

Wild Mustard in Soybeans and Sunflower

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Wild mustard (*Sinapsis arvensis* L.) has been an important weed problem in North Dakota for over one hundred years. On June 15, 1885, an eastern North Dakota farm diary contained "The fields are too wet to pull mustard, which worries Walter. The men dislike weeding more than any other work; nevertheless, they have pulled all the mustard on this farm every year we have been here. They come in with their backs just wet. Fred says they have to open and shut all day like jackknives" (5).

A survey of sunflower (*Helianthus annuus* L.) fields in North Dakota in 1979 indicated that wild mustard was the second most abundant weed with 75 percent of the fields infested (1). The infested fields contained an average of 2.7 wild mustard plants per square yard. Soybean [*Glycine max* (L.) Merr.] fields were not surveyed, but soybeans are grown on many of the same fields as sunflower. Wild mustard seed survives for several years in the soil (4). Thus, once a field is infested, wild mustard plants will occur in all crops grown in that field for many years.

Wild mustard is highly competitive with wheat (*Triticum aestivum*) (3). Wild mustard at 42 plants per square yard caused a 30 percent wheat yield loss. Wild mustard is effectively controlled in wheat and other cereal grains by treatment with 2,4-D [(2,4-dichlorophenoxy)acetic acid]. However, control in sunflower presently is limited to preemergence chloramben (3-amino-2,5-dichlorobenzoic acid). Bentazon (3,1-methylethyl-(1H)-2,1,3-benzothiadiazin-4(3H)-one 2,2-dioxide), acifluorfen [5-[2-chloro-4-(trifluoromethyl)phenoxy]-2-nitrobenzoic acid], and naptalam [2-[(1-naphthalenylamino)carbonyl]benzoic acid] plus dinoseb (2-(1-methylpropyl-4,6-dinitrophenyl) are all registered for postemergence wild mustard control in soybean. Information on the losses from wild mustard competition in sunflower and soybean would provide a basis for determining the economic benefit from various control practices, so research has been conducted to determine the influence of various wild mustard infestations in soybean and sunflower.

Wild Mustard in Soybean. The experiments were conducted at Casselton and Fargo, ND during 1968 to 1970. The wild mustard was seeded immediately after the soybeans were seeded, except when indicated otherwise. Wild mustard was thinned to the desired population by hand pulling within two weeks after emergence. 'Traverse' soybeans were seeded except where indicated otherwise. The

plot area was treated with trifluralin [2,6-dinitro-N, N-dipropyl-4-(trifluoromethyl)benzenamine] to control weeds other than wild mustard. Individual plots were three soybean rows wide and 24 feet long. The seed and dry matter yields were harvested by hand from the center row of each plot. All plots were cultivated once in a manner not disturbing the established wild mustard in the row.

One experiment involved wild mustard at 1, 2, 4, 8, and 16 plants per foot of soybean row spaced 20 and 40 inches apart and seeded at 60 and 120 pounds per acre. The experiments were established on May 23 and 15 at Casselton and May 31 and 28 at Fargo in 1968 and 1969, respectively. The experiment was a randomized complete block arranged in a split-plot with row spacing as the main effects and treatments were replicated six times.

An experiment was conducted to determine the critical period of wild mustard competition after soybean emergence. Traverse soybean was seeded in 1969 and 'Merit' in 1970. Soybean rows were 40 inches apart and were seeded at 90 pounds per acre on May 27 in 1969 and June 2, 1970. The wild mustard population was established at approximately 12 plants per foot of row. The wild mustard plants were pulled by hand 1, 2, 3, 4, 5, 6, 8, 10, and 12 weeks after soybean emergence. The experiment was a randomized complete block with treatments replicated six times.

A separate experiment was conducted to determine the influence of time of wild mustard emergence on competition with soybean. Traverse soybeans were seeded at 85 pounds per acre in rows spaced 38 inches apart, on June 5, 1969 and June 19, 1970. Wild mustard was seeded three and six days before, with, and three and six days after the soybean. The plots were watered after each seeding to assure wild mustard emergence.

Wild Mustard in Sunflower. An experiment was conducted to determine the competition from wild mustard in sunflower during 1967, 1968, and 1969 at Casselton, ND. 'Peredovik' sunflower were seeded during the last week of May each year. The plots were five 40-inch spaced rows of sunflower 12 feet long. The wild mustard plants were thinned within one week after emergence to 0, 1, 2, 4, 8, and 16 plants per foot of row. The experiment was a randomized complete block with four replications each year.

RESULTS AND DISCUSSION

Wild Mustard in Soybean. Soybean seed yield decreased as the density of wild mustard increased for soybean in both 20 and 40-inch spaced rows at Casselton and Fargo, averaged over seeding rate and years (Table 1). The decrease in yield per wild mustard plant was higher with the lower wild mustard infestations. One wild mustard per foot in 20-inch spaced soybean rows reduced soybean yield 4.6 bushels per acre at Fargo and 9.7 bushels per acre at Casselton. The yield reduction was 6.8 bushels per acre or 36 percent from one wild mustard plant per foot of row, averaged over locations, years, seeding rates, and row spacing. The average yield loss was 11.4 bushels per acre or 60 percent with 16 wild mustard per foot of row. The yield loss per plant with 16 wild mustard per foot of row was 0.7 bushels per acre.

Soybean without wild mustard had the same yield in 20 or 40-inch rows. The lack of a higher yield in narrow than wide rows may have resulted from the rather late seeding date and the dry conditions during the years of the experiment.

The percentage yield loss from a given wild mustard density per foot of row was higher for soybean in 20 than 40-inch rows (Figure 1). However, at a given number of wild mustard plants per foot of row, the number of wild mustard plants per acre would be twice as high for 20 than 40-inch rows. The percentage yield loss from wild mustard on a plant per acre basis generally was similar for soybeans in 40 or 20-inch rows. For example, one wild mustard per foot of 20-inch spaced row caused a 38 percent yield loss, while two plants in 40-inch rows caused a 39 percent yield loss. Other research had indicated that soybean in narrow rows was more competitive with weeds than when in wide rows (2). The intense competition from even low wild mustard densities may have masked any competition advantage from the soybean in narrow rows.

The lowest infestation used in the experiment, one wild mustard per foot of soybean row, caused more than a 30

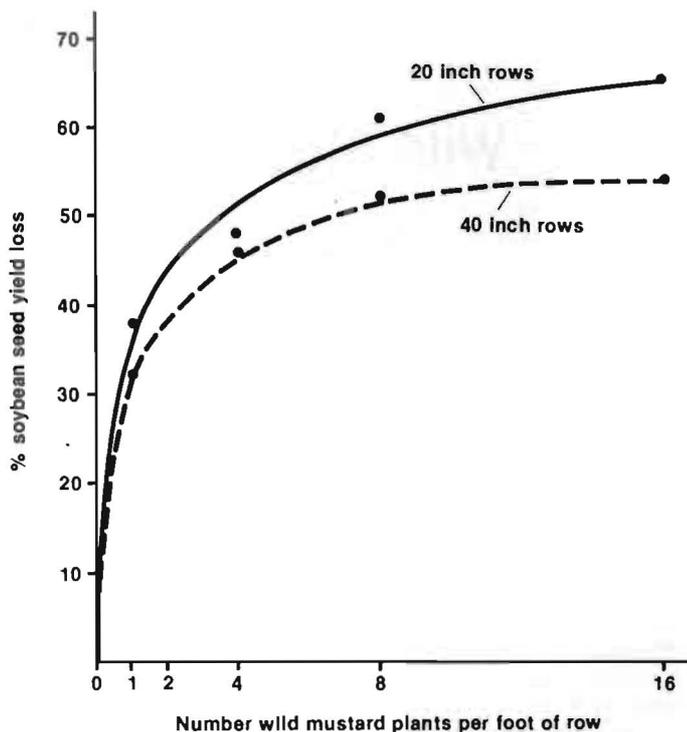


Figure 1. Percent soybean yield loss with various wild mustard infestations in soybeans at two row widths.

percent yield loss. Lower wild mustard plant populations would have been helpful in developing economic thresholds for various control practices. The data indicate that the competition from individual mustard plants was greater with the lower than high populations and the competition varied with locations. However, a linear yield loss was assumed with wild mustard from one to zero plants per foot of row. The average soybean yield loss would be 6.3 percent for each plant per 6 feet of soybean row spaced 20 inches apart and 5.3 percent for rows spaced 40 inches

Table 1. Soybean seed yield as influenced by wild mustard competition with soybean at two row widths, averaged over seeding rate and years.

Wild mustard in row (No./ft)	Fargo		Casselton		Soybean yield	
	Row spacing, inches				Average	Reduction (%)
	20	40	20	40.		
None	14.8b ^a	17.6a	21.7a	21.9a	19.0	---
1	10.2de	13.2bc	12.0bc	13.3b	12.2	36
2	9.6e	12.3cd	10.2cde	11.4bcd	10.9	43
4	9.0e	11.1cde	9.3cdef	9.8cdef	9.8	48
8	6.5f	9.7e	7.4ef	9.0def	8.2	57
16	5.5f	9.3e	7.2f	8.4ef	7.6	60
Avg.	9.3	12.2	11.4	12.3		

^a Values for a location followed by the same letter do not differ at the 5% level according to Duncan's Multiple Range Test.

apart. In solid seeded soybean with 6 to 10-inch spaced rows, the competition from wild mustard could be greater than when in the rows 20 or 40 inches apart, because the wild mustard would not be confined to an in-row high soybean density.

The reduction in soybean dry matter with various wild mustard infestation (Table 2) related directly to the seed yield reduction (Figure 1). Dry matter production of soybean and wild mustard was inversely related; generally a unit increase in wild mustard dry matter resulted in one unit decrease in soybean dry matter (Table 2). The total dry matter produced per unit area, soybean plus wild mustard, was the same for all wild mustard infestations at Fargo. The total dry matter production at Casselton was higher with the high wild mustard infestation than for soybean alone or with one wild mustard plant per foot of row. These data indicate that any growth of wild mustard in soybean caused nearly equal reduction in soybean growth. The average soybean density was seven plants per foot of row. The wild mustard at approximately equal density of eight plants per foot of row produced nearly twice the dry matter as the soybean at Fargo and nearly four times that of soybean at Casselton. On a plant-for-plant basis, wild mustard was more competitive than soybean.

The height of the soybean plants decreased as the wild mustard density increased (Table 2). Wild mustard height only tended to increase with density at Fargo but increased at Casselton. The wild mustard apparently increased in height as the competition for light increased. The competition from the wild mustard with soybean was apparently so great that the soybean could not grow to compensate for shading from the wild mustard.

Wild mustard competition in soybean caused a reduction in seeds per pod, pods per plant, seeds per plant and

seed weight (Table 3). The reductions in all these yield components tended to decrease as the wild mustard density increased. Wild mustard competition increased the height of the lowest pod, probably by preventing development of the lower flowers.

Wild mustard which was allowed to compete with soybeans for three weeks after emergence caused a 10 percent yield loss (Table 4). The competition from wild mustard increased rapidly from three to six weeks after soybean emergence with a 60 percent soybean yield loss with six weeks of competition. The wild mustard density was approximately 12 plants per foot of row. The high density accentuated the loss, but indicates the need for control of wild mustard within three weeks after emergence to minimize soybean yield loss.

Emergence of wild mustard prior to the soybean caused greater soybean yield losses than when the wild mustard emerged after the soybean (Table 5). The wild mustard plants which emerged eight days before the soybean caused an 89 percent lower yield than the weed-free soybean, and wild mustard which emerged eight days after soybean only caused an 11 percent lower yield. A four-day delay in wild mustard emergence after soybean reduced soybean yield 12 percent compared to a 43 percent reduction when emergence was at the same time as the soybean. Further, wild mustard which emerged four days earlier than soybean reduced soybean yield 80 percent compared to 43 percent when wild mustard emerged at the same time as the soybean. These losses were with 12 wild mustard plants per foot of row and were in reference to yield of weed-free soybeans. The emergence of wild mustard four days before or after soybean emergence was important in determining the soybean yield losses from wild mustard competition. The species, either wild mustard or soybean, which became established first apparently gained a large competitive advantage.

Table 2. Dry matter yields of wild mustard and soybean as influenced by wild mustard competition averaged over row widths, soybean sowing rates, and years at Fargo and Casselton.

Location	Wild mustard/ per foot of row (No.)	Dry matter			Plant height	
		Wild mustard	Soybeans	Combined	Wimu	Soyb
		----- (lb/A) -----			----- (inch) -----	
Fargo	Weed free	---	3062a	3062a	---	29a
	1	849d ^a	2083b	2932a	31a	24b
	2	1172c	1780c	2952a	31a	23de
	4	1629b	1410d	3038a	31a	22c
	8	2023a	1097e	3120a	32a	20d
	16	2108a	1149de	3254a	33a	20d
Casselton	Weed free	---	3586a	3586b	---	29a
	1	1963c	2017b	3980b	34c	25b
	2	2704b	1572c	4276a	36c	23c
	4	3030b	1288c	4318a	37b	22d
	8	3466a	859d	4325a	38ab	20e
	16	3659a	824d	4483a	39ab	19e

^a Values followed by the same letter within each column at each location do not differ at the 5% level according to Duncan's multiple range test.

Table 3. The influence of wild mustard at various densities on various characteristics of soybean.

Location	Spacing of wild mustard plants/ foot of row	No.	Seeds/ pod	Pods/ plant	Seeds/ plant	200 seed weight	Height of lowest pod
	(No.)		----- (No.) -----			----- (g) -----	----- (inch) -----
Fargo	Weed free		2.26a ^a	19.5a	44.0a	31.4a	12.4b
	30.5	1	2.06b	15.2b	31.3b	30.6ab	12.4b
	15.3	2	2.09b	12.0c	25.1c	30.4ab	13.2ab
	7.6	4	2.01b	10.6cd	21.2cd	29.7b	13.2ab
	3.8	8	1.92b	8.8de	17.1de	29.9b	13.2ab
	1.9	16	1.95b	7.8e	15.2e	29.8b	14.6a
Casselton	Weed free		1.98a	17.4a	33.8a	35.9a	11.9d
	30.5	1	1.85ab	9.9b	12.5b	35.6ab	12.7cd
	15.3	2	1.87ab	7.9bc	9.8bc	34.6ab	13.5bcd
	7.6	4	1.77bc	7.5cd	7.4cd	33.8ab	14.0abc
	3.8	8	1.66c	6.2cd	4.9d	32.7ab	14.7ab
	1.9	16	1.63c	5.8c	4.0d	32.2b	15.5a

^a Values followed by the same letter within each column at each location do not differ at the 5% level according to Duncan's multiple range test.

Table 4. Soybean seed yield as affected by removal of wild mustard at various weeks after soybean emergence at Fargo, averaged over 1969 and 1970 data.

Weeks of removal	Soybean seed yield	Yield reduction
	(bu/A)	(%)
Weed free	18.80a ^a	0
1	19.10a	0
2	18.89a	0
3	16.88ab	10
4	14.19bc	24
5	11.06c	41
6	7.55d	60
8	6.85d	64
10	7.23d	62
12	6.97d	63

^a Values followed by the same letter within each column do not differ at the 5% level according to Duncan's multiple range test.

The fresh and dry weight produced by wild mustard and soybean which emerged at various times related to competition between the species (Table 5). Wild mustard which emerged before the soybean grew more than when emergence was after soybean, and conversely soybean grew more when emergence was before the wild mustard. The vegetative growth of one species was directly influenced by the growth of the other species. The combined weight of both species was similar regardless of which species emerged first.

The severe competition from the wild mustard which emerged before the soybean indicated that the species which established first had the competitive advantage. Seeding soybean to fields with emerged or already germinated wild mustard would increase the potential yield

reduction for a given wild mustard infestation. A cultivation for seedbed preparation as close as possible to seeding soybean would reduce the potential for wild mustard to emerge before soybean and reduce potential yield loss. Wild mustard germinates at lower temperatures than soybean, so with cold conditions at or after seeding the wild mustard would emerge prior to the soybean and increase wild mustards' competitive advantage over soybean. The differences in competition from wild mustard between years and locations may have been due in part to differences in time of emergence caused by soil moisture and temperature after seeding. The tillage for seedbed preparation always was within one day of seeding the soybean in the experiments with various wild mustard densities.

Wild mustard competition with sunflower varied greatly from year to year (Table 6). Sixteen wild mustard plants per foot of row caused a 60 percent yield loss in 1969 and only 11 percent in 1967, so environmental conditions influenced the yield reductions caused by wild mustard. In 1969 the higher competition than the other years may have been from the adequate moisture early in the season which favored early wild mustard germination and growth.

Information was not obtained on the influence of duration of wild mustard competition or time of emergence on yield losses in sunflower. However, early established wild mustard probably would be more competitive than the later emerging wild mustard as occurred for the experiments in soybean.

The percent oil and the iodine value of the oil from sunflower or soybean seed was the same whether from plants grown weed free or with wild mustard. Wild mustard competition which caused high yield reductions did not reduce the quality of soybean or sunflower seed.

The results of these experiments indicate the potential soybean and sunflower yield losses from various wild

Table 5. Soybean seed yield and growth of wild mustard and soybean as affected by various intervals of wild mustard emergence at Fargo.

Wild mustard emergence relative to soybeans	Soybean seed		Fresh weight, 1969		Dry weight, 1970	
	Yield	%	Soybeans	Wild mustard	Soybeans	Wild mustard
	(lb/A)	(%)	----- (lb/A) -----			
8 days before	123c ^a	89	757d	9470a	363b	2853a
4 days before	232c	80	936d	12246a	412b	2205b
Same day	655b	43	7142c	2235b	367a	1129c
4 days after	1007a	12	9362bc	1193b	1420a	846cd
8 days after	1013a	11	10420ab	1041b	1797a	575d
Weed free	1143a	0	12641a	0	2220a	0

^a Values followed by the same letter within each column do not differ at the 5% level according to Duncan's multiple range test.

Table 6. Sunflower seed yields as affected by wild mustard competition at Casselton, North Dakota.

Wild mustard plants per foot of row	Years				Yield reduction
	1967	1968	1969	Combined	
	----- (lb/A) -----				(%)
0	1022a ^a	1588a	1382a	1331a	0
1	985a	1580a	1117b	1227ab	8
2	899a	1415b	1118b	1144b	15
4	899a	1401b	750c	1017c	24
8	914a	1394b	682cd	997c	25
16	910a	1294b	567d	924c	31

^a Numbers within a column followed by the same letter do not differ at the 5% level according to Duncan's multiple range test.

mustard infestations. The magnitude of the loss from a given wild mustard density will vary with environmental conditions and cultural production practices. Wild mustard consistently caused greater yield reductions when in soybean than in sunflower.

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