrida izvedenih iz ove populacije. Selekcione metode za intrapopulacijska poboljšanja kvantitativnih osobina kod kukuruza mogu biti bazirana na individualnim ili familijskim osobinama, za popravku populacije *per se*, ili potomstva hibrid-test ukrštanja za poboljšanje kombinacionih sposobnosti (Hallauer i Miranda, 1981). Cilj rada je bio da se prouče promene morfoloških osobina tokom sedam ciklusa halfsib rekurentne selekcije na prinos. Za rad su odabrane tri populacije: BSSSC₀ i BSSSC₇ (originalni sintetici), i ZPSIN2C₂ (novostvoreni sintetik BSSS osnove). Urađena su FS i HS(Mo17) potomstva (100 potomstva). Proučavane su sledeće osobine: visine biljke, visine klipa, ukupan broj listova i ugao lista. Urađena je analiza varijanse Nested dizajna- Random model. Tokom sedam ciklusa HS-RS došlo je kod FS potomstava do visoko značajnog smanjenja visine biljke, visine klipa, ukupnog broja listova i ugla lista u BSSSC₇, u odnosu na BSSSC₀. Kod FS potomstava u sintetiku ZPSIN2C₂ je visoko značajno povećana visina biljke i klipa, značajno smanjen broj listova, a ugao lista je sličan kao kod BSSSC₇. Kod HS(Mo17) potomstava tokom selekcije došlo je do visokoznačajnog povećanja visine biljke, visine klipa i broja listova, a ugao lista je visoko značajno smanjen kod BSSSC₇, u odnosu na BSSSC₀. Kod ZPSIN2C₂, u odnosu na BSSSC₇, došlo je do visokoznačajnog povećanja visine biljke, visine klipa i ugla lista, dok nije bilo razlika za broj listova.

CHANGES OF MORPHOLOGICAL CHARACTERISTICS IN BSSS MAIZE POPULATIONS VIA RECURRENT SELECTION

Recurrent selection improves the characteristics of the population by increasing the frequency of desirable alleles. Considering maize (*Zea mays* L.), it is expected that a high frequency of desirable alleles in the population will affect the improvement of the characteristics of inbred lines and hybrids produced from such populations. Selection methods for intrapopulation improvements of quantitative characters in maize can be based on individual or familiar characteristics, for the improvement of the population *per se* or the progeny of hybrid-test crossing for the improvement of the combining ability (Hallauer and Miranda, 1981). The objective of the investigation discussed in this paper was to study the changes of morphologic characteristics during seven cycles of half-sib recurrent selection for yield. Three populations were used: BSSSC₀ and BSSSC₇

(original synthetics) and ZPSIN2C2 (new synthetic of BSSS basis). FS and HS (Mo17) progenies were made (100 progenies). The characteristics studied-were: plant height, ear height, total number of leaves and leaf angle. Analysis of the variance by the Nested design-Random model was performed. In the course of 7 cycles HS- RS in FS progenies, plant height, ear height, total number of leaves and leaf angle significantly changed in BSSSC7 compared to 13SSSC0. In the FS progenies in the synthetics ZPSIN2C2, plant height and ear height increased very significantly while the number of leaves was reduced and the leaf angle was similar as in BSSSC7. In HS(Mo17) progenies, the plant height, ear height and number of leaves, very significantly increased while the leaf angle was significantly reduced in BSSSC7 compared to BSSSC0. In ZPSIN2C2 compared very to BSSSC7 the plant height, ear height and leaf angle was very significantly increased, while there was no difference in the leaf number.

KORELACIJE IZMEĐU VAŽNIJIH AGRONOMSKIH SVOJSTAVA KOD S₁ I HS FAMILIJA U DVA KOMPOZITA KUKURUZA

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U radu su proučavane genetičke korelacije između prinosa zrna i nekih važnijih agronomskih svojstava (visina biljke i klipa, dužina klipa, broj redova zrna i masa 1000 zrna) kod po 100

S₁ i 100 HS familija iz dva opozitna kompozita kukuruza (Kompozit B i M). Takođe su proučavane i genetičke korelacije između dva navedena tipa familija za data agronomska svojstva. Rezultati su pokazali da je u najvećoj genetičkoj korelaciji sa prinosom zrna kod S₁ familija u oba kompozita bila dužina klipa, a kod HS familija masa 1000 zrna, a zatim i dužina klipa. Ostale osobine nisu bile u visokoj korelaciji sa prinosom, što je povoljno sa selekcionog stanovišta za visinu biljke i klipa, jer omogućava paralelnu selekciju na visok prinos a nizak habitus biljke. Indirektna selekcija na prinos zrna preko nekog drugog svojstva u ovim populacijama ne bi imala smisla, osim HS selekcije preko povećanja mase 1000 zrna u Kompozitu M. Što se tiče genetičkih korelacija između S₁ i HS familija, najniža je bila korelacija za prinos zrna u oba kompozita, ali je ova vrednost bila veća u Kompozitu M. Ovo ukazuje na veću sličnost u alelskoj frekvenciji između dva tipa familija za prinos zrna u Kompozitu M, ili na veći udeo aditivne u ukupnoj genetičkoj varijansi za prinos zrna, u odnosu na Kompozit B. Ova druga činjenica je povoljna za selekciju, pošto ukazuje na veću mogućnost genetičke dobiti od selekcije na prinos zrna. Za ostale osobine sve ove korelacije bile su visoko značajne, i uglavnom jake u oba kompozita.

CORRELATION BETWEEN MORE IMPORTANT AGRONOMIC TRAITS OF S₁ AND HS FAMILIES IN TWO COMPOSITES OF MAIZE

Genetic correlations between grain yield and some of the more important agronomic characters (plant and ear height, ear length, number of kernel rows and 1000 kernel weight) were investigated using samples of 100 S₁ and 100 HS families from two opposite composites of maize (Composite B and M). Also, the genetic correlations for these traits between S₁ and HS were investigated. Results showed that the grain yield of S₁ families in both composites was in the greatest genetic correlation with the ear length, and in HS families with the 1000 kernel weight, and also ear length. The other traits were not importantly correlated with yield, which is especially favourable for plant and ear height, because this allows a parallel selection for a high yield and low plant habitus in these composites. An indirect selection for grain yield over some other trait in these populations would not be successful, except HS selection over the increase of 1000 kernel weight in Composite M. As far as the genetic correlations between S₁ and HS families are concerned, the correlation for grain yield in both composites was the lowest, but it was higher in Composite M. This points to a greater similarity in allelic frequencies between two types of families for grain yield in Composite M, or to a greater proportion of

the additive in the total genetic variance for gram yield in Composite M, in comparison with Composite B. The second fact is desirable for breeding, because it indicated the possibility of greater genetic gain from the selection for grain yield. For other traits these correlations were all highly significant, and mostly strong in both composites.

OCENA PARAMETARA STABILNOSTI ZP HIBRIDA KUKURUZA (*Zea mays* L.)

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Na bazi većeg broja ogleda u okviru četiri grupe zrenja (FAO 400, 500, 600 i 700) izračunati su parametri stabilnosti za pnos zrna ZP hibrida primenom modela Eberhart-a i Russell-a (1966). Ogledi su bili postavljeni 1993. godine po RCB dizajnu, sa 15 hibrida po svakom ogledu u odgovarajućim gustinama po grupama zrenja, u četiri ponavljanja i 7 lokacija, izuzev ogleda FAO grupe 400 koji su sejani u tri lokaliteta. Cilj rada je bio da se hibridi međusobno i u odnosu na standard uporede u pogledu reakcije na uslove spoljne sredine, kao i da se dâ pregled adaptibilnosti ZP hibrida po grupama zrenja.

EVALUTION OF STABILITY PARAMETERS IN ZP MAIZE HYBRIDS (*Zea mays* L.)

Based on numerous trials within four maturity groups (FAO 400, 500, 600 and 700), stability parameters for grain yield of ZP hybrids were determined by the model of Eberhart and Russel (1966). Trials were set up according to RCB design with 15 hybrids in each trial and appropriate densities for maturity groups with four replications at seven locations in 1993, except the FAO 400 trials which were set up in three locations. The original purpose of this study was to compare hybrids among themselves and with the standard regarding their responses to environmental conditions, as well as, to present an estimate of adaptability of ZP hybrids over maturity groups.

GENETIČKE I FENOTIPSKU KORELACIJE IZMEĐU AGRONOMSKIH OSOBINA KOD TOP-CROSS POPULACIJA KUKURUZA (*Zea mays* L.)

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Na osnovu parametara dobijenih iz analize varijanse po Nested dizajnu – Random model izračunate su genetičke i fenotipske korelacije između prinosa zrna, visine biljke, visine klipa, a komponenti prinosa kod HS potomstava kod četiri top-cross populacije kukuruza (BS12C8C₁ x L82, BS12C8C₁ x L15, ZPEP x L82 i ZPEF x L15). Ogledi su postavljeni u

1991. god. u Zemun Polju, Indiji i Velikoj Plani po Nested dizajnu (Cochran i Cox, 1957).

Značajna i jaka genetička i fenotipska korelacija je utvrđena između prinosa zrna i visine biljke, kao i između prinosa zrna i visine klipa kod tri ispitivane populacije (BS12C8C₁ x L82, ZPEP x L82 i ZPEP x L15), dok kod BS12C8C₁ x L15 ove korelacije nisu bile značajne. Između prinosa zrna i dužine klipa kod sve četiri populacije je utvrđena značajna, srednje jaka do jaka korelaciona zavisnost. Kombinacije sa sintetikom EP su imale srednje jake i značajne genetičke i fenotipske koeficijente korelacije između prinosa zrna i broja redova zrna, dok u kombinacijama sa BS12C8C₁ ova zavisnost nije bila značajna. Najjači genetički i fenotipski korelacioni koeficijenti su dobijeni između visine biljke i visine klipa kod ispitivanih populacija. Rezultati ukazuju na genetičku povezanost između ispitivanih osobina, što je od značaja za primenu istovremene selekcije u odnosu na više osobina.

GENETIC AND PHENOTYPIC CORRELATION BETWEEN AGRONOMIC TRAITS IN TOP-CROSS POPULATIONS OF MAIZE (*Zea mays* L.)

Genetic and phenotypic correlations between grain yield, plant height, ear height and yield components in HS progenies of four top-cross populations of maize (BS12C8C₁ x L82, BS12C8C₁ x L15, ZPEP x L82 and ZPEP x L15) were determined according to parameters obtained by the analysis of variance using the Nested design - Random model. The trials were set up in 1991 in Zemun Polje, Indija and Velika Plana according to Nested design (Cochran and Cox, 1957). Significant and strong genetic and phenotypic correlations were detected between grain yield and plant height, as well as, between grain yield and ear height in the three studied populations (BS12C8C₁ x L82, ZPEP x L82 and ZPEP x L15), while these correlations were not significant in BS12C8C₁ x L15. Significant, medium strong to strong correlations were determined between grain yield and ear length in all four populations. Combinations with the synthetic EP had medium strong and significant genetic and phenotypic coefficients of correlations between grain yield and the number of kernel rows per ear, while this correlation was not significant in combinations with BS12C8C₁. The strongest genetic and phenotypic correlation coefficients in the populations studied were determined between plant height and ear height. Obtained results indicate genetic relations between observed traits, which is important for a

simultaneous selection of several traits.

UTICAJ PROMENA KARBOHIDRATNOG SASTAVA NA KVALITET ZRNA KUKURUZA

ŠEĆERCA (*Zea mays L. saccharata*)

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Praćene su promene ugljeno-hidratnog sastava kukuruza šećerca po fazama razvoja endosperma, odnosno posle 10, 15, 20, 23 i 28 dana od oplodnje. Za ispitivanje su odabrana dva hibrida kukuruza šećerca, ZPSC504su i ZPSC520su. Ugljeno-hidratni sastav zrna ispitivanih hibrida je određivan metodom visokopritisne hromatografije na koloni sa hemijski vezanom stacionarnom fazom tipaNH₂ i polarnom mobilnom fazom acetonitril-voda. Ugljeno-hidratni sastav zrna se menja tokom razvoja endosperma, i to tako što se smanjuje procentualni udeo fruktoze i glukoze, uz istovremeni porast procentualnog udela saharoze, sve do postizanja njene maksimalne vrednosti (u fazi 23 dana od oplodnje), posle čega se odvijaju suprotne promene. Saharoza daje slatkoću zrnju šećerca, pa samim tim i njen visok sadržaj uslovljava kvalitet proizvoda.

EFFECTS OF CARBOHYDRATE COMPOSITION CHANGES ON GRAIN QUALITY IN SWEET

CORN (*Zea mays L. saccharata*)

Carbohydrate composition changes in sweet corn were observed through endosperm developmental stages, i.e. after 10, 15, 20, 23 and 28 days from pollination. Two sweet conrs, ZPSC504su and ZPSC520su, were selected for this study. The grain carbohydrate composition of studied hybrids was determined by the HPLC method with a chemically bound NH₂ stationary phase and acetonitrile-water polar mobile phase. This composition changes during endosperm development so that the percentage share of fructose and glucose decreases with the simulatneous increase of the percentage share of sucrose until its maximum value (in the stage of 23 days after pollution), and then opposite changes occur. Sucrose provides the sweet corn grain with sweetness, and therefore its high content conditions the quality of the product.

**OPTIMALAN ODNOS IZMEĐU BROJA PONA VLJANJA I BROJA LOKACIJA U
PRELIMINARNIM TESTIRANJIMA NOVIH HIBRIDNIH KOMBINACIJA KUKURUZA (*Zea mays*
L.)**

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U cilju smanjenja troškova i mogućih grešaka u setvi, berbi i u toku daljeg rada na materijalu, praktičnije je da se ogledi postavljaju u manjem broju ponavljanja po lokaciji ispitivanja. Time se stvara mogućnost za povećanje broja lokacija. Takvi ogledi omogućuju bolje uzorkovanje uslova spoljne sredine. Pretpostavka je da će jedino do dva ponavljanja po lokaciji dati isti odgovor pri izboru superiornog genotipa, kao i testiranje sa većim brojem ponavljanja. Za ovo ispitivanje koristili su se komercijalni hibridi Instituta za kukuruz „Zemun Polje”, kao i neki strani hibridi. Ogledi su bili postavljeni po RCB dizajnu i to sa po tri ponavljanja u tri lokaliteta, sa dva ponavljanja u pet lokaliteta, i sa jednim ponavljanjem u pet lokaliteta. Rezultati su pokazali da se hibridi ZPSC 678A, ZPSC 677, i ZPSC 701, nalaze na prva tri mesta u ogledu sa tri ponavljanja u tri lokacije i u ogledu sa dva ponavljanja u pet lokacija. Kod ogleda sa jednim ponavljanjem u pet lokaciji hibrid ZPSC 677 se takođe nalazi u vrhu, dok ostali rezultati odstupaju. Na osnovu rezultata istraživanja predlaže se smanjenje broja ponavljanja unutar lokaciji i povećanje broja lokaciji.

**THE OPTIMUM RELATIONSHIP BETWEEN THE NUMBER OF REPLICATIONS AND THE
NUMBER OF LOCATIONS IN EARLY TESTING OF NEW MAIZE HYBRID COMBINATIONS (*Zea*
mays L.)**

In order to curtail expenses and possible mistakes in plating, harvesting, and during further work on materials, it is useful to reduce the number of replications within locations. This way that possibility is created for increasing the number of locations. Such trials make possible better sampling of environmental conditions. It is assumed that one to two replications within locations will give the same answer in identifying the „best hybrid”, as tests with a greater number of replications within locations. For this examination we used a commercial hybrid of the Maize Research Institute „Zemun Polje”, and some foreign hybrids. The trials were conducted in RCB design with three replications in three locations, two replications in five locations and one replication in five locations. The results showed that hybrids ZPSC 678A, ZPSC 677 and ZPSC 701 occupy the first three places in trials with three replications in three locations and two replications in five locations. In the trial with one replication in five locations the hybrid ZPSC 677 is also first, but the other results are different. On the basis of these results the reduction at the number of replications within locations and the increase of the number of locations is recommended.

GENETIČKE I FENOTIPSKE KORELACIJE IZMEĐU OSOBINA REPRODUKTIVNIH ORGANA KUKURUZA

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Rekurentna selekcija omogućava istovremeno povećanje frekvencije poželjnih alela u populaciji i očuvanju genetičke varijabilnosti populacije. Kod dve sintetičke populacije kukuruza šire genetičke osnove NS 796 A/92 i NS 2040 B/92 ispitivana je varijabilnost, heritabilnosti u širem smislu, genetičke i fenotipske korelacije za: prinos zrna, zakašnjenje u svilanju, procenat jalovih biljaka, procenat vlage u zrnu i broj klipova po biljci. Half sib familije (S₁ x inbred tester) ispitivane su u 1994. godini na dve lokacije u uslovima jake suše tokom vegetacije. Između populacija nisu ustanovljene značajne razlike u prinosu zrna. Populacija NS 796 A/92 imala je manji procenat jalovih biljaka, manje zakašnjenje u svilanju i veći broj klipova po biljci od populacije NS 2040 B/92. Ustanovljena je visoka heritabilnost za sve ispitivane osobine: prinos zrna (52,00% i 68,86%), procenat jalovih biljaka (52,38% i 54,10%), zakašnjenje u svilanju (46,18% i 38,28%), procenat vlage u zrnu (59,99% i 60,52%) i broj klipova po biljci (58,88% i 66,71 %). Prinos zrna je bio u pozitivnoj korelaciji sa procentom vlage u zrnu kod populacije NS 796 A/92 ($r_g = 0,773^{**}$) i sa brojem klipova po biljci kod populacije NS 2040 B/92 ($r_g = 0,999^{**}$). U negativnoj korelaciji sa prinosom bio je procenat jalovih biljaka i zakašnjenje u svilanju kod obe populacije.

GENETIC AND PHENOTYPIC CORRELATIONS BETWEEN THE CHARACTERISTICS OF REPRODUCTIVE ORGANS OF MAIZE

Recurrent selection enables the increase of the frequency of desirable genes and maintenance of genetic variability in the population. Two synthetic maize populations with a broad genetic basis, NS 796 A/92 and NS 2040 B/92 were studied for variability, heritability in the broad sense, genetic and phenotypic correlations for grain yields, delayed silking, barrenness, percentage of grain moisture and number of ears per plant. Half-sib families (S₁ x inbred tester) were studied in 1994 on two locations under the conditions of severe drought during the growing period. No significant differences were discovered between the populations regarding to grain yield. The population NS 796 A/92 had a lower per cent of barren plants, less delayed silking and more ears per plant than the population NS 2040 B/92. High heritability was found for all studied characteristics grain yield (52.00% and 68.86%), barrenness (52.38% and 54.10%), delayed silking (46.18% and 38.28%), grain moisture per cent (59.99% and 66.71%) and the number of ears per plant (58.88% and 66.71%). Grain yield was in positive correlation with moisture percent in grain in the population NS 796 A/92 ($r_g = 0.773^{**}$) and with the number of ears per plant in the population NS 2040 B/92 ($r_g = 0.999^{**}$). Barrenness and delayed silking were in negative correlation with the yield in both populations.

RESELEKCIJA RODITELJSKIH KOMPONENTI ELITNOG SC HIBRIDA KUKURUZA (*Zea mays* L.) ZA OSOBINU PRINOS ZRNA

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U ovom radu pošlo se od pretpostavke da inbred linije roditelji elitnog dvolinijskog hibrida A654 x Fu4, koji je izabran za popravku, nose na izvesnom broju lokusa nepoželjne alele čiji se efekat ispoljava u hibridu. Korišćenjem inbred linija kao potencijalnih donora poželjnih alela i procenom njihove relativne vrednosti lokusa po metodu Dudley-a (1978b) moguće je izabrati inbred liniju za popravku elitnog hibrida za određenu osobinu ili veći broj osobina. Kao potencijalni donori poželjnih alela ispitivane su četiri genetički nesrodne inbred linije (ZPLB554dr, ZPLB176dr, ZPLB380, ZPLB368). Kao sobinu prinosa zrna poželjno je da linije donori imaju dominantne alele na lasi lokusa G, gde roditelji elitnog hibrida imaju recesivne alele, tj. izbor najbolje linije donora se zasniva na najvećim pozitivnim vrednostima parametara μG . Najveću vrednost parametra μG imala je linija ZPLB368 i ona je najbolji donor poželjnih alela za popravku osobine prinosa zrna kod elitnog hibrida A654 x Fu4. Druga po rangju je bila linija ZPLB554dr, dok su linije ZPLB176dr i ZPLB380 imale nešto niže vrednosti parametara μG u odnosu na prve dve linije. Sve ispitivane linije su pokazale veću genetičku srodnost sa linijom Fu4, za osobinu prinosa zrna, što ukazuje da bi se popravka elitnog hibrida za ovu osobinu vršila popravkom linije Fu4. Pošto kod sve četiri linije donora nije bilo značajne razlike između parametara μG i μF najbolji način za zasnivanje početne populacije bi bio samooplodnja F1 generacija ukrštanja linija donora x Fu4, što bi omogućilo najveću verovatnoću za dobijanje novih linija (popravljenih Fu4), koje će imati veći broj poželjnih alela za osobinu prinosa zrna na klasama lokusa F i G bilo od linije Fu4 ili od linije donora.

RE-SELECTION OF PARENTAL COMPONENTS OF THE ELITE SC HYBRID OF MAIZE (*Zea mays* L.) FOR GRAIN YIELD

The assumption that inbred lines, parents of the elite single cross hybrid A654 x Fu4, selected for improvement, have unfavourable alleles at a certain number of loci, expressing their effects on the hybrid, was the starting point of this study. It is possible to select an inbred line for improvement of a certain trait or a greater number of traits, of the elite hybrid, using inbred lines as potential donors of favourable alleles and by evaluating relative values of their loci with the method of Dudley (1978b). Four genetic unrelated inbred lines (ZPLB554dr, ZPLB176dr, ZPLB380, ZPLB368) were studied as potential donors of favourable alleles. It is desirable that inbred donors for grain yield have dominant alleles at G class loci, where parents of the elite hybrids have recessive alleles, i.e. the selection of the best inbred donor is based on the highest positive value of the parameter μG . The highest value of this parameter was determined in the inbred ZPLB368 and it was the best donor of favourable alleles for the improvement of grain yield in the elite hybrid A654 x Fu4. The second best

inbred was ZPL1554dr, while the values of the parameter μ_G in the inbreds ZPLB176dr and ZPLB380 were lower than the values of the first two inbreds. All observed inbreds indicated a higher genetic relation for grain yield to the inbred Fu4, pointing out that improvement of the elite hybrid should be done by improving the inbred Fu4. As there were no significant differences between parameters μ_G and μ_F in all four inbred donors, the best way of deriving the initial population should be self-pollination of the F1 generation cross inbred donor x Fu4, as this would provide the highest probability for the development of new inbreds (improved Fu4) with the highest number of favourable alleles for grain yield at F and 0 classes loci either of the inbred Fu4 or the donor inbred.

NASLEĐIVANJE DUŽINE KLIPA KUKURUZA (*Zea mays* L.)

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Petnaest hibrida F₁ generacije dobijenih dijalelnim ukrštanjem šest inbred linija kukuruza je korišćeno za ispitivanje načina nasleđivanja dužine klipa kukuruza. Analiza kombinacionih sposobnosti je rađena po Griffing-u (1956), metod 2, matematički model I, bez recipročnih ukrštanja, a analiza komponenti genetičke varijanse i regresiona analiza su urađeni po modelu Hayman-a (1954), Jinks-a (1954) i Mather-a i Jinks-a (1971). Na osnovu analize varijanse kombinacionih sposobnosti utvrđene su veoma značajne vrednosti za OKS i PKS u obe ispitivane godine, što govori da je za nasleđivanje dužine klipa značajno aditivno i dominantno delovanje gena. Odnos OKS/PKS je u obe ispitivane godine bio manji od jedinice što ukazuje na veći značaj dominantnih gena na ispoljavanje ove osobine. Analiza komponenti genetičke varijanse za dužinu klipa pakazuje da aditivna (D) i dominantne komponente (H₁ i H₂) imaju značajan uticaj u nasleđivanju ove osobine. Vrednost parametra D koja je manja od H₁ i H₂ ukazuje da dominantni geni imaju preovlađujući uticaj za nasleđivanje dužine klipa. Dobijeni rezultati su u saglasnosti sa rezultatima analize varijanse kombinacionih sposobnosti za datu osobinu. Negativna vrednost F pokazuje da je broj recesivnih gena bio veći od broja dominantnih gena, kod roditelja uključenih u dijalelno ukrštanje. To potvrđuje i odnos ukupnog broja dominantnih i recesivnih alela kod svih roditelja (Kd/Kr) koji je u obe ispitivane godine bio manji od jedinice. Prosečan stepen dominacije koji je bio veći od jedinice i presek linije regresije sa W_r osorn ispod koordinatnog početka ukazuju na superdominaciju u nasleđivanju dužine klipa kukuruza.

HERITABILITY OF THE EAR LENGTH IN MAIZE (*Zea mays* L.)

A total of 15 hybrids of the F₁ generation, developed by diallel crossing of six maize inbred lines were used in order to observe the mode of maize ear length heritability. Analysis of combining abilities was done using the Griffing (1956), Method 2, Mathematical model I, while the analysis of variance of genetic components and regression analysis were done using the model of Hayman (1954), Jinks (1954) and Mather and Jinks (1971). Very significant values of general (GCA) and specific (SCA) combining abilities were determined for both investigated years by analyzing variance, which means that additive and dominant gene effects were important for ear length heritability. The relation GCA/SCA was lower than 1 for both years, indicating a greater significance of dominant genes on the expression of this trait. The analysis of variance of genetic components for ear length indicates that additive (D) and dominant (H₁ and H₂) components significantly affect heritability of this trait. The value of the parameter D, is lower than values of H₁ and H₂, which indicates their prevailing significance in ear length heritability. Obtained results are in accordance with the results of the analysis of variance of combining abilities for this trait. The negative value of F reveals that the number of recessive genes was higher than the number of dominant genes in parents included in diallel crossing. This is, also, confirmed

by the ratio between the total number of dominant and recessive alleles in all parents (K_d/K_r), which was lower than 1 in both investigated years. The average degree of dominance, higher than 1, and the intersection point of the regression line with the W_r axis under the point of origin indicate superdominance in heritability of maize ear length.

OČEKIVANA I REALIZOVANA GENETIČKA DOBIT OD FENOTIPSKE REKURENTNE SELEKCIJE U ZPSynP1 POPULACIJI KUKURUZA (*Zea mays* L.)

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Preko tri ciklusa fenotipske rekurentne selekcije (bioparentalna masovna selekcija) procenjeni su očekivana i realizovana genetička dobit, u višeklipoj ZPSynP1 populaciji kukuruza. Akumulirana genetičke dobit izražena linearnim koeficijentom regresije za sukcesivne cikluse selekcije SynP1(M) *per se* pokazuje pozitivne odgovore za ispitivane osobine. Opaženi linearni trend za višeklipost i prinos zrna kukuruze ukazuje da je selekcijom došlo do komplementarne promene frekvencije alela za ove osobine. Ovo upućuje na brzi početni uspeh, akumulacijom poželjnih alela za višeklipost i pozitiven kolerirajući odgovor za prinos zrna. Procenom očekivane genetičke dobiti u početnim i kasnijim ciklusa selekcije, na bazi S1 i FS familija, ukazano je da je moguć dalji progres u povećanju prinosa direktnom selekcijom na višeklipost. Povoljne promene u performansama procenjene na bazi ispitivanih potomstava za proučavane osobine sugerišu da je selekciona procedura bila efikasna u promeni frekvencije alela sa pretežno aditivnim efektima. Odgovor selekcije je bio uspešan u povećanju frekvencije poželjnih alela u narednim ciklusima, u poređenju sa originalnom sintetičkom populacijom, SynP1(M)Cp, zahvaljujući selekcionom metodu i početnoj vrednosti ove originalne germplazme kukuruza.

EXPECTED AND REALISED GENETIC GAIN FROM THE PHENOTYPIC RECURRENT SELECTION IN THE ZPSynP1 POPULATION OF MAIZE (*Zea mays* L.)

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The evaluation of expected and realised genetic gain was done through three cycles of phenotypic recurrent selection (biparental mass selection) in the prolific maize population ZPSynP1. The accumulated genetic gain expressed by the linear coefficient of regression for successive selection cycles of SynP1(M) *per se* indicates positive responses for the studied traits. The observed linear trend for prolificacy and grain yield of maize indicates that selection resulted in the complementary frequency modification of alleles for these traits. This points out both a swift initial success of the accumulation of favourable alleles for prolificacy and a positive correlating response for grain yield. The evaluation of expected genetic gain in the initial and later selection cycles, based on S1 and FS families, points out that further progress in the grain yield increase is possible by a direct selection for prolificacy. Favourable changes in performances evaluated according to studied progenies for observed traits suggest that the selective procedure was efficient in the frequency modification of alleles with mostly additive effects. The selection response was successful in increasing the frequency of favourable alleles in succeeding cycles compared to the original synthetic population, SynP1(M)Co, due to the selection method and the initial value of this original germ plasma of maize.

HERITABILITET OSOBINA MLEČNOSTI U STANDARDNOJ LAKTACIJI OPLEMENJENIH CRNO-BELIH GOVEDA

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Koeficijenti heritabiliteta prinosa mleka, procenta mlečne masti i prinosa 4% FCM u standardnoj laktaciji su istraživani na uzorku od 841 prvotelke-kćeri 54 testirana bika na 9 farmi PKB. Prosečne vrednosti ispitivanih osobina bile su: prinos mleka 5810 kg, sadržaj mlečne masti 3.84% i prinos 4% FCM 5668 kg. Efekti farmi bili su slučajni. Koeficijenti heritabiliteta: za prinos mleka 0.151, za sadržaj masti 0.244, za prinos 4% FCM 0.184. Utvrđeni koeficijenti naslednosti ukazuju na mogućnost daljeg uspešnog genetskog unapređenja ispitivanih osobina.

THE HERITABILITY OF MILK TRAITS IN THE STANDARD LACTATION OF CROSSBRED BLACK-WHITE COWS

The coefficients of heritability of milk yield, fat percentage and 4% FCM yield in the standard lactation were investigated on the sample of 841 first time calving daughters of 54 bull-sires at 9 PKB farms. The average values of investigated traits were: milk yield 5810 kg, fat percentage 3.84 and 4% FCM yield 5668 kg. The effect of farms were random. The coefficients of heritability were: milk yield 0.159; fat percentage 0.244 and 4% FCM yield 0.184. The estimated coefficients of heritability indicated the possibility of future genetic advancement of investigated traits.

GERMPLAZMA U OPLEMENJIVANJU KUKURUZA (*Zea mays*, L.) U NAREDNIH DESET GODINA

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Izbor germplazme igra važnu ulogu u programu oplemenjivanja, bilo da je to primenjeni program oplemenjivanja za unapređenje inbred linija ili za unapređenje populacija. Kukuruz je veoma divergentan rod s velikim brojem morfoloških i bioloških razlika. Ispoljavanje heterozisa zavisi od razlika frekvencije gena roditeljskog materijala, bilo varijeteta ili inbred linija, koje se koriste kod ukrštanja. U toku poslednjih 40-50 godina, kada se shvatilo da postoji velika varijabilnost unutar vrste *Zea mays*, došlo je do organizovanih napora da se sakupe, prouče, očuvaju i koriste potencijalni genetski resursi u svim delovima sveta. U našoj zemlji vršeni su pokušaji da se u domaće programe oplemenjivanja introdukuju strani materijali. Ako se uzmu u obzir naši klimatski uslovi, uvođenje stranog materijala za oplemenjivanje kukuruza u programe oplemenjivanja predstavlja mukotrpan i dugotrajan posao. U procesu unapređivanja nalazi se nekoliko populacija. Različite sukcesivne metode selekcije koje se koriste za unapređivanje populacija zavise od cilja oplemenjivanja i polaznog materijala. Svake godine koristi se po nekoliko stotina različitih tipova ukrštanja u cilju dobijanja polaznog materijala za stvaranje roditeljske linije za hibride kukuruza, različitih starosnih grupa i različitih svojstava. U našoj zemlji postoji bogat materijal za oplemenjivanje kukuruza. U toku narednih 10 godina, glavni cilj kod germplazme kukuruza biće rad na unapređenju genetskog varijabiliteta i pronalaženje novih heterotičkih parova za nastavljavanje procesa oplemenjivanja kukuruza.

GERMPLASM IN MAIZE (*Zea mays* L.) BREEDING IN THE NEXT TEN YEARS

The choice of germplasm plays an important role in breeding program, whether an applied breeding program for inbred line development or population improvement. Maize is an extremely diverse genus, with a lot of morphological and biological differences. The expression of heterosis depends on the differences in gene frequency of the parental stocks, whether varieties or inbred lines are used to produce the crosses. In the last 40 to 50 years, when it was realized that a great amount of variability existed within the species *Zea mays*, organized efforts made to collect, study, preserve, and use potential genetic resources in all parts of the world. Consequently, in our country attempts have been made to introduce foreign materials into domestic breeding programs. Taking into account our climatic conditions, the introduction of foreign maize breeding materials in breeding programs is a tedious and time-consuming task. Several populations are in improvement processes. Different recurrent selection methods used for population improvement depend on the breeding aim and basic material. Several hundreds of different types of crosses are used each year for making the basis material to create maize lines as parents for maize hybrids of different maturity groups and with different

properties. In our country there is rich maize breeding material. In the next 10 years, the main target in the maize germplasm is to work on the improvement of genetic variability and to find new heterotic pairs for the continued progress of maize breeding.

DOPRINOS IZUČAVANJU GENETIČKE KONTROLE SINTEZE VIŠIH MASNIH KISELINA U ZRNU KUKURUZA

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Lipidi u zrnju kukuruza predstavljaju rezervne materije u formi triglicerida deponovanih u tkivu klice. Funkcionalni lipidi u formi lipoproteina i fosfolipida su zastupljeni kako u tkivu klice tako i u endospermu. U strukturi lipida učestvuju zasićene i nezasićene više masne kiseline. Stepenn nezasićenosti i položaj više masne kiseline su genetički determinisani. Oplemenjivanjem na povećan sadržaj lipida dobijeni su genotipovi kukuruza sa izmenjenim sastavom viših masnih kiselina kako u klici tako i u endospermu. U ovom radu su vršena ispitivanja dejstva rekurentne selekcije u dve visokouljane sintetičke populacije na odnos zasićenih i nezasićenih viših masnih kiselina u klici i dve frakcije tkiva endosperma (brašnast i rožastdeo) zrna sa izmenjenim sadržajem ulja. U lipidima klice utvrđena je visoka korelacija nezasićenih viših masnih kiselina (oleinske i linolne). Ukupni zbir ove dve nezasićene kiseline se ne menja tako da se oleinska kiselina može smatrati prekursorom linolne. Lipidi endosperma se razlikuju po sastavu viših masnih kiselina u odnosu na lipide klice. Za neke od ispitivanih genotipova je utvrđeno da odnos linolna/oleinska kiselina iznosi 3.0 uz visok sadržaj linolenske kiseline koja u strukturi molekula ima jednu nezasićenu dvostruku vezu više. U rožastom delu endosperma nekih od ispitivanih genotipova taj odnos iznosi 4.5 uz istovremeno veći sadržaj linolenske kiseline. Kako rezervni lipidi (trigliceridi) endosperma učestvuju sa manje od 0.5% u ukupnom sadržaju lipida u zrnju kukuruza dobijeni rezultati ukazuju da su dobijene razlike u sastavu viših masnih kiselina lipida klice i endospermu posledica različitog sastava lipoproteina i fosfolipida u zrnju kukuruza.

A CONTRIBUTION TO THE STUDY OF GENETIC CONTROL OF FATTY ACID BIOSYNTHESIS IN THE MAIZE KERNEL

Maize kernel lipids belong to the storage lipids deposited as glycerolesters of fatty acids presumably in the embryo tissue. Functional lipids in the Lipoproteins or phospholipids are present both in the embryo and endosperm tissue. Unsaturated and saturated fatty acids are structural units of all lipid classes. The level of saturation and the position in triglycerides are genetically determined. Breeding programmes for an increased oil content have also resulted the genotypes with an improved fatty acid composition. In this report the effect of recurrent selection of two high oil populations on relations between unsaturated and saturated fatty acids in the embryo and two fractions of endosperm tissue (soft and hard) with an increased oil content have been investigated. A high coefficient of correlation between oleic and linoleic unsaturated fatty acids has been determined in embryo lipids. The constant sum of these two acids indicates that oleic acid is a precursor of linoleic fatty acid. There exists a difference in the fatty acid composition between lipids of embryo and

endosperm tissue. In some high oil genotypes the oleic/linoleic acid ratio 3.0 was accompanied with a high content of linolenic acid which has three unsaturated bonds in the molecule. An even higher ratio of these two fatty acids (4.5) and a very high linolenic content was determined in the endosperm hard tissue fraction of 'a particular genotype. As storage lipids (mainly in the tryglyceride form) represent less than 0.5% of total kernel lipids in the endosperm tissue, the obtained results indicate that differences between the embryo and endosperm fatty acid composition are probably the consequence of different lipoprotein and phosphoiipid compositions.

AKUMULACIJA RAB17 i RNK U LISTOVIMA KUKURUZA TOKOM STRESA SUŠE U POLJU

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U odgovoru biljaka na stres suše dolazi do promena u ekspresiji mnogih gena. Istovremeno, povećava se koncentracija abscisinske kiseline (ABA). Svaki gen aktiviran sušom ili abscisinskom kiselinom mogao bi imati ulogu u adaptaciji biljaka na sušu. Do danas, najveći broj istraživanja promena u ekspresiji gena u odgovoru na vodni deficit vršen je u ranim fazama razvića biljke pod kontrolisanim uslovima spoljašnje sredine. Međutim, stresni uslovi primenjeni u laboratoriji ne reprezentuju u potpunosti stresne uslove u polju i geni koje indukuje laboratorijski stres ne moraju takođe biti indukovani stresom u polju. Zato je potrebno ispitati da li se neki od već okarakterisanih sušom i abscisinskom kiselinom indukovanih gena takođe eksprimiraju tokom stresa suše u polju i da li su oni u vezi sa osobinama gajenih biljaka koje su korisne za održavanje prinosa u uslovima suše. Kada bi bili identifikovani, takvi geni mogli bi se koristiti kao „molekularni markeri” u procesu selekcije otpornih genotipova ili bi se mogli izolovati i „ugrađivati” u neotporne genotipove. U ovom radu pokazali smo da se RAB17 transkripti akumuliraju do nivoa koji se mogu detektovati u listovima kukuruza gajenog u navodnjavanom i nenavodnjavanom polju. Međutim, ta akumulacija je varirala kako od biljke do biljke unutar genotipa tako i među genotipovima. Nije bilo jasne korelacije između nivoa RAB17 transkripata i sadržaja ABA u listovima. Ovo sugeriše da u starijim biljkama gajenim u polju ABA možda nije glavni faktor koji determiniše ekspresiju RAB17 gena što je suprotno rezultatima dobijenim u eksperimentima sa mladim biljkama.

ACCUMULATION OF RAB17mRNAs IN MAIZE LEAVES DURING DROUGHT STRESS IN THE FIELD

Plant response to drought stress involves changes in the expression of many genes. Concurrent increase in the level of abscisic acid (ABA) takes place in droughted plants. Each particular drought- and ABA-induced gene may have a role in plant adaptation to a droughted environment. Most of the studies, to date, on changes in gene expression in response to water deficit have been carried out on developing embryos or on young plants grown under controlled environment conditions. Stress conditions applied in the laboratory may not represent those that occur in the field and genes that are induced during the laboratory stress may not be induced in the field. Therefore, it is relevant to determine whether some of the drought- and ABA-induced genes already characterized are expressed during drought stress in the field and if they are associated with traits that are beneficial in maintaining crop productivity under drought conditions. Once such an association has been found, marker- assisted selection and transformation techniques could help the breeders to develop improved

varieties of crop plants for droughted environments. We have shown that RAB17 transcripts accumulate to detectable levels in leaves of maize plants grown under irrigated and rainfed field conditions. However, this accumulation was variable both from plant to plant within a genotype and amongst genotypes. There was no clear correlation between RAB17 transcript levels and ABA content of the leaves. This suggests that in older held-grown plants ABA may not be a major factor in determining expression of the *rab17* gene in contrast to the situation for young cabinet-grown plants.

GENETSKA DIFERENCIJACIJA NOVIH IZVORA OTPORNOSTI PREMA *PUCCINIA RECONDITA TRITICI*

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U prošlosti su skoro sve Lr izogene otporne linije pšenice prema *Puccinia recondita tritici* bile osetljive u stadiju sejanaca prema različitim patotipovima parazita, kao i u međunarodnim testiranjima na širokoj teritoriji. U cilju traženja novih gena otpornosti, brojni materijali pšenice iz Internacionalnih rasadnika su testirani u četvorogodišnjem vremenskom periodu. Iz našeg obimnog selekcionog materijala stvoreno je oko 700 novih otpornih hibridnih linija. Izdvojeno je najboljih 15 ozimih hibridnih linija pšenice i 15 jarih, koje su testirane prema *Puccinia recondita tritici* u stadiju sejanaca i poljskim ELRVW rasadnicima. Većina ozimih hibridnih linija su potvrdile dobru otpornost, a najbolje rezultate od jarih linija pšenice pokazala je samo linija 647-CMA-14793. Druga grupa izvora otpornosti su bile hibridne linije pšenice nastale od izdvojenih najboljih hibrida prve grupe ukrštene sa jakim Lr genima (Lr9, Lr19 and Lr24). U prvoj godini (1989) 834 hibrida je bilo genetski diferencirano u stadiju sejanaca na osnovu devet različitih spektara reakcije. Ista testiranja sejanaca bila su realizovana i u 1990. godini sa 759 hibridnih linija. Iz ovih brojnih hibrida izdvojeno je za novu ELRWN 1989/90. dvadeset genetski različitih otpornih ozimih linija pšenice, 16 jarih i 5 Lr kontrolnih linija. Kooperativna testiranja sejanaca ovog rasadnika su bila sprovedena u osam zemalja, a reakcije u polju istog rasadnika su procenjene u trinaest zemalja. Najbolje ocenjene linije za lisnu rđu u stadiju sejanaca i odraslom stadiju su bile ozime linije pšenice: NS-66-9/2, NS-94-19/2, NS-94-24/1, NS-77-19/4, NS-77-19/4, NS-32-9/4, NS-32-24/3 i NS-146-19/5 i jare linije pšenice: 647-CMA-14793, 11-TH-ESWYT-25, 25-TH-ESWYT-3, 26-TH-ESWYT-10 i 26-TH-ESWYT-49.

GENETIC DIFFERENTIATION OF NEW SOURCES OF RESISTANCE TO *PUCCINIA RECONDITA TRITICI*

In the past, almost all Lr isogenic wheat lines for resistance to *Puccinia recondita tritici* were susceptible to different pathotypes in the seedlings, as well as in international testing on large territories. In order to find new resistant genes several hundred wheat materials from International nurseries were tested in a four year period. From our large breeding program about seven hundred new resistant hybrid lines were created. The best resistant 15 winter wheat hybrid lines and 15 spring wheat resistant lines were tested to *Puccinia recondita tritici* in the seedling stage and in the field in ELRWN nurseries. The majority of winter wheat lines confirmed good resistance, but in the spring wheat lines only the line 647-CMA-14793 showed the best results. The second group of resistance sources were wheat lines resulting from selected hybrids of the first group crossed with strong Lr genes (Lr9, Lr19 and Lr24). In the first year (1989) 834 hybrid lines were genetically differentiated in the seedling stage by nine different reaction spectrums. The same seedling testings were

realized in 1990. with 759 hybrid lines. From all these voluminous hybrids, 20 genetically different resistant hybrid winter wheat lines, 16 spring wheat lines and five Lr control lines are selected for new ELRWN 1989/90. Cooperative seedling testings of this nursery have been realized in eight countries. The field reactions of ELRWN 1989/90. have been evaluated in thirteen countries. The best evaluated lines for leaf rust in the seedling and adult stage, were winter wheat lines: NS-66-9/2, NS-94-19/2, NS-9424/1, NS-77-19/4, NS-77-19/4, NS-32-9/4, NS-32-24/3 and NS-146-19/5 and spring wheat lines: 647-CMA-14793, 11-TH-ESWYT-25, 26-TH-ESWYT-3, 26-THESWYT-10 and 26-TH-ESWYT-49.

EKOLOŠKA I GENETIČKA VARIJABILNOST KOMPONENATA PRINOSA PŠENICE

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Ispitivana je varijabilnost i komponente fenotipske varijacije za 28 divergentnih sorata pšenice iz celog sveta u trogodišnjim ogledima. Tri osobine su uzete u obzir: visina i masa biljke, kao važne karakteristike sorata, od uticaja i na žetveni indeks i masa zrna po biljci, kao važna komponenta prinosa zrna. Odabrani genotipovi su se značajno razlikovali za sva tri ispitivana svojstva. Masa zrna po biljci je pokazala najveći koeficijent varijacije ($V = 17\%$), dok je najmanja varijacija ispoljena kod visine biljke ($V = 7\%$). Visina i masa biljke su varirale od godine do godine, za razliku od mase zrna po biljci, gde se to variranje nije pojavilo. Ipak, za sve tri karakteristike, prema ANOVA-i, pojavile su se značajne interakcije genotip/spoljna sredina. Genetička komponenta varijanse za visinu biljke je iznosila 59%, za masu zrna po biljci 33%, a za masu biljke 18%. Ekološka komponenta fenotipske varijanse se kretala od 20%, za visinu biljke, do 4% za masu biljke.

ENVIRONMENTAL AND GENETIC VARIABILITY OF YIELD COMPONENTS IN WHEAT

A total of 28 divergent wheat varieties from all over the World were examined in three year trials for variability and components of phenotypic variability. Three traits were studied: plant height and plant weight, as important variety characteristics closely related to the harvest index, and grain weight per plant, as a substantial grain yield component. The chosen genotypes were significantly different for all considered traits. The grain weight per plant appeared to have the highest coefficient of variation ($V = 17\%$), while plant height had value the lowest ($V = 7\%$). The plant height and plant weight varied from year to year. However, a year to year variation for grain weight per plant did not occur. According to ANOVA, highly significant interactions between the genotype and environment occurred for all three traits. The genetic component of variation for plant height was the highest reaching 59%, for grain weight per plant 33%, and for plant weight 18. The environmental component of variation varied from 20%, for plant height, to 4% for plant weight.

KOMPONENTE GENETIČKE VARIJABILNOSTI I HERITABILNOST KVANTITATIVNIH OSOBINA SORATA I HIBRIDA PŠENICE

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Cilj ovog rada je da se utvrdi genetička varijabilnost i heritabilnost nekih kvantitativnih osobina u dijalelnom ukrštanju 4 divergentne sorte pšenice i njihovi F₁ hibridi. Dijalelno su ukrštene sledeće sorte: Agrounija, Sana, Francuska i KC-56, a dobieno je 6 hibrida. Ogled je izveden tokom 1992. i 1993. godine o slučajnom blok sistemu u tri ponavljanja, u selekcionoj stanici „Agrounija” u Indiji. Žetva je obavljena ručno i iz svakog ponavljanja slučajno je odabrano po 20 biljaka za merenje sledećih osobina: dužina klasa, broj klasića u klasu, broj zrna po klasu i masa zrna po klasu. U nasleđivanju broja zrna po klasu i dužine klasa veći efekat imaju neaditivni geni u odnosu na aditivne, dok masa zrna po klasu i broj klasića u klasu su pod većom kontrolom aditivnih gena. Na ovaj tip nasleđivanja ukazuju i F-vrednosti, tj. interakcija između aditivnih i neaditivnih gena. Prosečan stepen dominacije (koren iz H₁/D) je veći od 1 za masu i broj zrna po klasu, što pokazuje da se te osobine nasleđuju superdominantno, dok se dužina klasa i broj klasića u klasu nasleđuju parcijalnom dominacijom. Koeficijenti heritabilnosti u užem smislu iznosili su za masu zrna po klasu 10%, broj zrna po klasu –40%, dužina klasa – 68% i broj klasića u klasu – 70%. Ovaj materijal koji je dobijen ukrštanjem različitih sorti pšenice biće dalje iskorišćen radi dobijanja novih linija pšenice.

THE COMPONENTS OF GENETIC VARIABILITY AND HERITABILITY OF THE QUANTITATIVE WHEAT CULTIVAR AND HYBRID TRAITS

The objective of this study was to determine the genetic variability and heritability of quantitative traits in a diallel cross of 4 divergent wheat cultivars and their F₁ hybrids. The following cultivars were diallel crossed: Agrounija, Sana Francuska and KG-56. Six hybrids were obtained. The trial was carried out during 1992-1993 at the selection station „Agrounija”, Indija. A randomized block design was used with three replications. Manual harvesting was employed. Twenty plants were chosen at random per replication in order to monitor the following traits: spike length, number of spikelets per spike, number of kernels per spike and kernel weight per spike. Non-additive genes were found to be the major factor in the number of kernels per spike and spike length inheritance compared to additive genes. On the other hand, kernel weight per spike and number of spikelets per spike were more significantly affected by additive genes. This heritability type was largely determined by F- values, *i.e.* the interaction between additive and non-additive genes. The average domination level (H₁/D) was > 1 for kernel weight and kernel number per spike. These traits were shown to be inherited superdominantly. On the other hand, spike length and spikelett number per spike were shown to be inherited by partial dominance. The heritability coefficient for kernel weight per spike, number of kernels per spike, spike length and spikelet number per spike were 10,40,68 and 70 percent respectively. The material obtained in

crossing different wheat cultivars will further be used with the aim of creating new wheat lines.

GENOTIPSKA SPECIFIČNOST FOTOSINTEZE I ANATOMSKIH OSOBINA LISTOVA PŠENICE

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Zbog značaja fotosinteze u primarnoj produkciji organske materije, pri selekciji visokoprinosnih genotipova sve veći značaj pridaje se genetičkoj varijabilnosti ovog faktora (Kebede et al. 1992, Simon, 1994). Imajući u vidu značaj lista kao glavnog fotosintetskog organa, a posebno vršnih listova u formiranju prinosa, kvantitativna procena anatomskih karakteristika istih, bitna je za određivanje veze između funkcije i strukture, odnosno za tačnije interpretiranje nekih fizioloških (fotosintetskih) procesa (Kubinova, 1993). Stoga je fotosintetska varijabilnost povezana kako sa fiziološkim tako i sa anatomskim karakteristikama listova (Parker and Ford, 1982, Bhagwat and Bhatia, 1994). U programima stvaranja genotipova sa visokim potencijalima za prinos, sve veća pažnja posvećuje se odnosu broja hromozoma (nivoa ploidnosti) i anatomsko-fizioloških karakteristika (Pataky et al., 1983, Kebede et al., 1992). Stoga je cilj rada bio da se utvrdi da li kod genotipova pšenice, različitog nivoa plodnosti i različite fotosintetske aktivnosti, postoje i genotipske kvantitativne razlike osnovnih anatomskih struktura listova.

GENOTYPE SPECIFICITY OF PHOTOSYNTHESIS AND OF THE ANATOMY OF WHEAT LEAVES

Due to its role in the primary production of organic matter, the genetic variability of photosynthesis has called for increased attention in breeding of high-yielding genotypes (Kebede et al., 1992, Simon, 1994). Taking into consideration the role of the leaf as the most important photosynthetic organ, and in particular that of top leaves, in yield formation, the quantitative estimation of their anatomical characteristics is important in establishing the relationship between the function and structure, namely for a more precise interpretation of certain physiological (photosynthetic) processes (Kubinova, 1993). Therefore, the photosynthetic variability is related to both physiological and anatomical leaf characteristics (Parker and Ford, 1982, Bhagwat and Bhatia, 1994). In programs for the creation of high-yielding genotypes, particular attention has been focused on the relationship between the chromosome number (ploidy level) and anatomic-physiological characteristics (Pataky et al., 1983, Kebede et al., 1992). The aim of the present paper was to determine whether in wheat genotypes characterized by different ploidy levels and different photosynthetic activity genotypic quantitative differences in basic anatomical leaf structures also occur.

NASLEĐIVANJE RAZLIČITIH VRSTA OTPORNOSTI PREMA *Puccinia recondita tritici*

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Nasleđivanje kompletne i nekompletne otpornosti kod F₁ i F₂ potomstava iz ukrštanja kompletno sa više nekompletno otpornih genotipova ispitivano je u poljskim i kontrolisanim uslovima. Zaključci su doneti na osnovu klasičnih metoda i procenta potpuno osetljivih biljaka što nije uobičajeno korišćeno. Laboratorijski rad približen je uslovima u polju što je osnova za ocenjivanje vrednosti svake kombinacije sa aspekta otpornosti prema prouzrokovateljima bolesti. U potomstvima F₁ generacije nasleđivanje kompletne otpornosti je dominantno. U F₂ generaciji dolaze do izražaja i geni za nekompletnu otpornost. Postoji velika verovatnoća da oni nisu identični sa genima za kompletnu otpornost (procenat osetljivih biljaka je manji od očekivanog).

INHERITANCE OF DIFFERENT TYPES OF RESISTANCE TO *Puccinia recondita tritici*

Inheritance of complete and incomplete resistance to *Puccinia recondita tritici* in F₁ and F₂ progenies from crossings of completely with a few incompletely resistant varieties was analyzed in field and controlled conditions. Conclusions were formed on the basis of classic methods and the percent of totally susceptible plants, which is not usually used. Experiments in controlled conditions were very close to field conditions so it was possible to estimate the value of every combination from the aspect of resistance to the disease. In the F₁ generation inheritance of the resistance was dominant. In the F₂ generation genes for incomplete resistance were also expressed (low infection efficiency). All genes for complete resistance are not identical with genes for incomplete resistance.

PRIMENA METODE ELEKTROFOREZE ZA OCENU NAČINA NASLEĐIVANJA KOMPONENATA GLIJADINA U F₂ GENERACIJI HIBRIDA PŠENICE

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Proučavano je nasleđivanje glijadinskih komponenata u F₂ generaciji hibrida Skopjanka x Agounija primenom kisele poliakrilamidne gel elektroforeze (A-PAGE). Prvo su identifikovane razlike u glijadinskim blokovima (alelima) i elektroforetičkim trakama između raditelja. Utvrđeno je da oni imaju identične blokove na A2, B1, B2 i D1 lokusima, dok se prema A1 i D2 alelima razlikuju. Skopjanka ima Gli-A1b i Gli-D2 alele, dok Agrounija sadrži Gli-A1f i Gli-D2m aele. Između ove dve sorte ukupno je uočeno 12 različitih traka, od čega $\alpha 92$, $\alpha 94$, $\gamma 57$, $\beta 73$ kod Skopjanke i $\alpha 86$, $\alpha 88$, $\alpha 91$, $\alpha 93$, $\gamma 53$, $\gamma 57$, $\omega 27$, $\omega 30$ kod Agrounije. Na osnovu prisustva ili odsustva glijadinskih traka na elektroforegramima pojedinačnih F₂ hibridnih zrna ocenjeni su genetički modeli nasleđivanja glijadinskih komponenti. Prema dobijenim rezultatima može se konstatovati da se oba para glijadinskih blokova (alela) nasleđuju kodominantno, dok je za većinu pojedinačnih glijadinskih traka utvrđeno da njihovo nasleđivanje kontroliše samo po jedan gen.

APPLICATION OF THE ELECTROPHORETIC METHOD FOR ESTIMATING THE MODE OF INHERITANCE OF GLIADIN COMPONENTS IN THE F₂ GENERATION OF WHEAT

Inheritance of gliadin components in the F₂ generation of Skopjanka x Agrotunija cross was studied by acid polyacrylamide gel electrophoresis (A-PAGE). The differences between gliadin blocks (alleles) and electrophoretic bands in parental genotypes were first identified. It was found that they had similar blocks at A2, B1, B2 and D1 loci, while they differed in A1 and D2 alleles. Skopjanka had Gli-A1b and Gli-D2, whereas Agrounija contained Gli-A1f and Gli-D2m. A total of 12 different bands between these two cultivar were observed, namely $\alpha 92$, $\alpha 94$, $\gamma 57$, $\beta 73$ in Skopjanka and $\alpha 86$, $\alpha 88$, $\alpha 91$, $\alpha 93$, $\gamma 53$, $\gamma 57$, $\omega 27$, $\omega 30$ in Agrounija. On the basis of the presence or absence of these bands, in F₂ single seed electrophoretic patterns, the genetic models of gliadin components were determined. The results showed that both pairs of blocks (alleles) were inherited codominantly, while most single gliadin bands are controlled by one gene.

GENETIČKA ANALIZA BOKORENJA KOD HIBRIDA PŠENICE (*Triticum aestivum* L.)

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U dijalelnom ukrštanju (bez recipročnih) četiri divergentne sorte pšenice (Jugoslavija, Žitnica, Novosadska Rana 2 i Osiječanka) ispitivan je način nasleđivanja, efekti gena za opšte bokorenje kod F1 hibrida. Način nasleđivanja bokorenja bio je različit (parcijalna dominacija, dominacija, superdominacija) u zavisnosti od kombinacije ukrštanja. Analiza komponenti genetičke varijanse ukazuje da u ekspresiji ovog svojstva prevladavaju dominantni nad recesivnim genima, odnosno da glavni deo genetičke varijanse pripada dominantnom delovanju gena. Uočava se nejednak raspored pozitivnih i negativnih dominantnih alela kod roditelja. Izračunata vrednost prosečnog stepena dominacije ukazuje da se u nasleđivanju opšteg bokorenja, uzevši u obzir sve kombinacije ukrštanja, radi o superdominaciji.

GENETIC ANALYSIS OF TILLERING IN WHEAT HYBRIDS (*Triticum aestivum* L.)

In diallel crosses (without reciprocals) of four divergent wheat cultivars (Jugoslavija, Žitnica, Novosadska Rana 2 and Osiječanka), the mode of inheritance, gene effects and genetic components of variance in F1 hybrids were analyzed. The mode of inheritance of tillering was different (partial dominance, dominance, over-dominance) depending on the cross combination. Analysis of genetic components of variance indicate that dominant genes prevail over recessive in the expression of this trait, and that the main part of genetic variance belongs to the dominant gene effect, respectively. The positive and negative alleles at dominant loci were not equally distributed in parents. The computed value of the mean dominance degree indicated over-dominance in the inheritance of tillering after considering all cross combinations.

GENETIČKA DIVERGENTNOST SORTI PŠENICE KOMPOZICIJI *Gli*- ALELA

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Analizirane su 52 sorte pšenice stvorene u selekcionom centru Novi Sad i ocenjena su sličnost i razlike na osnovu kompozicije *Gli*- alela. Pedigree su korišćeni za analizu prenošenja *Gli*- alela sa roditelja na sorte potomke. Kod velikog broja sorti je nađen jedan isti roditelj, što se manifestovalo i u sličnosti kompozicije glijadinskih alela. Utvrđivana je proporcija nasleđivanja *Gli*- alela od oba roditelja i na osnovu toga dominantnost sorte roditelja. Na osnovu kompozicije *Gli*- alela izračunat je koeficijent sličnosti, koje je varirao između 0% i 100% a korišćen je za izradu dendograma. U dendogramu su se izdiferencirale 4 grupe međusobno sličnih sorti. U svakoj grupi međusobna sličnost kod većine sorti bila je veća od 50% prema kompoziciji glijadinskih alela. Ustanovljena je veća sličnost između prve (12 sorti) i druge grupe sorti (14) i treće (15) sa četvrtom grupom (8), koja je bila 30%. Osim ove 4 grupe izdvaja se sorta Crvenkapa koja je imala malu sličnost sa ostalim sortama - 16%, kao i Evropa i Francuska koje su imale najmanju sličnost i (7%) kompozicije glijadinskih alela sa ostalim sortama. Sorte koje su se najviše razlikovale po kompozicije *Gli*- alela (Crvenkapa, Francuska, Evropa) treba koristiti u programe oplemenjivanja i radi povećanja genetičke varijabilnosti za kompozicije *Gli*-alela.

GENETIC DIVERSITY OF WHEAT CULTIVARS ACCORDING TO THE *Gli*- ALLELE COMPOSITION

A total of 52 wheat cultivars from the Novi Sad selection center were analyzed and their similarity and differences for the *Gli*- allele composition were estimated. Pedigree data were used for analysis of the inheritance of *Gli*- alleles from parents by offspring cultivars. For a large number of cultivars the same wheat cultivar was found and it affected the similarity of gliadin alleles. The ratio of inheritance of *Gli*- alleles from parents in offspring cultivars and the impact and dominance of parent cultivars were analyzed. Based on the *Gli*- allele the coefficient of similarity was computed, which varied between 0% and 100% and was used to make an UPGMA dendrogram. The four groups of similar cultivars were differentiated. In each group the similarity in the majority of cultivars according to the *Gli*- allele composition was higher than 50%. A higher similarity between the first group (12 cv.) and second group (14) as well as between the third (15) and fourth group (8), was found and it was approximately 30%. Besides these 4 groups, the Crvenkapa cultivar had a low similarity with other cultivars -16%, and also Evropa and Francuska cultivars had the lowest similarity (7%) with other cultivars. The cultivars which differentiated most according to the *Gli*-allele composition (Crvenkapa, Francuska, Evropa) need to be used in breeding programs because of the increasing variability in the *Gli*- allele composition.

INTERAKCIJA GENOTIP/SPOLJNA SREDINA ZA KOMPONENTE PRINOSA PŠENICE

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U trogodišnjem ogledu je ispitivana varijabilnost i komponente fenotipske varijabilnosti za žetveni indeks (HI), broj i masu zrna po klasu, kod 28 genetički divergentnih genotipova pšenice. Između srednjih vrednosti su postojale značajne razlike u sva tri ispitivana svojstva. Koeficijent varijacije za žetveni indeks je bio najveći i iznosio je $V = 25\%$. Najmanju varijabilnost je pokazao broj zrna po klasu ($V = 13.6\%$). Istraživanjima je ustanovljena značajna razlika između godina i interakcija genotip/spoljna sredina za žetveni indeks i broj zrna po klasu. Masa zrna po klasu nije pokazala značajne razlike za faktor godine. Udeo genetičke varijanse za žetveni indeks je iznosio 18%, za broj zrna po klasu 21%, a za masu zrna po klasu 35%.

GENOTYPE/ENVIRONMENT INTERACTIONS OF YIELD COMPONENTS IN WHEAT Marija

Kraljević-

In a three year experiment the variability and phenotypic components of the variation for the harvest index (HI), number and weight of kernels per spike in wheat were evaluated. A total of 28 genetically divergent wheat genotypes were chosen. Significant differences were found in the genotypes regarding the HI, number and weight of kernels. The coefficient of variation was the highest for HI ($V = 25\%$) and the lowest for the kernel number per spike ($V = 13.6/0$). The characters varied from year to year (except for kernel weight), as well, indicating the existence of an interaction between the genotype and environment. The genetic component of variation for HI was 18%, for kernel number per spike 21%, and for kernel weight per spike 35%.

ALBINO REGENERANTI: ZNAČAJ U PRIMENI *IN VITRO* KULTURE ANTERA U OPLEMENJIVANJU PŠENICE

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Uspešna primena metode *in vitro* kulture antera u oplemenjivanju pšenice kod velikog broja genotipova je limitirana pojavom veoma visoke frekvencije albino regeneranata. Iako se ovim problemom bavio veliki broj istraživača, uzroci nastajanja ove nepoželjne pojave do danas nisu u potpunosti razjašnjeni. U okviru ovog eksperimenta ispitana je frekvencija formiranih zelenih i albino regeneranata kada su za izolaciju korišćene antere 15 različitih F₁ hibrida pšenice (*Triticum aestivum* L.). Materijal korišćen za izolaciju predstavlja deo selekcionog programa Instituta za ratarstvo i povrtarstvo u Novom Sadu. Izolovane antere sa mikrosporama u srednjem i kasnom jednojedarnom stadijumu mikrosporogeneze, gajene su na Potato 2 indukcionoj hranljivoj podlozi. Posle 4–6 nedelja kultivacije na ovoj podlozi, antere sa formiranim embriogenim kalusima su presađeni na 190-2 podlogu za regeneraciju biljaka. Rezultati su pokazali da je od sto antera korišćenih za izolaciju dobijeno u proseku 4.5 zelenih biljaka, sa varijacionom širinom od 0 do 21.6%. Prosečna frekvencija albino regeneranata je bila 6.7% sa varijacionom širinom od 0 do 23.5%. U odnosu na broj formiranih kalusa, prosečna frekvencija zelenih biljaka je bila 19.3%. Najveći procenat zelenih regeneranata u odnosu na broj formiranih kalusa imao je genotip „No. 4 x NS 55-25²” F₁- 52.9%. Prosečan broj albino regeneranata je bio 29.3%, da bi najviši procenat 66.7% bio kod genotipa „Pobeda x NSR.5” F₁. U celom eksperimentu, od ukupnog broja, regenerisanih biljaka 40% je bilo zeleno, dok je 60% bilo albino, što znači da se, u proseku, više od jedne polovine regeneranata ne može koristiti u oplemenjivanju pšenice. S obzirom na to da je u eksperimentu postojala velika razlika između genotipova u pogledu broja regenerisanih zelenih i albino biljaka, jasno je da postoji genetička kontrola ove pojave, te da je neophodno proučiti mehanizam njenog delovanja.

ALBINO REGENERANTS: SIGNIFICANCE ON THE APPLICATION OF THE *IN VITRO* ANTHER CULTURE IN WHEAT BREEDING

The successful application of the method of *in vitro* anther culture in wheat breeding is limited by the appearance of a very high frequency of albino regenerants in a great number of genotypes. Although, numerous researchers have dealt with this problem, the causes of this phenomenon have not been completely explained. In this experiment the frequency of regenerated green and albino plants was examined. Antehrs of IS different F₁ wheat (*Triticum aestivum* L.) hybrids were used for isolation. This material is part of the selection programme of the Institute of Field and Vegetable Crops in Novi Sad. Isolated anthers with microspores in the mid- and late uninucleate stage of microsporogenesis were grown on the Potato 2 inductive medium. After 4-6 weeks of culture on this medium, anthers with formed embryogenic calli were transferred on to the 190-2 medium for plant regeneration. Results showed that, on average, 4.5 green plants were obtained out of 100

isolated anthers. That number varied from 0 to 23.5%¹. In relation to the number of formed calli, the average frequency of regenerated green plants was 1.9.3%. The highest percentage of green regenerants was shown by the genotype „No. 4 x NS 55-25²” F2 -52.9%. The average number of albino regenerants was 29.3%, while the highest frequency of albino regenerants, 66.7% was shown by the genotype „Pobeda x NSR.S” F1. In the whole experiment, 40% of regenerated plants were green, while 60% of plants were albinos, which means that more than half of the regenerants cannot be used in wheat breeding. Considering that there was a great difference between genotypes in the number of regenerated green and albino plants in the experiment, it is clear that genetic control of this phenomenon exists and it is necessary to study the mechanism of its inheritance.

ISPITIVANJE NEKIH AGRONOMSKO-FIZIOLOŠKIH OSOBINA KOD KRAGUJEVAČKIH GENOTIPOVA *T. durum*

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Rezultati četvorogodišnjih ispitivanja ozimih i jarih genotipova *T. durum* prikazani su u ovom radu. Većina od ispitivanih linija je imala visinu stabijike i otpornost prema poleganju na prihvatljivom nivou. Neki genotipovi su veoma niski (67-76 cm) i otporni prema poleganju. Neke linije su ispoljile otpornost prema niskim temperaturama što ukazuje na njihove zadovoljavajuće predispozicije za setvu u našim uslovima. Većina ispitivanih sorti i linija imaju krupno zrno (> 40 g) i hektolitarsku masu (> 78 kg). Jari tipovi duruma su imali slabije nalivanje zrna. Sadržaj sirovih proteina je uglavnom sličan ili viši u odnosu na strane sorte. Prinos zrna je bio uglavnom viši ili na nivou najboljih stranih sorti. Jari durum su imali niže prinose nego ozimi. Posebno su prinosi jarih tipova pokazali zavisnost od uslova godine.

AN INVESTIGATION OF SOME AGRONOMIC AND PHYSIOLOGIC TRAITS IN GENOTYPES OF *T. durum* CREATED IN KRAGUJEVAC

The results of four-year investigations of winter and spring types of *T. durum* are shown in this paper. Most of the investigated lines have a stem height and lodging resistnace at an acceptable level. Some genotypes are very short (67-76 cm) and resistant to lodging. Some tines appeared to be resistant to low temperatures which points to their satisfactory predispositions for growing in our conditions. The majority of investigated cultivars and lines have large kernels (>40 g) and a good hectoliter mass (> 78 kg). The spring types of durum had a more inferior kernel filling. The content of crude proteins was mostly similar or higher than in foreign cultivars. The grain yield was mainly higher or at the level of the bestt foreign cultivars. Spring.g durums had lower grain yields than winter types. Yields of spring types appeared especially dependent on the weather conditions.

MOGUĆNOST SELEKCIJE PŠENICE NA KORIŠĆENJE SLOBODNOG AZOTA U ISHRANI

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U ovom radu ispitana je sposobnost sedam sorata pšenice da u svojoj ishrani koriste elementarni azot iz vazduha. Biljke su analizirane na broj i boju listova, masu suve materije, koncentraciju i sadržaj azota. Analize su obavljene primenom standardnih metoda. Sve ispitivane sorte, zahvaljujući diazotrofima iz njihove rizosfere, pokazale su sposobnost da fiksiraju azot u uslovima izvođenja ogleada, ali su između sorata dobijene značajne razlike.

A POSSIBILITY OF BREEDING WHEAT FOR UTILIZATION OF FREE NITROGEN IN NUTRITION

Seven wheat cultivars and their capability for nitrogen fixation from air were investigated. The leaf number, leaf color, dry matter, nitrogen concentration, and its plant content were analyzed in wheat cultivars. Analyses were carried out using standard methods. All investigated cultivars, due to the presence of diazotrophs from their rhizospheres, showed a capability of nitrogen fixation in the experimental conditions. Significant differences were found between cultivars.

OTPORNOST NA BOLESTI I PRINOS ZRNA KAO KRITERIJUMI ZA PRIZNAVANJE OZIMIH SORTI PŠENICE

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Cilj oplemenjivanja ozime pšenice je stvaranje sorti visokog potencijala za prinos zrna, odličnih hemijsko-tehnoloških svojstava i dobre adaptabilnosti u različitim agroekološkim uslovima. Za dobru adaptabilnost je važna otpornost sorti prema najvažnijim bolestima (lisna i stabljična rđa, pepelnica). U ovom radu su analizirani rezultati oplemenjivanja ozime pšenice na otpornost prema najvažnijim bolestima, potencijal za prinos zrna, veza između ovih svojstava i ocenjeno koliko se uzima u obzir stepen otpornosti prema bolestima kao kriterijum za priznavanje sorti. Ispitivano je 299 genotipova u ogledima Savezne komisije za priznavanje sorti, u periodu 1983-1990. godine. Ogledi su izvedeni po metodu slučajnog blok sistema, u pet ponavljanja (parcelica 5 m²), u 16 lokaliteta i 3 godine. Intenzitet napada bolesti je ocenjen u stadijumu odraslih biljaka, u uslovima veštačke infekcije, po modifikovanoj Cobb-ovoj skali (0-99%). Prinos zrna (t/ha) preračunat je na 14% vlage. Na osnovu analiziranih rezultati zaključeno je: Pri priznavanju sorti se uzima stepen otpornosti prema bolestima kao važan kriterijum, ali su visok potencijal za prinos zrna u izbalansiranosti drugih osobina odlučujući kriterijumi; Najotporniji genotipovi imaju niži potencijal za prinos zrna, što ukazuje na negativnu korelaciju ovih osobina i zbog toga najčešće ne budu priznati; Učinjen je napredak u oplemenjivanju ozime pšenice na povećan stepen otpornosti prema najvažnijim bolestima i povećan je potencijal za prinos zrna.

RESISTANCE TO DISEASES AND GRAIN YIELD AS CRITERIA FOR THE APPROVAL OF WINTER WHEAT VARIETIES

The aim of winter wheat breeding is to create varieties with a high genetic potential for grain yield, excellent chemical-technological traits and adaptability to different agroecological conditions. The resistance of varieties to most important diseases (leaf and stem rust, powdery mildew) is important for good adaptability. In this paper the results of breeding winter wheat for resistance to the most important diseases, the potential for grain yield and relationships between these traits were analyzed and the level of resistance to diseases taken as a criterion for the approval of varieties was evaluated. A total of 299 genotypes in official trials of the Federal commission of variety approval between 1983-1990 were investigated. The trials were conducted in a random block design, 5 replications (plot 5 m²), 16 locations, and 3 years. The intensity of disease attack was observed in the adult plant stage, under conditions of artificial infection according to the modified Cobb's scale (0-99%). Grain yield (t/ha) was calculated on the basis of 14% of grain moisture. Based on the results obtained the following is concluded: The level of resistance to diseases is taken as a criterion for the approval of varieties, but a high potential for grain yield and the balance of other characteristics are the most important criteria for a decision making; The most resistant genotypes have a lower potential for grain

yield, which indicates a negative correlation between these traits and because of this such genotypes are often not approved; Progress is evident in winter wheat breeding for a higher level of resistance to diseases and a higher potential for grain yield.

OCENA STABILNOSTI PRINOSA ZRNA JARIH SORTI I LINIJA PŠENICE ANALIZOM INTERAKCIJE GENOTIP x SPOLJNA SREDINA

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Reakcija genotipova na različite ekološke uslove se može odrediti statistički preko interakcije genotip x spoljna sredina. Kao stabilni genotipovi označavaju se oni koji imaju male vrednosti ove interakcije. U ovom radu ocenjene su razlike u stabilnosti prinosa zrna kod 7 sorta i 8 linija jare pšenice. Analiza podataka je bila zasnovana na trogodišnjim ogledima postavljenim na lokaciji Zaječar. Utvrđeno je da najveću stabilnost od isptivanih linija ima ZA-16, a od sorata Vesna. Rangovi stabilnosti dobijeni ovom analizom u značajnoj meri podudaraju se sa rangovima stabilnosti na osnovu regresione analize. Iako su dva najstabilnija genotipa obrazovala relativno nizak prosečan prinos, nije nađena negativna korelacija između ranga stabilnosti i apsolutne vrednosti prosečnog prinosa zrna.

ASSESSMENT OF YIELD STABILITY OF SPRING VARIETIES AND LINES OF WHEAT BY ANALYSIS OF THE INTERACTION GENOTYPE x ENVIRONMENT

Genotype reactions to different ecological conditions can be statistically determined through the interaction genotype x environment. Stable genotypes are those which have low values of this interaction. This paper evaluates the differences of yield stability of 7 varieties and 8 lines of spring wheat. The analysis of data is based on three-year experiments established in the locality of Zaječar. The line ZA-16 and the variety „Vesna” had the highest stability. The ranks of stability obtained by this analysis agree to a high degree with the ranks of stability based on regression analysis. Although the two most stable genotypes formed a relatively low average yield, no negative correlation existed between the rank of stability and the absolute value of the average yield.

**VARIJABILNOST I NASLEĐIVANJE DUŽINE DRUGE (BAZALNE) INTERNODIJE KOD
HIBRIDA PŠENICE (*Triticum aestivum* L.)**

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Dužina druge (bazalne) internodije je veoma značajna osobina od koje zavisi stepen otpornosti pšenice prema poleganju. U ovom radu je proučavana varijabilnost i nasleđivanje dužine druge internodije u hibridnim generacijama. Izvršeno je dijalelno ukrštanje (bez recipročnih) četiri divergentna genotipa pšenice (KG-75, Jugoslavija, Baranjka, NS 322) i dobijeno je hibridno potomstvo F1, F2 i F1BC generaciji. Varijabilnost izučavanog svojstva je bila različita pri čemu je koeficijent varijacije bio najveći u kombinaciji Baranjka x NS 322, a najmanji u kombinaciji KG-75 x Baranjka i KG-75 x Jugoslavija. Relativni heterozis je bio u granicama od 3.20% do 17.47%. Način nasleđivanja dužine druge internodije je različit, zavisno od kombinacije ukrštanja pri čemu je ispoljen intermedijarni i dominantni tip nasleđivanja. Analiza komponenti genetičke varijanse ukazuju da u F1 generaciji glavni udeo u nasleđivanju ovog svojstva imaju aditivni efekti gena, dok u F2 generaciji je značajan uticaj i neaditivne komponente. Za dalji selekcionni proces odabrane su kombinacije Jugoslavija x Baranjka i Jugoslavija x NS 322.

**VARIABILITY AND INHERITANCE OF THE LENGTH OF THE SECOND (BASAL) INTERNODE
IN WHEAT HYBRIDS (*Triticum aestivum* L.)**

The length of the second (basal) internode is a very important trait which influences the degree of wheat lodging resistance. The aim of this study was an investigation of the variability and inheritance of the length of the second internode in wheat hybrid generations. In diallel crosses (excluding reciprocals) of four different wheat cultivars (KG-75, Jugoslavija, Baranjka and NS- 322) with different lengths of the second internode, F1, F2 and F1BC hybrids were produced. The variability of the investigated trait was different. The cross combination F₁Baranjka x NS 322, had the highest coefficient of variance and it was lowest in crosses KG-75 x Baranjka and KG-75 x NS 322. The relative heterosis was between 3.20% and 17.47%. The mode of inheritance of the length of the second internode was different (intermediate, dominant), depending on the cross combination. Analysis of genetic components of variance indicated a dominant influence of the additive gene effect in the inheritance of the length of the second internode in F1 hybrids, and the non additive gene effect in F2 hybrids. The cross combinations Jugoslavija x Baranjka and Jugoslavija x NS 322 were selected

for future breeding.

NASLEĐIVANJE GLAVNIH KOMPONENTI PRINOSA KOD JARE PŠENICE

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Glavne komponente prinosa - broj i masa zrna - analizirane su kod nekoliko hibridnih kombinacija jare pšenice. Analizirano je pet visokoproduktivnih meksičkih linija, dve NS sorte jare pšenice i njihovi hibridi. Ukrštene su novosadske sorte sa svim meksičkim. Cilj ovog rada je bio da se utvrdi način nasleđivanja komponenti prinosa i heritabilnost ovih osobina jare pšenice. Statistička obrada podataka je urađena korišćenjem standardnih metoda, a u radu se prikazuju i diskutuju dobijeni rezultati. Analizirane su osobine broj i masa zrna po klasu, te masa 1000 zrna. Svojstva se nasleđuju najčešće intermedijarno, a vrednosti heritabilnosti su bile u veoma širokom dijapazonu.

THE INHERITANCE OF YIELD COMPONENTS IN SPRING WHEAT

Main yield components - gram number per spike and grain weight - were analysed in several hybrid combinations. Analyses were done for five high yielding Mexican lines crossed with two NS varieties. Each NS variety was crossed with five Mexican lines and the obtained results are presented and discussed in this paper. The mode of inheritance was mainly intermediate and heritability values differed depending on the studied combination

NAČIN NASLEĐIVANJA I EFEKAT GENA ZA VISINU STABLJIKE I ŽETVENI INDEKS RAZLIČITIH GENOTIPOVA PŠENICE

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Četiri genotipa pšenice (Jugoslavija, Žitnica, Osječanka, NS rana 2) odabrana su u cilju analize načina nasleđivanja i efekta gena za visinu stabljike i žetveni indeks. Ukrštanjem odabranih genotipova proizvedene su generacije potomstva (F₁, F₂ i FB₁). Ogled je postavljen po slučajnom blok sistemu u tri ponavljanja, na ogleđnom polju na Rimskim šančevima. Za ocenu efekta gena je primenjen aditivno-dominantni model. Epistatičan efekat gena je ocenjen primenom modela sa šest parametara (Mather and Jinks, 1982). Između srednjih vrednosti roditelja i potomstva postojale su značajne razlike za oba ispitivana svojstva. Visina stabljike, kod roditelja, kretala se od 50.9 cm (Osječanka) do 65.1 cm (Jugoslavija) i nasleđivala se dominantno, ili superdominantno. U većini ukrštanja je dominantni efekat gena bio značajniji od aditivnog. U ukrštanju Žitnice x NS rana 2 se nije pojavila epistaza, dok je kod ostalih hibrida zapažena interakcija $a \times a$, $a \times d$ i $d \times d$. Žetveni indeks se kretao od 22.2% (NS rana 2) do 31.1% (Žitnica). Nasleđivanje ovog parametra je bilo dominantno, ili superdominantno. U većini ukrštanja je dominantni efekat gena bio značajniji od aditivnog, izuzev u kombinaciji Jugoslavija x Osječanka. Kod žetvenog indeksa su dobijene interakcije gena $a \times a$ i $d \times d$.

THE INHERITANCE AND GENE EFFECT FOR PLANT HEIGHT AND HARVEST INDEX IN DIFFERENT WHEAT GENOTYPES

In order to analyze the inheritance and gene effect for plant height and harvest index (HI), four wheat genotype (Jugoslavija, Žitnica, Osječanka, NS rana 2) were chosen. They were crossed and F₁, F₂, FB₁ generations produced. The trial was conducted at the experimental field in Rimski Šančevi, in a randomized complete block design with three replications. The gene effects were studied on the basis of generation mean analysis (additive-dominance model). The epistatic gene effect was evaluated using the model of six parameters (Mather and Jinks, 1982). Significant differences were found between the mean values for plant height and HI. Plant heights varied from 50.9 cm (Osječanka) to 65.1 cm (Jugoslavija). The inheritance was dominant or superdominant. In most cases the value of the dominant effect was higher than the additive one. In the cross Žitnica x NS rana 2 epistasis was not observed. In all other hybrids epistasis occurred ($a \times a$, $a \times d$, $d \times d$). HI ranged from 22.2% (NS rana 2) to 30.1% (Žitnica). The mode of inheritance was dominant or superdominant. In most crosses there existed a preponderance of the dominant over additive gene effect, except in the combination Jugoslavia x Osječanka. The epistasis for HI was of a $a \times a$ and $d \times d$ type.

SPONTANI DVOSTRUKI HAPLOIDI U KULTURI ANTERA PŠENICE: NJIHOV ZNAČAJ U OPLEMENJIVANJU

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Danas, kada je proteklo više od dvadeset godina otkako su dobijene prve haploidne biljke gajenjem antera pšenice u kulturi in vitro, ova metoda našla je široku primenu u oplemenjivanju ove značajne biljne vrste. Da bi se kultura antera uspešno mogla koristiti u procesu stvaranja novih sorti veoma je važno povećati frekvenciju zelenih regeneranata koji imaju ili haploidan ili diploidan broj hromozoma. Haploidi, koji su inače sterilni, ne mogu se direktno koristiti u oplemenjivanju. Njihovo korišćenje je uslovljeno prethodnim udvostručavanjem broja hromozoma kolhicinom, pa se na taj način iz antera heterozigotne F1 ili F2 generacije mogu dobiti fertilna homozigotna potomstva. S druge strane, spontani diploidi, ili dvostruki haploidi, imaju veliki značaj u oplemenjivanju pšenice, jer njihova upotreba nije vezana za indukovano udvostručavanje broja hromozoma, koje je često komplikovano i ne daje očekivane rezultate. Dvostruki haploidi nastali spontanom udvostručavanjem broja hromozoma mogu se na isti način kao i indukovani dvostruki haploidi, kao homozigotan materijal direktno koristiti u oplemenjivanju pšenice. Rezultati naših istraživanja, koji su dobijeni na bazi proučavanja androgeneze kod 6 slučajno odabranih F1 hibrida, pokazali su da 90.5% zelenih regeneranata, dobijenih u kulturi antera, ima ili haploidan ili diploidan broj hromozoma. Svega 9.5% regenerisanih biljaka su bili poliploidi, aneuploidi ili miksoploidi. Frekvencija spontanih dvostrukih haploida bila je 49.2%, što ukazuje na to da se približno 50% zelenih regeneranata, dobijenih u kulturi antera, može direktno, bez primene tretmana kolhicinom koristiti u oplemenjivanju pšenice. Ova okolnost ima poseban značaj kada se in vitro kultura antera pšenice koristi kao savremena metoda za masovnu proizvodnju homozigotnih dvostrukih haploida.

SPONTANEOUS DOUBLED HAPLOIDS IN WHEAT ANTHHER CULTURES ITS SIGNIFICANCE IN BREEDING PROGRAMS

Today, twenty years after the first haploid plants were obtained by in vitro wheat anther culture, this technique has found a wide application in wheat breeding programs. To realise the successful application of the anther culture technique in the process of new cultivar production, it is very important to increase the frequency of green plants with a haploid or diploid chromosome number. In haploids, which are completely sterile, the number of chromosomes must be doubled by colchicine treatment and that is a unique way to obtain homozygous progenies when the anthers of heterozygous F1 or F2 are used for isolation. On the other hand, spontaneous doubled haploids have a great significance in wheat breeding because they can be directly included in the process of new cultivar production as homozygous material. Thus, induced chromosome doubling which

may be complicated and uncertain, can be avoided. In our experiment, the anthers of six random selected F1 hybrids were isolated and 90.5% of green plantlets obtained were haploid or spontaneous doubled haploid. Only 9.5% of green plantlets were polyploids, aneuploids or mixoploids. The frequency of spontaneous doubled haploids was 49.2%. This means that approximately 50% of regenerated green plantlets can be, as homozygous material, directly used in what breeding. This circumstance is very important in the case when the anther culture technique is applied in large scale production of homozygous doubled haploids.

VARIRANJE KVANTITETA I KVALITETA PROTEINA PŠENICE U ZAVISNOSTI OD GENOTIPA I AGROEKOLOŠKIH USLOVA

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Tehnološki kvalitet u celini, kao i kvantitet i kvalitet proteina uslovljeni su primarno genetskim potencijalom sorte pšenice koji se realizuje u većoj ili manjoj meri zavisno od agroekoloških uslova. Analogno tome prerađivačka vrednost, kao i tehnološki kvalitet njenih polufinalnih i finalnih proizvoda prvenstveno su uslovljeni kvantitetom i kvalitetom proteina. I pored relativno klimatske homogenosti u Vojvodini javijaju se dosta velika odstupanja u postignutom kvalitetu istih sorti, zavisno od mesta i rejona proizvodnje. Cilj ovog rada je da se izvrši analiza značajnosti razlika za većinu pokazatelja kvantiteta i kvaliteta proteina sorti pšenice predstavnika sve tri tehnološke grupe, koje su najviše zastupljene u merkantilnoj proizvodnji. To su, za sorte poboljšivače: Rodna, Proteinka i Balkan; za hlebne sorte: Jugoslavija, Novosadska rana 5 i Pobeda; za osnovne sorte: Lasta, Francuska i Evropa. Analizom varijanse objašnjava se uticaj različitih varijacija, a analizom međuzavisnosti parametara koji definišu kvantitet i kvalitet proteina utvrđena je značajnost njihove linearne veze.

VARIATIONS OF THE QUANTITY OF QUALITY OF WHEAT PROTEIN DEPENDING ON THE GENOTYPE AND AGROECOLOGICAL CONDITIONS

Technological quality as a whole, as well as the quantity and quality of the protein are principally related to the genetic potential of a wheat variety, which is realized more or less, depending on agroecological conditions. Consequently the processing value and technological duality of the half-final and wheat products mainly depend on the quantity and quality of the protein. In spite of the climatic homogeneity of Vojvodina, great differences exist in the quality of a wheat variety depending on the place and region of production. The purpose of this study was to determine, by statistical analysis, differences of the protein quantity and quality of wheat varieties - representatives of three technological groups mainly present in the mercantile production. They are: variety improvers - Rodna, Proteinka and Balkan; bread varieties - Jugoslavija, Novosadska 5, and Pobeda; basic varieties - Lasta, Francuska and Evropa. Analysis of statistical variance has explained the effect of various sources of variations, and analysis of the interdependence of parameters important for the quantity and quality of the protein has determined the significance of their linear connection.

NEKE OSOBINE NOVIH LINIJA JEČMA I OVSA UKLJUČENIH U OGLEDE JUGOSLOVENSKE KOMISIJE

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U mirkoogledima Centra za strna žita, Kragujevac u periodu 1990–1994. godine ispitane su 2 linije ozimog dvoredog ječma, jedna linija jarog dvoredog ječma i jedna linija jarog ovsa. Ove linije su bile uključene u oglede jugoslovenske Komisije za priznavanje sorti. Sve nove linije upoređene su sa standardnim sortama Novosadski 293 (ozimi ječam), Kraguj (jari ječam) i Condor (jari ovas). Nova linija KG-1/1-1/90 ozimog dvoredog ječma imala je prosečan prinos zrna za 4 godine ispitivanja 7527 kg/ha a linija KG-2/35-2-90 (7566 kg/ha) dok standardna ozima sorta Novosadski 293 (7025 kg/ha). Nova linija jarog dvoredog ječma KG-6/11 imala je prosečan prinos zrna u toku 5 godina ispitivanja 5190 kg/ha a standardna jara sorta Kraguj 4128 kg/ha. Međutim, jara kragujevačka linija ovsa KG-3/2-90 imala je prosečan prinos zrna u toku 4 godine ispitivanja 5535 kg/ha a standardna sorta Condor 4833 kg/ha. Na osnovu ovih rezultata kragujevačke nove selekcije ječma i ovsa su pokazale veći prinos zrna u proseku između 502-1062 kg/ha, a neki njegovi faktori kvaliteta zrna i stabilnosti prinosa zrna bili su na nivou standardnih sorti.

SOME TRAITS OF NEW LINES OF BARLEY AND OATS IN FEDERAL COMMISSION TRIALS

In microtrials at the Center for Small Grains in Kragujevac, during 1990–1994. 2 lines of two row winter barley, 1 line of two row spring barley and 1 line of spring oats were analysed. Also, these genotypes were included in trials of the Approval Federal Commission. All new lines were compared with check cultivars Novosadski 293 (winter barley), Kraguj (spring barley) and Condor (spring oat). The average grain yield of the new line of two row barley (KG-1/1-90) during 4 years of testing was 7527 kg/ha and for the KG-2/35-2-90 line it was

7566 kg/ha while for the check cultivar Novosadski 293 it was 7025 kg/ha. The average grain yield for the new KG-6/11 line of two row spring barley during 5 years of investigation was 5190 kg/ha and for check cultivars Kraguj it was 4128 kg/ha. However, the average grain yield during 4 years of examination for KG-3/2-90 line of spring oats was 5535 kg/ha and for the check Condor cultivar it was 4833 kg/ha. These results indicate that the new selection lines in Kragujevac of barley and oats had a higher grain yield on average between

502-1062 kg/ha than check cultivars. Also, some quality grain parameters and the stability of grain yield were at the level of check cultivars.

GENETIČKA ANALIZA BOKORENJA HIBRIDA JEČMA (*Hordeum vulgare* L.)

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Četiri divergentna genotipa ječma ukrštena su po shemi dialela da bi se ocenio način nasleđivanja, efekat gena i komponente genetičke varijanse u F1 i F2 generaciji. Ocena načina nasleđivanja data je na bazi signifikantnosti razlika srednjih vrednosti hibrida u odnosu na roditeljski prosek. Za utvrđivanje komponenti genetičke varijanse i regresionu analizu podataka korišćena je metoda Jinks (1954), Hayman (1954) i Mather and Jinks (1971). Nasleđivanje bokorenja ječma u F1 generaciji ispoljilo se po tipu superdominacije, parcijalne dominacije, intermedijarno a u F2 generaciji ispoljena je parcijalna dominacija. Izračunata vrednost aditivne komponente varijanse (D) u obe generacije ispitivanja veća je od vrednosti komponenti H1 i H2 što pokazuje da veći udeo u nasleđivanju imaju geni sa aditivnim delovanjem. Dobijena vrednost za veličinu $H2/4H1$ pokazuje nejednak raspored dominantnih i recesivnih gena, što potvrđuju različite frekvencije (u, v) dominantnih i recesivnih gena. Prosečni stepen dominacije manji je od 1 i ukazuje na parcijalnu dominaciju u nasleđivanju bokorenja, što potvrđuje linija regresije, koja seče W_r osu iznad koordinatnog početka. Raspored tačaka dijagrama rasturanja pokazuje da sorte Partizan i NS-293 imaju najveći broj gena sa dominantnim efektom, kod linije KC-15 prevlađuju geni sa recesivnim delovanjem.

INHERITANCE OF TILLERING IN BARLEY HYBRIDS (*Hordeum vulgare* L.)

In diallel crosses of four divergent barley genotypes the mode of inheritance, gene effects and genetic components of variances in F1 and F2 hybrids were analyzed. The mode of inheritance based on significant differences of average values in both hybrids and parents for tillering was estimated. The genetic components of variance and regression analysis, were analyzed using the methods of Hayman (1954), Jinks (1954), and Mather and Jinks (1971). In F1 hybrids different modes of inheritance (over dominance, dominance, partial dominance and intermediate) and in F2 hybrid partial dominance were found. The additive component of variance (D) in both generations were higher than dominant components (H1 and H2) indicating the main role of additive genes in the inheritance of tillering. The obtained value of magnitude $H2/4H1$ showed an unequal distribution of dominant and recessive genes, which was confirmed, by different frequencies (u, v) of dominant and recessive genes. The degree of dominance was lower than ones, indicating partial dominance in the inheritance of tillering. The regression line cut the W_r axis above the point of origin indicating partial dominance which is in agreement with the degree of dominance. The scatter of the array along the regression line indicated the presence of genetic diversity in the parents. The Partizan and NS-293 cultivars had more dominant genes and the KG 15 cultivar more recessive genes for tillering.

AGRONOMSKE I TEHNOLOŠKE OSOBINE NOVIH SORTI JAROG PIVSKOG JEČMA

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Jari dvoredi ječma je dugo vremena smatran jedinom formom ječma pogodnom za proizvodnju piva. Genetičkim istraživanjima i oplemenjivačkim radom stvorene su sorte ozimog dvoredog ječma, koje uz zadovoljavajuće tehnološke osobine imaju veći prinos zrna od jarog. Zbog toga je i u zemljama tradicionalnim proizvođačima jarog ječma došlo do smanjenja njegovih površina u korist ozimog. Međutim, jari ječma i dalje ima važnu ulogu kako zbog agronomskih i tehnoloških karakteristika, tako i zbog organizacije i raspodele primarne poljoprivredne proizvodnje između ozimih i jarih biljaka. Do poboljšanja agronomskih osobina jarog pivskog ječma u agroekološkim uslovima Vojvodine došlo je nakon introdukcije stranih sorti visokog prinosa i dobre otpornosti na poleganje. Metodom hibridizacije divergentnih genotipova u Institutu za ratarstvo i povrtarstvo u Novom Sadu stvoreno je 16 sorti jarog pivskog ječma. Od sorti priznatih osamdesetih godina najbolje agronomske i tehnološke osobine imaju Novosadski 294 i Novosadski 301. Sorte priznate devedesetih godina: Vihor, Jelen, Pek, Viktor i Milan imaju veći prinos od standarda Novosadski 294 za oko 1 t/ha i bolju citolitičku, proteolitičku razgrađenost slada. Novosadske sorte pivskog ječma odlikuju se dobrim agronomskim i tehnološkim osobinama; zrno sadrži oko 12% belančevina, a slad oko 78-80% ekstrakta.

AGRONOMIC AND TECHNOLOGICAL CHARACTERISTICS OF THE NEW SPRING MALTING BARLEY VARIETIES

Spring two-rowed barley was considered for along time to be the only type of barley appropriate for beer production. Using genetic studies and breeding several winter varieties of two-rowed barley have been created, which besides satisfactory technological characteristics have higher grain yields than spring varieties. That was the reason why in the countries known as traditional producers of spring barley its production area was reduced for the benefit of winter barley. However, spring barley is still very significant for its agronomic and technological characteristics, as well as for the organization and distribution of primary agronomic production among winter and spring plants. The agronomic characteristics of spring malting barley under agroecological conditions in Vojvodina were improved after high yielding foreign varieties resistant to lodging were introduced. In the Institute of Field and Vegetable Crops 16 spring malting barley varieties were created using the method of hybridization of divergent genotypes. Among the varieties released during 1980's the best agronomic and technological traits belonged to Novosadski 294 and Novosadski 301. The varieties Vihor, Jelen, Pek, Viktor and Milan released in 1990's have higher yields than the standard Novosadski 294 for about 1 t/ha and also better cytolytic, proteolytic and amylolytic malt modifications. Novi Sad varieties of malting barley have good agronomic and technological traits; the grain contains about 12% of protein, and malt contains about 78-80% of the extract.

IZOZIMSKA VARIJABILNOST ESTERAZA JEČMA I NJIHOVA PRIMENA U IDENTIFIKACIJI SORTI

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Metodom PAG elektroforeze ispitivana je izozimska varijabilnost esteraza i mogućnost primene dobijenih rezultata u identifikaciji sorti ječma selekcionisanih u Institutu za ratarstvo i povrtarstvo u Novom Sadu. Na zimogramu EST uočeno je pet izozimskih oblika. Lokusi Est2 i Est6 su bili monomorfni, u Est1 i Est4 javijala su se dva alelna oblika, dok je u lokusu Est5 uočeno tri alela. . Na osnovu karakterističnih alelnih kombinacija sorte ječma su podeljene u sedam različitih grupa. Samo u jednom slučaju se pojavila sorta sa jedinstvenim fenotipom, dok se u ostalim grupama nalazilo između 2 do 10 sorti.

ISOZYME VARIABILITY OF BARLEY ESTERASES AND THEIR APPLICATION IN CULTIVAR IDENTIFICATION

The PAGE method was used to determine isozyme variability of esterases in the barley cultivars originating from the Institute of Field and Vegetable Crops in Novi Sad, as well as the possibility of their use in barley cultivar identification. Five isozyme systems were noted. Loci Est2 and Est6 were monomorphic, Est1 and Est4 had two allelic forms, while three alleles were observed at the Est5 locus. Barley cultivars were divided into seven different groups, according to their specific allelic composition. Only in one case a single cultivar had a unique phenotype. As for the others, between 2 to 10 cultivars were present in each group.

**NASLEĐIVANJE NEKIH KVALITETNIH OSOBINA ZRNA KOD HIBRIDA KOD F4
GENERACIJE OD TRITICUM AESTIVUM L.**

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Ispitivani su ukupni sirovi proteini, čisti proteini i sedimentacija kod deset hibridnih linija od F4 generacije dobijenih sa unutarvidovnom hibridizacijom od sorti meke pšenice (*triticum aestivum* SSP *vulgare*). Ispitivanja su izvršena u 1993/94 god na eksperimentalnom polju Poljoprivrednog instituta u Skopju. Nasleđivanje kod ukupnih sirovih proteina kod osam hibridnih linija pokazalo je negativan heterozis, kod jedne linije – dominantno i intermedijarno. Čisti proteini kod devet hibridnih linija pokazali su negativan heterozis, a samo kod jedne linije parcijalno-dominantno. Pri nasleđivanju sedimentacione vrednosti kod dve linije zabeležen je pozitivan heterozis, kod jedne intermedijarno parcijalno dominantno, dok kod ostalih šest hibridnih linija, imalo je negativan heterozis.

**INHERITANCE OF SOME KERNEL QUALITY CHARACTERISTICS OF HYBRIDS AT F4
GENERATION OF TRITICUM AESTIVUM L.**

In this study total crude proteins, pure proteins and sedimentation value of ten hybrid lines at F4 generation obtained by inter-species hybridization of soft wheat varieties (*triticum aestivum* SSP. *vulgare*) have been analyzed. The experiments were performed during 1993/94 on the experimental field of the Agriculture Institute in Skopje region. The inheritance of the total crude proteins in eight hybrid lines showed negative heterosis and in one line is dominant and intermedial. Pure proteins in nine hybrid lines showed negative heterosis and only in one line partial dominant. The inheritance of the sedimentation value in two lines showed positive heterosis, in one line intermedial partial dominant, while in the other six lines there was negative heterosis.

UTICAJ CITOKININA NA REGENERACIJU BILJAKA SUNCOKRETA

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Delovi in vitro uzgojenih klijanaca kulturnog suncokreta (*Helianthus annuus* L.) su postavljeni na hranjivu podlogu u koju su dodani različiti citokinini. Uticaj citokinina na regeneraciju biljaka je ispitivan utvrđivanjem broja indukovanih izdanaka i regenerisanih biljaka, nakon prve i druge supkulture.

THE EFFECT OF CYTOKININS ON REGENERATION OF SUN FLOWER PLANTS

Parts of in vitro grown seedlings of cultivated sunflowers (*Helianthus annuus* L.) were placed on a nutrition medium supplemented with different cytokinins. The effect of cytokinins on regeneration of sunflower plants was studied by determination of the number of induced shoots and regenerated plants, after the first and second subculture.

ISTRAŽIVANJA MORFOFIZIOLOŠKIH KARAKTERISTIKA POLENA KOD RAZLIČITIH GENOTIPOVA SUNCOKRETA

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Cilj ovog rada bio je istraživanje autofertilnosti kod različitih genotipova suncokreta. Analizirana je klijavost polena koja je, zajedno sa procentom oplodnje, važan faktor visoke autofertilnosti suncokreta. U ovim istraživanjima korišćene su sorte, hibridi i linije suncokreta različitog porekla (Rumunija, Jugoslavija). Ispitivano je ukupno 28 genotipova. Za standard je korišćena rumunska sorta REKORD. Istraživanja su bila izvedena paralelno na dva lokaliteta: Fundulea (Rumunija) i Zaječar (Jugoslavija). Utvrđene su značajne razlike u procentu autofertilnosti kod različitih genotipova suncokreta. Najviše vrednosti procenta autofertilnosti utvrđene su u linijama AC:/90-3719A, AC/90-3688A, AC/90-3851B, 865418/26 i hibridima NS-H-52 i NS-H-OLIVKO.

AN INVESTIGATION OF POLLEN MORPHOPHYSIOLOGICAL CHARACTERISTICS IN DIFFERENT SUNFLOWER GENOTYPES

The aim of the work was auto-fertility research of different sunflower genotypes. Pollen germination was analyzed and together with the percentage of fertility it is an important factor for a high auto-fertility. Hybrids, varieties and sunflower lines of different origin (Romania, Yugoslavia) were used in this project. There were 28 genotypes. The Romanian variety REKORD was used as a standard. Investigations were undertaken parallel at two localities: Fundulea (Romania) and Zaječar (Yugoslavia). Very important differences were noticed for the auto-fertility percentage in different sunflower genotypes. The highest values were found for lines AC/90-3719A, AC/90-3688A, AC/90-3851B, 865418/26 and hybrids NS-H-52 and NS-H-OLIVKO.

VARIJABILNOST SADRŽAJA PROTEINA I ULJA U SEMENU SAMOOPLODNIH LINIJA SUNCOKRETA

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Dobijene su linije C6 generacije čije su srednje vrednosti sadržaja proteina u semenu više od prosečnih vrednosti za ista svojstva u odnosu na ishodni materijal (linije C4 generacije samooplodnje). Opšta srednja vrednost za sadržaj proteina u semenu linija C6 generacije iznosi 19.7%. Minimalan prosečan sadržaj proteina u semenu utvrđen je u liniji 863412/21 (14.8%), a maksimalan u liniji 358916-2/2 (25.5%). Srednja vrednost za sadržaj ulja u semenu linija C6 generacije iznosi 29.6%. Minimalan prosečan sadržaj ulja u semenu izmeren je u liniji 358913/30 (17.9%), a maksimalan prosečan sadržaj ulja u semenu u liniji 86346/18 (38.1 %). Dobijeno je pet samooplodnih linija suncokreta C6 generacije samooplodnje sa prosečnim sadržajem proteina u semenu višim od 22% i sadržajem ulja u semenu manjim od 40%.

VARIABILITY OF THE PROTEIN AND OIL CONTENT IN SEEDS OF SELF- FERTILIZATION SUNFLOWER LINES

C6 lines were obtained with mean values of the protein content higher than the average values in the initial material (self-fertilization lines of C4). The general average value for the seed protein content in C6 lines was 19.7%. The minimum seed protein content valuee was obtained for line 863412/21 anal is was 14.8%, and the maximum one for line 358916-2/2 was 25.5%. The mean value of the seed oil content measured for lines of the C6 generation was 29.6%. The minimum value of the seed oil content obtained for line 358913/30 was 17.9%, and the maximum one for line 86345/18 was 38.1%. Five self-fertilization sunflowez lines of the C6 generation were obtained with seed protein contents higher than 22% and seed oil contents lower than 40%.

UTICAJ INBREDINGA NA VARIJABILNOST KVANTITATIVNIH SVOJSTAVA ŠEĆERNE REPE

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U novije vreme oplemenjivači šećerne repe sve više poklanjaju pažnje iskorišćavanju heterozisa, odnosno povećanju potencijala rodnosti šećerne repe. Rezultati istraživanja daju odgovor u kojoj su meni korišćene populacije monogermne diploidne repe homogene i kakva im je oplemenjivačka vrednost u narednim ciklusima selekcije. Cilj je bio da se kod novostvorenih „0” linija, koje poseduju gene za mušku sterilnost (xxzz) utvrdi uticaj inbreeding depresije na realizaciju svojstava. Ispitivane su kvantitativne osobine: masa korena, dužina korena, prečnik korena, broj prstenova sprovodnih sudova i dr. Ocena homogenosti početnih populacija i homozigotnosti samooplodnih linija na kon S4 generacije samooplodnje izvršena je preko više parametara statističke analize rezultata kao što su: srednja vrednost svojstva, širina varijacije, koeficijent varijacije, standardne devijacije i dr. Depresivno dejstvo inbreedinga za masu korena i druga svojstva je zavisilo od genetičke konstitucije početne populacije i kretalo se od 74.0%, kod populacije NS-0400, do -242.0%, kod linije NS-300. Ovakva razlika u depresiji mase korena se pripisuje različitom nivou heterozigotnosti početnih populacija. Depresivno dejstvo inbreedinga za druga svojstva je bilo znatno manje, a naročito za dužinu korena. Kod nekih linija dužina korena se nije menjala u generacijama samooplodnje.

THE EFFECT OF INBREEDING ON THE VARIABILITY OF QUANTITATIVE CHARACTERISTICS OF SUGAR BEET

Recently, sugar beet breeders have been paying attention to the utilization of heterosis, i.e. increasing the sugar beet yield potential. The results of this study answer the question to which extent the applied populations of monogerm diploid sugar beet are homogenous and what is their breeding value in further cycles of selection. The aim was to determine the effect of inbreeding depression on the realization of the studied characteristics in new „0” lines that possess the genes for male sterility (xxzz). The studied quantitative characteristics are: root mass, root length, root diameter, number of rings of vessels, etc. The evaluation of homogeneity of the initial populations and homozygosity of inbred lines after S4 generations of self pollination was performed using several parameters of statistical analysis of the results such as: mean value of characteristics, variation range, variation coefficient, standard deviations, etc. The depressive effect of inbreeding on root mass and other characteristics depended on the genetic constitution of the initial population and ranged from -74% in the population NS-0400 to -242.0% in the line NS-300. Such a difference in root mass depression is due to different levels of heterozygosity of initial populations. The depressive effect of inbreeding on other characteristics was significantly lower, particularly on root length. In some of the lines, the root length did not change in inbred generations.

ANATOMSKA ANALIZA POJEDINIH FAZA EMBRIOGENEZE KOD ŠEĆERNE REPE (*Beta vulgaris* L.)

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Kao materijal u radu je korišćen diploidni muško sterilni genotip 954. Uzimani su oplođeni cvetovi u raznim fazama ontogeneze sa različitih delova cvetnog stabla. Uzorci su fiksirani u Carnoy II, stavljeni u parafin, a zatim sečeni na debijinu od 10 μm i bojeni hematoksilinom i safraninom. Sa sigurnošću je determinisano nekoliko faza razvića embriona, kao i promena u razvoju embrionove kese. Na preparatima su histoanatomskom analizom uočene sledeće faze embriogeneze: oplođena centralna ćelija, prva podela zigota pre formiranja ćelijskog zida, a potom i formiranje 16-o jedarnog embriona kao i loptastog embriona sa plazmatičnim omotačem.

ANATOMICAL ANALYSIS OF SOME STAGE OF EMBRYOGENESIS IN SUGAR BEET (*Beta vulgaris* L.)

The diploid male sterile genotype 954 grown in fields was investigated. Pollinated flowers, in various stages of ontogenesis were taken from different parts of the flower stalk. Samples were fixed in carnoy II and embedded in paraffin. Sections were cut using a microtome at 10 μm and stained with safranin and heamatoxylin. Several stages of embryo development were determined and also irregularities in embryo-sac development. According to the histological analysis, using a light microscope, the following stages of embryo development could be observed: fertilized polar nuclei, the first division of the zygote before the formation of a cell wall, a 16-cell embryo and an undifferentiated globular embryo.

ANALIZA GRUPA S2 AUTOFERTILNIH MONOGERMNIH FAMILIJA ČETIRI POPULACIJE ŠEĆERNE REPE

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Pošto uspeh u oplemenjivanju biljaka zavisi od postojanja genetske varijabilnosti u izvornoj populaciji, metode za utvrđivanje varijabilnosti imaju izuzetan značaj. Za istraživanja su korištene S2 autofertilne, monogermne familije održivači citoplazmatsko-nuklearne muške sterilnosti, kod četiri populacije šećerne repe: 1102-5-2, B1001, 1223, A84-38. Populacije su nastale metodom sukcesivne hibridizacije gde je poslednji roditelj bila linija čiju oznaku nosi populacija. Podaci su standardizovani pre početka analize uz primenu metoda udruživanja sličnih linija, na osnovu udaljenosti dve najbliže linije. Udaljenost između pojedinih S2 familija izražena je normalizovanim Euklidijskim rastojanjem. Dobijeni rezultati prikazani su u obliku dendrograma koji pokazuje da postoje značajne razlike između ispitivanih S2 familija, a takođe i niz sličnosti. Dobijene sličnosti i razlike između S2 familija kako između tako i unutar populacija mogu se objasniti pedigreeom koji ukazuje da su populacije tokom stvaranja imale niz zajedničkih roditelja koji su u populacije unosili različitu količinu germplazme, a razlikuju se minimum u poslednjem roditelju koji je uneo 50% germplazme populaciji.

CLUSTER ANALYSIS OF S2 FAMILIES OF FOUR SUGAR BEET SELF-FERTILE MONOGERM POPULATIONS

Success in plant breeding depends of the existing genetic variability in source; populations, so methods for detecting the variability in populations have great importance. S2 self-fertile, monogerm population maintainers of cytoplasmatic-nuclear male sterility (CMS), „0” types, marked as: 1102-5-2, 81001, 1223, A84-38 were used for investigations. Populations were developed by the successive hybridisation method, where the last parent was the line that named the population. Results were standardised using the single linkage method before analysis and cluster analysis. Differences between S2 were expressed with the normalised Euclidean distance. Results, presented by a dendrogram, showed similarities and dissimilarities between S2 families inside and between populations. This could be explained by the pedigree because during the development of populations they had common parents that gave different amounts of germplasm. All populations differed in, at least, the last parent.

IN VITRO INDUKCIJA DIHAPLOIDA ŠEĆERNE REPE (*Beta vulgaris* L.)

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Haploidne biljke šećerne repe dobijene su iz neoplođene jajne ćelije. Dihaploidi indukovani su mutagenim delovanjem kolhicina. Kolhicin dodat je u medijum za multiplikaciju u koncentraciji (50 mg/l; 150 mg/l) u vremenskom trajanju od 24 do 120 časova. Najefikasniji tretman je visoka koncentracija kolhicina (150 mg/l) i kraće vreme trajanja tretmana (48 časova). Ploidni nivo determinisan je brojanjem hloroplasta u ćelijama zatvaračicama stoma kod mladih listova. Kod haploidnih biljčica broj hloroplasta je od 8 do 12, dok dihaploidne biljke sadrže od 13 do 18 hloroplasta.

***IN VITRO* INDUCTION OF DIHAPLOIDS OF SUGAR BEET (*Beta vulgaris* L.)**

Sugar beet haploid plants were obtained from unpollinated ovules. Dihaploids were induced by the mutagenic effect of colchicine. Colchicine was added to the medium for multiplication in concentrations of 50 mg/l and 150 mg/l for 24 to 120 hours. The most effective treatment was with higher concentrations of colchicine (150 mg/l) for shorter periods of time (48 hours). The ploidy level was determined by counting chloroplasts in stomal guard cells with young leaves. In haploid plantlets the number of chloroplasts was from 8 to 12 in stomal guard cells, while the dihaploid plants contained from 13 to 18 chloroplasts.

UTICAJ IZOLOVANIH SOJEVA AZOTOBACTER CHROOCOCCUM NA HIBRIDE ŠEĆERNE REPE

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Poznata je sposobnost azotobaktera da fiksira azot iz atmosfere, kao i sposobnost da produkuje materije rasteinja. Dve osobine sojeva azotobaktera omogućuju njegov stimulatívni uticaj na rast biljaka. U ovom radu ispitan je uticaj šest sojeva azotobaktera (2, 3, 5, 8, 14 i 2/1) izolovanih iz rizosfere šećerne repe na četiri hibrida šećerne repe (Dana, Hy-11, Norma i Delta). Pri setvi svako seme je inokulisano sa 1 ml tečne kulture soja azotobakter gustine 109 ćelija/ml. Kontrolne biljke su bile bez inokulacije. Ogléd je postavljen u staklari u sudovima. Biljke su gajene u zemljišnim kulturama do starosti od 70 dana. Merena je masa suve materije, određena je % i sadržaj azota u biljkama. Masa biljaka u zavisnosti od hibrida kretala se od 0.30 do 590 grama. Veću masu, u odnosu na kontrolne neinokulisane biljke ostvarile su biljke inokulisane sojevima 3 i 5.

THE EFFECT OF ISOLATED STRAINS OF AZOTOBACTER CHROOCOCCUM ON SUGAR BEET HYBRIDS

Azotobacter chroococcum abilities to fix atmospheric nitrogen and produce some growth substances are well known. These traits enable the stimulating effect of Azotobacter strains on plant growth. The effect of six Azotobacter strains (2, 3, 5, 8, 14 and 2/1), isolated from the rhizosphere of four sugar beet hybrids (Dana, Hy-11, Norma and Delta) was investigated. During sowing, each seed was inoculated with a 1 ml broth culture of the Azotobacter strain (density of 10 cells/ml). The trial was setup in a greenhouse and plants were grown in pots for 70 days. The matter mass and nitrogen content in plants were estimated. The dry matter mass varied from 0.3 to 5.9 g. Inoculation of plants with strains 3 and 5 increased the dry matter mass.

ASOCIJATIVNA SPOSOBNOST SOJEVA AZOTOBACTER SA ŠEĆERNOM REPOM

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Ispitani su odabrani sojevi azotobaktera (2, 3, 5, 8, 14, 21) izolovani iz rizosfere šećerne repe u zajednicama sa hibridima šećerne repe (Hy-li, Dana). Selekcija, tj. odabiranje sojeva izvršeno je na osnovu aktivnosti nitrogenaze u čistoj kulturi sojeva, kao i prema količini proteina mladih biljaka kod ispitivanih hibrida inokulisanih sojevima azotobaktera. Praćena je kolonizacija korena šećerne repe sa selektiranim sojevima azotobaktera, kako u laboratorijskim uslovima sa biljkama različite starosti, tako i u poljskom ogledu. Kod biljaka inokulisanih sojevima azotobaktera na osnovu rezultata poljskog ogleda uočena je izrazita asocijativna sposobnost pojedinih ispitivanih sojeva sa korenom biljaka odabranog hibrida (soj 3 i 14 sa Hy-11 i 2 i 8 sa Danom).

ASSOCIATION ABILITY OF AZOTOBACTER STRAINS WITH SUGAR BEET

The object of this study were Azotobacter strains (2, 3, 5, 8, 14, 21) isolated from the rhizosphere of two sugar beet hybrids (Hy-11, Dana). The strains were selected for their nitrogenase activity in a liquid culture, and the protein content in seedlings of inoculated hybrids. Colonization of sugar beet roots with selected Azotobacter strains was observed *in vitro* (on plants of different ages) and in field trials. According to the results of field trials, there is a great difference in the association ability of some strains with roots of particular genotypes. The best results were obtained when Hy-11 was inoculated with strains 3 and 14, and Dana with strains 2 and 8.

UTICAJ PLOIDNOG SASTAVA RODITELJSKIH GENOTIPOVA NA PRODUKTIVIVTOST HIBRIDA F₁ GENERACIJE ŠEĆERNE REPE

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U ovom istraživačkom radu ispitivan je uticaj broja genoma roditeljskih genotipova na produktivnost hibrida. F₁ generacije šećerne repe. Ispitivanja roditeljskih genotipova i eksperimentalnih hibrida vršena su tokom 1989. i 1990. godine u Aleksincu. Utvrđene su sledeće osobine: prinos korena, sadržaj šećera i prinos polarizacionog šećera. Analizirani su sledeći genetički parametri: apsolutni i relativni heterozis u odnosu na prosek roditelja relativni efekat heterozisa u odnosu na standard i uticaj genotipova majčinskih komponenata i tipova oprašivača na vrednost osobina F₁ hibrida. Saglasno apsolutnim vrednostima za prinos korena sadržaj šećera i prinos polarizacionog šećera. najbolje rezultate dali su triploidni hibridi u kojima je kao majčinska komponenta korišćena CMS linija 51-60. Analizom varijanse polusrodnika utvrđen je jak uticaj genotipova CMS linija majki na vrednost osobina rodosti F₁ hibrida - izuzev za sadržaj šećera. (za prinos korena 0.90 za prinos polarizacionog šećera 0.72 i za sadržaj šećera 0.26).

THE INFLUENCE OF POLYPLOIDY OF PARENTAL GENOTYPES ON THE PRODUCTIVITY OF THE F₁ GENERATION OF HYBRID SUGAR BEET

This paper discusses the influence of the number of genomes of the parental material on the productivity of the F₁ generation of hybrid sugar beet. The parental material included: two diploid monogerm cytoplasmic sterile male lines, two diploid polygerm populations, two tetraploid monogerm populations and two tetraploid multigerm populations. The parental genotypes and experimental hybrids were investigated during 1989 and 1990 in Aleksinac. The following characters were assessed: root yield, sugar content, polarized sugar content. The data were statistically analyzed. Mean values and variability of treatments were calculated. The following genetic parameters were analyzed: absolute and relative heterosis in relation to the parental mean, relative effect of heterosis in relation to the control and the influence of the genotypes of maternal components and the types of pollinators on the properties of the F₁ hybrid. In accordance with the absolute values for root yield, sugar content and polarized sugar content the most favourable results were obtained using triploid hybrids and the CMS line 51-60 as a maternal component. Analysis of the variance of the half-sib showed that the productivity (root yield 0.90, polar sugar content 0.72 and sugar content 0.26) of the F₁ hybrid (except for sugar content) was significantly influenced by the genotypes of the maternal CMS lines.

OCENA KOMBINIRAJUĆIH SPOSOBNOSTI I AKCIJE GENA ZA NEKA SVOJSTVA KORENA ŠEĆERNE REPE (*Beta vulgaris* L.)

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Za ispitivanja nekih svojstava korena šećerne repe u ovom radu je korišteno devet diploidnih i devet tetraploidnih genotipova F1 generacije istog genetskog izvora, kao i njihovi roditelji (po 3 diploidna i tetraploidna oprašivača i 3 diploidne monogermne CMM linije). Dobijeni rezultati za masu, dužinu, prečnik korena i refrakciju statistički su obrađeni metodom linija x tester. Analizom je utvrđeno da su tetraploidni oprašivači imali veće vrednosti OKS od diploidnih za sva ispitivana svojstva. Najveće PKS vrednosti za masu korena imala je kombinacija čije su obe roditeljske komponente bile dobri opšti kombinatori, međutim visoke PKS vrednosti su pokazale i kombinacije roditelja koji su bili loši kombinatori. I kod ostalih ispitivanih svojstava visoke pozitivne PKS vrednosti bile su kod kombinacija čija su oba roditelja bili dobri ili loši kombinatori, kao i kod kombinacija čiji je jedan roditelj bio dobar a drugi loš kombinator. U ekspresiji mase korena veći značaj imala je neaditivna komponenta (dominacija i superdominacija), a to ukazuju veće vrednosti dominantne komponente geno- tipske varijanse od vrednosti aditivne komponente. Kod ostala tri svojstva (refrakcija, dužina i prečnik korena) utvrđene su veće vrednosti za aditivnu nego za dominantnu genotipsku varijansu što ukazuje na veći značaj aditivne genetske komponente u ekspresiji ovih svojstava. U ekspresiji mase korena doprinos oprašivača i interakcije oprašivač x majčinska komponenta bio je podjednak, dok je doprinos majčinske komponente bio minoran. U ekspresiji ostala tri svojstva dominantan doprinos imali su oprašivači, a potom interakcija roditelja.

ESTIMATION OF COMBINING ABILITIES AND GENE ACTION FOR SOME SUGAR BEET ROOT TRAITS

Nine diploid and triploid F1 genotypes from the same gene-pool (gene source), and their parents (three diploid & tetraploid pollinators and three diploid monogerm CMS strains) were used for the analysis of some sugar beet root traits. In this paper the weight, length, diameter and dry-matter content (DM) of the roots were analysed using line x tester analysis. Tetraploid pollinators had higher general combining ability (GCA) values than diploid pollinators in all cases. Hybrid-combinations whose components showed high GCA values had higher values for specific combining abilities (SCA) for root weight, but some strains and pollinators with low GCA values showed high SCA values in hybrid combinations. We also obtained similar results for other traits. The non-additive action was most important for root weight expression, but additive gene action was most important for other analyzed traits. The contribution of pollinators and CMS strains was equal, for root weight expression; but the CMS strain contribution was not significant. Pollinators and then parental interaction had the most important contribution to the expression of other measured traits. For expression of other measured

traits most important contribution showed polinators and then interaction of parents.

GERMPLAZMA U OPLEMENJIVANJU SOJE U NAREDNIH 10 GODINA

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Institut za ratarstvo i povrtarstvo poseduje veoma bogatu germplazmu soje (*Glycine may (L.) Merrit*). Postoji više od 600 različitih genotipova koji pripadaju starosnim grupama 000-111. Veštačka hibridizacija je najvažniji metod koji se koristi za dobijanje varijabiliteta u razvoju kultivara. Cilj oplemenjivača je da se formiraju kultivari visokog prinosa za korišćenje u raznim sistemima biljne proizvodnje. Genetsko oplemenjivanje koje se može realizovati hibridizacijom genotipova iz naše kolekcije je iscrpljeno. Prema tome, dalji uspeh zavisi od novih genotipova koji utiču na vreme cvetanja i zrelost (E1-4), veliku aktivnost peroksidaze (Ep), otpornost na pepelnicu (Rpm) i trulež izazvanu gljivama *Phytophthora* (Rps1-6). U narednom periodu aktivnost će biti usmerena na traženje ovakvih genotipova i na njihovo korišćenje u programima oplemenjivanja.

GERMPLASM IN SOYBEAN BREEDING IN THE FOLLOWING YEARS

The Institute of Field and Vegetable Crops possesses a very rich soybean (*Glycine may (L.) Merrit*) germplasm. There are more than 600 different genotypes that belong to maturity groups 000-111. The basic method used for obtaining variability in cultivar development is artificial hybridization. The breeder's purpose is to create high yielding cultivars for use in different cropping systems. The genetic improvement realized by hybridization of genotypes from our collection has been exhausted. Further success therefore, depends on new genotypes with genes affecting the time of flowering and maturity (E1-4) high peroxidase activity (Ep), resistance to downy mildew (Rpm) and *Phytophthora* rot (Rps1-6). In the next period we intend to find such genotypes and use them in our breeding programmes.

FREKVENCA LINIJA SA SMANJENOM AKTIVNOŠĆU TRIPSIN INHIBITORA U ZRNU PRI RANOM TESTIRANJU PRINOSA ZRNA SOJE

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Kunitz tripsin inhibitor je odgovoran za polovinu tripsin inhibitorske aktivnosti u zrnu soje. Njegovom eliminacijom značajno se povećava upotrebna vrednost sojinog zrna. Prisustvo Kunitz tripsin inhibitora je determinisano jednim parom gena. Njegov nedostatak predstavlja ekspresiju homozigotne recesivne kombinacije (ti ti). U cilju dobijanja visokoprinosnih linija sa smanjenom aktivnošću tripsin inhibitora u zrnu obavljeno je ukrštanje sorte KUNITZ (do- nora poželjnog svojstva) i adaptirane sorte KADOR. Po metodi Hamerstand-a i Black and Glower-a, utvrđena je ukupna tripsin inhibitorska aktivnost u semenu 200 odabranih F2 biljaka i upoređena sa aktivnošću roditelja. Konstatovan je očekivani fenotipski odnos 3:1 između individua sa povećanom i sa smanjenom aktivnošću tripsin inhibitora u zrnu. Ovaj odnos postoji i kada posmatramo 100 prinosnijih F2 biljaka. Isto je utvrđeno i u sledećoj generaciji pri testiranju potomstva 48 najprinosnijih individua, a održava se i kod F3 linija koje su bile prinosnije od adaptiranog roditelja. Pri odabiranju prinosnijih linija u ranim generacijama nije došlo do eliminisanja linija sa smanjenom aktivnošću tripsin inhibitora u zrnu. Prema tome, pretpostavljamo da odsustvo Kunitz tripsin inhibitora nije u vezi sa prinosom zrna soje.

THE FREQUENCY OF LINES WITH A REDUCED TRIPSIN INHIBITOR ACTIVITY IN GRAIN IN EARLY TESTING OF SOYBEAN GRAIN YIELD

The Kunitz trypsin inhibitor is responsible for half of the trypsin inhibitory activity in soybean grain. The utilisation value of soybean grain significantly increases by its elimination. The presence of the Kunitz trypsin inhibitor is determined by a pair of genes. Its absence presents the expression of the homozygous recessive combination (ti ti). The variety KUNITZ (a donor of a favourable trait) was crossed to the adapted variety KADOR in order to develop high yielding lines with a reduced activity of trypsin inhibitor in grain. The total trypsin inhibitory activity was determined in seeds of 200 selected F2 plants by the method of Hamerstand and Black and Glower and then it was compared with the activity of parents in order to develop high yielding lines. The expected phenotypic ratio 3:1 was detected between individuals with increased and decreased activity of the trypsin inhibitor in grain. This ratio existed when 100 more yielding F2 plants were monitored. The same ratio was found in the following generation when 48 of the most yielding individuals were tested, and it remained in F3 inbreds, which were more yielding than the adapted parent. Inbreds with a reduced activity of the trypsin inhibitor in grain were not eliminated while selecting more yielding inbreds in initial generations. Therefore, it could be assumed that the absence of the Kunitz trypsin inhibitor is not related to soybean grain yield.

KVANTITATIVNA I KVALITATIVNA SVOJSTVA F4 GENERACIJE LINIJA SOJE (*Glycine max* (L) (Merril) U ODNOSU NA RODITELJE

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Prema konceptu selekcije svojstava izborom roditeljskih parova, sprovedeno je deset kombinacija ukrštanja uključujući intenzivne domaće i strane sorte soje. U svakoj od kombinacija ukrštanja, izdvojena je jedna superiorna linija u četvrtoj filijalnoj generaciji. Ispitivana je i vršena selekcija na kvantitativna i kvalitativna svojstva za period od dve godine. Analizom varijanse utvrđeno je da su postojale signifikantne razlike između tretmana u celini, kao i u svakoj od ispitivanih godina u odnosu na njihove interakcije. Nulta hipoteza je bila odbačena i Lsd-test je pokazao da su linije superiorne u odnosu na roditelje i ispitivana svojstva. Zbog genetskih korelacija između prinosa semena, njihovih komponenata i drugih svojstava analiza linearnih korelacija je sprovedena, a utvrđen je i pravac i intenzitet uzajamnih odnosa između svojstava.

QUANTITATIVE AND QUALITATIVE TRAITS IN THE F4 GENERATION OF SOYBEAN (*Glycine max* (L) (Merril) LINES IN RELATION TO PARENTS

Using the concept of traits in the selection of parent couples (intensive domestic and foreign soybean varieties) ten ordinary crossing combinations were done. One superior line was selected in each crossing combination in the fourth filial generation. The qualitative and quantitative traits of selected descendants and parents were investigated during the period of two years. Using variance analysis it was established that there were significant differences among treatments as a whole, with in each investigation year and in their interaction. The zero-hypothesis was rejected and the Lsd-test showed the lines superiority in relation to parents for the investigated traits. Because of genetic correlations among seed yield, its components, and other traits the analysis of linear correlations was done and the direction and intensity of interrelations among traits were found.

STVARANJE HIBRIDNIH SORTI SIRKA METLAŠA

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Sirak metlaš (*Sorghum bicolor* (L.) Moench) gaji se zbog metlice, osnovna sirovina za izradu sirkovih metli. Seme je kvalitetna stočna hrana. U proizvodnji sirka metlaša su raširene isključivo slobodnooplodne sorte. Cilj ovog rada je bio ispitivanje mogućnosti stvaranja hibridnih sorti sirka metlaša. U prvoj fazi rada iz sirka za zrno su preneti, putem povratnog ukrštanja, faktori citoplazmatske muške sterilnosti (cms) u sirak metlaš radi stvaranja 6 muško-sterilnih, tzv. A-linija i njihovih održivača sterilnosti, takozvane B-linije. U drugoj fazi rada su ispitani jačina i pravac hibridne snage analizom 36 jednostrukih F1 hibrida stvorenih ukrštanjem 6 A-linija u svojstvu majke sa 6 R-linija, oprašivača. U pogledu mase neovršene i ovršene metlice, kao i mase semena po metlici, najbolji hibridi su nadmašili postojeće sorte–linije čak za 40%. Značajna poželjna hibridna snaga konstatovana je i za druga praćena svojstva. Stvaranje hibridnih sorti omogućava lakše rešavanje otpornosti na antraknozu i virus mozaične kržljivosti kukuruza kod kojih se rezistentnost nasleđuje monogeno dominantno. Pruža se i mogućnost stvaranja „besemenih” cms hibrida. Neophodno je obratiti pažnju na kompatibilnost roditeljskih linija u pogledu njihovih gena za visinu da bi hibridi zadržali poželjan patuljast rast stabla.

BREEDING HYBRID VARIETIES OF BROOMCORN

Broomcorn (*sorghum bicolor* (L.) Moench) is grown for its panicles used as basic raw material for manufacturing corn brooms. Its seed is valuable cattle feed. Broomcorn production is based only on open pollinated varieties. The aim of this research has been to examine the possibility of producing hybrid varieties of broomcorn. During the first phase of the project the factors responsible for cytoplasmic male sterility (cms) were transferred by backcrossing from grain sorghum into broomcorn in order to develop 6 A-lines along with their maintainers designated as B-lines. In the second part of the study the magnitude and direction of hybrid vigour in 36 single cross F₁ hybrids developed by crossing 6 A-lines as female with 6 R-lines as male parents was evaluated. Regarding the weight of unthreshed and threshed panicles as well as seed weight per panicle the best hybrids overyielded the existing open pollinated varieties as much as 40%. Significant desirable hybrid vigour was also noticed for other studied traits. Hybrid broomcorn facilitates the breeding for resistance to anthracnose and maize dwarf mosaic virus to which the resistance is inherited in the monogenic dominant way. It enables the creation of „seedless” cms hybrids. The compatibility of parental lines regarding their height genes required special attention in order to keep the stalk of the hybrids dwarf-like.

PREGLED IDENTIFIKOVANIH Lr GENA OTPORNOSTI PREMA PUCCINIA RECONDITA TRITICI U SISTEMU GEN-ZA-GEN

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U početku je objašnjen „gen-za-gen” sistem osnove prvih Flor-ovih istraživanja interakcija patogena rđe lana (*Melampsora lini* Desm.) i domaćina lana (*Linum usitatissimum* L.). Promenljivost u razvoju, odnosno epidemiologiji patogena lisne rđe pšenice zavisi od genetske varijabilnosti pšenice, *Triticum aestivum* L., genetske varijabilnosti patogena *Puccinia recondita* Rob. ex Desm., i varijabilnosti spoljnih uslova. Prvi je Samborski dokazao da se genetske interakcije pšenice i *Puccinia recondita* tritici ponašaju na osnovu gen-za-gen uzajamnih odnosa. Na osnovu gornje teorije u ovom radu se iznose sve publikovane informacije o Lr genima (geni sa otpornom reakcijom prema *P. recondita* tritici), zbog njihovog lakšeg i boijeg korišćenja u specifičnim odnosima *P. recondita* : *Triticum*. U radu se sumiraju informacije različitih autora o iznetim Lr genima otpornosti, njihovom poreklu, hromozomskim lokacijama, karakteristika tipova infekcije, relativnu osetljivost na spoljne uslove, sinonimi, reakcije linija domaćina kao i različite kulture patogena. Na kraju su izneta naša međunarodna eksperimentalna iskustva o efikasnosti većine od ovih Lr otpornih linija i naša buduća istraživanja sa nekim novim Lr genima otpornosti u svetu.

RECONDITA TRITICI IN THE GENE-FOR-GENE SYSTEM

The gene-for-gene system based on Flor's first investigations of interactions between flax rust (*Melampsora lini* Desm.) and its host, flax (*Linum usitatissimum* L.) was explained of the beginning. Variations in the development of wheat leaf rust are due to genetic variations of wheat, *Triticum aestivum* L, genetic variations in the parasite, *Puccinia recondita* Rob. ex Desm., and variations of the environment. Samborski first showed that genetic interaction of wheat and *P. recondita* tritici operate in a gene-for-gene relationship. Based on the theory given above this paper presents published information on all Lr genes (genes for low reactions to *P. recondita*) to facilitate the use of these genes as the basis for storing and retrieving information on the specific relations of *P. recondita* : *Triticum*. This paper summarizes information on these Lr genes, their origin, chromosome location, characteristic low infection types, relative environmental sensitivity, synonymy, reference host lines, and reference cultures. Our international experimental experience of the efficiency of most of these Lr resistant genes and our future work with some newly identified Lr genes in the world is presented at the end.

PRINOS ZRNA PO BILJCI U UKRŠTANJIMA BELIH PASULJA

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U radu je analiziran prinos zrna po biljci pasulja kod pet populacija roditelja (majke su dve linije izdvojene iz populacija Gradištanca i Tetovca, a očevi su sorte Medijana, Biser i Oplenac) te po šest populacija F1 i F2. Najveći prinos zrna po biljci kod roditelja imao je Tetovac, pa Gradištanac, a najmanji Oplenac. Varijabilnost prinosa zrna po biljci je srednja do visoka. Kod ispitivane osobine kao način nasleđivanja u F1 se pojavljuje heterotični efekat ili dominacija roditelja sa većom srednjom vrednošću. Heterozis je najveći u ukrštanju Gradištanac x Oplenac. U F2 dolazi do smanjenja srednjih vrednosti populacija. Način nasleđivanja za prinos zrna po biljci je intermedijaran u svim ispitivanim kombinacijama ukrštanja. Heritabilnost prinosa zrna po biljci u većini kombinacija bila je visoka. Kod ispitivanih osobina u ukrštanjima sa Gradištancem pojavile su se biljke sa transgresijama.

GRAIN YIELD PER PLANT IN WHITE BEAN CROSSES

Grain yield per bean plant was analyzed, in five parent populations (two lines selected from the populations Gradištanac and Tetovac were used as female plants and as male plants the varieties Medijana, Biser and Oplenac) and in six populations of F1 and F2. In parents, the highestt grain yield per plant was achieved with Tetovac, followed by Gradištanac and the lowest with Oplenac. Grain yield variability per plant is medium to high. The heterotic effect or parent dominance with a higher mean value occured as an inheritance mode in F1. Heterosis was higher in the crossing between Gradištanac x Oplenac. Mean values of the populations were reduced in F2. The inheritance mode for grain yield per plant was intermediary in all studied crossing combinations. Grain yield heritabilty per plant was high in most combinations. Considering the studied traits in the crossings with Gradištanac, plants with transgressions appeared.

OSOBINE LUKOVICE POPULACIJA CRNOG LUKA (*Allium cepa* L.)

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Crni luk (*Allium cepa* L.) tradicionalna je povrtarska vrsta našeg podnevlja. Geografski položaj i specifičnost agroekoloških uslova (sadašnje i bivše Jugoslavije) uticali su na formiranje različitih populacija i ekotipova crnog luka. Ove populacije se razlikuju po obliku, broju, prosečnoj težini lukovice i načinu gajenja, što predstavlja značajan izvor genetske varijabilnosti. Cilj ovog rada je ispitivanje varijabilnosti osobina populacija crnog luka za iznalaženje poželjnih svojstava koja se mogu koristiti u oplemenjivačke svrhe. Analizom su utvrđene značajne razlike u težini lukovice, koja je iznosila od 74.0 do 209.8 gr, a koeficijent varijacije za ovu osobinu je iznosio: 39.1. Ustanovljena je velika varijabilnost u sadržaju suve materije (10.0% - 16.0%). Lukovice su se razlikovale po boji i obliku.

CHARACTERISTICS OF BULBS OF ONION POPULATIONS (*Allium cepa* L.)

Onion (*Allium cepa* L.) is a traditional vegetable crop of our climatic region. The geographic position and specific agroecological conditions of the present and former Yugoslavia influenced the formation of various populations and ecotypes of onions. These populations differ according to shape, number of bulbs, average bulb weight and way of growing which represents a significant source of genetic variability. The objective of our study was to examine the variability of the characteristics of onion populations with the aim of determining desirable characteristics that could be used in onion breeding. The analysis determined significant differences regarding onion weight which ranged from 74.0 to 209.8 g while the variation coefficient for this characteristic was 39.1. A high variability of the dry matter content was found (10.0% -16.0%). The bulbs differed according to color and shape.

NAČIN NASLEĐVANJA MASE PLODA HIBRIDA PAPRIKE (*Capsicum annuum* L.)

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Paprika je jedna od najznačajnijih povrtarskih vrsta. Spada u familiju Solanaceae roda *Capsicum* vrsti *Capsicum annuum* L. Cilj ovog rada jeste ispitivanje načina nasleđivanja i delovanja gena za masu ploda hibrida paprike. Za ova istraživanja odabrano je 7 roditelja majke (sorte ili linije) i 3 roditelja kao očevi (tester). Na osnovu dobijenih podataka iz urađene analize došli smo do saznanja o načinu nasleđivanja, delovanju gena, opštim (OKS) i posebnim (PKS) kombinacionim sposobnostima za masu ploda, hibrida paprike. Dobijeni hibridi i njihovi roditelji su uzgajani u poljskim uslovima, po slučajnom blok sistemu u tri ponavljanja. Analiza kombinacionih sposobnosti rađena je po Singh-u i Chaudhary-u (1976). Ispitivani genotipovi su se značajno razlikovali u masi ploda. Nasleđivanje mase ploda kod F1 hibrida se različito ispoljilo, heterozis, dominacija i intermedijarnost. Geni sa aditivnim i neaditivnim delovanjem su imali značenja u nasleđivanju mase ploda, sa predominantnom ulogom neaditivnog delovanja. Najveću značajnu pozitivnu vrednost OKS imao je genotip Kalifornijsko čudo. Ukrštanja sa najboljim PKS vrednostima Albargija x Kalifornijsko čudo i Buketna 1 x Matica, mogla bi se koristiti u daljem radu na oplemenjivanju paprike.

THE INHERITANCE MODE OF THE FRUIT MASS OF PEPPER HYBRIDS (*Capsicum annuum* L)

Pepper is one of the most important vegetable species. It belongs to the family Solanaceae, genus *Capsicum*, species *Capsicum annuum* L. The objective of this paper was to study the mode of inheritance and effect of fruit mass genes in pepper hybrids. For this study, we selected 7 mother parents (varieties and lines) and 3 father parents (testers). According to the results we obtained information of the inheritance mode, gene effect, general and specific combination abilities for fruit mass of pepper hybrids. The hybrids and parents were grown in a field according to a random block design in three replications. Combining abilities were analysed according to Singh and Chaudhary (197). The studied genotypes differed significantly regarding fruit mass. The inheritance of fruit mass in F1 hybrids was differently manifested (heterosis, dominance and intermediary). The genes with additive and non-additive effects were important for the inheritance of fruit mass, with a predominant role of non-additive genes. The genotype Kalifornijsko čudo had the most significant positive value of OCA. The crossing between Albargija x Kalifornijsko čudo and Buketna 1 x Matica which had the best values of SCA could be used for the further breeding of pepper.

UTVRĐIVANJE GENETSKE PRIPADNOSTI HMELJA (*Humulus lupulus L.*) KULTIVAR „BAČKA”

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Postoje različita mišljenja, ali kako kada i gde je nastao kulturni hmelj za sada nije dokazano. Za vojvođanski hmeljarski region kultivar „Bačka” predstavlja tradiciju. Zapisi govore da ovaj kultivar nije autohton. Iako postoje različite teorije pa i da je ovaj kultivar nastao aklimatizacijom introdukovanih nemačko-francuskih kultivara, centar njenog porekla nije dokazan. Na osnovu fenotipskih i agrobioloških osobina kultivar „Bačka” i njoj sličnih izvedeno je 16 genotipova iz postojeće kolekcije Zavoda za hmelj, sirak i lekovito bilje koji ukazuju na mogućnost postojanja zajedničkog centra porekla. Materijal pripada evropskoj grupi hmeljeva koja je podeljena na tri subgrupe: Engleski, Bavarski i Češki ekotipovi. Ogled je trajao tri godine, i postavljen je po metodu slučajnog blok sistema. Svaka elementarna parcelica sastojala se od 10 biljaka, 4 ponavljanja. Analiza agronomskih parametara vršena je u poljskim a biohemijska u laboratorijskim uslovima. Ispitivano je 19 kvantitativnih osobina. Da bi utvrdili na koji način se ispitivani genotipovi međusobno razlikuju, primenjena je multivarijaciona metoda, metoda glavnih komponenti (PCA-Principal Component Analysis). PCA je rađena sa Varimax rotacijom pri čemu su izdvojena 3 glavna faktora koja su objašnjavala oko 80% ukupne varijanse i na taj način grupisala posmatrane genotipove u dve genetičke divergentne grupe. Analizom varijanse utvrđeno je da su mnogo značajniji faktori za određivanje sortne pripadnosti određenom ekotipu sadržaj i sastav eteričnog ulja jer nisu podložni ekološkom faktoru. PCA je ukazala na najvažnije diskriminatore koji određuju prvu, drugu i treću glavnu komponentu i na taj način redukovala dimenzionisanost strukturnih elemenata te ukazala na najbitnije osobine koje su bile od neposrednog značaja za ova istraživanja. Na osnovu posmatranja agronomskih i biohemijskih parametara i rezultata multivarijacione analize ustanovili smo da kultivar „Bačka” pripada Bavarskoj grupi hmelja.

DETERMINATION OF THE GENETIC IDENTITY OF THE HOP (*Humulus lupulus L.*) CULTIVAR „BAČKA”

Various speculations exist, but it is not yet clear how, when and where the cultivated hop was developed. The cultivar „Bačka” is traditionally grown in the Vojvodina hop growing region. Literature data suggest that this cultivar is not autochthonic. In spite of various theories, like the one that this cultivar was formed by acclimatization of introduced German-French cultivars, the centre of its origin is not yet clear. A total of 16 genotypes have been selected from the hop collection of the Department for Hops, Sorghums and Medicinal Plants based on their phenotypic and agrobiologic similarity to cultivar „Bačka”, suggesting the existence of the same centre of origin. This material belongs to the European group of hops divided into three subgroups: English, Bavarian and Czech ecotypes. The experiment lasted three years and the layout was a randomized block system. The elementary plots consisted of 10 plants in four replications. The

agronomic characteristics were evaluated in the field combined with biochemical analysis in the laboratory. 19 quantitative characteristics have been studied. In order to find out the different genotypes way, multivariate analysis was applied by the method of Principal Component Analysis (PCA). PCA was used with Varimax rotation choosing 3 main factors explaining 80% of the total variation that enabled grouping of the tested genotypes into two genetic divergent groups. Analysis of variance showed that the content and composition of etheric oils are most important for determining to which ecotype a certain variety belongs, since these traits are not influenced by environmental factors. The PCA revealed the most important discriminators determining the first, second and third main component, reducing this was the dimensions of structural elements and suggesting the major traits of direct importance to this study. Based on the agronomic and biochemical parameters studied and also the results of multivariational analysis, it was concluded that the cultivar „Bačka” belongs to the Bavarian group of hops.

EFEKTI „AFILA” GENA NA FORMIRANJE ZRNA GRAŠKA (*Pisum sativu* L.)

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Gen „af” u homozigotnom stanju kod graška uslovljava modifikaciju biljaka, tako da one umesto normalne građe lišća formiraju samo vitice sa zaliscima. Sorta filigreen „AFILA” tipa ukrštena je sa 12 sorata normalne građe lista s ciljem ispitivanja uticaja afila genotipa na formiranje broja zrna graška po biljci. Genetska analiza F1 i F2 generacije (odnos razdvajanja 3:1 normalni list AFILA) potvrdila je monogenetski recesivni karakter ove osobine. Broj zrna po biljci u F1 generaciji (koja je normalnog lista) bio je veći nego roditelja oba tipa prosečno 46 zrna što iznosi oko 25% viši od roditelja -očeva. U F2 generaciji, kod biljaka sa normalnom građom lišća prosek broja zrna po biljci opada u odnosu na F1, prosečno za 15% ali je viši za oko 7% od roditelja - očeva. Afile su slabije produktivnosti sa prosečno 34,7 zrna po biljci i zaostaju u proseku 25% u odnosu na F1 generaciju a formiraju 6% manje zrna po biljci od roditelja - očeva. Smanjenje broja zrna po biljci u F2 generaciji kod afila gneotipa uslovljen je smanjenjem asimilacione površine biljke.

EFFECTS OF THE „AFILA” GENE ON PEA (*Pisum sativum* L.) GRAIN FORMATION

At the recessive homozygosity level the „AFILA” gene in peas modifies plants which form tendrils instead of leaves. The variety Filigreen of the „Afila” plant type has been crossed with twelve varieties of normal plant and leaf type in the alme to investigate the influence of the „Afila” genotype on grain formation in peas. Genetic analysis of the F1 and F2 generation (separation ratio 3:1 normal leaves: Afila type) confirmed the recessive monogenetic character of the property. The number of grains per plant in the F1 generation (normal leaf structure) was greater compared to both parent types on average *i.e.* 25%. In the F2 generation in thee plants with normal levels the number of grains per plant was smaller by 15% couyared to the F1 generation, but at the same time 7% greater than in father plants.

**UTICAJ NASLEDNIH PARAMETARA NA NASLEĐIVANJE VISINE PRVE MAHUNE KOD
PASULJA (*Phaseolus vulgaris* L.)**

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Cilj istraživanja je utvrđivanje genetičkih parametara u nasleđivanju visine prve mahune na stablu pasulja. Dijalelnim ukrštanjem 6 divergentnih genotipova za visinu prve mahune izvedena je analiza po Hayman-u (1954) u F1 i F2 generaciji. Dobijeni rezultati su pokazali da je način nasleđivanja visine prve mahune pasulja različit (parcijalna dominacija, dominacija i superdominacija). Uzevši u obzir sve kombinacije ukrštanja, glavni deo genetičke varijanse pripada dominantnoj komponenti pri čemu u ekspresiji ove osobine preovlađuju dominantni (F1) nad recesivnim genima. Prosečan stepen dominacije ukazuje da se kod nasleđivanja visine prve mahune pasulja, radi o super dominacija uzevši u obzir sve kombinacije. Analiza varijanse opštih i posebnih kombinacionih sposobnosti po Griffing-u (1956), pokazuje da veći uticaj u nasleđivanju ove osobine ima aditivna u odnosu na dominantnu varijansu. Najbolji opšti kombinator je linija 6. Heritabilnost u užem smislu je 64%, a u širem 85%, što ukazuje na veliki uticaj genetičkih faktora u nasleđivanju ove osobine.

**THE INFLUENCE OF INHERITED FACTORS ON INHERITANCE OF THE FIRST POD HEIGHT
IN BEANS (*Phaseolus vulgaris* L.)**

The aim of this investigation was to determine the genetical mode effects on the inheritance of the first pod height on a bean stem. After diallele crosses of six diverse genotypes regarding the first pod height, analyses of the F1 and F2 generation were performed according to Hayman (1954). The results indicated that the mode of inheritance of the first pod height in beans varied as follows: partial dominance, dominant inheritance and overdominance. Considering all crossing combinations the main part of genetic variance belonged to the dominant components. The dominant alleles (F1) prevailed over recessive ones in the expression of this characteristic. The average dominance degree indicated that, after considering all combinations, superdomination was evident concerning the first pod inheritance. Analyses of variance of specific and general combining abilities (Griffing, 1956) show that additive variance has a greater influence on the inheritance of this characteristic than dominant variance. The best general combiner was line six. The heritability in the narrow sense was 64%, while in the broad sense it was 8.5%, which indicates a light influence of genetic factors in the process of inheritance of this characteristic.

NASLEĐIVANJE BROJA KOMORA PLODOVA PARADAJZA (*Lycopersicon esculentum* Mill.)

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U dijalelnoj analizi 6 roditeljskih genotipova paradajza, signifikantno različitih za broj komora po plodu ispitivano je nasleđivanje ove osobine u 15 hibrida F1 i F2 generaciji. Broj komora u F1 generaciji nasleđivao se aditivno. U F1 generaciji u osam kombinacija ispoljio se intermedijarno nasleđivanje, u pet kombinacija dominantno i parcijalno-dominantno. U četiri kombinacije nije utvrđeno nasleđivanje, jer roditeljski genotipovi nisu divergentni za ovu osobinu. U F2 generaciji u 5 kombinacija ispoljilo se intermedijarno nasleđivanje i u 6 kombinacija parcijalna dominacija roditelja sa manjim brojem komora. Rezultati kombinaciornih sposobnosti u F1 i F2 generaciji ukazuju da u nasleđivanju ove osobine preovlađuju geni sa aditivnim efektom. Analiza je rađena po Griffing-u, (1956), metoda 2, model I. Najvišu vrednost OKS pokazala je linija SP-109 (-1,067 u F1 generaciji).

THIS INFLUENCE OF THE LOCULE NUMBER IN TOMATO FRUITS (*Lycopersicon esculentum* Mill.)

A total of 6 parental genotypes of tomatoes significantly different in the number of locules per fruit were examined in a diallel analysis for the inheritance of this characteristic in 15 F1 and F2 generations. In the F1 generation, the number locules was inherited intermediately. In the F1 generation in 8 F1 combinations intermediary inheritance occurred, while in 5 F1 hybrids dominations, and partial domination of parents with large number of locules per fruit occurred. In 4 hybrids inheritance was not investigated due to insufficient divergence between the parents. In the F2 generation, intermediary inheritance was found in 5 F1 hybrids, and partial dominance of the parents with a large number of locules in 6 F1 hybrids. The results the combining ability in F1 and F2 generations, showed that genes with additive effects dominate in the inheritance of this characteristic. The combining analysis were performed using Griffing's (1950) method 2, model I.

NASLEĐIVANJE DEBLJINE PERIKARPA KOD NEKIH GENOTIPOVA PAPRIKE

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Analizom dijalelnih ukrštanja utvrđene su kombinacione sposobnosti, efekti gena i način nasleđivanja debljine perikarpa 5 divergentnih genotipova paprike. Kombinacione sposobnosti izračunate su po metodi 2 model I, po Griffing-u (1956), analiza komponenti genetičke varijanse je rađena po metodi Hayma (1954) i Jinks (1954), a regresione analiza po metodi Mather i Jinks (1971). Testiranjem srednjih vrednosti F1 generacije u odnosu na roditeljski prosek utvrđeno je da se u većini slučajeva javio intermedijaran način nasleđivanja najveće vrednosti OKS imali genotipovi L1 i L3 dok nijedan hibrid nije imao pozitivno signifikantne PKS vrednosti. Podaci dobijeni iz analize varijanse kombinacionih sposobnosti i podaci iz regresione analize pokazuju da glavnu ulogu imaju aditivne komponente. Linija regresije je dosta blizu limitirajuće parabole što potvrđuje konstataciju da aditivna komponente prevlađuje u nasleđivanju ove osobine. Presek linije regresije sa Y osom je iznad kordinatnog početka što govori o parcijalnoj dominaciji. Tačke dijagrama rasturanja se nalaze unutar limitirajuće parabole a njihov raspored nam ukazuje na genetičku divergentnost između roditelja. Frekvencija dominantnih gena je bila veća od frekvencije recesivnih. Genotipovi L1, L2, L4 i L5 imaju veći broj dominantnih gena, a genotip L3 je imao veći broj recesivnih gena za ispitivana svojstva.

THE INHERITANCE OF PERICARP THICKNESS IN SOME PEPPER GENOTYPES

The combining ability, gene effects and mode of inheritance of five divergent genotypes of pepper have been established through the analysis of diallel crossings. The combining ability was calculated using the method 2, model I of Griffing (1956). Analysis of components of genetic variance was performed using method of Hayman (1954) and Jinks (1954) and regression analysis was done according to Mather & Jinks (1971). Testing of mean values of the F1 generation in relation to parents showed that the most frequent mode of inheritance was intermediate. The genotypes L1 and L3 had the highest value of GCA while there were no hybrids with a positively significant PKS value. The analysis of variance of the combining ability and regression analysis showed that the additive component played a minor role in the inheritance this trait. The regression line cut the Y axis above the point of origin indicating partial dominance. The distribution of array points indicated genetic divergence between parents. The frequency of dominant genes for pericarp thickness was higher than the frequency of recessive genes. The genotypes L1, L2, L4 and L5 had a larger number of dominant genes, while the genotype L3 possessed a larger number of recessive genes.

GENETIČKA ANALIZA BROJA ZRNA U MAHUNI PO BILJCI KOD GRAŠKA (*Pisum sativum* L.)

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U radu je prikazan način nasleđivanja i efekat genaza komponentu prinosa, broja zrna u mahuni po biljci u F1 generaciji kod graška. Na osnovu pretpostavke da će se u F1 generaciji ispoljiti dominacija boljeg roditelja i heterozis za ispitivano svojstvo, postavljen je ogled. Za eksperimentalni materijal odabrano je šest genotipova. Konceptom izbora roditeljskih parova odabrane su roditeljske linije, Jof, Verdo, Wavertop, kao majčinske komponente, a za testere: Hunter, Skinado i Consort. Metodom linija puta tester ukrštani odabrani su genotipovi i proizvedeno je seme F1 generacije. U radu su izračunate srednje vrednosti i pokazatelj varijabilnosti. Ocena načina nasleđivanja je vršena t-testom signifikatnosti srednjih vrednosti generaciji u odnosu na roditeljski prosek (Borojević, 1965). Iz analiziranih podataka za ispitivano svojstvo način nasleđivanja se različito ispoljavao u F1 generaciji.

GENETIC ANALYSIS OF THE NUMBER OF SEEDS IN PODS PER PEA PLANT (*Pisum sativum* L.)

In this paper the mode of inheritance and gene effect for yield component, number of seeds in the pod per plant in the F1 generation of peas are presented. A trial was established which was based on the assumption that dominance of the better parent and heterosis for the studied characteristics will occur in the F1 generation. Six genotypes were used as experimental material. According to the concept of parent pairs selection, we selected parent lines Jof, Verdo, Wavertop as mother components and Hunter, Skinado and Consort as testers. According to the method line x tester the selected genotypes were crossed and seeds of the F1 generation were produced. Mean values and the variability indicator were calculated. Evaluation of the inheritance mode was performed using the t-test of significance of difference of mean values of the generations from the parent average (Borojević, 1965). According to the data analyzed, the inheritance mode is demonstrated differently in the F1 generation.

VIŠESTRUKA REGRESIONA ANALIZA ZA PRINOS SUVE MASE I VAŽNIJE PARAMETRE INTENZITETA BIOLOŠKE FIKSACIJE AZOTA CRVENE DETELINE (*Trifolium pratense*L.)

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U ovim istraživanjima je vršena korelaciona i regresiona analiza međusobnih odnosa i uticaja sedam pokazatelja intenziteta biološke fiksacije azota kod crvene deteline. Utvrđene su visoke korelacije za prinos suve mase (bazične osobine) i sledećih osobine: visine biljke, masa korena i aktivnost nitrogenaze. Takođe, visoke korelacije su zabeležene za aktivnost nitrogenaze i sadržaj sirovih proteina, kao i za broj nodula i većinu ispitivanih parametara. Visina biljke i broj nodula su imale jak direktan uticaj na prinos suve mase po biljci, identičan koeficijentu korelacije. Indirektan uticaj broja nodula, preko visine biljke uslovljava da ukupna korelacije za ova dva svojstva bude visoka. Za prinos suve mase po biljci i masu korena koeficijent korelacije je pozitivan i vrlo pouzdan ($p < 0.01$), međutim, direktan uticaj mase korena na prinos suve mase je slab i negativan. Ukupna korelacije za ove dve osobine je srednje jaka zbog jakog indirektnog uticaja preko visine biljke. Jak indirektan uticaj preko visine biljke ostvaren je i za dužinu korena. Sadržaj sirovih proteina je, takođe značajno uticao preko visine biljke na masu biljke, ali je taj uticaj negativan, što uslovljava da ukupna korelacije za ove dve osobine bude signifikantna ($p < 0.01$) i negativna. Ostvaren je visok koeficijent multiple determinacije ($R^2 = 0.901$), što znači da ispitivana svojstva u velikoj meri determinišu prinos suve mase po biljci.

A MULTIPLE REGRESSION ANALYSIS OF THE DRY MATTER YIELD AND PRINCIPAL PARAMETERS OF BIOLOGICAL NITROGEN FIXATION INTENSITY IN RED CLOVER (*Trifolium pratense* L.)

Correlation and regression analyses of interrelations and effects of seven biological nitrogen fixation parameters in red clover were carried out in these studies. High correlation was found for dry matter yield and the following traits: plant height, root mass and nitrogenase activity. Also, high correlation was detected for nitrogenase activity, crude protein content, as well as for the number of nodules and for the majority of observed parameters. The plant height and number of nodules had a strong direct effect on dry matter yield per plant identical to the correlation coefficient. The indirect effect of the number of nodules, over plant height, caused a high total correlation of these two traits. The correlation coefficient for dry matter yield per plant and root mass was positive and highly significant ($p < 0.01$). However, the direct effect of root mass on dry matter was weak and negative. The total correlation for these two traits was of medium intensity due to a strong

indirect effect through plant height. An intensive indirect effect through plant height was also obtained for root length. Also, the crude protein content significantly affected plant mass through plant height, but that effect was negative causing a significant ($p < 0.01$) and negative correlation for these two traits. A high coefficient of multiple determination ($R^2 = 0.901$) was achieved. This means that the studied traits determine to a great extent the dry matter yield per plant.

**GENETSKA ANALIZA PRINOSA I NEKIH KOMPONENTI PRINOSA SEMENA KOD RICINUSA
(*Ricinus communis L.*)**

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Genetski materijal za ova istraživanja sastojao se od pet sorata ricinusa sa kojima su urađena dijalelna ukrštanja, isključujući recipročna. Na biljkama koje su služile kao majke muški cvetovi su uklonjeni ručno u ranim jutarnjim časovima. Eksperimentalni materijal je bio zasejan u tri ponavljanja po slučajnom blok sistemu. Veličina uzorka za analizu broja semena po biljci, masu 1000 semena i prinos semena po biljci, bila je 30 biljaka po tretmanu po ponavljanju. Analiza komponenti genetske varijabilnosti (D, H₁, H₂, F) urađena je prema Hayman (1954). Obe komponente genetske varijabilnosti aditivna (D) i dominantna (H₁ i H₂) su bile uključene u genetsku kontrolu sva tri proučavana svojstva. Međutim, kod broja semena po biljci, aditivna komponenta je bila veća od dominantne, a kod mase 1000 semena i prinosa semena po biljci dominantna komponenta je bila veća od aditivne. Vrednost F je pozitivna za broj semena i prinos semena po biljci, a negativna za masu 1000 semena. Vrednosti izraza $(H_1/D)^{1/2}$ pokazuje da se kod broja semena po biljci u nasleđivanju ispoljila parcijalna dominacija uzevši u obzir sve kombinacije, a kod mase 1000 semena i prinosa semena po biljci ispoljila se superdominacija. Za svojstva broj semena i prinos semena po biljci roditelji su posedovali veći broj dominantnih gena, a za masu 1000 semena su posedovali veći broj recesivnih gena.

**A GENETIC ANALYSIS OF YIELD AND SOME SEED YIELD COMPONENTS OF CASTOR
BEANS (*Ricinus communis L.*)**

The genetic material for this research consisted of five varieties of castor beans that were used for diallel crosses, excluding reciprocal. Male flowers were manually removed early in the morning from the plants that were used as females. The experimental material was sown in three replications according to a random block design. Thirty plants per treatment per replication were used for the analysis of the number of seeds per plant, 1000 - seed mass and seed yield per plant. The analysis of the components of genetic variability (D, H₁, H₂, F) was done according to Hayman (1954). Both components of genetic variability, additive (D) and dominant (H₁ and H₂) were included in the genetic control of all three studied characteristics. However, considering the number of seeds per plant the additive component was higher than the dominant one, while for 1000 - seed mass and seed yield per plant the dominant component was higher than the additive one. The F value was positive for the number of seeds and seed yield per plant and negative for 1000 - seed mass. The value of $(H_1/D)^{1/2}$ indicates partial dominance in seed yield per plant. The parents had more dominant genes for the number of seeds and seed yield per plant and more recessive genes for 1000 - seed mass.

PROUČAVANJE PROIZVODNIH KARAKTERISTIKA DOMAĆIH POPULACIJA LUCERKE

(Medicago sativa L.)

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U cilju proširenja genetske osnove postojećeg selekcionog materijala praćene su važnije agronomске osobine 13 domaćih populacija u odnosu na standardne sorte lucerke K-1 i OS-66. Ogled je postavljen po slučajnom blok sistetu u pet ponavljanja. U trogodišnjim ispitivanjima praćene su: visina, ranostasnost, brzina regeneracije, olistalost, prinos zelene i suve mase i zdravstveno stanje. Rezultati su statistički obrađeni metodom analize varijanse. Značajnih razlika u visini između ispitivanih populacija i standarda nije bilo. Trogodišnji rezultati pokazuju značajne razlike u prinosu zelene i suve mase. Populacije iz Vojvodine su imale nešto niže prinose, posebno u godini zasnivanja. Četiri populacije iz okoline Paraćina, Zaječara, Kruševca i Batočine su ostvarile značajno veći prinos biomase od standarda, što se može objasniti visokom adaptivnošću na ekološke uslove u kojima su ispitivanja vršena. U pogledu ranostasnosti i brzine regeneracije nije bilo značajnih razlika između ispitivanog materijala. Na osnovu dobijenih rezultata može se zaključiti da se domaće populacije lucerke opravdano mogu koristiti kao izvorni materijal u procesu selekcije na rodnost.

A STUDY OF PRODUCTION FEATURES OF THE DOMESTIC POPULATIONS OF ALFALFA

(Medicago sativa L.)

Important agronomic features of 13 domestic populations regarding standard lines of alfalfa K-1 and US-66 were followed with the aim of broadening the genetic basis of the current selection material. The experiment was established according to the random block system in five replications. Height, early maturity, regeneration speed, foliation, production of green and dry mass and fitness were monitored during a three year study. The results were statistically processed by the method of variance analysis. There were no significant differences in height between the tested populations and the standards. The three year results illustrate significant differences in the production of green and dry mass. Vojvodina's population had a somewhat smaller productivity, especially in the seeding year. Four populations from the districts of Paraćin, Zaječar, Kruševac and Batočina reached a substantially higher productivity of biomass than the standard ones, which can be explained by high adaptivity to the ecological conditions where the testing was performed. There were no important differences among tested materials for early maturity and regeneration speed. Based on the results obtained it can be concluded that domestic populations of alfalfa can be normally used as a source material in the process of selection for production.

EKSPRESIJA POLA KOD DINJE (*Cocum melo* L.) MODIFIKOVANE UPOTREBOM ETRELA

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Cilj ovoga rada je ispitivanje dejstva Etrela (2-hloretil fosforasta kiselina) na ispoljavanje pola kod dinje. Ispitivana su dva genotipa od kojih je jedan monoecius a drugi andromonoecius. Dinje su gajene na polju i tretirane rastvorom Etrela različite koncentracije (0.24%, 0.36%, 0.48%, 0.96%) u fazi trećeg pravog lista. Kontrola je tretirana destilovanom vodom. Prvi uočljivi tretmani Etrelom su oštećenja na listovima i temenom pupoljku. Ovi efekti su praćeni usporenim porastom a kasnije povećanim grananjem. Početak cvetanja ženskih cvetova je odložen za oko 10 dana a muških i više od 30. Rezultati istraživanja ukazuju da se feminizirajuće dejstvo Etrela, kod dinje, može iskoristiti u proizvodnji hibridnog semena.

MUSKMELON (*Cucumis melo* L.) SEX EXPRESSION MODIFIED BY ETHREL

The aim of this work was to investigate the effects of Ethrel (2-chlorethanephosphonic acid) on muskmelon sex expression. The targets were two genotypes, one of them monocius and the other andromonoecius. Muskmelons were grown in the field and treated with different concentrations of Ethrel solutions (0.24%, 0.36%, 0.48%, 0.96%). at the 3 leaf stage. The control was distilled water. The first noticeable effects of Ethrel treatments were leaf and terminal bud damage. These effects were followed by a slight growth check which resulted in increased branching. Flowering of female flowers was delayed about ten days and flowering of male flowers was delayed more than thirty days. The results of the experiment showed that Ethrel increased the muskmelon female tendency, and that could be used practically in hybrid seed production.

MEĐUZAVISNOST OSOBINA PLODA I PRINOSA KOD PLAVOG PAT LIDŽANA (*Solanum melongena* L.)

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Plavi patlidžan je poznata povrtarska kultura. Narodima Azijskog kontinenta poznat je više hiljada godina (Indija, Kina, Japan). U nas se ubraja u novije kulture i koristi se zadnjih 80-90 godina. U ishrani se koriste plodovi isključivo prerađeni kao kuvani, pečeni, u ajvarima. Cilj rada je utvrđivanje međuzavisnosti između prinosa i broja plodova po biljci, prosečne težine ploda, visine ploda i širine ploda. Ogled je postavljen po slučajnom blok-sistemu na Oglednom poiju Instituta za ratarstvo i povrtarstvo 1993-94. godine. Ispitano je pet genotipova različitog porekla. Ispitivane sorte i hibridi su se razlikovale u broju plodova po biljci i on se kretao od 2.56 do 3.8. Između broja plodova i prosečne težine ploda i broja plodova i prinosa postoji pozitivna korelacija. Ujedno je utvrđena pozitivna korelacija i između prosečne težine ploda i prinosa, širine ploda i prosečne težine ploda i širine ploda i prinosa. Slaba negativna korelacija utvrđena je između visine ploda i prosečne težine ploda, visine ploda i širine ploda i visine ploda i prinosa.

**INTERDEPENDENCE OF THE CHARACTERISTIC OF FRUIT AND YIELD OF EGG- PLANTS
(*Solanum melongena* L.)**

Egg-plant is a well-known vegetable crop. The inhabitants of the Asian continent have known this plant for several thousands of years (India, China, Japan). In our country, this is a relatively new vegetable crop as it has been used for only 80-90 years. For human nutrition, the fruits are always cooked, baked, etc. The objective of the investigation discussed in this paper was to determine the interdependence of the yield and number of fruits per plant, average fruit mass, fruit length and width. The experiment was set up according to the randomised block design on the Experimental fields of the Institute of Field and Vegetable Crops in 1993-94. Five genotypes of different origin were studied. The studied varieties and hybrids differed according to the number of fruits per plant which ranged from 2.56 to 3.8. A positive correlation existed between the number of fruits and average fruit mass and the number of fruits and yield. A positive correlation was also found between the average fruit mass and yield, fruit width and average fruit mass and fruit width and yield. A low negative correlation was found between fruit length and average fruit mass, fruit length and fruit width and fruit length and yield.

OPLEMENJIVANJE VRSTA IZ RODA *Agrostis* L.

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Izučavanje više od 120 autohtonih populacija 5 vrsta iz roda *Agrostis* L. počeli smo 1988. godine s ciljem izbora najboljih za oplemenjivnje sorti. Kako u našoj praksi do sada na ovim vrstama nema domaćih sorti, a mogu se koristiti za različite namene, kosidba i ispaša, i dobrog su kvaliteta, to višestruko opravdava naša istraživanja. Prikazani rezultati odnose se, na izučavanje genetskog potencijala produkcije, predhodno analiziranih populacija, na osnovu kojih su odabrane porodice u drugoj godini iskorišćavanja (1995). Analizirano je ukupno 43 porodice poreklom iz 22 populacije *Agrostis stolonifera*, 14 populacija *Agrostis capillaris* i 7 populacija *Agrostis gigantea*. Analizom varijanse ostvarene produkcije zelene i suve mase u dva otkosa, utvrđeno je da postoji statistički vrlo značajna razlika između porodica, otkosa i interakcije između porodica i otkosa. Koeficijent varijacije za produkciju suve mase je 5.50. Rangom porodica za prosečno ostvareni prinos suve mase, 24 porodice su ostvarile statistički značajno viši prinos i to: 11 poreklom iz populacija *Agrostis stolonifera*, 9 iz populacija *Agrostis capillaris* i 4 iz *Agrostis gigantea*. Najviši prosečan prinos suve mase 5.68 t/ha ostvarila je porodica 3.42 iz populacije *Agrostis stolonifera* poreklom sa Kopaonika. Istovremeno u radu će biti prikazani rezultati osnovnih parametara kvaliteta suve mase, a na osnovu kojih će se uz prethodne rezultate obaviti izbor za oplemenjivanje produktivnih i kvalitetnih sorti ovih vrsta.

BREEDING OF SPECIES FROM GENUS *Agrostis* L.

Research on more than 120 autochthonous populations of 5 species from the genus *Agrostis*, was started in 1988. The aim of this research was choosing the best populations for breeding new cultivars. Since there are no domestic cultivars in our country and it is known that they have different uses, cutting and grazing, as well as good quality, made our research important. The presented results refer to the genetic potential for production of previously analyzed populations. This was the basis for choosing families in the second year of usage (1995). The totally 43 families originating from 22 populations of *Agrostis stolonifera*, 14 populations of *Agrostis capillaris* and 7 populations of *Agrostis gigantea* have been analyzed. By analyzing the variance of the obtained production of green and dry matter in two cuts it was found that there were statistically very significant differences between families, cuts and interactions within families and cuts. The coefficient of variation for the production of dry matter was 5.50. A total of 24 populations achieved a statistically very significantly higher yield of two cuts in populations ranking. They are 11 families originating from the populations *Agrostis stolonifera*, 9 families from *Agrostis capillaris* and 4 families from *Agrostis gigantea*. The highest average yield of dry matter, which was 5.68 t/ha was for family 3.42 from the population of *Agrostis stolonifera* originating

from Kopaonik. At the same time the work presents the main parameters of dry matter quality. Based on all the results and research the best breeding families will be chosen for new cultivars from these three species.

GENOTIPSKA VARIJABILNOST KVANTITATIVNIH SVOJSTAVA KUPUSA

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Tokom 1992. i 1993. godine, na lokalitetu Rimski šančevi, Instituta za ratarstvo i povrtarstvo, Zavoda za povrtarstvo, postavljen je ogled sa 12 genotipova kupusa različitih vrednosti kvantitativnih svojstava u tri ponavljanja po modelu slučajnog blok-sistema. Ogled je obrađen dvofaktirijalnom analizom varijanse i izračunate su genotipske varijabilnosti sledećih svojstava: prosečna težina glavice, koristan deo glavice, visina glavice, prečnik glavice, dužina unutrašnjeg kočana i prinos. Analizom kvantitativnih svojstava različitih genotipova kupusa u 1992. i 1993. godini, najmanji genetički koeficijent varijacije dobijen je za prečnik glavice (9.39), a najveći za dužinu unutrašnjeg kočana (20.31). Za ostala svojstva ovaj pokazatelj je varirao od 12.14 do 17.28.

GENOTYPIC VARIABILITY OF QUANTITATIVE CHARACTERISTICS OF CABBAGE

A trial with 12 cabbage genotypes with various values for quantitative characteristics was established in three replications according to the model of randomized block design. The trial was set up in the Vegetable Department of the Institute of Field and Vegetable Crops at the location of Rimski Šančevi in 1992 and 1993. Two-factorial variance analysis was applied for data processing and genotypic variabilities for the following traits were calculated: average head mass, utilizable head part, head height, head diameter, length of inner stem, and yield. The analysis of quantitative characteristics of various cabbage genotypes in 1992 and 1993 showed that the lowest genetic coefficient for variation was achieved for the head diameter (9.39) and the highest for the length of the inner stem (20.31). Considering other characteristics, this indicator varied from 12.14 to 17.28.

SELEKCIJA SOJEVA *Rhizobium meliloti* SA POVEĆANIM IN TENZITETOM AZOTOFIKACIJE

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Izolovani su sojevi *Rhizobium meliloti* iz različitih tipova zemljišta kruševačkog regiona, različitih načina korišćenja, i izvršene selekciju sojeva sa povećanim intenzitetom azotifikacije u simbiozi sa lucerkom *Medicago saliva*. Cilj rada je bio da se izolovani, autohtoni sojevi *R. meliloti* koriste kao polazni materijal za selekciju aktivnih sojeva, čime bi se stvorila mogućnost da se uporednom selekcijom visokoaktivnih sojeva i sorti lucerke, sa izraženom sposobnošću za azotifikacijom, doprinose uspešnijem gajenju lucerke na račun azota iz vazduha. Ispitivana je aktivnost u fiksaciji azota 17 sojeva *R. meliloti*. Rezultati ukazuju na heterogenost zemljišta kruševačkog regiona u aktivnosti ove vrste bakterije. 13 sojeva je pokazalo značajnu aktivnost (76,5%) koja nije u zavisnosti od prisustva ili odsustva biljke domaćina na lokalitetu, sa koga su izolovani, jer su najveću aktivnost pokazali sojevi poreklom sa ledine i njive a neaktivni su bili poreklom sa njive i lucerišta. Aluvijum je bio homogen u aktivnosti sojeva i odlikovao se veoma efikasnim sojevima. Step en efikasnosti u azotifikaciji sojeva poreklom sa zemljišta tipa smonice gajnjače i deluvijuma, je različit: od neaktivnih do onih različite aktivnosti. Sa lucerišta pseudogleja su izolovani sojevi umerene aktivnosti, što ukazuje na mogućnost selekcije sojeva sposobnih za azotifikaciju u kiselim zemljištima. Izražena heterogenost sojeva u azotifikaciji omogućila je selekciju veoma efikasnih sojeva, od kojih je najadekvatniji Sld3 soj, poreklom sa smonice.

SELECTION OF RHIZOBIUM MELILOTI CULTIVARS WITH INCREASED INTENSITIES OF NITROGEN FIXATION

Cultivars of *Rhizobium meliloti* were isolated from different types of soil and different land uses in the Kruševac region. Cultivars with an increased intensity of nitrogen fixation in symbiosis with lucerne, *Medicago saliva*, were selected. The aim of this paper was to use the isolated, autochthonous cultivars of *R. meliloti* as the base for the selection of active cultivars, so that, by comparative selection of highly active cultivars and varieties of lucerne with expressed ability of nitrogen fixation, more successful cultivation of lucerne can be achieved utilizing nitrogen from the air. The nitrogen fixation activity of 17 cultivars of *R. meliloti* was investigated. The results indicate that the soil of the Kruševac region is heterogeneous regarding the activity of this bacterial species. This 13 species showed a significant activity (76.5%) which was not dependent on the host plant presence or absence at the locality where they were isolated, because the cultivars from uncultivated land and arable fields showed the highest activity, and those from fields with or without lucerne were inactive. Alluvium was homogenous in cultivar activity and it was distinguished by very efficient

Cultivars. The degree of nitrogen fixation efficiency of the Cultivars from the soil types: smonitza, brown foest soil, and deluvium was different: from inactive to varying activities. Cultivars of moderate activity were isolated from Lucerne-field pseudogley, which suggests the possibility of selection of Cultivars capable of nitrogen fixation in acid soils. The heterogeneity of Cultivars concerning nitrogen fixation enabled the selection of very efficient cultivars, and the most suitable cultivar is Sld3, originating from smonitza.

FENOLNE KISELINE KAO MARKERI OTPORNOSTI BILJAKA PREMA BOLESTIMA

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Fenolne kiseline su produkti biosinteze biljaka i u svim organima biljke se nalaze u tragovima. Ako su biljke zdrave koncentracija fenolnih kiselina je niska. U slučaju da u toku života biljke nastaju nepovoljni uslovi rasta i razvoja, biljka oboli ili se mehanički ozledi, koncentracija fenolnih kiselina u svim organima biljke višestruko se povećava u odnosu na normalno stanje. Biljke se brane od gljiva, bakterija i virusa, tako što sintetišu odgovarajuće fenolne kiseline koje su kancerogena i istovremeno veoma otrovna jedinjenja za mikroorganizme i viruse. One biljne vrste koje nisu raspolagale mehanizmom da brzo sintetišu odgovarajuće fenolne kiseline u slučaju ozlede ili bolesti, davno su išezle sa zemljine kugle jer nisu uspele da se odbrane i da održe svoju vrstu. Metodom superkritične ekstrakcije a ugijen-dioksidom CO₂ i odgovarajućim modifikatorom mogu se iz biljnog tkiva kvantitativno ekstrahovati sve prisutne slobodne fenolne kiseline. Metodom HPLC hromatografije moguće je fenolne kiseline razdvojiti i odrediti njihovu koncentraciju kao što je prikazano u radu: Verešbaranji (1991). U radu je ispitivan sadržaj šest najvažnijih fenolnih kiselina i to: siringinske, hlorogenske, orto metoksi benzojeve neidentifikovane, benzojeve, para metoksi benzojeve i transcinamične. Određivane su u slami kod četrnaest sorti pšenice (Partizanka, Rana 2, Jugosalvija, Super zlatna, NS 28-78, Somborka, Staparka, Duga, NS 54-00, NS 52-61, NS30-00, NS 28-93, NS 29-49, NS 29-59). U toku dve godine ispitivane su u poljskim uslovima genetički divergentne sorte pšenice različite otpornosti prema pepelnici, stabljičnoj i lisnoj rđi. Izračunata je korelacija između značajnih fenolnih kiselina i otpornosti ispitivanih sorti pšenice prema bolestima. Izvršena je višestruka korelaciona analiza po Pearson-u. Dobijeni rezultati ukazuju na visoku korelaciju između sadržaja transcinamične kiseline i pojave stabljične rđe (0.804) i pepelnice (-0.764), a takođe i na visoku korelaciju između sadržajaa orto metoksi benzojeve kiseline i lisne rđe (-0.872).

PHENOL ACIDS AS MARKERS OF PLANT RESISTANCE TO DISEASES

Phenol acids are the products of plant biosynthesis and are found in traces in all plant parts. In healthy plants, the concentration of phenol acids is low. Under unfavourable conditions for plant growth and development, disease or mechanical injuries, the concentration of phenol acids increases several times compared to the normal condition. Plants defend themselves from fungi, bacteria and viruses by synthesing appropriate phenol acids taht are poisonous compounds for microorganisms and viruses. The plant species that did not have mechanisms for fast synthesis of appropriate phenol acids under conditions of disease or injury, disappeared from Earth a long time ago. The mehtod of supercritical extraction with CO₂ and an appropriate modifier enables the extraction of all free phenol acids from plant tissue. The method of HPLC enables the separation of phenol acids and determination of their concentration as is presented in the paper of Veresbaranji (1990). The

content of six more important phenol acids was studied in the straw of 14 wheat cultivars: syringic, chlorogenic, o-methoxybenzoic, unidentified, benzoic, p-methoxybenzoic and transcinamic. The wheat cultivars used in this study were: Partizanka, Rana 2, Jugoslavija, Super zlatna, NS 28-78, Somborka, Staparka, Duga, NS 54-00, NS 52-61, NS 30-00, NS 28-92, NS 29-49 and NS 29-59. Genetically divergent wheat cultivars with a different susceptibility to powdery mildew, and stem and leaf rust were tested under field conditions for two years. The correlation between significant phenol acids and resistnace to diseases was calculated. Multiple correlation analysis was performed according to Pearson. The results obtained indicate a high correlation between the content of transcinamic acid and the occurrence of stem rust (0.804) and powdery mildew (-0.764) as well as a high correlation between the content of ortho methoxy benzoic acid and leaf rust (-0.872).

GENETIČKA HETEROGENOST I EKOLOŠKA PLASTIČNOST SORATA DUVANA

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Terminom „plastičnost” (ecological stability) obično označavamo genetički determinisanu osobinu sorte da zadržava nivo produktivnosti i kvaliteta u širokom dijapazonu uslova gajenja. Praktični značaj takve karakterizacije sorte i potreba selekcioniranja u odgovarajućem smeru su očigledni. Biološki aspekt tog problema, čijom razradom će biti određene „tačke aplikacije” oplemenjivanja, sastojće se u otkrivanju genetičkih mehanizama plastičnosti. Plastičnost sorte zavisi od norme reakcije pojedinih genotipova, a takođe i od genetičke homeostaze sorte kao heterogene populacije. Ocena doprinosa individualne i populacione pufernosti upravo će i odrediti strategiju selekcije. U ovom radu genotipska heterogenost sorata određena je i ocenjena sistemskom analizom fenotipske promenljivosti kompleksa morfoloških i fenoloških osobina na materijalu sorata i linija - potomstava individualnih biljaka. Dokazan je bitan preobražaj genotipske strukture sorti pri uzgajanju u različitim ekološkim zonama. Norma individualnih genotipova ocenjena je prema rezultatima istraživanja morfogenetičkih korelacija.

GENETIC HETEROGENEITY AND ECOLOGICAL STABILITY OF TOBACCO CULTIVARS

The term ecological stability can best be characterized as the genetically determined cultivar trait able to preserve the rate of productivity and quality under a broad spectrum of different growing conditions. In practice, developing cultivars that can cope with these problems is becoming more important. The emphasis of the biological aspect of the problem, namely the determination of the „point of application” in a breeding program, will be on discerning the genetic mechanism of ecological stability. The ecological stability of a cultivar is affected not only by the reaction of some genotypes but also by the genetic homeostasis of the cultivar as the heterogenic population. The estimation of the contribution of „individual and population buffering” will determine the strategy in a selection program. The objective of this paper was to determine the genotype heterogeneity of the cultivars and to assess the phenotypic variables of the complex of morphological and phenological traits of cultivars and lines - descendants of individual plants using system analysis. Different ecological zones were found to affect the genotype structure of cultivars. The rate of reaction of individual genotypes was assessed using the results of the investigations on morphogenetic correlation.

PROCENA OSETLJIVOSTI NEKIH KLONOVA TOPOLA PREMA UZROČNICIMA OBOLJENJA LISTA I KORE

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Oboljenja lista (*Marssonina brunea* i *Melampsora sp.*) i rak kore (*Dothichiza populea*) predstavljaju velike probleme u gajenju topola. S obzirom na to da zaštita rasadnika, a posebno zasada u kasnijim fazama rasta, součava sa velikim teškoćama, u Institutu za topolarstvo istražuju sve mogućnosti stvaranja rezistentnih ili manje osetljivih sorti na pomenuta oboljenja. U ovom radu prikazani su rezultati testiranja osetljivosti 40 klonova prema pomenutim lisnim oboljenjima i rezultati testiranja 60 klonova topola prema raku kore na osnovu spontanijih infekcija. Ocene lisnih oboljenja date su na osnovu brojnosti zercvula *Marssonina brunea*, odnosno uredosorusa *Melampsora sp.* po 1 cm² lišća sa po dva izbojka od tri biljke iz matičnjaka genofonda, a ocene osetljivosti prema raku kore na osnovu brojnosti nekroza na po tri 2-godišnje sadnice iz selekcionog rastišta. Rezultati istraživanja pokazuju da na nekim klonovima nisu konstatovana pomenuta oboljenja, a kod ostalih klonova su utvrđene signifikantne interklonalne razlike. S obzirom na ove rezultate istraživani klonovi grupisani su u grupe od praktično neosetljivih do vrlo osetljivih klonova. Rezultati ovih istraživanja su u skladu sa prethodno saopštavanim rezultatima koji se odnose na druge serije klonova.

ASSESSMENT OF THE SUSCEPTIBILITY OF SOME POPLAR CLONES TO CAUSAL AGENTS OF LEAF AND BARK DISEASES

Leaf diseases (*Marssonina brunea* and *Melampsora sp.*) and bark necrosis (*Dothichiza populea*) cause great problems in poplar growing. As nursery protection, especially the protection of plants in the later stages of development, faces great difficulties, the Poplar Research Institute investigates the possibility of creating resistant or less susceptible varieties to these diseases. This paper presents the results of testing the susceptibility of 40 clones to the leaf diseases named above, and 60 clones to bark necrosis, based on spontaneous infections. Leaf diseases were evaluated based on the number of acervulus of *Marssonina brunea* or uredosorus of *Melampsora sp.* per 1 cm² of the leaves from two shoots taken from three plants from the parent gene pool, and the susceptibility to bark necrosis was assessed based on the number of necroses on three 2-year-old plants from the selection line. The results show that some clones did not show symptoms of diseases, and other clones showed significant interclonal differences. Consequently, the researched clones were classified from practically completely resistant to very susceptible clones. The results of this research agree with previously reported results referring to other series of clones.

TERPENSKO-MORFOLOŠKI PRILAZ TAKSONOMIJI CRNOG BORA (*Pinus nigra* Arn.)

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Korišćenjem terpena kao genetičkih markera metodom gasne hromatografije u kombinaciji sa morfološkim karakterima detaljnije su upoznati monoterpenski i seskviterpenski profil i hemotaksonomija 41 populacije crnog bora u 10 regiona iz 6 mediteranskih zemalja. Evidentno je postojanje 3 taksona. Jedan istočni, bogat u germakrenu-d koji okuplja populacije iz Kalabrije, Sicilije, Centralne i Severne Italije, Austrije, Slovenije i Grčke. Druga dva na zapadu deleći najverovatnije zajedničko iberijsko poreklo podeljeni su na crni bor iz Sevene i Pirineja bogat α -humulenom i kariofilenom i crni bor sa Korzike vrlo bogatim linalil acetatom. Nameće se drugačija sistematska definicija crnog bora sa Korzike, Kalabrije i Sicilije.

THE TERPENE-MORPHOLOGICAL APPROACH TO THE TAXONOMY OF BLACK PINE

Using terpenes as genetic markers with the gas-chromatography method (GC). combined with morphological characters, the monoterpene and sesquiterpene composition and chemotaxonomy in 41 populations of 10 regions from 6 mediterranean countries have been investigated in detail. A total of 3 taxons exist. One is in the East, rich in germacrene-d and includes the populations from Calabria, Sicily, Northern and Central Italy, Austria, Slovenia and Greece. The other two are in the West, having probably a common iberian origin and they are separated into the black pine from Cevennes and Pyrenees rich in α -humulene and caryophyllene and the black pine from Corsica, very rich in linalyl acetate. A different systematic definition of the black pine from Corsica, Calabria and Sicily is imposed.

**OSOBINE TRAKA LINGUMA VIRGILIJSKOG HRASTA (*Quercus virgiliana* Ten. (Ten.) NA
RAZLIČITIM STANIŠTIMA DELIBLATSKE PEŠČARE**

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Anatomska istraživanja traka lignuma *Quercus virgiliana* Ten. (Ten.) na Deliblatskoj peščari vezana su za dva lokaliteta (Velika Tilva i Rošijana), a tri različita staništa (na osnovu fizičko-hemijskih osobina zemljišta). Rezultati istraživanja anatomske građe (makro i mikro) potvrdili su da kompleksno delovanje genetičkih, populacionih i stanišnih uslova utiče na dimenzije, oblik i raspored traka lignuma, a preko njih i na fizičko-mehanička svojstva drveta. Visina traka lignuma istraživanih stabala kreće se od 0,02 mm do 4 do 5 cm, a širina od 0,1 do 0,6 mm. Najuže trake lignuma (0,1- 0,3 mm) nalaze se kod stabla sa lokalitetima Velika Tilva, a najšire (0,4 do 0,6 mm) izmerene su kod stabla sa lokalitetima Rošijane. Rastojanje između traka lignuma kod stabla sa lokalitetima Velika Tilva iznosi od 1 do 3,6 mm, a kod stabla sa lokalitetima Rošijana od 2 do 4 mm. Na osnovu osobina traka lignuma *Quercus virgiliana* se anatomski razlikuje od drugih vrsta koje pripadaju rodu *Quercus*, što ukazuje na posebne oblike: stabla ove vrste.

**PROPERTIES OF LIGNUM RAYS OF VIRGILIAN OAK (*Quercus virgiliana* Ten. (Ten.) ON
DIFFERENT SITES IN THE DELIBLATO SANDS**

Anatomic reserch of lingum rays of *Quercus virgiliana* oak in the Deliblato sands are connected with two localities (Velika Tilva and Rošijana), and three different habitats (based on physical - chemical properties of soil). The results of research of the anatomical structure (macro and micro) have confirmed that the complex action of genetic, population, and site conditions affects the size and arrangement of lignum rays and this way also the physical - mechanical properties of wood. The lignum ray height of the researched trees ranged between 0,02 mm to 4-5 cm, and the width between 0,1 and 0,6 mm. The narrowest lignum rays (0,1 - 0,3) occur at the locality Rošijana. The distance between lignum rays in the trees at Velika Tilva amounted to 1 to 3,6 mm, and in the trees at Rošijana from 2 to 4 mm. Based on the properties of lignum rays, the *Quercus virgiliana* oak is anatomically distinguished from other species of the genus *Quercus*, which indicates the special characteristics of trees of this species.

MORFOLOŠKE KARAKTERISTIKE ZNAČAJNE ZA SELEKCIJU I OPLEMENJIVANJE CERA (*Quercus cerris* L.)

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U radu su prikazane morfološke karakteristike *Quercus cerris* var. *austriaca* f. *cycloba* Borb., koju u narodu zovu „beli cer”. *Quercus cerris* var. *austriaca* f. *cycloba* Borb. odlikuje se plitko usečenim listovima, a režnjevi su zaobljeni i tupi. (Erdeši et Gajić, 1977). Istraživanja na padinama planine Rtanj (lokalitet Cerje) na staništu (Orno-*Quercetum cetrus- virgilinae* B. Jovanović, E. Vukićević, 1977) pokazuju da se ova forma cera, osim po karakteristikama listova, razlikuje i po načinu granjanja i po kori. Grane u donjem i središnjem delu krošnje polaze pod skoro pravim uglom od debla, što nije karakteristika tipične vrste. Kora se po boji i reljefu razlikuje u odnosu na ostale varijetete i forme dosad opisane kod ove autohtone vrste. Naime, boja kore je siva, nešto svetlija, a takođe je debija i nešto ispucala. Osim po morfološkim karakteristikama *Quercus cerris* var. *austriaca* f. *cycloba* Borb., razlikuje se po anatomskim karakteristikama drveta tj. ima osetno kvalitetnije drvo, te zaslužuje posebnu pažnju kod oplemenjivanja (selekcije i unutarvrstne hibridizacije) i šumskog drveća.

MORPHOLOGICAL CHARACTERISTICS SIGNIFICANT FOR THE SELECTION AND BREEDING OR BITTER OAK (*Quercus cerris* L.)

In this paper morphological characteristics of the special form *Quercus cerris* Var. *austriaca* f. *cycloba* Borb. which is popularly called „white bitter oak” are presented *Quercus cerris* Var. *austriaca* f. *cycloba* Borb. is characterized by shallowly lobed leaves, and rounded and blunt nothes (Erdeši et Gajić, 1977). Research on the slopes of the mountain Rtanj (locality Cerje on the site of Orno - *Quercetum cetrus-virgiliana* B. Jovanović et E. Vukićević, 1977), shows that this form of bitter oak, in addition to leaf characteristics, also differs in its way of branching and its bark. In the lower and middle part of the crown the angle of branching is almost right angled, which is not the characteristic of the typical species. The bark differs in colour and is gray, somewhat paler, and also thicker and more deeply fissured. In addition to morphological characteristics, *Quercus cerris* Var. *austriaca* f. *cycloba* Borb. also differs in the anatomical characteristics of the wood, *i.e.* it has a substantially better-quality wood, so it deserves special attention in breeding (selection and intraspecific hybridization).

KARAKTERISTIKE RASTA I VITALNOST RAZLIČITIH PROVENIJENCIJA DUGLAZIJE

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Jedan od osnovnih zadataka istraživanja provenijencija neke vrste sadržan je u eksperimentalnom utvrđivanju važnih naslednih osobina, pre svega karakteristika rasta i vitalnosti stabala. Ovi ogledi su pre svega potrebni kada je u pitanju duglazija koje je široko rasprostranjena na prirodnim nalazištima na kojima zahteva veoma različita staništa. Našim istraživanjem, u podignutim kulturama u kojima su na jednakom staništu posađene, jedna pored druge, različite provenijencije duglazije, obuhvaćeno je kvantitativno opažanje visinskog i debljinskog razvoja, kvaliteta debla i rezistentnosti prema klimatskim, biljnim i životinjskim štetnim faktorima. U ovom radu saopštavaju se rezultati opažanja pet provenijencija na staništu bukve (*Fagetum montanum*) i staništu sladuna i cera (*Quercetum farnetto cerris*) na antropogeno izmenjenom zemljištu (kopasol). Rezultati se zasnivaju na preciznom primeru prečnika i visina stabala i testiranju utvrđenih razlika u postignutim dimenzijama svake provenijencije.

GROWTH CHARACTERISTICS AND VITALITY OF DIFFERENT DOUGLAS FIR PROVENANCES

One of the main tasks in provenance research of a species is the experimental determination of major heritable characteristics, first of all characteristics of growth and tree vitality. These experiments are primarily necessary in the case of Douglas fir, as it has a wide range of distribution with varying site conditions. Our research in the plantations where different provenances of Douglas fir were planted side by side in identical site conditions, included quantitative observation of height and diameter development, stem quality, and resistance to climate, plant and animal adverse factors. This paper presents the results of the observation of five provenances on the sites of beech (*Fagetum montanum*) and Hungarian oak and bitter oak (*Quercetum farnetto cerris*) on antropogenically modified soil (kopasol). The results are based on precise measurements of the tree diameter and height and testing the recorded size differences of each provenance.

**INDIVIDUALNI VARIJABILITET POLENA OMORIKE *Picea otorica* (PANČ.
PURKYNE) IZ KULTURE NA BELOJ ZEMLJI**

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Na 25 test stabala omorike iz kulture na Beloj Zemlji analiziran je morfofiziološki varijabilitet polena. Varijaciono statističkom obradom potvrđena je opravdanost razlika na individualnom nivou u pogledu dimenzija polenovog zrna, klijavosti, energije klijanja i vitaliteta svežeg polena. Izdvojena stabla - polinatori, kao nosioci najkvalitetnijeg polena, biće iskorišćena u daljem oplemenjivanju ove za naše područje veoma dragocene i u šumarstvu danas sve priznatije vrste.

**INDIVIDUAL VARIABILITY OF THE POLLEN OF *Picea omorrica* (PANČ.) PURKYNE FROM THE
CULTURE AT BELA ZEMLJA**

The morpho-physiological variability of the pollen of *Picea omorrica* (Panč.) Purkyne has been analysed on 25 test-trees from the culture at Bela Zemlja, near Užice. Significant differences were confirmed between them in dimensions, germination facility, energy of germination and vitality of fresh pollen grains. Individuals with the best quality of pollen pollinator -trees, could be used in further improvement programs with this precious species in modern forestry.

NEKA FIZIOLOŠKO-GENETSKA SVOJSTVA SMRČE SA KOPAONIKA

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Veliki broj stručnjaka konstatuje da je priroda Kopaonika ozbiljno degradirana razvojem različitih aktivnosti (pre svega turizma) i sušenjem šuma, te stoga ističe potrebu zaštite i obnavljanja šumskih kompleksa, posebno smrčevih. U radu su prikazani rezultati prvih analiza osobina sedam odabranih matičnih stabala smrče sa Kopaonika. Matična stabla starosti 30 - 50 god. i visine 15-40 m odabrana su na lokalitetu Donji Babin grob, odeljenja 103, 104 i 26. Morfometrijska analiza šišarica i semena, zatim klijavost semena, sadržaj različitih formi vode u četinama, suva masa četina, sadržaj mineralnih materija, kao i analiza klijavaca, pokazala je da postoji izražena varijabilnost ovih svojstava kod analiziranih matičnih stabala.. Ona može omogućiti bliže utvrđivanje karaktera genetičke, fiziološke i morfološke promenljivosti, što doprinosi preciznijem vrednovanju i sigurnijem korišćenju sastojina smrče na Kopaoniku. Cilj istraživanja je bolje upoznavanje fiziološkog i genetskog potencijala smrče što može obezbediti produkciju kvalitetnih sadnica za obnavljanje šuma u cilju sprečavanja procesa erozije i rekonstrukcije šteta nastalih ovih procesom, turističkom aktiviranju novih područja i drugim zahvatima u zaštiti i korišćenju prirode Kopaonika.

SOME PHYSIOLOGICAL-GENETIC CHARACTERISTICS OF SPRUCE FROM KOPAONIK

Many experts have observed that the nature of the mountain Kopaonik has been seriously degraded by the development of various activities (first of all tourism) and by forest decline, so the need of conservation and regeneration of forest complexes, especially spruce, has been emphasized. This paper shows the results of the first analyses of certain characters of seven selected spruce trees from Kopaonik. The trees 30 - 50 years old, height 15 - 40 m, were chosen at the, locality Donji Babin Grob, compartments 103, 104, and 26. The morphometric analysis of cones and seeds, then seed germination, content of different forms of water in the needles, dry mass of needles, content of mineral matter, as well as analysis of the seedlings, showed that an expressed variability of these characteristics exists in the analyzed trees. This can enable a closer determination of the character of genetical, physiological and morphological variabilities, which contributes to a more precise evaluation and a more competent utilization of spruce stands on Kopaonik. The aim of this research is better knowledge of the physiological and genetical potential of spruce, which can ensure the production of quality seedlings for forest regeneration aiming at erosion control and the repair of damage caused by erosion, activation of new regions for tourism, and other undertakings in the conservation and exploitation of the natural wealth Kopaonik..

UTICAJ PRINUDNE SAMOOPLODNJE NA OSOBINE KLIJAVACA PAJASENA (*AILANTHUS ALTISSIMA SWINGLE*)

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U radu su izneti rezultati uporedno morfološko-fiziološke analize svojstava linija klijavaca 5 stabla izložena prinudnoj samooplodnji i 5 kontrolnih linija klijavaca pajasena.. Samooplodna potomstva pajasena obrazuju dva tipa klijavaca: \pm normalne i anormalne u proseku u odnosu 48,6 % : 51,4%; kod stranooplodnih, kontrolnih klijavaca udeo anormalnih je u proseku 3,8%. Ozbiljan gubitak varijabiliteta, usled znantog učešća anormalnih klijavaca, nastaje u prirodnim uslovima, tek kada su roditeljska stabla pajasena izložena samooplodnji. Srednja vrednost za dužinu hipokotila samooplodnih u odnosu na kontrole linije, umanjena je za 19,91%, dužina epikotila za 39,40%, dužina kotiledona za 16,86%, širina kotiledona za 15.20%, dužina osovinskog korena za 5,21%, i ukupna dužina bočnih korenova za 15,89% u proseku. Pojava anormalnih klijavaca nije štetna za pajasen kao vrstu. Naime, njihovo eliminisanje selekcijom smanjuje genetičko opterećenje kćerinskih generacija s jedne strane a nakon usmerene selekcije, obezbeđuje odgajivanje ukrasnih kultivara pajasena s druge strane. Polazni materijal evolucije pajasena čine ne samo superiorni genotipovi već i slabo adaptivni tzv. „gubitnici“. Usled toga, samooplodnja se češće u oplemenjivanju drveća koristi kao metod za otkrivanje heterozigotnih stabala sa mnogo letalnih i poluletalnih gena. Ogledi sa odabranim samooplodnim stablima pajasena predstavljaju izvor velikog broja informacija koje se tiču heterozisa. Stabla pajasena cvetaju rano, u 4- oj godini, pa je za kratko vreme moguće brzo proizvesti S2, S3 i S4 generaciju. Stabla pajasena imaju niz prednosti, pa pajasen kao vrsta može ući u red omiljenih modelnih objekata zaostvarivanje maksimalne genetske dobiti unutarvrskom hibridizacijom.

THE EFFECT OF FORCES SELF-FERTILIZATION ON SEEDLING CHARACTERISTICS OF THE TREE OF HEAVEN (*Ailanthus altissima Swingle*)

The results of comparative morphological-physiological analysis of characteristics of seedling lines of five trees subjected to forced self-fertilization and 5 control lines of tree of heaven seedlings have been presented. Self-fertilized tree of heaven offspring form two types of seedlings: \pm normal and abnormal, on average the percentage ration is 48.6% : 51,4%; and for control seedlings, the share of the abnormal type is on average 3.8%. The serious loss of variability, due to a significant percentage of abnormal seedlings, occurs in natural conditions only when the tree of heaven parent trees are subject to self-fertilization. The mean value of the hypocotyl length of self-fertilized compared to control lines is reduced by 19.91%, epicotyl length -39.40%, cotyledon length -16.86%, cotyledon width - 15.20%, root axis length - 5.21%, and total length of lateral roots - 15.89% on average. The occurrence of abnormal seedlings is not harmful to the tree of heaven as a species.

Namely, their elimination by selection reduces the genetic loading of daughter generations on one hand, but on the other hand, after directed selection, it enables the raising of ornamental cultivars. The starting material of the three of heaven evolution does not consist only of superior genotypes, but also of bodily adaptable ones the so-called „losers”. Consequently, in tree breeding, self- fertilization is often used as a method of discovering heterozygous trees with many lethal and semi-lethal genes. Experiments with selected self-fertilized trees are the source of much information concerning heterosis. Trees of heaven flower early, in the fourth year, so S2, S3 and S4 generations can be produced in a short period of time. Trees of heaven have a series of advantages, so the species can be classed as a favourite model source, for the realization of maximumm genetic gain by intraspecific hybridization.

**VARIJABILNOST MORFOMETRIJSKIH PARAMETARA LISTA
INTRA I INTERSPECIES HIBRIDNIH POTOMSTAVA AMERIČKE CRNE TOPOLE**

(*Populus deltoides* Bartr)

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Diskriminacija i identifikacija klonova topola ima značajnu ulogu u pravilnom vođenju rasadničke proizvodnje, prilikom osnivanja eksperimentalnih zasada, kao i u zaštiti autorskih prava. Pri tome posebnu pažnju treba pokloniti onim parametrima koje karakterišu visoko i značajno učešće varijanse zavisne od genotipa u ukupnoj fenotipskoj varijanse. U skladu sa takvim kriterijuma izvršena je ocena sledećih morfoloških parametara lista: dužina liske (x1), dužina po glavnom nervu (x2), širina liske (x3), dužina od vrha do najveće širine liske (x4), dužinaa lisne drške (x5), broj bočnih nerava sa jedne strane (x6), ugao između glavnog i drugog bočnog nerva (x7), kao i izvedeni parametri dobijeni dovođenjem u međusobni odnos prvih pet parametara. Merenja su izvršena na po tri lista iz zone 6-10. lista uzeta slučajnim izborom sa po tri ožiljenice 2/1 po klonu. Ispitane su 4 familije *P. deltoides* x *P. deltoides* i 2 hibridne familije *P. deltoides* x *P. x euramericana*, sa nejednakim brojem ispitanih klonova. Ocena komponenti varijanse je vršena na osnovu analize varijanse poduzoraka sa nejednakim brojem ponavljanja, a F test po Sattertweit-и (1946) (prema Hadživuković-u 1991). Ispitivanjem komponenti ukupne varijanse i koeficijenata heritabilnosti za familije i za klonove unutar familija, kao i ukupnu heritabilnost izvršena je ocena pojedinih parametara sa ciljem da se odaberu parametri sa većim uticajem genotipa na ukupno variranje parametara. Utvrđeno je da lisna drška (x5) i parametri izvedeni iz nje (x5/x1, x5/x2, x5/x3 i x5/x4), kao i ugao između glavnog i drugog bočnog nerva (x7) poseduju visoke koeficijente heritabilnosti u širem smislu i između familija i između klonova unutar familija, ali je F test pokazao da je samo variranje parametara između klonova značajno.

**VARIABILITY OF LEAF MORPHOMETRIC PARAMETERS OF INTRA AND INTERSPECIES
HYBRID PROGENIES OF EASTERN COTTONWOOD (*Populus deltoides* Bartr.)**

The discrimination and identification of poplar clones is significant in correct nersery practice, in the establishment of experimental plantings, as well as in the protection of authorship. Special attention should be paid to those parameters which are characterized by a high and significant share of the variance depending on the genotype in the total phenotype variance. In accordance with these criteria, the following leaf morphological parameters were evaluated: leaf length (x1.), lengt along the main nerve (x2), leaf width (x3), lengthh from the top to the widest part of the leaf (x4), length of petiole (x5), number of lateral nerves on one side (x6), angle between the main and the second lateral nerve (x7), as well as the parameters derived from the relationships of the first five parameters. Measurements were caned out on three leaves from the zone between the leaves 6 to 10 taken at random from three rooted cuttings 2/1 per clone. Four families were investigated *P.*

deltoides x *P. deltoides* and two hybrid families *P. deltoides* x *P* x *euramericana*, with an unequal number of investigated clones. The components of variance were evaluated based on the analysis of variance of subsamples with an unequal number of repetitions, and the F test was according to Satterthwaite (1946) (after Hadživuković 1991). By investigating the components of the total variance and the coefficient of heritability for families and for intra-family clones, as well as total heritability, individual parameters were evaluated with the aim to select the parameters with a greater effect of the genotype on the total variation of parameters. It was concluded that petiole (x5) and the parameters derived from it (x5/x1, x5/x2, x5/x3, and x5/x4), as well as the angle between the main and the second, lateral nerve (x7), have high coefficients of heritability in a wider sense both between families and between intra-family clones, but the F test showed that the only significant variation of parameters is between clones.

UTICAJ KLIJAVOSTI SEMENA NA PREŽIVLJAVANJE I VISINU DVOGODIŠNJIH BILJAKA DUGLAZIJE (PSEUDOTDUGA TAXIFOLIA BRITT.) RAZLIČITIH PROVENIJENCIJA

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Istraživan je uticaj klijavosti semena trideset provenijencija duglazije na preživljavanje i visinu dvogodišnjih biljaka. Provenijencijama je obuhvaćen skoro celi prirodni areal duglazije. Metodom regresije i korelacije analizirana je međuzavisnost posmatranih svojstava, kao i njihova zavisnost od geografskih koordinata i nadmorske visine provenijencija. Konstatovano je da postoji značajna pozitivna saglasnost (korelacija) u variranjima procenta klijavosti, procenta preživljavanja i visine dvogodišnjih biljaka. Na osnovu utvrđenog procenta klijavosti semena može se prilično pouzdano predvideti procenat preživljavanja i visina dvogodišnjih biljaka. Uticaj geografske širine nije se ispoljio kao značajan, dok je uticaj geografske dužine i nadmorske visine jasno ispoljen. Provenijencije sa veće geografske dužine i manje nadmorske visine imaju u proseku najveći procenat klijavosti semena (60%-70%), najveći procenat preživljavanja (40%-50%) i najveću visinu biljaka (25-30 cm). Rezultati ovog istraživanja imaju i aplikativan karakter.

THE INFLUENCE OF SEED GERMINABILITY ON THE SURVIVAL AND HEIGHT OF TWO-YEAR OLD DOUGLAS FIR PLANTS OF DIFFERENT PROVENANCES

The influence of seed germinability on the survival and height of two-yearold plants was studied on thirty Douglas fir provenances. The provenances covered almost the entire natural range of Douglas fir distribution. The regression and correlation method was used for analyzing the interdependence of the observed features, as well as their dependence on geographic coordinates and altitude of the provenances. A significant positive correlation (correlation) in variations of the germinability percent, survival percent and height of two-year old

plant, was noted. The percent of the survival height of two-year old plants can be quite reliably predicted based on the established percent of seed germinability. The influence of latitude was not observed as significant, while the influence of longitude and altitude was clearly shown. Provenances with higher longitudes and lower altitudes on average had the highest percent of seed germinability (60-70%), the highest survival percent (40-50%) and the greatest plant height (2.5-30 cm). The results of this research also have an applicatory character.

PRIMENA AUTOVEGETATIVNOG RAZMNOŽAVANJA OŽILJAVANJEM REZNICA U OPLEMENJIVANJU DRVEĆA

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U dosadašnjim radovima na podizanju klonskih plantaža šumskih vrsta drveća i žbunja, kako kod nas, tako i u svetu, proizvodnja sadnica obavlja se heterovegetativnim umnažanjem, tj. kalemljenjem. Ovaj vid kloniranja najčešće je povezan sa većim brojem tehničkih i finansijskih poteškoća, što je ograničavajući faktor u pogledu obima proizvodnje. Prevažilaženje ovog problema moguće je intenziviranjem primene metoda autovegetativnog razmnožavanja – ožiljavanja. Ovim putem bi se postigao takav nivo proizvodnje koji bi ostvano kvantitet sličan onome koji se postiže setvom semena. Dobijeni rezultati, kod nas u radu na ožiljavanju više značajnih vrsta drveća potvrđuju opravdanost primene ovog metoda razmnožavanja. Višegodišnji rezultati u radu na autovegetativnom razmnožavanju hrasta (*Quercus petaea*), kestena (*Castanea sativa*) i trepetljike (*Populus alba*) prikazani su u ovom radu.

THE APPLICATION OF AUTO VEGETATIVE REPRODUCTION BY ROOTING CUTTINGS FOR TREE IMPROVEMENT

In work, up to nam, on thee establishment of clonal plantations of forest trees and shrubs, in our country as well as in the world, the production of plants was carried out by heterovegetative reproduction *i.e.* grafting. This method of cloning is subject to a number of technical and financial difficulties, whild represents a limiting factor in respect to the amount of production. Overcoming this problem is possible through a much wider application of autovegetative reproduction - rooting of cuttings. Using this method, we could achieve a level of reproduction similar to that achieved by seed sowing. Results obtained so far, on rooting cuttings from some more important forest tree species, justifies the application of this method, of reproduction. In this paper our efforts concerning the autovegetat ve reproduction of oak (*Quercus petraea*), chestnut (*Castanea sativa*) and trembling aspen (*Populus tremula*) over a number of years will be presented.

USPEŠNOST INTRODUKCIJE I VARIJABILNOST POPULACIJA PINUS WALLICHIANA, A.B. JACKS, U BEOGRADU I OKOLINI

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Uspešnost introdukcije ove vrste u našim uslovima je procenjena proučavanjem tri manje populacije koje su dostigle fazu fiziološke zrelosti i semenošenja. Utvrđen je visok nivo varijabilnosti u pogledu visine, prsnog prečnika, fenofaza i obilnosti obrazovanja strobila, polena, šišarica i semena između i unutar populacija. Rezultati potomstva sa familijama polusrodnika su potvrdili da male populacije i ove vrste mogu posedovati visok stepen genetske varijabilnosti koja im obezbeđuje adaptaciju u novim uslovima sredine. Genetska dobit iz ovih populacija mogla bi biti veća ukoliko bismo individualnom selekcijom izdvojena najbolja stabla koristili za unutarvrstu i međuvrstu hibridizaciju.

THE SUCCESSFUL INTRODUCTION AND VARIABILITY OF POPULATIONS OF *PILAEUS WALLICHIANA*, A.B. JACKS, IN BELGRADE AND ITS SURROUNDINGS

The success of the introduction of this species in our conditions has been estimated by the investigation of three small populations which have reached the phase of physiological maturity and seed production. A high level of the variability in height, stem diameter, phenophase and abundance of production of strobili pollen, cones and seeds between and inside the populations has been established. Results of progeny tests with half-sib families confirmed that small populations of this species may also possess a high level of genetic variety which enables them to adapt to new environments. The genetic gain from these populations would be greater if we selected the best individual trees and used them for intra and interspecific hybridization.

REZULTATI SELEKCIJE CRNIH TOPOLA (SELEKCIJA AIGE1ROS) NA BUJNOST RASTA

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U poređenju sa ostalim vrstama šumskog drveća crne topole se odlikuju najvećim genetskim potencijalima u pogledu proizvodnje biomase. Hibridizacijom i višestrukom selekcijom stvaraju se u Institutu za topolarstvo visokoprinodne sorte sa ciljem da se što bolje iskoriste ti potencijali. U ovom radu prikazani su sumarni rezultati testiranja jedne serije od 13 half-sib i full-sib potomstva crnih topola u II fazi selekcije (I faza se odvija u toku rasadničke proizvodnje u vidu usmerene selekcije na oboljenja lista i kore) na bujnost rasta i sumarni rezultati uporednog testiranja 12 klonova u završnoj fazi selekcije. Rezultati ukazuju na izraženu diferencijaciju testiranih potomstava i na mogućnost izbora pojedinih genotipova u pogledu bujnosti rasta 6-o godišnjih stabala, koji značajno nadmašuju proseke potomstava i proseke standardnih klonova u istom ogledu. U narednom ogledu izražena je signifikantna diferencijacija testiranih klonova u pogledu svih taksacionih elemenata 9-o godišnjih stabala. Istraživanja u pomenutim ogledima će se nastaviti do kraja planiranog proizvodnog ciklusa.

RESULTS OF BLACK POPLAR (SECTION AIGEIROS) SELECTION FOR RAPID GROWTH

Compared to forest tree species, black poplars are characterized by the greatest genetic potential regarding biomass production. At the Poplar Research Institute, by hybridization and multiple selection, high-yield varieties are created with the aim of utilizing this potential. This paper gives a summary of the results of testing a series of 13 half-sib and full-sib progenies of black poplars in the second phase of selection (the first phase is during nursery production in the form of directed selection for leaf and bark diseases) for rapid growth and a summary of the results of comparative testing of 12 clones in the final stage of selection. The results point to a marked differentiation of the tested progenies and to the possibility of choosing genotypes with luxuriant growth of 6-year-old trees, which surpass the averages of the progenies and the averages of standard clones in the same experiment. The comparative experiment shows a significant differentiation of the tested clones in all the taxation elements of 9-year-old trees. Research will continue till the end of the planned production cycle.

SELEKSIONI FAKTORI I NASUMIČNI PROCESI FORMIRANJA GENETIČKE STRUKTURE POPULACIJE, PRI POŠUMLJAVANJU SADNICAMA IZ RASADNIKA

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Sadnice šumskog drveća proizvedene u rasadnicima sve više se koriste za pošumljavanje i uređivanje različitih površina. Tako se pojavljuje sve izraženiji činilac koji može da utiče na genetičku strukturu prirodnih populacija šumskog drveća, koja je za te vrste općenito malo proučavana. Dužina prereproduktivne faze, životnog ciklusa i samim time perioda smjene generacija produžavaju vrijeme empirijske spoznaje posljedica na prirodne procese u novostvorenim reproduktivnim cjelinama vrste. Intuitivno mogu da se očekuju promjene koje snižavaju adaptivnu vrijednost lokalnih populacija, poremećaji ostvarenog nivoa genetičke ravnoteže i isčezavanje nekih komponenti genofonda. Iz toga proizilazi potreba paralelnih proučavanja genetičke strukture prirodnih populacija šumskog drveća i koncipiranja modela za računarske simulacije procesa kojima se reprodukuje ili mijenja ta struktura u zavisnosti od postupaka koje se primenjuju u šumarstvu. Pristup ovoj složenoj problematici počinje sagledavanjem faktora koji imaju nasumične ili usmjeravajuće djelovanje na formiranje genetičke strukture u sklopu zasada i u reproduktivnim cjelinama koje nastaju od zasađenih i samoniklih jedinki na nekom prostoru. Proizvodnja, prikupljanje, ili nabavka sjemena za proizvodnju sadnica, kao i visoke stope preživljavanja jedinki u rasadnicima čak uz dosljednu primjenu selekcionarskih znanja i propisa iz oblasti šumarstva, sadrže pored usmjeravajućih (željenih) i nasumična, neželjena, neizvjesna ili haotična dejstva na strukturu plasiranog sadnog materijala za pošumljavanje. Izbor sadnog materijala iz okvira ponude rasadničke proizvodnje i sklop činilaca u područjima sadnje dalje povećavaju šanse procesa koji odstupaju i od prirodnih ili željenih tokova u populaciji. Nove spoznaje, promjene propisa i problemi praktične primjene, takođe, ulaze u skup analiziranih nasumičnih i selekcionih činilaca. Pored teorijskog razmatranja, daje se početak razrade modela na primjeru simulacije mogućih stanja varijantnosti male populacije, koja se uzima kao polazna sjemenska sastojina i čije jedinke imaju $2n=24$, a mogu da imaju dvije varijante svakog homologog hromosoma.

SELECTION FACTORS AND RANDOM PROCESSES OF THE FORMATION OF THE POPULATION GENETIC STRUCTURE IN AFFORESTATION WITH NURSERY SEEDLINGS

Forest tree seedlings produced in nurseries have increasingly been used in the afforestation and management of different sites. Thus, an increasingly pronounced factor appears which can affect the genetical structure of natural populations of forest trees which has generally been insufficiently studied for these species. The length of the pre-reproductive stage of the life cycle and therefore the period of generation change, lengthens the period of empirical study of the consequences for natural processes in the newly created reproductive units of the species. Intuitively, changes can be expected which lower the adaptive ability of local populations, disturb

the achieved level of genetic balance and lead to the disappearance of some components of the gene pool. Consequently, a parallel study of the genetic structure of natural populations of forest trees is necessary, as well as the definition of a model for computer simulations of the processes by which the structure is reproduced or changed, depending on the procedures which are applied in forestry. The approach to this complex problem begins by observing the factors which have random or desired effects on the formation of the genetic structure within the scope of the plantation and in the reproductive units which are created by native and planted trees. The production, collection and purchasing of seeds for the production of seedlings, as well as the high rate of survival in nurseries, even with the persistent application of selection knowledge and regulations in the field of forestry, are characterized by, in addition to the desired effects, random, unwanted, uncertain and chaotic effects on the structure of nursery stock for afforestation. The selection of nursery stock from the nursery production range, as well as the factors of planting, further increase the changes of processes which deviate from the natural and desired courses in the population. New insights, changes of regulations and problems of practical application, also participate in the set of analyzed random and selection factors. In addition to the theoretical considerations, the beginning of a model is presented by the example of a simulation of possible states of the variance of a small population, which has been taken as an initial seed orchard and whose individuals have $2n=24$, and can have two variants of each homologous chromosome.

POBOLJŠANJE KARAKTERISTIKA KOKUNA NEKIH RASA I HIBIRDA SVILENE BUBE

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Ispitivanja se bave izborom pogodnih načina poboljšanja svojstava kokona svilene bune (*Bombyx mori* L.) u laboratorijskim uslovima održavanja malih uzgojnih grupa. Korišteni su različiti kriterijumi selekcije u mješovitim i imbrid grupama i postupci međurasne hibridizacije. Primjena veličine i oblika položenog legla kao kriterijumi selekcije uzgojnih grupa rezultira fluktuacijom prosječne veličine kokona i količine svile u njemu. Kod većine rasa postoji tendencija opadanja dimenzija kokona u periodu 1990-1994, a neke rase pri istim uslovima uzgoja ispoljavaju tendenciju povećanja kokona. Mali prosjeci dužine kokona su uglavnom 1992. i 1993. godine. Dimenzije kokona dobro se održavaju j pri ponovljenim uzgojima nekih hibridnih linija tokom 2 do 4 generacije. Uzgoj jedinki iz legala koja su dobijena od roditelja sa natprosječnim dimenzijama kokona ukazuje da su ti roditelji heterozigotni. U uzgoju 1994. godine kao kriterijum selekcije legala korišten je i period njihovog polaganja. Takode su selekcionisana legla bez dijapauze. Uticaji ovih i nekih drugih kriterijuma selekcije je st djelimično analizirani. Laboratorijsko održavanje malih uzgojnih grupa smanjivalo je početni fond od 19 rasa. Virijabilnost veličine kokona unutar rasa se povećala. Istovremeno je stvoren veći broj linija pojedinih rasa od kojih su dobijene hibridne kombinacije sa povoljnom veličinom kokona i dobrim udjelom svile u njima.

IMPROVEMENT OF COCOON CHARACTERISTICS OF SOME STRAINS AND HYBRIDS OF SILKWORM

The choice of adequate methods for the improvement of silkworm cocoons (*Bombyx mori* L.) in laboratory conditions for maintaining small breeding group has been investigated. Different criteria of selection in the mixed and inbred groups and methods of inter-strain hybridization have been used. Using the size and form of the egg mass as a selection criterion results in the fluctuation of the average cocoon size and the quantity of silk in it. In the majority of strains there was a tendency for cocoon size reduction in the period 1990-1994, and some strains in uniform conditions showed the tendency of cocoon enlargement. The average lengths of cocoons were mainly small in 1992 and 1993. Cocoon sizes were well maintained in the repeated breeding of some hybrid lines during 2-4 generations. Breeding individuals from the egg mass obtained from the parents with more than average cocoon sizes indicates that these parents are heterozygous. In 1994, the criterion of egg mass selection was also the period of egg laying. Also egg masses without diapause were selected. The effects of these and some other criteria of selection have been partially analyzed. The laboratory maintenance of small breeding groups decreased the initial fund of 19 strains. The cocoon size variability within strains increased. Simultaneously, a greater number of lines of some strains was formed, from which hybrid combinations with a

favorable cocoon size and a good contribution of silk were obtained.

KARAKTERISTIKE PRIRASTA RANOLISTAJUĆEG I KASNOLISTAJUĆEG LUŽNJAKA (*Quercus robur*)

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U radu se prezentiraju rezultati istraživanja karakteristika prirasta, ranolistajućeg (*Q. robur* var. *praecox*) i kasnolistajućeg (*Q. robur* var. *tardisima*) lužnjaka. Takođe su obrađene strukturne i proizvodne karakteristike sastojina ovih varijeteta. Sastojine su stare 67 godina. Rezultati istraživanja baziraju se na dva premera (1972. i 1994. godine), analizi prirasta stabala u vegetacionom periodu i u zavisnosti od starosti. Ove analize obavljene su na osnovu merenja dendrometrima u obliku traka, analizi srednjih sastojinskih i dominantnih stabala i na osnovu izvrtaka. Rezultati pokazuju značajne razlike u dinamici rasta i visini produkcije navedenih varijeteta lužnjaka, pri čemu kasnolistajući lužnjak ima znatno povoljnije osobine.

INCREMENT CHARACTERISTICS OF EARLY-LEAFING AND LATE LEAFING PEDUNCULATE OAK (*Quercus robur*)

The results of research on the increment characteristics of early-leafing (*Q. robur* var. *praecox*) and late-leafing (*Q. robur* var. *tardisima*) pedunculate oak have been investigated. Structure and production characteristics of the stands of these varieties have also been considered. The stands were 67 years old. The results are based on two measurements (in 1972 and 1994), namely analyses of the increment in 1) the vegetation period and 2) depending of the age. These analyses were carried out by measurements with tape dendrometers, analysis of mean stand and dominant trees and increment cores. The results show significant differences in growth dynamics and the level of productivity of these pedunculate oak varieties, where late-leafing pedunculate oak has substantially better characteristics.

NEKE MORFOLOŠKE OSOBINE PINUS . SYLVESTRIS L. VAR. ZLATIBORICA OMAN. I PINUS SYLVESTRIS L. VAR. AUREA ZLATIBORENSIS'

TOŠIĆ Mihailo Tošić

„SiIva” Samostalni biro za stručne i razvojno-istraživačke poslove u šumarstvu i hortikulturi,
Užice

Mutacije morfoloških i drugih osobina šumskog drveća povećavaju genetički varijabilitet, koji je značajan izvor polaznog materijala za stvaranje kulturnih taksona traženih osobina. Genetske mutacije omogućuju da se nove osobine prenose sa roditelja na potomstvo, a somatske promene mogu se koristiti vegetativnim razmnožavanjem mutanata sa estetski vrednim osobinama za potrebe hortikulture. U radu se prikazuju neke morfološke osobine *Pinus sylvestris* L. var. *zlatiborica* Oman. i *Pinus sylvestris* L. *aurea zlatiborensis* Tošić. *Ps. var. zlatiborica* Oman., stablo belog bora, poznato kao „zlatni bor” u selu Negbina na Zlatiboru. Nije mu proveravan genotip testom potomstva, ali prema morfološkim osobinama, sa dosta verovatnoće, može se pretpostaviti da je rezultat somatske mutacije, zbog čega., čini se ima vrlo složenu himernu gradnju. Naime, prema boji iglica ima tri vrste ovih i to: zelene, žute i žutozelene. Žutih ima oko 20% od ukupnog broja jednogodišnjih iglica i one su na posebnim grančicama. Dužine dvogodišnjih iglica približno su iste za sve boje i kreću se od

40 do 57 mm. Pored pretežno zelenih iglica i žute starenjem dobijaju zelenu boju. I grančice su različite. One koje nose žute iglice obično su kratke i odvajaju se blizu vrha letorasta grane. Boja im je žuta do svetlobraon, a one koje nose zelene iglice imaju tamnosivu do tamnobraon boju. Rukavac kod žutih iglica je svetlo braon, a kod zelenih tamnosiv. *P.s. var. aurea zlatiborensis* Tošić je mlado, 14 god. staro stabalce belog bora sa zlatnožutim iglicama takođe u selu Negbina. Bitno se razlikuje od prethodnog varijeteta po boji, dužini i brojnosti iglica. Boja svih iglica je približno ista – zlatnožuta, ali su znatno kraće i brojnije. Dužina im je 21-32 mm. Po dužnom cm grančice imaju 9-11 pari iglica, dok kod *P.s. var. zlatiborica* Oman. 6-7 pari.

SOME MORPHOLOGICAL FEATURES OF *PILAEUS SYLVESTRIS* L, VAR *ZLATIBORICA* OMAN. AND *PINUS SYLVESTRIS* L. VAR. *AUREA ZLATIBORENSIS* TOŠIĆ

Mutations of morphological and other features of forest trees increase the genetic variety which is an important source of initial material for the creation of the cultural taxons having the features. Genetic mutations make it possible for new features to be transmitted from parents to posteriy, and somatic mutations can be used by vegetative propagation of mutants with estetically valuable features for horticulture. Some morphological features of *Pinus sylvestris* L. var. *zlatiborica* Oman. and *Pinus sylvestris* L. var. *aurea zlatiborensis* Tošić are given in this paper. *Pinus sylvestris* L. var. *zlatiborica* Oman. the Scots pine tree known as, the „golden pine”, in the village Negbina on the mountain of Zlatibor. The genotype has not been confirmed by the progeny test, but according to morphological features, with a great probability, it can be supposed that it is the result of

somatic mutation and because of that, it seems, it has a complex chimeric structure. Namely, according to the colour of the needles there are three types: green, yellow and yellow green. The yellow needles make up 20% of the total number of one year old needles and they are on separate branches. The length of two year old needles is almost the same for all colours and varies from 40 - 57 mm. Besides the mostly green needles, the yellow ones also go green as they get older. The branches are different, too. Those which carry yellow needles are usually short, separating near the top of the one year growth of the branch. Their colour is yellow to light brown, but the which carry green needles have a dark grey to dark brown colour. The channel of yellow needles is light brown but dark-grey for green ones. *Pinus sylvestris* L. var. *aurea zlatihorensis* Tošić is a young Scots pine tree about 14 years old with a golden yellow colour, growing in the village Negbina, too. It is essentially different from the former variety in colour, length and number of needles. The colour of all the needles is nearly the same - golden yellow, but they are much shorter and more numerous. Their length is from 21 - 32 mm. There are 9 - 11 pairs of needles along a branch while *Ps.* var. *zlatiborica* Oman. has 6 - 7 pairs.

VARIJABILNOST SVOJSTAVA SADNICA 8 PROVENIJENCIJA SMRČE U PILOT OBJEKTU U IVANJICI

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Proučavna je svojstava 8 odabranih provenijencija smrče – Golija, Zlatar, Čemerno, Radočelo, Kopaonik, Menina, Mašun i Jelovica, u ranom uzrastu u ogledima kod Ivanjice, započeto je 1989. godine, laboratorijskim proučavanjima semena i proučavanjem morfometrijskih svojstava 1, 2 i 3. godišnjih sadnica u pilot objektu u rasadniku. Morfometrijska analiza obuhvatila je sledeća svojstva 1. god., 2 god. i 3 god. sadnica: visinu sadnica, ukupan broj četina, dužinu osnovne žile, broj bočnih žila, dužinu bočnih žila, ukupnu dužinu žila, prečnik u korenovom vratu i broj grana. Slobodna genetička varijabilnost smrče vrlo je velika u svih osam analiziranih provenijencija, naročito na nivou semena i klijavaca. Može se pretpostaviti da je delovanje prirodne selekcije najmanje u uslovima rasadnika, gde su edafski faktori, a i makroklima modifikovani tehnologijom rasadničke proizvodnje. Slobodna genetička promenljivost sadnica. U prvim godinama, ekstremno je umanjena delovanjem prirodne selekcije na procenat preživaljavanja biljaka iz provenijencija iz Slovenije, dok je osetno veća kod srpskih provenijencija. Usled ovakve redukcije sadnica slovenačkih provenijencija, preostale sadnica su najverovatnije prilagođene na ekološke uslove Srbije. Istraživanja su imala za cilj utvrđivanje proizvodnih sposobnosti pojedinih provenijencija u juvenilnom stadijumu razvoja u manje - više istim i različitim ekološkim uslovima. Ovim istraživanjima došlo se do prvih informacija o karakteristikama i varijabilnosti unutar i između izabranih provenijencija., značajnih sa privrednog aspekta, jer mogu pomoći pri izboru provenijenca ili grupe provenijencija, odgovarajućih za pojedina staništa. Dobijene rezultate treba sa oprezom prihvatiti, jer se odnose na biljke u juvenilnom stadijumu razvića, tako da će se u daljim istraživanjima prikupiti potpuniji odgovori.

VARIABILITY OF SEEDLING PROPERTIES OF EIGHT SPRUCE PROVENANCES IN THE PILOT PLOT IN THE NURSERY AT IVANJICA

A study of the properties of eight selected provenances of spruce - Golija, Zlatar, Čemerno, Radočelo, Kopaonik, Menina, Mašun, and Jelovica - in the early stage, was started in 1989 with experiments near Ivanjica, a laboratory study of seeds and a study of morphometric characters- of 1-, 2-, and 3-year-old seedlings, in the pilot plot in the nursery. The morphometric analysis included the following characters of 1-, 2-, and 3-year-old seedlings: seedling height, total number of needles, length of main axis, number of lateral roots, length of lateral roots, total length of roots, diameter of root collar and the number of branches. The free genetic variability of spruce was very high in all eight analyzed provenances, especially at the level of seeds and seedlings. It can be supposed that the effect of natural selection is the lowest in nursery conditions, where the edaphic factors, as well as microclimate, are modified by the technology of nursery production. The free

genetic variability of seedlings in the first year was greatly lowered by the effect of natural selection on the survival percentage of the plants from Slovenian provenances, while it was much greater in Serbian provenances. Due to such a reduction of seedlings from Slovenian provenances, the remaining seedlings most probably adapted to the ecological conditions in Serbia. The aim of this research was to determine the productivity of individual provenances in the juvenile stage in more or less the same and in different ecological conditions. This research resulted in the first information on the characteristics and variability between and within selected provenances, which are economically significant, because they can aid in the selection of provenances of groups of provenances, suitable for particular sites. These results should be accepted with caution, because they refer to plants in the juvenile stage, and in further research more complete data will be collected.

MAKROGAMETOGENEZA U NEKIH SORTI TREŠNJE I VIŠNJE

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Proučavanje procesa makrogametogeneze kao i uticaja nekih klimatskih faktora na ovaj proces izvršeno je u rejonu Srema na sortama trešnje (kasinova rana, van, sue i bing) i višnje (majska, reksele, kereška i keliris 16). U ovih sorti praćena je makrogametogeneza od formiranja makrospore do obrazovanja normalnog ili Poligonum tipa embrionove kese. Ispitivanje je obavljeno u toku tri vegetacije 1988. i 1989. i 1990. godine. Proučavanja su obuhvatala praćenje vremena, trajanja i pravilnosti odvijanja navedenog procesa u diploidnih (ispitivane sorte trešnje) i tetraploidnih formi (ispitivane sorte višnji). Na osnovu izvršenog kompleksnog proučavanja vremena, trajanja i pravilnosti odvijanja makrogametogeneze, utvrđeno je da je ovaj proces autonoman, odnosno da postoji unutrašnji mehanizam koji reguliše trajanje ovog procesa u zavisnosti od genetičke osnove sorte i uslova spoljnih činilaca. Ispitivane vrste i sorte razlikovale su se u stabilnosti odvijanja makrogametogeneze. Poznavanje ovog procesa bitno je da bi se izvršio pravilan izbor sorti u savremenim zasadima i procesu hibridizacije.

MACROGAMETOGENESIS IN SOME CHERRY AND SOUR CHERRY CULTIVARS

Investigation of the processes of macrogametogenesis, and the effect of climatic factors on these processes, was conducted in the regions of Srem, on chery (Kassins Fruhe, Sue, Van, Bing) and sour cherry (May Duke, Pandy Meggy, Beutelspaeher Rexelle, Kelleris-16) cultivars. In these cultivars macrogametogenesis followed, from the formation of the macrospore to the formation of the normal or poygonum type embryo sack. This investigation, carried out during the vegetation seasons of 1988, 1989 and 1990, was concerned with the time, duration, and regularity of the processes that took place in the diploid forms of cherry and the tetraploid forms of sour cherry. The results by the complex study of the time, duration and regularity of macrogametogenesis, showed that the these processes are regulated by an internal mechanism which, in turn, is controlled by the genetic basis of the cultivar studied and environmental factors. The species and cultivars studied differed in the stability of acrogametogenesis. Knowledge of these processes is important for hybridization and a correct choice of cultivars for modern orchards.

PROUČAVANJE PERSPEKTIVNIH MEĐUVRSNIH HIBRIDA VINOVE LOZE

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Pored kompleksne otpornosti na bolesti, štetočine i nepovoljne ekološke uslove cilj oplemenjivačkog programa vinove loze jeste stvaranje novih sorti sa visokim prinosom i kvalitetom grožđa. Iz F₁ generacije međuvrsnog ukršanja M. hamburg x Vilard 108 izdvojeno je i u toku 1991–1993. godine proučavano 6 hibridnih sejanaca. Njihove važnije agrobiološke i tehnološke karakteristike određene su standardnim metodama. Za obradu rezultata istraživanja upotrebljena je analiza varijanse uz primenu Dannett-ovog testa. Prinos grožđa po čokotu u ispitivanih sejanaca pokazao je statistički značajne razlike i varirao od 1.94 do 6.72 kg. Međutim, u poređenju sa M. hamburgom koji je poslužio kao standard sa prinosom grožđa od 3.84 kg, ispitivani sejanci nisu se značajno razlikovali. Masa grožđa, sadržaj šećera i sadržaj ukupnih kiselina u širi kod izdvojenih sejanaca nisu značajnije odstupali od standarda. Statistički veoma značajne razlike u odnosu na M. hamburg utvrđene su za masu bobica. S obzirom da ispitivani hibridi za većinu osobina ne odstupaju od M. hamburga, kao standardne sorte, a ispoljavaju otpornost na bolesti, neki (19306, 19308 i 19314) mogu se preporučiti za postupak priznavanja, a da se u daijem oplemenjivačkom radu teži ka povećanju mase bobica.

INVESTIGATIONS OF PERSPECTIVE INTERSPECIES HYBRIDS OF GRAPEVINE

Besides complex resistance towards disease, pests and inconvenient ecological conditions, the purpose of grape breeding programs is the production of new cultivars with a high yield and grape quality. During the period 1991-1993 in the F_i generation of interspecies crossing from M. hamburg x Villard 108, six hybrid seedlings were selected and examined. Their important agrobiological and technological characteristics were determined by standard methods. Obtained results were analyzed using variance analysis with the Dannett test. The grape yield per vine of experimental seedlings showed statistically significant differences and varied from 1.94 to 6.72 kg. However, the experimental seedlings did not express significant differences compared with M. hamburg, as a standard cultivar with a grape yield of 3.84 kg/wine. The bunch mass sugar content and total acids in the grape must, in selected seedlings compared with M. hamburg did not show significant differences. High statistically significant differences of berry mass compared with the standard were found. Considering that experimental hybrids did not differ in most characteristics from M. hamburg, as a standard table cultivar, and were resistant towards disease, some seedlings (19306, 19308 and 19314) can be recommended for recognition. Further breeding work needs to lead to an increase of the berry mass.

SELEKCIJA KRUPNOPLODNIH GENOTIPOVA IZ POPULACIJE DŽANARIKE (PRUNUS CERASIFERA EHRH.)

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Džanarika (*Prunus cerasifera* Ehrh.) odlikuje se veoma bogatom i polimorfnom prirodnom populacijom. Osim uloge koju ima kao sejanac za podlogu sorata šljive i drugih prunusa, njeni plodovi interesantni su i za prerađivačku industriju. Ova istraživanja imala su za cilj selekcionisanje krupnoplodnih genotipova (preko 10 g) iz populacije džanarike kolekcionisane u Beloj Crkvi. Pored mase ploda kod 54 ispitivana genotipa proučavana je i masa koštice, dužina ploda, širina ploda i dužina peteljke ploda. Ogleđom su obuhvaćene i hemijske osobine ploda: sadržaj rastvorljivih suvih materija, ukupnih šećera, invertnih šećera i ukupnih kiselina. Od pomoloških osobina najviše je varirala masa koštice ($Cv = 20,63\%$), a najmanje dužina ploda ($Cv = 7,20\%$). Od hemijskih osobina najmanje je varirao sadržaj rastvorljivih suvih materija ($Cv = 10,67\%$), a najviše sadržaj invertnih šećera ($Cv = 20,19\%$). Na osnovu sprovedenih istraživanja izdvojeno je 9 genotipova džanarike koji odgovaraju postavljenom cilju selekcije, sa masom ploda od 10,10 do 13,04 g i sadržajem rastvorljivih suvih materija od 10,45 do 13,13%.

SELECTION OF LARGE FRUIT GENOTYPES FROM THE MIRA BELLE (PRUNUS CERASIFERA EHRH.) POPULATION

The natural population of Mirabelle (*Prunus cerasifera* Ehrh.) is very rich in polymorphic genotypes. Besides the use of Mirabelle seedlings as a rootstock for plum (prune) varieties and other *Prunus* species, their fruits are very interesting for industry. The purpose of this work was selection of large fruit genotypes (over 10 g) from collection of Mirabelle populations in Bela Crkva. We investigated 54 different genotypes in relation to fruit mass, stone mass, length of fruit, width of fruit and length of fruit stem. The following chemical properties of the fruit were investigated: content of soluble dry matter, total sugars, reductive sugars and total acids. In pomological characteristics the biggest variation existed for the stone mass ($Cv = 20,63\%$) and lowest for the length of fruit ($Cv = 7,20\%$). In chemical characteristics the lowest variation was for soluble dry matter ($Cv = 10,67\%$), and the biggest for the content of reductive sugars ($Cv = 20,19\%$). Based on these investigations we selected 9 Mirabelle genotypes which have a fruit mass from 10,10 to 13,04 g and content of dry matter from 10,45 to 13,13%.

KONSTITUCIJA ŽENSKOG GAMETOFITA KOD DIPLOIDNIH I TRIPLOIDNIH SORTI JABUKE

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U radu na oplemenjivanju jabuke od velike važnosti je konstitucija ženskog gametofita, posebno kod triploidnih sorti, za dobijanje većeg broja hibridnog potomstva, i dobijanja hibridnog potomstva sa različitim brojem hromozoma. Uporednim histološkim analizama konstitucije ženskog gametofita obuhvaćene su važnije standardne i autohtone diploidne (Ajdared, Gloster, Greni Smit, Budimka i Lepocvetka) i triploidne sorte (Jonagoid, Mucu i Kolačara). Analiza građe embrionih kesica kod diploidnih sorti pokazuje normalnu i za njih karakterističnu konstituciju, uz pojavu dopunskih embrionovih kesica. Kod triploidnih, sorti pojava dopunskih embrionovih kesica bila je uobičajena, uz primetnu pojavu embrionovih kesica sa atrofiranim elementima jajnog aparata.

THE STRUCTURE OF THE MEGAGAMETOPHYTE IN DIPLOID AND TRIPLOID APPLE CULTIVARS

In apple breeding, the structure of the megagametophyte is of great importance especially in triploid cultivars, for obtaining a larger number of hybrid progeny and hybrid progeny with a varying chromosome number. Comparative histological analyses of the megagametophyte structure involved some more important, standard and indigenous, diploid (Idared, Gloster, Granny Smith, Budimka and Lepocvetka) and triploid cultivars (Jonagold, Mutsu and Kolačara). The analysis of embryo sacs in diploid cultivars showed a normal structure, typical of these cultivars, with the occurrence of additional embryo sacs. In triploid cultivars, additional embryo sacs were commonly found with a noticeable occurrence of embryo sacs with atrophied elements of the egg apparatus.

OPRAŠIVANJE I ZAMETANJE KOD ORAHA (*Juglans regia* L.)

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Najveći broj sorti oraha koje se gaje u mnogim zemljama, pa i u našoj, nastale su klonskom selekcijom iz prirodne populacije. Skoro svaka od njih ima i značajnih nedostataka. Cilj planske hibridizacije oraha je da se uz korišćenje odabranih roditeljskih parova stvore nove sorte kombinovanih osobina: adaptivne na klimatske uslove, brzog stupnja na rod, visoke produktivnosti i kvalitetnog ploda i da ispunjavaju tolerantnost na prouzrokovane značajnijih bolesti i štetočina. U Centru za voćarstvo i vinogradarstvo u Čačku planska hibridizacija oraha se radi više godina, a kao roditelji koriste se odabrane sorte i selekcije dobrih privredno-bioloških osobina u ovdašnjim agroekološkim uslovima. Kao sorte majke najčešće su korišćene Šampion i G-251, a kao očevi Chico, G-139, G-251, Bačkovski, A-117, 41-9/82 i 32/82. Preliminarni rezultati i oprašivanja i zametanja plodova oraha pokazuju da je sorta Šampion oprašena sortom Chico dala 62,5% plodova od broja oprašenih cvetova., oprašena selekcijom G-251 – 53,3%, sa selekcijom A-117 50% zametnutih plodova. Cvetovi oprašeni Bačkovskim dali su 60% plodova, selekcijom 32/82 66,7%, a selekcijom 41-9/82 dobijeno je najviše plodova oraha čak 83%. Najmanje plodova dali su plodovi oprašeni sa sortom Konkord, svega 33,4%. Kod selekcije G-251 najviše plodova dobijeno je pri oprašivanju sa sortom Šampion 60%, a najmanje sa sortom Bačkovski 37,5%. Zapaženo je takođe da u sorte oraha čije se prašenje resa podudara sa otvaranjem ženskih cvetova (41-9/82) dala više zametnutih plodova od sorti sa kasnijim periodom prašenja resa (Konkord).

POLLUTION AND FRUIT SETTING IN WALNUTS (*Juglans regia* L.)

The majority of walnut cultivars grown, in many countries, and in our country, derived from clonal selection from the natural population. However, almost each of them has some major drawbacks. The planned hybridization of walnuts aims to develop new cultivars with combined characteristics by using selected parents. They should be adaptable to climatic conditions, precocious, highly productive, with good quality fruits, and show tolerance to important pests and causal agents of diseases. Planned hybridization of walnuts has been conducted at the Fruit and Grape Research Centre in Čačak for many years. The cultivars and selections with good economic-biological characters in our ecological conditions were used as parents. Šampion and CT-251 were most often used as female parents, whereas Chico, C1-139, G-251, Bačkovski, A-117, 41-9/82 and 32/82 were used as male parents. Preliminary results obtained with pollination and fruit setting show that cv Šampion pollinated with cv Chico gave 62.5% fruits from the number of flowers pollinated, with selection G-251 -53.3%, and with selection A-117 - 50% fruit set. The flowers pollinated with Bačkovski and selection 32/82 gave 60% and 66.7% fruits, respectively. The highest number of fruits was obtained with selection 41-

9/82 (83%), and the lowest in fruits pollinated with cv Concord (only 33.4%). With selection G-251, the highest number of fruits was obtained for pollination with cv Šampion (60%) and the lowest with cv Bačkovski (37.5%). The walnut cultivars in which the pollen shedding period coincides with the opening of female flowers (41-9/82) were found to have a higher fruit set compared with cultivars with a later period of pollen shedding (Concord).

HIBRID ŠLJIVE I/14 CK – KVALITETNA ŠLJIVA ZA SUŠENJE

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U toku dugogodišnjeg perioda (počev od 1947. godine) u Institutu za voćarstvo u Čačku (sada Centar Instituta za istraživanja u poljoprivredi „Srbija”) stvoren je veliki broj hibrida šljiva. Cilj je bio stvaranje novih stonih i industrijskih sorti različitog vremena zrenja, tolerantnih na šarku šljive (Plum pox virus). Hibrid No. I/14 CK je stvoren 1964. godine ukrštanjem požegače i kalifornijske plave. Selekcionisan je 1973, a okalemljen 1974. godine. U ispitivanju se nalazi već 20 godina. Stablo je iznad srednje bujnosti sa dugim i jakim skeletnim granama. Kruna je pramidalna, retka. Cveta srednje pozno, nekoliko dana posle čačanske rodne, istovremeno sa stenlejem. Samooplodna je. Polen je osrednje klijavosti. Rađa neredovno, ali ponekad obilno. List je srednje krupnoće (70/45,3 mm), neujednačenog oblika (od ovalnog do romboidnog), bleдозелene boje. Peteljka je kratka (13,6/1,68 mm) sa 1-2 stablo razvijene žlezde pri osnovi liske. Cvet je srednje krupnoće, bele boje. U cvetnom pupoljku ima 1,7 cvetova. Plod je srednje krupnoće (36 g), nepravilnog jajastog oblika. Dimenzije ploda: v-48,6; s-36,3; d-36,1 mm. Peteljkino udubijenje je plitko, srednje široko. Šav je slabo izražen ili neprimetan. Pokožica je srednje debijine, čvrsta, žučkaste osnovne boje koja prelazi u crvenkasto purpurnu pa u purpurno-plavu boju. Srebrnasti pepeljak je obilan. Meso je žuto, čvrsto, sočno, slatko- nakiselo, odličnog ukusa. Koštica je mala (0,96 g). Dimenzije koštice: v-21; š-13,7; d-6,7 mm. Odlično se odvaja od mesa. Peteljka je srednje dužine i debijine (15,5/1,38 mm). Odlično se drži za plod i granu. Šarkava stabla ispoljavaju karakteristične simptome na lišću ali su plodovi bez ikakvih promena – tolerantni. Vrlo je pogodna za sušenje. Suva šljiva je tamnočilibrane boje, odličnog kvaliteta.

PLUM HYBRID I/14 CK - AN EXCELLENT DRYINIG PLUM

Long-term work on plum breeding (started in 1947), conducted at the fruit Research Institute in Čačak (now: Fruit and Grape Research Centre within the Agricultural Research Institute „Serbia”) resulted in a great number of hybrids. The aim of this work was to develop new cultivars for fresh use and for processing, with differing ripening times, tolerant to sharka (Plum pox virus). Hybrid No. I/14 CK resulted from a Požegača x California Blue cross made in 1964. It was selected in 1973 and grafted in 1974. It has been under evaluation for 20 years. The tree has above average vigour, with long and sturdy scaffold branches ending with a pyramidal and sparse head. The flowering season is midlate, several days after Čačanska Rodan, simultaneous with Stanley. This is self-fertile. Its pollen has a moderate germination ability. Cropping is irregular, but sometimes abundant. Leaves are medium large (70/45.3 mm), varying in shape from oval to rhomboid, pale green. The petiole is short (13.6/1.68 mm), with 1-2 poorly developed glands at the base. The flower is white, medium-sized. The flower bud carries 1.7 flowers. The fruit is medium-sized (36 g), of an irregular-ovate shape. The fruit dimensions are:

length - 48.4; width - 36.3; thickness - 36,1 mm. The stem cavity is shallow, moderately wide. The suture line is inconspicuous. The skin is medium thick, firm, of a yellowish ground colour, turning first to reddish-purple and then to purple-blue, with a heavy silvery bloom. The flesh is yellow, firm, juicy, sweet-subacid, of an excellent flavour. The stone is small (0.96 g). The stone dimensions are: length - 21.6; width - 13,7; thickness - 6.7 mm. It separates very easily from the flesh. The stalk is moderately long and thick (15,5/1.3\$ mm). It adheres tightly to the fruit and branch. Sharka-affected trees show characteristic leaf symptoms, but the fruits remain unchanged-tolerant. The hybrid is highly suitable for drying. Pruneš are deep amber in colour, of excellent quality.

KORELACIJA IZMEĐU MORFOLOSKIH OSOBINA I KLIJAVOSTI SEMENA DIVLJE TREŠNJE

(*Prunus avium* L.)

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Najčešće korišćena podloga za kalemljenje sorata višnje i trešnje je sejanac divlje trešnje. Pošto je jedan od velikih problema slaba klijavost semena i vitalnost sejanca, ispitivana je korelacija između ovih i nekih morfoloških osobina sa ciljem da se olakša selekcija genotipova divlje trešnje iz prirodne populacije za proizvodnju generativnih podloga. Ogledom je bilo obuhvaćeno 18 genotipova kod kojih je praćena bujnost, površina liske, oblik, boja i vreme sazrevanja ploda, masa ploda, masa koštice, klijavost semena i vitalnost sejanaca. Uočeno je da postoji zjačajna korelacija između klijavosti semena i boje pokožice ploda ($r_s = 0,418x$), vitalnosti sejanaca i boje pokožice ploda ($r_s = 0,480x$), kao i između vitalnosti sejanaca i vremena sazrevanja ploda ($r_s = 0,468x$). Preporučuje se da matična stabla divlje trešnje za proizvodnju podloga imaju tamno obojene plodove koji kasnije sazrevaju.

CORRELATION BETWEEN MORPHOLOGICAL CHARACTERISTICS AND SEED GERMINATION IN THE WILD SWEET CHERRY (*Prunus avium* L.)

The seedlings of wild sweet cherries are most frequently used as rootstock for grafting cultivars of sour and sweet cherries. As one of the big problems is a low germination of seeds and viability of seedlings, correlation between these and some other morphological characteristics was examined in order to ease the selection of genotypes of sweet-cherry from the natural population for the production of rootstocks. In the experiment 18 genotypes were included where the following characteristics were followed: vigour, leaf surface, fruit shape, skin color, ripening date, fruit weight, stone weight, seed germination and seedlings viability. A significant correlation was noticed between seed germination and fruit skin color ($r_s = 0,418X$), seedling viability and fruit skin color ($r_s = 0,480X$), as well as between seedling viability and fruit maturity period ($r_s = 0,468X$). It is advisable that wild sweet cherry reproductive trees for the production of rootstocks have dark colored fruits which mature later.

STVARANJE SORTI CRNE RIBIZLE OTPORNIH PREMA KASNIM PROLEĆNIM MRAZEVIMA

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Jedan od problema u gajenju crne ribizle, izuzetno značajne jagodaste voćne vrste, jeste njeno rano cvetanje, a time i rizik od oštećenja cvetova ili zametnutih plodova izazvano pojavom kasnih prolećnih mrazeva, što može znatno umanjiti ili potpuno uništiti prinos. U cilju rešavanja navedenog problema, u Centru za voćarstvo i vinogradarstvo u Č:aćku se od 1982. godine radi na programu stvaranja novih genotipova crne ribizle koji će, pored ostalih pozitivnih karakteristika, imati i kasnije cvetanje od postojećih sorti. U proteklom periodu korišćeno je 16 sorti i tri odabrana hibrida u procesu planske hibridizacije sa više roditeljskih kombinacija. 1987. godine izdvojen je hibrid R/1/IX/87 (nepoznati roditelji), koji je dalje ispitivan uporedo sa drugim sortama. Navedeni hibrid ima kasnije cvetanje za 7 do 10 dana od standardnih sorti, a takođe i kasnije sazrevanje. Odlikuje se dugim grozdom sa dosta krupnih i kvalitetnih bobica i odličnom rodnošću.

BREEDING OF BLACK CURRANT CULTIVARS RESISTANT TO LATE SPRING FROSTS

One of the problems in growing black currants, a small fruit species of exceptional importance, is its early flowering, which carries the risk of flower or fruitlet damage by late spring frosts, resulting in substantial depression or complete loss of yields. To solve this problem, a programme was started in 1982 at the Fruit and Grape Research Centre in Č ačak to develop new black current genotypes which flower later than the existing cultivars, besides other positive characteristics. Over the past period, 16 cultivars and three selected hybrids have been used in planned hybridization with several parental combination. In 1987, the hybrid R/1/IX/87 (of unknown parentage) was singled out and further evaluated in comparative trials with other cultivars. This hybrid has 1-10 days later flowering than the standard cultivars, and later bearing. It is distinguished by long strigs with many large, good- quality berries, and with excellent yield.

GENETIČKA OSNOVA ANTOCIJANA U PLODU VRSTA, SORTI I SELEKCIJA JABUKE

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Za proizvođače, od posebnog komercijalnog interesa je crvena boja pokožice ploda jabuke. U literaturi ima malo podataka o kvalitativnim analizama antocijana kao genetske osnove crvene boje pokožice ploda. U ovom radu primenom hromatografije i spektrofotometrije ispitani su antocijani u pokožici ploda 92 genotipa jabuke (45 sorti, 42 selekcije, 3 podvrste i 2 vrste). Broj antocijana, u zavisnosti od genotipa, kretao se od 1 do 3. U pokožici ploda 63 genotipa identifikovana su tri antocijana (cyanidin-3-galactoside, cyanidin-3-arabinoside, cyanidin-7-arabinoside); u 24 dva (cyanidin-3-galactoside, cyanidin-3-arabinoside) i u 5 jedan (cyanidin-3-galactoside).

THE GENETIC BASIS OF FRUIT ANTHOCYANINS IN APPLE SPECIES, CULTIVARS AND SELECTIONS

Red fruit skin in apples is of special interest to growers. There is little information in the available literature on qualitative analyses of anthocyanins as the genetic basis of red fruit skin colour. Chromatography and spectrophotometry were employed in this paper to study the anthocyanins in the fruit skin of 92 apple genotypes (45 cultivars, 42 selections, 3 subspecies and 2 species). The number of anthocyanins, depending on the genotype, ranged from 1 to 3. Three anthocyanins were identified in the fruit skin of 63 genotypes (cyanidin-3-galactoside, cyanidin-3-arabinoside, cyanidin-7-arabinoside); two in 24 genotypes (cyanidin-3-galactoside, cyanidin-3-arabinoside) and one anthocyanin in 5 genotypes (cyanidin-3-galactoside).

**OPLEMENJIVANJE VIŠNJE NA KVALITET I OTPORNOST PREMA RHAGOLETIS CERASI L. i
BLUMERIELLA JAAPII (Rehm.)v. Arx.**

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Na oplemenjivanju višnje u Centru za voćarstvo i vinogradarstvo u Čačku radi se više od trideset godina. Najvažniji ciljevi su dobijanje sorti kvalitetnijih polodova, dobrih pomološko-tehnoloških osobina (krupnog i sočnog ploda, željene boje soka, bogatog rastvorljivom suvom materijom, pogodnog za stonu upotrebu, preradu i mehanizovanu berbu), otpornih prema privredno najznačajnijim štetocinamaj prouzrokovacima bolesti. U radu je korišćena planska hibridizacija biranjem roditeljskih parova među standardnim sortama višnje raširenim u proizvodnji u našim uslovima, kao i individualna selekcija najboljih jedinki. Selekcija na postavljene ciljeve vršena je u heterogenoj populaciji od 530 hibridnih sejanaca tri uzastopne godine od stupanja na rodnost. Ocenjivanje na otpornost prema trešnjinoj muvi i pegavosti lista vršeno je u uslovima prirodnog zaražavanja bez primene pesticida. Odabrano je 15 perspektivnih hibrida sa željenim pomološko-tehnološkim osobinama i različitim stepenom otpornosti prema trešnjinoj muvi i pegavosti lista. U ovoj grupi posebno se ističu hibridi III/23, IV/36 i XII/57. Poslednja dva hibrida poseduju izraženu otpornost prema *Blumeriella jaapii*.

**BREEDING OF SOUR CHERRIES FOR QUALITY AND RESISTANCE TO RHAGOLETIS CERASI
L. AND BLUMERIELLA JAAPII (Rehm.) v. Arx.**

Sour cherry breeding has been in progress at the Fruit and Grape Research Centre in Čačak for more than thirty years. The major goals are developing cultivars with superior fruit quality, good pomological-technological characteristic (large and juicy fruits, the desired juice colour, rich in soluble solids and suitable for fresh use, processing and for mechanized harvesting), resistance to the economically most important pests and causal agents of diseases. Planned hybridization by selecting parents from the standard sour cherry cultivars commercially grown in our conditions, as well as individual selection of superior individuals, were employed in the work. Selection for the set objectives was carried out among a heterogeneous population of 530 hybrid seedlings, for three consecutive years after coming into bearing. Screening for resistance to cherry fruit fly and leaf blight was done in the conditions of natural infection, with no pesticide applied. Fifteen promising hybrids have been selected, having the desired pomological-technological characteristics and varying levels of resistance to cherry fruit fly and leaf blight. Hybrids III/23, IV/36 and XII/57 stand out among the hybrids in this group. The last two hybrids show marked resistance to *Blumwriella jaapii*.

**ODREĐIVANJE VITALNOSTI I KLIJAVOSTI POLENA JABUKE (*Malus domestica* L.) I TREŠNJE
(*Prunus avium* L.)**

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U oplemenjivačkom radu u voćarstvu od velike je važnosti izbor adekvatne metode za precizno utvrđivanje vitalnosti polena izabranog muškog roditelja koji se koristi u hibridizaciji. Cilj ovog rada je da se ispita vitalnost polena kod četiri sorte jabuke i četiri sorte trešnje korišćenjem sledećih *in vitro* testova: klijavost polena na agrarozno-saharoznoj podlozi; bojenje polena sa fluorescentindiacetatom i njegovom analizom fluorescentnom mikroskopijom. Za ove testove uzima.n je polen sorti jabuke i trešnje u fenofazi punog cvetanja. U isto vreme trećom metodom, pomoću fluorescentnog mikroskopa, analizirana je klijavost polena i rast polenovih cevčica *in vivo* u stubiću u pojedinim kombinacijama oprašivanja. Uzorci za analizu su uzimani trećeg dana po oprašivanju sa izabranim sortama. Kod obe vrste voćaka i u svim kombinacijama oprašivanja može se zaključiti da je najpouzdanija i najefikasnija metoda ocenjivanja vitalnosti i klijavosti polena, kako u kvantitativnom tako i u kvalitativnom smislu, metod rasta polenovih cevčica *in vivo*. Iz tog razloga ova metoda za sada ostaje po svojoj preciznosti i efikasnosti nezamenljiva u oplemenjivačkom radu, genetičkim istraživanjima, kao i u genbanci. Kod obe ispitivane vrste voćaka u pogledu vitalnosti i klijavosti polena oprašivača, utvrđen je određen stepen pozitivne korelacije između ispitivanih metoda *in vitro* i *in vivo*.

**DETERMINATION OF POLLEN VIABILITY AND GERMINABILITY IN APPLE (*Malus domestica*
L.) AND SWEET CHERRY (*Prunusavium* L.)**

The choice of the appropriate method for the precise determination of pollen viability in the chosen male parent used in hybridization is of great importance in fruit breeding work. The objective of this paper was to study pollen viability in four apple and four sweet cherry cultivars by using the following *in vitro* tests: pollen germination on the agar-sucrose medium; staining of pollen with fluorescein-diacetate and its analysis by fluorescence microscopy. For these test, the pollen of apple and sweet cherry cultivars was taken at anthesis. At the same time, a third method, fluorescence microscopy, was employed to analyze pollen germination and pollen tube growth *in vivo* down the style in individual combinations of pollination. The samples for the analysis were taken on day 3 following pollination with the chosen cultivars. Pollen tube growth *in vivo* was found to be the most reliable and efficient method of evaluating pollen viability, both quantitatively and qualitatively, in both fruit species and in all combinations of pollination. Therefore, in terms of its precision and efficiency, this method remains irreplaceable in breeding work, genetic research and in a gene bank. In terms of pollen viability and germinability of pollinator cultivars, a certain degree of positive correlation was assessed between the *in vitro* and *in vivo* methods with both fruit species studied.

**PRIMENA MEŠOVITOG MODELA NAJMANJIH KVADRATA U OCENI HERITABILITETA
OSOBI NA MUZNOSTI CRNO-BELIH KRAVA**

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Ispitivanje je izvedeno na uzorku četvorogodišnjeg progenog testa 54 bika (841 kćer na 9 farmi PKB). U primenjenom modelu uticaj farme bio je slučajan jer je i distribucija semena bikova po farmama bila slučajna. Prosečne vrednosti ispitivanih osobina bile su: vreme muže 4.22 min, protok mleka 2.68 kg/min, intenzitet muže 85.10% i index vimena 45.58 %. Koeficijenti heritabiliteta ispitivanih osobina po navedenom redu iznosile su: 0.102, 0.129, 0.097 i 0.029. Primenjeni model doprineo je tačnijoj oceni aditivnih genetskih varijansi i heritabiliteta.

**THE ESTIMATION OF HERITABILITY OF DAIRY TRAITS OF BLOCK-WHITE COWS BY THE
MIXED MODEL**

The investigation was carried out on the sample of 4 year progeny test records of 54 bullsires (841 daughters on 9 PKB farms). The distribution of bull semen on the farms was random, so the effects of farms were random in the applied model. The average values were: milking time 4.22 min, milk flow 2.68 kg/min, milking intensity 84.10% and under index 45.58%. The coefficients of heritability of the investigated traits were 0.102, 0.129, 0.097 and 0.029, respectively. The contribution of the mixed model used was in the better estimation of additive genetic variance, and heritability of dairy traits.

PONOVLJIVOST DNEVNIH PRINOSA MLEKA TOKOM LAKTACIJE U CRNO-BELIH KRAVA

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Koeficijenti ponovljivosti dnevnih prinosa mleka i prinosa mleka u standardnoj laktaciji ispitani su primenom tri fiktivna i tri miksna modela najmanjih kvadrata. Ispitane su prve tri laktacije u 186 crno-belih krava ($n = 5581$ laktacija) i 5315 dnevnih kontrola mlečnosti. U mešovitim modelima krava je posmatrana kao sučajan uticaj. Primenom fiksnih modela utvrđen je opšti prosek za prinos mleka u standardnoj laktaciji od 6397 kg, a mešovitim modelom od 5983 kg. Prosečan dnevni prinos mleka varirao je od 14.7 kg do 28.9 kg (fiksni model) i od 12.0 kg do 27.5 kg (mešoviti model). U obe analize maksimalna dnevna mlečnost ustanovljena je u drugoj kontroli, a najmanja u devetoj. Koeficijenti ponovljivosti dnevnih prinosa mleka tokom prve tri laktacije iznosili su od 0.210 do 0.460 (fiksni model), i do 0.537 do 0.627 (mešoviti model). Repitabilitet prinosa mleka u prvih devet kontrola mlečnosti iznosio je od 0.005 do 0.210 (fiksni model), tj. od 0.192 do 0.399 (mešoviti model). Koeficijent determinacije primenjenih modela ukazuju na prednost mešovitog modela nad fiksnim, jer se mešovitim modelom realnije mogu oceniti ispitivani uticaji, a time i ponovljivost ispitanih pokazatelja.

REPEATABILITY OF DAYLY MILK YIELDS DURING LACTATION IN BLACK-PIED COWS

Coefficients of repeatability of daily milk yields during lactation and in standard lactation were investigated by application of 3 fixed and 3 mixed models of least squares. The first 3 lactations of 186 cows with 5581 lactations, and 5315 daily milk yields were included. In mixed models the cow was random factor. The average milk yield in standard lactation was 6,397 kg by fixed, and 5,983 kg by mixed model. The average daily milk yield varied from 14.7 to 28.9 kg (fixed model) and from 12.0 to 27.5 kg (mixed model). By both models the highest daily yields were in second control, and the minimum in ninth control. Repeatability coefficients of milk yields in first three lactations varied from 0.210 to 0.460 (fixed model), and from 0.537 to 0.627 (mixed model). Repeatability coefficients for nine controls of milk yield varied from 0.005 to 0.210 (fixed model), and from 0.192 to 0.399 (mixed model). Determination coefficients suggest that mixed models are better for determination of investigated influences.