Crop Profile for Alfalfa in Kansas

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General Production Information

The Northern and Central Plains are major regions for alfalfa production, contributing 15% and 16%, respectively, to the total U.S. production during 2002 and 2003. South Dakota led the region in alfalfa production, followed by NE, KS, and ND. SD ranked 4th in U.S. alfalfa production during 2002 and 2003 respectively, whereas NE ranked 5th/5th, KS ranked 6th/12th, and ND ranked 21st/21st during the same years. Alfalfa production varied within the region. In SD, the northwest region contributed significantly more than any other region, accounting for approximately one-fifth of total SD alfalfa production in 2003. The following table summarizes alfalfa area, yield, production, price per unit, ranks, and value of production in the Northern and Central Plains during 2002 and 2003 (http://www.nass.usda.gov:81/ipedb/grains.htm)

Year	State	Harvested	Yield	Production	Price per Unit	Value of production	Rank
		Acres - thousand	tons	1000 tons	$ / ton	X $1,000	
2002	KS	950	3.7	3515	97	340955	6
2002	NE	1350	3	4050	85.5	346275	5
2002	ND	1450	1.3	1885	70	131950	21
2002	SD	2250	1.5	3375	82	275520	4
2002	Total	6000		12825		1094700	
2002	Proportion	26.17%		17.57%		15.22%	
2002	US Total	22923	3.19	73014	100	7193786	
2003	KS	1000	3.4	3400	75	255000	12
2003	NE	1450	3.6	5220	65.5	341910	5
2003	ND	1600	1.65	2640	55.5	146520	21
2003	SD	2700	1.9	5130	67	343710	4
2003	Total	6750		16390		1087140	
2003	Proportion	28.63%		21.48%		15.71%	
2003	US Total	23578	3.24	76307	98	6921508	

Pesticide Usage on Alfalfa for Year 2003

A pesticide usage survey on Alfalfa in the Northern and Central Plains in 2003 was conducted by the Kansas Agricultural Statistics Service (KASS) and Kansas State University from October through December 2003. Alfalfa is one of the major forages in this region, and questionnaires were mailed directly to all sampled alfalfa growers identified by KASS (Kansas Agricultural Statistics Services). Most questions were patterned after those asked in a previous survey (http://www.ipmcenters.org/cropprofiles/docs/ksbarley.html). A total of 1,352 questionnaires were sent out, and 268 with valid data were returned from 92 counties in the 4 states. The following table displays the sample distributions in terms of states and counties.

Sampling Data Distribution

State	Sample Allocated	Sample Collected	Return Rate %	County	Sample %
KS	305	198	64.92	70	73.88
NE	493	31	6.29	9	11.57
ND	321	17	5.30	5	6.34
SD	233	22	9.44	8	8.21
Total	1352	268	19.82	92	100

Overall, valid questionnaire response was at about 20% return rate, 73% of Kansas surveys were returned with the balance coming from a few respondents living in the other 3 states. Approximately, 5.6% of pesticides used were applied directly by farmers/growers/rancher-self against various pests and 94.4 % of pesticides were applied by commercial entities.

Cultural Practices

Alfalfa hay is produced under both irrigated and non-irrigated cropping practices, with most of the acreage in the areas surveyed grown under irrigation. Alfalfa is primarily grown for hay and as a source of pasture; however seed can be produced in this region if weather conditions are appropriate. Alfalfa can be planted either in the spring or late summer with late summer the preferred time for most producers. In irrigated areas, plantings may occur from April through early June. Late-summer plantings are typically completed during mid-August.

Efficient seedbed preparation is important to reduce establishment costs and moisture loss. Seedbeds should be firm, level and free from weeds that compete with seedlings for moisture and plant nutrients. Alfalfa seed is treated with fungicides and inoculated with commercially available rhizobium inoculum prior to planting. Alfalfa seed is planted to a depth of 0.25 to 0.75 inch, depending on soil types. No-till alfalfa planting is becoming more common and it may be planted into row-crop stubble in the spring and after small grain cereals or in forage sorghum and silage stubble during late summer. Late summer seedings are often undertaken in winter wheat or spring oat residues. Fields with high residual activity herbicides applied to the previous crop are avoided to reduce the chance of carry-over herbicide damage to alfalfa seedlings. In eastern Kansas, farmers sometimes employ a nurse or companion crop, such as spring oats, when planting alfalfa. Late-fall plantings may require a nurse crop, such as spring oats or millet to protect seedlings from harsh temperatures and prevent soil erosion.

Planting rates vary across the states and with differing conditions. In western Kansas, 8-20 lb of alfalfa seed per acre is recommended with the higher rate used on irrigated fields, while 8-15 lb of seed per acre is generally adequate for central and eastern Kansas depending on soil types and moisture conditions. Plant populations decline after the first growing season. After 3-5 years (sometimes much longer), a declining stand may need to be destroyed.

As a leguminous crop, alfalfa generally does not require additional inputs of nitrogen to achieve adequate growth. However, applications of phosphate and potassium fertilizers to alfalfa fields can significantly increase forage production and quality.

Alfalfa is a major component of cropping options in South Dakota, both as a feed source for livestock and as a marketable

commodity for cash sales. Alfalfa production in South Dakota generally is undertaken for one of three purposes. Some alfalfa producers in the state concentrate efforts toward producing dairy quality hay to capture premiums offered in some marketing channels marketing. Most alfalfa for this purpose is grown in the Southeast and East Central crop districts and under irrigation in the Northwest region of the state. High quality hay is most often marketed as forage hay; however, some is channeled to processed pellet production. A second focus is alfalfa seed production, which occurs in a small region centered in the North Central district of the state. This area is generally managed under dryland production practices. The balance of the state produces alfalfa as a feed source for the local livestock industry, which consists primarily of beef and sheep production. No organic production enterprises were noted in recent surveys.

Alfalfa for hay is harvested at one to four cuttings per year, depending on location within the region. Western areas of South Dakota often are able to take only one cutting per year due to low rainfall, whereas Southeast South Dakota usually can support four and occasionally five cuttings per year. Highest quality hay is taken when alfalfa is in the pre-bud to early bud stage of development.

Pest resistance has been and continues to be important for many alfalfa producers when alfalfa varieties are selected. Over 100 disease, insect or nematode pests may potentially affect alfalfa production in this region, but many losses can be prevented or reduced if resistant varieties are grown. There are over 200 alfalfa varieties available in the northern USA and Canada with new varieties introduced each year. In practice, alfalfa varieties should be chosen through a comprehensive consideration of winter hardiness, yield potential, pest resistance, persistence, forage quality and availability.

Worker Activities

Alfalfa growing and management in the Northern and Central Plains is heavily mechanized. Worker activities for alfalfa production involve field preparation, planting, fertilizer and pesticide application, pest scouting, and harvesting cuttings. Most of these operations are conducted by growers, family members, their employees, or consultants with farming tools. The primary worker activities in the early season involve irrigation and herbicide application against weeds such as Barnyardgrass, Blue Mustard, Foxtails, Johnsongrass, Kochia, Large crabgrass, Sandbur, Velvetleaf, and Waterhemp. The major activities during the summer involve pest monitoring and fungicide/insecticide applications against several primary plant diseases (e. g., Leaf spots, Crown stem and root rots, and Wilt) and insects (e. g., Alfalfa Weevil, Army cutworm, and others). Activities that bring workers in direct contact with alfalfa during the growing season are not a great concern in this region.

Insect Pests

Although many insect species are present in almost every alfalfa field in the region, most are of no serious concern to producers; many are even beneficial. However, problems from the following insects have been experienced in this region on a frequent basis and chemical and non-chemical measures were applied against these insect pests during 2003.

Alfalfa Weevil (*Hypera postica)*. The adults lay eggs inside alfalfa stems during warm days in the fall, or in the spring. Small, yellow-green, legless larvae feed on the terminal and upper leaves of the plant during early spring. Most damage occurs before the first alfalfa cutting. However, both larvae and adults can reduce yields by suppressing plant growth. It has been reported that losses from alfalfa weevil larvae sometimes reach 0.8 to 1 ton/acre in Kansas. Large numbers of uncontrolled alfalfa weevil larvae in the first cutting can result in severe carryover losses to second, third, and fourth cuttings. The survey indicated this pest was treated with insecticides in Kansas and South Dakota. (*Image: Alfalfa Weevil Larvae on Alfalfa Terminal). (*All images of insects and their damages are provided by Dr. Phil Sloderbeck, Kansas State University unless specified.)

Army cutworm (*Euxoa auxiliaries*). Damage to alfalfa seedlings occur in late winter - late January in Kansas, and sometimes into June in North Dakota. It is important to detect the infestation before significant foliage has been destroyed. Treatment should be applied when 2 or more larvae per square foot are present on seedling alfalfa, or more than 5 per square foot are found in established stands. Treatments using insecticides were reported in Kansas based on the 2003 survey. (Larval image courtesy of http://www.wardlab.com/info/Army_Cutworms.htm).

Grasshoppers (*Melanoplus spp., several species*). Grasshoppers typically overwinter as eggs in undisturbed grassy areas and field margins. As grasses mature, grasshoppers may move into nearby alfalfa fields. Relatively dry weather in early and middle summer is favorable for grasshopper population build-up. If economic thresholds are reached during seedling stages, treatment may be necessary. Chemical control includes products containing the active ingredients carbaryl, carbofuran, chlorpyrifos, cyfluthrin, dimethoate, lambda-cyhalothrin, malathion, methyl parathion, and other products. (Image: differential grasshopper on Alfalfa).

Damage may occur from late spring until frost as grasshoppers chew the foliage. Young stands less than 6 inches tall or the post-cutting re-growth of established plantings might be needed to be protected with an insecticide. Treatment of non-field border areas is necessary if vegetation bordering alfalfa matures and dries down, and if grasshoppers move into the field. Grasshopper infestations may affect the blossom and seed pods. Pesticide treatments on various grasshoppers were reported in Kansas.

Alfalfa Blotch Leafminer (*Agromyza frontella*). black fly about 1/8-inch long; it emerges from the pupal stage that overwinters in ground litter. Females pierce holes on the undersides of leaves, creating a conspicuous pinhole on leaflets. Males and females feed on fluids that seep from these pinholes, and females deposit eggs under the lower epidermis. Yellowish maggots emerge in 5-10 days. These maggots feed within the leaf as they develop through three instars, forming a mine that develops into a characteristic comma-shaped blotch as the larvae mature. After feeding, the third instars exit the leaf and drop to the ground to pupate. Damage includes pinholing, leaf mines, and leaf drop. Wounded leaves may be more susceptible to diseases, especially spring black stem. Alfalfa bloch leafminer was a serious pest on alfalfa and this pest was treated with Ambush 25W WSP and Pounce 25 WP across Kansas based on the 2003 survey. (Damage symptom by alfalfa blotch leafminer, image courtesy of http://www.gov.on.ca/OMAFRA/english/crops/pub811/5blotch.htm#damage).

Aphids (several species).The pea aphid and occasionally the spotted alfalfa aphid can potentially damage alfalfa in this region. Spotted alfalfa aphids, the smaller of the two species in body size, is about 1/16 inch long and has 4-6 rows of spots on the back. This aphid injects a toxin into the plant when feeding, which causes leaf drop. This damage can be severe in seedling alfalfa stands. The pea aphid is larger in size, about 1/8 inch long and yellow to blue-green in color. This aphid can cause alfalfa to wilt, if infestations are heavy. (Image: Spotted Alfalfa Aphids, *Therioaphis maculate*). Several insecticides were used to treat aphids on alfalfa in Kansas and South Dakota based on the 2003 survey.

Fall armyworm, variegated cutworm, and webworms are also considered as major pests on alfalfa in this region although there was no report of pesticide treatment on these pests based on the 2003 survey. However, certain cultural and other non-chemical practices may have been adopted by growers/producers on alfalfa pest management.

Insecticide control

A previous pesticide usage survey conducted in Kansas in 1992, that 43% of Kansas alfalfa acreage received treatment of insecticides. Early cutting or burning was reportedly used as non-chemical methods to control insect pests. 9% of the alfalfa acres were cut early, however no estimate was available on the percent of acres burned. Carbofuran was the most commonly used insecticide on alfalfa in 1992, with 24% of alfalfa acres treated with an average application rate of 0.56 pound per acre. During 2003, approximately 33% of alfalfa acreage was treated with various insecticides. At least 6 different insecticides (ingredients) were used in the control of 5 major insect pests on alfalfa across the region. The following table lists the insecticides used and the insect pests targeted on alfalfa.

Insecticides applied and insect pests targeted

Insecticide (Ingredients)	Insect Pest Targeted
Carbofuran	Alfalfa Weevil, Aphids
Chlorpyrifos	Alfalfa Weevil, Aphids
Lambda-cyhalothrin	Alfalfa Weevil, Aphids, Army cutworm
Malathion	Alfalfa Weevil, Grasshoppers
Permethrin	Alfalfa Blotch Leaf-miner, Alfalfa Weevil, Army cutworm
Phosmet	Alfalfa Weevil

The following table displays the insecticide trade names, acres treated, percentage of area treated, and application rate.

Insecticide usage survey on alfalfa

Insecticide (Ingredient)	Trade name	Acres Treated	Percent Treated*	Rate (lb a.i./a)
Carbofuran	Furadan 4F	520	18	0.38
Chlorpyrifos	Lorsban 4E	432	15	0.48
lambda-cyhalothrin	Warrior T	1459	50	0.026
malathion	Malathion 57 EC, Malathion 5E	127	4	0.84
permethrin	Ambush 25W WSP, Pounce 25 WP	185	6	0.096
phosmet	Imidan	185	6	0.096

*: Percent Treated = (acreage treated with a given insecticide / the total acreage treated (2908 acres) * 100.

Lambda-cyhalothrin was the most frequently applied insecticide employed against various insect pests on alfalfa in the Northern and Central Plains. Up to 50% of the sampled treated areas received this insecticide at an average rate of 0.026 lb/a, followed by carbofuran at a rate of 0.38 lb/a.

Diseases

The following alfalfa diseases may occur across the region and could cause substantial losses to yield, quality, and may hinder

stand establishment:

Leaf Spots, a wide variety of different leaf spots may be viewed across the region. Leaf spots can be different in color, and may be raised above the leaf surface. Smaller spots are scattered over the entire surface of the leaf; larger spots may be oblong and show concentric rings of light to dark colors. Yellow areas may surround some spots. Leaves with several or many spots may turn yellow and fall to the ground. Common Leaf Spots including Downy Mildew, Rusts, Bacterial Leaf Spot, Yellow Leaf Blotch, Stemphylium Leaf Spot, and Summer and Spring Black Stem and Lepto Leaf Spot all cause symptoms called "leaf spot". In general, moist weather conditions and dense stands favor all leaf spots. Certain leaf spots may be favored by cool temperatures (Lepto Leaf Spot, Spring Black Stem) while most prefer warmer temperatures (Stemphylium Leaf Spot, Summer Black Stem). Leaf spots may occur after cutting or after several weeks of growth depending on the leaf spot agent and the environmental conditions. Leaf spots could be caused by include fungi (*Pseudopeziza medicaginis*, *Peronospora trifoliorum*, *Leptosphaerulina briosiana*, *Phoma medicaginis*, and *Stemphylium* spp) and several bacteria. (image courtesy of http://www.uky.edu/Agriculture/IPM/scoutinfo/alfalfa/disease/leafspot/alflfspt.htm).

Crown stem, and root rots are major causes to the progressive decline of alfalfa stands. Fungi, such as *Fusarium spp.* and *Rhizoctonia crocorum*, are the primary organisms involved in the alfalfa crown, stem, and root rot complex. Phytophthora root rot is a major cause of seedling death in newly seeded alfalfa fields in this region. It also causes the gradual decline of established stands. The disease is favored by hot and humid weather. Alfalfa stands suffering from phytophthora root rot are often thin, weedy, and have plants exhibiting irregular growth. Management practices include proper soil and water management and the use of resistant alfalfa varieties. Seed treated with metalaxyl also can reduce development of the diseases. (Image, *Rhizoctonia* lesions on alfalfa taproots, courtesy of http://ohioline.osu.edu/ac-fact/0042.html).

Wilt can be caused by the bacterium *Corynebacterium insidiosum* and fungus *Fusarium oxysporum f. sp. Medicaginis* and *Verticillium albo-atrum.* The initial symptoms of bacterial wilt appear on scattered plants throughout a stand, beginning in the second or third years of production. Plants may turn yellow-green, are stunted, and growth may be distorted. A yellow-brown ring will be evident near the outer edge of infected taproots. Infected plants are more visible after cutting. Fusarium wilt is a severe vascular disease, affecting the entire state. Infected plants have yellow leaves that become bleached; sometimes a reddish tint is present on only one side of the plant. The symptoms most often appear sometime prior to harvest but can be present anytime of the year. The symptoms may become less conspicuous when temperatures rise to 90 ºF. Infected plants may die in several months. (Image courtesy of http://www.gov.on.ca/OMAFRA/english/crops/facts/88-036.htm).

General management practices to control alfalfa diseases including:

- Select a well-drained field for alfalfa to prevent the development of seedling damping-off, *Phytophthora* root rot, and *Aphanomyces* root rot.
- Rotate crops to reduce soilborne inoculum of several diseases including *Verticillium* wilt.
- The most important method to control diseases is to plant varieties resistant to *Phytophthora* root rot, *Aphanomyces* root rot, anthracnose, and stem nematode.
- Treat seeds with metalaxyl to protect seedlings from *Pythium* and *Phytophthora.*
- Use proper fertility, timely irrigation, proper cutting schedule, and insect control to reduce root and crown rot.

Although plant diseases may impact alfalfa production, there was no report regarding fungicide usage based on year 2003

survey on alfalfa. However, farmers/producers may have applied certain non-chemical practices (e. g., cultural approaches) in the control of plant diseases (see table '**Cultural Control Approaches'**).

Weeds

Weeds may interfere significantly with alfalfa production by reducing plant stands, forage quality, and yields. Alfalfa seedlings are not competitive with weeds, and heavy weed pressure in newly seeded alfalfa often chokes out alfalfa seedlings, causing thin stands. Good alfalfa-stand establishment reduces future weed competition and enhances the crop's life and productivity. Vigorous alfalfa stands are very competitive with weeds, and with proper management, may reduce populations of certain weeds such as common milkweed, hemp dogbane, Johnsongrass, and shattercane. A successful weed-management program begins before alfalfa is seeded and continues throughout the life of the stand. Weeds often are controlled prior to planting with tillage operations for seedbed preparation. Tillage can effectively control annual weeds but does not provide long-term control of perennial weeds. Several herbicides can be used prior to planting alfalfa for weed control in reduced-tillage systems or for perennial-weed control:

Alfalfa Establishment

1. **Preplant/preemergence** for control of existing vegetation:
2. Glyphosate **(Roundup)** for annual and perennial weed control and paraquat (**Gramoxone Extra)** for annual weed control but does not provide long-term control of perennial weeds.
3. **Preplant Incorporated:** EPTC **(Eptam),** benefin **(Balan),** and trifluralin **(Treflan)** control many summer annual grasses and some summer annual broadleaves, but are ineffective for control of most winter annual weeds.
4. **Postemergence:** Bromoxynil **(Buctril),** 2,4-DB **(Butyrac),** imzamox **(Reptor),** sethoxydim **(Poast Plus),** imazethapyr **(Pursuit),** and clethodim **(Select)** are used to control the following weeds in seedling and established alfalfa stands:
5. **Summer annual weeds** such as foxtails, shattercane, kochia, velvetleaf, cocklebur, crabgrass, volunteer cereals, lambsquarters, and pigweeds are the primary weed problems with spring-seeded alfalfa in Kansas.
6. **Winter annual weeds** such as henbit, field pennycress, tansy mustard, cheatgrass, and volunteer wheat can be problematic in fall-seeded alfalfa.
7. Butyrac and Buctril can be applied after the two and four-trifoliolate stage of alfalfa, respectively, to control small broadleaves. Pursuit and Raptor can be used postemergence after the two-trifoliolate stage and on established alfalfa stands to control many summer annual broadleaves and grasses. Pursuit and Raptor also provide good control of many winter annual broadleaf weeds, especially if applied as a fall treatment rather than a spring treatment. Poast Plus and Select can be applied on seedling or established alfalfa stands to control foxtails, crabgrass, and volunteer cereals. They can also provide control of perennial grasses.

Established alfalfa

Herbicides used in established alfalfa can be divided into postemergence herbicide treatments that are applied during the growing alfalfa season, and dormant-season treatments where herbicides are applied during the winter when alfalfa is in dormant stages.

1. **Postemergence: Butyrac, Gramoxone Extra, Poast Plus, Pursuit, and Select** are used as postemergence treatments as described in the seedling alfalfa section.
2. **Dormant: Gramoxone Extra,** diuron **(Karmex),** metribuzin **(Sencor),** terbacil **(Sinbar),** hexazinone **(Velpar), Treflan,** and norflurazon **(Zorial)** can be used as dormant-season herbicides.

Following are brief descriptions on major weeds in alfalfa fields in this region, which were treated using herbicides in 2003:

Barnyardgrass (*Echinochloa crusgalli*), member of the Grass family, is an annual that

prefers wet sites. It is not usually a problem in well-drained cultivated fields but can grow heavily around irrigation pipe leaks and other wet spots in the field. It is a vigorous, warm season annual grass reaching 1 - 5' in height. Many stem bases are reddish to dark purple. Leaf blades are flat, broad, smooth, and without a ligule or auricle at the junction of sheath and blade. Seed are the only source of reproduction. It flourishes in warm conditions. Barnyardgrass was treated with various herbicide products in Kansas based on the 2003 survey. (Image courtesy of http://alfalfa.okstate.edu/weeds/sumanngrass/barnyardgr-516.htm).

Blue Mustard (*Chorispora tenell).* Blue mustard, member of the Mustard family, is a winter annual. Blue mustard is one of the noxious weeds. Seed germinates in late summer and fall. The plant overwinters as a rosette. The flower stalk usually elongates in early spring. The flowers are bluish-purple to purple and appear thereafter. Viable seed can be produced approximately 10 days after bloom. Herbicide treatments on this weed were reported in Kansas and Nebraska based on the 2003 survey. (Image courtesy of http://alfalfa.okstate.edu/weeds/mustard/bluemustard/blue-mustard-01.htm).

Foxtails, including giant (*Setaria faberi*) **bristlegrass, Chinese foxtail, Chinese millet, nodding foxtail)** native of Asia**; green** (*Setaria viridis* L.) **(green bristlegrass, pigeongrass, wild millet)** native of Eurasia**; and yellow** (*Setaria glauca* L.*)* **(yellow bristlegrass, pigeongras, wild millet)** native of Europe. Foxtails thrive across the region**.** Seeds are the only source of reproduction. Common on cultivated grounds, waste places, roadsides and degraded rangeland and pastures. Foxtails can significantly reduce alfalfa yields and stands across the region and herbicide treatments were reported in Kansas based on the 2003 survey. (*Setaria viridis*, Image courtesy of http://alfalfa.okstate.edu/images/weeds/grass,w-s/summer-grass-05.htm).

Johnsongrass (*Sorghum halepense* L.), is a perennial grass that originated from the Mediterranean region, flourishes in warm conditions. Rhizomes and seeds are the source of reproduction. Found in moist soil of waste places, cultivated fields, pastures, and roadsides. This weed was treated with herbicides in Kansas based on the 2003 survey. (Image courtesy of http://www.invasive.org/browse/detail.cfm?imgnum=0581065).

Kochia (*Kochia scoparia* L.), **(summer cypress, fireweed, belvedere, mock cypress, Mexican firebush)** is an early germinating summer annual weed, native of Eurasia. Summer is flowering season. Seeds are the only source of reproduction. Found on rangeland, pastures, fields and disturbed sites. Kochia is an annoying weed across the regions and treatments with herbicides were reported in Kansas based on the 2003 survey. (Image courtesy of http://alfalfa.okstate.edu/weeds/sumbroad/kochia/kochia-540.htm).

Large crabgrass (*Digitaria sanguinalis*), **(hairy crabgrass, purple crabgrass)** is a warm season grass, native of Europe. Seeds are the only source of reproduction. Found in cultivated fields, gardens, roadsides, pastures, and waste places. Large crabgrass was treated with herbicides in Kansas based on the 2003 survey. (Image courtesy of http://alfalfa.okstate.edu/weeds/sumanngrass/crabgrass/crabgrass-12.htm).

Sandbur (*Cenchrus pauciflorus*), member of the Grass family, is a warm season annual with tufted stems. It grows 8"- 3' tall, occasionally erect, but usually spreading horizontally and forming dense mats. Leaf sheaths are flattened, very loose, and smooth with hairy margins. Burs are thickly set with stiff, sharp, spreading spines. They usually contain two light brown, oval to oblong seed. Sandbur was treated using herbicides in Kansas based on the 2003 survey. (Image courtesy of http://www.vettorpisani.net/dune/galleria/cenchrus.frutti.jpg).

Velvetleaf (*Abutilon theophrasti*), **(Indian mallow, butter print, elephantear, buttonweed)** originated from India. Flowering seasons vary with state in this region, normally during summer and early fall. Seeds are the only source of reproduction. Found in summer crop fields such as sorghum, corn, and soybeans, in waste places, roadsides, and fence rows. Velvetleaf was treated using herbicides in Nebraska based on the 2003 survey. (Image courtesy of http://www.nwcb.wa.gov/weed_info/Written_findings/Abutilon_theophrasti.html).

Waterhemp (*Amaranthus rudis*), **(common waterhemp)** is a native weed. Flowering season lasts from June to October in the south region. Seeds are the only source of reproduction. Found in cultivated fields, roadsides, marshes, sandbars, riverbanks, and waste places. Waterhemp stems and leaves are hairless with narrower leaves than Redroot pigweed or Palmer amaranth. Confirmed resistance to triazine and ALS inhibiting herbicides. Waterhemp was treated using herbicides in Nebraska based on the 2003 survey. (Image courtesy of http://www.weedscience.org/Case/Case.asp?ResistID=333).

Herbicide Usage in 2003

Various weed species compete for resources with alfalfa. Approximately 19% of alfalfa areas were treated with herbicides in 2003, indicating weed control is important for alfalfa production in the Northern and Central Plains. The survey shows eight herbicides (ingredients) were applied for the control of 10 different weeds in alfalfa production. The following table lists the herbicides used and weeds controlled based on the survey results. Other non-chemical methods may also be applied for weed control.

Herbicides applied and targeted Weeds treated

Herbicide (Ingredients)	Weeds Targeted
2,4-D	#
clethodim	Foxtails, Large crabgrass
diuron	#
hexazinone	#
imazethapyr	Blue Mustard, Foxtails
metribuzin	Kochia
sethoxydim	Foxtails, Johnsongrass
trifluralin	Barnyardgrass, Large crabgrass, Sandbur, Velvetleaf, Waterhemp

Unspecified.

The following table displays the herbicide trade names, acres treated, percentage of area treated, and application rate.

Herbicide usage survey on alfalfa

Herbicide (Ingredient)	Trade Name	Acres Treated	Percent Treated*	Rate (lb a.i./a)
2,4-D	2,4-D Ester	#	#	#
clethodim	Select 2EC	145	5	0.38
diuron	Karmex DF	110	3	1.2
hexazinone	Velpar L	110	3	0.38
imazethapyr	Pursuit DG	95	3	0.06
metribuzin	Sencor	280	9	0.17
sethoxydim	Poast Plus	20	1	0.02
trifluralin	Treflan E.C., Treflan TR-10	2399	76	1.96

*: Percent Treated = (acreage treated with a given herbicide / the total acreage treated (3159 acres)) * 100.

#: Data unspecified.

Treflan products were the most frequently applied herbicides for control of various weeds on alfalfa in the Northern and Central Plains, with 76% of the treated areas at an application rate of 1.96 lb/a, metribuzin was the second most used herbicide on alfalfa, with 9% of treated areas.

Pesticide Application Methods

Pesticide application methods may vary with target pests and crops. Alfalfa pesticide application by pest is presented in the following tables.

Application Methods

Control Method	Weed (%)	Insect (%)	Disease (%)
1 Broadcast (ground)	73.33	78.43	#
2 Broadcast (by air)	0.00	17.65	#
3 Spot Treatment	0.00	1.96	#
4 In irrigation	20.00	1.96	#
5 Banded in or over row	0.00	0.00	#
6 Foliar or directed spray	6.67	#	#
7 In seed furrow	#	#	#

Data unspecified.

Broadcast (ground) application is the most likely used method applying pesticides for weed and insect control. Application in irrigation is the second most common method for weed control, while broadcast (by air) is the second most common method for insect control.

Non-chemical Control Practices

Non-chemical (cultural) control is one of the important approaches to pest control in alfalfa production in the region. The following table '**Cultural Control Practices'** lists 12 possible cultural approaches adopted by grower/producers in the control of alfalfa pests (weeds, insects, and diseases).

Cultural Control Practices

Control approaches	Practice Case	Rate1 (%) *	Rate2 (%) **
Releasing any beneficial organisms	1	0.78	0.37
Mowing, burning, or tilling around the fields	38	29.46	14.18
Cultivating during growing season	3	2.33	1.12
Adjusting planting/harvesting dates	6	4.65	2.24
Alternating chemical usage to minimize resistance	7	5.43	2.61
Rotating crops planted	29	22.48	10.82
Utilizing and water management practices	3	2.33	1.12
Cleaning field equipment between uses	17	13.18	6.34
Utilizing treated seed	12	9.30	4.48
Utilizing soil analysis	13	10.08	4.85
Adjusting row spacing or plant density	0	0.00	0.00
Others***	0	0.00	0.00

Unspecified targeted pests (weeds, insect pests, or diseases) in this survey.

* The proportion of growers (among the 129 sampled growers) who adopted a given cultural approach to pest control. e. g., over 22% farmers used the 'rotating crops planted' approach controlling pests (weeds, insect pests, or diseases).

** The likelihood that a given cultural approach was used by farmers for pest control in alfalfa production. e. g., there is a 10.8% chance that the approach 'rotating crops planted' was applied by farmers to control various pest. Please note that one

farmer may use more than two approaches in pest control.

*** Unspecified cultural approaches.

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