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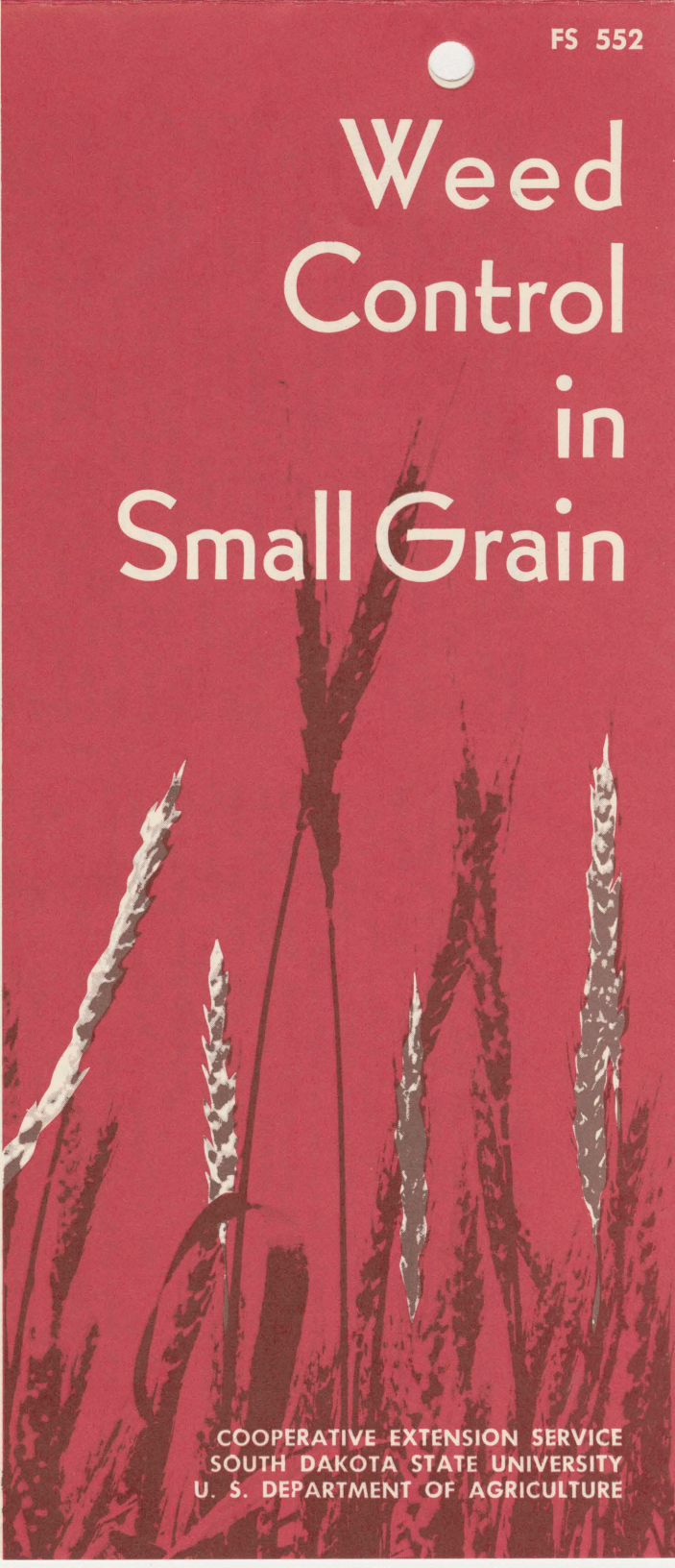

COOPERATIVE EXTENSION SERVICE
SOUTH DAKOTA STATE UNIVERSITY
U. S. DEPARTMENT OF AGRICULTURE

Weed Control in Small Grain

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Each year South Dakota farmers plant about 2.6 million acres of oats, 1.8 million acres of wheat (1,184,000 hard red spring, 522,000 hard red winter and 105,000 durum), 368,000 acres of barley, 704,000 acres of flax and 274,000 acres of rye. This amounts to over 5.7 million acres devoted to small grain and flax.

Over 1 million of the 5.7 million acres planted to small grain and flax are infested with noxious weeds. Large acreages are also infested with wild buckwheat, mustard, foxtail, cocklebur, sunflowers and other annual weeds.

Weeds frequently reduce small grain yield by 30% to 50%. Field samplings show that field bindweed reduced the average yield of eight wheat fields from 21.7 to 12.7 bushels per acre, 12 oat fields from 44.6 to 30.0 bushels, and reduced barley yield from 21.5 to 7.5 bushels. Mustard reduced the yield of oats from 127.2 to 72.6 bushels per acre. Foxtail reduced flax yield from 23.6 to 18.9 bushels. Canada thistle reduced the yield of wheat from 34.4 to 12.1 bushels, and perennial sowthistle decreased oat yield from 54.3 to 17.0 bushels per acre.

General Control Methods

Clean seed, proper seedbed preparation, good rotations, and sound soil management practices are required for controlling weeds in crops. These practices will eliminate many annual weeds and prevent infestations of most perennial weeds. Herbicides are valuable supplements to these practices, but are not intended as a replacement of sound management practices.

Once weeds become established, special practices are needed to eliminate them.

Special cultivation, competitive crops, and herbicides in addition to the practices already mentioned are helpful. A single method or application seldom eliminates all perennial weeds. Once they are eliminated, new seedlings from seeds in the soil must be controlled. Some of these seeds remain viable for as long as 20 years.

Herbicides

Herbicides may cause damage to crops if applied at certain stages of growth. This is particularly true when treating perennial weeds. If the tolerant stage of the crop does not occur when the weeds are in the most susceptible stage of growth, there are two choices—risk injuring the crop to get good weed control, or get poor weed control with less chance of injuring the crop. Good weed control usually pays in the long run. In several experiments, small grain actually produced higher yields even though the crop was damaged when 2,4-D was applied to control the weeds.

SAFETY FIRST

Read and follow all label directions and precautions. Federal regulations and the label directions concerning the use of chemicals are subject to change.

The use of tradenames does not imply endorsement of one product over another.

Herbicide Recommendations

The information presented in this publication is based on field tests and observations in South Dakota. Herbicide uses suggested herein conform to those outlined in the **Summary of Registered Agricultural Pesticide Chemical Uses** prepared by the Environmental Protection Agency (EPA). The rates and uses suggested conform to those stated on the product label, however, the label directions often include additional rates and uses that have not been tested or that do not apply to situations in South Dakota. The labeler will assume responsibility only for those uses stated on the label. The user is responsible for applications that do not conform to label directions.

Spring Grains

Numerous tillage and chemical methods for weed control in crops are available. It is possible to eliminate some of the most persistent perennial noxious weeds while growing crops if the proper combination of crops, cultivation, and herbicides is used.

Cropping

In many areas of South Dakota, a spring grain crop is grown 3 years out of 4. As a result, weeds establish growth characteristics similar to those of the crop. As an example, much of the spring wheat growing area is badly infested with wild oats. The crop and the weed germinates, grows, and matures at the same time. Many wild oat seeds shatter before harvest, leaving seed for next year's crop of wild oats.

Rotation. Seeding to perennial grasses or legumes is helpful in controlling weeds. Frequent cultivation of row crops as well as frequent cutting or grazing prevents production of weed seeds. In time, the weed seeds in the upper levels of the soil germinate; if others are not planted, these upper levels eventually become weed seed free. Plowing grass or legume sod, will bring a new crop of seeds to the surface. Therefore, include at least 2 years of a grass or legume and at least 1 year of a row crop or summer fallow in a 4- to 6-year rotation.

Delayed Seeding. Annual weeds, such as wild oats, that do not germinate readily during the fall can be destroyed with spring tillage. Harrow and pack the area early in the spring. This forms a good seed bed to induce early germination of weed seeds. After the weeds emerge, kill them with cultivation before the crop is seeded. However, the weeds do not emerge early enough to permit seeding small grains at the normal time. This can partially be overcome by using early maturing varieties.

Herbicides for Barley and Spring Wheat

Use 2,4-D or MCPA to control numerous broadleaved weeds. Both chemicals are available in amine or ester formulations. Apply when the crop is between the 5-leaf and early boot stage (Figure 1). Use only the amount needed to control the weeds (Table 1). Rates of $\frac{1}{2}$ pound of 2,4-D ester or $\frac{3}{4}$ pound acid equivalent per acre of 2,4-D amine or MCPA ester or amine seldom cause appreciable crop damage.

Use bromoxynil (tradename *Brominal* or *Buctril*) to control wild buckwheat in spring wheat and barley. Use dicamba (tradename *Banvel*) for wild buckwheat control in spring wheat (Table 2). Apply bromoxynil at rates of $\frac{1}{4}$ to $\frac{3}{8}$ pound acid equivalent (1 to $1\frac{1}{2}$ pt product) per acre when grain has reached the 2-leaf stage and before the boot stage. Apply $\frac{1}{8}$ pound acid equivalent of dicamba ($\frac{1}{4}$ pt product) per acre when the grain is in the 2- to 5-leaf stage. To improve control of broadleaved annual weeds other than wild buckwheat, mix $\frac{1}{4}$ pound acid equivalent of MCPA or 2,4-D ester per acre with bromoxynil (*Brominal* only). The mixture of MCPA ester and bromoxynil (tradename *Brominal Plus* or *Bronate*) is sold as a commercial premix. Use 1 to $1\frac{1}{2}$ pints of premix per acre. Mixtures of 2,4-D or MCPA with bromoxynil should be applied when the grain has reached the 5-leaf stage and before the boot stage. To improve the control of broadleaved annual weeds other than wild buckwheat, mix $\frac{1}{4}$ pound acid equivalent of 2,4-D or MCPA amine per acre with dicamba. The mixture of MCPA amine and dicamba is also sold as a commercial premix (tradename *MonDak*). Apply $\frac{4}{5}$ pint (1 gal/10 acres) of the premix per acre on spring wheat. Mixtures of dicamba with 2,4-D or MCPA should be applied when the spring wheat is in the 4- to 5-leaf stage. Do not graze or feed threshings from grain treated with dicamba to dairy cattle.

Use triallate (tradename *Far-go*) or barban (tradename *Carbyne*) to control wild oats. Apply triallate preplant or preemergence at the rate of $1\frac{1}{4}$ pound active ingredient ($1\frac{1}{4}$ qt product) per acre for barley and 1 pound (1 qt product) per acre preemergence for wheat. Apply to smooth soil and incorporate to a depth of $\frac{1}{2}$ to $1\frac{1}{2}$ inches. Apply $\frac{1}{3}$ to $\frac{3}{8}$ pound active ingredient ($\frac{1}{3}$ to $\frac{3}{8}$ gal product) of barban per acre when wild oats are in the 2-leaf stage (Figure 1). The crop should not to be sprayed later than 14 days after emergence or after the crop reaches the 4-leaf stage.

Use 2,4-DB or MCPA to control broadleaved weeds in grain underseeded with a legume. Apply 1 pound acid equivalent of 2,4-DB per acre when the grain is tillered and the legume seedlings have 2 to 4 true leaves. Use $\frac{1}{4}$ pound acid equivalent of MCPA amine per acre after the small grain has tillered until boot stage and legume seedlings are 2 to 3 inches tall. Do not harvest hay or graze areas treated with 2,4-DB within 30 days after spraying.

Ester and amine formulations of 2,4-D and MCPA are available. There appears to be slightly less risk of crop injury with MCPA than with 2,4-D. Some reports indicate that MCPA may be slightly less effective than 2,4-D on some broadleaved weeds and in larger weeds when used at low rates. Amine formulations of 2,4-D or MCPA are usually less injurious to the crop than esters. It is very important to spray the crop in the proper stage if the risk of injury is to be minimized. Crop injury is usually greater with most herbicides if the crop is growing under stress. Spring wheat and barley are most sensitive to 2,4-D before 2-leaf stage. They are still sensitive between the 2-leaf and 5-leaf stage of growth. Spraying during this period frequently inhibits tiller formation. A reduced number of tillers results in fewer heads and a serious (25%) yield reduction.

These crops are relatively tolerant to 2,4-D between the 5-leaf stage (Figure 1) and the time that the growing head inside the plant begins to swell the boot (Figure 2). The herbicide sometimes reduces yield by reducing the number of seeds per head. If there is adequate soil moisture and cool temperatures, the number of seeds per head may be reduced by application of 2,4-D at any time during this period. A slight (5%) yield reduction may result, but weeds generally would cause more damage. If soil is dry and temperature is high, there is a chance of reducing yields about 20% of the time (1 day out of 5). Spraying on the wrong day may drastically reduce the number of seeds per head resulting in a serious (10% to 15%) yield reduction. There is no way to determine which day is the wrong day until it is too late. Weeds must be controlled during this period if they are to be killed before they suppress crop yield.

Spraying with 2,4-D or MCPA between the 5-leaf and boot stages of growth may cause the formation of many abnormal heads without causing a depression in yield.

Spraying small grain with 2,4-D between boot and dough stage may cause a serious (25% to 35%) reduction in crop yield. Sometimes many heads do not form, others are half filled and still others are badly deformed with missing kernels. On other occasions there is little damage. The risk of crop damage is generally too great to offset any yield increase that might result from weed control.

It is safe to apply 2,4-D to small grain after the kernels are in the dough stage. An application of 1 pound per acre seldom causes yield reduction. However, spraying at this time will not prevent weeds from depressing the yield.

Barley and spring wheat appear to have good tolerance to bromoxynil. The optimum time to apply bromoxynil is longer than for dicamba. Wild buckwheat control is best if applications are made before the weed reaches the 4-leaf stage. Use the higher rate of bromoxynil during dry periods, or when weeds are larger. Bromoxynil is primarily a contact-type herbicide, therefore, good coverage is essential. More water is required to give coverage with this chemical than with systemic herbicides like 2,4-D or MCPA. Use the amount of water specified on the product label.

Bromoxynil will control several broadleaved annual weeds if they are treated in the seedling stage; however, overall broadleaved weed control is generally better if 2,4-D or MCPA is mixed with bromoxynil. An ester formulation of 2,4-D or MCPA is suggested, although an amine may be used. If an amine is used, mix it in the tank before adding the bromoxynil (an ester) to avoid mixing problems. Adding MCPA ester to the mixture appears to be slightly less injurious to the crop than 2,4-D ester. The commercial premix contains MCPA ester with bromoxynil.

Dicamba can cause injury symptoms at any stage. Yields may be reduced considerably if it is applied after the 5-leaf stage. However, in recent research trials, yields were not significantly reduced when dicamba was applied according to recommendations. The benefits from wild buckwheat control usually more than offset any crop injury. Wild buckwheat should be sprayed at the 2-leaf stage for best control. Dicamba will control several other broadleaved annual weeds if they are sprayed in the seedling stage. Control of lambsquarters, wild mustard and other weeds generally is better if 2,4-D or MCPA is mixed with dicamba. Amine formulations are less difficult to mix and less injurious to the crop than esters. Likewise, MCPA mixtures are less toxic than 2,4-D mixtures. Mixtures of either 2,4-D or MCPA with dicamba are more hazardous than either chemical used alone as the herbicides have a different optimum time for application. There appears to be less risk of injury from low-rate applications of 2,4-D or MCPA made too early than from applications of dicamba made too late. Therefore, the suggested crop stage is the 4- to 5-leaf stage.

Barban may cause some crop injury; however, it is less toxic at the 2- to 3-leaf stage than at later stages. Use 5 gallons of water per acre and 45 pounds of pressure. Do not mix barban with other chemicals. A limited amount of data indicate that yields of wheat and barley are not reduced by applying barban alone and the 2,4-D or MCPA about 2 weeks later. Do not use on grains underseeded to legumes.

Triallate is a volatile herbicide that must be incorporated into the soil before it evaporates. Some tests indicate that it is absorbed by the shoots of wild oats and the roots of wheat. Therefore, the layer of chemical must be above the planted grain where wild oat shoots must grow through it and above the area where the crop roots will come in contact with it. Triallate may be applied either before or after planting barley but only *after* planting spring wheat. It may be desirable to apply triallate before planting barley if a press drill is used so the field does not have to be harrowed after planting. Incorporate preplant applications with a disk set to cut 1 to 3 inches deep followed by a harrow. Incorporate preemergence applications with two harrowings at right angles.

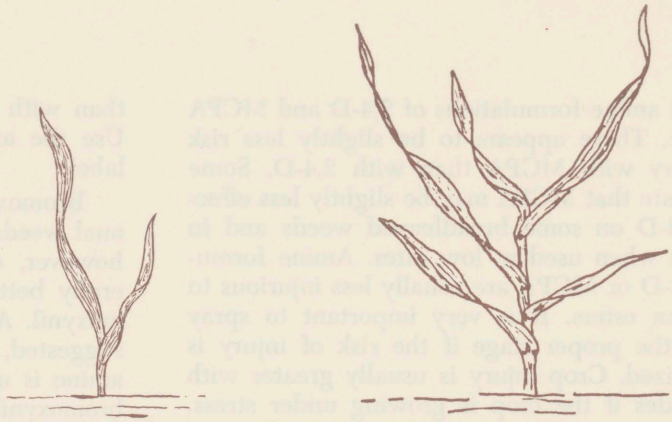


Figure 1. Small Grain Growth Stages. Count all the leaves on small plants. If tillers are present, count each tiller and all leaves above the tillers (leaves below tillers may disappear).

Triallate applied in the fall can be just as effective as when applied immediately before or after planting. However, the smooth seedbed required is conducive to wind erosion over winter. Triallate is not effective when a deep-furrow drill is used. Chemical applied before planting is moved out of the row by the drill. Chemical applied after planting cannot be applied to a smooth surface. The harrowing required for incorporation fills the furrows, nullifying some of the advantages gained from use of the deep-furrow drill. Limited data indicate that crops are not damaged by a preemergence application of triallate to control wild oats and later applications of 2,4-D or MCPA to control broadleaved weeds.

2,4-DB is less injurious to legume seedlings than MCPA. Legume seedlings are seldom injured from 2,4-DB. Ester and amine formulations of 2,4-DB are available. Legume seedlings may be injured, but are seldom killed from applications of MCPA. The legume seedlings are injured less if the crop and/or weeds provide a protective canopy, however, 2,4-DB or MCPA will not control large weeds as well as small weeds.

2,4-D is not registered for use on small grain underseeded to legumes.

Herbicides for Oats

Use 2,4-D amine or MCPA ester or amine to control broadleaved weeds. Apply when the crop is in the 3- to 4-leaf or very early boot stage (Figure 1). Use the minimum amount needed to control the weed (Table 1). Rates of ½ pound of 2,4-D or MCPA amine or ⅓ pound acid equivalent of MCPA ester per acre seldom cause appreciable damage.

Use dicamba (tradename *Banvel*) to control wild buckwheat (Table 2). Apply ⅛ pound acid equivalent (¼ pt product) per acre when oats are in the 2- to 5-leaf stage. Mix with ¼ pound acid equivalent of MCPA or 2,4-D amine per acre for better control of other broadleaved weeds. Do not graze or harvest forage from treated grain for dairy cattle before crop maturity.

Use 2,4-DB or MCPA to control broadleaved weeds in oats underseeded with a legume. Apply 1 pound acid equivalent to 2,4-DB per acre when the oats are tillered and the legume seedlings have 2 to 4 true leaves. Use ¼ pound acid equivalent of MCPA amine per acre after the oats are tillered until boot stage and the legume seedlings are 2 to 3 inches tall. Do not harvest hay or graze areas treated with 2,4-DB within 30 days after spraying.

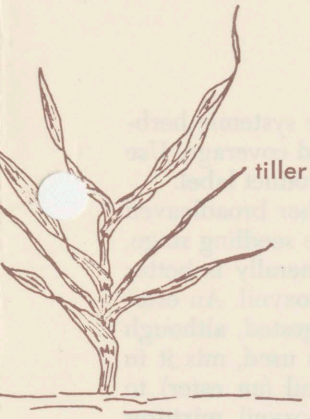
Oats are less tolerant to 2,4-D and MCPA than other spring grains, however, oats are more tolerant to MCPA than 2,4-D. Therefore, it is advisable to use MCPA when wild mustard, lambsquarters or Canada thistle is the major weed problem. MCPA is less effective than 2,4-D on several kinds of broadleaved weeds and on most larger weeds when used at low rates. Oats are more tolerant to amine than ester formulations. Crop injury can result from using 2,4-D ester. The amount of injury varies considerably and is affected by several factors. The risk of injury usually is greater when growing conditions are near ideal and the crop is lush.

Table 1. Susceptibility of several oat varieties to 2,4-D ester

Most Tolerant	Intermediate	Most Susceptible
Brave	Kelsey	Clintland
Burnett	Lodi	Clintford
Coachman	O'Brien	Jaycee
Dodge	Orbit	Tippecanoe
Garland	Ortley	Tyler
Holden	Portage	
Sioux	Kota	

Table 2. Number of Wild Buckwheat Seeds per Pound of Threshed Grain for Several Herbicide Treatments Garden City, South Dakota—2-year average

Plot Treatment	Rate (acid equivalent) lb/A	Spring Wheat	Oats	Barley
Check	—	549	808	587
2,4-D amine	¾	56	115	86
2,4-D ester	½	18	259	54
Bromoxynil	¼	20	—	13
Bromoxynil	⅜	9	—	7
Bromoxynil + MCPA	¼+¼	13	—	11
Dicamba + 2,4-D	1/16+¼	20	38	—
Dicamba + 2,4-D	⅛+¼	9	20	—
Dicamba + MCPA	1/16+¼	41	119	—
Dicamba + MCPA	⅛+¼	9	40	—



5-LEAF STAGE
ND 3 LEAVES ABOVE THE TILLERS)

LATE BOOT STAGE

Some growers fail to carefully check the growth stage of the crop and the spraying is done too late. Recent research indicates oats are most susceptible to injury in the 5-leaf and in the boot stage. To facilitate harvest 2,4-D can be applied at 1 pound per acre after the crop is in dough stage. Do not feed the straw from this late application.

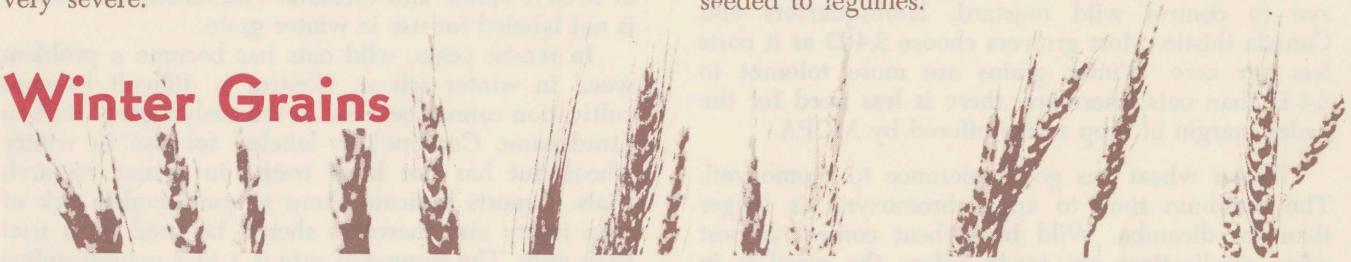
Oat varieties differ in susceptibility to 2,4-D. The results of tests using 2,4-D ester are shown in Table 1. Benefits from early weed control usually more than offset slight crop injury. Use considerable care when spraying varieties with an intermediate rating as losses can be substantial. Susceptible varieties should be sprayed only if weed infestations are very severe.

Dicamba can cause injury symptoms at any stage, however, significant yield losses have not been observed in research trials. Yields may be reduced considerably if the grain is sprayed after the 5-leaf stage. Wild buckwheat should be sprayed at the 2-leaf stage for best control. Dicamba will control several broadleaved annual weeds if sprayed in the seedling stage. Control of lambsquarters, mustard, and other broadleaved weeds usually is better if 2,4-D or MCPA is mixed with dicamba. MCPA mixed with dicamba is less apt to cause crop injury than 2,4-D with dicamba. Use amine formulations with dicamba to avoid mixing problems.

2,4-DB is less injurious to legume seedlings than MCPA. 2,4-DB seldom causes injury to legume seedlings. Legume seedlings may be injured, but are seldom killed from applications of MCPA. The legume seedlings are injured less if the crop and/or weeds provide a protective canopy, however, 2,4-DB or MCPA will not control large weeds as well as small weeds. Ester or amine formulations of 2,4-DB are available.

Bromoxnyil is not registered for use on oats. Oats appear to have fair tolerance to bromoxynil although slight stunting has been observed. Triallate or barban should not be used for wild oats control as cultivated oats are extremely sensitive to these chemicals. 2,4-D is not registered for use on small grain underseeded to legumes.

Winter Grains



Cropping

In much of the winter wheat area, winter wheat is grown 2 to 3 years out of 4 and Japanese chess (*Bromus japonicus*) and downy bromegrass (*Bromus tectorum*)—both called cheat—are a problem. Winter wheat and the weeds have the same life cycle. Seed germinates in the fall, grows the next spring and matures during late June or early July. Pennycress has the same life cycle, but it can be killed with 2,4-D.

Herbicides to control Japanese chess or downy bromegrass presently are labeled for use in a few Pacific northwest states, but are not registered for use in the midwest. Until a control is developed a rotation of crops that do not have the same life cycle as the weed is suggested. A winter wheat-sorghum-fallow rotation has been very effective in Nebraska.

A one-way disk used early in the spring of the fallow year aids in the control of annual bromegrass. However, the soil must be dry and must be removed from weed roots or weeds will continue to grow. A blade or rod weeder is less effective.

A rotary hoe, spike-toothed harrow, or similar implement will control many summer annual weeds during early spring when operated in the grain at the time the weeds are emerging, but is much less effective for winter annuals, such as pennycress, Japanese chess, or downy bromegrass. Winter annuals generally come up during the fall and are established by spring, implements that will kill them generally will injure the crop.

Herbicides for Winter Grains

Use 2,4-D to control broadleaved weeds in winter wheat and rye. Apply in the spring after the grain is fully stooled and before the boot begins to swell (Figure 1). Rates of ½ pound in the ester form or ¾ pound acid equivalent per acre in the amine form seldom cause appreciable crop damage. Use the minimum amount needed to control the weed (Table 4).

Use bromoxynil (tradename *Brominal* or *Buctril*) or dicamba (tradename *Banvel*) to control wild buckwheat in winter wheat. Apply ¼ to ⅜ pound acid equivalent of bromoxynil (1 to 1½ pt product) per

acre in the spring before the crop reaches the early boot stage (Figure 1).

Apply $\frac{1}{8}$ pound acid equivalent of dicamba ($\frac{1}{4}$ pt product) per acre in the spring before the crop begins to joint. To improve control of wild mustard and lambsquarters, mix $\frac{1}{4}$ pound acid equivalent of MCPA ester or 2,4-D ester per acre with bromoxynil (*Brominal* only) or mix $\frac{1}{4}$ pound acid equivalent of 2,4-D or MCPA amine per acre with dicamba. Commercial premixes of bromoxynil plus MCPA ester (tradename *Brominal Plus or Bronate*) are also available. Use 1 to $1\frac{1}{2}$ pints of the premix per acre.

Winter wheat and rye produce tillers in the fall and small amounts of 2,4-D will inhibit tiller formation. A reduced number of tillers can result in a significant yield reduction. One-half pound of 2,4-D ester or $\frac{3}{4}$ pound acid equivalent of 2,4-D amine per acre seldom cause any material decrease in yield if applied in the spring before the boot begins to swell. One pound acid equivalent of 2,4-D per acre seldom injures crop if applied after the grain is in the dough stage. However, there have been reports of injury on wheat with applications made immediately after heading. These late treatments will prevent weed seed production and facilitate harvesting operations.

MCPA may also be used on winter wheat and rye to control wild mustard, lambsquarters and Canada thistle. Most growers choose 2,4-D as it costs less per acre. Winter grains are more tolerant to 2,4-D than oats; therefore, there is less need for the wider margin of crop safety offered by MCPA.

Winter wheat has good tolerance to bromoxynil. The optimum time to apply bromoxynil is longer than for dicamba. Wild buckwheat control is best when applications are made before the weed is in the 4-leaf stage. Use the higher rates during dry periods or if weeds are large. Bromoxynil is primarily a contact herbicide and good spray coverage is necessary. More water is needed than for systemic herbicides like MCPA or 2,4-D to give good coverage. Use the amount of water specified on the product label.

Bromoxynil will control several other broadleaved annual weeds if they are treated in the seedling stage. Overall broadleaved weed control generally is better if 2,4-D or MCPA is mixed with bromoxynil. An ester formulation of 2,4-D or MCPA is suggested, although an amine may be used. If an amine is used, mix it in the tank before adding the bromoxynil (an ester) to avoid mixing problems. MCPA-bromoxynil mixtures are slightly less injurious to the crop than 2,4-D mixtures.

Dicamba can cause injury symptoms when applied at any stage. Yields may be reduced considerably if applications are made after the jointing stage. However, the benefits gained from wild buckwheat control usually offset any effects of spraying when applications are made according to recommendations.

Wild buckwheat can cause significant yield loss, but harvesting losses and dockage discounts can be even larger. Dicamba will control some other broadleaved annual weeds if sprayed in the seedling stage. Control of other broadleaved weeds is improved by mixing 2,4-D or MCPA with dicamba. Amine formulations are less difficult to mix and less injurious to the crop than esters. Likewise, MCPA mixtures are less toxic than 2,4-D mixtures. The commercial premix of MCPA amine and dicamba (tradename *MonDak*) is not labeled for use in winter grain.

In recent years, wild oats has become a problem weed in winter wheat. Control is difficult because cultivation cannot be done in the early spring. Barban (tradename *Carbyne*) is labeled for use in winter wheat but has not been tested in recent research trials. Reports indicate there is considerable risk of crop injury and therefore should be used on a trial basis only. The suggested rate is $\frac{1}{4}$ to $\frac{3}{8}$ pounds active ingredient ($\frac{1}{4}$ to $\frac{3}{8}$ gal product) per acre. It must be applied when the majority of the wild oat plants are in the 2-leaf stage.

Flax

Cropping

Good crop rotations and timely tillage are the basic cultural practices for weed control in flax. The best crop sequence includes a row crop, such as corn, soybeans, or sorghum the year before flax is grown. Proper cultivation of the row crop prevents weeds from producing seed. When small grain precedes flax, use early after-harvest tillage to aid in the control of perennial weeds, prevent seed production of some weeds, and stimulate weed seed germination. Shallow tillage before seeding the flax eliminates the possibility of bringing other weed seeds to the surface to germinate and cause a weed problem.

Full stands of flax are essential in obtaining satisfactory weed control. Flax drilled in 6 inch rows are less weedy than flax drilled in 7 inch rows or broadcast. Delayed seeding of flax to permit late spring tillage is helpful for control of wild oats. However, the seeding must be delayed until late May to permit wild oats to emerge and be killed by cultivation. Conse-

quently, the yield of flax is often lower than it would be if seeded at the normal date of seeding. However, several varieties yield well when planted late.

Herbicides for Flax

Use MCPA amine or ester to control susceptible broadleaved annual weeds. Use up to ¼ pound acid equivalent of MCPA per acre. Apply when flax is 4 to 8 inches tall and before it is in the bud stage. Weeds should be less than 4 inches tall.

Use dalapon (tradename *Dowpon*) to control foxtails or barnyard grass. Apply ¾ pound acid equivalent of dalapon (1 lb product) per acre. Apply when the flax is 2 to 6 inches tall, and before weeds are over 2 inches tall. Dalapon and MCPA may be tank-mixed at the above rates to control annual grasses and broadleaved annual weeds in one spray operation.

Use diallate (tradename *Avadex*) or barban (tradename *Carbyne*) to control wild oats. Apply diallate preplant or preemergence at the rate of 1½ pounds active ingredient (1½ qt product) per acre. Apply to a smooth soil surface and incorporate to a depth of ½ to1½ inches. Use ¼ to ⅜ pound active ingredient of barban (¼ to ⅓ gal product) per acre. Apply when the wild oats are in the 2-leaf stage(Figure 1) and not later than 14 days after crop emergence or before the 12-leaf stage of the flax.

Use MCPA amine to control annual broadleaved weeds in flax underseeded to legumes. Use ¼ pound acid equivalent of MCPA per acre.

MCPA is less toxic to flax than 2,4-D. The use of 2,4-D on flax may be cancelled in the future because of insufficient residue data. Although MCPA ester has not been tested extensively on flax in South Dakota, it appears the amine formulation may be slightly less injurious to the crop. Weeds should be sprayed when small, as MCPA at low rates will not control large weeds. It is most effective on mustard, lambsquarters and Canada thistle. MCPA may cause a slight delay in maturity, although usually less than 5- to 7-day delay caused with 2,4-D. Flax often appears wilted for several days after spraying and the stems are usually curved, but this does not necessarily mean that yield will be reduced. Using higher rates than suggested may result in reduced yield. Spraying flax with MCPA right after the bolls set may cause poor germination of seed. Therefore, do not spray flax grown for seed at this stage of growth.

Dalapon seldom causes injury to flax when it is applied properly. Although dalapon will not injure legume underseedings in flax, it is not registered for this use. Dalapon presently is not labeled for aerial application, although this may be changed in the near future.

Diallate is a volatile herbicide that must be incorporated into the soil before it evaporates. Diallate may be applied before or after planting flax. It may be desirable to apply diallate before planting flax if a press drill is used so the field does not have to be harrowed after planting. Incorporate preplant applications with a disk set to cut 1 to 3 inches deep followed by a harrow. Incorporate preemergence applications with two harrowings at right angles.

Flax is more susceptible to barban than wheat. There is less risk of crop injury from the lower rates. Barban is not registered for use on flax underseeded to alfalfa.

Legume seedlings in flax may be injured but are seldom killed from applications of MCPA. Less injury is noted if the crop or weeds provide a protective canopy over the legume seedlings.

Dicamba (tradename *Banvel*) and bromoxynil (tradename *Brominal* or *Buctril*) and 2,4-DB are not registered for use on flax.

NOXIOUS WEED CONTROL

Spraying in small grain with 2,4-D or MCPA aids in the control of most noxious weeds. It prevents seed production, kills susceptible weeds, and weakens those that are less susceptible. After-harvest operations can be used to kill some of the weeds not killed by the spraying. A post-harvest application of 2,4-D may be used, but is generally less effective than cultivation.

Dicamba (tradename *Banvel*) may be used for treatment of most broadleaved perennial weeds in land to be planted to wheat. The rate suggested is 1 to 2 pounds acid equivalent (1 to 2 qt product) per acre of area treated. It should be applied in the fall when the weeds are actively growing. Apply anytime within 30 days before planting and up to crop emergence. This has not been evaluated in research trials, however, in one test, dicamba gave 85% field bindweed control when applied in the fall after the grain was sprayed with 2,4-D. Considerable crop injury can be expected. This rate would appear to be too low for complete eradication and represents a considerable cost for partial control.

For more details on methods of controlling noxious weeds, see the Extension servce fact sheet that discusses the weed in question.

Grain, 2,4-D and Cultivation

Use ½ to ¾ pound acid equivalent of 2,4-D per acre when the grain is in the 5-leaf stage to prevent the weed form going to seed and also weaken some plants. The small grain gets ahead of the weed and holds it in check until harvest.

Stands were reduced 10% to 90%, depending on the weeds being treated, in experimental tests by plowing 2 weeks after harvest and cultivating 3 or 4 times during September and early October with a duckfoot cultivator. It is believed that a sharp 24 to 30-inch sweep cultivator is equally effective on the weeds and leaves a stubble mulch on the soil surface.

This system is useful when included in a rotation which materially reduces the stand.

Winter grain has some advantage over spring grain by keeping the soil covered over the winter and starts growth earlier in the spring. However, early fall seeding prevents late cultivation.

Cost of Spraying

The approximate cost (suggested price) of herbicides purchased in small quanities is given in Table 3. The cost of application is usually $.90 to $1.35 per acre. Contact your dealer or custom applicator for current chemical and application costs.

Table 3. Cost of Herbicides

Chemical	Cost/lb*	Lb*/A	Cost/A
2,4-D	$.90-1.40	¼-¾	$.25-1.05
MCPA	2.00-2.35	¼-¾	.50-1.75
2,4-DB	7.00	1	7.00
Dalapon	1.20	¾	.90
Barban	12.00	¼-⅜	3.00-4.50
Diallate	3.35	1½	5.00
Triallate	3.35	1-1¼	3.35-4.20
Dicamba	7.50	⅛	.95
Bromoxynil	8.00	¼-⅜	2.00-3.00

*Acid equivalent or active ingredient.

Table 4. The quantity of herbicide required for control varies with the weed species. The same amount of herbicide is less effective as the weed matures. The amount of 2,4-D or MCPA required to control numerous weeds at different stages of growth is listed below. The control may vary slightly due to growing conditions and the chemical or formulation used.

¼ lb./A.	⅓ lb./A.	½ lb./A.	¾ lb./A.	1 lb./A. or more
Kochia, 2-4 in.	Kochia, 4-8 in.	Kochia, over 8 in.	Canada thistle	Blue lettuce
Marsh elder, 2-4 in.	Marsh elder, over 4 in.	Cinquefoil	Dandelion	Yarrow
Ragweeds, 2-4 in.	Ragweeds, over 4 in.	Gumweed, 6-12 in.	Field bindweed	Goldenrod
Pennycress, 4-6 in.	Pennycress, over 6 in.	Mare's tail	Perennial sowthistle	Hoary cress
Pigweeds, 2-4 in.	Pigweeds, over 4 in.	Puncture vine	Flodman's thistle	Leafy spurge
Mustard, 4-6 in.	Mustard, over 6 in.	Plantains	Bull thistle	Russian knapweed
Lambsquarters, 4-6 in.	Lambsquarters, over 6 in.	Cocklebur, over 6 in.	Burdock (early)	Sand sagebrush
	Cocklebur, 2-6 in.	Sowthistle, annual, over 6 in.		Vervain
	Sowthistle, annual, 2-6 in.	Sunflower, over 6 in.		Toadflax
	Sunflower, 2-6 in.	Lady's thumb, over 6 in.		Water hemlock*
	Lady's thumb, 2-6 in.	Velvetleaf, over 6 in.		Fringe sage*
	Velvetleaf, 4-6 in.	Wild lettuce, over 6 in.		Buckbrush*
	Wild lettuce, 4-6 in.	Russian thistle, 4-6 in.		Bur ragweed*
	Russian thistle, 2-4 in.			Big sagebrush*
	Wild buckwheat, 2 leaves			Wild rose*
	Morningglory, annual			Willows*
	Peppergrass, annual			

***These weeds require at least 2 lbs. acid equivalent per acre.**

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