

Crop Profile for Proso Millet In Colorado

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Panicum miliaceum L. (Poaceae)

General Production Information

Colorado Facts

	1992	1997	1999	2000	2001
Acres in Colorado:	unavailable	unavailable	250,000	190,000	240,000
Percent U.S. Acreage:	29%	33%	42%	43%	37%
National Ranking	2 nd	2 nd	1 st	1 st	1 st
Per Acre Value:			\$65.28	\$72.00	\$67.08
Value of Production in Colorado:	\$3,635,000	unavailable	\$16,320,000	\$13,680,000	\$16,100,000

Data from 1997-2001 Colorado Agricultural Statistics Services

Production Facts

- Acres harvested: 150,000 in 2000; 240,000 in 1999.*
- Yield (bushels per acre): 19 in 2000; 34 in 1999.*
- Total production (bushels): 2,850,000 in 2000; 8,160,000 in 1999
- Annual production costs: \$54 to \$82 per acre
- *Decreases due to dry conditions in 2000.

Description of Crop

Proso millet is a short season, summer annual grass grown as a grain crop. The harvested grain is a seed enclosed in a hull that is typically white or creamy-white, yellow or red, but may be gray, brown, or black. White-seeded varieties are most often grown, followed by red-seeded varieties. It is used for bird and livestock feed in the U.S. and for livestock feed and human consumption internationally. The Central Great Plains states of Colorado, Nebraska, and South Dakota are the major producers of proso millet in the United States. Other states producing proso include Kansas, Wyoming, Minnesota, and North Dakota. Proso production in the U.S. has dramatically increased in the past ten years.

Plant height ranges from 12 - 48". Plant stems are stout and erect; and both stems and leaves are hairy. The panicle (flower head) is large, open, and drooping, similar to oats. There are three variety classes, based on the shape of the panicle: (1) spreading, (2) loose and one-sided, and (3) erect. Proso is self-pollinating, but may outcross. Proso is grown in conventional and in no-till systems, most often in no-till. Yields are typically higher in a no-till system. It is grown in dryland conditions (a very small number of acres are irrigated) as part of a continuous crop rotation with winter wheat and dryland corn or after a summer fallow period. It is grown using the same equipment used for dryland winter wheat production. Historically, it has been grown as a replacement crop planted when the winter wheat crop failed, but it is now an important part of crop rotations in eastern Colorado. The crop needs moderately warm temperatures and is readily injured by frost. The number of days from planting to harvest is between 60 and 90. Usual harvest is in September. Among grain crops, proso needs the least amount of water; and can yield grain using as little as 6" of water. Total crop water use is about 13 to 14". Because it is shallow rooted and takes most of its needed water from the top 2 to 6" of soil, it is susceptible to drought. However, proso can produce a reasonable yield following a long period of low rainfall if sufficient rain falls later in the season. Production of proso millet reduces air pollution caused by dust blowing from farmland that might otherwise be fallow.

Cropping System

Planting:

Planting date ranges from May 15 - June 30. For no-till systems, early to mid-June is best. For conventional production systems, mid-May is optimal because soil temperatures rise sooner than in no-till. Optimum soil temperature for planting ranges from 55° F to 65° F. Late planting may yield less grain due to early fall freezes. Heavy rains soon after planting can bury seed and cause soil crusting, resulting in a poor stand. Soil pH and weed control at planting time are concerns. The crop is typically planted using a grain drill (7" disk) at a rate of 8 - 20 lb per acre, higher seeding rates are recommended. Planting depth is ½ - ¾". Common row spacing is 7, 10 or 12 inches. The number of plants per acre ranges from 850,000 to 1,400,000.

Fertilizer Use:

Nitrogen deficiency in soil is common in proso production areas, especially when planted following winter wheat. Normal application rates range from 40 - 60 lb per acre. Phosphorous may also be needed and is normally applied at a rate of 20 lb per acre. Zinc is required in some cases. Nitrogen, phosphorous and sulfur are applied in eastern Colorado for proso millet production. It is recommended to band nitrogen with or near the seed.

Irrigation:

Proso millet is grown as a dryland crop without any supplemental irrigation. However, there are a very small number of acres produced in the state that are irrigated.

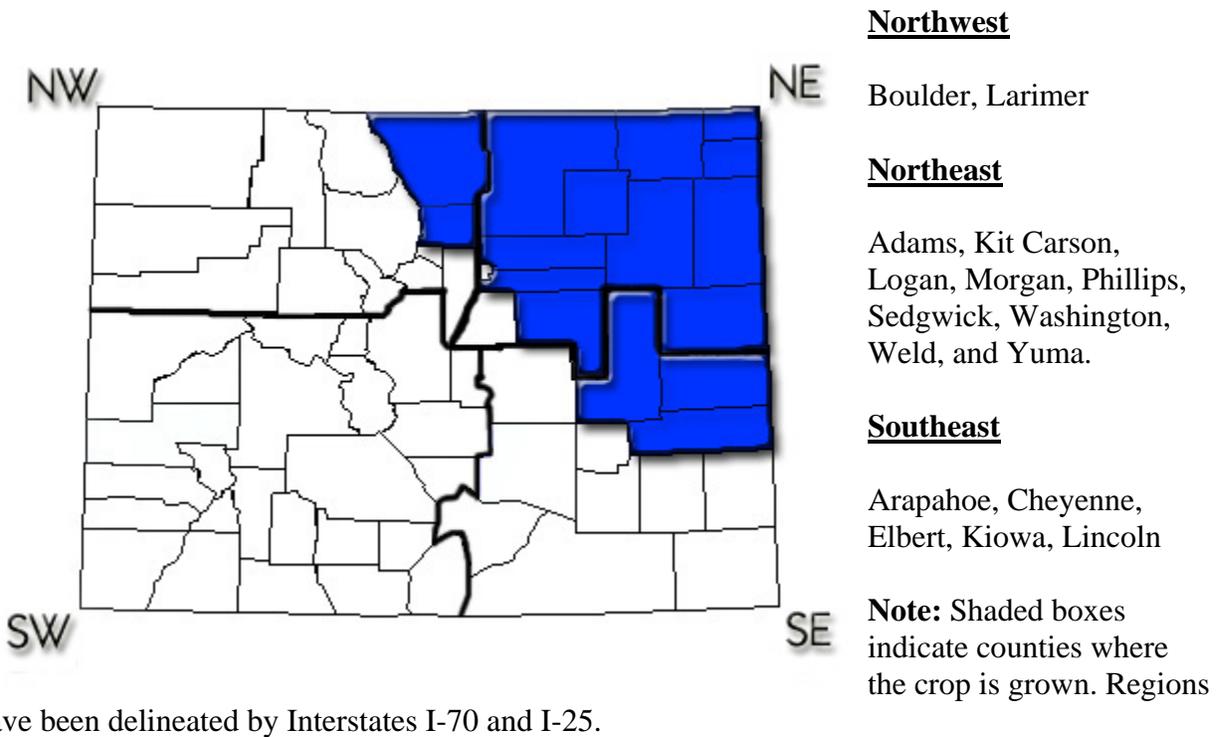
Harvest:

Proso millet is harvested when the seed in the upper half of the panicle are mature. In Colorado this is usually during September. The crop is swathed and allowed to dry and cure in windrows. Swathing too soon reduces yield and test weight. Swathing too late results in losses due to lodging and shattering. Proso cannot be direct combined because (1) the seed shatters soon after it is ripe, (2) proso lodges when left standing, and (3) the straw moisture content is too high at harvest time. Normal test weight is 56 pounds per bushel. Seed moisture content of 13% or less is optimal.

Storage:

Proso millet stores well when the moisture content of the seed is 13% or less.

Location of Production



Insect Pests

Banks grass mite, *Oligonychus pratensis* (Banks)

In June, Banks grass mites may move from maturing wheat into the edges of proso fields. Damage on seedlings and young plants appears as elongated chlorotic areas. Very dry conditions can cause severe infestations and lead to loss of leaves or whole plants.

European corn borer, *Ostrinia nubilalis* (Hübner)

Millet that is planted in the corners of cornfields grown under center pivot sprinklers is a favorite gathering place for European corn borer moths. Corn is a better host, but the moths will lay eggs on millet. The larvae will bore into stems, causing significant damage.

Grasshoppers

Grasshoppers are a traditional problem in millet. Grasshoppers move to proso fields from nearby wheat fields and from nearby CRP lands. Feeding damage will first be seen around the field edges and later throughout the field. Planting the proso crop earlier in the season may help to manage losses caused by grasshoppers.

Greenbug, *Schizaphis graminum* Rondani

Colonies of these small, pale green aphids are found on the underside of leaves. Most greenbugs have a darker green stripe down the back. Feeding results in small yellow spots and later larger chlorotic areas.

Thrips

In June, like the Banks grass mite, thrips move from mature wheat fields to neighboring proso fields. Symptoms include non-patterned yellowing of leaves, similar to virus symptoms in small grain crops. The leaves of stressed proso plants may turn brown and die after intense feeding by thrips. Thrips damage is worse during very dry conditions.

Wheat stem maggot, *Meromyza americana*

Maggot larvae hatch from eggs that are laid on grass culms. Once they hatch, they bore into the stem and feed on stem tissue. The inflorescence dies prematurely and the millet heads appear white or discolored. The heads droop toward the ground and may be easily pulled from the plant.

Key Insect Management Strategies

Cultural Controls

Insect pests do not pose a major problem to proso millet production in Colorado. Therefore, there are no insecticides considered to be important to its production. Only formulations of spinosad

are labeled for use in proso, so control options are limited if a severe outbreak occurs. The best management practices for insect/mite control are the use of sound crop production practices to ensure a vigorous crop and rotation of proso with other crops. There are however several insect pests that can affect proso millet, and in some cases they cause economic loss and they are listed above.

Insecticides-

Pesticide: **azadirachtin** (Aza-Direct)

- Target Pests: Mites, Aphids, Thrips, Maggots
- Recommended rate: 0.15-0.50 oz ai/A (12.5-42 oz product/A)

Pesticide: **spinosad** (Tracer)

- Target Pests: Borers
- Recommended rate: 0.66-1.3 fl oz ai/A (1.5-3.0 fl oz product/A)

Weeds

Key Weeds Buffalobur, *Solanum rostratum*

This weed is a native annual reaching a height of 2'. Its leaves are 2 to 5" long covered with spines. It has 1" wide yellow flowers with 5 lobes. It is common on prairies and is quite drought resistant. Buffalobur serves as a host for the Colorado potato beetle. It is not a competitive plant.

Common and Netseed lambsquarters, *Chenopodium album* and *Chenopodium berlandieri*

These annual weeds, which reproduce from seed, have solitary, erect stems that grow to a height of 1 to 6'. The alternate leaves are smooth, pink or purple striped and are shaped like a goosefoot. The underside of the leaves is commonly covered with a mealy-white coating. These plants are fast growing and rapidly draw water from the soil. Netseed is similar to common except that its seed is slightly roughened, while the common seed is rather smooth. Netseed lambsquarters may be more prevalent in Colorado than common lambsquarters.

Common sunflower, *Helianthus annuus*

This annual weed reaches heights ranging from 1 to 10'. The tall stems are erect to branched. The alternant leaves are simple, ovate or heart-shaped with toothed edges. Common sunflower produces showy flowers July through September.

Downy brome, *Bromus tectorum*

This winter annual grass grows to a height of 4 to 30" and reproduces by seed. Downy brome is on the Colorado noxious weed list. Its leaf sheaths and flat leaf blades are covered with soft hair, hence the name "downy". It is a strong competitor for moisture because of its winter and early spring growth habit. Downy brome is a crop seed contaminant and also poses a threat as a fire hazard. Crop rotation (winter wheat-proso millet-fallow) is typically used as a control method.

Field sandbur, *Cenchrus incertus*

This weed is a warm-season annual with tufted stems 8" to 3' tall. It usually grows in a prostrate fashion and forms mats. Its rough, flat leaves are 2 to 6" long. The 1 to 3" spikes bear clusters of 10 to 30 burs per spike. Each bur is about ¼" around and has 15 to 30 stout sharp spines. Control methods include crop rotation, with a burn-down herbicide application such as glyphosate immediately following the winter wheat harvest. A second burn-down application may be necessary later in the fall if weed populations warrant it.

Green foxtail, *Setaria viridis*

This grass has short, roughened and hairless leaf sheaths. Green foxtail is on the Colorado noxious weed list. Its presence in proso fields results in lower proso yield and increased cleaning costs. It flowers and produces seed from July through September.

Kochia, *Kochia scoparia*

This annual weed grows to a height of 1 to 6'. Kochia is on the Colorado noxious weed list. Its tall, branched stems are slender and round and are often red-tinged. It has alternate lance-shaped leaves that are ½ to 2" long. The flowers are inconspicuous. Kochia is very widespread throughout the western U.S., flowering and producing seed from July to September. ALS herbicide resistant biotypes are a major problem.

Prostrate knotweed, *Polygonum aviculare*

This annual weed, which reproduces from seed, is a mat-forming plant with slender, pale-green stems. It usually grows in a prostrate fashion, but sometimes branches upward 4" to 3'. Its leaves are alternate and lance-shaped and its flowers are inconspicuous.

Puncturevine, *Tribulus terrestris*

This weed is a prostrate annual that forms mats of trailing stems ½ to 5' long. Puncturevine is on the Colorado noxious weed list. Its leaves are hairy and are divided into 4 to 8 pairs of leaflets. The flowers are small and yellow with 5 petals. The 5-sectioned fruits break when mature into tack-like structures with sharp curving spines. These hard, spiny burs damage wool and injure livestock if eaten. Puncturevine is difficult to eradicate because the seed can lay dormant for 4 - 5 years. The plant flowers and produces seed from July through October.

Redroot pigweed, *Amaranthus retroflexus*

This weed is an annual reaching a height of 2 - 3'. The lower stems are often red or red-striped. Its leaves are lance-shaped with long petioles and prominent veins. Flowers grow in clusters with spiny scales. Redroot pigweed will germinate throughout the growing season if sufficient moisture is available. This is the major weed problem in proso production. ALS herbicide resistant biotypes are a problem.

Russian thistle, *Salsola iberica*

This annual weed grows to a height of ½ - 3' and appears rounded, very branched and bushy. It reproduces by seed. Russian thistle is on the Colorado noxious weed list. Its stems are usually red or purple striped. The leaves are small and alternate. The flowers are inconspicuous. Russian thistle seed are spread when plants blow as tumbleweeds. This weed is very well adapted to dryland agriculture areas.

Volunteer wheat, *Triticum aestivum*

This winter annual grass germinates from seed lost due to shattering, hail damage, or during harvest. It is a strong competitor with proso millet. It serves as a host for wheat streak mosaic virus, which is carried by the wheat curl mite. It also serves as a host for the Hessian fly and the Russian wheat aphid, two important insect pests of wheat. Crop rotation (winter wheat-proso millet-fallow) is typically used as a control method.

Wild buckwheat, *Polygonum convolvulus*

This weed is an annual, reproducing by seed. It has heart shaped leaves arranged alternately on stems that trail along the ground and twine around other plants. It is similar in appearance to field bindweed.

Key Weed Management Strategies

Cultural Controls

Cultural methods of weed control include pre-plant tillage (in some circumstances), narrow row spacing, high plant population, and rotating proso millet with other crops. Weeds are the number one pest management issue. Avoid rotations with other warm season grasses, unless grass weeds are successfully controlled in these crops. Rainfall in the first three weeks after planting is undesirable. After several rotation cycles of winter wheat-proso millet, there should be two years between millet crops to reduce foxtail weeds.

Roundup (**glyphosate**) is applied pre-emergence and Peak (**prosulfuron**) is applied after crop emergence. Other herbicides that are used include **2,4-D** and Clarity (**dicamba**). Currently, there are no herbicides available that growers considered reasonably effective since Proso millet was removed from the atrazine label. Atrazine was labeled for use in proso millet, but this use has been dropped from the label.

Herbicides-

Pesticide: **2,4-D** (2,4-D Amine Weed Killer)

- Target Pests: Lambsquarters, Sunflower, Puncturevine, Pigweed, Knotweed, Russian Thistle
- Recommended rate: 3.7-7.5 fl oz ai/A (0.5-1.0 pt product/A)
- Use Data:

1992= rate used- 0.50 lb ai/A

9% of total acres treated

1997= rate used- 0.50 lb ai/A

2% of total acres treated

Pesticide: **dicamba** (Clarity)

- Target Pests: Kochia, Wild buckwheat
- Recommended rate: 2.3 fl oz ai/A (4 fl oz product/A)
- Use Data:

1992= rate used- 0.11 lb ai/A

8% of total acres treated

1997= rate used- 0.30 lb ai/A

1% of total acres treated

Pesticide: **glyphosate** (many)

- Wiper Application:

Target Pests: Sunflower, Redroot Pigweed
Recommended rate: 1 Gal Product/2 Gal Water

- Pre-emergence Application:

Target Pests: Lambsquarters (6"), Downy Brome (6"), Sandbur (12"), Wheat (12"), Foxtail (8")
Recommended rate: 3.5-7.0 fl oz ai/A (8-16 fl oz product/A)

Pesticide: **prosulfuron** (Peak)

- Target Pests: Buffalobur, Lambsquarters, Knotweed, Russian Thistle, Kochia, Pigweed
- Recommended rate: 0.22-0.28 oz ai/A (0.38-0.5 oz product/A)
- Comments: Kochia and Redroot Pigweed both contain resistant biotypes

Critical Pest Management Issues

Weed management is the major pest problem facing proso producers. Proso, like most crops, is a poor competitor at the seedling stage. Cultural practices used to manage weeds include tillage just before planting, directed fertilizer placement, higher seeding rate, and use of taller cultivars. Problem weeds include redroot pigweed, kochia and common sunflower. Biotypes of these weeds that are resistant to the ALS herbicides are a major concern for proso growers.

There are no nematode pests that pose a significant problem to proso millet producers at this time.

ALS herbicide resistance can be selected for very quickly, even after two applications. More commonly, population pressure due to consecutive applications or continuous production of the same crop year after year using only ALS herbicides selects for resistance. In many situations, resistance is selected for along right-of-ways and then resistant biotypes move into agricultural fields. It is important to rotate herbicide modes of action to prevent future cases of herbicide resistance.

Weeds, diseases, and insects can all develop resistance over time to pesticides. When the same pesticide is used consecutively over a period of time, the target pest can become resistant to that pesticide and render the pesticide obsolete.

Diseases

Bacterial Stripe Disease, *Pseudomonas avenae*

Pseudomonas avenae is a seed-borne pathogen. Therefore, planting registered or certified disease free seed can prevent disease loss. Symptoms of this disease include brown, water soaked streaks on leaves, sheaths and culms.

Head Smut, *Sphacelotheca destruens*

The fungus *Sphacelotheca destruens* causes head smut. Because it is a seed-borne disease, head smut is easily controlled by seed treatment. Protectant type thiram is typically used as a seed treatment to control this disease.

Kernel smut, *Ustilago crameri*

The fungus *Ustilago crameri* is more difficult to control than head smut. Methods to control kernel smut include seed treatment and crop rotation.

Key Disease Management Strategies

Cultural Controls

Currently, there are no diseases that pose significant problems to producing proso millet. Consequently, there are no fungicides considered important to production. There are several diseases that do affect proso millet, though not at levels that result in economic loss and they are listed above. Head smut has become a problem in recent years but is controlled with seed treatments of thiram.

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