AN ABSTRACT OF THE THESIS OF

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Title: FACTORS INFLUENCING WILD OAT CONTROL WITH N-BENZOYL-N-(3, 4-DICHLOROPHENYL) ALANINE (SD 30053)

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Studies were conducted in 1969 and 1970 to evaluate the effectiveness of an experimental herbicide, SD 30053 (alanine, N-benzoyl-N-(3, 4-dichlorophenyl)-, ethyl ester), for wild oat (Avena fatua L.) control in winter cereals.

The 1969 field studies showed that postemergence applications of SD 30053 were effective in controlling wild oats. Wild oat control and grain yields were consistently better when SD 30053 was applied to wild oats when one to three stem nodes were visible. The application of 1 lb a.i. /A[1] of SD 30053 to wild oats at the third node stage of growth gave similar results as 2 lb a.i. /A applied to wild oats with one stem node visible or 4 lb a.i. /A applied to wild oats which had 1-4 tillers formed. The grain yields from the above

[1] a.i. refers to active ingredient

treatments were all significantly higher than the weedy check. The tank-mixing of SD 30053 with the dimethylamine salt of 2, 4-D reduced the effectiveness of SD 30053 in controlling wild oats. Nugaines winter wheat was quite tolerant to all SD 30053 applications while Wade fall barley was not sufficiently tolerant.

The 1970 wild oat control results were similar to those obtained in 1969. When applied alone, SD 30053 was more effective at lower rates in controlling wild oats in the one- to 3-stem node growth stage than at earlier growth stages. On these later dates of application, only 1.0 to 1.5 lb ai./A of SD 30053 were required to give satisfactory wild oat control. When applied to wild oats which were beginning to tiller, 3.0 lb a.i./A of SD 30053 gave only fair wild oat control. However, the grain yields from these early applications were comparable or higher (depending upon location) than the later applications even though wild oat control was much poorer on the early application date. The delay in application caused a yield reduction from prolonged wild oat competition.

The addition of a non-phytotoxic oil to SD 30053 definitely increased its herbicidal activity at lower rates and on earlier dates of application.

Growth chamber studies in 1970 showed that SD 30053 was much more effective when applied alone to wild oats which had not been previously sprayed with the dimethylamine salt of 2, 4-D.

Factors Influencing Wild Oat Control with N-benzoyl-N-(3, 4-dichlorophenyl) alanine (SD 30053)

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INTRODUCTION

Wild oats (Avena fatua L.) infests agricultural fields in 31 countries of the world, causing a staggering economic loss to the farmer (18). This annual weed not only reduces the yield and quality of the grain crop, but also costs the farmer additional expense in extra tillage practices and handling costs (28).

Farmers are faced with a most difficult and complex problem in controlling wild oats. Nature has abundantly endowed the plant with the following characteristics to ensure its perpetuation:

a. Early maturity and shedding of seeds before the grain crop ripens.

b. Variable seed dormancy (28).

c. Many different strains or selections which differ in growth habits and life cycle (23).

At present, methods used to reduce wild oat populations in cereal crops are cultural controls and chemicals. Cultural control measures can be effective in reducing the wild oat population but will not eradicate the problem.

The following three chemicals are presently registered for

wild oat control in cereal crops: (a) triallate (S-(2, 3, 3-trichloroallyl) diisopropylthiocarbamate), (b) diallate (S-(2, 3-dichloroallyl) diisopropylthiocarbamate), and (c) barban (4-chloro-2-butynyl m-chloro-carbanilate). The main problems with diallate and triallate are that they must be incorporated into the soil in order to be effective and crop injury may occur if the chemicals move into the crop seeding zone. Barban is most effective when applied postemergence to wild oats in the 1 1/2- to 2-leaf growth stage (12). Barban has been helpful to the cereal growers in reducing wild oat populations, but because of this critical timing factor, it has been inconsistent.

The present methods of controlling wild oats in cereal crops by cultural or chemical means have suppressed the wild oat population but are not the complete answer. The development of a more effective chemical would be of great value to the cereal growers.

In 1968, Don Rydrych, Pendleton Experiment Station, reported that postemergence applications of a new experimental chemical, SD 30053 (alanine, N-benzoyl-N-(3, 4-dichlorophenyl)-, ethyl ester) were very effective in controlling wild oats (22).

With these results in mind, a number of field trials and one growth chamber experiment were established in 1969 and 1970 to evaluate the effectiveness of SD 30053 for controlling wild oats in winter cereals. The objectives of this thesis were as follows: (a) determine the optimum rate and time of application of SD 30053

for maximum wild oat control when applied alone or in combination with a non-phytotoxic oil, (b) evaluate SD 30053 for wheat and barley selectivity, (c) obtain yield data from plots treated at different times to provide information on wild oat competitive effects versus maximum control, and (d) evaluate the effectiveness of a combination treatment of 2, 4-D amine plus SD 30053 for wild oat control.

LITERATURE REVIEW

Wild Oat Competition

Nalewaja (18) reported that the most important impact of a wild oat infestation in field crops is the tremendous reduction in crop yield. Yield reduction is influenced by a crop's competitive ability for moisture, nutrients, and sunlight and by the population and time of wild oat emergence.

The percent yield reduction caused by a wild oat density in a crop varies considerably according to the soil and climatic conditions at a given location and year. Based on the average percent yield reduction, wheat competes less with wild oats than barley. An infestation of 40 wild oat plants per square yard in North Dakota spring wheat resulted in a 15% or greater reduction, and with 160 plants per square yard, a 40% yield reduction. In normal field conditions, 40 wild oat plants per square yard is a light infestation; however, 160 wild oat plants per square yard is not uncommon. Barley, though a better competitor than wheat, had a yield loss exceeding 35% with an infestation of 250 wild oat plants per square yard.

Bowden and Friesen (4) found that from 10 to 40 wild oat plants per square yard were sufficient to cause significant yield reduction

in spring wheat when grown on summer fallow land in Winnipeg, Canada. Wild oat competition reduced the number of tillers per wheat plant, but did not affect the protein content of the harvested grain. Wild oat competition may have already commenced prior to the emergence of wheat, especially at the higher densities of wild oats. The competitive effects increased with time and with wild oat density.

Holmer and Pfeiffer (14) in Essex, England reported that autumn-germinated wild oats were a far more serious weed problem than spring-germinated plants in winter wheat.

In 1969, Abu-Irmaileh (1) conducted several field experiments in the Willamette Valley of Oregon on the effect of wild oat competition on winter wheat yields. His results at the Wait Farm showed that severe competition occurred and a significant yield reduction resulted from a high density of wild oats (175-198 wild oat plants per square yard). There was a 32% reduction in grain yield and a 35% reduction in wheat tillers formed. At another location, where annual ryegrass and wild oats were both present, there was a 56% reduction in grain yield. Where the wild oats were removed only once, grain yields were higher in plots from which wild oats were removed at the beginning of spring or at the heading stage than in those plots from which the wild oats were removed early (2-leaf stage). He also found that wild oats were germinating continuously

throughout the growing season. This would partially explain these lower yields where the wild oats were removed early.

Wild Oat Control

Today cultural methods and the use of selective herbicides are being employed by cereal growers to control wild oats. The use of these control measures have been helpful in reducing the wild oat problem but more research is needed, especially in the development of more effective and selective herbicides.

Cultural Control Measures

The following cultural control methods must be carried on for several years in order to be effective in controlling wild oats:

1. Delayed Seeding--Experiments have established this as the best method for controlling the current crop of wild oats. The soil surface should be tilled to a depth of not more than 4 inches early in the spring to aerate the soil and promote germination of wild oat seeds. Seeding is delayed until there is a maximum number of wild oats that can be killed by pre-seeding tillage. An early maturing spring barley is the most suitable crop for delayed seeding and should be seeded at a slightly heavier rate than normal.
2. Post Seeding Cultivation--The harrow or rod weeder can be

used to destroy wild oat plants after the crop has been planted. In order to utilize this method, seeding should be deeper than normal and cultivation should begin when the coleoptile on the grain is one-half inch in length.

3. Fall Cultivation--Cultivation after harvest causes early spring germination of wild oats and results in cleaner crops (6).
4. Summer Fallow--When carefully managed, a year of fallow will "grow out" a large number of wild oat seeds lying to a depth of five inches. This method can cause a substantial reduction in wild oat population on heavily infested fields (5).
5. Cropping Methods--(a) Green feed crops, such as oats cut for forage prior to the heading of wild oats. (b) Forage crops, such as grasses and legumes included in a systematic crop rotation from two to five years will help reduce the wild oat population (6).

The above cultural control methods can be effective in reducing the wild oat population but will not eradicate the problem.

Chemical Control Methods

Presently the following three herbicides are used commercially to control wild oats selectively in cereal crops: (a) barban, (b) triallate, and (c) diallate (18). An experimental herbicide, SD 30053 has shown potential for controlling wild oats in cereals (25).

Barban

Barban is recommended as a postemergence treatment for wild oat control in winter and spring varieties of wheat and barley. It should be applied when the wild oats are in the 1 1/2- to 2-leaf stage of growth (18). The time of application is important; poor results will be obtained if spraying is done before or after the above recommended stage. Wild oats emerging after the barban application will not be controlled (6). Because of this critical timing of application, barban has been inconsistent in controlling wild oats.

Triallate

Triallate is a preemergence herbicide for wild oat control in barley, and in durum, spring, and winter wheat. Proper application and soil incorporation are the keys to success with triallate. For best crop selectivity, it should be applied broadcast and incorporated after seeding. Immediately after application, the chemical should be incorporated to a depth of two inches or less with a disk-type implement or cultivator, with the latter followed by a spike-tooth or spring-tooth harrow. Pre-seeding applications are also recommended but this method of application can be less selective and result in a stand reduction (17). The main problems with triallate are that the chemical must be incorporated into the soil to be

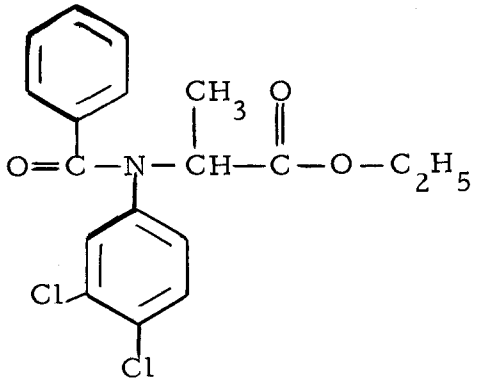
effective and that crop injury can occur if the chemical gets into the crop seeding zone.

Diallate

Diallate is used in the same manner as triallate. The major differences are that triallate has a greater margin of crop safety to wheat and barley. Also, diallate is registered on only barley (16).

Experimental Herbicide SD 30053

Shell Chemical Company is presently developing SD 30053, an experimental postemergence herbicide for wild oat control in cereals. Its chemical structure is:



The pure chemical is an off-white crystalline powder which melts at 54-56 C. At 20 C it is soluble in xylene (35-40%) and Shellsol A (30-35%).

The LD_{50} has been found to be 1, 555 mg/kg of body weight for rats and 2, 000 mg/kg for dogs.

The mode of action of SD 30053 is not yet completely understood. The growth of the treated wild oats is initially arrested. Competition from the crop combined with the action of SD 30053 eventually causes death (25).

POSTEMERGENCE APPLICATIONS OF SD 30053 FOR WILD OAT CONTROL IN CEREALS

General Material and Methods

Seven field experiments were established in 1969 and 1970 in the Willamette Valley of Oregon to evaluate the experimental herbicide SD 30053 for wild oat control in winter cereals. The objectives of these field experiments were as follows:

a. to determine the optimum rate and time of postemergence applications of SD 30053 for wild oat control when applied alone or in combination with a non-phytotoxic oil,

b. to evaluate SD 30053 for winter wheat and fall barley selectivity,

c. to obtain yields from plots treated at different times to provide information on the wild oat competitive effect versus maximum control, and

d. to study a possible interaction between a combination treatment of SD 30053 with the dimethylamine salt of (2, 4-dichlorophenoxy) acetic acid.

Six of the experimental trials were conducted on commercially established cereal fields. The seventh experiment was initiated on the Oregon State University East Farm near Corvallis, Oregon.

SD 30053 postemergence treatments were applied broadcast

with a bicycle-wheel plot sprayer using water as the carrier at approximately 45 gallons per acre. Barban was applied postemergence in approximately 20 gallons of water per acre as a commercial standard.

Experiments were arranged in a randomized block design. Treatments were replicated five times except at the Wait, Owens, and Oakley Farms where only four replications were used. Individual plots were 8 × 30 feet except at the Oakley Farm where they were 8 × 25 feet.

Wild oat head counts, grain yields, and visual estimates of percent crop injury and wild oat control were taken prior to harvesting. A scale of 0 to 100% was used to estimate wild oat control and crop injury. A zero rating indicated no visible reduction in stand or plant growth. A rating of 100 represents complete plant elimination. Wild oat head counts were made by placing at random a 1-sq. ft. quadrat and counting the number of wild oat heads inside the quadrat. Four counts were made for each individual plot.

The plots were harvested for grain yield using a self-propelled plot combine with a 5-ft. header. The harvested grain samples were cleaned and yield data were subjected to analysis of variance.

Field Experiments--1969

Riddell Farm

Materials and Methods

An experiment was established on Wade winter barley at the Riddell Farm near Monmouth, Oregon in November 1969. Post-emergence applications of SD 30053 were applied at 0.5, 1.0, 2.0, and 4.0 lb a.i./A on three different dates and growth stages of the barley and wild oats. A tank-mix combination treatment of 2.0 lb a.i./A of SD 30053 plus 0.75 lb a.i./A of the dimethylamine salt of (2, 4-dichlorophenoxy)acetic acid was also applied on these various dates. The dates of application and growth stages of the barley and wild oats are described in Table 1. Barban was applied postemergence on November 28, 1969 at 0.33 lb a.i./A when wild oats were in the 1- to 2-leaf stage and barley 3- to 5-leaf stage.

Table 1. Summary table of the growth stages of the wild oats and Wade barley on the three dates of SD 30053 applications at the Riddell Farm.

Application	Date	Growth Stages	
		Wild Oats	Wade Barley
First	February 12, 1970	2-leaf to 3 tillers formed	8-10 tillers formed
Second	April 17, 1970	first to second stem node visible	first stem node visible to heading
Third	May 6, 1970	heading	heading

Barley yields, wild oat head counts, and visual observations on wild oat control data were not taken at this location because of severe lodging of the barley and winter killing of the wild oats. Visual estimates on reductions in Wade barley stand and height were made on May 27, 1970.

Results and Discussion

The stand and height of the Wade barley were substantially reduced from the second postemergence applications of SD 30053. The barley injury increased as the rate of SD 30053 increased. The first and third dates of SD 30053 application caused some slight barley injury, but not nearly as much as the second application. Table 2 and Appendix Table 1 illustrate these points. Behrens et al. (2) found that early postemergence applications of SD 30053 did not cause any injury to Larker spring barley but a later application did. They also observed that a late postemergence application was more effective in controlling wild oats than an early postemergence application. Friesen (10) and Zimdahl and Thiele (28) also have shown from their research that barley does not have an adequate tolerance to SD 30053 applications.

There appeared to be a possible interaction from the tank-mixing of SD 30053 with the dimethylamine salt of 2, 4-D when applied on the second application date. The tank-mix treatment showed less

Table 2. Summary of SD 30053 effects applied postemergence to Wade barley--1969 study at the Riddell Farm.

Treatment	Rate Lb a.i./A	Visual Evaluations on Barley Vigor: Average Stand Reduction (%)	Average Height Reduction (%)
First Application Date			
SD 30053	.5	2	1
SD 30053	1	1	2
SD 30053	2	3	1
SD 30053	4	18	9
SD 30053 + 2, 4-D (tank-mix)	2 + .75	5	2
Second Application Date			
SD 30053	.5	20	12
SD 30053	1	45	18
SD 30053	2	59	34
SD 30053	4	68	43
SD 30053 + 2, 4-D (tank-mix)	2 + .75	47	23
Third Application Date			
SD 30053	.5	1	1
SD 30053	1	5	3
SD 30053	2	13	8
SD 30053	4	13	9
SD 30053 + 2, 4-D (tank-mix)	2 + .75	15	10
Others			
Barban	.33	0	0
Untreated check	0	0	0

barley injury than the application of the comparable rate of SD 30053 applied alone. Zimdahl and Thiele (29) reported that 60% of the wild oats were controlled by a postemergence application of 0.75 or 1.0 lb a.i./A of SD 30053 plus oil when applied to wild oats in the 5-leaf stage of growth. If 0.5 lb a.i./A of 2,4-D amine was added to these SD 30053 treatments, wild oat control was reduced to only 10 and 20 percent respectively.

Owens Farm

Materials and Methods

This field experiment was initiated on Nugaines winter wheat at the Owens Farm near Corvallis, Oregon in November 1969.

As previously described, SD 30053 postemergence treatments were applied to the following three wild oat growth stages: (a) first application made on March 24, 1970 to wild oats which had 1 to 4 tillers formed, (b) second application with the first stem node visible on April 15, 1970, and (c) the third application was sprayed on May 2, 1970 to wild oats with the second stem node visible. The wheat growth stages were the same as the wild oats on the April and May application dates, but in March, the wheat was in the fully tillered stage of growth. Barban was applied postemergence on January 20, 1970 to wild oats in the 2- to 3-leaf growth stage.

The trial area was sprayed with a preemergence application of

1.6 lb a.i./A of diuron (3-(3, 4-dichlorophenyl)-1, 1-dimethylurea) in the fall for Italian ryegrass (Lolium multiflorum Lam.) control. Only fair control was obtained and a heavy stand of ryegrass remained in the trial area.

The same data as previously described were collected and are recorded in Table 3 and Appendix Tables 2 and 3. The area harvested for grain yields was 5 × 30 feet.

Results and Discussion

The first postemergence applications of SD 30053 required the high rate of 4 lb a.i./A to give satisfactory wild oat control with a grain yield significantly higher than the untreated check. All other treatments of SD 30053 on this date gave poor wild oat control and grain yields similar to the untreated check. In general, the later postemergence applications of SD 30053 in April and May gave better wild oat control and higher grain yields at lower rates than the early applications in March. The postemergence application of 1 lb a.i./A of SD 30053 in May gave grain yields and wild oat control comparable to 2 lb a.i./A applied in April or 4 lb a.i./A applied in March. These data show that SD30053 is more effective in controlling wild oats that are in a later stage of growth (one to two stem nodes visible). Nugaines winter wheat was quite tolerant to all rates and dates of SD 30053 applications.

Table 3. Summary of the effects of SD 30053 applied postemergence on three dates of application for wild oat control in winter wheat--1969 study at the Owens Farm.

Treatment	Rate Lb. a.i./A	Visual Evaluations - Average Wild Oat Control (%)	Winter Wheat Injury (%)	Average Number of Wild Oat Plants (heads/sq. ft.)	Average Wheat Yield (Bu/A)
First Application Date					
SD 30053	.5	10	0	11.4	38.7
SD 30053	1	18	0	9.9	46.5
SD 30053	2	43	0	7.9	46.0
SD 30053	4	84	0	1.5	57.6
SD 30053 + 2, 4-D (tank-mix)	2 + .75	33	0	8.8	53.6
Second Application Date					
SD 30053	.5	45	0	9.9	44.0
SD 30053	1	65	0	6.9	46.5
SD 30053	2	83	0	3.2	54.2
SD 30053	4	95	0	0.9	51.8
SD 30053 + 2, 4-D (tank-mix)	2 + .75	54	0	8.1	40.2
Third Application Date					
SD 30053	.5	63	0	8.1	51.3
SD 30053	1	85	0	3.5	52.8
SD 30053	2	93	0	1.7	53.5
SD 30053	4	97	0	0.8	54.2
SD 30053 + 2, 4-D (tank-mix)	2 + .75	64	0	5.6	46.5
Others					
Barban	.33	53	0	6.4	65.9
Untreated	0	0	0	14.1	43.6

$LSD_{0.5}$ = 9.7 Bu/A

In 1970, Nalewaja (19) reported that postemergence applications of 0.75 and 1.5 lb a.i./A of SD 30053 to wild oats in the 1 1/2 to 2-leaf stage of growth gave only 60% control. When the wild oats were in the 5-leaf stage, 1.5 lb a.i./A of SD 30053 gave 98% wild oat control. In his studies, Waldron spring wheat was quite tolerant to postemergence applications of SD 30053.

Under field conditions, wild oats which were affected by late postemergence applications of SD 30053 showed the following symptoms: (a) a darker green color in leaves, (b) dying back of the last leaf formed, starting from the tip and progressing down the leaf blade (Figure 1), (c) stunting of plant growth, and (d) inhibition of floral formation (Figure 2).

Plots treated with the combination treatment of SD 30053 plus the dimethylamine salt of 2,4-D applied as a tank-mix yielded less grain than those plots where SD30053 was applied alone at a comparable rate. This was not surprising since 2,4-D often reduces yields when applied during the jointing stage. The addition of 2,4-D distinctly reduced wilt oat control, indicating a possible antagonistic effect. The lower yields may have been partially due to the poorer wild oat control.

Swan (27) found in his Nugaines winter wheat field trials that the addition of a low volatile ester of 2,4-D or MCPA ([(4-chloro-o-tolyl)oxy]acetic acid) with SD 30053 reduced its effectiveness for

Figure 1. SD 30053 applied at 2.0 lb a.i./A to wild oats in the first stem visible stage of growth caused the last leaf formed to become chlorotic and die.

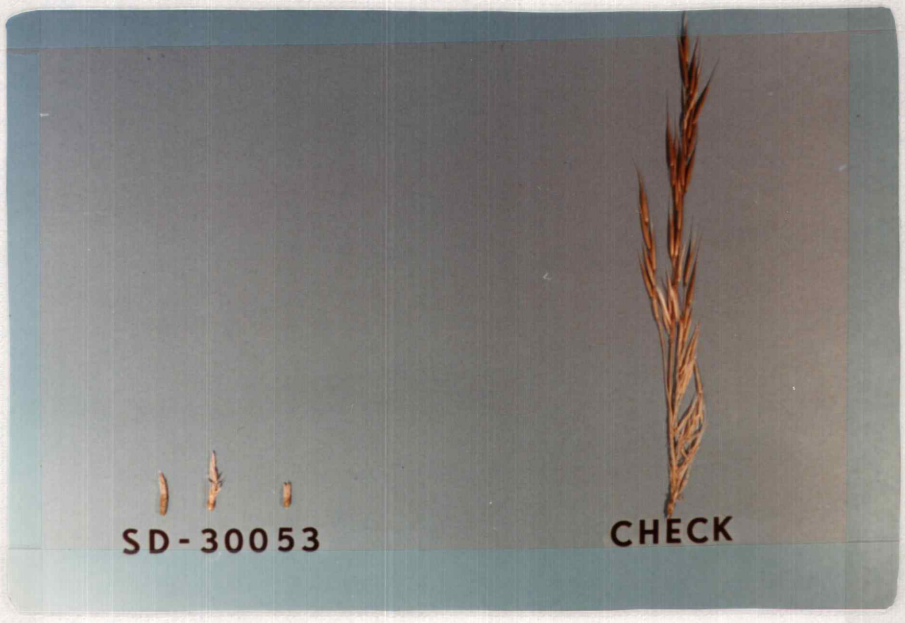


Figure 2. SD 30053 applied at 2.0 lbs a.i./A to wild oats in the first stem node visible stage of growth caused an inhibition of floral development.

controlling wild oats.

Barban, when applied to wild oats in the 2- to 3-leaf stage, gave poor wild oat control but the grain yield was the highest at this location. Some of this increased grain yield can be attributed to the fact that barban gave 75% control of Italian ryegrass in the plot area. The SD 30053 treatments did not control the ryegrass, therefore, wheat yields were reduced.

Wait Farm

Materials and Methods

A third field trial was established in Nugaines winter wheat in the fall of 1969 on the Wait Farm near Rickreall, Oregon.

The same SD 30053 treatments were applied as previously described at the Owens and Riddell Farms. The growth stages of the wild oats and winter wheat on the three dates of SD 30053 applications are recorded in Table 4.

Table 4. Summary table of the growth stages of wild oats and Nugaines wheat on the three dates of SD 30053 applications at the Wait Farm.

Application	Date	Growth Stages	
		Wild Oats	Nugaines Wheat
First	March 31, 1970	1-3 tillers formed	4-5 tillers formed
Second	April 14, 1970	First stem node visible	Second stem node visible
Third	May 2, 1970	Second to third stem node visible	Third stem node visible

Barban was applied, as before to wild oats in the 2- to 3-leaf stage.

The grower applied 1.6 lb a. i. /A of diuron preemergence in the fall for Italian ryegrass control. Good control was obtained and only a light stand remained in the trial area.

Data were collected as in the other experiments except the area harvested for grain yields was 5 × 28 feet.

Results and Discussion

Results are given in Table 5 and Appendix Tables 4 and 5. The data obtained were quite similar to those at the Owens Farm.

The late postemergence applications of SD 30053 in April and May gave better wild oat control and higher grain yields at lower rates than the early application in March. All SD 30053 treatments applied in April and May resulted in grain yields significantly higher than the untreated check.

The tank-mixing of SD 30053 with the dimethylamine salt of 2, 4-D caused a substantial reduction in wild oat control when applied in April and May (Figure 3). These data strongly indicate that there is an antagonistic effect from the tank-mixing of these two herbicides.

Field work in North Dakota by Nalewaja (20) showed that wild oat control from SD 30053 applications was greatly reduced when applied with either 2, 4-D amine, dicamba (3, 6-dichloro-o-anisic acid), or picloram (4-amino-3, 5, 6-trichloropicolinic acid).

Table 5. Summary of the effects of SD 30053 applied postemergence on three dates of application for wild oat control in winter wheat--1969 study at the Wait Farm.

Treatment	Rate Lb. a.i./A	Visual Evaluations - Avg Wild Oat Control (%)	Visual Evaluations - Avg Winter Wheat Injury (%)	Average Number of Wild Oat Plants (Heads/sq. ft.)	Average Wheat Yield (Bu/A)
First Application Date					
SD 30053	.5	6	0	24.4	39.4
SD 30053	1	20	0	17.8	41.0
SD 30053	2	33	0	16.3	48.7
SD 30053	4	78	0	5.1	54.5
SD 30053 + 2, 4-D (tank-mix)	2 + .75	33	0	17.3	38.4
Second Application Date					
SD 30053	.5	43	0	15.3	56.7
SD 30053	1	65	0	6.3	61.7
SD 30053	2	84	0	4.9	67.4
SD 30053	4	93	0	0.8	70.8
SD 30053 + 2, 4-D (tank-mix)	2 + .75	43	0	14.2	57.0
Third Application Date					
SD 30053	.5	64	0	8.9	56.8
SD 30053	1	84	0	4.9	60.0
SD 30053	2	90	0	2.6	65.9
SD 30053	4	95	0	2.1	65.3
SD 30053 + 2, 4-D (tank-mix)	2 + .75	66	0	9.1	57.8
Others					
Barban	.33	23	0	17.3	56.5
Untreated	0	0	0	27.3	41.2

$LSD_{.05}$ = 10.4 Bu/A

gure 3. SD 30053 applied at 2.0 lb a.i./A to wild oats in which the first stem node was visible at the base of the shoot.

Figure 4. Tank-mix treatment of 2.0 lb a.i./A of SD 30053 with 0.75 a.i./A of the dimethylamine salt of 2, 4-D applied to wild oats when the first stem node was visible at the base of the shoot.

Summary of 1969 Field Experiments

Postemergence applicationsof SD 30053 showed great promise for controlling wild oats in winter wheat. Excellent wild oat control and higher yields were obtained from applications when wild oats had one stem node visible or up to the third node stage of growth. In the early stage of wild oat growth (1-4 tillers formed), a high rate of 4 lb a. i. /A of SD 30053 was required to obtain satisfactory wild oat control. When applied to wild oats in the 1-3 stem node stage, only 1 or 2 lb a. i. /A of SD 30053 was required for control. Wild oat control was better from applications on the third date (May) than on the second (April), but the effect of this increased control on grain yields was partially (Owens Farm) or completely (Wait Farm) offset by the additional competition suffered by delaying application.

A reduction in grain yields from a tank-mix combination treatment of SD 30053 with the dimethylamine salt of 2, 4-D is not surprising since 2, 4-D alone will often cause a yield reduction when applied in the early jointing stage. But there was a distinct reduction in wild oat control from this tank-mix treatment, indicating an antagonistic effect.

Nugaines winter wheat was quite tolerant to SD 30053 applications. Wade fall barley was seriously injured from SD 30053 applications at the early jointing stage.

Field Experiments--1970

Herr Farm

Materials and Methods

This field experiment was established in the fall of 1970 on a commercial field of Nugaines winter wheat at the Herr Farm near Salem, Oregon.

The trial was carried out as described in the previous experiments except SD 30053 was applied with a non-phytotoxic oil, either as a tank-mix or as a formulation which already contained oil. The following postemergence applications of SD 30053 were applied on the first and second dates of application: (a) alone at 1.0, 1.5, 2.0, and 3.0 lb a.i./A, (b) as a tank-mix including 1.5 lb a.i./A of SD 30053 plus 1 quart per acre of a non-phytotoxic oil, and (c) at 0.75, 1.0, and 1.5 lb a.i./A of SD 30053 oil-containing formulation. On the third date of application, SD 30053 was applied alone at 1.0, 1.5, 2.0, and 3.0 lb a.i./A. The dates and growth stages of the wild oats and wheat plants are recorded in Table 6.

Barban was applied postemergence on December 11, 1970 to wild oats in the 2-leaf stage of growth. Wild oats were removed from the hand-weeded check plots on December 4, 1970 and March 1, 1971.

Table 6. Summary table of the growth stages of the wild oats and Nugaines winter wheat on the three dates of SD 30053 applications at the Herr Farm.

Application	Date	Growth Stages	
		Wild Oat	Nugaines Wheat
First	February 12, 1971	Beginning of tillering	Beginning of tillering
Second	April 17, 1971	First stem node visible	First stem node visible
Third	May 6, 1971	Third stem node visible	Second to third stem node visible

Data as described in the general materials and methods were collected and recorded. The area harvested for grain yields was 5 × 27 feet. The average wild oat population in the trial area was 8.5 plants/sq. ft.

Results and Discussion

The results are recorded in Table 7 and Appendix Tables 6 and 7. There was no wheat injury from any of the SD 30053 treatments.

First Application Date. When SD 30053 was applied without oil, poor wild oat control was obtained from the 1.0, 1.5, and 2.0 lb a.i./A rates. The 3.0 lb a.i./A rate gave fair control of the wild oats (62%). However, even though the wild oat control was not satisfactory, the grain yields from the 1.5, 2.0, and 3.0 lb a.i./A rates were significantly higher than the untreated check.

The SD 30053 became more effective in controlling wild oats at lower rates when applied with the oil. Tank-mixing of 1.5 lb

Table 7. Summary of the effects of SD 30053 applied postemergence on three dates of application for wild oat control in winter wheat--1970 study at the Herr Farm.

Treatment	Rate Lb. a.i./A	Visual Evaluations - Avg Wild Oat Control (%)	Winter Wheat Injury (%)	Average Number of Wild Oat Plants (Heads/sq. ft.)	Average Wheat Yield (Bu/A)
First Application Date					
SD 30053	1	4	0	16.8	65.6
SD 30053	1.5	31	0	12.1	77.4
SD 30053	2	32	0	12.3	75.3
SD 30053	3	62	0	7.6	85.5
SD 30053[a]	.75	28	0	13.0	79.6
SD 30053[a]	1	44	0	11.9	81.2
SD 30053[a]	1.5	81	0	4.8	89.3
SD 30053 + oil[b]	1.5 + 1 qt/A	80	0	5.8	90.4
Second Application Date					
SD 30053	1	56	0	8.5	76.4
SD 30053	1.5	74	0	5.1	79.1
SD 30053	2	83	0	4.0	78.0
SD 30053	3	93	0	2.0	81.7
SD 30053[a]	.75	86	0	2.3	79.6
SD 30053[a]	1	91	0	2.2	76.9
SD 30053[a]	1.5	95	0	1.3	76.9
Third Application Date					
SD 30053	1	63	0	8.4	65.6
SD 30053	1.5	82	0	5.2	66.7
SD 30053	2	88	0	4.3	71.5
SD 30053	3	92	0	2.6	72.6
Others					
Barban	.33	69	0	9.2	85.5
Untreated	0	0	0	22.2	62.4
Hand-weeded check	0	100	0	0	89.3

a - Formulation contains oil b - Superior Spray Oil L.S.D.$_{.05}$ = 8.1 bu/A

a. i. /A of SD 30053 with 1 qt. /A of a non-phytoxic oil[2] or 1. 5 lb a. i. /A of the oil-containing formulation gave satisfactory wild oat control. The grain yields from these treatments were the highest at this location and were equal to the hand-weeded check.

These results agree with those of Behrens, Strand, Smith, and Elakkad (2) of Minnesota who found in their spring wheat field trial that the addition of oil to postemergence applications of SD 30053 made it more effective in controlling wild oats.

Second Application. As in other field trials, the delaying of SD 30053 applications increased its effectiveness in controlling wild oats at lower rates. When applied without oil, the 1. 0 lb a. i. /A rate gave fair wild oat control while the 1. 5, 2. 0, and 3 lb a. i. /A rates gave satisfactory to excellent control. The grain yields from all of these treatments were significantly higher than the untreated check. In comparison with the grain yields from the first SD 30053 applications without oil, all were slightly higher except at the 3. 0 lb a. i. /A rate where the yield was slightly lower.

The oil formulation of SD 30053 gave excellent wild oat control at 0. 75, 1. 0, and 1. 5 lb a. i. /A rates. The grain yields from these treatments were significantly higher than the check but were generally lower than the oil treatments on the first application date.

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[2]Superior Spray Oil a product of Pennwalt Chemical Corporation.

Third Application Date. All treatments of SD 30053 were applied alone; there were no oil combination treatments on this date of application.

Satisfactory wild oat control was obtained from the 1.5, 2.0, and 3.0 lb a.i./A rates of SD 30053. The 1.0 lb a.i./A rate gave only 63% wild oat control. Grain yields from the 2.0 and 3.0 lb a.i./A rates were significantly higher than the untreated check. Even though these treatments were very effective in controlling the wild oats, the grain yields were substantially lower than those obtained in the two earlier dates of application. This delay in application enabled wild oat competition to reduce the grain yields.

Barban Application. The early postemergence application of 0.33 lb a.i./A of barban gave 69% wild oat control with a grain yield significantly higher than the untreated check. The following treatments of SD 30053 on the first date of application gave grain yields comparable to the barban treatment: (a) 3.0 lb a.i./A of SD 30053 applied without oil, (b) 1.5 lb a.i./A of the SD 30053 oil-containing formulation, and (c) the tank-mixing of 1.5 lb a.i./A of SD 30053 with 1 qt./A of Superior Spray Oil.

East Farm

Materials and Methods

This field trial was established on Nugaines winter wheat in the fall of 1970. The experiment was located on the East Farm, an Oregon State University research farm located near Corvallis, Oregon.

When the wild oats were beginning to tiller, the first post-emergence applications of SD 30053 were applied on January 26, 1971. The winter wheat was just beginning to tiller at this time. The following SD 30053 treatments were applied at this time: (a) without oil at rates of 1.0, 1.5, 2.0, and 3.0 lb a.i./A, (b) 1.5 and 3.0 lb a.i./A of the SD 30053 oil-containing formulation, and (c) tank-mixing of 0.75 or 1.5 lb a.i./A of SD 30053 with 1 qt./A of Superior Spray Oil.

The second postemergence applications of SD 30053 treatments were made on April 29, 1971. The first stem node on both the wild oats and Nugaines wheat was visible at the base of the shoot. The same treatments were applied as above except the SD 30053 oil-containing formulation treatments were excluded.

The last postemergence applications were made on May 14, 1971. SD 30053 was applied alone at 1.0, 1.5, 2.0, and 3.0 lb a.i./A to wild oats and wheat which had the third stem node visible.

A postemergence application of 0.33 lb a.i./A of barban was sprayed on December 11, 1970 to wild oats in the 2-leaf stage of growth.

On December 14, 1970 and February 19, 1971, wild oats were removed from the hand-weeded check plots.

The average wild oat population in the trial area was 7.3 plants/sq. ft. Similar data were collected as in previous experiments. The grain yields from the SD 30053 oil treatments were not included in the statistical analysis because they were not replicated or were replicated only twice. The plot area harvested for grain yields was 5 × 27 feet.

Results and Discussion

The results are recorded in Table 8 and Appendix Tables 8 and 9.

When SD 30053 was applied alone on the first date of application, it gave 16% wild oat control at the 1.0 lb rate and only 68% control at the 3.0 lb rate. The grain yields from all SD 30053 rates were significantly higher than the untreated check. Grain yields from the 1.5, 2.0, and 3.0 lb a.i./A treatments were only 5 to 6 bushels below the grain yield of the hand-weeded check of 66 bu/A. In general, even though the wild oat control was unsatisfactory on this first application date, the grain yields were higher than those

Table 8. Summary of the effects of SD 30053 applied postemergence on three dates of application for wild oat control in winter wheat--1970 study at the East Farm.

Treatment	Rate Lb. a.i./A	Visual Evaluations - Avg Wild Oat Control (%)	Winter Wheat Injury (%)	Average Number of Wild Oat Plants (Heads/sq. ft.)	Average Wheat Yield (Bu/A)
First Application Date					
SD 30053	1	16	0	15.3	53.2
SD 30053	1.5	35	0	11.9	61.3
SD 30053	2	56	0	9.6	61.8
SD 30053	3	68	0	8.2	60.2
SD 30053[a]	1.5	55	0	7.5	65.6[b]
SD 30053[a]	3	90	30	2.0	64.5[b]
SD 30053 + oil[c]	.75 + 1 qt/A	50	0	12.3	60.2[b]
SD 30053 + oil	1.5 + 1 qt/A	65	0	9.5	43.3[b]
Second Application Date					
SD 30053	1	39	0	14.7	55.4
SD 30053	1.5	58	0	11.6	53.8
SD 30053	2	74	0	8.0	50.6
SD 30053	3	78	0	7.4	53.2
SD 30053 + oil[c]	.75 + 1 qt/A	68	0	6.9	39.8[b]
SD 30053 + oil[c]	1.5 + 1 qt/A	83	0	4.5	58.1[b]
Third Application Date					
SD 30053	1	61	0	13.3	49.5
SD 30053	1.5	68	0	10.6	50.0
SD 30053	2	71	0	10.1	45.7
SD 30053	3	78	0	7.1	56.5
Others					
Barban	.33	98	0	0.5	60.8
Untreated	0	0	0	21.2	43.0
Hand-weeded check	0	100	0	0	66.1

a - Formulation contains oil b - Not included in the statistical analysis c - Superior Spray Oil L.S.D.$_{.05}$ = 9.7 Bu/A

obtained on the second or third date of application. The SD 30053 oil treatments gave better wild oat control and higher grain yields at lower rates than the SD 30053 without oil treatments. As previously mentioned, these yields were not included in the statistical analysis because of the limited number of replications.

In North Dakota, the addition of Sun Superior Spray Oil 11E at 1 gal/A to SD 30053 applications increased the effectiveness of SD 30053 in controlling wild oats in spring wheat (20). The wild oats at the time of application were in the 4- to 5-leaf stage.

The second postemergence applications of SD 30053 gave better wild oat control but grain yields were generally lower than from treatments on the first date by 5 to 10 bu/A. However, the grain yields from the 1.0, 1.5, and 3.0 lb a.i./A rates were significantly higher than the untreated check. As in previous trials, the addition of Superior Spray Oil increased the activity of SD 30053 in controlling wild oats.

As a group, the third applications of SD 30053 gave better wild oat control, especially at the lower rates of 1.0 and 1.5 lb a.i./A. However, the grain yields varied from 4 to 15 bu/A below the yields of those from the first application date. The delay in SD 30053 applications increased its effectiveness in controlling wild oats but resulted in lower yields because of wild oat competition.

The early postemergence application of 0.33 lb a.i./A of

barban gave the best wild oat control (98%) with a grain yield significantly higher than the untreated check.

Oakley Farm

Materials and Methods

In the early spring of 1971, a sixth field trial was established on a commercial field of Nugaines winter wheat. The trial was located on the Oakley Farm near Albany, Oregon.

The main purpose of this trial was to evaluate the effectiveness of postemergence applications of SD 30053 for wild oat control when applied with and without oil. The SD 30053 oil treatments were applied in the two ways: (1) tank-mixing of SD 30053 with 1 qt/A of Superior Spray Oil, and (2) application of a SD 30053 oil-containing formulation.

The first SD 30053 postemergence applications were made on March 19, 1971 to wild oats which were in the "early tillering to tillers formed" stage of growth. The wheat on this application date was in the early tillering growth stage. SD 30053 was applied alone at 0.75, 1.0, and 1.5 lb a.i./A. The SD 30053 oil-containing formulat on was applied at the same rates. The tank-mix treatments were applied at 0.75, 1.0, 1.5, and 3.0 lb a.i./A of SD 30053 plus 1 qt/A of Superior Spray Oil.

On May 1, 1971, the second SD 30053 postemergence treatments were applied to wild oats and wheat which had the first stem node visible at the base of the shoot. The same SD 30053 treatments were applied as above except the tank-mix treatment of 3 lb a. i. /A of SD 30053 plus 1 qt/A of Superior Spray Oil was excluded.

The wild oat population in the trial area was 7.0 plants per square foot. Wild oat plants were removed from the hand-weeded checks on March 17 and 24, 1971. The same data were collected as previously described. The area harvested to obtain yield data was 5 × 22 feet.

Results and Discussion

The results are recorded in Table 9 and Appendix Tables 10 and 11. On both application dates there was no wheat injury from any of the treatments.

First Application Date. The only treatment on the first date that gave satisfactory wild oat control (85%) was the combination of 3.0 lb a. i. /A of SD 30053 with 1 qt/A of Superior Spray Oil. It was the only treatment that gave a grain yield significantly higher than the untreated check. The grain yield was 50.8 bu/A which was only 2 bu/A below the hand-weeded check.

Second Application Date. As in other trials, the later date of SD 30053 applications gave much better wild oat control than the first

Table 9. Summary of the effects of SD 30053 applied postemergence on two dates of application for wild oat control in winter wheat--1970 study at the Oakley Farm.

Treatment	Lb. a.i./A	Visual Evaluations - Avg Wild Oat Control	Winter Wheat Injury	Average Number of Wild Oat Plants	Average Wheat Yield
		(%)	(%)	(Heads/sq. ft.)	(Bu/A)
First Application Date					
SD 30053	.75	10	0	24.9	29.7
SD 30053	1	10	0	27.4	27.7
SD 30053	1.5	5	0	28.6	27.7
SD 30053 + oil[b]	.75 + 1 qt/A	28	0	24.1	33.0
SD 30053 + oil[b]	1 + 1 qt/A	28	0	24.1	35.6
SD 30053 + oil[b]	1.5 + 1 qt/A	38	0	21.3	35.6
SD 30053 + oil[b]	3 + 1 qt/A	85	0	6.7	50.8
SD 30053[a]	.75	0	0	28.7	25.1
SD 30053[a]	1	3	0	29.3	33.7
SD 30053[a]	1.5	33	0	23.1	37.0
Second Application Date					
SD 30053	.75	44	0	20.9	32.3
SD 30053	1	64	0	17.5	42.9
SD 30053	1.5	60	0	16.4	35.6
SD 30053 + oil[b]	.75 + 1 qt/A	84	0	8.0	38.9
SD 30053 + oil[b]	1 + 1 qt/A	76	0	16.6	33.0
SD 30053 + oil[b]	1.5 + 1 qt/A	84	0	10.4	33.0
SD 30053[a]	.75	73	0	15.6	35.6
SD 30053[a]	1	78	0	12.7	32.3
SD 30053[a]	1.5	86	0	8.0	33.7
Others					
Untreated check	0	0	0	29.7	29.7
Hand-weeded check	0	100	0	0	52.8

a - Formulation contains oil b - Superior Spray Oil L. S. D.$_{.05}$ = 11.2 Bu/A

application date. The SD 30053 oil treatments were more effective in controlling wild oats than the SD 30053 without oil applications. However, the only treatment that gave a grain yield significantly higher than the untreated check was 1.0 lb a.i./A of SD 30053 without oil. Generally, the grain yields on the second application date were equivalent to or slightly higher than those of the first application date. But these yields have been reduced from wild oat competition prior to the delayed SD 30053 applications.

The yield data from this trial was quite variable because of a very heavy stand of bindweed (Convolvulus arvensis) which occurred mainly in the second, third, and fourth replications. Grain yields were also reduced in the first and second replications by scattered rodent damage.

Jorgensen Farm

Materials and Methods

The last field experiment was established on a commercial field of Druchamp winter wheat in December of 1970. The trial was located on the Jorgensen Farm near Corvallis, Oregon.

Postemergence applications of SD 30053 were applied alone at 1.0, 1.5, 2.0, and 3.0 lb a.i./A to two different wild oat growth stages. The first postemergence applications were made on

April 1, 1971 to wild oats and wheat which were in the "beginning of tillering" stage of growth. When the wild otas had one to two stem nodes visible, the second postemergence applications were made on May 27, 1971. The wheat on this date was in the "early heading" stage of growth.

Barban was applied postemergence at 0.33 lb a. i. /A on December 19, 1970. The wheat and wild oats were in the 2- to 3-leaf stage.

The wild oat population in the trial area was 2 plants/square foot.

Wild oat head counts and visual evaluations on wild oat control and crop injury were taken on July 2, 1971. Yield data were not collected from this location because of a severe reduction in wheat stand from winter killing and flooding.

Results and Discussion

Results are recorded in Table 10 and in Appendix Tables 12 and 13.

The first postemergence applications of SD 30053 gave very poor wild oat control at all rates tested. The second postemergence applications gave satisfactory wild oat control at 1.5, 2.0, and 3.0 lb a. i. /A. Barban gave only 48% control of the wild oats. There was no visual wheat injury from any of the treatments.

Table 10. Summary of the effects of SD 30053 applied postemergence on two dates of application for wild oat control in winter wheat--1970 study at the Jorgensen Farm.

Treatment	Rate Lb. a.i./A	Visual Evaluations - Average Wild Oat Control	Visual Evaluations - Average Winter Wheat Injury	Average Number of Wild Oat Plants
		(%)	(%)	(Heads/sq. ft.)
First Application Date				
SD 30053	1	10	0	14.1
SD 30053	1.5	8	0	15.3
SD 30053	2	18	0	14.5
SD 30053	3	18	0	14.1
Second Application Date				
SD 30053	1	52	0	10.6
SD 30053	1.5	72	0	6.2
SD 30053	2	74	0	6.7
SD 30053	3	78	0	5.7
Others				
Barban	.33	48	0	11.8
Untreated check	0	0	0	20.5

Summary of 1970 Field Trials

Results from these four locations verify previous conclusions that postemergence applications of SD 30053 can be very effective in controlling wild oats in winter wheat. As in 1969, when SD 30053 was applied without oil, wild oats were controlled more effectively on the second and third dates of application. However, the grain yields from the first applications were comparable or higher (depending upon location) than the second applications even though wild oat control was poorer on the first applications. The delaying of application caused a yield reduction because of prolonged wild oat competition. This reduction in yield from delayed application was more evident on the third date of application. The lowest yields were consistently obtained from the third date of application even though wild oat control was excellent.

The addition of oil to SD 30053 definitely increased its effectiveness even on the first date of application (wild oats in the beginning of tillering stage). Research by Hammond (13) and Saunders and Lonnecker (24), showed that non-phytotoxic oils give better foliage wetting and facilitates the penetration of herbicides. A rate of 1.5 lb a.i./A of SD 30053 oil-containing formulation or 1.5 lb a.i./A plus 1 qt./A of Superior Spray Oil gave better wild oat control than 3.0 lb a.i./A of SD 30053 applied without oil. The best treatments in 1970

for overall wild oat control and grain yields were the SD 30053 oil applications.

Nugaines winter wheat had a good tolerance to all SD 30053 applications. Visual observations at Jorgensen's Farm showed no apparent injury to Druchamp winter wheat from SD 30053 applications.

ANTAGONISTIC EFFECT OF 2, 4-D ON SD 30053 FOR WILD OAT CONTROL

Materials and Methods

Field data from the Wait and Owens Farms have shown that a tank-mix combination of the dimethylamine salt of 2, 4-D with SD 30053 resulted in a marked reduction in the effectiveness of SD 30053 for controlling wild oats.

To study this problem further, an experiment was initiated in a growth chamber in the fall of 1971.

Ten wild oat seeds were planted in 4 × 4-inch plastic pots and placed in the greenhouse. The soil was a loam greenhouse soil with peat moss added. When the shoots emerged above the soil surface, the oats were transferred to a growth chamber. Growth chamber conditions were as follows: air temperature 16 C day and 8 C night, day length 8 hours and light intensity 1, 500 ft. C. Upon reaching the four-leaf stage, the wild oats were thinned to five plants per pot. When the wild oats were in the five-leaf to beginning of tillering stage of growth, the oil-containing formulation of SD 30053 was applied at 1. 0, 1. 5, and 3. 0 lb a. i. /A as follows: (a) to wild oats which had not been previously sprayed with the dimethylamine salt of 2, 4-D amine, (b) to wild oats which had been sprayed 2 weeks prior with a postemergence application of 0. 75 lb a. i. /A of 2, 4-D

amine, (c) to wild oats which had been sprayed 1 week prior with 0.75 lb a.i./A of 2,4-D amine, and (d) as a tank-mix treatment with 0.75 lb a.i./A 2,4-D amine to wild oats which had not been previously sprayed with 2,4-D amine. After the SD 30053 applications, the growth chamber conditions were changed to the following: air temperature 22 C day and 10 C night, day length 16 hours. To maintain good plant growth throughout the experiment, a liquid fertilizer (Ortho-Grow) was added to each pot once a week.

At the end of the experimental period, above-ground portions of the plants were harvested at the soil line and dry weights were determined (Appendix Table 14). The dry weights were converted to percent reduction in wild oat growth (Appendix Table 15). An analysis of variance was determined on these percentages using a randomized complete block design with four replicates per treatment.

Results and Discussion

Results are illustrated in Figure 5 and Appendix Tables 14 and 15.

SD 30053 was much more effective in reducing wild oat growth when applied postemergence to wild oat plants which had not been previously sprayed with the dimethylamine salt of 2,4-D. The application of 2,4-D, either as a tank-mix application with SD 30053 or applied 1 or 2 weeks prior to SD 30053 applications, caused a

significant reduction in the effectiveness of SD 30053 in reducing wild oat growth (Figure 5). SD 30053 applied at 1.5 lb a.i./A to wild oats which had not been previously treated with 2,4-D resulted in a 66.5% reduction in wild oat growth. If the wild oats had been sprayed 2 or 1 week prior with 0.75 lb a.i./A of 2,4-D amine, the 1.5 lb a.i./A rate of SD 30053 reduced wild oat growth by only 51.3 and 43.6%, respectively. The tank-mix treatment of 1.5 lb a.i./A of SD 30053 plus 0.75 lbs a.i./A of 2,4-D amine reduced wild oat growth by only 40.8%. Similar results were obtained with the 1.0 and 3.0 lb a.i./A rates of SD 30053. It appears from these data that the closer the application of 2,4-D amine prior to SD 30053 applications the less effective SD 30053 will be in controlling wild oats.

Nalewaja (19) and Friesen and Dew (11), in field experiments with spring wheat, found that the addition of the dimethylamine salt of 2,4-D to SD 30053 applications nullified its effectiveness as a wild oat killer. Nalewaja (20) in further studies found combinations of SD 30053 with dicamba, bromoxynil (3, 4-dibromo-4-hydroxybenzonitrile), or picloram gave similar results. Swan (27) in several winter wheat trials found similar results with combination treatments of the low volatile esters of 2,4-D and MCPA with SD 30053.

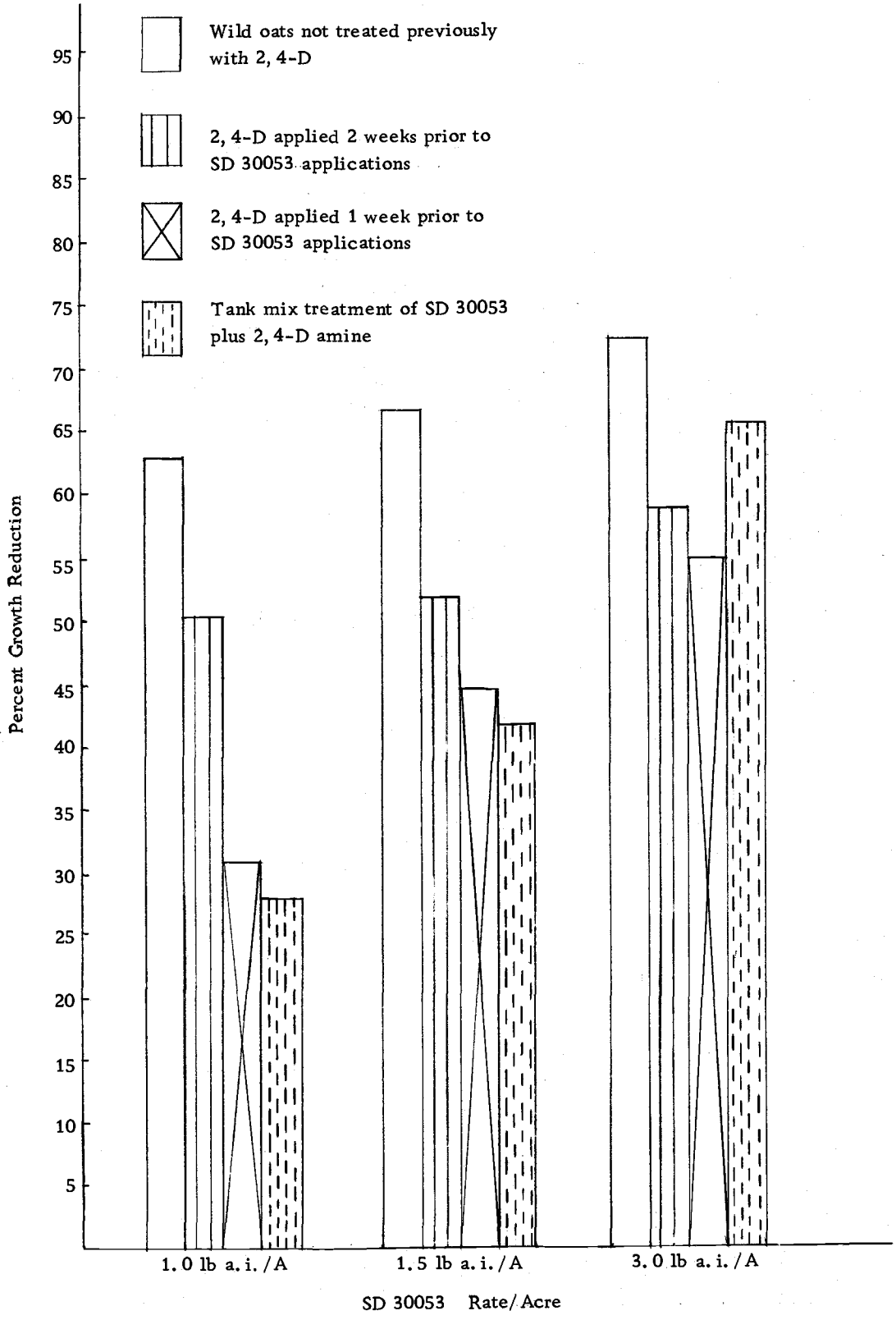

Figure 5. Percent growth reduction of wild oats from postemergence applications of SD 30053 and 0.75 lb a.i./A of 2, 4-D amine.

SUMMARY AND CONCLUSIONS

My field research has shown that postemergence applications of SD 30053 are very effective in controlling wild oats in winter wheat. SD 30053 was most effective when applied to wild oats when the first stem node was above the soil surface. Earlier applications (wild oats beginning to tiller) were effective, but the rates had to be increased two fold or a non-phytotoxic oil had to be added with the SD 30053. Bowden (3) in Canada also found that wild oat control increased as the applications were delayed with the late tillering stage being the most effective. One possible reason for this marked difference in wild oat activity between early and late postemergence applications could be attributed to the fact that when the first stem node is visible, the growing point is above the soil surface and exposed to the herbicide. SD 30053 is probably being absorbed and translocated a shorter distance to this growing point which is most sensitive to SD 30053.

Wild oats treated with SD 30053 show the following symptoms: (a) a darker green color in leaves, (b) necrosis of last leaf formed, starting from the tip and progressing down the leaf blade, (c) stunted plants, and (d) inhibition of normal floral formation. Shell Development Company (25) personnel do not know the mode of action of SD 30053 but believe that crop competition along with the action of the

chemical eventually caused death. Friesen (8) described the following wild oat symptoms caused from another wild oat herbicide, barban: (a) plant growth arrested, and (b) thickened leaves turn a deep blue-green color and became necrotic. He believes that barban causes a suppression of growth and development rather than actual killing of the wild oat plant. Hoffman (14) found that barban inhibited terminal growth of the wild oat. Dubrovin (7) and Hoffman (14) reported that barban probably derives its herbicidal action by interfering in some way with normal cell elongation and division. Since SD 30053 and barban cause similar symptoms in wild oats, SD 30053 may inhibit cell division as barban does.

Field studies and a growth chamber study showed that the closer the application of 2, 4-D amine prior to SD 30053 applications the less effective it will be for controlling wild oats. Nalewaja (20) found that wild oat control from SD 30053 applications were greatly reduced when applied with either 2, 4-D amine, dicamba, or picloram. Since SD 30053 and barban's herbicidal activity may be similar, Pfeiffer, Baker, and Holme's results (21) may be applicable. They found antagonistic effects from the mixing of the growth hormones, (2, 3, 6-trichlorobenzoic acid) or 2, 4-D, with barban. Friesen (9) reported a similar antagonistic effect by mixing barban with the growth hormones; dicamba, MCPA, and 2, 4-D. Future research should

be continued with this problem because these phenoxy and benzoic herbicides will be applied for broadleaf weed control about the same time SD 30053 is sprayed for wild oat control. This research should include a study of the effects of growth hormone treatments on SD 30053's wild oat activity when applied after SD 30053.

The 1968 field studies showed that grain yields from later postemergence applications of SD 30053 were comparable or higher than those obtained from the early application date. However, in 1969, the yields from the first applications (depending upon location) were comparable or slightly higher than those from the second application even though wild oat control was poorer from the earlier applications. The lowest yields were obtained from the third date of application undoubtedly because of competition from the wild oats. These yield data do not correlate exactly with those obtained in 1968. Upon evaluation of these data, I was unable to explain these yield differences. But as Nalewaja (18) reported, the percent yield reduction caused by a wild oat density in a crop varies considerably according to the soil and climatic conditions at a given location and year. Bowden (3) in 1971 reported that wild oat control increased as applications of SD 30053 were delayed, but the highest yields were obtained from early applications. However, at another location in 1971, Strobbe and Bowden (26) found that the later application dates resulted in higher grain yields. They also were

unable to explain the yield differences between these two trials.

When SD 30053 is applied alone to wild oats with the first stem node visible, optimum wild oat control and grain yields are obtained with rates of 1.5 to 2.0 lb a.i./A.

The addition of a non-phytotoxic oil with SD 30053 increases its effectiveness in controlling wild oats at lower rates and on earlier dates of application. More research is needed in this area to observe if consistent results can be obtained with this combination treatment when applied to wild oats in the 3-leaf to beginning of tillering stage of growth.

Winter and spring wheat varieties are quite tolerant to all applications of SD 30053 but fall and spring barley tolerance is questionable.

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APPENDIX

Appendix Table 1. The effect of postemergence applications of SD 30053 on Wade fall barley vigor--1969 study at the Riddell Farm.

Treatment	Lb. a.i./A	Visual Evaluations on Barley Vigor									
		Percent Stand Reduction					Percent Height Reduction				
		I	II	III	IV	Avg	I	II	III	IV	Avg
First Application Date											
SD 30053	.5	0	3	0	5	2	0	0	0	3	1
SD 30053	1	0	0	3	0	1	3	0	3	3	2
SD 30053	2	5	3	0	5	3	0	0	0	5	1
SD 30053	4	28	25	10	10	18	8	15	5	8	9
SD 30053 + 2, 4-D (tank-mix)	2 + .75	10	3	5	3	5	3	0	3	3	2
Second Application Date											
SD 30053	.5	15	5	38	23	20	8	3	18	18	12
SD 30053	1	38	45	50	45	45	15	25	18	15	18
SD 30053	2	45	55	80	55	59	35	40	40	20	34
SD 30053	4	70	60	68	75	68	50	50	30	40	43
SD 30053 + 2, 4-D (tank-mix)	2 + .75	35	55	68	30	47	23	25	20	23	23
Third Application Date											
SD 30053	.5	0	3	0	3	1	0	3	0	3	1
SD 30053	1	8	0	3	8	5	5	0	3	5	3
SD 30053	2	20	5	8	18	13	10	3	5	13	8
SD 30053	4	25	8	13	8	13	15	3	10	8	9
SD 30053 + 2, 4-D (tank-mix)	2 + .75	25	15	5	15	15	15	8	3	13	10
Others											
Barban	.33	0	0	0	0	0	0	0	0	0	0
Untreated check	0	0	0	0	0	0	0	0	0	0	0

Appendix Table 2. The effects of postemergence applications of SD 30053 on the number of wild oat heads/sq. ft. on three dates of application--1969 study at the Owens Farm.

Treatment	Lb. a.i./A	Number of Wild Oat Heads/sq. ft.																
		Replication I Count Number				Replication II Count Number				Replication III Count Number				Replication IV Count Number				
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	Total
First Application Date																		
SD 30053	.5	10	15	21	8	10	4	27	9	11	7	9	10	10	11	10	10	182
SD 30053	1	11	9	9	17	13	9	10	4	19	3	10	4	10	8	19	4	159
SD 30053	2	14	10	13	6	7	14	2	6	8	4	16	2	4	6	13	2	127
SD 30053	4	1	1	3	2	3	4	5	1	1	0	1	0	4	1	5	2	24
SD 30053 + 2, 4-D (tank-mix)	2+ .75	7	11	14	7	15	5	13	10	15	3	5	7	7	10	6	6	140
Second Application Date																		
SD 30053	.5	10	5	12	14	12	10	16	11	11	5	5	10	13	5	11	8	158
SD 30053	1	2	8	5	8	8	5	8	5	8	1	8	10	6	8	7	13	110
SD 30053	2	3	1	4	4	5	1	4	3	1	1	8	1	5	1	5	4	51
SD 30053	4	1	1	1	0	1	0	4	1	4	0	1	0	1	0	0	0	15
SD 30053 + 2, 4-D (tank-mix)	2+ .75	9	3	5	7	10	9	5	14	6	4	7	9	9	13	14	6	130
Third Application Date																		
SD 30053	.5	8	6	9	7	13	2	17	6	10	8	5	8	2	11	4	13	129
SD 30053	1	8	4	6	3	4	1	5	2	6	4	0	3	4	1	1	4	56
SD 30053	2	2	0	1	1	3	3	1	1	2	3	4	0	1	3	0	2	27
SD 30053	4	2	2	0	0	0	0	1	0	3	0	1	0	2	0	1	0	12
SD 30053 + 2, 4-D (tank-mix)	2+ .75	5	7	5	5	13	2	9	4	9	3	7	4	7	5	3	3	89
Others																		
Barban	.33	6	10	2	10	6	10	12	6	1	9	3	1	7	6	7	6	102
Untreated check	0	19	12	13	17	13	11	16	14	12	10	21	8	15	10	19	15	225

Appendix Table 3. Grain yields and visual evaluations on percent wild oat control and wheat injury from postemergence applications of SD 30053 on three date of application--1969 study at the Owens Farm.

Treatment	Lb. a.i./A	Visual Evaluations %										Wheat Yield--lb/plot					Wheat Yield
		Wild Oat Control					Wheat Injury										
		I	II	III	IV	Avg	I	II	III	IV	Avg	I	II	III	IV	Avg	Bu/A
First Application Date																	
SD 30053	.5	0	0	20	20	10	0	0	0	0	0	4.4[a]	9.5	9.2	9.0	8.0	38.7
SD 30053	1	20	10	30	10	18	0	0	0	0	0	8.8	9.2	10.6	9.7	9.6	46.5
SD 30053	2	20	50	50	50	43	0	0	0	0	0	9.5	8.4	8.9	11.0	9.5	46.0
SD 30053	4	80	80	90	85	84	0	0	0	0	0	15.1	10.5	10.4	11.4	11.9	57.6
SD 30053 + 2, 4-D (tank-mix)	2+.75	30	30	20	50	33	0	0	0	0	0	7.0	9.1	8.2	10.7	8.8	42.6
Second Application Date																	
SD 30053	.5	60	30	40	50	45	0	0	0	0	0	7.5	9.0	9.0	11.0	9.1	44.0
SD 30053	1	70	60	70	60	65	0	0	0	0	0	10.2	8.8	9.4	9.0	9.6	46.5
SD 30053	2	90	75	80	85	83	0	0	0	0	0	13.9	9.8	10.7	10.4	11.2	54.2
SD 30053	4	95	90	98	98	95	0	0	0	0	0	9.8[a]	11.2	11.2	11.0	10.8	51.8
SD 30053 + 2, 4-D (tank-mix)	2+.75	75	75	40	50	54	0	0	0	0	0	5.7[a]	8.5	10.2	8.8	8.3	40.2
Third Application Date																	
SD 30053	.5	60	50	70	70	63	0	0	0	0	0	11.5	10.0	9.9	11.0	10.6	51.3
SD 30053	1	85	80	85	90	85	0	0	0	0	0	12.0	11.0	9.8	10.9	10.9	52.8
SD 30053	2	95	90	90	95	93	0	0	0	0	0	10.8	11.5	11.5	10.4	11.0	53.5
SD 30053	4	98	95	98	98	97	0	0	0	0	0	9.4	11.8	11.4	12.2	11.2	54.2
SD 30053 + 2, 4-D (tank-mix)	2+.75	70	50	60	75	64	0	0	0	0	0	8.3[a]	10.4	9.7	10.1	9.6	46.5
Others																	
Barban	.33	40	30	70	70	50	0	0	0	0	0	13.1	12.8	14.5	13.9	13.6	65.9
Untreated check	0	0	0	0	0	0	0	0	0	0	0	6.6	8.0	10.7	10.6	9.0	43.6

[a]The wheat lodged

Analysis of Variance Table on Grain Yields

in Appendix Table 3

Source of Variation	df	SS	MS	F
Replication	3	9.85	3.283	1.729
Treatment	16	130.39	8.150	4.292**
Replication × Treatment	48	91.17	1.899	
Total	67	231.41		

**Significant at 1% level
C.V. = 13.6%

Treatment LSD at .05 level = 2.10 lb/plot or 9.7 bu/A, at .01 level = 2.6 lb/plot or 12.6 bu/A.

Appendix Table 4. The effects of postemergence applications of SD 30053 on the number of wild oat heads/sq. ft. on three dates of application--1969 study at the Wait Farm.

Treatment	Lb a.i./A	Number of Wild Oat Heads/sq. ft.																
		Replication I Count Number				Replication II Count Number				Replication III Count Number				Replication IV Count Number				
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	
First Application Date																		
SD 30053	.5	25	17	25	29	24	20	25	10	17	22	26	24	26	38	32	30	390
SD 30053	1	25	30	10	9	14	12	25	14	20	16	32	13	13	22	14	15	284
SD 30053	2	18	15	19	10	13	16	25	13	13	24	10	10	15	23	13	24	261
SD 30053	4	1	1	2	3	8	2	8	10	8	2	4	2	10	5	11	4	81
SD 30053 + 2, 4-D (tank-mix)	2 + .75	17	17	15	23	13	14	25	17	22	16	18	12	9	20	21	17	277
Second Application Date																		
SD 30053	.5	4	8	19	18	14	10	17	11	25	20	21	23	12	14	13	16	245
SD 30053	1	10	7	11	5	6	2	2	9	8	4	7	5	28	7	25	25	101
SD 30053	2	6	1	3	7	2	5	2	4	10	8	9	9	4	0	7	2	79
SD 30053	4	2	0	2	1	2	0	0	1	0	1	0	0	1	0	1	2	13
SD 30053 + 2, 4-D (tank-mix)	2 + .75	7	12	21	16	8	12	19	7	16	19	14	5	28	14	13	16	227
Third Application Date																		
SD 30053	.5	11	11	8	7	4	7	5	13	9	9	10	8	9	10	11	10	142
SD 30053	1	8	4	0	3	4	5	7	3	2	8	12	3	8	3	6	2	78
SD 30053	2	4	2	3	5	6	1	3	3	5	0	2	0	3	1	2	2	42
SD 30053	4	2	1	3	5	0	2	4	1	2	0	2	0	1	5	4	1	33
SD 30053 + 2, 4-D (tank-mix)	2 + .75	9	8	13	10	10	8	9	8	9	10	12	7	4	9	9	10	146
Others																		
Barban	.33	6	20	22	18	18	10	22	14	21	27	14	19	19	9	11	26	276
Untreated check	0	22	20	26	18	29	11	35	40	33	22	30	22	38	40	31	20	437

Appendix Table 5. Grain yields and visual evaluations on percent wild oat control and wheat injury from postemergence applications of SD 30053 on three dates of application--1969 study at the Wait Farm.

Treatment	Lb. a.i./A	Visual Evaluations - %										Wheat Yield--Lb/Plot					Average Wheat Yield
		Wild Oat Control					Wheat Injury										
		I	II	III	IV	Avg	I	II	III	IV	Avg	I	II	III	IV	Avg	Bu/A
First Application Date																	
SD 30053	.5	10	10	5	0	6	0	0	0	0	0	13.0	8.0	5.4	3.9	7.6	39.4
SD 30053	1	20	20	10	30	20	0	0	0	0	0	12.0	8.4	6.6	4.6	7.9	41.0
SD 30053	2	40	30	30	30	33	0	0	0	0	0	14.1	8.9	7.2	7.4	9.4	48.7
SD 30053	4	85	80	75	70	78	0	0	0	0	0	12.6	12.2	9.8	7.5	10.5	54.5
SD 30053 + 2, 4-D (tank-mix)	2 + .75	40	30	20	40	33	0	0	0	0	0	12.6	9.6	6.3	8.3	9.2	38.4
Second Application Date																	
SD 30053	.5	50	40	30	50	43	0	0	0	0	0	15.4	12.3	7.7	8.3	10.9	56.7
SD 30053	1	80	70	70	40	65	0	0	0	0	0	17.0	12.3	8.5	9.8	11.9	61.7
SD 30053	2	90	90	70	85	84	0	0	0	0	0	15.0	15.4	9.2	12.4	13.0	67.4
SD 30053	4	98	90	95	90	93	0	0	0	0	0	13.1	15.2	11.3	15.0	13.7	70.8
SD 30053 + 2, 4-D (tank-mix)	2 + .75	50	50	40	30	43	0	0	0	0	0	16.3	11.0	8.4	8.2	11.0	57.0
Third Application Date																	
SD 30053	.5	70	65	60	60	64	0	0	0	0	0	11.8	13.6	8.5	9.9	10.9	56.8
SD 30053	1	90	85	80	80	84	0	0	0	0	0	13.3	13.0	9.4	10.6	11.6	60.0
SD 30053	2	90	95	85	90	90	0	0	0	0	0	14.9	13.8	10.4	11.6	12.7	65.9
SD 30053	4	95	98	98	98	95	0	0	0	0	0	15.9	12.3	10.3	11.9	12.6	65.3
SD 30053 + 2, 4-D (tank-mix)	2 + .75	65	70	60	70	66	0	0	0	0	0	15.2	10.5	8.7	10.2	11.2	57.8
Others																	
Barban	.33	20	30	10	30	23	0	0	0	0	0	15.5	11.3	7.3	9.5	10.9	56.5
Untreated check	0	0	0	0	0	0	0	0	0	0	0	12.2	7.8	5.0	6.8	7.9	41.2

Analysis of Variance Table on Grain Yields
in Appendix Table 5

Source of Variation	df	SS	MS	F
Replication	3	351.75	117.250	58.217
Treatment	16	212.90	13.306	6.607**
Replication × Treatment	48	96.70	2.014	
Total	67	661.35		

**Significant at 1% level
C.V. = 13.1%

Treatment LSD at .05 level = 2.0 lb/plot or 10.4 bu/A, at a .01 level = 2.7 lb/plot or 14.0 bu/A.

Appendix Table 6. The effects of postemergence applications of SD 30053 on the number of wild oat heads/sq. ft. on three dates of application--1970 study at the Herr Farm.

Treatment	Lb. a.i./A	Number of Wild Oat Heads/sq. ft.																				Total
		Replication I Count Number				Replication II Count Number				Replication III Count Number				Replication IV Count Number				Replication V Count Number				
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	
First Application Date																						
SD 30053	1	19	31	20	14	20	14	19	17	17	14	21	13	23	15	13	10	19	12	14	10	335
SD 30053	1.5	15	10	13	11	6	18	10	25	15	8	12	10	22	14	12	10	7	10	3	10	241
SD 30053	2	8	18	9	6	17	11	15	14	14	23	12	20	14	10	10	8	10	8	8	10	245
SD 30053	3	7	3	8	5	11	19	5	7	10	14	16	5	13	10	8	5	0	2	2	2	152
SD 30053[a]	.75	20	11	17	8	20	7	7	18	20	22	16	18	20	9	10	6	12	9	5	4	269
SD 30053[a]	1	16	8	14	7	11	8	9	12	16	10	27	19	15	10	11	4	13	5	6	16	237
SD 30053[a]	1.5	6	5	7	1	4	8	0	7	8	5	7	3	8	9	2	6	1	3	5	0	95
SD 30053 + oil[b]	1.5+1 qt./A	1	2	8	0	9	4	11	15	10	6	4	9	6	6	2	1	4	4	11	2	115
Second Application Date																						
SD 30053	1	14	3	13	11	4	8	3	9	12	16	7	10	6	12	9	3	7	8	6	9	169
SD 30053	1.5	4	6	4	5	13	4	6	10	2	0	1	3	10	3	9	6	3	5	2	6	102
SD 30053	2	5	3	3	4	3	6	5	2	6	6	8	5	2	1	1	0	3	2	5	10	80
SD 30053	3	8	3	4	1	2	1	4	0	4	0	4	3	1	0	1	2	0	0	2	0	40
SD 30053[a]	.75	2	2	2	1	3	2	0	1	3	2	1	2	4	1	5	6	2	2	1	4	46
SD 30053[a]	1	7	2	2	3	0	1	3	1	1	3	3	2	1	4	0	1	2	0	3	4	43
SD 30053[a]	1.5	0	0	1	3	2	1	2	3	1	1	0	1	1	0	4	2	0	0	2	2	26
Third Application Date																						
SD 30053	1	17	13	15	4	4	5	0	3	5	17	17	10	7	8	14	13	3	4	4	5	168
SD 30053	1.5	3	4	5	7	1	5	7	4	5	0	8	1	5	5	7	9	6	5	9	8	104
SD 30053	2	7	5	4	8	0	0	8	6	4	2	14	8	3	3	2	6	0	0	0	5	85
SD 30053	3	5	4	3	3	7	0	1	8	0	1	1	1	2	0	1	3	4	0	4	3	51
Others																						
Barban	.33	4	19	5	14	5	7	6	8	13	12	13	9	4	4	6	5	15	12	11	9	184
Untreated	0	21	18	26	26	19	25	24	32	19	19	30	20	20	22	17	27	20	17	23	19	444
Hand-weeded check	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

a - Formulation contains oil b - Superior Spray Oil

Appendix Table 7. Grain yields and visual evaluations on percent wild oat control and wheat injury from postemergence applications of SD 30053 on three dates of application--1970 study at the Herr Farm.

Treatment	Lb. a.i./A	Visual Evaluations - %												Wheat Yield--Lb/Plot						Average Wheat Yield
		Wild Oat Control						Wheat Injury												
		I	II	III	IV	V	Avg	I	II	III	IV	V	Avg	I	II	III	IV	V	Avg	Bu/A
First Application Date																				
SD 30053	1	0	0	0	10	10	4	0	0	0	0	0	0	10.3	13.8	11.2	12.7	13.2	12.2	65.6
SD 30053	1.5	30	30	30	15	50	31	0	0	0	0	0	0	13.9	13.8	14.5	13.1	16.6	14.4	77.4
SD 30053	2	30	20	20	30	60	32	0	0	0	0	0	0	13.8	13.9	12.2	14.0	16.0	14.0	75.3
SD 30053	3	60	50	50	70	80	62	0	0	0	0	0	0	15.3	14.8	14.8	16.9	17.8	15.9	85.5
SD 30053[a]	.75	20	30	10	50	30	28	0	0	0	0	0	0	13.8	15.2	13.7	15.3	15.8	14.8	79.6
SD 30053[a]	1	50	60	40	30	40	44	0	0	0	0	0	0	14.8	15.2	13.9	15.8	15.8	15.1	81.2
SD 30053[a]	1.5	80	80	75	85	87	81	0	0	0	0	0	0	16.1	16.3	16.1	17.0	17.5	16.6	89.3
SD 30053 + oil[b]	1.5 +1 qt./A	85	75	70	85	87	80	0	0	0	0	0	0	16.3	16.4	16.9	16.6	17.6	16.8	90.4
Second Application Date																				
SD 30053	1	45	70	40	75	50	56	0	0	0	0	0	0	12.7	15.0	12.8	15.0	15.7	14.2	76.4
SD 30053	1.5	80	60	85	70	75	74	0	0	0	0	0	0	13.8	12.5	15.8	14.7	16.6	14.7	79.1
SD 30053	2	80	85	75	95	80	83	0	0	0	0	0	0	14.1	13.3	13.5	16.0	15.5	14.5	78.0
SD 30053	3	85	95	95	95	95	93	0	0	0	0	0	0	14.2	15.8	12.8	17.0	16.1	15.2	81.7
SD 30053[a]	.75	82	90	87	87	85	86	0	0	0	0	0	0	13.3	15.1	15.2	14.0	16.2	14.8	79.6
SD 30053[a]	1	90	95	80	92	98	91	0	0	0	0	0	0	13.9	12.8	13.5	15.1	16.0	14.3	76.9
SD 30053[a]	1.5	95	90	98	95	98	95	0	0	0	0	0	0	14.3	13.1	14.0	14.0	16.0	14.3	76.9
Third Application Date																				
SD 30053	1	40	70	50	70	85	63	0	0	0	0	0	0	9.7	14.0	11.1	11.3	14.8	12.2	65.6
SD 30053	1.5	80	80	80	85	85	82	0	0	0	0	0	0	12.4	12.3	13.1	12.4	12.0	12.4	66.7
SD 30053	2	85	90	80	90	95	88	0	0	0	0	0	0	11.1	14.7	9.9	16.2	14.8	13.3	71.5
SD 30053	3	90	80	95	98	98	92	0	0	0	0	0	0	12.4	12.1	14.3	13.9	14.6	13.5	72.6
Others																				
Barban	.33	70	70	60	75	70	69	0	0	0	0	0	0	15.0	16.2	15.4	16.9	16.2	15.9	85.5
Untreated	0	0	0	0	0	0	0	0	0	0	0	0	0	7.3	13.2	12.3	11.9	13.2	11.6	62.4
Hand-weeded check	0	100	100	100	100	100	100	0	0	0	0	0	0	16.0	15.5	17.5	16.7	17.4	16.6	89.3

a - Formulation contains oil b - Superior Spray Oil

Analysis of Variance Table on Grain Yields

in Appendix Table 7

Source of Variation	df	SS	MS	F
Replication	4	44.5	11.13	
Treatment	21	227.6	10.84	7.24**
Replication × Treatment	84	125.8	1.50	
Total	109	397.9		

**Significant at 1% level
C.V. = 8.5%

Treatment LSD at .05 level = 1.5 lb/plot or 8.1 bu./A, at .01 level = 2.0 lb/plot or 10.8 bu/A.

Appendix Table 8. The effects of postemergence applications of SD 30053 on the number of wild oat heads/sq. ft. on three dates of application--1970 study at the East Farm.

Treatment		Number of Wild Oat Heads/sq. ft.																Total	Average
		Replication I Count Number				Replication II Count Number				Replication III Count Number				Replication IV Count Number					
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV		
First Application Date																			
SD 30053	1	15	10	13	13	9	17	22	13	14	24	25	19	10	14	14	13	245	15.3
SD 30053	1.5	12	16	14	11	10	13	11	12	20	15	14	5	13	9	6	10	191	11.9
SD 30053	2	6	16	16	15	10	12	11	16	7	8	10	9	7	6	5	10	154	9.6
SD 30053	3	10	11	6	6	9	11	11	7	12	12	4	7	9	7	4	5	131	8.2
SD 30053[a]	1.5	-	-	-	-	7	8	14	12	-	-	-	-	8	12	5	5	30	7.5
SD 30053[a]	3	-	-	-	-	-	-	-	-	-	-	-	-	1	3	1	3	8	2.0
SD 30053 + oil[b]	.75 + 1 qt./A	-	-	-	-	-	-	-	-	16	11	10	12	-	-	-	-	49	12.3
SD 30053 + oil[b]	1.5 + 1 qt./A	-	-	-	-	-	-	-	-	8	6	6	8	-	-	-	-	38	9.5
Second Application Date																			
SD 30053	1	16	12	15	14	16	13	12	20	14	18	21	13	10	12	15	14	235	14.7
SD 30053	1.5	7	11	12	10	16	12	14	13	13	12	12	16	14	10	5	8	185	11.6
SD 30053	2	14	6	7	4	11	5	5	7	9	13	7	9	6	9	9	7	128	8.0
SD 30053	3	7	9	6	9	8	10	9	3	5	10	6	10	4	3	7	12	118	7.4
SD 30053 + oil[b]	.75 + 1 qt./A	6	6	3	4	11	9	9	7	-	-	-	-	-	-	-	-	55	6.9
SD 30053 + oil[b]	1 + 1 qt./A	2	5	3	4	-	-	-	-	-	-	-	-	8	6	4	4	36	4.5
Third Application Date																			
SD 30053	1	12	14	16	12	17	15	17	14	14	15	20	7	4	9	7	19	212	13.3
SD 30053	1.5	10	8	7	7	12	14	17	15	12	16	8	12	9	6	8	9	170	10.6
SD 30053	2	13	10	13	7	10	8	13	20	7	12	9	10	2	4	15	8	161	10.1
SD 30053	3	4	6	5	8	4	9	6	10	9	9	6	8	6	5	9	10	113	7.1
Others																			
Barban	.33	0	1	0	0	1	0	0	1	0	2	0	0	0	1	0	1	7	0.5
Untreated	0	18	20	18	29	27	19	20	19	23	26	20	27	20	19	17	17	339	21.2
Hand-weeded check	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

a - Formulation contains oil b - Superior Spray Oil

Appendix Table 9. Grain yields and visual evaluations on percent wild oat control and wheat injury from postemergence applications of SD 30053 on three dates of application--1970 study at the East Farm.

Treatment	Lb. a.i./A	Visual Evaluations - %										Wheat Yield--Lb/Plot					Average Wheat Yield
		Wild Oat Control					Wheat Injury										
		I	II	III	IV	Avg	I	II	III	IV	Avg	I	II	III	IV	Avg	Bu/A
First Application Date																	
SD30053	1	35	10	0	20	16	0	0	0	0	0	8.8	6.9	10.7	13.2	9.9	53.2
SD 30053	1.5	50	20	30	40	35	0	0	0	0	0	7.6	11.8	13.0	13.3	11.4	61.3
SD 30053	2	50	45	60	70	56	0	0	0	0	0	11.6	9.2	11.0	14.2	11.5	61.8
SD 30053	3	65	60	70	75	68	0	0	0	0	0	8.6	9.5	12.9	13.7	11.2	60.2
SD 30053[a]	1.5	-	50	-	60	55	-	0	-	0	0	-	9.8	-	14.6	12.2	65.6[b]
SD 30053[a]	3	-	-	-	90	90	-	-	-	30	-	-	-	-	12.0	12.0	64.5[b]
SD 30053 + oil[d]	.75 + 1 qt/A	-	-	50	-	50	-	-	0	-	0	-	-	11.2	-	11.2	60.2[b]
SD 30053 + oil[d]	1.5 + 1 qt/A	-	-	65	-	65	-	-	0	-	0	-	-	8.6[c]	-	8.6	43.3
Second Application Date																	
SD 30053	1	40	40	30	45	39	0	0	0	0	0	6.7	7.4	13.1	14.0	10.3	55.4
SD 30053	1.5	60	55	50	65	58	0	0	0	0	0	5.4	9.1	12.1	13.2	10.0	53.8
SD 30053	2	75	80	70	70	74	0	0	0	0	0	7.3	7.1	10.8	12.2	9.4	50.6
SD 30053	3	75	80	80	75	78	0	0	0	0	0	6.7	8.7	10.5	13.8	9.9	53.2
SD 30053 + oil	.75 + 1 qt/A	70	65	-	-	68	0	0	-	-	0	9.5	5.2	-	-	7.4	39.8[b]
SD 30053 + oil	1.5 + 1 qt/A	80	-	-	85	83	0	-	-	0	0	8.3	-	-	13.2	10.8	58.1[b]
Third Application Date																	
SD 30053	1	65	50	65	65	61	0	0	0	0	0	8.4	5.7	9.8	12.7	9.2	49.5
SD 30053	1.5	75	65	60	70	68	0	0	0	0	0	8.5	6.1	9.6	13.0	9.3	50.0
SD 30053	2	70	75	70	70	71	0	0	0	0	0	6.5	6.0	9.2	12.2	8.5	45.7
SD 30053	3	80	80	80	70	78	0	0	0	0	0	7.0	10.2	10.8	13.8	10.5	56.5
Others																	
Barban	.33	98	98	98	98	98	0	0	0	0	0	9.5	7.7	12.2	15.9	11.3	60.8
Untreated	0	0	0	0	0	0	0	0	0	0	0	6.9	6.3	8.6	10.2	8.0	43.0
Hand-weeded check	0	100	100	100	100	100	0	0	0	0	0	10.8	9.4	14.8	14.0	12.3	66.1

a - Formulation contains oil b - Not included in the statistical analysis c - Reduced yield due to water damage d - Superior Spray Oil

Analysis of Variance Table on Grain Yields
in Appendix Table 9

Source of Variation	df	SS	MS	F
Replication	3	299.9	99.97	
Treatment	14	81.4	5.81	3.73**
Replication × Treatment	42	65.5	1.56	
Total	59	446.8		

**Significant at 1% level

C.V. = 12.28%

Treatment LSD at .05 level = 1.8 lb/plot or 9.7 bu/A, at a .01 level = 2.4 lb/plot or 12.9 bu/A.

Appendix Table 10. The effects of postemergence applications of SD 30053 on the number of wild oat heads/sq. ft. on two dates of application--1970 study at the Oakley Farm.

Treatment	Lb. a. i./A	Number of Wild Oat Heads/sq. ft.																Total	Average
		Replication I Count Number				Replication II Count Number				Replication III Count Number				Replication IV Count Number					
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV		
First Application Date																			
SD 30053	.75	21	15	4	2	25	40	37	32	21	34	42	26	30	20	28	22	399	24.9
SD 30053	1	19	18	13	15	27	32	21	42	27	16	35	29	16	59	35	34	438	27.4
SD 30053	1.5	15	12	13	5	27	35	23	30	41	17	35	29	38	39	46	53	458	28.6
SD 30053 + oil[a]	.75 + 1 qt/A	7	3	10	4	29	35	16	20	12	14	21	31	45	29	58	40	385	24.1
SD 30053 + oil[a]	1 + 1 qt/A	8	6	4	5	24	36	28	15	17	23	21	27	45	36	40	51	386	24.1
SD 30053 + oil[a]	1.5 + 1 qt/A	11	2	1	2	21	19	29	15	11	30	28	21	12	34	48	56	340	21.3
SD 30053 + oil[a]	3 + 1 qt/A	3	6	1	0	9	12	5	10	4	5	12	10	11	3	10	6	107	6.7
SD 30053[b]	.75	20	32	8	8	20	31	27	41	47	21	35	26	33	47	41	52	459	28.7
SD 30053[b]	1	30	21	10	6	42	35	29	31	17	41	28	36	24	33	45	40	468	29.3
SD 30053[b]	1.5	3	13	7	3	20	10	15	25	17	26	24	33	33	52	41	48	470	23.1
Second Application Date																			
SD 30053	.75	9	5	15	6	25	21	31	28	16	11	25	13	32	29	40	28	334	20.9
SD 30053	1	3	1	4	0	8	10	12	11	19	36	25	15	21	27	36	52	280	17.5
SD 30053	1.5	9	4	5	1	20	13	15	24	18	23	18	15	15	27	30	29	262	16.4
SD 30053 + oil[a]	.75 + 1 qt/A	2	4	2	5	10	14	15	10	2	0	1	1	17	15	20	10	128	8.0
SD 30053 + oil[a]	1 + 1 qt/A	4	1	3	9	9	11	8	4	17	13	8	10	25	17	29	38	266	16.6
SD 30053 + oil[a]	1.5 + 1 qt/A	0	2	1	7	7	8	10	14	6	2	15	21	10	16	20	27	166	10.4
SD 30053[b]	.75	6	3	5	3	16	19	12	10	13	13	10	20	23	12	38	47	250	15.6
SD 30053[b]	1	0	0	6	3	10	10	9	18	4	9	25	19	17	12	25	36	203	12.7
SD 30053[b]	1.5	4	1	4	1	2	5	5	10	1	1	0	5	22	28	21	18	128	8.0
Others																			
Untreated	0	16	19	7	6	29	43	24	20	25	45	19	39	56	37	48	42	475	29.7
Hand-weeded check	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

a - Superior Spray Oil b - Formulation contains oil

Appendix Table 11. Grain yields and visual evaluations on percent wild oat control and wheat injury from postemergence applications of SD 30053 on two dates of application--1970 study at the Oakley Farm.

Treatment	Lb. a.i./A	Visual Evaluations - %										Wheat Yield--Lb/Plot					Average Wheat Yield
		Wild Oat Control					Winter Wheat Injury										
		I	II	III	IV	Avg	I	II	III	IV	Avg	I	II	III	IV	Avg	Bu/A
First Application Date																	
SD 30053	.75	20	0	0	20	10	0	0	0	0	0	6.3	2.7	4.6	4.3	4.5	29.7
SD 30053	1	10	0	0	30	10	0	0	0	0	0	5.5	2.9	5.3	5.2	4.2	27.7
SD 30053	1.5	20	0	0	0	5	0	0	0	0	0	6.3	3.0	4.0	3.4	4.2	27.7
SD 30053 + oil[a]	.75 + 1 qt/A	60	20	30	0	28	0	0	0	0	0	7.4	4.1	5.6	3.0	5.0	33.0
SD 30053 + oil[a]	1 + 1 qt/A	50	30	30	0	28	0	0	0	0	0	6.0	5.3	5.3	4.9	5.4	36.6
SD 30053 + oil[a]	1.5 + 1 qt/A	50	30	40	30	38	0	0	0	0	0	7.3	4.4	6.0	3.9	5.4	35.6
SD 30053 + oil[a]	3 + 1 qt/A	90	80	85	85	85	0	0	0	0	0	5.1[c]	8.1	10.4	7.3	7.7	50.8
SD 30053[b]	.75	0	0	0	0	0	0	0	0	0	0	5.9	3.2	3.8	2.3	3.8	25.1
SD 30053[b]	1	0	0	10	0	3	0	0	0	0	0	6.4	4.2	4.9	5.0	5.1	33.7
SD 30053[b]	1.5	60	50	20	0	33	0	0	0	0	0	8.2	6.3	5.6	2.2	5.6	37.0
Second Application Date																	
SD 30053	.75	50	30	65	30	44	0	0	0	0	0	7.8	2.7	6.3	2.8	4.9	32.3
SD 30053	1	80	75	50	50	64	0	0	0	0	0	7.3	8.0	5.7	4.8	6.5	42.9
SD 30053	1.5	70	60	60	50	60	0	0	0	0	0	7.8	4.1[c]	5.8	3.9	5.4	35.6
SD 30053 + oil[a]	.75 + 1 qt/A	90	80	90	75	84	0	0	0	0	0	6.7	3.9	7.8	5.3	5.9	38.9
SD 30053 + oil[a]	1 + 1 qt/A	80	85	80	60	76	0	0	0	0	0	6.6	5.5	3.8	3.9	5.0	33.0
SD 30053 + oil[a]	1.5 + 1 qt/A	90	85	80	80	84	0	0	0	0	0	6.0	4.1	6.7	3.0	5.0	33.0
SD 30053[b]	.75	80	70	80	60	73	0	0	0	0	0	6.8	4.2	5.7	4.7	5.4	35.6
SD 30053[b]	1	90	80	70	70	78	0	0	0	0	0	7.4	3.5	5.3	3.2	4.9	32.3
SD 30053[b]	1.5	90	90	95	70	86	0	0	0	0	0	6.0	4.8[c]	6.3	3.4	5.1	33.7
Others																	
Untreated check	0	0	0	0	0	0	0	0	0	0	0	7.0	3.9	5.4	1.5	4.5	29.7
Hand-weeded check	0	100	100	100	100	100	0	0	0	0	0	7.9	8.4	7.9	7.7	8.0	52.8

a - Superior Spray Oil b - Formulation contains oil c - Rodent damage

Analysis of Variance Table on Grain Yields
in Appendix Table 11

Source of Variation	df	SS	MS	F
Replication	3	88.3	28.43	
Treatment	20	86.7	4.34	2.98**
Replication × Treatment	60	87.3	1.46	
Total	83	262.3		

**Significant at 1% level
C. V. = 22.8%

Treatment LSD at .05 level = 1.7 lb/plot or 11.2 bu/A, at .01 level = 2.3 lb/plot or 15.2 bu/A.

Appendix Table 12. The effects of postmergence applications of SD 30053 on the number of wild oat heads/sq. ft. on two dates of application--1970 study at the Jorgensen Farm.

Treatment	Lb. a.i./A	Replication I Count Number				Replication II Count Number				Replication III Count Number				Replication IV Count Number				Replication V Count Number				Total	Average
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV		
First Application Date																							
SD 30053	1	9	5	11	12	9	12	24	14	12	13	18	12	16	15	13	23	18	21	10	15	281	14.1
SD 30053	1.5	10	10	10	4	8	8	6	14	18	17	22	24	17	21	20	12	18	12	25	19	305	15.3
SD 30053	2	15	14	8	7	10	12	14	9	15	19	16	10	13	12	14	17	29	20	23	12	289	14.5
SD 30053	3	13	11	8	8	12	11	14	10	10	12	18	11	19	18	10	12	19	25	19	22	282	14.1
Second Application Date																							
SD 30053	1	5	6	3	8	7	0	7	11	13	10	11	5	15	12	16	10	10	17	16	21	212	10.6
SD 30053	1.5	8	1	3	2	0	1	10	1	6	5	4	5	12	17	6	14	2	5	11	10	123	6.2
SD 30053	2	1	6	3	5	1	3	5	4	5	5	3	5	9	11	6	7	8	18	14	14	133	6.7
SD 30053	3	4	1	1	2	4	4	3	5	6	4	6	5	8	13	7	5	8	6	11	10	113	5.7
Others																							
Barban	.33	9	12	6	4	16	14	6	13	5	10	11	8	9	11	8	14	25	19	14	22	236	11.8
Untreated check	0	19	12	10	9	18	17	22	24	21	18	18	13	28	20	25	20	18	27	33	38	410	20.5

Appendix Table 13. Visual evaluations on percent wild oat control and wheat injury from postemergence applications of SD 30053 on two dates of application--1970 study of the Jorgensen Farm.

Treatment	Lb. a.i./A	Visual Evaluations - %											
		Wild Oat Control						Winter Wheat Injury					
		I	II	III	IV	V	Avg	I	II	III	IV	V	Avg
First Application Date													
SD 30053	1	10	0	0	30	10	10	0	0	0	0	0	0
SD 30053	1.5	10	20	0	0	10	8	0	0	0	0	0	0
SD 30053	2	30	20	0	40	0	18	0	0	0	0	0	0
SD 30053	3	30	20	20	20	0	18	0	0	0	0	0	0
Second Application Date													
SD 30053	1	50	50	60	60	40	52	0	0	0	0	0	0
SD 30053	1.5	80	85	80	50	65	72	0	0	0	0	0	0
SD 30053	2	80	85	85	60	60	74	0	0	0	0	0	0
SD 30053	3	85	80	85	75	65	78	0	0	0	0	0	0
Others													
Barban	.33	50	60	50	60	20	48	0	0	0	0	0	0
Untreated check	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix Table 14. Dry weights of wild oat plants which had been treated with postemergence applications of 2, 4-D and SD 30053--1971 growth chamber study.

Treatment	Rate	Date of Application		Dry Weights - Grams				
	lb. a.i./A	SD 30053[a]	2, 4-D[b]	R1	R2	R3	R4	Avg
Without 2, 4-D								
SD 30053	1	10/21/71	--------	0.992	1.045	1.185	1.002	1.039
SD 30053	1.5	10/21/71	--------	0.939	1.050	0.892	0.998	0.970
SD 30053	3	10/21/71	--------	2.571	3.344	2.781	2.897	2.898
Control	0	--------	--------					
2, 4-D Two Weeks Prior								
SD 30053 + 2, 4-D	1 + .75	10/21/71	10/7/71	0.848	1.030	0.953	0.785	0.904
SD 30053 + 2, 4-D	1.5 + .75	10/21/71	10/7/71	0.667	0.824	0.929	0.923	0.836
SD 30053 + 2, 4-D	3 + .75	10/21/71	10/7/71	0.778	0.824	0.819	0.536	0.739
Control + 2, 4-D	0 + .75	--------	10/7/71	1.725	1.974	1.664	1.589	1.738
2, 4-D One Week Prior								
SD 30053 + 2, 4-D	1 + .75	10/21/71	10/14/71	1.232	1.599	1.449	1.748	1.507
SD 30053 + 2, 4-D	1.5 + .75	10/21/71	10/14/71	1.306	1.461	1.220	0.973	1.240
SD 30053 + 2, 4-D	3 + .75	10/21/71	10/14/71	1.099	0.903	0.920	1.093	1.004
Control + 2, 4-D	0 + .75	--------	10/14/71	1.979	2.503	2.421	1.907	2.203
Tank-mix								
SD 30053 + 2, 4-D	1 + .75	10/21/71	10/21/71	1.728	1.716	2.092	1.548	1.771
SD 30053 + 2, 4-D	1.5 + .75	10/21/71	10/21/71	1.457	1.335	1.527	1.505	1.456
SD 30053 + 2, 4-D	3 + .75	10/21/71	10/21/71	0.883	0.789	1.026	0.827	0.881
Control + 2, 4-D	0 + .75	--------	10/21/71	2.549	2.378	2.271	2.677	2.469

a - Formulation contains oil b - dimethylamine salt of 2, 4-D

Appendix Table 15. Dry weights of wild oat plants in Appendix Table 14 expressed as a percent reduction in growth.

Treatment	Rate Lb. a. i. / A	Date of Application SD 30053[a]	Date of Application 2, 4-D[b]	% Growth Reduction R1	R2	R3	R4	Avg
Without 2, 4-D								
SD 30053	1	10/21/71	--------	61.4	68.7	57.4	65.4	63.2
SD 30053	1.5	10/21/71	--------	63.5	68.6	67.9	65.9	66.5
SD 30053	3	10/21/71	--------	74.4	77.1	64.0	70.9	71.6
2, 4-D Two Weeks Prior								
SD 30053 + 2, 4-D	1 + .75	10/21/71	10/7/71	51.8	47.8	42.7	58.8	50.3
SD 30053 + 2, 4-D	1.5 + .75	10/21/71	10/7/71	61.3	58.3	43.5	41.9	51.3
SD 30053 + 2, 4-D	3 + .75	10/21/71	10/7/71	54.3	58.3	50.8	66.3	57.4
2, 4-D One Week Prior								
SD 30053 + 2, 4-D	1 + .75	10/21/71	10/14/71	37.7	36.1	40.1	8.3	30.6
SD 30053 + 2, 4-D	1.5 + .75	10/21/71	10/14/71	34.2	41.6	49.6	49.0	43.6
SD 30053 + 2, 4-D	3 + .75	10/21/71	10/14/71	44.5	63.9	62.0	42.7	53.3
Tank-mix								
SD 30053 + 2, 4-D	1 + .75	10/21/71	10/21/71	32.2	27.8	7.9	42.2	27.5
SD 30053 + 2, 4-D	1.5 + .75	10/21/71	10/21/71	42.8	43.9	32.8	43.8	40.8
SD 30053 + 2, 4-D	3 + .75	10/21/71	10/21/71	65.4	66.8	54.8	69.1	64.0

a - Formulation contains oil b - dimethylamine salt of 2, 4-D L. S. D.$_{.05}$ = 12.5%

Analysis of Variance Table on the Percentages in Appendix Table 15

Source of Variation	df	SS	MS	F
Replication	3	308.85	102.9500	1.3709
Treatment	11	8,608.60	782.6000	10.4216**
Replication × Treatment	33	2,478.11	75.0942	
Total	47	11,395.56		

**Significant at 1% level
C.V. = 16.8%

Treatment LSD at .05 level = 12.5% at .01 level = 16.9%