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# YIELD AND ELEMENTS OF PRODUCTIVITY OF NEW EXPERIMENTAL SUNFLOWER HYBRIDS (*HELIANTHUS ANNUUS* L.)

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## Abstact

*G. Georgiev, Nenova N., Georgiev G., Peevska P., Chamurliyski P., 2016 Yield and elements of productivity of new experimental sunflower hybrids (Helianthus annuus L.). FCS 10(1):115-119*

In the contemporary breeding programs of sunflower the development of highly productive hybrids is a leading trend. Many topical researches study the relation of the elements of yield with the production potential and the correlations that determine formation of yield.

***The aim*** *of this investigation was to study the yield and the elements of productivity of sunflower hybrids under the conditions of Dobrudzha region.*

The field experiment was carried out in the trial field of Dobrudzha Agricultural Institute (DAI) during 2012 – 2013. Twenty-one hybrid combinations of sunflower breeding were tested, which were obtained from the crossing of five sterile lines to nine fertility restorer lines. The hybrid combinations were grown in three replications. The size of the plot was 7.35 $m^2$. The following hybrids were used as standards: San Luka, Meldimy, Clarissa, P64LE19.The production potential and the elements related to yield formation were investigated: duration of the vegetation period, head diameter, seed set, number of seeds per plant, seed weight per plant, 1000 kernel weight, husk, kernel and percent of kernel. Two-factor, dispersion and correlation analyses were applied for statistical assessment of the results.

With regard to their vegetation period, the investigated materials were significantly earlier than the standards. Hybrid combinations 217A x 89R, 2008A x 84R, 813A x 84R possessed good combination of high number of seeds per plant, 1000 kernel weight and high seed yield. The productivity of the investigated accessions was formed mainly by these indices. The following hybrids realized highest yields averaged for the two years of the experiment 217A x 99R, 217A x 85R, 217A x 87R, 217A x 88R.

**Key words:** sunflower, elements of productivity, hybrid, yield

## Резюме

*Г. Георгиев, Ненова Н., Георгиев Г., Пеевска П., Чамурлийски П., 2016. Добив и елементи на продуктивността на нови експериментални хибриди слънчоглед (Helianthus annuus L.). FCS 10(1):114-119*

В съвременните селекционни програми на слънчогледа, създаването на високо продуктивни хибриди е едно от водещите направления. Много актуални изследвания търсят връзката на елементите на добива с продуктивния потенциал и зависимостите, които обуславят формирането на добива.

**Целта** на настоящото изследване е да се проучат добива и елементите на продуктивността на хибриди слънчоглед в условията на Добруджа.

Полският експеримент е изведен в опитно поле на Добруджански Земеделски Институт (ДЗИ) в периода 2012 - 2013 година. Изпитвани са двадесет и една хибридни комбинации от селекцията на слънчоглед, които са получени при кръстосването на пет стерилни линии със девет линии-възстановители на фертилността. Хибридните комбинации са заложени в три повторения. Големината на парцела е 7,35м$^2$. Като стандарти са използвани следните хибриди Сан Лука, Мелдими, Клариса, P64LE19. За статистическата оценка на резултатите са използвани двуфакторен дисперсионен, вариационен и корелационен анализи. По отношение на вегетационен период изследваните материали са доказано по-ранозрели от стандартите. Хибридните комбинации 217A x 89R, 2008A x 84R, 813A x 84R се характеризират с доброто съчетание на голям брой семена от едно растение, маса на семена от едно растение и висок добив семе. Продуктивността на проучените образци се формира основно от тези два показателя. Хибриди реализирали най-високи добиви средно за двете години на изследването са: 217A x 99R, 217A x 85R, 217A x 87R, 217A x 88R.

**Ключови думи:** слънчоглед, елементи на продуктивността, хибрид, добив

## INTRODUCTION

Sunflower is the main oil seed crop in Bulgaria. In contemporary breeding of sunflower (*Helianthus annuus* L.), heterosis plays a leading role in the development of sunflower hybrids. It became much more successful after the discovery of the stable source of CMS PET1 by Leclercq (1969) and of the fertility restorer genes of the produced hybrid (Kinman, 1970). The developed heterosis hybrids are with higher seed yield, higher oil content, their morphology and maturation are more uniform, they are more resistant to diseases, parasites and pests (Azarin K.V. 2011, Petrov et al. 1994). According to Kovacik and Skaloud (1972), number of seeds per plant is a trait ensuring high yield. The final goal of each breeding program is developing a highly productive hybrid which expresses its production potential under constantly changing environmental conditions (Georgiev 2014). This high productivity is primarily related to high seed yield which, on its part, is formed by a number of other related traits (Georgiev, 2013, Georgiev, 2014).

***The aim*** *of this investigation was to study the seed yield and the elements of productivity of new experimental sunflower hybrids under the conditions of Dobrudzha region.*

## MATERIAL AND METHODS

The field experiment was carried out in the trail field of Dobrudzha Agricultural Institute (DAI) during 2012 – 2013 according to a conventional technology for cultivation of sunflower (Georgiev *et al*., 1997). Twenty-one hybrid combinations were tested, which were obtained from the crossing of five lines with cytoplasmic male sterility to nine fertility restorer lines. The hybrid combinations were tested in a trial carried out in three replications according to the Latin square design. The size of the plot was 7.35 m$^2$. The standards used were the Bulgarian hybrid San Luka and some of the most productive and well established in Bulgaria foreign hybrids Meldimi, Clarissa and P64LE19. The following indices were investigated: duration of the vegetation period, represented as number of days from emergence to technical maturity, number of seeds per plant, seed weight per plant (g), 1000 kernel weight (g), seed yield (kg/da).

## RESULTS AND DISCUSSION

The results from the trial concerning productivity and the elements of yield are

presented in Table 1. Sunflower hybrid **813A x 99R** was the latest to mature, five days after the mean standard, and **217A x 84R** was the earliest. On the whole, significant variations with regard to the vegetation period were not observed among the investigated accessions. Maximum number of seeds was formed by **217A x 84R, 2003A x 100R** and **217A x 97R.** Highest weight of seeds per plant was determined for hybrids **2003A x 100R** и **2008A x 85R.** Thousand kernel weight of 73.9 g was obtained from hybrid combination **217A x 84R**, followed by **813A x 87R** with 73.5 g, and **2008A x 84R** with 72.8 g. With regard to oil percent, seven hybrids with about 50 % oil content are worth mentioning, the level of the mean standard being 46.5 %.

**Table 1.** Yield and elements of productivity

| Hybrid | Vegetation period | No of seeds per plant | Seed weight per plant, g | 1000 kernel weight, g | Oil, % | Yield, kg/da |
|---|---|---|---|---|---|---|
| **217A x 84R** | 107,0 | 1832,5 | 82,6 | 73,9 | 49,0 | 372,7 n.s. |
| **217A x 85R** | 109,5 | 1724,0 | 79,1 | 64,9 | 51,0 | 427,95** |
| **217A x 87R** | 109,5 | 1713,0 | 82,0 | 67,2 | 49,5 | 447,85*** |
| **217A x 88 R** | 118,5 | 2111,0 | 70,4 | 64,9 | 50,2 | 426,6** |
| **217A x 89R** | 118,0 | 2201,0 | 86,3 | 72,1 | 44,4 | 402,2* |
| **217A x 97R** | 119,0 | 2850,5 | 75,7 | 60,0 | 50,9 | 380,45 n.s. |
| **217A x 98R** | 117,0 | 1653,0 | 87,2 | 69,4 | 48,5 | 377,55 n.s. |
| **217A x 99R** | 115,5 | 2252,0 | 68,8 | 55,1 | 48,8 | 455,1*** |
| **1017A x 84R** | 113,0 | 1706,5 | 76,8 | 66,2 | 46,7 | 375,25 n.s. |
| **1017A x 98R** | 116,5 | 1573,5 | 82,0 | 40,6 | 48,8 | 327,95 n.s. |
| **1017A x 99R** | 114,5 | 1999,5 | 88,8 | 50,4 | 50,4 | 346,1 n.s. |
| **813A x 84R** | 118,0 | 1478,0 | 96,9 | 66,9 | 45,7 | 341,05 n.s. |
| **813A x 98R** | 119,0 | 1754,5 | 112,5 | 40,2 | 44,0 | 375,3 n.s. |
| **813A x 99R** | 120,5 | 2250,5 | 110,2 | 55,4 | 45,5 | 325,2 n.s. |
| **813A x 100R** | 119,5 | 2703,5 | 171,2 | 63,7 | 43,8 | 338,3 n.s. |
| **2003A x 84R** | 119,0 | 2144,5 | 162,8 | 60,6 | 49,3 | 361,9 n.s. |
| **2003A x 98R** | 119,5 | 1744,0 | 170,2 | 58,1 | 50,5 | 361,7 n.s. |
| **2003A x 99R** | 114,5 | 1641,5 | 115,7 | 56,8 | 51,5 | 401,7* |
| **2008A x 84R** | 117,0 | 2211,0 | 179,7 | 72,8 | 49,1 | 374,3 n.s. |
| **813A x 87R** | 117,0 | 3075,5 | 206,3 | 73,5 | 45,7 | 368,35 n.s. |
| **2003A x 100R** | 118,0 | 2897,0 | 250,1 | 59,0 | 49,3 | 424,55** |
| **2008A x 85R** | 119,5 | 2732,0 | 207,6 | 56,9 | 50,4 | 353,5 n.s. |
| **Mean standard** | 115,5 | 2230,5 | 120,3 | 60,9 | 46,5 | 340,3 |
| **SE** | 0,8 | 102,3 | 11,5 | 2,0 | 0,5 | 8,0 |
| **VC%** | 3,2 | 22,8 | 44,6 | 15,6 | 5,0 | 9,8 |

*** - $p \leq 0,01$; ** - $p \leq 0,05$; * - $p \leq 0,1$; n.s – non significant
LSD5%=57,8; LSD1%=76,1; LSD0,5%=94,1

Two hybrids exceeded the productivity of the mean standard at high level of significance, and variation was noted in five of the accessions as well, although at lower significance. A maximal result was obtained from **217A x 99R,** which formed yield of 455.1 kg/da.

According to (Thaksin, 2012), the trials carried out and the results from them showed that the number of seeds per plant varied over years depending on the meteorological conditions of the respective region (Skoric, 2012). The productive potential of hybrid **217A x 99R** was mainly due to the high number of seeds per plant (Skoric, 2012), while the yield of the next in productivity accession **217A x 87R** resulted from the good combination of number of seeds per plant with 1000 kernel weight.

(Georgiev, G. 2004) found out that the genotypes with higher percent of kernel were characterized also with higher 1000 kernel weight and higher oil content. The greater part of sunflowers exceeding the standard was derived from hybrid combinations involving line **217A** as a mother component. Fifteen of the investigated materials were at the level of the mean standard. The very high values of the variation coefficients of the indices for seed weight per plant and number of seeds per plant should be noted. Lowest was the variation of the vegetation period and oil percent, averaged for two years. Such a tendency seems normal having in mind that the experiment was carried out for two years only.

There was a significant difference between the genotypes of the investigated hybrids according to the index yield (Table 2). The years, during which the trial was carried out, had positive effect on yield, as well as the genotype x environment interaction. The different lines reacted differently to the conditions of the environment. Concerning the trait oil content, there was a very well expressed statistical difference between the hybrids. The climatic conditions also had high statistical significance and significant differences. Concerning the trait 1000 kernel weight, there was a significant difference between the genotypes, the climatic conditions being with the highest influence.

**Table 2.** Dispersion analysis (MS)

| Indices | MS genotype | MS years | MS G x Y | MS error |
|---|---|---|---|---|
| **Yield** | 4155,9 * | 58451,6 *** | 2705,7* | 1306,2 |
| **Oil %** | 36,8 *** | 539,9 *** | 5,5 * | 1,2 |
| **1000 kernel weight** | 352,8** | 21157,1*** | 94,2* | 75,4 |
| **Weight per 1 seed** | 13391,95*** | 1193,2** | 247,9* | 191,8 |
| **No of seeds per plant** | 1130046*** | 182 042,5*** | 14 092,4* | 161,6 |
| **Vegetation period** | 77,7* | 11686,09*** | 96,6* | 0,8 |
| **df** | 21 | 1 | 21 | 88 |

*** - p ≤ 0,01; ** - p ≤ 0,05; * - p ≤ 0,1; n.s. – non significant

The genotypes differed by the trait seed weigh per plant and the climatic conditions did not have effect on it. The number of seeds per plant was influenced by the environment. The climatic conditions x genotype interaction had highest effect on the duration of the vegetation period.

**Table 3.** Correlation analysis

| | Vegetation period | No of seeds per plant | Weight of seeds per plant, g | 1000 kernel weight, g | % of Oil | Yield, kg/dka |
|---|---|---|---|---|---|---|
| **Vegetation period** | 1 | | | | | |
| **No of seeds per plant** | 0,42 * | 1 | | | | |
| **Weight of seeds per plant, g** | 0,42 * | 0,61 *** | 1 | | | |
| **1000 kernel weight, g** | -0,29 n.s | 0,16 n.s. | 0,06 n.s. | 1 | | |
| **% of Oil** | -0,31 n.s. | -0,10 n.s. | -0,06 n.s. | -0,07 n.s. | 1 | |
| **Yield, kg/dka** | -0,41 * | 0,45 * | 0,56 ** | 0,24 n.s. | 0,23 n.s. | 1 |

*** - p ≤ 0,01; ** - p ≤ 0,05; * - p ≤ 0,1; n.s. - non significant

Table 3 presents the results from the correlation analysis. Highest significant positive correlation was calculated between the number of seeds per plant and the weight of seeds per plant. It was found that yield was formed by and depended on these two indices. There was a positive and significant correlation between these indices and the vegetation period. A correlation was found, although a low one, between the indices growth season and seed yield per da.

## CONCLUSIONS

Highest number of seeds per plant was formed by the hybrid combinations 217A x 84R, 2003A x 100R and 217A x 97R. Highest weight of seeds per plant was observed in hybrids 2003A x 100R and 2008A x 85R. Hybrid combination 217A x 99R formed yield of 455.1 kg/da. The most typical feature of the productivity of hybrid combination 217A x 87R was the good combination of number of seeds per plant with 1000 kernel weight.

The production potential of hybrid 217A x 99R was mainly due to the high number of seeds per plant.

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