

IMPROVEMENT OF SUNFLOWER FOR CONSUMPTION

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Growing sunflower (*Helianthus annuus* L.) for consumption is becoming more and more attractive in the whole world and in our country, as well. The consumption of this product has been considerably increased because it is being used more and more in various forms: sunflower seed in a hull, hulled kernels fried or non-fried, salted or non-salted with addition of various spices. The sunflower kernel is used for preparing over 100 different food products: special types of bread, cakes, ice-cream, chocolate. In accordance with the trade demands, the aims of sunflower seeds for consumption improvement are: high productivity, greater content of proteins, lesser content of oil, oncreased mass of 1000 seeds, lesser portion of the hull, easy nibbling, as well as tolerance to dominant diseases in the growing region. In the Agricultural and Technological Research Center in Zajecar, 4 genotypes of protein sunflower (two cultivars and two hybrids) have been created so far. This study shows the results achieved in increasing the content of protein, the mass of 1000 seeds, decreasing the content of oil and hull of the new 90 hybrid combination. The hybrid combinations were obtained by crossing of the CMS and restorer lines.

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INTRODUCTION

Growing sunflower (*Helianthus annuus* L.) for consumption is becoming more and more attractive in the whole world and in our country, as well. Sunflower seed is being consumed by humans as well as some animals. People consume it in various forms: as sunflower seed in a hull, hulled kernels fried or non-fried, salted or non-salted with addition of various spices. Sunflower kernel is used for preparing over 100 different food products, such as: special types of bread, cookies, ice-cream, chocolate. In addition to aforesaid, the consumption seed sunflower is used for production of high-quality butter. Crushed sunflower seed and the isolates are very rich in protein content and are used both in human and animal nourishment, HENDERSON, 1986. The consumption sunflower seed and the products obtain from it are also used in macrobiotic food mixtures for humans and animals.

The chief aims of the consumption sunflower seed improvement are: Increase of seed yield, greater content of proteins in seed, yield index, higher resistance to dominant diseases, earlier maturing (ŠKORIĆ, 1989). Within the improvement programmes for consumption sunflower seed, beside yield and resistance to diseases, according to FICK and MILLER (1997), what is very important is the coarseness of seed, its shape and colour, low content of the shell, equalization in size, easy nibbling and long-term and safe storage of seed. High content of proteins is highly important for this type of hybrid. In the Agricultural and Technological Research Center in Zaječar, 4 genotypes of protein sunflower (two cultivars and two hybrids based on cytoplasmic male sterility) have been created so far. These genotypes, besides increased protein content in seed and increased mass of 1000 seed, are characterized by very thin hull being separated easily from the kernel, so that it is very convenient for mechanical nibbling and further processing of the kernel.

The aim of the study was to estimate 90 new hybrid sunflower combinations in relation to the standard ones (the protein hybrid Proteinac 94, and the oily one NS H 111).

MATERIALS AND METHODS

The material for this study included 90 hybrid combinations by crossing cytoplasmic male sterile lines (mother's lines) and the restorer lines (father's lines). The sunflower lines had been selected in the Agricultural and Technological Research Center in Zaječar. The crossing were carried out in 1998, 1999, 2000 and 2001. The plants from the middle rows were taken for analyses. As standard, it was used the protein hybrid, the Center's selection Proteinac 94, and the oily hybrid NS H 111 produced in Novi Sad.

The 1000 seed mass (g) was determined on a random sample of absolutely clear and airily dry seed. The hull content (%) was obtained by comparing

the mass of 10 g of unibbled seed kernel mass. The difference in mass, calculated in per cents, is the kernel content. The difference up to 100% belongs to the hull content. The seed protein content (%) was determined by the IC method on the Inframatic apparatus, while the oil content (%) by the nuclear resonance method (NMR).

The data were statistically processed by usage of the computer programme COSTAT. The statistical analysis was carried out by the variance analysis (HADŽIVUKOVIĆ, 1991).

RESULTS AND DISCUSSION

The oil content in the selected sunflower seed material is in the range from 27 to 64% (BEDOV, 1985). The average oil content in seed of the investigated hybrid combinations was 38.14%, while the achieved maximum was at the combination No 66 with 50.75%.

The protein content in seed was determined by greater number of genes (minor genes or polygenes) and it was the results of the interaction of these genes and factors of the environment. BEDOV and ŠKORIĆ (1981) state that protein content in sunflower seed material of various genetic origin ranges from 16 to 29%. The mean value of the protein content amounted 19.27% with the achieved maximum of 26.60% at the combination No. 50.

The mass of 1000 seed represents the relation between the weight and number of seeds. The polygenous way of inheritance causes greater varying. The 1000 seed mass of all hybrid combinations was 90.31 g averagely with an extraordinary high standard deviation of 23.46. Preety great mass of 1000 seed of 156 g was achieved by the combination No. 67.

The hull content is in relation to the genetic constitution of the observed genotype. According to MARINKOVIĆ'S investigations 1992, average hull content varied from 14.0 to 55.6% at 78 diverged sunflower populations. The average hull content at 90 investigated hybrid combinations was 30.89%, although there were some combinations with significantly lower portion of hull in seed, as, for example, the combination No.66 at wich the minimum hull content amounted 18% (Table 1.).

Table 1. Average values of chief productivity characteristic of sunflower hybrid combinations

Attribute	Mean	SD	Min	Max
oil %	38.14	5.15	24.80	50.75
protein %	19.27	2.64	12.92	26.60
1000 ker. weight	90.31	23.46	42.80	156.00
hull %	30.89	6.12	18.00	48.00

Oil content in seed (%) - Significant differences in oil content of the investigated hybrid combinations were established. The variance analysis of the hybrid combinations showed that on the significance level of 0.05, two combinations

achieved significantly greater oil content (combination No.66 48.36% and the combination No.58 48.30%) than the standard oily hibrid NS H 111 (41.28%), while 74 combinations showed the oil content on the level of the standard NS H 111 (Fig. 1.). On the significance level of 0.01 not only any of the combinations achieved statistically significant greater oil content but 73 combinations were on the level of the standard one, NS H 111.

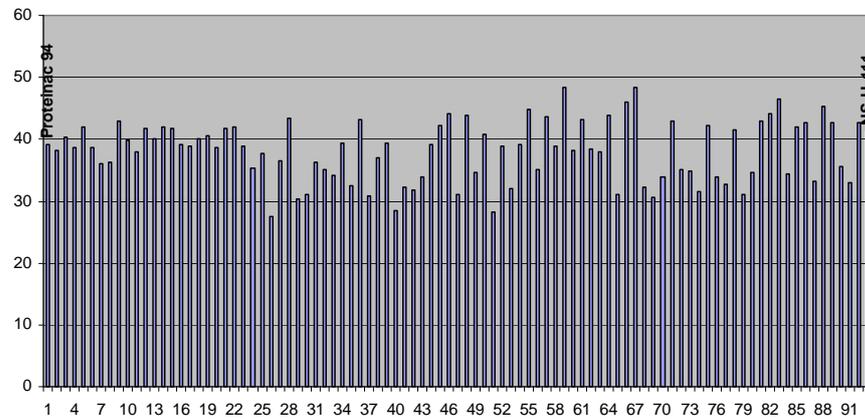


Fig. 1. Oil content in seed (%) of hybrid combinations (LSD_{0.05} = 3.517, _{0.01} = 4.639)

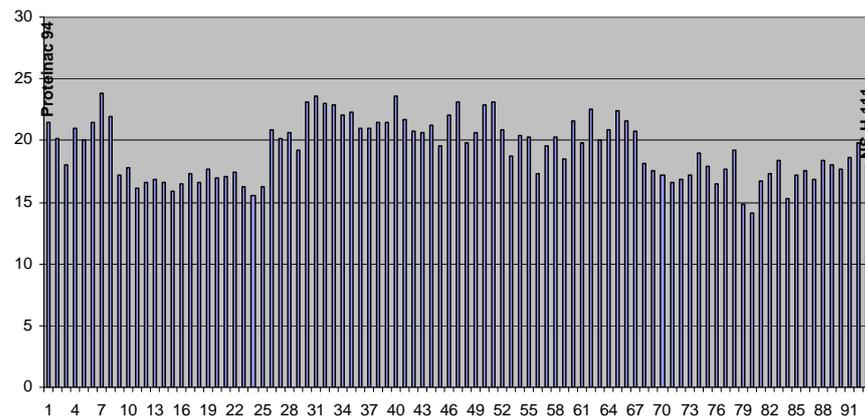


Fig. 2. Protein content in seed (%) of sunflower hybrid combinations (LSD_{0.05} = 2.293, _{0.01} = 3.025)

Protein content in seed (%) - The average protein content in the seed of the hybrid Proteinac 94 amounted 21.43%. All hybrid combinations achieved the protein content at the standard level being on the verge of significance of 0.05. Relating to this characteristic, 87 combinations were on the verge of significance of 0.01 on the standard level, while only three combinations had significantly lower protein content than hybrid Proteinac 94 (Fig. 2.)

1000 seed mass (g) - Referring to this characteristic, it was also established the existence of statistically significant differences among hybrid combinations. Significantly greater mass of 1.000 seeds of the standard NS H 111 (54.4g), on the significance level of 0.05, was shown by 54 sunflower combinations, while 23 combinations achieved significantly greater mass than Proteinac 94. 43 combinations achieved greater mass than NS H 111 on the significance verge of 0.01, while it was the same with 21 combinations than Proteinac 94 (Fig. 3).

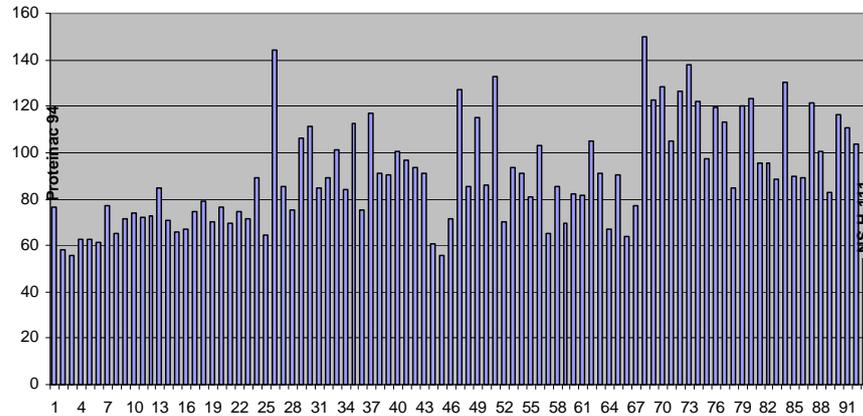


Fig. 3. 1000 seed mass (g) of sunflower hybrid combinations (LSD_{0.05} = 14.250, LSD_{0.01} = 18.799)

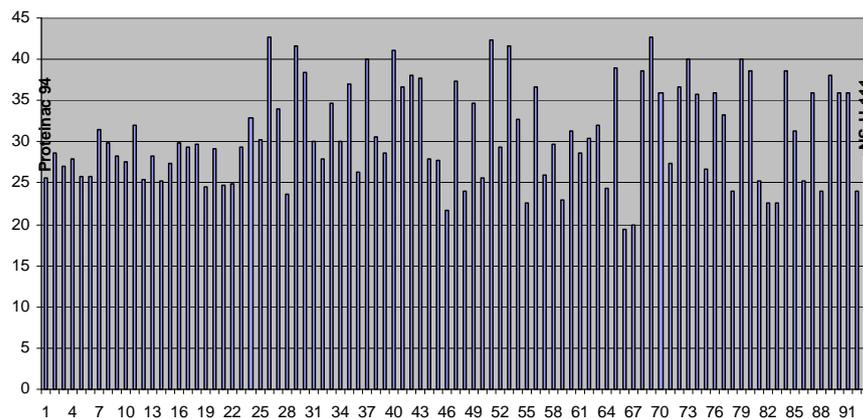


Fig. 4. Hull content in seed of sunflower hybrid combinations (LSD_{0.05} = 2.886, LSD_{0.01} = 3.807)

Hull content in seed (%) - One of the aims of the sunflower for consumption improvement programmes is to achieve the low content of hull. 5 hybrid combinations achieved significantly lower content of hull in relation to both standards (Proteinac 94 and NS-H-111 -28.3 %), while only one combination showed

significantly lower content of hull at both standards on the significance level of 0.01 (Fig. 4.)

CONCLUSION

Significant differences were established among mean values of the investigated characteristics at most hybrid combinations. The greatest oil content was achieved by two hybrid combinations, while according to the protein content in seed, all hybrid combinations were on the level of the standard one, Proteinac94 mass of 1.000 seeds over 100g was found at 29 combinations. 12 hybrid combinations showed the hull content smaller than 24%. The obtained results of these investigations show that there is, for sure, the wide area for creation of new hybrids that can be used for consumption or processing in food industry.

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OPLEMENJIVANJE SUNCOKRETA ZA KONZUM

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Izvod

Suncokret (*Helianthus annuus* L.) za konzumnu upotrebu privlači pažnju u celom svetu a takođe i u našoj zemlji. Potrošnja ovog proizvoda je u osetnom porastu jer njegovo korišćenje dobija sve veću primenu: suncokret u ljusci, oljuštena jezgra koje mogu biti pržena, nepržena, soljena ili nesoljena sa dodatkom raznih začina. Jezgro suncokreta koristi se za pripremanje preko 100 različitih prehrambenih proizvoda-specijalne vrste hlebova, kolača, sladoleda, čokolada. U skladu sa zahtevima tržišta ciljevi oplemenjivanja konzumnog suncokreta su visoka produktivnost, veći sadržaj proteina, manji sadržaj ulja, povećana masa 1000 semena, manji udeo ljuske, laka gricljivost kao i tolerantnost na dominantne bolesti u reonu gde se gaje. U Centru za poljoprivredna i tehnološka istraživanja Zaječar do sada su stvorena 4 genotipa proteinskog suncokreta (dve sorte i dva hibrida). U radu su prikazani rezultati ostvareni na povećanju sadržaja proteina, mase 1000 semena, smanjenju sadržaju ulja i ljuske 90 novih hibridnih kombinacija. Hibridne kombinacije su dobijene ukrštanjem CMS i restorer linija.

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