Fig. 1. Double rows of sunflowers spaced 70 feet apart on fallow-land. Note white sticks in field where moisture measurements were made. Minot, October, 1968.

Sunflower Rows To Protect Fallow From Wind Erosion

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Strip cropping, though effective in controlling wind erosion, has been tried by many farmers and abandoned because of the inconvenience of operating present-day large equipment and severe sawfly infestations in the edges of the crop strips (3). Both situations result in economic losses.

Various cover crops, both solid seeded and in strips, have been tried (1, 5). These give good wind erosion control when fall growth is substantial. These crops usually are seeded in late July or early August. Because of dry topsoil and low rainfall common at that time of year, they often do not make enough growth to provide needed protection. Furthermore, the farmer recovers no economic return for this expense. Often he will observe reduced growth and yield potential in the following crop where the cover crop strips were planted.

Double rows of corn planted at wide spacing also effectively control wind erosion (2). However, corn grain production is not dependable in the northern plains, and special harvesting equipment is needed. When corn matures farmers cannot control the volunteer corn in the succeeding cereal crop with selective herbicides. Thus farmers in the northern plains have never adopted the practice.

Loss of topsoil from fallow land by wind erosion is a major problem of agriculture in this area.

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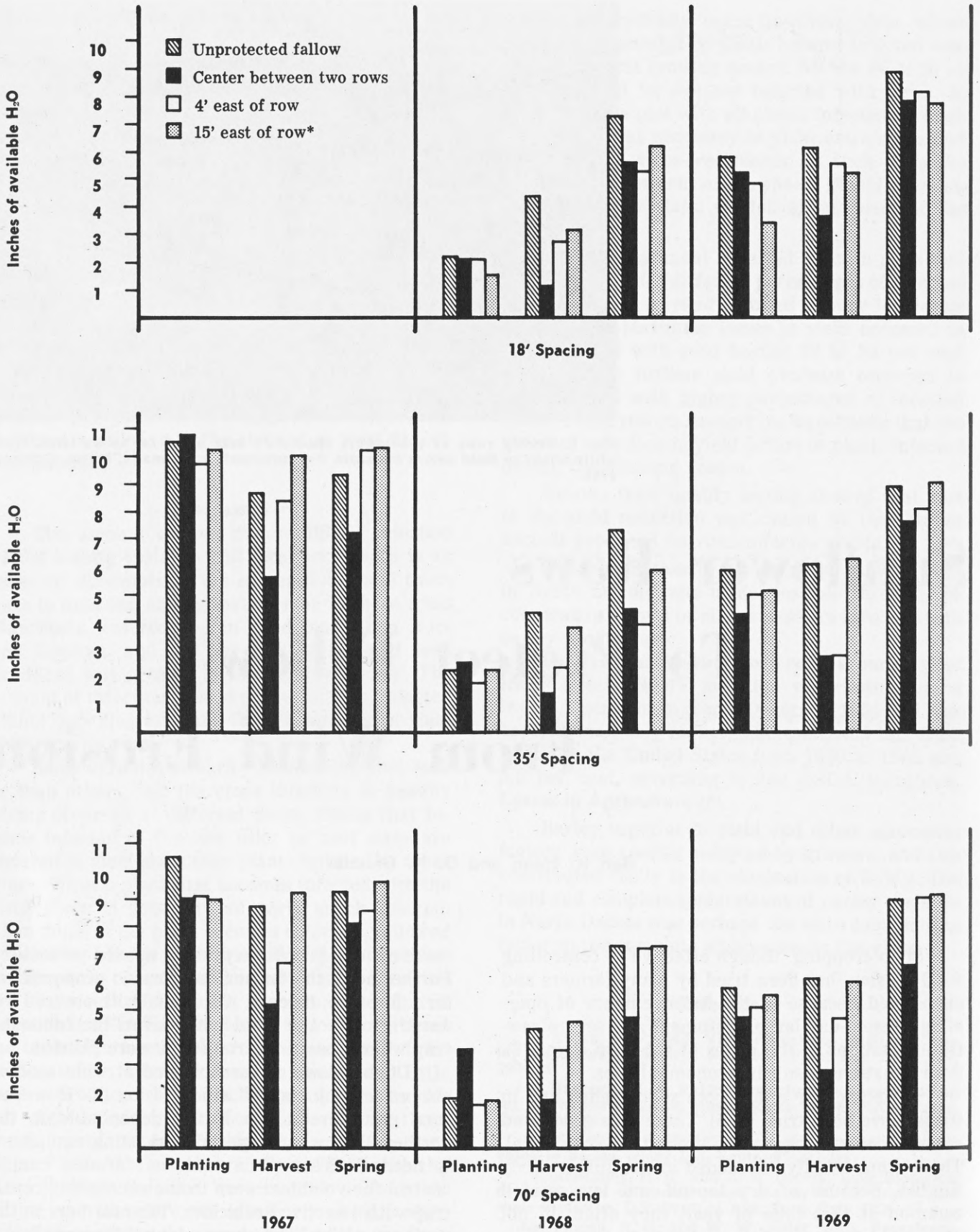

Fig. 2. Inches of available water in the 0 to 4 foot soil depth, measured during the crop season and the following spring at Minot (1967-1969).

*18' spacing had moisture determined at the 10' east of row area.

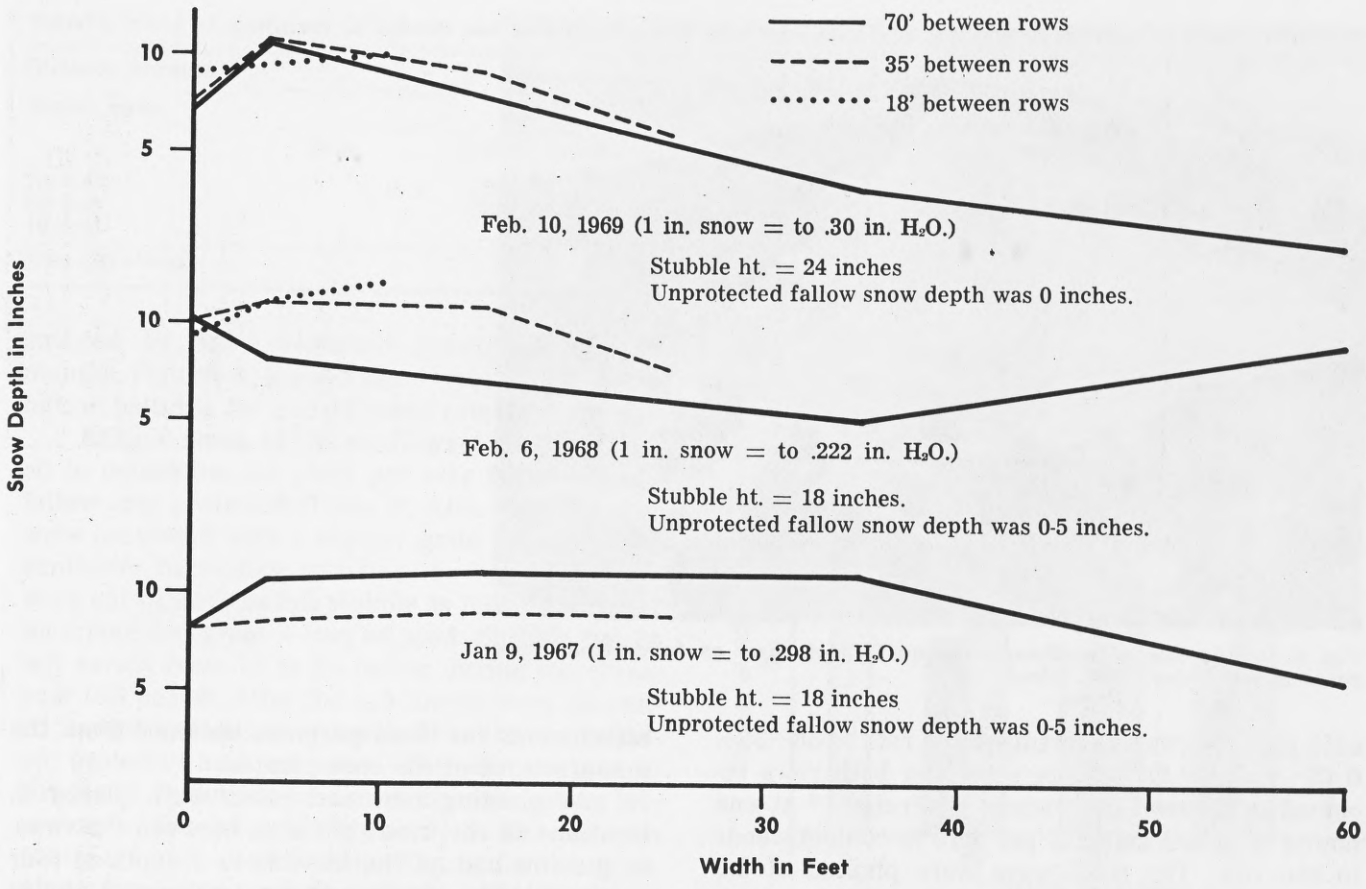

Fig. 3. Depth of snow at various distances from the sunflower rows on fallow-land at Minot, N.D., (1967-1969).

Much fallow is practiced because of acreage restrictions under government farm programs and because it expedites operations for farmers seeding large acreages. This type of erosion removes part of the top soil and deposits the coarser portion in fence rows and road ditches. The finer portions of the soil are carried away to be washed out by rains in some downwind area.

Once the drift soil covers the grass in the fence rows and road ditches, it provides a seedbed favorable for annual weeds which produce heavy crops of seeds that blow onto adjacent cropland.

Ridging the soil with heavy duty cultivators late in the fall is not always an effective control, especially when snowfall is below and winds above average. Cultivating to leave the crop residue on the surface also is not always effective. In some years, the many cultivations required to control weeds break up the crop residue and incorporate it into the surface, so that by fall the fallow is bare and unprotected.

Tree rows planted at intervals of 20 to 40 rods, depending on soil type, have been used. Where used they are effective in reducing wind erosion. They are not popular with some farmers as they reduce crop acreage, and where large machinery is used they interfere with field operations. Trees also are susceptible to injury by the herbicides used for selective weed control in the field crops. The rows become infested with weeds and their seeds spread to the adjoining cropland. This is especially serious when noxious weeds become established in the rows.

This test studied the economic and erosion control benefits of planting double rows of sunflowers early enough to produce a seed crop for which there is a **contract market**. The value of the sunflower crop could offset some of the fallowing costs and yield losses in succeeding crops, and possibly produce some additional income.

Procedure

The land was first cultivated as is normal for fallow in this area. Then double rows of sunflowers were planted at 70-, 35- and 18-foot intervals in late May or early June on a field that was summerfallowed during the respective seasons (Figure 1). The field was large enough that an unprotected area could be left on the windward (west) side of the planting. As the planting was made, one row of

Fig. 4. Double row of sunflowers spaced 18 feet apart on fallow-land. Snow cover in November, 1968, Minot.

each pair of rows was fertilized at a rate of 28+35+0 ($N+P_2O_5+K_2O$) pounds/acre, and both rows received in-the-row applications of Treflan[1] [2] at one pound of actual material per acre to control weeds in the row. The sunflowers were planted at 3.3 pounds of seed per acre with a two-row corn planter. The fertilizer and Treflan were applied with attachments for these purposes obtained from the manufacturer of the corn planter.

At planting time soil tubes were placed in locations on the windward side, between the rows, in the row and on the lee side to a depth of four feet and at the spacings shown in Figure 2 and in the unprotected area. This made it possible to take moisture readings with a neutron probe to study the influence of the sunflowers on the available water content to the four-foot depth.

Depth of snow measurements and moisture content were made and the extent of the area

[1]*Trade names used in this publication are solely for the purpose of providing specific information. Mention of a trade name does not constitute a guarantee or warranty of the product.*

[2]*Trifluralin (a, a, -trifluoro-2, 6-dinitro -N dipropyl - P - toluidene).*

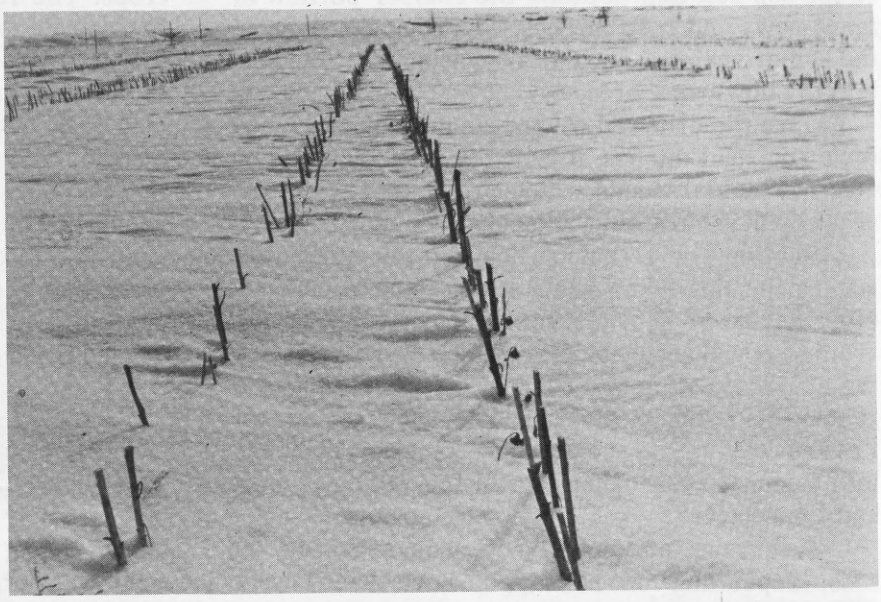

Fig. 5. Double rows of sunflowers spaced 35 feet apart to the right of the center rows and 18 feet apart to the left of the center rows. Snow cover in January, 1969, Minot.

Table 1. Yield of sunflower in pounds per acre for the row plus protected area at different spacings at Minot (1967-1969).

Distance between double rows:	Fertilizer							
	None				28+35+0			
Year:	1967	1968	1969	3-yr. av.	1967	1968	1969	3-yr. av.
70 feet	128	132	135	131	130	134	141	135
35 feet	256	255	284	265	260	258	281	266
18 feet		529	489	509[1]		550	460	505[1]

[1]Two-year average.

covered by snow observed during the winter months. Figures 3, 4 and 5 show typical snow distribution patterns for the different row spacings.

Sample areas of the sunflowers were harvested to determine the yield per acre for the entire fallow area protected (Table 1). After this the rows were harvested with a regular grain combine with sunflower harvesting attachments. The sunflowers were cut to leave as tall stubble as possible without incurring too great a loss of seed. Stubble height left varied from 18 to 24 inches during the three-year test period. After the sunflowers were harvested, samples of soil were taken from the unprotected, protected and row areas. The soil was sent to the North Dakota State University soil testing laboratory at Fargo for fertility analysis. The nitrogen content varied considerably (Figure 6), the phosphate level was medium to high, and the potash level was very high.

The following spring 17 pounds of actual nitrogen per acre was spread on the sunflower rows and disced in to replace the nitrogen used by the sunflowers (Figure 6). After this the whole field was cultivated with a cultivator with a rod-weeder attachment, then seeded to durum wheat. The whole field was fertilized with 5.5+24+0 pounds per acre by drill attachment as the crop was seeded.

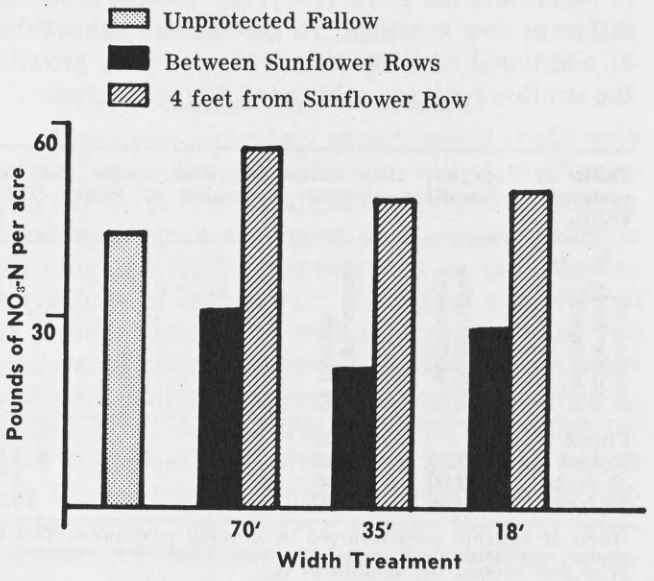

Fig. 6. Pounds per acre of NO_3-N. Determined in the Fall after the sunflower crop was harvested at Minot, N.D., (1968 and 1969).

Broadleaf weeds and volunteer sunflowers were controlled by spraying the durum crop with selective herbicides when the seedling plants were five to seven inches tall.

At harvest time, square-yard areas of durum were harvested in the old sunflower row and ad-

Table 2. Yield of durum wheat on fallow where sunflower rows protected the fallow from wind erosion at Minot (1968-1970).

Spacing of double rows of sunflowers	Plot distance from sunflower rows	Crop Appearance 1-5[1]		Yield in Bushels per acre			
	1968	1969	2-yr. av.	1968	1969	1970	3-yr. av.
	unprotected fallow	4.0	3.0	3.5	38.6	39.9	25.6	34.7
70 feet	10 feet west	3.5	3.0	3.3	35.7	45.5	25.0	35.4
	Center[2]	2.0	2.0	2.0	34.5	34.1	19.6	29.4
	4 feet east	3.0	2.5	2.8	34.4	35.6	24.2	31.4
	15 feet east	4.0	3.0	3.5	43.4	39.1	23.3	35.3
	35 feet east	5.0	3.0	4.0	42.2	38.3	26.6	35.7
35 feet	10 feet west	4.0	3.0	3.5	39.7	43.7	21.9	35.1
	Center	2.0	2.0	2.0	31.1	36.7	24.6	30.8
	4 feet east	3.0	3.0	3.0	34.8	42.4	27.4	34.9
	15 feet east	3.5	3.0	3.3	36.6	39.3	24.5	33.8
18 feet	Center		2.0		35.4[3]	39.2	20.9	31.8
	4 feet east		2.5		34.1[3]	34.2	23.6	30.6
	10 feet east		3.0		39.9[3]	41.6	26.1	35.8

[1]Stand and appearance on 1-5 scale; 1 poor, 5 very good.
[2]Center between the two rows of sunflowers the previous year.
[3]Yield calculated to make average yields comparable to other spacings.

jacent areas where soil moisture measurements had been made. Data are reported in Table 2. The yields were applied to the proportionate area representative of the locations where moisture measurements were made and an average yield of durum calculated for the entire area represented by each spacing. The durum yield times $1.50 per bushel and the sunflower yield, arrived at as described above, times four cents a pound were used to determine the gross two years' income from the different row spacings. To get the net gain (Table 3), additional variable costs (4) incurred by growing the sunflowers were subtracted from the gross.

Table 3. Two-year crop value per acre under the two systems of handling summer fallowing at Minot (1967-1970).

Spacing of double rows of sunflowers	3-yr. av. value of sunflowers	3-yr. av. value of durum	Total of crops	Extra costs[1]	Net Gain
Check		$52.05	$52.05		
70 feet	$ 5.24	50.10	56.39	$2.48	$ 1.86
35 feet	10.60	49.35	60.55	3.79	4.71
18 feet	20.36	47.40	68.66	5.72	10.29

[1]Total of variable costs incurred by growing sunflowers. This includes estimated fixed costs for extra machinery required to grow and harvest the sunflowers (4).

Discussion

Available water measurements at the time the sunflowers were planted were not uniform for all of the locations measured. Soil moisture accumulated in the top four feet of soil as the season progressed. However, much less water was accumulated in the area where the sunflower rows grew and at least four feet on either side of the rows. The areas farther from the row accumulated water at about the same rate as the unprotected area (Figure 2).

During the winter, the snow drifted off the unprotected area into the protected area. In the 70-foot row spacing this was not sufficient to cover the whole area between the rows, but was adequate to protect the soil against wind erosion. In the 35- and 18-foot spacings the area between the rows accumulated snow to a rather uniform depth as indicated by Figures 3, 4 and 5.

The additional moisture from the snow did not increase the available water content in the areas 10, 15 or more feet from the rows to more than in the unprotected fallow. Where the sunflower rows were and in the adjacent area available water increased considerably over that measured when the sunflowers were harvested. However, the water supply was not restored to the same level as in the unprotected area (Figure 2). This evidently was one of the causes for the lower yields of durum in the sunflower row and four feet from the row areas (Table 2). Nitrogen content of the latter was not lowered (Figure 6). The yield in the row area also may have been lowered by some apparent injury in the row area where the Treflan was applied.

The calculated value of the crop produced in the two years, using the yield of the unfertilized sunflowers, for the respective row spacings show enough gain over the unprotected fallow for the 70-foot row spacing to cover the extra costs incurred. The income gain from the 35- and 18-foot row spacing increased the two-year income over the unprotected plot by $4.71 and $10.29, respectively, after deducting all of the variable costs (4) of growing the sunflowers (Table 3).

Application of Treflan did not control some of the perennial weeds. After two years of testing, Canada and sow thistle patches were found in the sunflower row areas on one field.

Summary

Double sunflower rows planted on fallow at 70-, 35- and 18-foot intervals after the first cultivation in late May or early June controlled wind erosion and trapped winter snow. The additional snow trapped did not increase the available water content in the protected area over that in the unprotected fallow to a depth of four feet. It did, however, replenish to a fair degree the available soil water content in the row area and four feet to either side of the row where the growing sunflower roots had lowered the amount of available water.

The yield of durum was lower in the row and immediate adjacent area than in the unprotected area.

The two-year crop income was greater for the area protected by the sunflower rows than for the unprotected area. Income per acre increased as distance between double rows decreased.

The sunflower crop did not give economic yield increases to fertilizer application.

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