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THE INFLUENCE OF IRRIGATION AND NUTRITIVE CONDITIONS ON SUNFLOWER YIELD

Comprehensive studies of soil moisture content and sunflower plant nutritive conditions are most important for sunflower irrigation, as a proper correlation of these factors is instrumental in assuring bumper yields. Trials conducted by the All-Union Research Institute of Oil Crops, the All-Union Research Institute of Hydrotechnology and Land Reclamation, and the Gorsky Agricultural Institute revealed the lower threshold of preirrigated moisture of the upper 1 m layer of soil, which comprised 75-80% of the maximum field water capacity. The most effective rates of nitrogenous-phosphoric fertilizers were identified (S.S. Agalarov, 1972; Z.M. Urutskoyev, 1973; M.Zh. Eneyev, 1971) in the black soil conditions of the North Caucasus (N 40-60, P 60-90 kg/ha a.i.). Plant feeding areas were also tested.

A repeated field trial on watering regime, rates of fertilization and feeding areas of Peredovik variety was carried out for the first time in 1973-1975 on chestnut soils of the Stavropol Territory. A moderate watering regime with the lower treshold of preirrigated moisture of the upper 1 m layer of soil being 70% MFWC and the intensive one being 80%, was investigated. Normal ($N_{60}P_{90}$) and heavy ($N_{120}P_{180}$) rates of fertilizers and three feeding areas of 0.25; 0.17, and 0.13 m^2 per plant were also tested.

Experimental plots had chestnut medium loamy soils with a depth of humus layer being 40 cm. Humus content in a cultivated layer averaged 3.5%, total nitrogen 0.5%, phosphorus 0.18%, potassium 2.42%, and the MFWC of the 1 m layer was 26.6%.

After harvesting of maize, the preceding crop, fertilizers were applied according to the trial's scheme and the soil was ploughed at the depth of 25-27 cm. Sunflower was sown using SPCh-6 m drill. Care of plantings included a pre-shoot harrowing, two inter-row cultivations, plant thinning for obtaining a needed plant density and 2-3 vegetative sprinklings with a rate of 600-750 m^3/ha. Variants with a heavy watering regime were irrigated some days earlier at a higher rate. Sprinkling units DDA-100 m and DDN-70 were used for irrigation. Under arid conditions of 1975 the irrigation period was especially intensive as compared to previous years.

Sunflower was harvested with the SK-5 combine harvester with the attachment 34-103. Plot discount area averaged 300-700 m^2.

Investigations showed that improved water supply and mineral nutrition contributed to a more rational water use by plants, improvement of soil nutritive regime, active plant growth and formation of higher seed yield.

Water consumption coefficient was significantly lower in variants with better water and mineral nutrition conditions. In heavy irrigated plots (80% of MFWC) with plant density of 60,000 per hectare and a high rate of fertilizers (N_{120} P_{180}) the coefficient reached 1846 m^3 per ton of seeds, in irrigated plots (80% of MFWC) without fertilizers - 2285 m^3 per ton of seeds, and in non-irrigated and non-fertilized plots - 2600 m^3 per ton of seeds.

Plant height in irrigated conditions was 15-21 cm higher than in rainfed conditions. Improved watering and nutritive regiones promoted formation of larger leaf square. Depending on the level of mineral nutrition and plant density the leaves surface square increased by 9460 - 22,220 m^2/ha under irrigation; the highest increase of leaf assimilating surface was noted at all fertilization and irrigation rates with an average plant density of 60,000 per hectare.

The exception was a non-fertilized irrigated variant where a high leaf square was observed at the plant density of 80,000 per hectare. Fertilization and irrigation promoted improved assimilation of mineral nutrition from the soil.

Improved watering and nutritive regimes had a considerable effect on seed yield. Yield gains in nonfertilized plots under irrigation ranged from 5.2 to 9.6 c/ha, and with application of nitrogenous-phosphoric fertilizers - from 7.3 to 12.8 c/ha (Table 1).

Effectiveness of fertilizers' application under irrigation was twice or thrice higher than under rainfed conditions. Yield gain from fertilization under irrigation reached 4.1-4.5 c/ha.

The optimum plant density under all rates of fertilizers was 60,000 per hectare under irrigation and 40,000 per hectare under rainfed conditions. It should be noted that irrigation and application of fertilizers provided high yield gains only in the optimum feeding areas.

The highest effect was obtained under combined action of irrigation and fertilization (Table 1). The highest seed yield (30.8 c/ha) and maximum yield gain (14.1 c/ha) were formed under a high watering regime and high rates of nitrogenous-phosphoric fertilizers with plant density of 60,000 per hectare.

A moderate watering regime combined with a high rate of fertilization provided virtually the same yield gains as a high watering regime combined with a common rate of fertilization, this points to some interconnection between these factors. Irrigation did not decrease oil content of seeds.

Economic analysis showed that variants with an average rate of fertilizers ($N_{60}P_{90}$) at a high (80% of MFWC) and moderate (70% of MFWC) watering regimes and the optimum plant density (60,000 per hectare) proved to be more effective.

The results of the investigation showed that a high sunflower seed yield was only formed at the optimum combination of soil moisture conditions and mineral nutrition.

Table 1

Effect of Irrigation and Mineral Fertilizers on Sunflower Yield Under Different Feeding Areas

No.	Irrigation regime, rate of fertilization	Plant density, thous/ha	Seed yield, c/ha			Average for three years	Yield gain, c/ha		
			1973	1974	1975		from irrigation	from fertilizers	from fertilizers and irrigation
1	2	3	4	5	6	7	8	9	10
	Without irrigation								
1.	Without fertilizers	40	15.9	22.8	14.5	17.7	-	-	-
2.	Same	60	16.8	20.2	13.2	16.7	-	-	-
3.	Same	80	14.0	18.8	12.4	15.1	-	-	-
4.	$N_{60}P_{90}$	40	16.4	24.8	15.5	18.9	-	+1.2	-
5.	Same	60	17.6	21.8	14.9	18.1	-	+1.4	-
6.	Same	80	14.4	19.7	12.8	15.6	-	+0.5	-
7.	$N_{120}P_{180}$	40	16.6	24.6	15.9	19.0	-	+1.3	-

Table (cont.)

1	2	3	4	5	6	7	8	9	10
8.	N_{120} P_{180}	60	18.0	21.4	14.5	18.0	-	+1.3	-
9.	Same	80	14.5	19.7	12.6	15.6	-	+0.5	-
	Irrigation at 70% of MFWC								
10.	Without fertilizers	40	22.7	26.5	19.5	22.9	+5.2	-	-
11.	Same	60	23.8	29.0	20.7	24.5	+7.8	-	-
12.	Same	80	19.5	27.9	19.9	22.4	+7.3	-	-
13.	N_{60} P_{90}	40	24.6	31.1	23.0	26.2	+7.3	+3.3	8.5
14.	Same	60	26.4	33.6	25.7	28.6	+10.5	+4.1	11.9
15.	Same	80	21.6	30.5	24.0	25.4	+9.8	+3.0	10.3
16.	N_{120} P_{180}	40	25.1	32.4	24.6	27.4	+8.4	+4.5	9.7
17.	Same	60	27.1	34.2	25.8	29.0	+11.0	+4.5	12.3
18.	N_{120} P_{180}	80	22.3	32.3	25.4	26.7	+11.1	+4.3	11.6

Table (cont.)

1	2	3	4	5	6	7	8	9	10
	Irrigation at 80% of MFWC								
19.	Without fertilizers	40	23.4	28.8	21.4	24.5	+6.8	-	-
20.	Same	60	24.7	26.6	23.5	26.3	+9.6	-	-
21.	Same	80	20.0	29.8	23.7	24.5	+9.4	-	-
22.	$N_{60}P_{90}$	40	24.6	32.4	25.3	27.4	+8.5	+2.9	9.7
23.	Same	60	26.8	34.1	27.4	29.4	+11.3	+3.1	12.7
24.	Same	80	22.0	32.1	25.8	26.6	+11.0	+2.1	11.5
25.	$N_{120}P_{180}$	40	25.3	32.0	26.7	28.0	+9.0	+3.5	10.3
26.	Same	60	27.4	35.2	29.8	30.8	+12.8	+4.5	14.1
27.	Same	80	22.5	32.4	27.6	27.5	+11.9	+3.0	12.4
	m, %		3.5	4.6	1.8				
	LSD 0.95		2.2	3.6	1.1				