

P.N. Yaroslavskaya,
P.Ya. Bogomolov, USSR

ANTI-EROSION SOIL CULTIVATION FOR SUNFLOWER

In the North Caucasian steppe regions large areas are under clean-tilled crops. In the Krasnodar Territory, for instance, they account for 45 to 50% of the plowland in the crop rotations. The annual tillage of fall-plowed land by the moldboard method alone has in recent 15 to 20 years brought about the acceleration of wind erosion processes.

Combatting wind erosion is therefore now of prime importance together with other measures to raise the agronomical level in general.

Anti-erosion methods of tilling soil protect it from deflation and at the same time they must ensure the crops that would be not lower than those obtained with the ordinary agronomy in current use.

Our research was geared to study the efficacy of employing the flat-cut tillage of soil for sunflower in the Krasnodar Territory. The experiments were conducted in the zone of unstable moistening the territory of which is almost annually affected by dust storms early in the spring. The soils are super powerful carbonate chernozems.

Two systems of basic sunflower tillage were studied, viz., (1) the loosening by the KPG-250 the depth of 22-25 cm, preceded by the double scuffling to 8-10 cm by the flat-cutter KPP-2.2 (anti-erosion), and (2) the moldboard plowing to the depth of 22-25 cm with a preliminary double disc scuffling (ordinary).

One soil protecting element in the system of the anti-erosion fall-plowed land tillage is the stubble that has remains on the ground. By spring 47% of the initial stubble remained on average during the years of observation, or some 200 plants per 1 sq m.

Early in the spring in 1973, 1974, and 1976 dust storms were rather powerful but there was almost no erosion on the plots with a flat-cut tillage, while the ordinary fall-plowed land was eroded to a considerable extent (160-190 tons/ha in the case of fine earth).

Stubble left in the field helps preserve moisture in the soil during summer and autumn and accumulate it by spring. After flat-cut scuffing 100-120 tons/ha more moisture is preserved in the one metre layer of the soil than after disc scuffing. This advantage is there till spring. An average of 70-90 tons/ha more productive moisture was in the one-metre layer of the soil in the case of stubble than after the moldboard plowing. But in the conditions of the Krasnodar Territory, and especially in the zone with an unstable moistening the stubble on the field does not decompose by the spring, but remains stable. This makes it difficult to prepare the soil for sowing. To crush and cover the stubble in spring it is necessary to perform additional operations which dry up the upper soil layer, worsen the sowing equality and decrease the field germination of seeds.

Research conducted by workers of the V.S. Pustovoit All-Union Research Institute of Oil Crops was aimed at finding the most effective methods of the flat-cut fall-plowed land cultivation for sunflower before sowing; it was demonstrated that the best tools making it possible to eliminate the stubble left from the autumn and plow the land well were the spike-tooth harrow BIG-3 and the fallow-land cultivator. When soil with stubble is tilled by these tools only 5 or 7% of stubble remain on the surface, which does not actually influence the quality of sunflower sowing.

It has been found at the same time that the basic soil cultivation without molding a layer coupled with the above methods of presowing cultivation do not lead to an excessive erosion of the upper (0-10 cm) layer. The content of

the primary particles (of less than 0-25 mm) in this layer was an average of 8.9% with the non-moldboard cultivation, as against 8.5% with the moldboard tillage. On the carbonate chernozems, however, according to the Kuban Agricultural Institute, the physical properties worsen if there are more than 12% of primary particles of the total soil weight. The number of wind-resistant crumbs (those larger than 1 mm in diameter) before wintering was an average of 14.4% more with moldboard plowing than after flat-cut tillage. But in early spring the percentage of wind-resistant crumbs and lumps became equal in the soil differing in the methods of cultivation, i.e. the moldboard fall-plowed land lost its advantages by the structure of the upper soil layer.

The results obtained show that in the Krasnodar Territory a most essential measure of combatting wind erosion on the carbonate chernozems is the presence of stubble on the surface of the earth rather than the structure of the soil, i.e. the number of wind-resistant crumbs.

Although it is effective as a method of combatting deflation the system of flat-cut cultivation also helps spread weeds in the crops. When the soil is tilled without molding a layer the bulk of the weeds' seeds (up to 57%) is in the 0-10 cm layer and there is just a fraction of them in the lower layers, while with the moldboard method the upper layer has 25-30% less of them. The weeds' seeds concentrated in the upper layer grow quicker with the non-moldboard tillage, given the favourable temperature and moisture. In our experiments 2.5-3 times as many weeds grew with the flat-cut cultivation as with the moldboard tillage. This requires more intensive methods of weed control in the pre-sowing period and during the subsequent cultivation of sunflower.

Our experiments have also shown that a most effective method of clearing sunflower crops of weeds on the flat-cut fall-plowed land is their treatment of treflane. When this herbicide

was applied in the dose of 1.5 kg per hectare according to the acting substance on the moldboard-plowed earth the sunflower crops' weediness decreased 2.6 times and the seeds' yield grew by 1.3 c/ha (Table).

Treflane was more effective on the flat-cut fall-plowed land: the weeds' weight decreased four times and the seeds' yield grew by 2.5 c/ha. There were small differences in the seeds' yield with the moldboard and flat-cut tillage coupled with the use of herbicides, the differences being within the field experiment error. Differences reduce still more and sunflower yields correspondingly grow on the flat-cut fall-plowed land when mineral fertilizers are used in spring. In the case of flat-cut fall-plowed land the efficacy of the small doses of fertilizers ($N_{10}P_{20}$) doubles as compared to their use after moldboard plowing.

We can sum up our discussion as follows.

On the carbonate chernozems of the insufficient moistening zone of the Krasnodar Territory the most effective protection of fall-plowed field from wind erosion is the presence of standing stubble, rather than the structure of the upper soil layer.

The anti-erosion preparation of the fall-plowed land helps better preserve and accumulate moisture, because any non-moldboard tillage leads to a greater weediness of the crops. To eliminate this shortcoming sunflower crops sown on the flat-cut fall-plowed land must be treated to highly-efficacious herbicides. When treflane is used and mineral fertilizers are applied before sowing, sunflower seed yields are equally high in the case of anti-erosion and ordinary fall-plowed land, and the danger of soil erosion decreases.

Table

Crop Weediness and Sunflower Yield
Depending on the Methods of Cultiva-
tion. VNIIMK (average for 1974-1975)

Variant	Weediness before harvest		Seeds yield, c/ha
	plants/sq. m	g/sq. m	
Moldboard plowing to 22-25 cm without herbicides	10	154	28.1
Ditto plus treatment to treflane	4	58	29.4
Flat-cut loosening to 22.25 cm without herbicides	17	246	26.1
Ditto plus treatment to treflane	5	60	28.6