Performance of some sunflower genotypes grown under dry weather conditions in south Bulgaria

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Abstract

Information on yield and agricultural performance of new sunflower (*Helianthus annuus* L.) hybrids grown under dry weather conditions in South Bulgaria is limited. The objectives of this field study is to acquire information on seed yield and other agricultural characteristics of five sunflower hybrids and their parental lines in South Bulgaria. This research was carried out on the Experimental farm at the Agricultural University in Plovdiv, Bulgaria in the seasons of 2008 and 2009. Statistical analysis revealed that the differences among genotypes for all studied characters were significant in both seasons as well as in the combined one.

Keywords: sunflower, hybrids, dry weather conditions, seed yield, oil content

Introduction

Sunflower (*Helianthus annuus* L.) is one of the important oil crops in the world. It ranked the 3rd after soybean and ripe with respect to oil production in the world (year book of Agriculture, FAO 2009). Sunflower is one of the major crops grown in Bulgaria. Previous studies made on sunflower's genotypes provided a useful indication about variability for several morphophysiological traits under different environments.

El-Ahmer et al. (1989); Abelardo et al., 2002 studied the differences among 18 sunflower genotypes. They found that the earliest varieties in flowering were SH 1031/81 and SH 136/88, while Maiak cv. was the latest one. The greatest seed and oil yields were produced from Florida 2000. Petrov et al. (1994) found that the yield for Albena and Super Start were 326 kg*da^{-1} and 342 kg*da^{-1}, respectively. Oil content is 46.0% from the Albena hybrid and 46.8% for hybrid Super Start, respectively. While weight of 1000 seeds were 60.0 g for Albena and 63.0 g for Super Start. Georgiev et al. (1990) evaluated some sunflower cultivars and hybrids at three experimental stations for cultivar testing in Southeast Bulgaria during the period 1986 – 1988. The following hybrids were studied: NS-27 from Yugoslavia, Florom 206 from Romania and three hybrids from Bulgaria Albena, Dobrich and Super Start and Peredovik (standard). After studying the yield-bearing, oil content and oil

obtained per decare, Florom 206, Albena and Peredovik were recommended to be grown as most suitable hybrids. Ghafoor, A. et. al., 2005 research stability of sunflower's yield from eight location in Pakistan and Angelova et al. (1999) examined the effect of climatic condition on the yield of the Albena hybrid in Northwest Bulgaria. The research was carried out during 1987- 1996 and it was recorded that the highest seed yield (368 kg*da^{-1}) of Albena was obtained in 1995, while the lowest yield (52.0 kg*da^{-1}) was recorded in 1993. Petakov et al. (1997) studied the comparison between the new Pearl hybrid and two other hybrids - Albena and Viola in the period 1990-1994. As a result it was found out that the seed yields for Pearl, Albena and Viola were respectively 291 kg*da^{-1}, 292 kg*da^{-1} and 224 kg*da^{-1}. The oil content was as follows: 47.2% for Pearl, 42.9% for Albena and 41.9% for Viola. Petakov et al. (1995) compared two new high oleic sunflower hybrids (Diamond and Pearl) with two other hybrids (Viola and Albena). It was recorded that the seed yield for Diamond is 2937 kg*ha^{-1}, Pearl 2910 kg*ha^{-1}, Viola 2237 kg*ha^{-1} and Albena- 2924 kg*ha^{-1}. The oil content in the seed was 4-5% higher and the oil yield of the new hybrids was about 9% higher than Albena. Nikolova et al. (1995) found that the plant height for lines 1607, 2607 and 1234 were 120 cm, 119 cm and 113 cm, respectively and the head diameter was 16.0 cm for line 1607, 17.4 cm for line 2607 and 190.6 cm for line 1234. The stem diameter was 2.2 cm for line 1607, 2.1 cm for line 2607 and 2.3 cm for line 1234. The present study was carried out to determine the performance of sunflower genotypes grown under the conditions in South Bulgaria.

Materials and Methods

The study was carried out on the Experimental farm at the Agricultural University in Plovdiv, Bulgaria in 2008- 2009 to determine performance of some sunflower genotypes. Five sunflower hybrids (Albena, Super Start, Zora, Santafe and San Luka) and their parental lines (2607, 1234, 1607, 147 R, RW-666, RF-673 and 19R) were evaluated in the course of two years. The experiment was held in a randomized complete block design with four replications with distance between rows of 70 cm and within rows of 30 cm.

The following characteristics were analyzed: days to 50% flowering, number of leaves/plant, plant height (cm), stem diameter (cm), head diameter (cm), 1000 seed weight, seed yield/plant, number of seeds/plant, number of flowers/plant, seed filling (%), hectoliter (g), husk content (%), kernel content (%), seed yield/ha (kg) oil content (%) and oil yield/ha (kg).

The head diameter was measured at the stage of physiological maturity. The number of flowers and the number of seeds/plant were counted in laboratory conditions. The weight of 1000 seeds, kernel and husk content and yield/plant were also determined in the laboratory. Oil content in seed was determined by the method of Stoyanova and Ivanov (1968).

The sample size for the above analysis was 20 plants per replication. Analysis of variance was done according to Snedecar and Cochran (1967). Means comparisons were carried out using the L.S.D.

Results and Discussion

The results (tables 1, 2, 3) showed the mean values of the characters for five sunflower hybrids and their parental lines in the seasons of 2008, 2009 and the mean of two seasons.

Statistical analysis revealed that the differences among genotypes for all studied characters were significant in both seasons as well as in the combined one.

With regard to hybrids:

The data showed that the Albena hybrid was the earliest one to flower (63.2 days) while the San Luka hybrid was the latest (66.3 days). There is a difference in the height of the stems: the tallest stems (167.0 cm) have the highest number of leaves (33.2), the greatest seed yield per plant (77.1 g) and the greatest seed yield per hectare (3095 kg), but gave the lowest oil content (44.67%). These results are in agreement with those reported by El Ahmer et al (1989). The Super Start hybrid had the greatest seed number per head (1652.8) the greatest oil content (49.14%) and ranked the 4th concerning seed yield per plant (70.7 g) and the seed yield per hectare (2782 kg) and the 2nd concerning the oil yield per hectare (1371.2 kg), while Super Start had the lowest value for 1000 seed weight (42.2 g). Hybrid Albena gave the highest oil yield (1374.8 kg*ha^{-1}) and ranked 2nd concerning seed yield per plant (74.0 g), while the second position with respect to seed yield per hectare (3081 kg) was occupied by the Santafe hybrid which ranked 3rd concerning seed yield per plant (72.5 g). The Zora hybrid had the lowest values for the number of leaves/plant (27.6), plant height (151.6 cm), head diameter (16.3 cm), seed yield per plant (58.4 g), number of seeds/plant (1032.7) and seed yield/ha (2427 kg) and for oil yield per hectare (1189.7 kg). On the other hand but it had the highest values for 1000 seed weight (56.3 g) and hectoliter weight (434.5 g).

With regard to parental lines

The data in tables (1, 2, 3) show that line Rf-673 was the earliest one in flowering (57.3 days). The earliest line had the shortest stem (76.1 cm) with the smallest heads (9.5 cm) and the lowest seed yield per plant (29.7 g). The latest lines in flowering were line 147-R and 19-R which showed the tallest stem: 124.7 cm and 146.1 cm respectively. It is shown that the highest number of leaves/plant is 29.0 and 31.6, respectively, the highest seed yield/plant is 42.4 g and 51.8 g respectively, while for line 147-R the highest seed yield and oil yield is 1738 kg*ha^{-1}, and for line 19 R. 805 kg*ha^{-1}. The lowest seed yield and oil yield is 830 kg*ha^{-1} for line 147-R and 404.6 kg*ha^{-1} which makes clear the difference between line 19- R and line RW-666. The highest value of oil content (49.04%) was obtained from line 147-R followed by line RW-666 (48.77%) and line RF-673 (48.39%), while the lowest values of oil content (41.37% and 41.77%) were obtained from lines 1607 and line 1234.

Table 1. Performances of some sunflower genotypes grown in the region of Plovdiv, South Bulgaria

Genotypes	Days to 50% flowering			Number of leaves/plant			Plant height (cm)			Stem diameter (cm)			Head diameter (cm)			1000 seed weight (g)		
	2008	2009	Comb.,	2008	2009	Comb.,	2008	2009	Comb.,	2008	2009	Comb.,	2008	2009	Comb.,	2008	2009	Comb.,
Hybrids																		
Albena	56.7	69.7	63.2	32.2	30.2	31.2	167.8	144.7	156.2	2.29	1.60	1.95	20.8	14.7	17.7	56.0	41.2	48.6
Super Start	60.3	71.0	65.7	31.2	29.8	30.5	170.8	146.2	158.5	2.39	1.68	2.04	20.7	14.8	17.7	51.3	33.2	42.2
Zora	60.3	71.3	65.8	28.9	26.2	27.6	164.7	138.5	151.6	2.38	1.61	2.00	18.2	14.4	16.3	58.6	54.1	56.3
Santafe	62.0	70.0	66.0	34.0	31.2	32.6	184.3	148.6	166.4	2.40	1.77	2.09	21.4	16.6	19.0	57.0	47.6	52.3
San Luka	62.3	70.3	66.3	34.7	31.7	33.2	185.5	148.5	167.0	2.37	1.68	2.03	20.9	16.5	18.9	54.2	43.8	49.0
Parental lines																		
2607	62.7	71.3	67.0	29.8	25.3	27.6	130.5	115.0	122.8	1.91	1.35	1.63	16.8	12.4	14.6	44.4	45.8	45.1
1234	62.3	69.0	65.7	26.5	20.6	23.5	126.5	99.1	112.8	2.17	1.35	1.76	20.6	11.6	16.2	77.3	40.2	58.8
1607	63.0	69.3	66.2	24.6	21.8	23.2	120.0	100.8	110.4	1.98	1.40	1.69	18.7	12.4	15.5	67.4	40.1	53.8
147 R	63.7	71.3	67.5	29.0	29.0	29.0	128.0	121.3	124.7	1.93	1.50	1.72	12.9	10.9	11.9	27.0	27.4	27.2
RW-666	63.3	70.0	66.7	29.4	23.2	26.3	101.5	97.2	99.3	1.98	1.58	1.87	11.9	9.6	10.8	22.3	23.2	22.7
RF-673	52.7	62.0	57.3	24.1	19.8	21.9	85.5	68.7	76.1	1.52	1.31	1.42	10.6	8.5	9.5	41.5	38.6	40.0
19 R	64.3	70.7	67.5	34.6	28.6	31.6	153.5	138.7	146.1	2.15	1.59	1.87	17.1	12.0	14.6	33.9	26.6	30.3
L.S.D 0.05%	0.78	0.82	0.54	1.90	3.12	1.72	11.70	11.40	7.70	0.21	0.16	0.12	1.67	1.32	2.27	6.15	7.78	4.68
0.01%	1.05	1.12	0.74	2.68	4.40	2.34	16.53	16.09	10.47	0.30	0.22	0.17	2.36	1.87	3.09	8.68	10.99	6.35

Table 2. Yield structural elements of some sunflower genotypes grown in the region of Plovdiv, South Bulgaria

Genotypes	Yield/plant (g)			Number of seeds/plant			Number of flowers/plant			Seed filling (%)			Hectoliter (g)		
	2008	2009	Comb.,	2008	2009	Comb.,	2008	2009	Comb.,	2008	2009	Comb.,	2008	2009	Comb.,
Hybrids															
Albena	94.1	54.0	74.0	1690.5	1316.7	1503.6	1703.5	1325.3	1514.4	99.2	99.3	99.3	412.3	404.9	408.6
Super Start	91.9	49.5	70.7	1801.4	1504.2	1652.8	1820.0	1515.4	1667.7	99.0	99.3	99.1	384.5	395.2	389.9
Zora	69.4	47.5	58.4	1187.2	878.2	1032.7	1204.7	889.2	1046.9	98.5	94.9	96.7	425.1	443.8	434.5
Santafe	90.9	54.0	72.5	1605.7	1148.0	1376.8	1619.5	1164.2	1391.9	99.1	98.7	98.9	417.4	389.9	403.6
San Luka	98.2	56.0	77.1	1813.0	1297.5	1555.3	1841.7	1309.2	1575.5	98.4	98.8	98.6	382.6	388.2	385.4
Parental lines															
2607	48.9	28.0	38.5	1110.9	681.5	896.2	1196.9	721.2	959.1	92.6	94.6	93.6	382.0	390.9	386.5
1234	51.4	29.0	40.2	670.7	723.4	697.1	935.9	806.9	871.4	70.8	89.7	80.3	375.6	316.2	345.9
1607	46.9	25.0	36.0	699.9	625.7	662.8	1084.4	733.5	909.0	64.9	85.2	75.0	335.3	314.2	324.7
147 R	55.0	29.8	42.4	2073.9	1092.5	1583.2	2265.7	1275.3	1770.5	91.5	96.9	94.2	412.5	406.7	409.6
RW-666	36.8	23.0	29.9	1669.6	998.0	1333.8	2008.1	1175.0	1591.6	84.2	94.8	89.5	440.8	430.2	435.5
RF-673	34.7	24.7	29.7	847.5	490.6	669.1	1052.7	590.0	821.4	83.0	92.4	87.7	443.6	437.7	440.7
19 R	65.6	38.0	51.8	1952.5	1401.3	1676.9	1998.6	1411.2	1704.9	97.7	99.3	98.5	373.9	378.3	376.1
L.S.D 0.05%	7.19	8.42	5.22	164.27	259.39	155.40	165.42	297.04	160.20	1.22	3.66	1.82	24.37	25.92	16.76
0.01%	10.2	11.9	7.09	231.82	366.04	211.2	233.44	419.15	217.70	1.72	5.16	2.47	34.39	36.57	22.78

Table 3. Correlation of husk and kernel (%), seed yield (kg*ha^{-1}), oil content (%), oil yield (kg*ha^{-1}) of some sunflower genotypes grown in the region of Plovdiv, South Bulgaria

Genotypes	Husk (%)			Kernel (%)			Seed yield/ha (kg)			Oil percentage (%)			Oil yield/ha (kg)		
	2008	2009	Comb.,	2008	2009	Comb.	2008	2009	Comb.,	2008	2009	Comb.	2008	2009	Comb.,
Hybrids															
Albena	27.7	30.7	29.2	72.3	69.4	70.8	3285	2563	2924	46.63	47.80	47.22	1531.9	1224.9	1378.4
Super Start	27.5	27.9	27.7	72.5	72.2	72.4	3207	2357	2782	50.10	48.18	49.14	1606.7	1135.7	1371.2
Zora	26.7	30.1	28.4	73.3	69.9	71.6	2644	2210	2427	50.20	47.60	48.90	1327.3	1052.0	1189.7
Santafe	31.5	33.8	32.6	68.6	66.2	67.4	3313	2849	3081	45.20	45.78	45.49	1497.3	1212.7	1355.0
San Luka	29.8	31.9	30.8	70.2	68.1	69.2	3331	2859	3095	44.93	44.40	44.67	1496.6	1180.6	1338.6
Parental lines															
2607															
1234	23.3	27.6	25.4	76.7	72.4	74.6	1980	1268	1624	45.75	45.03	45.39	905.9	570.4	738.2
1607	23.8	27.0	25.4	76.2	73.1	74.6	1970	1406	1688	41.85	41.68	41.77	824.4	586.2	705.3
147 R	24.6	29.8	27.2	75.4	70.2	72.8	1912	1139	1526	41.83	40.90	41.37	791.1	465.8	628.5
RW-666	28.4	35.7	32.0	71.7	64.3	68.0	1762	961	1362	46.15	51.93	49.04	813.6	498.9	656.3
RF-673	26.7	39.9	33.3	73.3	60.1	66.7	1035	624	830	48.73	48.80	48.77	504.4	304.7	404.6
19 R	27.1	33.8	30.4	72.9	66.3	69.6	1226	484	855	50.25	46.53	48.39	615.9	225.1	420.5
	32.1	36.8	34.5	67.9	63.2	65.6	1646	1829	1738	45.35	47.20	46.28	746.5	863.4	805.0
L.S.D 0.05%	4.10	3.92	2.67	4.10	3.92	2.67	43.30	41.26	26.54	2.00	1.90	1.36	17.06	19.14	12.37
0.01%	5.78	5.53	3.63	5.78	5.53	3.63	58.84	56.09	35.84	2.69	2.56	1.81	23.19	26.02	16.70

Conclusion

The Albena and Super Start hybrids gave the highest oil yield and the Santafe and San Luka hybrids gave the highest seed yield, but the Zora hybrid showed the lowest values for seed and oil yield per hectare.

Among the parental lines - line 19R gave the highest seed and oil yield per hectare.

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