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SUNFLOWER UNDER IRRIGATION

Throughout the growing period sunflower plants consume a lot of water. Data of six-year trials (1970-1975) showed that water consumption averaged 343 ml annually with seed yield of 20.2 c/ha. Half of this amount is consumed during a period from head formation to flowering. This period usually falls on the end of June and the beginning of July, a hot and arid period of summer which is critical for sunflower crop. In Donbas soil moisture reserves are concentrated in spring at the depth of 50-70 cm and are consumed by sunflower plants before the critical period of growth. That is why summer precipitation is of greatest importance. The dependence of sunflower seed yield upon amount of precipitation during June-July in the Voroshilovgrad region is expressed by the correlation coefficient +0.7, which shows a close connection between seed yield and precipitation at this period. Effective water supply of sunflower plants during the period may be achieved only by vegetative sprinklings.

The aim of 1962-1975 trials was to study the main agrotechnical problems of sunflower irrigation, including the influence of irrigation on seed yield and seed quality, optimum plant density, effectiveness of fertilizers and herbicides under irrigation, and afterreap sowing of sunflower. Irrigation was carried out in the form of 2-3 vegetative sprinklings at a rate of 600-700 m^3/ha, which made it possible to maintain the soil moisture content at about 80% of the maximum field water capacity (MFWC) within a period of flowering and seed formation.

Irrigation insured high and stable seed gains. In arid years they reached 14.4-23.2 c/ha, and in years with sufficient moistening

8 - 13.1 c/ha. In the course of 11 years seed yield of irrigated sunflower averaged 34.1 c/ha, and under rainfed conditions it was 21.8 c/ha. Irrigation promoted better growth of sunflower: plant height was increased by 25 cm, head diameter - by 4.6 cm. Weight of 1,000 seeds of irrigated sunflower reached 83.4 g as against 55.4 g under rainfed conditions; and oil content increased by 0.5%.

Effectiveness of sunflower irrigation was studied during 1964 - 1972 under commercial conditions of Shevchenko and Rodina collective farms of Maryinsky district, Ukraina of Volnovakhsky district, Novy Donbas of Konstantinovsky district in Donets region, and at the Komsomolets state farm of Voroshilovgrad region where seed yield under irrigation ranged from 19.7 to 32 c/ha and seed gain reached 7.5-15.2 c/ha. At Ukraina collective farm of Volnovakhsky district seed yield under rainfed conditions averaged 19.9 c/ha and under irrigation - 28.2 c/ha. Inputs per hectare were 68.0 and 85.1 roubles, respectively, seeds purhcase price 318.4 and 451.2 roubles, net income - 250.4 and 366.1 roubles, profitability - 368 and 430%. Thus, irrigation increased not only yield and income per one ha but also sunflower profitability, despite increased inputs in irrigation.

Differences in plant density influenced sunflower growth and development under irrigation. Increase of plant density up to 30,000-40,000 per hectare led to a head and seed size decrease. With plant density of 10,000-20,000 per hectare sunflower plants had stunted and thick stalks, strong leaves and large heads with swelled, globe-shaped seeds. Seeds were losely located in a head. With a heavy seeding (60,000 per hectare) plants had long and thin stalks with traces of etiolation. The central part of heads was well developed and no empty seeds occurred in all the variants.

Plant density increase up to 40,000 per hectare led to seed yield increase in all trials. Under favourable conditions higher density (60,000 per hectare) resulted in yield increase, and under arid conditions - in yield reduction. In the course of five years the highest seed yield of 35.1 c/ha was obtained at a density of 40,000 per hectare, and 34.7 c/ha at a density of 60,000 per hectare. Oil content of seeds was rather reduced at thin seedings, and in other variants oil content was the same. Increase of plant density led to reduction of 1,000 seed weight, but as a whole it remained rather high even at a plant density of 60,000 per hectare (79.0 g).

Under favourable watering regime seeds have improved yielding euality. The cutput of large seed fraction doubles or trebles over the rainfed conditions, reaching 18-20 c/ha. This amount of seeds is enough for sowing about 200 ha, i.e. 2-3 ha of seed sowing under irrigation provide enough seeds for commercial sowing at 400-500 ha. In our trials we tested seeds of irrigated sunflower for growing under rainfed conditions. Average data of eight-year trials showed that seeds grown in irrigated plots yielded 24.4 c/ha, and in rainfed plots - 23.3 c/ha. Ander favourable conditions yield gain was 2.5 c/ha, and there were no differences in yield arid years.

Increase of seed yield and vegetative bulk of irrigated sunflower stimulated consumption of nutrients. To prevent washing out of fertilizers and their transformation into unaccessible compounds, it is necessary to cut to the minimum the period from the fertilizers' application to their assimilation by sunflower plants, i.e. to apply fertilizers during sowing and for top-dressing. Sprinkling irrigation promoted fertilizers' solution and penetration into the root layer of soil, thus stimulating the development of the upper roots. The latter promoted assimilation of fertilizers, covered to little depth.

In the course of six years application of granular superphosphate simultaneously with sowing at the rate of 15-20 kg/ha of active ingredient resulted in the 2.7 c/ha yield increase. In the combination with ammonium nitrate top-dressing applied during the second interrow cultivation gave a seed gain of 3.4 c/ha; seed yield under non-fertilized conditions averaged 30.2 c/ha.

Irrigated fields are more weedy with spring and offset weeds. Combination of soil cultivation and herbicides application, particularly treflan and prometrin, proved to be very effective for weed control, especially with enough moisture content in soil. In our trials herbicides were applied immediately after sowing with harrow placement at the rate of 3 kg of active ingredient when applied separately and 2 kg of each herbicide when applied in combination. During five years the number of weeds at the final stage of sunflower flowering averaged 28.5 in check plots, 9.9 in plots with prometrin application, 7.5 in plots with treflan application, and 6 weeds per sq. m in plots with combined application of these herbicides. The combined application of prometrin and treflan led to a complete extermination of spring weeds and to a high degree of depression of offset weeds. Yield gain reached 2.6 due to prometrin 3.4 due to treflan, and 3.6 c/ha due to a combined application of these herbicides - seed yield in check plots was 29.0 c/ha. Oil content, huskness, and 1,000 seed weight did not significantly differ. Prometrin application is economically expedient: the relevant inputs were 23.03, yield gain value 50.0, conditional net income 26.97 roubles/ha, and profitability 118%.

Sunflower afterreap sowing following early harvesting of crops for green fodder is promising under irrigation. During three years in the Ukraina collective farm of Maryinsky district sunflower seed yield averaged 14.6

c/ha when sunflower was sown after winter rye harvested for green fodder with one vegetative sprinkling the yield of vegetative bulk of winter rye being 146 c/ha. In 1973-1974 the seed yield in afterreap sowing applying two vegetative sprinklings (each 400-500 m^3/ha) averaged 23.6 c/ha in Druzhkovsky state farm of Donets region, the vegetative bulk yield of winter rye averaging 189 c/ha in the same field. In 1975 in Michurin collective farm of Maryinsky district under extremely arid conditions sunflower seed Maryinsky district under extremely arid conditions sunflower seed yield when afterreap sown averaged 14.0 c/ha; winter rye sown for gren fodder yielded 155 c/ha. The plots were sprinkled twice (400 m^3/ha), before sowing and before flowering. Sunflower seed yield when sown after fall ploughing under rainfed conditions was almost the same - 14.3 c/ha.