INFLUENCE OF ROW SPACING ON YIELD CHARACTERS OF SUNFLOWER CULTIVARS[1]

Enver Esendal[2] Nejdet Kandemir[3]

ABSTRACT

Sunflower (Helianthus annuus L.) is the main oilseed crop growing in Turkey. This study was undertaken to determine the performance of oilseed sunflower cultivars in terms of yield and seed quality on different row spacing (50, 65, 80 or 95 cm) in Samsun-Turkey, in 1989.

Ten cultivars of sunflower, including nine of hybrids and one open-pollinated composite (Vniimk 8931) were inspected. Vniimk 8931, traditionally is still the main cultivar of this crop in Turkey (Some 50 % of total sunflower planting). The maximum seed yield has been produced with the highest population as of 67 thousand plants/ha and yields were significantly depressed by population. As plant populations increased from 35 to 67 thousand plants/ha yield increased linearly from 3987 to 5958 kg/ha and also oil and protein contents of seeds increased from 35.57 to 41.88 % and from 15.26 to 17.35 %, respectively. Significant alterations had been observed among the cultivars in terms of yield, yield components and seed quality. Hybrid cultivars P.6480 and 6431 yielding the highest yield as of 6071 and 5176 kg/ha, respectively, would be taken into consideration in advising for areas where conventional production techniques

---

1 The research had been supported financially by The Foundation of Research Program of Ondokuz Mayıs University, Samsun-Turkey.

2 Prof. of Agronomy., Plant Sci. Dep., Faculty of Agriculture, Univ. of Ondokuz Mayıs, Kurupelit 55139, Samsun-Turkey.

3 Plant Sci. Dep., Faculty of Agriculture, Cumhuriyet Univ., 60110 Tokat-Turkey.

applied, but IS.8101, P.6440, H.1 and P.6480, which were able to combine the higher yield and quality components needed for mechanization and uniformity, may be recommended for the areas were advenced cultivation systems applied by taking into considering their economic values.

INTRODUCTION

Sunflower (Helianthus annuus L.) is one of the major oil crops in the world. Because of its high quality of oil, high yield and adaptation ability. It is also leading oil crop in Turkey, and for compensation of Turkey's national oil deficiency sunflower seems to be most hopeful crop even in future. A number of hybrid varieties of sunflower have been introduced to Turkey since 1984, and a traditional open pollinated variety, Vniimk 8931, is still the main cultivar of this crop in the country (some 50 % of total sunflower planting). Most of hybrids have been losing face right after the first or second year following introduction even not enough to be acquainted with. High rate of planting are use to insure adequate plant populations and to reduce losses from uneven plant distribution (17). On the other hand sunflower plants have a quite range capability for maximum yield with a certain row spacing. But after a certain point, even if growing conditions are optimum, non-proper plant densities may cause the losses from maximum yields. The main objectives of this research were: 1. Testing the new hybrids in comparison with common composite variety, V.8931, on different plant densities as influencing row spacings, 2. Inspecting the alteration of quality components as affecting the row spacing.

Incekara (9) reported that sunflowers varieties fall into three groups for maturation periods; as early (90-120), medium (120-130), and late groups (more than 130 days). Because of the rapid drying of heads at the high populations, this period may be shortened (17). Gubbels and Dedio (8) observed that plants were shorter at high rate of planting. At low populations, N content of the seeds were found high (13). Effect of plant population on oil content of seeds were conflicted by individual investigations

in different areas. Mathers and Steward (13).and Robinson et al. (17) found that the high populations increased the oil content, while Rao and Reddy (15) found that it is decreased. In Minnesota, as rate of planting increased, Robinson et al. (17) found that the seed yield of sunflower were ranged between 987-3706 kg/ha. This has been found as of 2530-3790 in Russia (5), and 3580-3770 in Romania (20), and 5180 kg/ha in Czechoslovakia (11). Robinson (16) reported that the sunflower seed yield has been majorly determined by three factors i.e, plant density, number of seeds/ head, and 1000-seed weight. Occassionally, at non-optimum condi-tions, because of a compensation among these three factors, plant densities shown no effect on yield from two or three-fold increases in populations (16). In the case of optimum conditions, increasing plant density increases seed yield (12, 16, 17).

MATHERIAL AND METHODS

Nine hybrids of ten cultivars, including AS.506 from AsGraw; P.6431, 6440 and 6480 from Pioneer; IS.7479, 7775 and 8101 from Isomax; Triumph from France and H.1 and one composite, Vniimk 8931 (open pollinated variety), were planted by hand jab-type planters (3-4 seeds/jab) in rows aparted by different spacing (50, 65, 80 or 95 cm) and plants distanced by 30 cm on the rows after thinned. Consequently, the population exemined were 66670, 51280, 41670 and 35090 plants/ha.

Soils of trials were fine-clay in soil texture with slightly alcaline in soil reaction (pH=7.74). Soils were rich in K and organic matter, but poor in P and lime. Sites has temperate climate with a 14.8 °C of annual mean temperature, 706.9 mm of annual precipitation, and 61.3 % of relative humidity, according to the long- term data. These figures for the experimental year were 14.4 °C, 609.0 mm, and 72.3 %, respectively.

Field experiments were conducted on moisture-retentive soils at Kurupelit Campus of Ondokuz Mayıs University under the rainfed conditions on Black Sea coastal area in Northern Turkey. The experimental designe was a randomized complate block in split-plot

layout with three replications. Cultivars were main plots and row spacings were subplots. Subplots size was 4 rowsx4.5 m. Ammonium nitrate (N, 26%) and superphousphate (P_2O_5, 45%) fertilizers were applied preplant at the rate of 20 kg of N and 15 kg of P_2O_5 per ha.

Trials were planted on 12 of May, 1989, and harvested on 27 of September, 1989 (135 days-period from planting to harvesting). Only fifteen heads of plants on to Center rows from each subplot were harvested for yield and other variables. These heads were saved from bird damage by cowering perforated polyethylen bags at the end of the full pollination period.

All variables have been evaluated on yield of these heads. Seed oil and protein percentages were determined by Soxhelet extraction and Kjeltec analysis. All data were subjected to standard analysis of variance and Duncan's multiple range test was used in comparison the means. Cultivars were also subjected to "Economic Value" analyses by a partly modified method described by Bacos (3) and Dobrescu et al (6).

RESULTS

Maturation, Plant Height and Plant Population

Increasing row spacing delayed the maturation from 126.3 to 133.1 days (Table 1). This difference was found significant. At high populations, head moisture content is reduced earlier and this resulted in early maturation (17). The varieties did not differ significantly for maturation and their growing period varied between 126.5 (H.1) - 134.1 days (Triumph).

Significant (1%) differences were found among varieties for plant hight. P.6480 was the tallest (136.6 cm) and P.6440 was the shortest varieties(118.0 cm).In general, at narrow spacings plant hights were shorter with the exception of 50 cm. Plants were the shortest at 65 cm row spacing and the highest at 95 cm plots.

Seed Quality and Plant Population

Row spacing affected the seed quality significantly due to kernel ratio, and oil and protein contents. These variables had had higher values at large row spacings (Table 1).

In a broad sense, composite V.8931 had been found to have a good seed quality. Its kernel ratio was the highest (% 75.80), and oil and protein contents were seconds, in turns (Table 1). Hybrid IS.8101 had had the highest oil and protein contents as of 42.66 and 17.99 %, respectively. Differences among varieties were greatly significant.

Yields, Seed Yield Components and plant Population

Average seed yield decreased from 5958 to 3987 kg/ha as row spacing enlarged from 50 to 95 cm. Each value of the row spacing had been found significantly different than that of the others. In contrary to seed yield, yield components i.e, head diameter, number of seeds/head and 1000-seed weight, were increased with increasing row spacing.

In the similar way, the oil yield was increased at high populations even if oil content of seed was low, and this shows that seed yield had become more important effect on oil yield than that of its effect on oil content.

Hybrid varieties had been found more yielded for seed and oil yields than composite V.8931.

Ecomomic Value Analysis of Varieties

Economic values of varieties based on standart variety, V.8931 were summarized in Table 2. Five hybid varieties had economic values over two-fold of V.8931.

DISCUSSION AND CONCLUSSION

According to Incekara (9) sunflower varieties felt into medium and late maturing group. It is concludet that maturing period at high population is longer than that of low population (16, 17). In many works in different areas, it is reported that plants at high population were taller(1, 17). Although, as plant

Table 1. Characters of sunflower varieties and the effects of row spacing.

	Maturation period (d)	Plant Height (cm)	Head Diameter (cm)	Lodging Ratio (%)	Number of seed per Head	1000-seed Weight (gr)	Kernel Ratio (%)	Oil Content (%)	Protein Content (%)	Seed Yield (Kg/ha)	Stem Yield (kg/ha)	Oil Yield kg/ha
Varieties												
P.6480	129.6	138.0 a	21.32 a	12.00	2038 a	60.81 b	71.29 d	40.78 a	15.53 c	6071 a	5014 a	2460 a
P.6431	127.1	118.0 bc	19.02 b	10.45	1804 ab	58.68 bc	73.02 bcd	39.51 a	15.87 c	5176 ab	3636 bc	2038 ab
IS 8101	123.2	119.6 bc	19.12 b	9.40	1522 bc	67.75 a	74.62 ab	42.66 a	17.99 a	5070 b	3991 bc	2161 ab
P.6440	128.7	109.7 c	19.12 b	5.60	1689 ab	61.61 b	74.40 ab	40.37 a	16.48 bc	4958 b	3841 ab	1989 ab
IS 7775	131.4	137.1 a	19.15 b	11.45	1904 ab	52.98 cd	71.29 d	41.53 a	16.15 bc	4899 b	4425 ab	2018 ab
IS 7479	129.3	130.5 ab	19.29 b	12.29	1910 ab	52.86 cd	71.45 cd	38.62 ab	15.70 c	4827 b	4052 bc	1847 bc
H.1	126.5	130.3 ab	19.30 b	9.68	1912 ab	51.01 d	71.79 cd	41.60 a	16.23 bc	4660 b	4579 ab	1938 ab
Triumph	134.1	139.5 ab	19.16 b	10.99	1483 bc	57.20 bc	73.71 abc	35.31 b	15.86 c	4600 b	4236 ab	1625 bc
AS 506	131.3	136.6 a	20.23 ab	9.21	1864 ab	56.40 bcd	68.72 e	39.94 a	16.26 bc	4221 bc	4234 bc	1681 bc
V 8931	131.0	134.6 a	16.48 c	11.40	1199 c	61.70 b	75.80 a	40.87 a	17.18 ab	3353 c	3276 c	1365 c
LSD		12.87**	1.82**		392.9**	5.568**	2.699**	3.72**	1.09**	958.5**	779.8**	517.2**
Row spacings												
50	126.3 c	130.4 a	18.12 d	8.96	1634 b	54.18 d	72.09 b	37.57 c	15.26 c	5958 a	5250 a	224.6 a
65	129.3 b	125.3 b	18.91 c	11.54	1677 b	57.33 c	72.37 ab	39.89 b	16.09 b	4808 b	4225 b	191.9 b
80	130.5 ab	127.5 ab	19.58 b	10.86	1794 a	59.29 d	72.88 a	41.13 ab	16.59 b	4385 c	3812 c	180.9 bc
95	133.1 a	130.3 a	20.26 a	10.47	1835 a	61.61 a	73.09 a	41.88 a	17.35 a	3987 d	3201 d	167.4 c
LSD	2.7** L	4.53** Q	0.14** L		113.1** L	1.91** L	0.19** L	1.26** L	0.58** L	306.3** L-Q	356.6** L-Q	201.7** L-Q

** Not significant at P<0.01.

Table 2. Economical value analysis of variates.

Variety	Seed Yield (kg/da)	Oil Contents (%)	Plant height (cm)	Lodging (5)	Maturat. Period (d)	General value cofficient	Relative economic value
IS.8101	507.0	0.63	1.18	0.95	0.69	0.586	239.4
P.6440	495.8	0.52	1.26	0.96	0.69	0.543	216.9
H.1	466.0	0.58	1.28	0.95	0.71	0.576	216.3
P.6480	607.1	0.54	1.11	0.94	0.69	0.431	210.8
P.6431	517.6	0.48	1.24	0.94	0.72	0.487	203.1
IS.7775	489.9	0.58	1.08	0.94	0.67	0.442	174.5
As.506	422.1	0.50	1.25	0.95	0.66	0.439	149.3
IS.7479	482.7	0.43	1.13	0.93	0.68	0.354	137.7
V.8931	335.3	0.54	0.96	0.94	0.67	0.370	100.0
Triump	460.0	0.27	1.02	0.94	0.64	0.190	70.4

population increased, head diameter decreased (1, 13, 16, 17). There has been exist a great varition among the varieties in terms of the had diameter (9, 10, 17), plant height (8, 14), and 1000-seed weight (4, 7, 16) because of the growing conditions and genetics variation of cultivars.

As the distance between plants becoming close protein content of seeds increases because of high level of nitrogen in seeds (13) while seeds per plant decreases (12, 17, 21). Although, research at single locations in other areas has produced conflicting data on the plant population-oil content. Some has stated that increasing population increased the seed oil (1, 17) but some has been found in adverse (15,18), and also some shown no effect on oil content coming from plant population (2, 19). It is very common sense high population has increased the seed and oil yields (1, 12, 16, 17). Despita of the increased in yield component, decresing in seed yield confirmed that the plant density was the main factor affecting seed yield (17). Under the optimum growing conditions, decreases in seed yield components were not as high as in poor conditions in case of the yields were stable at different populations (16).

It was attributed obtaining that high yield in this research to no bird damage allowed on protected heads and calculating yields based on the heads of plans that were perfectly spaced with an ideal number of plant/ha.

According to results of the study, it is concluded that because of their high yields P.6480, 6431 (6071 and 5176 kg/ha, respectively) may be recommended to the areas where conventional production techniques applied, but IS.8101, P.6440, H.1 and P.6480 which were able to combine the high yield and quality components may be recommend for the areas were advanced cultivation systems applied .

REFERENCES

1. Arslan, O. 1973. Ayçiçeğinde bitki sıklığı ve çeşitli gübrelerin verim ve bazı bitki özellikleri üzerine etkisi (Doctorate Thesis, Unpublished).
2. Ashoub, M. A. 1986. Response of sunflower to some cultural treatments. Field Crop Abst.39:1016.
3. Bakos, Z.S. 1974. Assesment of the agromomic and industrial value of sunflower varieties expressed by an over-all economic index. Proceed. 6 th. Int. Sunflower Conf. Bucharest-Romania. 481-484.
4. Beard, B.H., S. Geng. 1982. Interrelationships of morphological and economic character of sunflower. Crop S. 22:817-822.
5. Burlov, V.V. 1974. Utilization of male sterility in sunflower breeding for heterosis. Proceed. 6 th. Int. Sunflower Conf. Bucharest-Romania. 353-360.
6. Dobrescu, C., E. Nicsulescu, H. Beghes. 1974. Sunflower mechanical harvest in Romania. Proceed. 6 th. Int. Sunflower Conf. Bucharest-Romania. 611-618.
7. Ehdaie, B. 1974. Evaluation and comparison of 14 varieties of sunflower (Helianthus annuus L.) under semiarid conditions. Prooceed. 6 th. Int. Sunflower Conf. Bucharest-Romania. 485-492.
8. Gubbels, D. H., W. Dedio. 1989. Response of sunflower hybrids to row spacing. Field Crop Abst. 42:447.
9. İncekara, F. 1972. Endüstri Bitkileri ve ıslahı. Cilt:2. Ege Üni. matbaası. İzmir.
10. Knowles, P.F. 1978. Morphology and Anatomy. Sunflower (Ed.:J. F. arter), ASA, Crop S. Soc. of Amer. Medison, Winconsin. 55-86.
11. Kovacık, A., V. Skaloud. 1988. Determination of the optimum density of a sunflower crop. Field Crops Abst.41:996.
12. Massey, J.H.1971. Effect of Nitrogen rates and plant spacing on sunflower seed yields and other characteristics.

Agron. J. 63:137-138.

13. Mathers, A.C., B.A. Steward. 1982. Sunflower nutrient uptake, growth and yield as affected by nitrogen or manure and plant population. Agron. J. 74:911-915.
14. Pathak, R.S. 1974. Yield component in sunflower. Proceed. 6 th. Int. Sunflower Conf. Bucharest-Romania. 271-282.
15. Rao, Y.T., S.C. Reddy. 1987. Effect of phosphourus levels at different plant desities on the yield attributes of sunflower. Field Crops Abst. 40:814.
16. Robinson, R.G. 1978. Production and culture. Sunflower science and technology. ed. J.F. Carter. ASA. Crop Sci. Soc. of America. Madison, Wisconsin.
17. Robinson, R.G., J.H. Ford, W.E. Lueschen, D.L. Rabas, L. J. Smith, D.D. Warnes, J.V. Wiersma. 1980. Response of sunflower to plant population. Agron. J. 72:869-871.
18. Skoric, D. 1974. Correlation among the most important characters of sunflower in generation.Proceed. 6 th. Int. Sunflower Conf. Bucharest-Romania. 283-292.
19. Steer, B.T., P.D. Coaldrake, C.J. Pearson, C.P. Canty. 1986 Effect of nitrogen supply and population density on sunflower. Field Crop Abst. 39:729.
20. Tomoroga, P., H. Simota. 1974. Contributions to sunflower crop technology under irrigation in Dobrudja. Proceed. 6 th. Int. Sunflower Conf. Bucharest-Romania. 569-576.
21. Vega, M.A.,O.R.Quaino.1987. Effect of plant spacing and distance between rows of **Helianthus annuus** L. II. Late maturing cultivar. Field C. Abst. 40:844.