

Crop Profile for Dry Beans in Kansas

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General Production Information

In 2002, Kansas ranked 14th in U.S. Pinto bean production behind ND, MI, NE, MN, ID, CA, CO, WA, WY, MT, NY, TX, and SD. Kansas contributed 0.5% to the total U.S. Pinto production. The total production of Pinto beans in 2002 was 160,000 cwt, down 38% from 2001 production. Over 75% of total dry edible bean production in Kansas was Pinto beans. Total acreage planted with Pinto bean was 18,000, up 2,000 acres from 2001. Total acreage harvested for all dry edible beans in 2002 was 14,000, down 3.4% from 2001. The State average yield of Pinto bean was 1,100 pounds per acre, down 750 pounds from 2001 yield. Farm value of all dry edible beans in 2001 was 4.7 million dollars.

Production Regions

In 2002, the northwestern region (Figure 1) led the state in total dry bean production with 101,000 cwt, followed by west central region with 43,000 cwt. The northwestern region accounted for 63.1% of Kansas total dry bean production. Northwestern region accounted for 62.7% and 60.7% of the state's planted and harvested acres of all dry beans. Sherman in northwestern and Wallace in west central Kansas (Figure 2) led the state in total all dry bean production with 76,000 and 42,000 cwt, respectively. The next highest county was Cheyenne in the northwestern region with 23,000 cwt.

Figure 1

AGRICULTURAL STATISTICS DISTRICTS

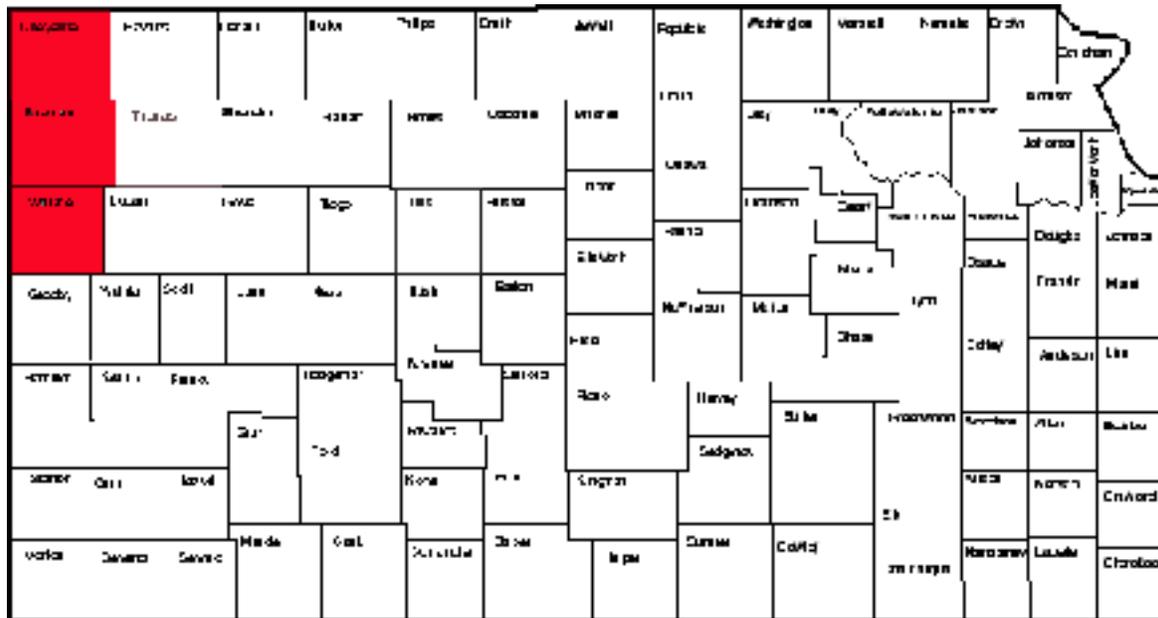
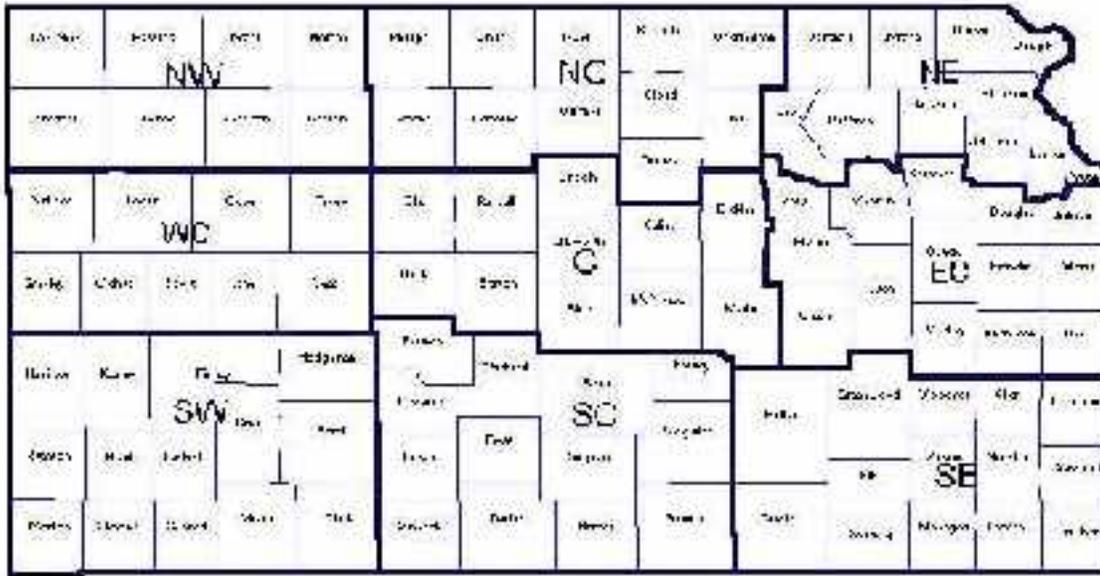


Figure 2. Top Three Counties in All Dry Beans Production, 2002.

Cultural Practices

The state of Kansas is divided into nine districts (Figure 1). Soil types vary within a district. In general, northwestern and most of the west is deep, dark gray-brown silt loams, except the southwest counties are silt and sandy loams, and brown loamy fine sands. A moderately deep, dark gray-brown silt loams, and gray clays dominate the central and north central districts of Kansas. Northeastern Kansas has very dark

brown silt, clay and silty clay loams soils whereas, the southeastern part has shallow, very dark gray-brown silt, clay, and silty clay loam soils. Average rainfall ranges from 16-18 inches in the western half of Cheyenne, Sherman, and Wallace counties in the northwest to 42-44 inches in eastern half of Crawford and Cherokee counties in the southeast region.

Dry-edible beans are relatively minor crops in Kansas. The common classes grown in Kansas are mostly Pinto and Great Northern beans. Most of the pinto grown in Kansas is concentrated in the irrigated regions of western Kansas, with low rainfall to produce beans with low disease problems.

Dry beans can be planted in different types of soil. However, loamy soil with high organic matter is preferred. Heavy, poorly drained, alkaline, and previously treated with triazine herbicide are unfavorable soils for dry bean growth. Low temperatures at any stage of plant growth, moist or rainy weather is also unfavorable to dry beans. Beans can be planted after frost period has passed and when soil temperatures, at seeding time, reach 55 to 60 °F in May. Generally, earlier planting can be made in eastern or southern part of the western regions. Seeds are planted at 1 to 3 inches deep depending on soil texture, moisture conditions, and condition of the seedbed. Row spacing is between 22 and 30 inches, depending on soil type, with 4-6 plants per foot of row.

Planting rates depend on row spacing, seed size, plant growth habit, and percent of pure live seed. Under irrigation, planting rates range between 50 to 60 pounds per acre, and 12 to 15 pounds per acre for dry-land beans.

Only certified seeds for genetic purity and low levels of disease, noxious weeds, inert matter, and other crop seeds are planted to reduce infection from seed-borne pathogens. Seeds are treated with fungicides, bactericides, and insecticides to reduce seed rot, blight contamination, and soil insect damage, respectively.

Irrigated dry bean are grown in rotation every three- to four- years, with other crops such as alfalfa, wheat, barley, and corn to reduce diseases and insect problems.

Dry bean plants require 90 to 100 days to mature. Plants are pulled when 33 to 50% of the pods turn yellow. After the beans have dried in the windrows they are threshed with a combine equipped with pickup attachment. Beans are stored at less than 18% moisture, and mechanically dried to bring harvested beans to this moisture level.

On year 2002 survey, we did not collect information on worker activities (e. g., hand weeding, pruning, thinning, spot-treating, mowing, hand-harvesting, and hand pollination) involved in growing this crop.

Pesticide Usage on Dry Beans for Year 2002

Year 2002 Kansas pesticide usage survey on dry beans was conducted by the Kansas Agricultural Statistics Service (KASS) and Kansas State University from October to December 2002. Since dry bean

is one of the small crops in Kansas, questionnaires were mailed directly to all growers for commodity dry beans (which were identified by KASS based on year 2001 survey). A total of 99 questionnaires were sent out and 36 of them were collected, with valid data from 3 regions and 10 counties. The following table displays the sample distributions in Kansas in terms of regions and counties.

Sampling Data Distribution

Regions	County	Survey	Sample (%)
10	5	23	64
20	3	11	31
30	2	2	6
sum	10	36	100

Region 10 and 20 were the major contributors to dry bean production in Kansas for year 2002. Accordingly, approximately 95% of the sampling data were collected from those two regions. Approximately 42.9% of the pesticides were applied directly by farmers/growers/rancher-self against various pests and 57.1% were applied by commercial entities.

Insect Pests

Insect pests do not cause significant yield reduction of dry beans in Kansas. However, the following insects can be potential pests in Kansas on dry beans.



Grasshoppers (*Melanoplus* spp.) (differential, redlegged, two-striped, migratory grasshoppers) The most common grasshoppers in Kansas have short antennae, the pronotum is not extended to the length of the wings, and the tarsi are 3-segmented. Only 15 out of 118 species cause significant damage to crops. Adults generally lay eggs in capsules in the ground in late summer and early fall. Eggs hatch from April to August, depending on the species. Grasshoppers feed on the foliage of non-crop areas before moving into field crops. They will feed first in the field margins and then move into the field. Damage from grasshopper feeding results in holes in the leaves and pods. (Image resource = http://www.insects.org/entophiles/orthoptera/orth_003.html). Seedcorn maggots



(*Delia platura* and *D. florilega*) attack bean seeds, preventing germination and reducing the stand. The yellowish white maggot tunnels into the seed or stem. The gray flies are found in the spring in early May when soil temperatures reach 50 °F. They lay eggs in soil, on crop residue, or on the seed or seedling. Wet and cool conditions and high organic matter soils favor seedcorn maggots. (*Delia platura*, image source = <http://www.msue.msu.edu/msue/imp/mods1/visuals/image62.jpg>).

Non-Chemical Control*:

- Fall plowing of crop residue
- Proper planting date



Western bean cutworm (*Richia albicosta*) is an important pest of corn and dry beans in the western one-third of the state and especially in the northwestern region. Females lay eggs on the lower side of bean leaves. The young, brown larvae, with a diamond

pattern on the back, feed on leaf

tissues and blossoms. As they grow they begin to chew holes in the pods and on the developing seeds. (Image source = <http://www.ext.colostate.edu/pubs/insect/05538.html> (above); <http://www.ianr.unl.edu/pubs/insects/g1359.htm> (below)).



Potato leafhopper (*Empoasca fabae*) is found in hot dry growing seasons. The adult leafhopper is wedge shaped, 1/8 inch long, yellowish green color with a row of six white spots behind the head. Both the adults and nymphs suck plant sap from the vascular system of the leaves. In the process, they inject a toxin that causes injury to the plant. The injected area on the leaf turns yellow, then brown, and finally dies. If infestations occur at early stages of growth, plant will be stunted. However, infestations after bloom do not affect yields. (Image sources = [http://](http://www.ento.vt.edu/Fruitfiles/PLH.html)

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Flea beetle (*Chaetocnema pulicaria*) is 1/16 inch long, has a shiny body with enlarged hind femora for jumping. Adults overwinter under crop residue. They can be found in mid-spring, during warm days. Females lay eggs in the soil around the base of the plants. Adults feed on seedlings by chewing on plant tissue causing holes in the leaves. Severely infested seedlings become stunted and may die.

(Image source = http://www.ipm.uiuc.edu/vegetables/insects/corn_flea_beetle/ (above); <http://scarab.msu.montana.edu/HPIPMImage/Images/1203/sm/IMG0020.jpg> (below)).



Green cloverworm (*Plathypena scabra*) moths are dark brown with lighter brown areas and dark brown or black dots. The larvae are light green, looper caterpillars with 4 white lines down the back and sides. They feed on leaves creating a transparent skin on the leaf surface. Older cloverworms eat holes in the leaves of alfalfa, clover, cowpea, soybean, vetch, and some other plants. Since they rarely cause severe injury, treatments are not required. (Image source = <http://www.ent.iastate.edu/imagegal/lepidoptera/gcloverworm/0212.24gcloverworm.html>).



Cutworms Several species are potential pests, but damaging levels are fairly rare. Most cutworms attack young seedlings. They chew them off slightly below or at the soil surface. A few species climb up on plants and feed on the leaves. (Variegated cutworm, *Peridroma saucia*, image source = <http://www.ipm.ucdavis.edu/PMG/P/I-LP-PSAU-LV.014.html>).



Two-spotted spider mite (*Tetranychus urticae*) adults are yellow to dark green with two to four black spots. Hot, dry weather conditions favor infestations of two-spotted spider mite. They are found on the lower surface of leaves. They feed on leaves of young and mature plants causing them to drop during heavy infestations. Acaricide treatment is difficult and hardly ever recommended. (Image source = http://creatures.ifas.ufl.edu/orn/twospotted_mite02.htm).



Onion thrips and western flower thrips (*Thrips tabaci* and *Frankliniella occidentalis*) attack dry beans. In general, thrips are small, slender, and with or without fully developed wings. Thrips have rasping mouthparts. They rasp the tissue and consume the sap, causing stunting and deformation of the

plants. Thrips mostly attack young plants but may attack developed plants. Infestations and yield losses from onion thrips are negligible. Western flower thrips are yellow with dark bands on the abdomen (adult). They attack flowers and cause flower and pod drop. Number of pods per plant can be reduced if five western flower thrips per blossom are found. (*Thrips tabaci*, image source = <http://www.nysaes>.

cornell.edu/ent/hortcrops/english/thrips.html). **Wireworms** (*Elateridae*) can grow to an inch or more in



length. The larvae are yellowish with hard bodies. Wireworms attack seedling by tunneling in the seed then feeding on roots and later may feed on the hypocotyl. Infected spots in the field show areas with reduced stands. Seedling plants attacked by wireworms become wilted and stunted. Wireworms cause little damage to dry beans because beans are planted during late May to late July when temperatures are favorable for rapid seed germination and plant establishment. (Image source =

<http://www.uky.edu/Agriculture/Entomology/entfacts/fldcrops/ef120.htm>).

For year 2002, 30% of the total dry beans were treated with various insecticides, indicating insect pest control is a relatively minor practice in comparison with weed control. Two insecticides (ingredients) were applied in the control of 3 major insect pests in dry beans. The following table lists the insecticides used and major insect pests controlled in year 2002.

Insecticides and Targeted Insect Pests

Insecticide (Ingredients)	Insect Pests Targeted
Acephate	Thrips, Western Bean Cutworm
Phorate	Grasshoppers, Thrips

Next table displays the insecticide trade names, their modes of actions, acres treated, percentage of area treated, and rate.

Insecticide Usage Survey on Dry Bean

Insecticide (Ingredient)	Trade Name	Mode of Action ^b	Acres Treated	Percent Treated*	Rate (lb. a. i./a)
Acephate	Orthene	CI	1787	92.73	1.21

Phorate	Thimet 15G, Thimet 20G	CI	140	7.27	#
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b: CI = Cholinesterase inhibitor.

#: No data reported.

*: Percent Treated = (acreage treated with a given insecticide / the total acreage treated (1927 acres)) * 100.

Diseases

Fungal Diseases



Rust, caused by the fungus *Uromyces appendiculatus*, is one of the most important diseases affecting dry bean production. Although the disease can be found annually in Kansas, epidemics occur only sporadically.

Temperatures between 60 and 85°F and prolonged exposure of leaf surface to wetness from mid-July through August favor rust development. Initial symptoms of rust infection are the development of small, yellow or pale, slightly raised lesions on either side of the leaf.

The lesions enlarge and form cinnamon-colored pustules that contain numerous spores that are responsible for the secondary spread of the

disease. Severely infected leaves curl upwards and dry out prior to dropping from the plant. A severely infected field will appear scorched from a distance. Pod set and seed size can be reduced if early infection is severe. The fungus can overwinter on crop debris. (Image source = <http://plantpath.unl.edu/peartree/homer/disease.skp/Hort/Bean/DrBeRst.html>).

- Three- to four- years crop rotations.
- Incorporate bean debris into the soil in late summer or early fall and remove volunteer beans in the spring.
- Plant at the recommended time for the variety and location.
- When using sprinkler irrigation, avoid timings that would result in extended periods of leaf wetness.
- Use resistant varieties.
- Scout fields regularly and use protectant and/or systemic fungicides when disease thresholds are reached.



White mold, caused by the fungus *Sclerotinia sclerotiorum*, is an



important disease affecting dry bean production. The fungus can overwinter in the soil as sclerotia for many years. Symptoms appear on stems, leaves and pods following bloom. Soft, watery, irregular-shaped areas first occur on stems just above the soil surface, then on leaves and pods. These spots rapidly enlarge and, in a short time, dense, white, cottony masses of mycelia cover the infected spot. Small, hard, black sclerotia form in and on the affected plant parts. Stems become bleached and shredded. Severe infection under cool, wet weather conditions late in the growing season may cause significant yield reduction. (Image source = <http://www.ianr.unl.edu/pubs/plantdisease/g1103.htm>).

Management:

- Four-year rotations with non-host crops such as wheat, corn or sorghum.
- Plant resistant varieties.
- Plant bush-type varieties.
- Avoid excessive nitrogen fertilization that will promote an overly dense canopy.
- Avoid narrow row spacings.
- Irrigation should be applied only when required, and soil surfaces should be kept as dry as possible from pod formation through maturity.
- Fungicides may be applied to highly susceptible varieties at 100% bloom.



Root rots may cause occasional damage to dry beans in Kansas. Pathogens live for several years on decomposed organic matter in the soil and attack the plants when soil and weather conditions are favorable. (Image source = <http://www.ext.colostate.edu/pubs/crops/02938.html>).



Fusarium root rot or dry rot, caused by *Fusarium solani* f sp. *phaseoli*, rarely kills infected plants. Infected roots will have reddish-brown spots or streaks on the hypocotyl and the primary root two to three weeks after emergence. Later, the entire taproot may become discolored and roots become hollow and dry. The pith area of the tap root

is often bright red. Lateral roots are

often destroyed and secondary roots may form near the soil surface, above the area of infection. Above ground, plants are usually stunted and yellow, similar to drought or nitrogen deficiency. Under moderate to severe infection, pod fill is reduced. (Image source = <http://vegdis.cas.psu.edu/VegDiseases/identification/befdr.html>).



Rhizoctonia root rot and damping-off is caused by *Rhizoctonia solani*. Preemergence damping-off may occur on scattered plants or in distinct areas of the field. Initial symptoms appear on the roots or hypocotyl shortly after emergence as sunken, linear-to-circular, reddish-brown spots with a brown to reddish margin. (image source = <http://www.ext.colostate.edu/pubs/crops/02938.html>).



Pythium damping off is caused by various *Pythium* species. The disease may cause rot of the seed before germination, but typically it infects newly emerged plants. Initial symptoms include elongated, water soaked areas on the hypocotyl and roots. The outer stem tissue may first become slimy, and then turn tan to brown in color. (Image source = <http://www.ext.colostate.edu/pubs/crops/02938.html>).

Management:

- A three-year crop rotation will reduce levels of Fusarium root rot. Both *Pythium* and *Rhizoctonia* have extremely wide host ranges and crop rotation has limited benefits for these diseases.
- Crop residual should be incorporated into the soil.
- Avoid excessive fertilization.
- Plant when soil conditions are favorable for rapid germination and emergence.
- Use certified seed.
- Limit early season irrigations.

Bacterial Diseases:

Three bacterial blight diseases commonly occur in Kansas. Bacterial blights can overwinter on crop debris and volunteer seed left in the field. When temperature and moisture conditions are favorable, infection will occur. Infection is frequently spread by splashing rain, especially when accompanied by high winds.



Common blight is caused by *Xanthomonas campestris* pv. *phaseoli*. Temperatures above 80° F favor common bacterial blight infections. Initial symptoms include water-soaked spots on the leaves. These spots rapidly coalesce, resulting in large areas of dried out tissue on the leaves. Severely infected leaves typically drop from the plant. Infected pods



develop circular, water-soaked spots that produce yellow masses of bacterial ooze. Later, the pod lesions dry and appear as reddish brown spots. Infected pods become discolored, shriveled, and contaminated seeds are discolored. (Image source = <http://plantpath.unl.edu/peartree/homer/disease.skp/agron/drybeans/BeCmnBlt.html>).



Halo blight, is caused by *Pseudomonas syringae* pv. *Phaseolicola* Unlike common blight, cool temperatures favor halo blight. Symptoms include small, water-soaked spots on the underside of diseased leaves that turn reddish brown. The surrounding tissue forms a large yellow-green halo around the lesions. Spots rapidly enlarge and coalesce to form large, brown, dead areas on leaves that eventually cause defoliation. Severe infection can cause yellowing and death of new foliage. Symptoms on stems and pods resemble those of common blight, except that any bacterial exudate that forms on the pods is creamy in color. (Image source = <http://www.ipm.ucdavis.edu/PMG/P/D-BN-PSYR-FO.001.html>).



Brown Spot, caused by *Pseudomonas syringae* pv. *syringae* has symptoms similar to halo blight. Dark brown necrotic spots of various sizes occur on diseased leaves, but without the initial water-soaking symptoms common to other foliar diseases caused by bacteria. The marginal halos surrounding the lesions are also absent. Pod symptoms are brown spots and, frequently, a pod twisting at the point of infection. (Image source = <http://scarab.msu.montana.edu/HPIPMImage/Images/1122/sm/IMG0012.jpg>).

Management:

- Practice a three- to four-year crop rotation using cereals or other resistant crops.
- Incorporate all bean residues into the soil and control volunteer beans.
- Plant certified seed.
- Plant resistant varieties.
- Treat seed with a seed-protectant bactericide.
- Avoid reusing irrigation runoff water.
- Do not cultivate when foliage is wet.
- Begin applications of copper-based bactericides at the earliest sign of infection. Protectant applications before symptoms develop are effective, but more costly.

Blight and Brown Spots were two serious diseases threatening dry bean production in 2002 in the northwestern areas in Kansas. For year 2002, areas treated with various fungicides were approximately 52% of total planted areas. At least three different fungicides (ingredients) were applied against various plant diseases in dry bean production for year 2002. Following table lists the fungicides used and diseases targeted.

Fungicides Used and Targeted Plant Diseases

Fungicide (Ingredients)	Diseases Targeted
Copper oxychloride	Blight, Brown Spots
Copper Hydroxide	Blight, Brown Spots
NuCop	Blight, Brown Spots

Next table lists the fungicide common names, modes of action, areas treated, percent treated, and average treated rate (lb/a).

Fungicide Usage on Dry Beans

Fungicide (Ingredient)	Trade Name	Mode of Action	Acres Treated	Percent Treated**	Rate (lb a. i./a)
Copper oxychloride	Copper oxychloride	MOAI*	1060	52.11	1.65
Copper Hydroxide	Champ 2	MOAII*	490	24.09	1.25
Copper Hydroxide	NuCop	MOAII*	484	23.80	1.25

MOAI*: Copper ions release from copper oxychloride act as a fungicide by denaturing proteins and enzymes within fungal spores. Spores actively accumulate copper and germination is inhibited, even at very low concentrations. MOAII*: Copper prevents spore production and inhibits mycelial growth of the fungus by inhibiting RNA synthesis.

** : Percent Treated = (acreae treated with a given fungicide / the total acreae treated (2034 acres)) * 100. E. g., up to 52% areas was treated with Copper.

Weeds

Broadleaves:



Kochia (*Kochia scoparia* L.) (**summer cypress, fireweed, belvedere, mock cypress, Mexican firebush**) is an early summer germinating annual weed, native of Eurasia. Kochia is a highly branched annual herb up to 2 m tall. The stems are yellowish green, green or streaked with red. Both lower and upper leaves are linear. The stems and leaves are often densely hairy. The greenish flowers are small and inconspicuous. The fruit is bladderlike, containing one seed each. Flowering season is from July to October. Seeds are the only source of reproduction. Found on rangeland, pastures, fields and disturbed sites. Confirmed resistance to triazine and ALS inhibiting herbicides. Refer to

following links to learn more about this weed: <http://www.hort.purdue.edu/newcrop/afcm/kochia.html>, http://plants.usda.gov/cgi_bin/plant_profile.cgi?symbol=KOSC&photoID=kosc_001_avd.tif and http://www.nwcb.wa.gov/weed_info/kochia.html. (Image source = <http://www.agf.gov.bc.ca/cropprot/weedguid/kochia.htm>).



Russian thistle (*Salsola iberica*) (**tumbleweed, tumbling thistle**) is a native of Europe. It is an annual, round, bushy, much-branched plant growing up to 3.5 feet high. The branches are slender, succulent when young, and woody when mature. The leaves alternate and are 1 to 2.5 inches long. These drop off and later leaves are short, stiff, spiny. The flowers are small, inconspicuous, green-white or pink. Seeds are about 1/16 inch in diameter, the only source of reproduction. Flowers can be seen from July to October in Kansas. Found on small grain fields, cultivated dryland fields, and waste areas. Confirmed resistance to triazine and ALS inhibiting herbicides. Refer to following link to learn more about this weed: <http://extension.usu.edu/rangeplants/forbs/russianthistle.htm>. As for the weed management please refer to link http://www.co.stevens.wa.us/weedboard/other%20weeds/russian_thistle.htm. (Image source = <http://www.naturesongs.com/vvplants/russianthistle.html>).



Common lambsquarters (*Chenopodium album* L.) (**lambsquarters goosefoot, white goosefoot**) is a native of Europe. It is a summer annual up to 3.5 feet in height capable of producing thousands of seeds. Leaves are alternate, light green, rounded, triangular. Flowers are green, inconspicuous, without petals. Flowering season is from June to September. Seeds are the only source of reproduction. Found in cultivated crop fields, gardens, pastures, vacant lots, waste ground, and other disturbed areas. Can become a problem weed in no-till

situations. Refer to following link to learn more about this weed: http://www.ppws.vt.edu/scott/weed_id/cheal.htm. (*Chenopodium album*, image source = <http://www.cloudnet.com/~djeans/FlwPlant/Lambs-quarter.htm>)

Pigweed Family:



Palmer amaranth (*Amaranthus palmeri*) and **redroot** (*Amaranthus retroflexus* L.) (**rough pigweed, careless weed**) are native weeds. Flowering season is from June to October. Seeds are the source of reproduction. Found in cultivated and fallow fields, gardens, waste ground, and roadsides. Palmer amaranth leaf and stem surfaces are smoother with few or no hairs than redroot pigweed. It is an erect summer annual that may reach 6.5 feet in height, it closely resembles many other pigweed species. Leaves are alternate, without hairs (glabrous), and lance-shaped or egg-shaped in outline, with prominent white veins on the undersurface. Leaves occur on relatively long petioles. Refer to following link to learn more about this weed: http://www.ppws.vt.edu/scott/weed_id/amapa.htm. (*Amaranthus palmeri*, image source = http://www.ppws.vt.edu/scott/weed_id/amapa.htm).



Waterhemp (*Amaranthus rudis*) (**common waterhemp**) is a native weed. Waterhemp stems and leaves are hairless with narrower leaves than Redroot pigweed or Palmer amaranth. Leaves are longer and narrower than those of redroot pigweed. Flowering season is from June to October. Seeds are the only source of reproduction. Found in cultivated fields, roadsides, marshes, sandbars, riverbanks, and waste places. Confirmed resistance to triazine and ALS inhibiting herbicides. Refer to following link to learn more about this weed http://plants.usda.gov/cgi_bin/plant_profile.cgi?symbol=AMRU. As to this weed management please refer to link <http://muextension.missouri.edu/explorepdf/agguides/crops/G04871.pdf>. (Image source = http://plants.usda.gov/cgi_bin/plant_profile.cgi?symbol=AMRU).



Redroot pigweed (*Amaranthus retroflexus* L.) (**rough pigweed, careless weed**) is a native weed. Leaves alternate and are ovate in outline. A single seeded utricle can reach 2 mm in length and are wrinkled when dry. Each utricle splits open in the middle to expose a single glossy black to dark brown seed. Flowering season is from July to October. Seeds are the only source of reproduction. Redroot pigweed stems and leaves are covered with fine pubescence. Confirmed resistance to triazine herbicides. Found in cultivated and fallow fields, gardens, waste ground, and roadsides. Refer to following link to learn more about this weed http://www.ppws.vt.edu/scott/weed_id/amare.htm. (Image source = <http://www.nwr.mcnary.wa.us/plant18.html>).

Buffalobur (*Solanum rostratum*) (**Kansas thistle**) is a native weed. Leaves alternate and are egg-shaped



in outline and leaf venation is very prominent. Stems are erect or spreading, up to 2 ft tall. Flowers are bright yellow in color, 5-parted, and approximately 1 inch wide. Berry fruit is about 8 to 12 mm in diameter. Flowering season is from May to October. Seeds are the only source of reproduction. Survive in all types of soil, although it is more abundant in sandy soils. Commonly found in

corrals, feedlots, overgrazed pastures, roadsides, and waste areas. Refer to following links to learn more about this weed http://www.nwcb.wa.gov/weed_info/buffalobur.html and http://www.ppws.vt.edu/scott/weed_id/solro.htm. As to the weed management please refer to the link http://www.co.stevens.wa.us/weedboard/htm_weed/bb.htm.http://www.wa.gov/agr/weedboard/weed_info/buffalobur.html).



Canada thistle (*Cirsium arvense*) (**field thistle**) is a native of Eurasia and North Africa. *Cirsium arvense* is a perennial thistle up to 1.5 meters tall. It is notorious by its creeping horizontal lateral roots, which produce dense patches of shoots. The sessile and prickly leaves are dark green. The heads of purple to white flowers are 1 to 2.5 cm long and one-third to one-fourth as wide. Flowering season is from June to August. Seeds and rhizomes are the source of reproduction. Found on cropland, ditch banks, roadsides, mud flats, stream and lake bank, and in moist soils. As for this weed management please refer to link <http://www.agric.gov.ab.ca/pests/weeds/64010010.html>. Refer to following link to learn more about this weed http://www.wildflowers-and-weeds.com/weedsinfo/Cirsium_arvense.htm. (Image source = <http://www.agf.gov.bc.ca/cropprot/weedguid/canthist.htm>).

http://www.wildflowers-and-weeds.com/weedsinfo/Cirsium_arvense.htm. (Image source = <http://www.agf.gov.bc.ca/cropprot/weedguid/canthist.htm>).



Common cocklebur (*Xanthium strumarium* L.) is a native weed. It is a summer annual that produces a conspicuous prickly 'cocklebur' and ranges from 0.5 to 6.5 feet in height. Common cocklebur is found throughout the United States and is primarily a weed of agronomic and horticultural crops, nurseries. The stem is purple at the base and often green in the upper portion. The first true leaves are opposite, while all subsequent leaves are alternate. Flowering season is from July to September. Seeds are the only source of reproduction. Common cocklebur is especially abundant in areas

where retreating water has exposed previously submerged land. Confirmed resistance to ALS inhibiting herbicides. Refer to following links to learn more about this weed http://www.ppws.vt.edu/scott/weed_id/xanst.htm. (Image source = <http://tncweeds.ucdavis.edu/esadocs/xantstru.html>).



Field bindweed (*Convolvulus arvensis* L.) (**Creeping Jenny**) is a native of Eurasia. Leaves are arrow-shaped and are arranged alternately on the stems. Flowers are white to pink, funnel-shaped and up to 3 cm in diameter. They have a long flower stalk. Flowers open in sunlight and close in shade. Flowering season is from June to September. Seeds,



spreading roots and rhizomes are the source of reproduction. Found on both cultivated and uncultivated land. It is most common in small grain and summer crop fields. It also can be found in waste places, gardens, and roadsides. Refer to following links to learn more about this weed

http://plants.usda.gov/cgi_bin/plant_profile.cgi?symbol=COAR4. (Image source = http://www.missouriplants.com/Whitealt/Convolvulus_arvensis_page.html).



Jimsonweed (*Datura stramonium* L.) (**moonflower, thornapple**) is a native weed. It is an [annual](#) herbaceous plant, sometimes getting much taller in rich soil. The plant is generally irregularly branched and resembles a shrub. The leaves are alternate, with foul smelling. The flowers have 5 Regular Parts and are up to 15cm long. They are white sometimes violet. The long delicate trumpet shaped flowers are attractive and fragrant. They open in the evening to attract nocturnal insects. Flowering season continues from July to

September. Seeds are the only source of reproduction. Found on cultivated fields, old feed lots and corrals, waste areas, gardens, and pastures. Refer to following links to learn more about this weed

<http://2bnthwild.com/plants/H266.htm>. (Image source = http://www.erowid.org/plants/show_image.php?image=datura/datura_stramonium9.jpg).



Knotweed (*Polygonum arenastrum*) (**doorweed, matweed**) is a native weed. Flowering season is from June to October. Seeds are the only source of reproduction. It appears common in lawn. The achene is about 2 to 3 millimeters, at maturity two sides are convex. The plant is a common weed of many habitats, abundant in disturbed places, often on the borders of marshes and ponds. Refer to following links to learn more about this weed http://plants.usda.gov/cgi_bin/plant_profile.cgi?symbol=POAR11. (Image source = <http://www.bioimages.org.uk/HTML/P161224.HTM>).



Eastern Black Nightshade (*Solanum ptycanthum*) is a native weed. It is an erect summer annual. Eastern black nightshade is primarily a weed of agronomic crops, pastures, and hay fields. Leaves are alternate and ovate. Young leaves remain purple- or maroon-tinted on the undersurface. Flower has Star-shaped, white or purple-tinged, in umbel-like clusters. Berry fruit is about 5 to 12 mm in diameter, green when immature, turning purplish-black at maturity. Flowering season is from May to October. Seeds are the only source of reproduction. Found in roadsides, open woodland, stream

banks, cultivated fields, gardens row crops, and waste places. Refer to

following link to learn more about this weed http://www.ppws.vt.edu/scott/weed_id/solpt.htm. (image source = http://www.botany.wisc.edu/wisflora/bigphoto/SOLPTY_EJJ.jpg).



Purslane (*Portulaca oleracea*) is native of Eurasia. It is a common annual weed in Suriname; it can grow up to a height of 20 inches. The stems are reddish and the fleshy succulent leaves alternate, while the small flowers are yellow and growing in clusters. Purslane is used as a vegetable in Europe and Asia. Purslane has also medicinal applications.

Flowering season is from May to November.

Seeds and stem fragments are the source of reproduction. Found in gardens, flower beds, lawns, orchards, and cultivated lands. It is most persistent in soils that remain moist most of the time. Refer to following link to learn more about this weed http://plants.usda.gov/cgi_bin/plant_profile.cgi?symbol=POOL. (Image source = <http://www.mobot.org/gardeninghelp/plantfinder/codea/A759.shtml>).

Common sunflower (*Helianthus annuus*) (**annual sunflower**) is a native weed.



It is an annual herbaceous plant, which is able to reach a height of 3 Meters. The stalk is hairy. The leaves are alternate and opposite on the lower stalk. Each cordate leaf is irregularly toothed. The flowers are yellow and have numerous parts. Blooms first appear in early summer and continue into early fall. Cultivated plants often have extremely large disk flowers exceeding 30cm wide. Fruits have dark achenes with white stripes. Seeds are the only source of reproduction. Found in cultivated fields, pastures, gardens,

roadsides, waste ground, and disturbed sites. Confirmed resistance to ALS inhibiting herbicides. Refer to following links to learn more about this weed <http://2bnthewild.com/plants/H285.htm> and http://plants.usda.gov/cgi_bin/plant_profile.cgi?symbol=HEAN3. (Image source = <http://www.plantfacts.com/Family/Asteraceae/Helianthus.annuus.shtml>).



Velvetleaf (*Abutilon theophrasti*) (**Indian mallow, butter print, elephant ear, buttonweed**) originated from India. It is an annual tap-rooted weed in the Mallow Family. Entire plant is covered with short, soft, velvety hairs. Leaves are heart-shaped. Velvetleaf has yellow to yellow-orange flowers. Flowering season is from July to October. Seeds are the only source of reproduction. Found in summer crop fields such as sorghum, corn, and soybeans. It can be also found in waste places, roadsides, and fence rows. Refer to following link to learn more about

this weed http://www.ppws.vt.edu/scott/weed_id/abuth.htm. (Image source: <http://www.ppws.vt.edu/~sforza/weeds/abuth.html>).

Grasses:



Barnyardgrass (*Echinochloa crusgalli*) (**cockspur, watergrass**) is originally from Europe. It is an annual weed growing up to 1.5 meters tall; stems usually flattened in cross-section at the base; smooth leaves often purplish at the base. Flowers can produce over 1 million seeds. This weed could remove as much as 80 percent of nitrogen from the soil. Seeds are the

only source of reproduction. It flourishes in warm conditions. It is common particularly in moist areas high in fertility, such as irrigated fields and old feedlots. Can become a problem weed in no-till situations. Refer to following link to learn more about this weed http://plants.usda.gov/cgi_bin/plant_profile.cgi?symbol=ECCR. (Image source = <http://www.ipm.ucdavis.edu/PMG/E/W-GM-ECRU-SG.003.html>).



Foxtails, including giant (*Setaria faberi*) (**giant bristlegrass, Chinese foxtail, Chinese millet, nodding foxtail**) native of Asia; **green** (*Setaria viridis* L.) (**green bristlegrass, pigeongrass, wild millet**) native of Eurasia; **yellow** (*Setaria glauca* L.) (**yellow bristlegrass, pigeongrass, wild millet**); and **bristly foxtail** (*Setaria verticillata*) native of Europe. Seeds are the only source of reproduction. Common on cultivated grounds, waste places, roadsides and degraded rangeland and

pastures. Foxtails are summer annual grasses and are common in Kansas. Mature foxtail plants are 1 to 3 feet tall. Flower heads are dense spikes with yellow to reddish bristles or green to purplish bristles, depending on species. Learn more about species *Setaria faberi* please refer to following link http://www.ppws.vt.edu/scott/weed_id/setfa.htm. (**Green foxtail, image source =** <http://www.agron.iastate.edu/~weeds/Ag317-99/id/WeedID/Ffox.html>



Longspine sandbur (*Cenchrus longispinus*) (**field sandbur, burgrass**) is a native weed. Seeds are the only source of reproduction. Flourish in warm conditions. It is common in roads, waste places, cultivated fields, lawns, and rangeland in poor condition. It can grow well on sandy soils, but also found on heavier soils. Longspine sandbur is an annual grass and its leaves are rolled in the shoot. Refer to following link to learn more about this weed http://www.ppws.vt.edu/scott/weed_id/cchpa.htm. (Image source = [http://botit.botany.wisc.edu/images/401/Magnoliophyta/Liliopsida/Commelinidae/](http://botit.botany.wisc.edu/images/401/Magnoliophyta/Liliopsida/Commelinidae/Poaceae/Cenchrus/Cenchrus_longispinus_DW.html)

[Poaceae/Cenchrus/Cenchrus_longispinus_DW.html](http://botit.botany.wisc.edu/images/401/Magnoliophyta/Liliopsida/Commelinidae/Poaceae/Cenchrus/Cenchrus_longispinus_DW.html)



Shattercane (*Sorghum bicolor*) (**Black amber, chicken corn, wild cane**) is a native of Africa. Seeds are the only source of reproduction. Flourish in warm conditions. Found in cultivated fields of corn, grain sorghum, and soybeans. Shattercane may grow to a height of 12 feet. However, short-statured shattercane has also been found in fields. As plants mature, the open-panicle seed heads tend to droop. A single



head may produce up to 2,000 seeds. Head types vary considerably, reflecting the genetic diversity of shattercane. Seeds vary in color, usually covered with glumes. These glumes protect them from rotting

in the soil. Refer to following link to learn more about this weed http://plants.usda.gov/cgi_bin/plant_profile.cgi?symbol=SOBI2. (Image source = <http://www.weedscience.org/Case/Case.asp?ResistID=474>).



Downy brome (*Bromus tectorum*) (**wild oats, cheatgrass, military grass**) is native of Europe. It is a summer or winter annual weed with densely hairy leaves and sheaths and drooping seedheads when mature. Downy brome is primarily a weed of landscapes, fencerows, pastures, hay fields, and occasionally winter small grain crops. The densely hairy leaves and sheaths and drooping seedheads are all characteristics that help to identify this weed. It is only a problem prior to planting in no-till. Seeds are the only source of reproduction. Commonly found on rangeland, fields, disturbed sites, roadsides, and waste area. Refer to following links to learn

more about this weed <http://eesc.orst.edu/AgComWebFile/EdMat/PNW474.pdf> and http://plants.usda.gov/cgi_bin/plant_profile.cgi?symbol=BRTE. (Image source = <http://tncweeds.ucdavis.edu/photos/brote05.jpg>).

Weed Managements

Successful weed control for dry bean production may require integration of all possible approaches including cultural practices and herbicide application. It is important to carefully plan a program to coordinate crop rotation, cultural practices, and herbicide application in weed management.

Cultural techniques can suppress weed growth. **Preplant:** Normal seedbed preparation may temporarily control many annual weeds by leaving dry soil on the surface. **Postplant:** After plants are established, cultivation with sweeps, knives, or rolling cultivators can significantly limit the growth of weeds that may have escaped from earlier cultural or chemical control approaches.

Preplant herbicides should be combined with cultural methods to achieve desired weed control. Weeds that escape control by preplant herbicides may sometimes be effectively controlled by a postplant treatment. Most preplant herbicides are applied to the soil surface and mixed into the soil before the crop is planted; these are called preplant incorporated herbicides and require soil moisture for best performance. Learn more information about weed management in dry beans please refer to link <http://www.ipm.ucdavis.edu/PMG/r52700111.html>.

Year 2002 weed management

Even though several weed species compete for resources with dry beans, only a few weed species were listed as the primary target weeds for control with herbicides by growers/farmers. For the year 2002, areas treated with various herbicides were approximately 198% of total dry bean planting areas, indicating many fields were treated with more than one herbicide. Therefore weed control is one of the important practices for dry bean production in Kansas. The survey shows seven herbicides (ingredients) were applied for the control of 16 different weeds in Kansas dry bean production. The following table lists the herbicides applied and weeds targets for control.

Herbicides and Targeted Weeds

Herbicide (Ingredients)	Weeds Targeted
Alachlor	Barnyardgrass
Dimethenamid	Barnyardgrass, Foxtails, Kochia, Palmer Amaranth, Pigweed, Russian Thistle, Waterhemp
EPTC	Barnyardgrass, Cocklebur, East Black Nightshade, Foxtails, Kochia, Longspine Sandbur, Pigweed, Russian Thistle, Velvetleaf
Ethalfuralin	Barnyardgrass, Field Bindweed, Cocklebur, Eastern Black Nightshade, Foxtails, Kochia, Lambsquarter, Longspine Sandbur, Palmer Amaranth, Pigweed, Russian Thistle, Shattercane, Waterhemp
Pendimethalin	Barnyardgrass, Kochia, Pigweed, Russian Thistle, Others
S-Metolachlor	Eastern Black Nightshade, Foxtails, Kochia, Palmer Amaranth, Pigweed, Russian Thistle, Shattercane
Trifluralin	Barnyardgrass, Cocklebur, Downy Brome, Eastern Black Nightshade, Foxtails, Kochia, Pigweed, Velvetleaf

The next two tables display the herbicide trade names, modes of action, acres treated, percentage of area

treated, and rate. Table ‘**Herbicide Usage on Dry beans at Different Stage**’ details the herbicides and amount used at different stages in terms of plant growth. Overall, weed control is one of the important practices in dry bean production in Kansas.

Herbicide Usage Survey on Dry Beans

Herbicide (Ingredient)	Trade Name	Mode of Action ^b	Acres Treated	Percent Treated*	Rate (lb a.i./a)
Alachlor	Partner 65 WDG	SI	60	0.5	0.52
Dimethenamid	Frontier 6.0	SI	1380	11.8	0.47
EPTC	Eptam	SI	1556	13.3	2.60
Ethalfuralin	Sonalan	RI	4308	36.8	0.86
Pendimethalin	Prowl	RI	1144	9.8	0.94
S-Metolachlor	Dual	SI	2351	20.1	0.97
Trifluralin	Treflan	RI	900	7.7	1.21

Herbicide Usage on Dry beans at Different Stages

Herbicide (Ingredient)	Preplant (lb a.i./a)	Preemergence (lb a.i./a)	Postemergence (lb a.i./a)	Directed Postemergence (lb a.i./a)
Alachlor	0.52	0	0	0
Dimethenamid	0.47	0	0	0
EPTC	2.85	0	0.86	0
Ethalfuralin	0.92	0.59	0.79	0
Pendimethalin	0	0.94	0	0
S-Metolachlor	0	0.97	0	0
Trifluralin	1.21	0	0	0

*: Percent Treated = (acreage treated with a given herbicide / the total acreage treated (11699 acres)) * 100.

b:ALS = ALS (Acetolactate synthase) synthase inhibitors; RI = Seedling root (Tubulin protein) inhibitors; SI = Seedling shoot inhibitors.

Among the herbicides applied for weed control, ethalfluralin was the most frequently used, with and more than 36% areas treated at an average rate 0.86 lb/acre. Weeds were most likely to be treated at pre-plant and pre-emergence. There was no herbicide used at the directed postemergence stage.

Application methods may vary with target pests and crops. Table ‘**Pesticide Application Methods**’ lists the all possible methods used in dry bean pest control.

Pesticide Application Methods

Control Method	Weed (%)	Insect (%)	Disease (%)
Broadcast, ground without incorporation	25.5	3.0	8.9
Broadcast, ground with incorporation	54.2	0.0	0.0
Broadcast, by air (Aerial application)	0.0	97.0	43.6
Spot Treatment	0.0	0.0	0.0
In irrigation	8.7	0.0	47.5
Banded in or over row	1.9	0.0	0.0
Foliar or directed spray	9.7	0.0	0.0
In seed furrow	0.0	0.0	0.0
chisel/injected or knifed in	0.0	0.0	0.0

Non-chemical Pest Control Approaches

Non-chemical (cultural) control is one of the approaches for pest control in dry bean production in Kansas. The following table ‘**Cultural Control Approaches**’ lists 12 different cultural approaches used by farmers/growers to control pests (weeds, insects, and diseases).

Cultural Control Approaches?

Non-chemical control approaches	Practice Case	Rate1 (%)*	Rate2 (%)**
Releasing any beneficial organisms	0	0.0	0.0
Mowing, burning, or tilling around the fields	2	5.6	1.9

Cultivating during growing season	19	52.8	17.6
Adjusting planting/harvesting dates	5	13.9	4.6
Alternating chemical usage to minimize resistance	7	19.4	6.5
Rotating crops planted	20	55.6	18.5
Utilizing and water management practices	13	36.1	12.0
Cleaning field equipment between uses	8	22.2	7.4
Utilizing treated seed	15	41.7	13.9
Utilizing soil analysis	15	41.7	13.9
Adjusting row spacing or plant density	4	11.1	3.7
Others	0	0.0	0.0

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

* The proportion of growers (among the 120 sampled growers) who adopted a given cultural approach to pest control. e. g, 55.6% farmers used the ‘rotating crops planted’ approach to control pests.

** The likelihood of a given cultural approach was used by farmers for pest control in dry bean production. e. g., there is 18.5% chance that the approach ‘rotating crops planted’ was used by farmers to control various pest. Please note that one farmer may use more than one approach in pest control.

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