

Managing Weeds in Alfalfa

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Figure 1. Flixweed (*Descurainia sophia*), an annual mustard, infestation in alfalfa. These late winter weeds are relatively easy to control with several post-emergence herbicides.

IMPORTANCE OF WEED MANAGEMENT

Managing weeds is a critical component of alfalfa production, and under New Mexico growing conditions, effective weed management will pay for itself if the market for alfalfa exists.

Weeds are plants that interfere with the management objectives for a particular crop or situation (Figure 1). Weeds negatively impact alfalfa production by competing for space, nutrients, sunlight, and moisture (Figure 2). Additionally, weeds also play a major role in the production of premium alfalfa (Figure 3) because they can reduce the quality of harvested alfalfa. Weeds affect alfalfa stands in different ways during the various stages of alfalfa production: prior to establishment, in the seedling stage, and in established stands.

When establishing an alfalfa stand, it is especially critical that the field be free from perennial weeds, such as field bindweed (Figure 4), silverleaf nightshade, yellow nutsedge, and johnsongrass. These weeds are extremely aggressive and will outcompete seedling alfalfa if the field is planted prior to their control. Taking time to manage any perennial weeds prior to alfalfa establishment will help prevent reseeding costs or excessive weed control costs in the future. It is also important to control annual weeds during the establishment stage to reduce competition.

Weeds exert their greatest impact during the seedling stage. If competition from weeds is high enough during crop establishment, it can cause stand fail-

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Figure 2. Weeds infest open areas within the field and can spread as stands get older and as alfalfa plants die, exposing more open ground.



Figure 3. A weed-free field of alfalfa near Los Lunas, NM.



Figure 4. Field bindweed (*Convolvulus arvensis*) competition with alfalfa.

ure. Light to moderate weed infestations can reduce alfalfa growth, which will impact yield or delay production. In seedling alfalfa, weed type/pressure varies with the timing of seeding. Spring plantings usually experience the greatest weed pressure. In areas with mild winters, winter annual weeds also may cause problems in alfalfa planted in late summer or early fall. However, weed control in New Mexico and the Southern High Plains is generally much easier to achieve in late summer- to fall-planted alfalfa than in alfalfa planted in the spring.

In established alfalfa stands, weeds not only compete for resources but also reduce the quality of the forage. The vigor of an established stand depends on how well the weeds were managed during the previous stages of production. Once a healthy alfalfa stand is established, problems associated with weeds can lessen because the alfalfa becomes much more competitive. Weeds can become a problem in established stands because of factors such as poor soil fertility, improper irrigation and/or harvest management (Figure 5), disease and insect pressures, and other practices. Aside from standard crop rotation practices, growers report that weeds are the main reason many fields are taken out of production.

PRINCIPLES OF WEED MANAGEMENT

Weed Identification

Developing a successful management plan requires that growers first properly identify the target weeds. Weeds typically found in alfalfa fields are divided into three major classes: broadleaf weeds, grasses, and sedges. Broadleaf weeds usually have a taproot system, two cotyledons (embryonic leaves) at germination, and netted veins on the leaves. Broadleaf weeds, such as plantain (Figure 6), can be some of the toughest weeds to control in alfalfa. Grasses usually have a fibrous root system, a single cotyledon at germination, and leaves with parallel veins. Sedges are often confused with grasses, but unlike grasses they have stems that are triangular in cross-section.

Weeds in each of these classes are also grouped according to their life cycles. Annual weeds, either winter or summer, complete their life cycles in one year. Winter annuals germinate in the fall and complete their life cycles the following spring, while summer annuals germinate in the spring and complete their life cycles in the fall. Biennial weeds, such as musk thistle, complete their life cycles in two years. Annual and biennial weeds spread through seed production only, so the key to effective management is to not let them set seed. Perennial weeds are capable of coming back year after year because they have vegetative reproductive structures such as tillers, rhizomes, stolons, or underground roots with adventitious buds, crowns, or tubers.



Figure 5. Drought/irrigation termination effects on alfalfa plant size (left: irrigation terminated, right: fully irrigated). Improper irrigation management can lead to open areas in the stand and subsequently increased weed pressure.

Perennials are difficult to manage because, in most cases, management plans have to deal with both vegetative reproduction and seed production. There are two groups of perennials: simple perennials and creeping perennials. Simple perennials, such as common mallow and dandelion, spread only by seed and have no normal means of spreading vegetatively. However, if the roots of some species are cut or broken, each piece could send out roots and stems to form a new plant. Creeping perennials, such as bindweed or johnsongrass, may reproduce not only by seeds but also by creeping roots or stems, such as stolons (aboveground stems) and/or rhizomes (underground stems).

Accurate identification of weeds is necessary to apply to most effective control measure. Some of the more common weeds found in New Mexico alfalfa fields during different stages of alfalfa production are listed in Table 1. Additional information regarding the classification and distribution of the weeds listed in Table 1 can be found at the USDA PLANTS Database at <http://plants.usda.gov>.

Management Options

Successful weed management requires an integrated approach that includes multiple strategies. There are four general weed management strategies used in alfalfa: (1) preventive, (2) mechanical, (3) cultural, and (4) chemical. Sustainable and successful weed control requires a system that integrates all four management strategies.

Preventive weed management

The most important part of integrated weed management is preventive management. Growers can and



Figure 6. Plantain (*Plantago lanceolata*), a late spring/early summer perennial weed that is more difficult to control in broadleaf crops like alfalfa with post-emergence herbicides. Pre-emergence herbicides will have little to no effect on perennial plants unless they are germinating from seed.

should prevent weeds from getting into the field. Strategies such as managing weeds in the fencerow, irrigation canals, or along ditches; controlling weeds before they set seed; planting certified seed; and taking time to remove weeds from mechanical equipment when going from field to field can reduce the potential spread of weeds such as field bindweed, johnsongrass, sandbur, and other troublesome weeds.

Mechanical weed management

Although quite effective in row crop production, mechanical weed management offers little help in managing weeds in established alfalfa. Fields heavily infested with winter annual mustard weeds often are cut prematurely to eliminate the mustards. However, mustard plants produce lateral branches from below the cut stem, quickly form new flowers, and can produce viable seed anyway. Plowing or disking prior to planting alfalfa is also a common way of destroying existing weeds during land preparation. This method is often utilized for tough weeds such as plantain. Equipment should always be checked and cleaned when moving from one field to another to prevent the spread of any spreading root or stem structures of difficult-to-control perennial weeds.

Cultural weed management

The central theme of cultural weed management is giving alfalfa the competitive edge against weeds. Site selection and knowing a field's potential and limitations are critical first steps of cultural management. Historically, weedy fields, fields with a history of drainage or disease issues, and highly saline soils should be avoided.

Table 1. Some of the Common Weeds Associated with the Different Stages of Alfalfa Production			
Common name	Scientific name	Class	Life cycle*
Prior to establishment			
Bermudagrass	<i>Cynodon dactylon</i>	Grass	CP
Field bindweed	<i>Convolvulus arvensis</i>	Broadleaf	CP
Johnsongrass	<i>Sorghum halepense</i>	Grass	CP
Purple nutsedge	<i>Cyperus rotundus</i>	Sedge	CP
Silverleaf nightshade	<i>Solanum elaeagnifolium</i>	Broadleaf	CP
Texas blueweed	<i>Helianthus ciliaris</i>	Broadleaf	CP
Yellow nutsedge	<i>Cyperus esculentus</i>	Sedge	CP
Fall-seeded seedling alfalfa			
Downy brome (cheatgrass)	<i>Bromus tectorum</i>	Grass	WA
Flixweed	<i>Descurainia sophia</i>	Broadleaf	WA
London rocket	<i>Sisymbrium irio</i>	Broadleaf	WA
Rescuegrass	<i>Bromus catharticus</i>	Grass	WA
Shepherdspurse	<i>Capsella bursa-pastoris</i>	Broadleaf	WA
Tansymustard	<i>Descurainia pinnata</i>	Broadleaf	WA
Spring-seeded seedling alfalfa			
Bermudagrass	<i>Cynodon dactylon</i>	Grass	CP
Dodder	<i>Cuscuta</i> spp.	Broadleaf	SA
Green foxtail	<i>Setaria viridis</i>	Grass	SA
Kochia	<i>Kochia scoparia</i>	Broadleaf	SA
Pigweed species	<i>Amaranthus</i> spp.	Broadleaf	SA
Russian thistle	<i>Salsola iberica</i>	Broadleaf	SA
Sandbur (grassbur)	<i>Cenchrus</i> spp.	Grass	SA
Yellow foxtail	<i>Setaria glauca</i>	Grass	SA
Yellow nutsedge	<i>Cyperus esculentus</i>	Sedge	SA
Established alfalfa stands			
Common mallow	<i>Malva neglecta</i>	Broadleaf	SP
Dandelion	<i>Taraxacum officinale</i>	Broadleaf	SP
Dodder	<i>Cuscuta</i> spp.	Broadleaf	SA
Downy brome (cheatgrass)	<i>Bromus tectorum</i>	Grass	WA
Flixweed	<i>Descurainia sophia</i>	Broadleaf	WA
Green foxtail	<i>Setaria viridis</i>	Grass	SA
Johnsongrass	<i>Sorghum halepense</i>	Grass	CP
Kochia	<i>Kochia scoparia</i>	Broadleaf	SA
London rocket	<i>Sisymbrium irio</i>	Broadleaf	WA
Pigweed species	<i>Amaranthus</i> spp.	Broadleaf	SA
Plantain	<i>Plantago</i> spp.	Broadleaf	SP
Purple nutsedge	<i>Cyperus rotundus</i>	Sedge	CP
Rescuegrass	<i>Bromus catharticus</i>	Grass	WA
Russian thistle	<i>Salsola iberica</i>	Broadleaf	SA
Shepherdspurse	<i>Capsella bursa-pastoris</i>	Broadleaf	WA
Tansymustard	<i>Descurainia pinnata</i>	Broadleaf	WA
Whorled milkweed	<i>Asclepias</i> spp.	Broadleaf	CP
Yellow foxtail	<i>Setaria glauca</i>	Grass	SA
Yellow nutsedge	<i>Cyperus esculentus</i>	Sedge	CP
*WA = winter annual, SP = simple perennial, SA = summer annual, and CP = creeping perennial.			

Begin by ensuring the field is free of any major weed problems before planting. Planting certified seed and varieties suited for the area (e.g., proper fall dormancy rating) are two other ways growers can improve the chances of good establishment and a competitive alfalfa stand. Maintaining proper field fertility and managing any disease or insect problems also helps maintain healthy alfalfa stands prior to weed establishment. When using flood irrigation, growers can give alfalfa a competitive edge by irrigating properly and knowing when to turn the water off. By not overwatering, growers reduce ponding, which drowns alfalfa and favors weed invasion. If irrigation occurs soon after cutting alfalfa, the added moisture can favor summer annual grass germination because there will not be enough regrowth from the alfalfa to shade out the competing grasses. Irrigating prior to cutting and then harvesting the alfalfa as soon as drying permits allows the alfalfa to be more competitive. Although ideal in some ways, this is not always possible due to irrigation schedules and water availability. Proper harvest management (particularly during the last cutting of the season) allows alfalfa plants to store root energy prior to harvesting and, therefore, helps maintain a dense and healthy alfalfa stand.

Chemical weed management

Growers may opt to use herbicides to manage weeds. Chemical management should be used in conjunction with previously mentioned management techniques as part of an integrated approach. In general, herbicides fall into one or more of the following application timings: pre-plant, seedling alfalfa, and established alfalfa. Also, some herbicides are labeled for “dormant season” use only. A secondary weed management system developed more recently is the Roundup Ready alfalfa. This system allows producers to apply glyphosate to both seedling and established alfalfa to control many broadleaf and grassy weeds without injury to the alfalfa. This method is only applicable in Roundup Ready alfalfa. A list of currently registered herbicides for alfalfa in New Mexico and some information regarding their usage is given in Table 2. Be sure to read and understand the label before using the product and follow all labeled directions and restrictions when making an application. Pay particular attention to information such as timing of application, rates of application, types of weeds controlled, harvest or grazing restrictions, tank-mix combinations or restrictions, additives, and crop rotation restrictions. Many times an herbicide’s poor performance or nonperformance can be traced to improper use and failure to follow label directions.

When using chemical control, be advised that repetitive usage of a single herbicide or a particular herbicide family (group number) with the same site of action could select for herbicide-resistant weed biotypes. Therefore, make sure to rotate herbicides with different group numbers and do not make more than two consecutive applications of herbicides with the same group number against

Table 2. List of Herbicides Registered for Use on Alfalfa in New Mexico (2017) ^{a,b}						
Common Name	Example of Trade Name ^c	Weed		Timing		
		Grass	Broadleaf	Prior to Establishment	Seedling	Established
2,4-DB amine	Butyrac 200	No	Yes	No	Yes	Yes
Benefin	Balan DF	Yes	Yes	Yes	No	No
Clethodim	Select 2EC	Yes	No	No	Yes	Yes
Diuron	Karmex DF	Yes	Yes	No	No	Yes
EPTC	Eptam 7E	Yes	Yes	Yes	Yes	Yes
Flumioxazin	Chateau	Yes	Yes	No	No	Yes
Glyphosate	Roundup	Yes	Yes	Yes	No	No
Hexazinone	Velpar DF, L	Yes	Yes	No	No	Yes
Imazamox	Raptor	Yes	Yes	No	Yes	Yes
Imazethapyr	Pursuit	Yes	Yes	No	Yes	Yes
MCPA	MCP Amine 4	No	Yes	No	No	Yes
Metam-potassium	K-PAM HL	Yes	Yes	Yes	No	No
Metam-sodium	Metam CLR 42%	Yes	Yes	Yes	No	No
Metribuzin	Sencor DF	Yes	Yes	No	No	Yes
Norflurazon	Solicam DF	Yes	Yes	No	No	Yes
Paraquat	Gramoxone SL	Yes	Yes	Yes	No	Yes
Pelargonic acid	Scythe	Yes	Yes	Yes	No	Yes
Pendimethalin	Prowl H2O	Yes	Yes	No	Yes	Yes
Pronamide	Kerb 50W	Yes	Yes	No	Yes	Yes
Pyraflufen-ethyl	ET Herbicide	No	Yes	Yes	No	No
Sethoxydim	Poast	Yes	No	No	Yes	Yes
	Poast Plus					
Terbacil	Sinbar WDG	Yes	Yes	No	No	Yes
Trifluralin	Treflan 4 EC, Treflan 4D	Yes	Yes	No	Yes	Yes
	Treflan TR-10					

^a See Table 3 for a description of each herbicide active ingredient.

^b The list is current as of May 2017; however, labels change frequently, and the herbicide's current label should be reviewed for the most recent conditions or restrictions before it is used. Read all labels carefully and comply with their site-use directions. For the very latest label information on a given herbicide, contact the manufacturer, your county Extension office (<http://aces.nmsu.edu/county/>), or the company or distributor that sells the product.

^c Other trade names of the above-mentioned active ingredients alone or in combination may be available in the market. (Notice: Mention of herbicide trade names does not constitute endorsement of any material.)

the same weed. If possible, combine herbicides based on the label directions. Mixing two or more herbicides with different group numbers can delay or prevent the development of herbicide resistance in weeds and dramatically increase the spectrum of weed control. This is especially true since no single herbicide controls all weeds commonly found in alfalfa. For more information on herbicide resistance in weeds, see NMSU Extension Guide A-616, *Herbicide Resistance: Development and Management* (http://aces.nmsu.edu/pubs/_a/A616.pdf).

If you have been relying on one particular herbicide for several years and notice that some weed species that were effectively controlled in past seasons are now abundant, or that some species are now present that you have not dealt with before, this could be an indication that an herbicide-

resistant biotype or a shift in weed species has developed. If you suspect the development of herbicide resistance on a weed in your field, contact your county Cooperative Extension Service agent (<http://aces.nmsu.edu/county/>) or Extension Weed Specialist.

The information on herbicides shown in Table 3 can help producers develop an effective alfalfa weed management program. When considering using an herbicide, no recommendations can take the place of the product label and making applications according to label directions. Most up-to-date chemical and supplemental labels can be accessed at either <http://www.greenbook.net> or <http://cdms.net>. Table 4 shows the varying degrees of management that herbicide active ingredients may provide for various weed species.

Table 3. Detailed List of Herbicides Approved for Use on Alfalfa in New Mexico ^a			
Herbicide Common Name	Example of Trade Name	Timing	Rates of Application
2,4-DB amine	Butyrac 200	Post-emergence	2.0–6.0 pt Butyrac 200/acre
Comments: 2,4-DB amine is a “restricted use” pesticide in New Mexico, so the applicator is required to be certified. Some broadleaf crops such as cotton are as sensitive to 2,4-DB amine as many weeds, and only a trace of the chemical as spray drift, vapor drift, or contaminant in soil or water may cause serious damage. Therefore, follow label precautions carefully to minimize possible unwanted crop injuries. In seedling alfalfa: Apply in spring or fall when seedling alfalfa has at least two trifoliate leaves and weeds are less than 3 inches tall. Do not graze treated fields for 60 days following application. In established stands: Certain winter annual mustards are better controlled using a late fall/early winter treatment. The grazing restriction for treated fields is 30 days. Do not apply this herbicide if daytime temperature is expected to exceed 90°F or drop below 40°F within 2 or 3 days following application. Field research in New Mexico showed this to be an inconsistent treatment; sometimes it works and other times it doesn't appear to provide any control. In seedling stands, the addition of bromoxynil has improved 2,4-DB amine's efficiency, but erratic results are still observed.			
Benefin	Balan DF	Incorporate pre-plant	2.0–2.5 lb Balan DF/acre
Comments: A pre-plant herbicide that must be incorporated within 4 hours following application if the soil is moist, and within 8 hours under dry soil conditions. This herbicide will not control mustard species but can be effective on small-seeded broadleaf weeds and annual grasses.			
Clethodim	Select 2E	Post-emergence	6–8 fl oz Select 2E/acre
Comments: Clethodim is a grass herbicide with no activity on broadleaf weeds. It may be applied to seedling and established stands of alfalfa. Always add a crop oil concentrate at 1.0% v/v to the final spray solution. Do not apply within 15 days of grazing, feeding, or harvesting alfalfa for forage or hay. Clethodim offers control of several winter annual <i>Bromus</i> species as well as sandbur and the summer annual foxtails.			
Diuron	Karmex 80DF	Pre- or post-emergence	1.5–3.0 lb Karmex 80DF/acre
Comments: While there is some post-emergence activity with this herbicide, uptake from the soil by susceptible plants is the main mechanism for activity. Uptake requires some form of incorporation, usually irrigation or rainfall, within 2 weeks of application. Studies have shown that if the incorporation occurs sooner than 2 weeks post-application, control improves. The strength of this herbicide is its mustard control, for which applications must be made after the alfalfa's fall dormancy but before regrowth occurs in the spring . Do not make applications to frozen ground. Be sure to read and follow all crop rotation restrictions on the label.			
EPTC	Eptam 7E	Incorporate pre-plant	3.5–4.5 pt Eptam 7E/acre (seedling alfalfa)
		Pre-emergence	2.25–3.5 pt Eptam 7E/acre (established stands)
Comments: As a pre-plant incorporated treatment, it is important to incorporate 3–4 inches deep immediately following the application. In established stands, the herbicide is usually applied by chemigation. The strength of this herbicide is its activity on yellow and purple nutsedge.			
Flumioxazin	Chateau	Pre- or post-emergence	0.25–10 oz Chateau/acre
Comments: While there is some post-emergence activity with flumioxazin, weeds are mainly controlled by its residual activity. Applications should be made as soon as possible after cutting and removing alfalfa to minimize injury to alfalfa regrowth. Flumioxazin may be applied to established alfalfa with a maximum amount of regrowth of 6 inches or less for the pre-emergence control of weeds. Application to alfalfa with greater than 6 inches of regrowth may result in unacceptable crop injury. Application rates are based on rotation intervals of the alfalfa crop.			

Table 3. Detailed List of Herbicides Approved for Use on Alfalfa in New Mexico (Cont.)			
Herbicide Common Name	Example of Trade Name	Timing	Rates of Application
Glyphosate	Roundup PowerMAX	Post-emergence	Up to 44 fl oz Roundup PowerMAX/acre
Comments: In conventional alfalfa, this herbicide is for site preparation and spot treatment only. Glyphosate is a nonselective herbicide, so any alfalfa that comes in contact with it will be killed or severely damaged. Application rates depend on the weed species. Adding a surfactant and nitrogen fertilizer improves efficacy, as does reducing the total sprayer output volume to about 10 gal/acre of total spray solution.			
In Roundup Ready alfalfa, glyphosate can be applied at any stage of alfalfa production based on the label directions. However, in order to prevent or delay the occurrence of herbicide-resistant weed species and control the glyphosate-tolerant weed species, it is recommended to apply glyphosate in a mixture with other registered alfalfa herbicides, such as Pursuit, based on the label directions.			
Hexazinone	Velpar DF	Pre- or post-emergence	0.3–2.0 lb Velpar DF/acre
	Velpar L		1.0–6.0 pt Velpar L/acre
Comments: Application rates are based on soil type and organic matter content. Make applications to well-established stands in the fall after the onset of dormancy but before the field begins regrowth in the spring. Do not make applications to frozen ground. Moisture is necessary within 2 weeks after application to activate the herbicide in the soil. Do not graze for 30 days after application. Be sure to observe all crop rotation restrictions on the label.			
Field studies have shown that at low application rates, this herbicide will not only control winter annual mustards but also provides partial to complete control of winter annual grasses. At higher rates, residual control of some weed species may continue into summer and fall. Hexazinone is also available in mixture with diuron (e.g., Velpar AlfaMax).			
Imazamox	Raptor	Post-emergence	4.0–6.0 fl oz Raptor/acre
Comments: Apply imazamox when the majority of weeds are 1–3 inches tall. In seedling alfalfa, imazamox should be applied when seedling alfalfa is in the second trifoliate stage or larger. In established stands, imazamox can be applied in the fall, winter, or spring to dormant or semi-dormant alfalfa or between cuttings. Any application should be made before significant alfalfa growth or regrowth (3 inches or less) to allow imazamox to reach the target weeds.			
Do not make a sequential application of Pursuit herbicide followed by Raptor (or Raptor followed by Pursuit) within a 60-day timeframe due to increased potential alfalfa crop response.			
Imazethapyr	Pursuit	Post-emergence	3.0–6.0 fl oz Pursuit/acre
Comments: The key to obtaining good weed control with imazethapyr is applying it to small weeds. Applications can be made to seedling stands when alfalfa has at least two trifoliate leaves and when the majority of the weeds are 1–3 inches tall. With established stands, applications need to be made according to the weed size. The standard rate of 4 fl oz Pursuit/acre has shown outstanding control of winter annual mustards. This product can also provide extended control of annual grasses, and mixes well with clethodim and sethoxydim.			
When using Pursuit, remember:			
• It is critical that an adjuvant, either a surfactant or a crop oil concentrate, be added to the spray mixture according to the label directions. • Studies have shown that adding a liquid fertilizer solution (such as 28% N, 32% N, or 10-34-0) improves the product's performance. Apply 1–2 qt/acre. • The following cropping plantback restrictions apply to the use of Pursuit: – Peanuts: any time – Wheat: 4 months – Field corn: 8.5 months – Cotton: 18 months – Lettuce: 8 months – Chile: 40 months			
These rotation restrictions frequently change, so be sure to check the most current label for any adjustments.			

Table 3. Detailed List of Herbicides Approved for Use on Alfalfa in New Mexico (Cont.)			
Herbicide Common Name	Example of Trade Name	Timing	Rates of Application
MCPA	MCP Amine 4	Post-emergence	1 pt MCP Amine 4/acre
Comments: MCPA is registered for broadleaf weed control in alfalfa and should be applied in late fall following frosts when alfalfa is dormant.			
Metam-potassium	K-PAM HL	Incorporate pre-plant	30–60 gal K-PAM HL/acre
Metam-sodium	Metam CLR 42%		15–74.5 gal Metam CLR 42%/acre
Comments: These products are listed as a “restricted use” pesticide, so the applicator is required to be certified. Metam-potassium and metam-sodium are soil fumigants for control of several weed species, soilborne fungi, nematodes, and insects. These products are applied following harvest of the previous crop and 14–21 days before alfalfa is planted. In some locations, fall application is preferred because the products will dissipate over the winter, which allows planting in favorable springtime conditions. These products will suppress or control pests that are in the fumigated zone at the time of treatment; however, application rates will vary depending on the soil texture and the depth of treatments.			
Metribuzin	Sencor DF	Pre- or post-emergence	0.5–1.3 lb Sencor DF/acre
Comments: Make a single application in the fall to well-established alfalfa stands following the beginning of dormancy but before regrowth begins in the spring. To become activated, the herbicide requires moisture within 2 weeks after application. Do not use on soils with a pH greater than 8.2. The labeled grazing restriction is 28 days.			
Norflurazon	Solicam DF	Pre-emergence	1.25–2.5 lb Solicam DF/acre
Comments: Rates of application are based on soil texture. Do not apply to alfalfa less than 3 months old. On young alfalfa, apply no more than 1.25 lb of product the first time, with a second application of 1.25 lb later in the year if needed. Incorporation is necessary to activate this pre-emergence herbicide, either through rainfall, irrigation, or tillage. However, tillage practices to established stands of alfalfa will likely reduce stand life and yield. Rotation restriction: Only cotton, soybeans, peanuts, and asparagus may be planted in fields previously treated with Solicam DF, with peanuts showing a greater sensitivity to the herbicide. Solicam DF may be tank-mixed with several of the registered alfalfa herbicides.			
Paraquat	Gramoxone SL	Post-emergence	Application-dependent rates
Comments: Paraquat is a “restricted use” pesticide, so the applicator is required to be certified. Paraquat can be used at two times: 1. Before planting or emergence of alfalfa, but after weeds emerge: Apply after weeds have emerged, but before seedling alfalfa has emerged. This herbicide will kill any emerged alfalfa. Application rates of 2.5–4.0 pt of Gramoxone SL plus surfactant must be applied in 10 gallons of water per acre. If applied by air, reduce the spray solution to 5 gal/acre of total spray mix. This application will control emerged annual weeds and burn off emerged perennial weeds. Do not allow grazing on treated areas. 2. Between cuttings: Apply 1 pt of Gramoxone SL plus surfactant in 10 gallons of water per acre. Applications must be made within 5 days following alfalfa cutting. If seedling stands are allowed to regrow more than 2 inches before application, the application will injure the stand but will not likely kill the plants. In first-year alfalfa, make no more than two applications; established stands can tolerate up to three applications in one year. Do not apply by air. There is a harvesting restriction of 30 days when using this herbicide.			
Pelargonic acid	Scythe	Post-emergence	Application-dependent rates of 3–10%
Comments: Pelargonic acid is a contact, non-selective, broad-spectrum herbicide that can be used for burndown before planting or emergence of alfalfa but after weeds emerge, and between cuttings but before regrowth. This herbicide will damage emerged or green alfalfa. For best control or burndown, use the indicated rate of this product in 75 to 200 gallons of spray solution per acre through boom, handheld, or high-volume equipment. Use a 3–5% solution for annual weeds and vegetation, 5–7% solution for perennial herbaceous and late-stage annuals, and 7–10% for maximum vegetation burndown.			

Table 3. Detailed List of Herbicides Approved for Use on Alfalfa in New Mexico (Cont.)			
Herbicide Common Name	Example of Trade Name	Timing	Rates of Application
Pendimethalin	Prowl H2O	Pre-emergence	1.0–4.0 qt Prowl H2O/acre
Comments: Apply to established alfalfa grown for forage/hay. For seedling alfalfa, Prowl H2O can be applied at 1–2 pt per acre once alfalfa has reached the second trifoliate stage of development but prior to reaching 6 inches in growth. In established alfalfa, pendimethalin can be applied 1) in the fall after the last cutting, 2) during the winter dormancy, or 3) in the spring or between cuttings but before the alfalfa reaches 6 inches in regrowth. Applications made after the alfalfa exceeds 6 inches in height may result in poor weed control. Do not apply this product less than 50 days prior to harvest for forage or hay. For optimal dodder control, the highest labeled rate should be used. Be sure to read the label for harvest and crop rotation restrictions.			
Pronamide	Kerb 50W	Pre- or post-emergence	1.0–4.0 lb Kerb 50W/acre
Comments: Pronamide is a “restricted use” pesticide, so the applicator is required to be certified. Application rates depend on the weed species to be controlled and whether there is furrow or overhead irrigation. Apply during the fall or winter months before the soil freezes. Optimal herbicide activity is achieved when applications are made at air temperatures of 55°F or lower and are followed by water incorporation. In seedling alfalfa, do not apply this product before the trifoliate leaf stage. Field studies conducted in New Mexico have not shown this option to be very effective or consistent. Be sure to observe all restrictions on the label.			
Pyraflufen-ethyl	ET Herbicide	Pre-plant burndown	0.5–2.0 fl oz ET Herbicide/acre
Comments: Pyraflufen-ethyl must be applied at least 30 days prior to planting for contact (burndown) broadleaf weed control. For best results, use this product for control of annual or perennial herbaceous broadleaf weeds less than 4 inches in height, or rosettes less than 3 inches in diameter. Adding a crop oil concentrate or nonionic surfactant is recommended for optimal control.			
Sethoxydim	Poast 1.5 E	Post-emergence	1.5–2.5 pt Poast 1.5 E/acre
	Poast Plus 1.0 E		1.5–3.75 pt Poast Plus 1.0 E/acre
Comments: Sethoxydim controls only grass weeds. Application rates are based on the grass species to be controlled and the county and state in which you live. Adding a crop oil concentrate is critical. Adding UAN solution or ammonium sulfate also improves control. Ground applications must be made with equipment calibrated to deliver at the rate of 10 gal/acre of total spray solution. Applications are most effective to young, actively growing weeds, so growers may need to irrigate before making the application.			
Terbacil	Sinbar WDG	Pre- or post-emergence	0.5–1.5 lb Sinbar WDG/acre
Comments: Apply to well-established stands in the fall after the beginning of dormancy but before the field begins regrowth in the spring. Do not make applications to frozen ground. To become active, terbacil requires moisture within 2 weeks after application. There is no grazing restriction with the use of terbacil. Be sure to observe all crop rotation restrictions on the label. Low application rates have proven effective when applied to young, actively growing winter annual mustards.			
Trifluralin	Treflan 4 EC	Pre-emergence	1.5–4.0 pt Treflan 4 EC/acre
	Treflan TR-10		20 lb Treflan TR-10/acre
Comments: When considering the use of trifluralin, be sure to read the label; certain formulations can be water incorporated, while others must be incorporated using “incorporation equipment that will ensure thorough soil mixing with a minimum of damage to established alfalfa.” However, tillage practices to established stands of alfalfa will likely reduce stand life and yield. Using the granular formulation (Treflan TR-10) requires specific application equipment and an incorporation requirement of 3 days following application. Observe a 21-day harvest restriction. According to its label, two applications of Treflan TR-10 at the rate of 20 lb Treflan TR-10/acre can be used to control dodder. The first application must be made in the spring prior to weed germination. The second application should be made 60 days following the first, or after at least two cutting cycles. Applications can be made both with ground and aerial application equipment. Incorporate within 3 days after application.			
^a When considering the use of an herbicide, nothing can take the place of reading the label and making applications according to label directions. Pay attention to label information on controlled weed species, timing of application, rates of application, and methods of incorporation. Also note other directions such as worker protection standards, requirements for personal protective equipment (PPE), restricted entry interval (REI), storage and disposal, and sprayer cleanup.			

Brand names appearing in publications are for product identification purposes only. No endorsement is intended, nor is criticism implied of similar products not mentioned. Persons using such products assume responsibility for their use in accordance with current label directions of the manufacturer.

The pesticide recommendations in this publication are provided only as a guide. The authors and New Mexico State University assume no liability resulting from their use. Please be aware that pesticide labels and registration can change at any time; by law, it is the applicator's responsibility to use pesticides ONLY according to the directions on the current label. Use pesticides selectively and carefully and follow recommended procedures for the safe storage and disposal of surplus pesticides and containers.

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