

# Sudan Grass, Millets, and Sorghums *in Oregon*

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Figure 1. A good crop of sorghum in western Oregon.

# Sudan Grass, Millets, and Sorghums *in Oregon*

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## Introduction

SUDAN grass, millets, and sorghums have been grown in varying acreages in several sections of Oregon for many years. These crops are of relatively minor importance but the acreage is gradually increasing as adapted and improved varieties are obtained, more satisfactory cultural practices are determined, and wider utility is developed. In some sections they are now considered to be standard field crops. In others, some of them are grown as temporary or emergency crops during seasons that are unfavorable for other crops.

Use of Sudan grass is increasing more rapidly than use of millets and other sorghums. It has been estimated that in 1948, the acreage had increased to approximately 45,500. The place of Sudan grass as a forage plant in Oregon is definitely established. Further increased production of Sudan grass for forage is warranted, particularly for summer pasture. Production for seed fluctuates according to seasonal conditions, with approximately 2,700 acres harvested in 1948.

Of the millets, proso, also known as hog millet and hershey, is grown most extensively. It is used chiefly as a grain feed for livestock, and is coming into use as a food for upland and migratory birds. Foxtail millet is used almost entirely for hay. Japanese barnyard millet was introduced for experimental purposes in 1917 by the John Jacob Astor Branch Experiment Station. It became an increasingly popular summer soiling crop in the coastal region during the next 10 or 12 years. About 1930 the use of the crop began to decline. In 1948, none, apparently, was grown. The decline resulted largely from the substitution of seed of the weedy "barnyard millet" or "water grass" for seed of genuine Japanese barnyard millet and because of newly introduced higher yielding and more widely adapted forage crops.

Sorghums are grown only to a limited extent because present varieties are not well adapted to most Oregon growing conditions. Sorghums are divided into four general types: (1) Sorgo, or sweet sorghum, used for forage, sirup-making, and grain, (2) grain sorghum, (3) broom corn, and (4) grass sorghum, including Sudan grass and Johnson grass.

## Adaptations in Oregon

### Climatic adaptations

Regions most favorable to the production of Sudan grass, proso, foxtail millet, sorghum, and Japanese barnyard millet are shown in Figure 2.

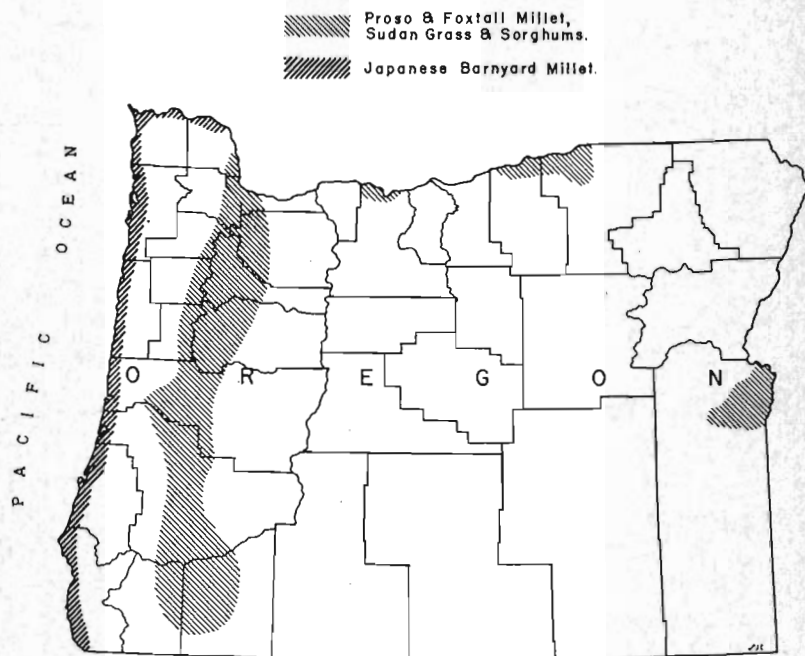


Figure 2. Regions in Oregon most favorable to production of millets, Sudan grass, and sorghums.

Sudan grass grows best in comparatively warm locations where there are no frosts between May 1 and October 1 and where summer moisture supplies are comparatively good. During germination and early growth it will not endure as much cold as corn. Where temperatures alternate regularly from warm to cold, or drop suddenly and remain low for several days during the early growing period, growth is usually checked. During low-temperature periods, if not killed, Sudan grass remains practically dormant, and if this condition continues too long, the plants are stunted and never make normal growth. At the higher altitudes, because of untimely frosts or periods

of low temperatures and the comparatively cool-to-cold growing season, Sudan grass makes poor growth. In Oregon the crop has been successful only at lower altitudes and in the warmer sections.

In western Oregon, the warmer sections of the Willamette, Umpqua, and Rogue River valleys are best adapted to Sudan grass. In eastern Oregon the warmer irrigated sections along the Columbia and Snake rivers and larger tributaries of these in the lower altitudes are reasonably well suited to Sudan grass. This crop has little value in the coastal regions.

Sudan grass, in common with the other sorghums, becomes dormant during droughty periods, and unless the drouth is too severe, will resume growth when contditions become favorable.

The climatic requirements for proso are similar to those of Sudan grass, except that early varieties will mature during shorter and slightly cooler summers. Frost-free growing seasons are essential to successful production. The earliest varieties require 65 to 75 days to reach maturity in eastern and southern Oregon; in the Willamette Valley, 75 to 85 days are required.

Proso has a low water requirement, but can be injured by drought. The crop is not well adapted to growing under irrigation where water costs are high because it does not seem to make most economical use of the moisture.

Foxtail millet grows under warmer and more moist conditions than proso and under cooler conditions than Sudan grass. For hay production the early varieties require a season of 60 to 80 days without frost. This is several days shorter than is usually required by Sudan grass for development to the hay stage. In eastern and southern Oregon the crop generally requires less time to reach the hay stage than in the Willamette Valley. Foxtail millet has a comparatively shallow root system and is sometimes severely injured by drought, from which it makes poor recovery.

Japanese barnyard millet thrives best at low altitudes where the period between May 1 and October 15 is frost-free, and where the summers are moderately warm and soil moisture plentiful throughout most of the growing season. In regions of long cool or frequent cold periods during the summer, Japanese millet makes slow growth. The crop will, however, do well where the summers are not warm enough for good yields of corn.

Japanese barnyard millet production is largely confined to a narrow strip along the coast and lower Columbia River where, during August and part of September, the weather is usually warm, and during some years moderately dry. The crop is often ready to cut for



green feed about 60 days after seeding. The plant seldom matures seed for harvest in Oregon. The seed crop, however, is a valuable food for migratory waterfowl in western Oregon areas subject to winter flooding.

Sorghum and Sudan grass are practically identical in their climatic adaptations, except that sorghum requires a longer season to reach maturity. Sorghum has a much more fibrous root system than corn, and is a better-adapted crop for forage or grain in warm regions where irrigation or natural soil moisture is insufficient to produce corn successfully.

### Soil adaptations

Sudan grass makes most satisfactory growth on fertile, light, warm soils that have fair depth and hold moisture well. It makes a good growth also on the warmer, heavier soils. On cold soils growth is slow and the plants are likely to be crowded out by weeds. Very coarse, porous, sandy or gravelly soils are generally unfavorable for Sudan grass. Drainage is important where seedings are made on soils that may become wet and soggy during rainy periods or by over-irrigation. On such lands Sudan grass makes slow growth, or the plants may die or become distinctly stunted.

Soils well adapted to the production of Sudan grass are suited for growing proso, foxtail millet, and sorghum. Proso and foxtail millet, because of their comparatively shallow root systems, will grow satisfactorily on fairly fertile soils that are too shallow for good yields of sorghum or Sudan grass. Proso is suited also to soils that are too cold for Sudan grass.

Sorghum has a marked tolerance to alkali. The crop is reported to make fair yields of forage on soils having as high as 0.8 per cent of white alkali, if the soil is well supplied with moisture. Yields of seed are generally low on distinctly alkaline soils.

Japanese barnyard millet, for best growth, requires fairly deep soils of high fertility. Warm, well-drained, diked tidelands or good bottom lands of high fertility generally produce the highest yields. The deeper upland soils are also satisfactory, but do not ordinarily produce the highest yields. Cold, poorly drained lands are not suited to this crop. Land of low natural fertility and worn-out crop lands require heavy applications of fertilizer to produce satisfactory yields.

Manure is a very satisfactory fertilizer. On upland soils, 15 tons an acre, and on tide and bottom lands, 5 to 10 tons an acre is a common application. Commercial nitrogenous fertilizers may be used to supplement insufficient manure supplies.

## Seedbed Preparation

Sudan grass, proso, foxtail millet, and sorghum require firm seedbeds. Spring plowing is best because it hastens warming of the soil. This should be done early on unirrigated lands, and the soil well worked soon after to prevent loss of moisture. Before seeding, the soil should be worked one or twice to kill weeds, thus effecting a partial summer fallow. When one of these crops is seeded as a catch crop following failure of a fall or early-spring planted crop on fall-plowed land, it is doubtful if spring plowing would be of enough benefit to justify the extra expense involved. In such a case, thorough disking is usually satisfactory.

On soils low in nitrogen, well-rotted barnyard manure applied in the fall or early spring at the rate of 5 tons per acre and well worked into the soil, or a nitrogenous fertilizer, such as ammonium sulphate or calcium nitrate, at the rate of 100 to 200 pounds per acre is sometimes advisable. Nitrogenous fertilizers are usually applied and worked into the soil shortly before seeding.

Fields to be irrigated should be leveled, if necessary, before seedbed preparation, to eliminate pronounced low spots where water might accumulate.

When subsurface moisture is low on loose seedbeds, packing with a roller before seeding is desirable.

Japanese barnyard millet requires a fine, firm, weed-free seedbed with abundant moisture close to the surface. Early plowing and subsequent thorough disking and harrowing are advantageous, especially where sod or manure is turned under. Thorough cultivation for weed control is desirable before planting because the seedlings do not compete with some of the rapidly growing weeds of the coastal region. On loose soils, packing with a roller before seeding may be desirable.

## Rodents and Birds

### Rodents

Rodent enemies of Sudan grass, millets, and sorghums generally start their depredations soon after the seed is planted by digging out and consuming the seeds or the newly emerged seedlings. Depredations often continue throughout the season, the larger rodents frequently destroying considerable areas. Eastern Oregon sections experience the greatest trouble, especially during years when ground squirrels are numerous. Fields near rimrock ledges may suffer from marmot or woodchuck damage. In western Oregon, Douglas ground squirrels, commonly called "gray diggers," are very troublesome.

Jack rabbits are at times destructive in eastern Oregon and are becoming more so in western Oregon. Field mice may do some damage to newly planted seed, and often become destructive to the bound and shocked material being saved for seed. Pocket gophers and moles are responsible for considerable underground injury as well as smothering and other damage caused by mounds. With the exception of the small ground squirrel and marmot of eastern Oregon, which usually go into hibernation during June and July, rodents are often destructive in some degree during the entire growing season.

Ground squirrels, jack rabbits, woodchucks, mice, and pocket gophers may be effectively controlled by the use of special strychnine baits. Poison baits should not be placed where domestic livestock can reach them. Moles can be controlled best by trapping. This method is also used effectively for pocket gophers. The Oregon State College Extension Bulletin 335 contains information about the control of rodents and other small animal pests in Oregon.

### Birds

Various kinds of birds are sometimes destructive to Sudan grass, millet, and sorghum plantings. Pheasants and quail may scratch the seeds out of the ground, causing thin or uneven stands, especially along fences or near brush cover. Crows and pheasants eat considerable numbers of seedling plants. Further damage by birds is mostly confined to ripening seed or bound and shocked seed crops. Black-birds, sparrows, quail, pheasants, and pigeons, both domestic and the wild band-tailed, often gather in large numbers to feed on these crops.

Control methods against bird depredation are generally expensive, time consuming, and of doubtful value, because crop consumption by birds is usually balanced by the good they do in consuming weed seeds and insect pests. Making the plantings at considerable distances from timbered, brushy, or waste areas minimizes the damage done by birds. To protect crops from damage by migratory birds, including band-tailed pigeons, ducks, and geese, growers should communicate with the regional office of the U. S. Fish and Wildlife Service, Portland, Oregon, or the nearest field office of this organization.

The growing of these crops to produce seed for fall and winter feed for upland game birds and waterfowl has received considerable attention during recent years. Sudan grass and proso millet are best adapted to higher lands and Japanese millet to low lands.



## Diseases

### Red spot

Red spot, or sorghum blight, is a bacterial disease affecting Sudan grass and other sorghums. It first appears on the leaves as red spots which gradually enlarge, resulting in death of the affected leaves. This disease has not been serious in Oregon. It is likely to be most prevalent during moist, warm growing seasons. No control methods are known, though plant breeders are attempting to develop resistant varieties.

### Smut

Kernel smuts attack sorghum, Sudan grass, and millets, causing the kernels to be replaced by masses of dark spores enclosed in gray-colored membranous sacs, which develop to a larger size than the normal kernels and which are partly enclosed in the glumes. These smut balls are usually broken when the seed is threshed. Kernel smut can be effectively controlled by seed treatment with New Improved Ceresan. The Ceresan treatment is easy to apply as it is used in the dust form. To avoid injury to the seed, treatment should be delayed until shortly before planting time. Forage and grain sorghum seed should always be treated before planting.

Head smut of sorghum destroys practically the entire seed head leaving a mass of dark spores. No control measures are known, but spread and subsequent infection may be lessened by destroying the infected heads as soon as they are discovered.

## Insects

### Cutworms

Sudan grass, millets, and sorghums are frequently injured by cutworms. The full-grown worm is from 1 to 2 inches long and a mottled or striped green, grey, or brown color, thick bodied and smooth. When uncovered in the soil the worm usually assumes a curled position. Cutworms are most active at night, usually remaining hidden in the soil during the day. They are particularly injurious to seedling plants, cutting them off just below or just above the surface of the soil.

For control of cutworms, the Department of Entomology of the Oregon Agricultural Experiment Station recommends the use of poisoned bran bait. A recommended formula is:

Coarse wheat bran .....	25 pounds
Salt .....	$\frac{1}{2}$ pound
White arsenic or paris green .....	1 pound
Sirup or brown sugar .....	1 pint
Water to make a crumbly mash	

The bran, salt, and arsenic or paris green are mixed thoroughly, and the sirup and water added. Too much water will make the mash sticky, and difficult to spread evenly. The bait is spread evenly over the field at 12 to 15 pounds per acre, as soon as a cutworm attack is evident. It has been generally thought that domestic animals and fowls should be kept off treated areas. Investigations conducted by Dr. F. E. Whitehead of the Oklahoma State Agricultural Experiment Station, reported in Bulletin 218 of that station, indicate it would be perfectly safe to permit domestic animals and fowls to have access to areas treated this way. Farmers' Bulletin 1691, U. S. Department of Agriculture, contains similar information.

That the addition of salt to cutworm baits is not essential but in some cases may act as a repellent is indicated by extensive studies reported by S. E. Crumb, Technical Bulletin 88, U. S. Department of Agriculture.

Fall or early spring plowing followed by frequent harrowing is sometimes helpful in cutworm control. Clean fallow ground has no food supply for cutworms, so they are unlikely to be numerous on such land.

### Grasshoppers

Sudan grass, millet, and sorghums sometimes suffer severely from grasshopper attacks. Eastern Oregon areas are subject to invasions of the migratory grasshopper. This species is not found west of the Cascade Mountains. The nonmigratory forms are often troublesome in the western part of the state.

Destructive grasshopper attacks can be successfully controlled with poison baits. The Oregon Agricultural Experiment Station recommends the following bran-mash formula:

Coarse bran .....	100 pounds
Sawdust .....	equal in bulk to 300 pounds of bran
Sodium arsenite (4 pounds material) .....	2 gallons
or Sodium fluosilicate, 16 pounds	
Water to make a crumbly mash .....	10-40 gallons
The amount of water to use depends on the moisture in the sawdust.	

The sawdust should be at least 2 years old, well preserved, and of low moisture content. Coarse material should be removed by sifting through a 1-inch mesh screen.

Too much water in the mash will make it sticky and impossible to spread evenly.

Spreading in the early morning at the rate of 4 to 5 pounds per acre is recommended.

Grasshopper control may be partly accomplished by fall plowing or disking close to fences and along ditches and roadsides, to destroy the eggs.

## Sudan Grass

### Description

Sudan grass is an annual belonging to the sorghum genus. The plant develops no rootstalks, stools freely, has slender, occasionally branching, rather stiff stems 4 to 6 feet tall, numerous soft leaves, and loose, open panicles. The seed is about the size of a small wheat kernel, oblong, brown colored, and completely enclosed in yellow to dark brown or purple, smooth hulls, which usually remain attached to the kernel after threshing.

### New varieties of Sudan grass

During recent years, much work has been done by experiment stations on improvement of Sudan grass. At present, seed of one improved variety, Sweet, is on the market in considerable quantities and its use is increasing rapidly. Experimental trials have shown that Sweet Sudan grass may produce 20 to 30 per cent more forage than ordinary Sudan grass in Oregon. It is also more palatable to livestock. Tift Sudan grass, another improved variety, is a heavy yielder of forage, but seed is as yet available only in small amounts. Both improved varieties mature seed later than ordinary Sudan grass, and consequently difficulty in harvesting often occurs in Oregon.

### Date of seeding

Sudan grass should not be seeded until the soil has become warm. This is usually about corn-planting time, generally between May 1 and June 15 west of the Cascade Mountains, and usually not later than June 1 in eastern Oregon. Planting should not be delayed after soil and air temperatures become uniformly warm. On unirrigated lands, rapid loss of soil moisture near the surface may result in low or uneven seed germination and poor stands.

When Sudan grass is grown for seed, late planting may result in loss of the seed crop, particularly in seasons of early fall frosts or rains.

### Rate and method of seeding

Sudan grass is usually drilled or broadcast at the rate of 25 to 35 pounds an acre. A grain drill set to sow 3 pecks of wheat to the acre will ordinarily sow 25 to 30 pounds of Sudan grass, though the rate may vary according to the type and condition of the drill. For making cultivated row seedings, some of the drill holes may be plugged to allow drilling the seed at the desired row intervals.

Drilling is more satisfactory than broadcasting because the seed is evenly distributed and can be planted at the depth where moisture

conditions are most favorable for germination. In general, more uniform stands result when the seed is drilled, with less possibility of loss of seed because of birds and rodents.

Seeding depth varies from  $\frac{1}{2}$  to 2 inches, depending on soil type and moisture conditions.

Sudan grass seed is sometimes of inferior quality in germination or purity or both. Good seed should germinate at least 90 per cent and have 98 per cent purity or better. Seed that has been hulled during threshing usually germinates well for one year after harvest if the germs have not been injured. The rate of seeding should be proportionately increased when germination is less than 90 per cent.

Impurities in Sudan grass seed are, other crop seeds, chaff, stems, dirt, and weed seeds. The most common weed seed is Johnson grass, the seed of which closely resembles Sudan grass. Johnson grass is a long-lived perennial that spreads rapidly by seed and rootstalks. Fortunately, it has not become a serious pest in Oregon, but is a menace in the warm irrigated sections of southern and eastern Oregon.

### Utilization as pasture

Sudan grass makes satisfactory pasture for cattle, horses, sheep, and hogs, and is proving to be valuable as a range plant for poultry, especially turkeys. It is increasing in popularity as a summer and early fall unirrigated pasture crop, principally in the Willamette Valley and west of the Cascade Mountains in southern Oregon. In regions of warm, dry summers, it is considered to have a higher carrying capacity than any other annual grass or legume.

Under favorable climatic conditions it makes a rapid growth and should be ready for pasturing in 6 to 8 weeks after seeding, or when the growth reaches a height of 6 to 7 inches. When continued warm weather brings on rapid growth, the crop should be closely pastured to keep it in a uniformly tender, succulent, palatable condition. When uneven stands, varying soil-moisture conditions, or undergrazing result in uneven pasturing and excessive trampling, clipping is often practiced to even the stand and stimulate new growth. After heavy irrigation or drenching rains, pasturing should be discontinued, or considerable damage may result from trampling.

When soil-moisture and temperature conditions are favorable, Sudan grass harvested early for hay or silage will produce considerable second growth that is usually used most advantageously for pasture.

Sudan grass that is short and dark green sometimes develops dangerous amounts of hydrocyanic acid, and when pastured by cer-

tain kinds of livestock, poisoning may result in considerable loss. Cattle, sheep, and goats are about equally susceptible. There have been reports of injury to horses from Sudan-grass poisoning, but no reports of injury to hogs or poultry.

Leaflet 88, U. S. Department of Agriculture, Bureau of Animal Industry, *Poisoning of Livestock by Plants that Produce Hydrocyanic Acid*, gives detailed information on this subject.

The Sudan grass pasture season varies from about 45 to 100 days. The longest seasons usually occur in southern Oregon and the shortest in unirrigated sections of eastern Oregon. In the Willamette Valley, 60 to 75 days is the usual period when the livestock load is not excessive. The number of livestock an acre of Sudan grass will carry varies widely. Under favorable conditions one acre should support 2 to 3 animal units during the pasture season. One animal unit is usually designated as either 1 cow, 1 horse, 7 sheep, or 5 hogs. Figure 3 shows heavy-producing unirrigated Sudan-grass pasture.

Average composition and digestible nutrients in green and dry forage of Sudan grass, millets, and sorghums are shown in Table 1.



Figure 3. Heavy-producing unirrigated Sudan-grass pasture.

### Soiling and silage

Sudan grass, because of its palatability while green, and its rapid recovery after cutting, is a satisfactory soiling crop. A soiling crop is one that is cut green, raked, and hauled immediately from the field for feeding. Under this system a forage crop on a given area of land usually produces more green feed than if the crop is pastured,



Table 1. AVERAGE COMPOSITION AND DIGESTIBLE NUTRIENTS IN GREEN AND DRY FORAGE OF SUDAN GRASS, MILLETS, AND SORGHUMS.

Forage*	Total dry matter	Digestible protein	Total digestible nutrients	Nutritive ratio	Average total composition				
					Protein	Fat	Fiber	N-free extract	Mineral matter
Sudan grass—green									
All analyses	25.7	1.4	17.7	1:11.6	2.0	0.6	8.5	12.8	1.8
Before or in bloom	23.2	1.6	16.0	1: 9.0	2.2	0.6	7.5	11.2	1.7
In seed	28.5	0.6	16.1	1:25.8	1.7	0.5	9.6	14.6	2.1
Foxtail millet—green	29.9	1.9	19.1	1: 9.1	2.9	0.8	9.4	14.3	2.5
Japanese millet—green	21.7	1.0	14.2	1:13.2	1.7	0.6	6.8	11.0	1.6
Proso millet—green	24.7	1.2	16.2	1:12.5	2.0	0.6	7.4	12.9	1.8
Sweet sorghum—green	24.9	0.8	17.3	1:20.6	1.5	1.0	7.0	14.0	1.4
Sudan grass—hay									
All analyses	89.2	4.3	48.5	1:10.3	8.8	1.6	27.9	42.9	8.0
Before bloom	89.6	6.7	45.0	1: 5.7	11.4	1.6	25.9	41.2	9.5
In bloom	89.2	4.7	51.7	1:10.0	8.4	1.5	30.7	41.7	6.8
In seed	89.5	2.5	50.2	1:19.1	6.8	1.6	29.9	44.4	6.8
Straw	90.4	3.3	44.6	1:12.5	7.1	1.5	33.0	42.3	6.5
Foxtail millet—hay	90.0	5.2	51.5	1: 8.9	8.7	2.8	25.5	46.4	6.6
Proso millet—hay	90.7	5.3	51.8	1: 8.8	8.8	2.5	21.3	52.2	5.9
Japanese millet—hay	86.5	5.1	47.3	1: 8.3	8.3	1.6	27.6	40.8	8.2
Sweet sorghum—dry fodder	89.2	3.6	52.7	1:13.6	6.4	2.5	25.8	47.3	7.2
Grain sorghum—dry fodder†	90.5	.....	78.7	1: 7.9	13.0	3.3	1.5	70.9	1.7‡

\* Feeds and Feeding—Morrison, Twentieth Edition.

† U. S. Department of Agriculture, Farmers' Bulletin 1764, *Growing and Feeding Grain Sorghums*.

‡ Ash.

but the labor required is greater. A soiling crop should be cut daily and only in amounts sufficient for the day. Fresh green forage spoils quickly when piled and allowed to stand.

The use of Sudan grass for soiling is chiefly restricted to small farms where pasture is limited. Because of the possibility of hydrocyanic acid poisoning, caution should be used in feeding green Sudan grass that has been injured by frost or severe drought.

The use of Sudan grass for silage is limited because the more commonly used silage crops generally give higher yields. When heavy rains make it impossible to cure Sudan grass hay or seed crops, the material may be saved by using it for silage. Sudan grass makes the best silage when the seeds are in the hard dough stage and is about equal to corn silage in feeding value although less palatable.

### Hay

Sudan grass, because of its medium fine stems and numerous soft leaves, is a satisfactory hay plant, approximately equal in feeding value to timothy, and palatable to horses, cattle, and sheep. It is not recommended as the only roughage in the ration. Feeding experience indicates that injurious effects rarely result from feeding good Sudan grass hay, there being comparatively little danger of poisoning when well cured and free from mold. A damp or moldy condition of hay increases the danger of poisoning.

Sudan grass should be cut for hay when the early heads reach the soft dough stage. At this stage it is usually considered to have a low hydrocyanic-acid content.

Hay is usually harvested with the mower, although sometimes the binder is used when the weather is favorable. The grass should be raked within a few hours after mowing and shocked when about half cured. It should be left to cure in the shock until the stems are sufficiently dried to permit stacking or putting under cover with safety.

### Seed

Sudan grass seed production in the Pacific Coast states is chiefly centered in the Sacramento and San Joaquin valleys of California. Production is increasing in the southern portion of the Willamette Valley and in the Rogue River and Umpqua valleys of Oregon.

On fertile soil Sudan grass produces fair to good crops, except during seasons when early fall rains or frosts occur. The upright panicles produce seeds freely and do not shatter badly, making harvesting comparatively easy. Soil for Sudan grass seed production should be reasonably uniform throughout the field so that the crop

will mature evenly. Seed that is immature when harvested is usually yellow in color and of low germination.

Close-drilled or broadcast seeding is recommended for seed production. Cultivated row plantings tiller so profusely that seed heads in all stages of development usually occur on the same plants, resulting in uneven maturity.

Sudan grass seeds so closely resemble those of Johnson grass that only experienced seed analysts are able to distinguish between the two. Separation cannot be made with any known seed-cleaning machinery. It is important, therefore, to use pure seed, particularly when growing the crop for seed production. When Johnson grass plants are found growing in a seed field they should be removed and burned. This applies particularly in southern and eastern Oregon as these areas more than any other Sudan grass-producing section of the state have a climate favorable to the growth of Johnson grass.

Harvesting of Sudan grass seed is usually done with the grain binder. As stems and leaves may be somewhat green at harvest time, and varying amounts of immature heads may be bound with the matured seed, it is advisable to put the bundles in loose, medium-sized shocks to allow free air circulations and rapid drying. When it is necessary to remove the crop from the field and stack it before threshing, there is danger of heating and molding, which may result in low seed germination. Threshing is done with the ordinary grain separator with the cylinder speed and number of concaves adjusted to prevent excessive seed hulling. It is usually necessary to reclean the seed before marketing or planting. Yields of seed vary from 400 to 1,200 pounds of clean seed per acre.

During recent years some Sudan grass seed has been harvested standing with combines. When this method is used the seed throughout the field should be uniformly mature and the seed dry. If not there is danger of the seed molding and heating with probable subsequent reduction in germination. Threshed seed that contains immature or moist seed should be dried immediately after threshing. Drying may be by artificial means or by spreading the seed on a tight floor or a canvas in a well ventilated place and stirring regularly until dry.

Sudan grass grown for seed should not be planted near sorghum fields because the two species cross readily.

### **Place in rotations**

Sudan grass is valuable because of its ability to produce a large amount of forage within a short time after seeding. Sudan grass for forage fits well into short rotations and is quite satisfactory as an emergency catch crop when other forage crops fail.

On some of the poorly drained soils in the Willamette Valley, most fall-seeded crops cannot be grown on account of excessive moisture during the winter. These soils cannot be worked until late spring, and may become quite dry in the summer. Fall-seeded crops that can endure the winter moisture, such as ryegrass, are not heavy forage producers during the dry part of the summer. On such soils Sudan grass can be grown with fair success for pasture and hay. Yields are not generally high because of rather low soil fertility.

### **Improvement in Sudan grass**

During recent years considerable work has been done by experiment stations on improvement of Sudan grass. At present, seed of two improved varieties, Tift Sudan grass and Sweet Sudan grass, is on the market in limited amounts. Preliminary experimental work indicates that as forage these improved varieties outyield ordinary Sudan grass. Also they appear to be somewhat more palatable, especially in the fresh condition. Both mature seed later than ordinary Sudan grass, and consequently harvesting difficulties may be encountered in Oregon. Acclimated early strains of these new varieties may develop to make seed production more certain.

## **Proso**

### **Description and varieties**

Proso is an annual grass having erect or semierect, coarse, hollow, round, or slightly flattened hairy stems 1 to 4 feet in height, comparatively few wide, hairy leaves well distributed on the stem, and loose, open, drooping panicles. The seed is enclosed in hard, shiny hulls of varying color, which remain attached to the seed after threshing, unless threshing is very close.

Several well-known varieties varying in seed color, plant height, and time of maturity are in use. The most common varieties in Oregon are: Early Fortune, an early, yellow-seeded variety; Red Russian, an early variety with dark orange seeds; and White French, a late-maturing, tall variety with white seeds.

### **Date of seeding**

Proso may be seeded a few days earlier than Sudan grass but planting in cold soils is likely to result in poor stands and slow growth. West of the Cascade Mountains, seedings are usually made between May 1 and June 15. In eastern Oregon, plantings should be made from April 15 at the lower altitudes, to June 1 in the higher elevations. Late planting may result in late seed maturity with consequent possible loss of the seed crop.

### Rate and method of seeding

The seeding rate is ordinarily 35 to 50 pounds an acre. On soils with good summer moisture, the heavier rate is generally used. In eastern Oregon, where soil moisture is limited, proso is sometimes planted in cultivated rows 18 to 24 inches apart.

A grain drill set to sow 2 pecks of wheat should seed about 35 pounds of proso per acre. Drilling is usually more satisfactory than broadcasting. The depth of planting may vary from  $\frac{1}{2}$  to 2 inches, depending on soil moisture.

### Utilization as pasture

Proso may be used occasionally for emergency pasture. The stubble often supplies a small amount of pasture after the seed crop has been harvested.

### Soiling and silage

Proso is of little value as a soiling crop. It matures rapidly and is not capable of long-sustained growth and quick recovery after cutting. The stems and leaves are hairy and rather unpalatable to live-stock.

Proso produces comparatively low yields of silage. When the crop is in danger of being damaged or lost on account of unfavorable weather, it may be utilized for silage with fairly satisfactory results.

### Hay

Proso is not a desirable hay plant because of its coarse hairy stems, lack of leafiness, and low yields. When it is to be planted for hay, a late-maturing variety such as White French or Yellow Manitoba is best.

### Seed

Proso is usually ready to harvest for seed when the upper half of the seed head is ripe. At this stage the leaves and stems are still green. Longer delay may result in considerable shattering. Proso may be harvested with a grain binder. The bundles should be put in long, narrow shocks to allow rapid drying of the green straw. Threshing is done with the grain thresher. Proso threshes easily and excessive hulling of the seeds often results from high cylinder speed and too many concaves. The crop may also be mowed and swathed. After drying it is threshed with a combine harvester equipped with a "pick-up" attachment. When the stems are very short, the crop must be mowed and raked, or pastured off by poultry, hogs, or sheep.



The market for proso grain is limited, and growers should arrange for markets for this seed before planting, or plan to feed the grain on the farm. Proso grain is a good feed for all kinds of live-stock, especially lambs, hogs, and poultry. Grinding or crushing is desirable except for poultry feeding.

Seed yields of several proso varieties grown at the Oregon Agricultural Experiment Station at Corvallis are shown in Table 2. Yields of 15 to 35 bushels of seed per acre are common.

Table 2. ANNUAL AND AVERAGE SEED YIELDS OF PROSO VARIETIES AT THE OREGON AGRICULTURAL EXPERIMENT STATION, CORVALLIS, FOR THE PERIOD 1932-1937.

Variety	Yields of seed per acre						
	1932	1933	1934	1935	1936	1937	6-year average
	<i>Bushels</i>	<i>Bushels</i>	<i>Bushels</i>	<i>Bushels</i>	<i>Bushels</i>	<i>Bushels</i>	<i>Bushels</i>
Red Russian .....	49.55	49.64	19.33	23.21	16.50	37.80	32.67
Turghai .....	46.42	44.82	17.60	21.07	13.74	38.07	30.29
Early Fortune .....	42.84	37.05	22.41	27.00	16.50	35.44	30.21
Black Voronezh .....	47.05	40.17	15.12	22.64	10.22	35.77	28.49
Yellow Manitoba .....	50.89	36.96	12.42	17.85	12.04	37.09	27.87
Kropf .....		35.35	17.01	24.32	11.93	32.76	24.27*
White French .....	33.48	28.57	11.31	19.46	6.93	21.80	20.32

Weights per bushel: proso, 56 pounds; barley, 48 pounds; oats, 32 pounds.

\* Five-year average.

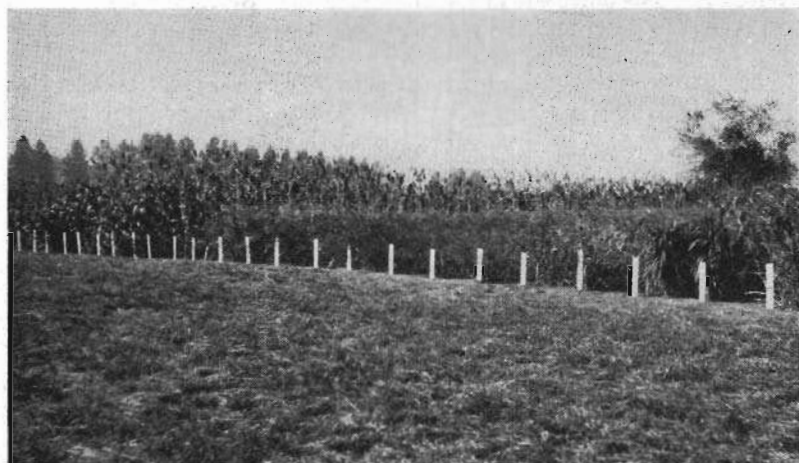


Figure 4. Proso millet nursery, Oregon Agricultural Experiment Station. Sorghum in background.

During the same period for which the yields of proso are shown in Table 2 the two most commonly grown spring grains in western Oregon, Hannchen barley and Victory oats, produced average yields of 29.92 and 50.65 bushels per acre respectively. Conditions under which these grains were grown and yields obtained were practically identical with those for the millets.

Figure 4 shows a nursery trial of proso varieties at the Oregon Agricultural Experiment Station.

### Place in rotations

Proso has no regular place in rotations under Oregon conditions, and is generally considered to be an emergency or catch crop. Ordinarily, the more commonly grown spring grains when planted at the right time and under favorable conditions outyield proso. The crop is satisfactory to plant after the spring-grain-seeding season has passed.

## Foxtail Millet

### Description and varieties

Foxtail millet is an annual grass having smooth, slender, erect or semierect, occasionally branching stems 2 to 5 feet tall, numerous broad, smooth leaves, and dense, cylindrical, nodding, somewhat bristly seed heads. It is from this latter characteristic that the plant derives its name. Foxtail millet resembles the wild green foxtail, or pigeon grass, but is considerably larger. The seed, in the head, is enclosed in thin glumes, which are removed in threshing, leaving the hard, distinctly veined hulls attached to the seed as in the case with proso millet and Sudan grass. Seed color varies according to variety. Most varieties have pale yellow seeds.

The best-known varieties in Oregon are Hungarian, with yellow to purple or black seeds; Kursk and Siberian, with pale orange seeds; and German, or Golden, with pale yellow seeds. Hungarian millet is the earliest maturing, followed by Kursk, Siberian, and German, in the order named.

### Date of seeding

Foxtail millet is usually seeded between May 10 and June 15 west of the Cascade Mountains and from May 1 to June 1 in eastern Oregon. Planting before soil and air temperatures have become uniformly warm is not advisable. Because of its more rapid growth and its use for hay, this crop may be seeded later than Sudan grass or sorghum.

### Rate and method of seeding

Foxtail millet is usually drilled or broadcast at the rate of 15 to 20 pounds an acre. Drilling is generally most satisfactory. On dry soils the rate of seeding may be reduced 5 to 10 pounds an acre, or the crop may be planted in cultivated rows 18 to 24 inches apart. When surface soil moisture is sufficient for good germination, shallow seeding at about  $\frac{1}{2}$  inch depth is desirable.

### Utilization as pasture

Foxtail millet is seldom grown for pasture. On soils having good fertility and moisture, it produces considerable pasture after the hay crop is harvested.

### Soiling and silage

Foxtail millet is not well adapted for soiling. The crop matures quickly and recovers slowly after cutting. It may be used for silage when the crop is in danger of spoiling during unfavorable weather.

### Hay

Foxtail millet is grown chiefly for hay and the best quality is obtained when the crop is cut between the full bloom and soft dough seed stage. Harvesting is usually done with the mower. During good haying weather, the crop may be mowed in the early morning and raked into windrows late the same day. Foxtail millet stems are comparatively fine and are easier to cure than Sudan grass. After curing sufficiently in windrows, it should be shocked and allowed to finish curing before removing from the field. Millet hay is very leafy, and well-made shocks shed light rains without much damage to the hay.

Continued feeding of foxtail millet hay to horses often causes digestive trouble.

### Seed

Foxtail millet is grown only occasionally for seed in Oregon. The crop is ready to harvest when the seed can be easily rubbed out by hand. Harvesting methods and precautions indicated for proso apply to foxtail millet. The threshed straw of foxtail millet is superior to that of proso for livestock feeding.

### Place in rotation

This crop, like proso, does not occupy a regular place in farm rotations in Oregon. It is not generally equal to Sudan grass for hay, but will produce a hay crop in a shorter time, and is sometimes used when the growing season is not long enough for Sudan grass.

## Japanese Barnyard Millet

### Description and varieties

Japanese barnyard millet is an annual grass resembling the weedy barnyard millet, or water grass. The plant stools heavily, has coarse, upright stems 3 to 5 feet tall, numerous wide, coarse leaves, and long, closely branching panicles that bear seed so densely as to resemble unbranched heads when observed from a distance. The seed is enclosed in hard, distinctly veined, awnless and almost spineless, brownish-grey hulls that usually remain attached to the seed after threshing. No distinct varieties of Japanese barnyard millet occur.

### Date of seeding

This crop grows slowly when seeded before the soil becomes warm. Early seedings may be seriously checked or smothered by weeds. In the southern coastal regions of Oregon, plantings are seldom made before May 1, and farther north seldom before May 10. When soil moisture is sufficient for seed germination, seedings may be made as late as June 15.

### Rate and method of seeding

On bottom and tidelands of high fertility, Japanese barnyard millet is usually seeded at the rate of 25 to 30 pounds an acre. Seeding at 20 to 25 pounds an acre is the general rate on less fertile upland soils. Seeding may be done by broadcasting or drilling. Broadcasting and covering with the harrow is almost as satisfactory as drilling, because the coast soils are usually well supplied with moisture at planting time. This seed should not be planted more than 1 inch deep.

### Utilization as pasture

Japanese barnyard millet may be utilized for pasture after cutting for summer green feed has been discontinued. Considerable pasture may be obtained during warm moist falls.

### Soiling and silage

Japanese barnyard millet is grown almost solely for soiling in Oregon, and under favorable conditions, produces good yields of palatable green forage.

The crop is ready to cut when 2 to 3 feet tall, at which stage the plants are very leafy. It is not necessary to wait until the plants are in head. Under good management, early plantings often produce a second cutting as large as the first. In the warmer sections, 3 cut-

tings may be harvested. Yields of green feed of from 12 to 20 tons per acre are commonly obtained on fertile soil.

It is seldom used for silage although it can be when there is no other use for it or there is danger of loss otherwise.

### Hay

Because of large stems and extreme leafiness, Japanese barnyard millet is difficult to cure for hay in the coastal and lower Columbia River regions.

### Place in rotations

Japanese barnyard millet may be used as a catch crop, but it can occupy a definite place in rotations, especially on dairy farms on the coast. As pastures are usually low in production on unirrigated lands of the coast area in August and September, this crop can be used for green feed during this period.

This crop has excellent possibilities as a food for migratory waterfowl when planted on the margins of areas dry in summer and flooded in winter. Since the ripe straw is tall and stiff it should not be planted where open water is desired. Figure 5 shows Japanese barnyard millet planted for waterfowl food on a swamp border.



Figure 5. Japanese barnyard millet planted for waterfowl food on border of swamp.



## Sorghum

### Description and varieties

Sorghum is an annual closely resembling corn in leaf and stem characteristics. The plant tillers freely, producing very coarse, smooth stems, 3 to 8 feet tall, usually covered with a waxy bloom, and having pith that is dry or juicy and sweet, according to variety. The leaves are wide, waxy, and smooth, and generally shorter than corn leaves. The seed is borne on upright, or occasionally nodding, spreading or dense panicles of varying sizes. Seed shape, size, and color vary widely. In some varieties the seed hulls are mostly removed in threshing.

Sorghums are usually divided into two groups: sorgos or sweet sorghums, used for forage and sirup, and grain sorghums, used for grain and forage. Two other groups are also often referred to, these being: grass sorghums (Sudan grass and Tunis grass), used for pasture and forage, and broomcorn, grown for its brush.

Many varieties of sorghum differing in plant characters and uses are available. Only a few are suited to Oregon conditions.

The most satisfactory sorgo or sweet sorghum varieties are Black Amber and Early Sumac. These are good all-purpose varieties, although the seeds of sorgos are somewhat bitter and may be objectionable for feeding to farm livestock other than poultry. Figure 1 shows Black Amber sorgo grown for forage on the Oregon Agricultural Experiment Station. Early Kalo and Kalo are grain-sorghum varieties which, under favorable conditions, produce good grain crops and are of some value for forage. Figure 6 shows low- and high-growing types of grain sorghum at Hermiston, Oregon.

### Date of seeding

Sorghum should not be planted until the soil is warm. Corn and sorghum planting dates usually coincide and are generally between May 1 and June 15 west of the Cascade Mountains and not later than June 1 in eastern Oregon. After soil and air temperatures have become uniformly warm, planting should not be delayed.

### Rate and method of seeding

Sorghums in Oregon have been most successful when planted in cultivated rows. Willamette Valley sorghum growers generally plant in rows 3 feet apart, with individual plants 12 inches apart in the rows. Such spacing results in good production when grown without irrigation for forage, seed, or sirup. Closer spacings are unsatisfactory in general unless irrigation is available, and when the

crop is to be grown for forage. In eastern Oregon, where sorghum is grown chiefly for grain, row and plant spacings are largely determined by the amount of moisture available. Row intervals vary from 3 to 4 feet, and plant spacings in the rows from 6 to 18 inches. For grain production, close planting is not conducive to highest yields.

Drilling may be done with a corn planter equipped with a special plate, or with a grain drill in which feed holes have been plugged to give the desired row spacing. Seeding rates vary from 6 to 12 pounds per acre. After the crop is started, the plants are usually thinned and spaced to individual plants.

Large-seeded sorghums may be planted deeper than small-seeded varieties. Planting depth should not exceed 3 inches. Shallow seeding is better unless the seedbed is dry and loose.

### Utilization as pasture

Sorghum under Oregon conditions is seldom used for pasture. Fall pasturing for the purpose of utilizing any late growth that may occur should be practiced with caution on account of the danger of hydrocyanic acid poisoning.



Figure 6. Low- and high-growing types of grain sorghum, Hermiston, Oregon.

## Soiling and silage

Sorghum has little or no value in Oregon as a soiling crop. For silage it is sometimes of considerable value in warm, dry sections where irrigation water or the natural moisture supply is insufficient for successful corn production.

Sorgo or sweet sorghum is generally more satisfactory than grain sorghum for silage. There is apparently little difference in feeding value.

Sorghum is ready to harvest for silage when the seeds become hard. Silage made from immature sorghum is usually sour and of inferior keeping quality. Under Oregon conditions, particularly in the Willamette Valley, early-maturing varieties such as Black Amber and Early Sumac will mature to the silage stage in most seasons and produce good yields.

Sorghum for silage is handled similarly to corn. The corn binder can be used satisfactorily.

Yields of green forage for a number of sorghum varieties grown at the Oregon Agricultural Experiment Station at Corvallis are shown in Table 3.

Table 3. ANNUAL AND AVERAGE YIELDS OF GREEN FORAGE IN TONS AN ACRE AND SEED IN BUSHELS AN ACRE FOR SORGHUM VARIETIES ON THE OREGON AGRICULTURAL EXPERIMENT STATION, CORVALLIS, DURING THE PERIOD 1932-1934.

Variety	Yields per acre							
	1932		1933		1934		Averages	
	Forage	Seed	Forage	Seed	Forage	Seed	Forage	Seed
	Tons	Bushels	Tons	Bushels	Tons	Bushels	Tons	Bushels
Black Amber sorgho .....	8.48	12.60	8.88	14.25	8.40	.....	8.59	13.42
Dakota Amber sorgho .....	6.40	9.32	7.85	11.16	6.80	.....	7.02	10.24
Early Sumac sorgho .....	.....	.....	7.15	13.25	8.00	.....	7.57	13.25
Kalo .....	9.20	14.30	8.90	16.00	8.88	.....	8.99	15.15
Early Kalo .....	.....	.....	7.00	12.16	6.80	.....	6.90	12.16
Modoc Pink Kafir .....	12.40	6.25	8.40	6.25	8.00	.....	9.60	6.25
Dwarf Freed .....	10.66	5.60	12.15	6.20	10.80	.....	11.20	5.90
Dwarf Kafir .....	14.26	2.50	10.72	5.65	9.60	.....	11.52	4.07
Day Milo .....	7.84	8.45	7.75	8.30	7.36	.....	7.65	8.37
Feterita .....	15.36	2.75	12.26	.....	10.96	.....	12.86	2.75
Grohoma .....	6.76	.....	5.84	.....	.....	.....	6.30	.....

Blank spaces in seed-yield columns indicate that the varieties failed to mature seed. Grohoma was not grown in 1934.

## Hay and fodder

Sorghum makes satisfactory hay only in regions where close seedings are successful. In Oregon, dried sorghum forage is utilized in the form of the more or less coarse-stemmed fodder. The sorgos or sweet sorghums, because of the sweet juice in the stems, are generally better fodder crops than the grain sorghums. Sorghum

is ready to harvest for fodder when the seeds are mature. Immature sorgho is difficult to cure because of the juicy stems. Only the early-maturing varieties can be satisfactorily cured during most seasons.

Sorghums may be harvested by hand with corn knives, or with a corn binder. The cut material is tied into bundles when cut by hand. Curing in loose round or long shocks in the field is generally practiced. West of the Cascade Mountains, the cured fodder should be put under shelter.

There is usually considerable waste in feeding sorghum fodder. Shredding reduces waste, but only extensive growers and feeders are justified in purchasing shredding equipment.

### **Seed**

Most of the sorghum seed produced in Oregon is used for feeding on the farm and very little is used for seeding purposes.

Sorghum seed is ready to harvest when it is fully colored and beginning to harden. It is usually headed in the field by hand either before or after the stalks are cut. Machine-harvesting methods include the use of a modified grain header, the one-row sorghum header, the corn binders, or the combined harvester and thresher.

Sorghum grain may be threshed with an ordinary grain separator. Excessive cracking of the seeds should be avoided by removing part or all of the concave teeth and running the cylinder at approximately two-thirds speed, as for wheat. Broken sorghum seeds may heat and lose their quality rapidly in storage. Many growers feed the unthreshed sorghum heads with satisfactory results.

Sorghum varieties and Sudan grass cross readily. Fields to be used for the production of seed for planting should be isolated from other sorghum varieties and Sudan grass.

Seed yields of a number of sorghum varieties grown on the Oregon Agricultural Experiment Station at Corvallis are shown in Table 3.

### **Sirup**

United States Department of Agriculture Farmers' Bulletin 1389 gives complete information on the culture and varieties of sorghum most satisfactory for sirup, and its manufacture.

### **Place in rotations**

Sorghum may be used as a catch crop when other plantings have failed. In the drier, warmer sections of Oregon, sorghum may be used as the cultivated crop in rotations in place of corn.

There are some disadvantages connected with the growing of sorghum. The crop rather completely exhausts soil moisture and

fertility, which may be a detriment to succeeding crops especially in the drier areas. The fibrous root system of sorghum holds soil very tenaciously, causing it to turn up cloddy when plowed and increases the amount of work necessary to develop a good seedbed. The soil usually receives little organic matter from a sorghum crop because most of the above-ground growth is removed. For these reasons, sorghum is not considered a satisfactory crop for rotations. Much of the difficulty may be overcome by following sorghum with a spring application of manure or commercial nitrogenous fertilizer, and a spring-planted crop. Fall seedings following sorghum are generally unsatisfactory on lands of moderate or low fertility and poor tilth.