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SUNFLOWER

A Potential Alternate Crop For the Cooler Regions of Idaho

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Fig. 1. Sunflower head during seed fill.

Sunflower is the most rapidly expanding crop in the U.S. The first commercial production of the dark hulled, oil bearing sunflower was in 1968. By 1979, more than 7,000,000 acres of this crop were grown. The availability of large export markets for both the unprocessed seed and the refined oil has encouraged this rapid expansion. Also, a rapid increase in demand has occurred recently in domestic markets for sunflower oil as a high quality, polyunsaturated cooking oil.

Sunflowers have found a home in the crop rotations of the cotton belt, the corn belt and the wheat production areas of the Northern Plains States. Initial tests indicated that sunflowers were adapted to many areas in Idaho (See CIS 434 *Potential Sunflower Production in Idaho*), and many growers expressed an interest in production. This publication gives the latest research information on sunflower production in the cooler crop production areas of Idaho.

Variety Testing

Cytoplasmic, male, sterile sunflowers have allowed the rapid development of hybrid varieties. During 1978 and 1979, several of these varieties were evaluated to determine their adaptation in the cooler irrigated and dryland regions of Idaho.

Dryland

The varieties at Moscow in 1978 averaged 2,301 pounds of seed per acre (Table 1). The top six varieties yielded an average of 2,620 pounds per acre. Early maturing varieties such as Do 704 and IS 7775 produced the highest seed yields. The oil content of the varieties ranged from 39.7 to 46.7 percent and averaged 42.8 percent. Only the late maturing varieties produced less than 40 percent oil. The sunflowers in this treatment suffered only minor damage from the sunflower moth and white mold.

The varieties at Moscow in 1979 averaged 1,738 pounds of seed per acre (Table 1). Dry soil conditions during the summer reduced the yields of all varieties. The three highest yielding hybrids in this trial were Sun Bred 254, Sun Hi S301 A and Do 704. The seed oil content of all varieties ranged from 44.2 to 48.7 percent.

The varieties at Grangeville in 1979 were subjected to severe drought conditions but still averaged 1,334 pounds of seed per acre (Table 1). The top four varieties yielded in excess of 1,500 pounds of seed per acre. The highest yielding hybrids flowered in early July. The seed oil content of the hybrids ranged from 44.9 to 49.1 percent and averaged 46.5 percent.

The successful production of sunflowers in the dryland production areas of northern Idaho will require varieties that mature by mid-September. Several hybrids such as Sun Bred 212, Do 704 and IS 7775 can be defoliated in late August, harvested in mid-September and produce good seed yields and high oil contents. However, the widespread production of sunflower in this area will require even earlier maturing varieties which are grown and managed in much the same way as cereal grains.

Irrigated

The varieties grown at Coeur d'Alene yielded an average of 1,613 pounds in 1978 and 2,023 pounds of seed per acre in 1979. The intermediate and early maturity varieties such as Hybrid 894, S301 and Sun Bred 212 produced the highest seed yields. In both years, the sunflower moth and foliar diseases reduced seed yield. Even the highest yielding hybrids did not produce enough seed to justify their production on high value, irrigated land. Oil contents under irrigated conditions at Coeur d'Alene averaged 45.3 and 44.2 percent for 1978 and 1979 respectively.

At Tetonia, the sunflower varieties averaged only 1,661 pounds of seed per acre in 1979. Even the highest yielding hybids produced less than 2,000 pounds of seed. In eastern Idaho, sunflowers would not be an economical crop on irrigated land using current varieties and cultural practices. Making sunflowers a viable crop in the cooler irrigated regions of Idaho will require new types of varieties and management practices.

Seed Size Trials

Commercial hybrid sunflower seed is separated by size into four groups — designated as groups 2, 3, 4 or 5. Size 2 seed is the largest and size 5 the smallest. To determine if the size of the sunflower seed effects agronomic performance, sizes 2, 3, 4 and 5 seeds of both Hybrid 903 and Hybrid 894 were obtained from Dr. Gary Fick at SIGCO Sun Products at Breckenridge, Minnesota, and planted at Moscow in 1978 and 1979.

Seed size did not affect seed yield, silage yield or oil content in either planting year (Table 2). However, the dry weight of the seedlings increased as seed size increased. The larger size 2 and size 3 seed produced larger seedlings than the small size 5 seed of both hybrids.

Fig. 2. Sunflower fertilizer trials at Moscow, Idaho, 1978.

These data indicate that growers could purchase and plant the less expensive sizes 4 and 5 sunflower seed without reducing the silage yield, seed yield or oil content. Using smaller seed will require more precise planting to establish a population of 18,000 to 25,000 plants per acre. The use of smaller seed could help reduce the production costs of relatively low value crops such as sunflower silage or seed fields established on marginal dryland sites.

Fertilizer Testing

The major objective of these studies was to correlate nitrogen, potassium and sulfur levels in northern Idaho soils with sunflower seed yields and oil content. Soil tests were taken to rooting depth or until an impervious layer was encountered. Nitrogen rates were based on Midwest recommendations of applying 50 pounds of nitrogen per acre for each 1,000 pounds per acre of sunflower seed expected. Phosphorus, sulfur or potassium were added at sites where these nutrients were deficient. All fertilizers were broadcast on the soil surface after planting. Each fertilizer treatment was replicated four times.

Dryland Trials

Fertilizer trials were conducted at Moscow and Bonners Ferry in 1978 and Moscow, Grangeville and Genesee in 1979.

Moscow (1978 and 1979) — Application of nitrogen or potassium fertilizer in 1978 did not significantly alter seed yields and oil content. Based on soil tests, a nitrogen response was expected (Table 3). Shallow soils and limited soil moisture at the Moscow site could have reduced expected responses from nitrogen fertilizer. Average seed yield was 2,200 pound per acre with an oil content of 47 percent.

In 1979, application of 100 pounds of N per acre produced optimum seed yields (Table 4). The addition of 20 pounds of sulfur per acre with 100 pounds of nitrogen per acre did not increase seed yield when compared to 100 pounds of nitrogen alone. Sulfur addition to 50 and 100 pounds of nitrogen per acre gave no increase in seed yield compared to nitrogen alone. Oil content was not significantly altered by fertilizer application. However, as nitrogen level increased, there appeared to be a trend toward increased oil level. Average oil content was 47.9 percent.

Bonners Ferry (1978) — Seed yield and oil content were not significantly altered by any nitrogen or potassium treatment. Herbicide drift delayed maturity and caused multiple heading at this location. Lack of fertilizer response may have been caused by

Table 1. Seed yield and oil content of seven varieties of sunflower tested in the cooler regions of Idaho during 1978 and 1979.

Variety	Moscow 1978			Moscow 1979			Grangeville 1979		Coeur d'Alene 1978		Coeur d'Alene 1979		Tetonia 1979
	Bloom Aug. 3	Seed yield	Oil content[1]	Bloom July 19	Seed yield	Oil content[1]	Seed yield	Oil content[1]	Seed yield	Oil content[1]	Seed yield	Oil content[1]	Seed yield
	(%)	(lb/A)	(%)	(%)	(lb/A)	(%)	(lb/A)	(%)	(lb/A)	(%)	(lb/A)	(%)	(lb/A)
Sun Bred 254	17	2,180	41.6	1	2,110	46.9	1,260	46.4	1,750	46.1	1,860	43.8	1,200
Sun Bred 212	91	2,430	45.9	85	1,690	47.1	1,760	47.6	1,470	44.6	2,370	45.9	1,880
Do 704	90	2,860	44.0	59	2,000	45.0	1,680	46.8	1,750	45.5	2,200	43.4	1,240
IS 7775	84	2,540	41.1	21	1,920	45.1	1,300	45.4	1,570	43.4	1,860	42.5	1,550
Sun Hi S301A	30	2,280	44.0	1	2,070	48.2	910	48.9	2,220	49.9	1,940	46.7	1,360
Hybrid 894	51	2,440	43.4	11	1,940	47.4	1,110	45.7	2,290	47.1	2,130	43.4	1,920
Peredovick	69	2,230	44.9	—	—	—	—	—	1,730	45.0	—	—	—
Range of all varieties	5 to 90	1,620 to 2,860	39.7 to 46.7	1 to 85	1,560 to 2,110	44.2 to 48.2	770 to 1,760	44.9 to 49.1	820 to 2,290	44.4 to 49.9	1,520 to 2,520	42.1 to 46.7	1,200 to 1,950
Average of all varieties	59	2,301	42.8	36	1,738	46.3	1,334	46.5	1,613	45.3	2,023	44.2	1,661
Total number of varieties	22			19			19		22		19		19
Planting date: Harvest date:	May 4 Sept. 9 dryland			April 21 Sept. 18 dryland			May 4 Sept. 19 dryland		April 25 Sept. 20 irrigated		April 26 Sept. 25 irrigated		May 23 Oct. 30 irrigated

[1]Determined by the nuclear magnetic resonance method on dried seed at the Montana Eastern Agricultural Research Center, Sidney.

Table 2. Seedling weight, silage yield, seed yield and oil content of four sizes of sunflower seed. Data are averaged over hybrids SIGCO 894 and SIGCO 903 grown at Moscow in 1978 and 1979.

Seed size	1978				1979			
	Dry weight 25 seedlings	Silage yield	Seed yield	Oil content	Dry weight 25 seedlings	Silage yield	Seed yield	Oil[1] content
	(g)	(ton/acre)	(lb/A)	(%)	(g)	(ton/A)	(lb/A)	(%)
2	25.8 a[2]	14.9 a[2]	2,120 a[2]	42.7 a[2]	67.4 a[2]	7.6 a[2]	1,591 a[2]	44.8 b
3	23.4 a	15.5 a	2,090 a	41.8 a	62.2 ab	7.4 a	1,568 a	46.0 a
4	22.6 ab	16.9 a	2,040 a	41.6 a	59.8 b	7.3 a	1,482 a	45.6 ab
5	19.9 b	15.7 a	1,960 a	41.3 a	55.8 b	6.8 a	1,482 a	44.9 b
Planting date: May 4 Harvest date: Sept. 9					Planting date: April 22 Harvest date: Sept. 18			

[1]Determined by the nuclear magnetic resonance method on dried seed at the Montana Eastern Agricultural Research Center, Sidney, Montana.
[2]Means not followed by the same letter differ at the 0.05 level of probability by Duncan's new multiple range test.

Growers who follow the cultural practices provided in this publication should produce successful crops of sunflowers. For many growers in the cooler regions of Idaho, this will require the purchase of corn planters, cultivation equipment and combine headers.

Sunflowers should offer an economic return comparable to that from spring barley. Therefore, growers should make a careful study of this crop's role in relation to crop rotation, farm operations and commodity marketing before initiating sunflower production. Sunflowers could provide an excellent alternate crop in selected areas of this region once its limitations are better understood.

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Trade Names

Trade names are used in this publication to simplify the information presented. Such use does not imply an endorsement of any product nor criticism of similar products that are not mentioned.

Chemical Recommendations

The chemical recommendations made in this publication are based on the best information available at the time of printing. Before using any pesticide, read the instructions on the label. Follow all precautions and restrictions for safe product use.

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Table 3. Soil test data [1] for sites selected for sunflower evaluation trials in northern Idaho in 1978 and 1979.

Location (date)	Soil depth	NO_3-N	SO_4	P	K	Acidity
	(inches)		—— (ppm) ——			(pH)
Moscow	0- 6			5.4	158	5.7
(4-18-78)	0-12	3.7	7			
	12-24	3.4	4			
	24-36	2.5	4			
Moscow	0-12	4.4	8	10.8	234	6.1
(4-20-79)	12-24	2.0	6			
	24-36	2.0	3			
Coeur d'Alene	0-12	8.5	9	5.1	55	5.5
(4-20-78)	12-24	2.1				
Coeur d'Alene	0- 6					
(4-26-79)	0-12	13.2	4	5.6	147	5.7
	12-24	8.8	4			
Grangeville	0- 6			6.5	130	6.4
(5-3-79)	0-12	8.8	5			
	12-24	12.9	6			
Genesee	0- 6			8.9	—	6.0
(5-5-79)	0-12	4.4	10			
	12-24	2.8	8			
	24-36	1.6	6			

[1]Analyzed by the University of Idaho Soil Testing Laboratory.

Table 4. Effect of N and S fertilizer on seed yield and oil content of sunflower, Moscow, Idaho, 1979[1].

N and SO_4 rate	Seed yield	Oil content
	(lb/A)	(%)
0	950 c[2]	47.8 a
50 N	1,397 b	47.4 a
100 N	1,725 ab	48.0 a
150 N	1,578 ab	47.4 a
100 N 10 S	1,516 b	47.9 a
100 N 20 S	1,723 ab	48.2 a
100 N 30 S	1,403 b	47.4 a
150 N 10 S	1,534 ab	47.8 a
150 N 20 S	1,681 ab	48.6 a
150 N 30 S	1,896 a	48.1 a
Average	1,540	47.9

[1]Planted April 20 in four-row plots with 21 inches between rows and one plant per foot, 19,900 plants per acre. Fertilizer applied as ammonium nitrate alone or with ANS (30-0-0-6). Sunflowers were defoliated on Sept. 6 and two center rows harvested with a Hege combine.

[2]Means within the same column followed by the same letter are not significantly different at the .05 level according to Duncan's multiple range test.

Table 5. Effect of N and S on incidence of Sclerotinia at Genesee, Idaho, 1979.

N and SO_4 rate	Sclerotinia
(lb/A)	(%)
0	2 a[1]
25 N	3 a
50 N	9 a
75 N	10 a
100 N	13 a
125 N	7 a
150 N	32 b
100 N 10 S	14 a
100 N 20 S	8 a
100 N 30 S	4 a

[1]Numerical values followed by identical letters are statistically similar (LSD at 5% level).

Table 6. Effect of N and K fertilizer on seed yield, oil content and head moth damage of sunflower, Coeur d'Alene, Idaho, 1979.[1]

N and K rate	Seed yield	Oil content	Head moth damage
(lb/A)	(lb/A)	(%)	(%)
0	1,881 abc[2]	46.6 a	25 bc
50 N	2,182 ab	45.1 b	32 bc
100 N	2,326 ab	44.1 bc	42 abc
150 N	2,394 a	43.1 c	45 abc
50 K	2,005 abc	47.0 a	32 bc
100 K	1,636 c	46.8 a	32 bc
150 K	1,863 bc	47.5 a	18 bc
50 N, 100 K	2,270 ab	45.0 b	35 bc
100 N, 100 K	1,827 c	42.9 c	50 ab
150 N, 100 K	2,121 abe	42.2 c	68 a
Averages	2,050	45.0	38

[1]Planted April 25 in four-row plots with 21 inches between rows and one plant per 10 inches, 990 plants per acre. Fertilizer applied on the soil surface after planting as ammonium nitrate alone or in combination with muriate of potash. Six inches of water total was applied in three applications on July 6, July 18 and August 1, by sprinkler. Sunflowers were defoliated on Sept. 14 and harvested on Sept. 25.

[2]Means within the same column followed by the same letter are not significantly different at the .05 level according to Duncan's multiple range test.

Table 7. Guide for sunflower moth control in sunflower in Idaho.

Insecticide	Rate active ingredient/ acre	Interval between last application and harvest	Interval between treatments
Supracide[1]	½ lb	50 days	7 days
Parathion	1 lb		5 days
Thiodan[1]	1 lb		4-7 days

[1]Do not feed treated forage to livestock.

Table 8. Registered herbicides to control weeds in sunflower crops and registered defoliants to aid in harvest.

Herbicide	Rate ai/acre	Guides on use (read and follow the label)
Weed problem: Annual broadleaf and grass weeds		
Treflan (trifluralin)	.5 to 1 lb 1 to 2 pt	Apply Treflan before planting, and incorporate thoroughly 4 to 6 inches deep with a disc or field cultivator in at least two directions. Incorporation may be delayed 24 hours, but best results are obtained with prompt incorporation. Use the lower rate on sandy coarse soils and the higher rates on clay soils.
Tolban (profluralin)	.5 to 1 lb 1 to 2 pt	Apply Tolban prior to planting, and incorporate at time of application. If this is not possible, Tolban should be incorporated within 4 hours to insure maximum activity. Incorporate Tolban thoroughly 4 to 6 inches deep in at least two directions. Low rates are to be used on coarse sandy soils and higher rates on fine clay soils.
Weed problem: Wild Oat		
Carbyne (barban)	.375	Apply carbyne within 30 days after the sunflowers emerge. Best control is obtained when wild oats are in the 2-leaf stage of growth.
Defoliant	**Rate ai/acre**	**Guides on use (read and follow the label)**
Paraquat	.25 to .5 lb 1 to 2 pt	Apply in 5 gallons per acre by air or 20 to 40 gallons for ground application. Apply at maturity when heads are yellow and bracts are turning brown. Use higher rate for heavy stands of crop or weeds. Harvest 7 to 21 days after application. Do not graze treated areas or feed treated forage.

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one or both of these factors. Average seed yield and oil content were 1,870 pounds per acre and 44 percent respectively.

Grangeville (1979) — No differences in seed yields or oil contents were observed. Lack of moisture limited the yield response to nitrogen application. Precipitation was 3.19 inches below normal for the crop year (September 1978 to August 1979), with the rainfall in June recorded at 2.1 inches below normal. Average seed yield was 1,090 pounds per acre. Some bird damage occurred, but sunflower moth problems were minimal.

Genesee (1979) — As nitrogen level increased, so did incidence of Sclerotinia (Table 5). Plants that received no nitrogen had the lowest level of Sclerotinia (2 percent) while plants that received 150 pounds of nitrogen per acre had the highest level of Sclerotinia (32 percent). Plots were not harvested to determine seed because of severe bird damage.

Irrigated Trials

Fertilizer trials were conducted under sprinkler irrigation on Rathdrum Prairie near Coeur d'Alene in 1978 and 1979.

Coeur d'Alene (1978) — Seed yield and oil content were not significantly altered by phosphorus or potassium fertilizer. Average seed yield and oil content were 1,720 pounds per acre and 46 percent respectively. Soil test data (Table 3) indicated that potassium was deficient, and a response had been expected. Sunflower head moth reduced seed yield and could have masked a potassium response at this location. Soil test values for NO_3-N (Table 3, Coeur d'Alene, 1978) did not measure the recent application of 90 pounds of N per acre as anhydrous ammonia. Nitrogen would normally be needed when soil test values are 8.5 ppm or below.

Coeur d'Alene (1979) — Optimum nitrogen level for seed yield was 100 pounds of nitrogen per acre (Table 6). The addition of potassium in combination with nitrogen did not increase yields more than nitrogen alone. Potassium alone at 50 pounds per acre did not increase yields more than the plots fertilized with nitrogen alone or the unfertilized control plots. Higher levels of potassium alone or in combination with 100 pounds of nitrogen per acre tended to depress seed yields. Sunflower plants that received no nitrogen or potassium appeared yellow, as did plants that received potassium only. Nitrogen and combinations of nitrogen with potassium increased green color of plants compared to plants that were fertilized with nitrogen or those fertilized with potassium only.

Fig. 3. Moth damage on sunflower head.

Sunflower moth damage ranged from 18 to 68 percent in these plots (Table 6). As the level of nitrogen increased, so did head moth damage. Sunflower moth damage was greatest on plants that received combinations of nitrogen and potassium and was highest where maximum nitrogen and potassium rates were used. Potential yield increase from fertilizer application was probably masked by the sunflower moth injury. Seed oil content was significantly reduced by nitrogen application while potassium had no apparent influence on oil levels.

Insect Problems

Sunflower moth, *Homoeosoma electellum*, was the only important insect found in the sunflower fields surveyed during 1979. This insect occurred at high levels in northern Idaho, but only a small percentage of fields in southern Idaho had light infestations.

Sunflower moths appeared in fields at the onset of bloom. These slender, gray-white moths are about one-half inch long. At rest, the wings are folded closely over the length of the body. The females deposit eggs on the sunflower head, and the larvae hatch within 2 to 3 days.

The larvae have an orange head and reddish-brown stripes that run the length of the body. Younger larvae feed on the sunflower head's floral parts while older larvae may feed on ovaries, developing seeds and the seed head. Larvae can easily be detected by the trashy appearance of sunflower heads, the result of frass and webbing made by larval feeding. Insect damage appears to promote head rot caused by the fungus *Rhizopus*.

Chemical control of sunflower moth requires application of insecticides at about 10 to 20 percent bloom. A threshold density for adults in sunflowers in the Northern Plains States has been determined. Moth numbers of more than 1.3 per plant warrant chemical control. More research is necessary to develop effective and practical control of the sunflower moth for the Pacific Northwest. One or two (but not more than two) chemical treatments at 4 to 7-day intervals are suggested, depending on the severity of the infestation. The insecticides registered in Idaho for use against the sunflower moth are given in Table 7.

The other insects which feed on developing sunflower seeds were found at low levels in several sunflower fields in Idaho. These species are the seed weevil *Smicronyx sordidus* and the sunflower maggot *Neotephritis Finalis*. Neither insect appeared to be causing economic damage.

General pests such as grasshoppers and cutworms may cause occasional damage in sunflower fields. These pests will probably not be a serious problem, however.

Weed Control

To get maximum crop yield and oil content, sunflowers must be grown under weed-free conditions. A sunflower crop is quite competitive with weeds once it becomes established. However, uncontrolled weeds competing with sunflower plants in the first 4 to 6 weeks of the growing season can seriously hinder the crop's development.

When the spring weather is cool and wet, weeds can often grow vigorously while the sunflower plants have a slower rate of growth. Potential crop yields can be reduced as a result of excessive weed competition. At Moscow, sunflower plants failed to mature in 1980 where severe wild oat (*Avena fatua*) and mayweed (*Anthemis cotula*) infestations were present.

Only three herbicides are registered in Idaho for weed control in sunflowers (Table 8). Treflan at .5 to 1.0 lb/A and Tolban at .5 to 1.0/A are effective on many annual broadleaf and grassy weeds. These herbicides, however, are weak on mustard species such as tumble mustard (*Sisymbrium altissium*), shepherdspurse (*Capsella bursa-pastoris*), field pennycress (*Thlaspi arvense*) and tansymustard (*Descurainia pinnata*). Research results indicate that Treflan and Tolban will provide little control of mayweed and only partial control of wild oats. Seedling wild oats that germinate below the herbicide treated soil will escape. Carbyne at .375 lb/A can effectively control wild oat plants that are in the 2-leaf stage of growth. This herbicide is specific for wild oat control and is not effective on other weed species.

Growers should plan to use cultural control methods to supplement chemical control measures in fields where resistant weed species are present. Timely and proper mechanical weed control operations can effectively reduce weed populations. Preplant tillage can control many germinating annual weed seedlings and eliminate established winter annual species. Preplant incorporated herbicides can be applied during the time of these tillage operations.

The sunflower crop should be planted as soon as possible after the last tillage operation. If some escaped weeds emerge with the sunflower plants, cross-harrowing can be used for weed control before the crop reaches the 4 to 6-leaf stage of growth. The sunflower stand may be reduced by this method of control; therefore, slightly higher planting rates should be used. If row spacing is proper and equipment is available, weeds between the rows can be eliminated with cultivators equipped with sweeps.

Summary

The production of sunflowers in the cooler regions of Idaho will require that the growers seed early maturing hybrids such as Do 704 and Sun Bred 212. The use of the preplant incorporated herbicides, Treflan or Tolban, combined with cultivation will provide control of broadleaf weeds. Carbyne can be used to control wild oat infestations.

Optimum nitrogen rates are approximately 100 pounds of available nitrogen per acre. A soil test should be taken to avoid excessive nitrogen application which increases lodging, delays maturity and increases the occurrence of Sclerotinia white mold.

Sunflowers may require sulfur fertilization for optimum seed yields. Sulfur should be applied at rates similiar to those normally used in winter wheat production.

Responses to phosphorus and potassium fertilization have not occurred in our tests. However, phosphorus may improve yields on eroded soils and exposed hill tops.

Most sunflower fields in northern Idaho will be infested with the sunflower moth. This pest will require one to two applications of the registered insectides.

To allow harvest by mid-September, sunflower fields should be defoliated in late August. Many growers have used aerial application of paraquat to defoliate their fields and minimize losses caused by sheltering and bird feeding. Information on harvesting, drying and marketing sunflowers is available in University of Idaho CIS No. 434 *Potential Sunflower Production in Idaho.*