

Growing Millets for Grain, Forage or Cover Crop Use

Millets are diverse and broadly adapted crops but also a source of some confusion for both farmers and consumers. The term millet actually covers a wide range of agriculture plants from around the world, all of them grasses. Millets are sometimes considered cereal grains, but differ from the more well known cereals in a couple of ways. Common cereal grains such as wheat, rye, barley, and oats grow best in the cooler weather of fall and spring while millets are warm season plants that do best in the heat of summer. Two exceptions to this seasonal growth pattern are the cereal grains corn and rice, which like millets are warm season plants. Millets also differ from other cereal grains by having small, rounded seed while most cereal grains have the elongated, pointed seeds familiar from wheat or rice grains. The cool season winter cereal grains originated in the Middle East and were commonly used in Europe for thousands of years before spreading to other parts of the world. Millets are from many parts of Asia and Africa, but most have not been used in Europe, with the exception of proso and foxtail millet. The primary millets addressed in this publication are listed in Table 1.

Table 1. Millet common and scientific names and centers of origin.

Common name	Scientific name	Center of origin
Pearl millet	<i>Pennisetum glaucum</i>	African Sahel zone
Foxtail millet	<i>Setaria italica</i>	East central Asia
Proso millet	<i>Panicum miliaceum</i>	Central and east Asia
Japanese millet	<i>Echinochloa esculenta</i>	Southeast Asia
Browntop millet	<i>Urochloa ramosa</i>	Southeast Asia
Finger millet	<i>Eleusine corocana</i>	East central Africa

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Figure 1. Various millets grown by the author in Missouri: foxtail millet on the left, proso millet in the center, and pearl millet on the right. (Photo credit: R. Myers)

Although the scientific name and the most common U.S. name is provided above, most of these crops are known by multiple common names, which will be provided in the sections later in this publication on each crop. If you ever order seed of one of these millets, be sure to order exactly what you want – if you go in asking for millet and expecting pearl millet, you may get something completely different like proso millet. Foxtail millet in particular is sold under many names in the U.S., such as Italian millet or German millet.

A few other grasses harvested for seed are sometimes referred to as millets. Sorghum (*Sorghum bicolor*), a common crop in the U.S. also known as milo, has been called the “great millet” in Africa, where it originated. Job’s Tears (*Coix lacryma-jobi*), also referred to as adlay millet, is from southeast Asia where it grows as a perennial, but it can be grown as a summer annual in temperate regions. The seeds grow in a hard, rounded fruiting shell, or caryopsis, about the size of a pearl that is often strung together for necklaces or prayer beads. White fonio (*Digitaria exilis*), sometimes called hungry rice, is grown in West Africa and is occasionally lumped in with millets, despite its much smaller seed. Teff (*Eragrostis tef*) is another small-seeded African grain that is sometimes loosely grouped with the millets, mainly because it’s an African grass crop. Additional details on sorghum and teff are provided near the end of the publication.

In this publication, both the grain and cover crop uses of these millets will be discussed, and where relevant, their use for forage or other economic uses. Some basic information on growing each millet are also provided, including in tables on seeding practices.

Before going into the specific characteristics of each millet, a few general observations about these crops may be helpful. First, knowing where they originated gives some idea to where their best fit for various growing conditions. For example, proso millet, being from the colder parts of central and east Asia, is best adapted to cooler areas of the U.S. with short growing seasons. Japanese millet, from Southeast Asia, is tolerant of hot humid summers and wet conditions, and thus is popular for wildlife planting in creek bottoms or other wet conditions. Pearl millet, from the African Sahel, a low rainfall area, tolerates dry conditions but also hot and humid conditions, and thus is popular in the southeastern U.S. and southern Plains.

All millets were domesticated millennia ago for seed harvest, with the primary use of the seed being for human food. Thus, all are edible and all are still used for human food in their regions of origin and other areas. However, in terms of current U.S. consumption, only proso millet has any significant use as a food grain. Most of the millets in the U.S. have been used more as forage plants for livestock than as grain crops. More recently, some of the millets have been sold for wildlife plantings and for cover crop use, particular as part of cover crop mixes. Foxtail millet and pearl millet are the two with the greatest popularity for cover crop use, while Japanese millet probably leads among millets used for wildlife.

While all millets are minor crops in the U.S. compared to major commodities like corn and soybeans, elsewhere in the world they are important crops. Pearl millet, for example, is grown on over 70 million acres worldwide, an area larger than all the wheat fields combined in the U.S. Even some of the smaller-acreage millets are important food crops in their primary growing regions. As a result, all the millets exist in the form of multiple varieties in their home regions, though relatively few of those varieties have been tested in the U.S., and an even smaller number are available in the U.S. seed industry. This creates an opportunity for further testing and evaluation of various millet varieties to see what is best adapted to a given region.

As a group, the millets in the U.S. have been underutilized. Given their ability to tolerate tough growing conditions, they deserve greater consideration. Certainly they have a potential role as part of an effort to diversify cropping systems, whether as a grain, forage, cover crop or for other conservation use. Humans selected and domesticated these plants because of their valuable characteristics and most have been used for

thousands of years. However, they also have limitations, particularly because there is little industry support in the U.S. for millets. Only pearl millet and proso millet have had much in the way of U.S. variety development efforts, and those have been regionally focused with proso developed for the High Plains and pearl millet varieties primarily developed in the south. Few herbicides or pesticides are labeled for millet use, and even those that are labeled are usually restricted to proso and/or pearl millet. Crop insurance and commodity program support are not available with the exception of crop insurance for proso millet in limited portions of the High Plains. Markets for millets are limited, but a creative and persistent person can find ways to sell most of the millets. Yields are generally modest, and with transportation costs to market being an issue, profitability as a grain can be low.

General observations on millets as cover crops

The millets as a group do not have an extensive history of use as U.S. cover crops, with the slight exception of foxtail millet. However, the rapidly growing interest in cover crops, including diverse mixes of covers, has brought new attention to several of the millets as potential covers. Foxtail millet remains in use a summer smother crop in vegetable systems, while pearl millet has gained regular use in summer cover crop cocktails. Others millet species are sold less frequently as covers but still show up as options for custom cover crop mixes, particularly where farmers and other land managers seek to attract wildlife or achieve a high level of biodiversity in their cover crop cocktails.

Knowing about the biology of each species and their preferred growing conditions can help make decisions about which millets to use for particular cover crop situations. Table 2 provides some summary information, while additional details are provided in the “cover crop use” sections below for each millet species. Some general tips on using millets for cover crop use are as follows:

For optimum biodiversity: Combine one or more millets with legumes and other grasses and broadleaves. A diversity of plant species from different families and of different plant heights and growth characteristics will best support a diversity of soil organisms and offer more potential for helping support wildlife and/or pollinators and other beneficial insects. Having both a flood-tolerant plant like Japanese millet and a drought-tolerant plant like foxtail millet can increase the odds of the cover crop mix doing well in a variety of rainfall conditions.

For quick cover: Foxtail millet is perhaps the best choice for a fast-growing summer cover, but all the millets are relatively good in this regard. Proso millet

Table 2. Height, biomass, moisture requirements, and typical U.S. growing regions for various millet species.

Common name	Typical height, biomass amount	Soil conditions, regions
Pearl millet	Grain-types: 4 feet, medium biomass Forage-types: 6–7 feet, higher biomass	Dry to moderate moisture Southeastern U.S., south and west of Corn Belt
Foxtail millet	3–4 feet, medium biomass	Dry to moderate moisture Eastern two-thirds of U.S.
Proso millet	3 feet, low to medium biomass	Dry conditions High Plains and other parts of Western U.S.
Japanese millet	4 feet, medium biomass	Moderate to high moisture Southeast to central U.S.
Browntop millet	4 feet, medium biomass	Moderate to high moisture Southeast to central U.S.
Finger millet	4–5 feet, medium biomass	Low to moderate moisture Adaptation in U.S. not well known but okay in central U.S.

is fast maturing but lacks in biomass compared to the other covers, at least through most of the Corn Belt and southeastern U.S. In the semi-arid High Plains, proso becomes a more viable option for quick cover. Japanese millet is a good fast-growing smother crop in higher moisture situations.

For maximum biomass: For most row-crop regions, forage-type pearl millet provides the most biomass compared to other millets. In fact, the only things that might out-produce forage-type pearl millet for mid-summer biomass are sorghum-sudangrass or some of the forage/biomass sorghum varieties (silage-type corn also produces a lot of biomass where rainfall is adequate, but in the case of cover cropping, corn is not normally used since it's already part of most crop rotations).

For dry conditions: All the millets can tolerate relatively dry conditions, but the best are pearl and proso millet, followed by foxtail millet. Pearl millet seems particularly tolerant of sandy loam or sandy clay loam soils with a dense fibrous root system.

For hot, humid regions: Pearl, browntop, and Japanese millet are the best fits here. Finger and foxtail millet can be used, while proso millet would be a poor choice in hot humid areas, such as the southeastern U.S.

For wet soils, such as creek bottoms: In locations where soils are frequently wet or shallow flooding may occur, Japanese millet is the best choice. However, Japanese millet will be killed if completely submerged in floodwaters for an extended period.

For waterfowl: Japanese millet is particularly sold for areas intended to support ducks; browntop millet may also have some value for waterfowl but is less tolerant of flooding.

To attract and support songbirds and non-waterfowl game birds: Proso, foxtail, and pearl millet are the species best known for attracting songbirds. All of the millets can and will be eaten by at least some bird species, but more research is needed on the attractiveness of the less common millets for feeding various types of birds in the U.S.

For nutrient management and soil health: Unfortunately, we don't yet know which of the millets contributes most to helping with nutrient management or other soil health factors, such as stimulating soil mycorrhizae. More research is needed on these species for their cover crop merits in terms of specific soil health factors. However, it's certain that using any millet as a summer cover is better than using no cover crop where fields would otherwise be bare in mid or late summer.

Pearl millet

Of all the millets, pearl millet has been most extensively used in southern states like Missouri. Other names it is occasionally called include bulrush millet or cattail millet (due to the somewhat similar appearance of the grain heads to cattails). It is the most vigorous of the millets in terms of plant height and biomass, making it competitive with weeds and able to produce a significant amount of biomass. Most of the pearl millet varieties sold in the U.S. are intended for forage use, having been bred for high biomass, good palatability for cattle, and tolerance of southern U.S. growing conditions. A moderate number of forage varieties are available. In the last few decades, a more modest effort has existed to develop a few new grain varieties of pearl millet as semi-dwarf plants with high seed yield. To get maximum yield, hybrids have been developed, meaning that new hybrid seed needs to be purchased every year

from the seed dealer rather than saving seed for planting. None of the other millet species aside from pearl are sold as hybrids.

Grain crop use: After a few grain-type pearl millet hybrids were released in the 1990s, there was hope that pearl millet could gain traction for U.S. grain harvest, with the primary end use expected to be for poultry feed. Despite good agronomic characteristics, including drought tolerance and the semi-dwarf stature well-suited to combine harvesting, pearl millet grain-type varieties have not gained much use. The yields of these grain hybrids has not been quite high enough to displace sorghum or especially corn. In the future, pearl millet may yet have a role for certain soil and climate situations in the U.S. as a grain. Internationally, its use as a grain crop in Africa continues and it has gained acceptance in other hot, dry areas of the globe. Pearl millet does have good qualities as a grain, including higher protein than corn.

Forage use: As a forage, pearl millet continues to have a fair degree of popularity. It is similar to using sorghum-sudangrass. Both of these crops are fast growers that provide forage in the heat of summer. Sorghum-sudangrass has the advantage of typically higher biomass, but the pearl millet is considered a safer forage to feed beef cattle, with no danger of prussic-acid poisoning to livestock, unlike sorghum-sudangrass. However, for lactating dairy cows, it is advisable to monitor butterfat levels which may be affected by the pearl millet, and if need be, reducing the percentage of the pearl millet forage fed in the diet.

Cover crop use: Pearl millet is not commonly used in a solid stand for cover crop use, but does get planted as part of mixes. The forage type would normally be sold as a cover crop due to wider availability and greater biomass. In a mix it plays the same role as sorghum-sudangrass, providing a vigorous warm season plant that produces more biomass than most of the other species in the cover crop “cocktail.” As a cover crop, the longer growth period of pearl millet is sometimes a benefit in situations where it is preferred to have longer vegetative growth, such as for grazing, and to avoid seed production on the cover crop plant before fall frost.

An example of a mix of warm season cover crops would be pearl millet, sorghum-sudangrass, sunflower, sunhemp, cowpea, and buckwheat. Often a few cool season cover crops are also added to the mix, such as radishes, clovers, oats, or winter cereals. Among the species listed, pearl millet, sunflower, and buckwheat would be the ones likely to provide seed by fall that songbirds and some game birds could eat.

Birdseed use: The seed from pearl millet, especially the higher-yielding grain types, has some potential as a food for songbirds. Goldfinches in particular

are attracted to the seed heads, which look similar to cattails. Entire seed heads can be hand cut and bundled together, such as a half-dozen each, and marketed as novelty bird feeders than can be hung on a fence or shed. The larger but less premium market is bulk seed for bird feeders. The author was part of an effort to send pearl millet seed to various birdseed packagers for evaluation in the early 2000s. Their reaction was that the grayish-brown appearance of the seed didn't excite them compared to other seed options, such as reddish sorghum seeds, white proso millet, yellow ground corn, and of course black sunflower. They felt that birdseed mixes with pearl millet would not particularly catch consumers' interest; the birds are presumably unconcerned about seed colors, but songbirds don't get to buy the birdseed!

Foxtail millet

Although soybeans made their way from China to the U.S. and became one of our two most widely grown crops, foxtail millet is another Chinese crop that has received considerably less attention in the U.S. After Chinese crops started spreading around the world, foxtail millet was found a home in some European countries because it could mature quickly in the short European summers. In the process, foxtail millet became known by several other common names such as German millet, Hungarian millet, Italian millet, Siberian millet, etc. This confusing mix of common names has perhaps held back some awareness and acceptance of foxtail millet in the U.S. For example, a seed dealer may offer both German millet and Italian millet in a way that implies they are different crops but in fact they are the same species.

The most commonly used name of “foxtail” millet is probably not too appealing to some farmers because of the name similarity to common summer weeds of field crops such as green foxtail and yellow foxtail. Indeed, foxtail millet is a cousin of these weeds, being part of the same genus but different species. Fortunately, foxtail millet does not have any weedy characteristics since it is a fully domesticated crop developed for human food use. It does not have hard seed that persist in the soil for years, unlike the weedy foxtails. Foxtail millet is easily grown in many parts of the U.S., planted with a grain drill and harvested for grain with a regular combine or with forage harvesting equipment for livestock feed. It also has good suitability for cover crop use in selected situations, particularly where a fast-growing summer cover is needed.

Grain crop use: While foxtail millet is a very acceptable food grain grown in many countries for food use, it has in the past gotten little attention for grain harvest or food use in the U.S. With greater interest in

multigrain food products, there may be more of a market for foxtail millet grain going forward. Though only a few varieties of foxtail millet are available in the U.S. market, there are significant differences in the characteristics of those varieties, and yield differences can be expected depending on location and growing conditions. Thus, some testing of available varieties is recommended to see which performs best for a given area. Seeding rates for foxtail and other millets are listed in Table 3.

Markets for foxtail millet grain are limited in the U.S. Despite the edible nature of foxtail millet grain, it seldom finds its way into the U.S. food market. The grain can be fed to livestock but little work has been done to evaluate it for livestock feed. Primary existing uses for harvested foxtail millet seed to people wanting the seed to plant as a forage crop. Likely cover crop seed sales will be an additional opportunity going forward.

Forage use: Foxtail millet has been used as a hay forage crop for decades in the western U.S., especially the western part of the Grain Plains. While it is considered a minor forage in terms of importance, it does provide the benefit of being a fast-growing summer option that can produce a hay crop without irrigation, unlike perennial irrigated alfalfa that often is used in some of the same areas where foxtail millet may be grown. As a hay, it's highly palatable, but the limitation is that generally only one or two cuttings may be obtained, unlike with perennial forages that may provide multiple cuttings (assuming adequate soil moisture from rain or irrigation). Foxtail millet and proso millet are generally considered the two species of millets easiest to make into hay.

As with other millets, caution is in order when weather stress, such as from drought, can make nitrates accumulate that are toxic to livestock (testing the hay is advised if nitrates are a concern). Foxtail millet hay should not be fed as a major portion of horse hay because it contains a glucoside that can affect horse organ and bone health; it can also act as a laxative to horses.

Cover crop use: The most extensive use of foxtail millet as a cover crop has been in vegetable systems. It has fit in well as a fast-growing summer cover that can create a nice mulch layer when mowed down or roller-crimped after seed heads have started to form. Most often, it's used after early season vegetables are harvested in June. The foxtail millet can be grown during the summer to suppress weeds and provide some soil protection/improvement until fall vegetables are ready to be planted.

With wider use of cocktail covers, both by vegetable and grain farmers, it's likely that foxtail millets will be used some in those mixes. Particularly for people wanting to provide a beneficial plant for songbirds or

Table 3. Millet seeding rates and primary U.S. markets.

Common name	Seeding rate*	Primary U.S. markets
Pearl millet	Grain varieties: 3–5 pounds/acre Forage varieties: 10–15 pounds/acre	Grain for poultry feed forage for cattle
Foxtail millet	15–20 pounds/acre	Forage and pet birdseed
Proso millet	12–20 pounds/acre	Birdseed and human food
Japanese millet	10–20 pounds/acre	Wildlife plantings
Browntop millet	10–20 pounds/acre	Forage and wildlife plantings
Finger millet	10–15 pounds/acre	Forage

*Note that all the millets except pearl millet are normally planted with a grain drill in narrow (6 to 8 inch wide) rows. Pearl millet is more commonly planted on 15 to 30 inch rows. If used in a mix of cover crops, seeding rates should be proportional to the amount of millet seed in the mix. Most of the millets need warm soil temperatures of typically 70 degrees F. or more for seed germination, so are normally planted in the latter half of May or early June depending on the growing region; proso millet can tolerate cooler temperatures and can be seeded when soil temperature is 55 to 65 degrees F. If millets are used as a summer cover crop, planting can be mid-summer after an early season cash crop is harvested, such as wheat, potatoes, or spring greens. Maturity varies with foxtail, proso, Japanese and browntop millet being the fastest maturing types (60-90 days depending on planting date and variety and weather), and with pearl and finger millet being more intermediate in maturity (roughly 100 to 110 for seed harvest). Proper time for harvesting millets for hay varies by species.

game birds, foxtail millet has merit in a mix because of its relatively fast seed production and appeal of the seed for birds. Foxtail millet will work well with other mid-height summer covers such as buckwheat and cowpeas. If used with bigger plants such as sunflowers and sorghum-sudangrass, it's best to keep seeding rates low for those larger species so they don't completely shade out the smaller covers.

Birdseed use: One of the novel uses of foxtail millet is harvesting of the whole heads as a birdseed "spray" sold for caged birds such as parakeets. Other birds will eat foxtail millet, so it could be used in birdseed mixes sold for songbirds, but this has been rarely done due to limited availability of foxtail millet seed in the market.

Proso millet

When millet is listed as an ingredient on the label of a food product in the U.S., such as multigrain bread, the type of millet is almost always proso. Even though all the other millets discussed here were domesticated for human food and are perfectly edible, for a variety of reasons, only proso millet has had any significant food use in the U.S. Proso does have good functionality for food use, and is used in both whole seed and puffed or cracked forms, and also ground into flour and used in baked goods such as artisanal breads. Despite its use in a variety of human food products, its biggest market is for birdseed, almost always mixed with other birdseeds including sunflower and sorghum. Proso is a crop of the High Plains, particularly Colorado, western Nebraska, and South Dakota.

Grain use: The main use of proso millet is for seed or grain harvest. As described above, with most seed being for either human food or whole seed birdfood, delivering good quality seed is important for producers. A number of varieties are available and detailed production information is available through university extension publications such as from University of Nebraska.

Forage use: Proso millet has had more value for grain harvest than as a forage, but it has occasionally been used as a forage. Although its biomass production potential is limited, the drought tolerance and relatively fast growth of proso make it an option for hay production in northern moisture limited areas of the High Plains.

Cover crop potential: To date, proso millet has not seen significant use as a cover crop. Compared to the other millets, it has the least amount of biomass and is a shorter plant overall. However, it may have a role as in drought-tolerant mixes of summer annual cover crops, including where people want to provide some seed attractive to songbirds or gamebirds. As with any of the other millets, just adding biodiversity to a cover crop cocktail mix can pay benefits for supporting a wider range of below ground soil organisms.

Japanese millet

Japanese millet, also known as barnyard millet or billion-dollar grass, is well adapted to much of the eastern U.S. It tolerates heat and humidity well and can tolerate periodically wet soils or shallow flooding (provided part of the plant remains above water). It has been used in the U.S. both for forage and wildlife planting, particularly to attract and support ducks, but it also has potential for human food and cover crop use. Japanese millet is not likely to become a weed issue in upland fields, but in wet areas, including rice fields, does have some potential to show up as a volunteer weed, so thought should be given on where to plant it.

Forage use: Whether in creek or river bottoms or upland sites, Japanese millet can make a suitable hay crop or can be directly grazed. Relative biomass production will vary depending on soils and climate, but generally Japanese millet produces the second highest amount of biomass among the millets after pearl millet. It has a little better potential for regrowth than some of the other millets, provided the cutting is done earlier enough, such as by 36 inches, and at least 6 to 10 inches of stem height is left for regrowth. Adequate soil moisture for regrowth will be needed. In a University of Minnesota trial, Japanese millet had more crude protein after one cutting (14.1 percent) than pearl, foxtail, or proso millet, and after multiple cuttings (16.6 percent) was comparable to pearl millet and sudangrass. In the Minnesota trial, biomass harvested was 3.5 dry tons per acre with one cutting and a total of 5.0 tons with multiple cuttings.

Cover crop use: Best uses for Japanese millet as a cover crop are where soils tend to be wet or where feed for waterfowl or other birds is desired. However, due to reasonably vigorous growth, Japanese millet can also be used as a single species cover in upland sites to smother weeds; one study found a dense stand of Japanese millet was effective in reducing yellow nutsedge weed population. Another trial found that Japanese millet worked well in mixes with cowpeas. In general, Japanese millet is a viable option for mixes, especially to help support wildlife and provide diversity of plant types that can respond to different soil moisture conditions. Farmers can also consider growing Japanese millet seed for cover crop (or wildlife) seed sales.

Wildlife use: A significant market for Japanese millet in the U.S. is currently the wildlife market. Some studies indicate that Japanese millet is a preferred food source not only for ducks and other waterfowl but also turkey and doves. It is also eaten by pheasants and a variety of songbirds. In flooded situations, ducks and other waterfowl may be able to strip the seeds directly off the seed heads. Generally the seed heads will persist longer than most of the other millets. Songbirds may also feed directly on the seed heads by landing on the stems. For groundfeeding birds like pheasant, turkey, quail, and doves, it may be helpful to mow down the mature Japanese millet plants to better scatter the seed on the ground. While Japanese millet can be used in either upland or flood prone sites, if used in the latter situation, it's best to plant it before flooding occurs.

Browntop millet

Like Japanese millet, browntop millet is also from Southeast Asia and is tolerant of hot, humid areas. However, there are some differences, including that browntop is less adapted to wet soil conditions than

Japanese millet. The seed heads are also different, with browntop millet having more of an open panicle and Japanese millet having a narrower, elongated seed head. Browntop millet has white or light-colored seed and Japanese millet seed are reddish-purple.

Forage use: Browntop millet was brought into the U.S. from India in the early 1900s to grow as a forage crop, a use that continues in the southeastern states. It is lower yielding in forage biomass than other summer forages such as pearl millet or sorghum sudan, but is a fast growing hay crop for situations where quick production is needed. There is potential for excess nitrates if the crop is grown in drought or cold situations, so that should be monitored for hay or grazing use.

Cover crop use: Vegetable growers have used browntop millet occasionally as a cover crop in the southeastern U.S. One reported use is between tomato or pepper crops to help control root knot nematodes. It is probably best suited to cover crop mixes on southeastern upland fields, as opposed to the wetter bottomland that would favor Japanese millet.

Wildlife use: Because browntop millet produces a large number of small edible seeds (as with other millets), it has been used some for attracting and supporting wildlife. One study showed morning doves eating browntop millet as a significant fraction of their diet. It is reportedly eaten by many other game species, including deer, ducks, turkeys, quail, and pheasants.

Finger millet

This crop gets its name from the way the seed heads look like fingers pointing upwards. When the seed heads are first developing, it looks like the several “fingers” of the seed head are pointing straight upwards like an open hand with the palm facing upwards. Then, as the seed head matures, the seed head fingers tend to curl inwards, like a hand starting to close. Finger millet is believed to have first been domesticated in the highlands of Ethiopia and/or Uganda. As an important food crop in parts of east Africa and India, finger millet is grown on an estimated 5 to 10 million acres worldwide. In India, finger millet is also called ragi or sometimes African millet. Unfortunately, because of its more minor status compared to crop such as corn (maize) and rice, finger millet has received very little research or development to advance it as a modern crop.

According to a report by the National Academy of Sciences (*Lost Crops of Africa*, published in 1996), finger millet is one of the most nutritious food grains available. The report cited particularly high levels of the essential amino acid methionine, which is low in cassava and plantain-based diets. Finger millet could be an important aid in battling malnutrition in additional

regions of the world. It also has a reportedly high acceptance as a food because of good taste qualities compared to other millets. Another reported benefit is its ability to be stored for many years without insect damage. Limiting factors to greater use of finger millet include modest grain yields and the significant effort involved with weeding the crop and harvesting it. In many of the traditional areas of finger millet use, it has been gradually replaced by corn or sorghum.

Finger millet is somewhat drought-tolerant, though not quite as drought-resistant as pearl millet or sorghum. It is adapted to moderately high elevations, generally grown at elevations between 3000 and 7000 feet in Africa and also uplands in India and Nepal.

Grain use: As a significant food source with a long history of use in parts of Africa and India and Nepal, finger millet has a variety of uses developed for its grain. Like the seed of most grass crops, it can be made into a porridge or ground into a flour for making flatbreads. It's also been used for yogurt and as with other fermentable grains, into beer. One of the novel uses is for malted products, including malted infant foods popular in India for their nutritional qualities. Some references mention finger millet (ragi) being used in hundreds of different recipes in India.

Cover crop use: Due to a lack of seed availability in the U.S., finger millet has received little attention as a cover crop to date. However, given its reasonably vigorous growth and tolerance of tough growing conditions, it may have merit for use in cover crop mixes. It should be particularly suited to areas at 2000 feet or more in elevation of the Western Plains.

Other grass crops sometimes referred to as millets

Sorghum (the “great millet”) originated in the same part of Africa as pearl millet and finger millet. Africa is still a major producer of sorghum, but the crop is also popular in many other regions of the world, including the U.S. Sorghum is used much more worldwide than the other millets, so perhaps the “great millet” term is deserved. It has small, rounded seeds that are similar to but a little larger than the other millets. It has also had far more research and development than all the other millets combined, particularly in the U.S. where it can be considered a “mid-major” crop, to use a sports analogy. Grown annually on 5 to 10 million acres in the U.S., it's found all along the southern and western edge of the Corn Belt. Basically, anywhere where soil moisture is limited by rainfall or soil type is where sorghum is usually found, provided it's hot enough. Sorghum is not currently used as far north as corn. Sorghum needs

plenty of summer heat and plenty of time for fall dry down to reach harvest readiness.

Rather than trying to address here the large amount of information available on sorghum, the reader is referred to a number of excellent sorghum production guides available on the Internet from various university extension programs or the United Sorghum Checkoff program. The main points to keep in mind are:

- Sorghum varieties are diverse, from semi-dwarf grain types to tall forage sorghums and even taller biomass or bioenergy sorghums. There are also “broom-corn” types and types used for making sorghum syrups from the sugars in the stems. This range of plant types creates some opportunities to use sorghums in different ways as cover crops as well as their existing uses for grain and forage. More use of sorghum for bioenergy may also be feasible in the future, based on promising research done to date at a number of U.S. locations.
- Sorghum is a drought-resistant crop that can tolerate a range of soil types from clay to light-textured sandy loams, but has its best competitive advantage compared to other grass crops on moisture-deficient soil or lower rainfall areas, similar to pearl millet.
- Most grain-type sorghums have been bred to have high levels of tannins in the seed as a way of discouraging birds from eating them. Low tannin sorghum varieties are preferred when used in wildlife food plots and may be desirable for some cover crops use.
- Sorghum has been hybridized with sudangrass to create sorghum-sudan, a vigorous summer grass used as both a forage and for cover crop cocktail mixes.

Among the minor African “millets,” teff has gained interest in the U.S. in the last two decades. Like many alternative grain crops domesticated for making food elsewhere in the world, teff is being grown primarily as a forage in the U.S. There is a very small amount grown for grain, but nearly all is grown as a hay crop, particularly for horses given its palatable nature and high quality as a hay. Teff is fast-growing but also short in stature and quick to maturity, so as a cover crop its main potential would be as a quick summer cover for a couple of months.

Fonio and Job’s tears, the other minor crops referred to earlier in this publication, are not readily available in the U.S. seed industry, greatly restricting any potential to use them as cover crops. However, they’ve been grown successfully by the author in Missouri, and may have potential in mixed cover crop stands if affordable seed supplies can be developed in the future.

Marketing millets

Seed markets

When considering any millet for seed harvest, markets should be identified before planting, as it may be challenging to find a buyer. Transportation cost is a major consideration, as delivery points for the grain may be several hundred miles away if conventional markets are pursued.

The current markets for seed of specific millets were described above, but as with any crop, additional markets could be developed by people with entrepreneurial skills. Continued expansion of cover crop acreage may be creating opportunities to grow one or more types of millets for cover crop seed sales. However, doing some small acreage test production for a year or two and then lining up markets before planting any significant acreage is strongly recommended. Development of new markets for bird seed sales or even human food products are possible. Interest in ancient grains and gluten-free grains has been growing, and millets are not only gluten-free but typically marketed as ancient grains (the reader is advised that “ancient grains” is a vague and inconsistently applied marketing term and not a precise scientific term).

Forage and hay markets

On-farm use of millets for grazing, silage, or hay eliminates the question of finding a market. However, if excess hay is produced beyond farm needs, it may be possible to find a market, particularly if other forages are in short supply. Since millet hay is unfamiliar to many buyers, getting the hay tested and having information on feed value and forage quality will be essential to getting full value from selling millet hay. Just as teff has found some high-end markets for horse hay, it may be possible to custom market selected millet species for particular forage markets. Starting small and focusing on a good quality product is key to success in custom hay sales.

In cases where millets are stressed during growth, such as from drought or cold weather, it may be advisable to have a lab test for nitrate levels in the hay to avoid having toxicity problems with livestock. If moderate nitrates are found, ensiling the millet hay can help reduce nitrate levels, or the hay can potentially be restricted to a small percentage of the diet (be careful to make sure individual animals don’t get too much of the hay at one time). At very high nitrate levels (such as over 1.76 percent for any livestock or 1.54 percent for pregnant animals) the hay should not be used at all.

More information

The U.S. Department of Agriculture (USDA) Natural Resources Conservation Service has published online fact sheets on most of the millets discussed here. To find them, do a web search using phrases such as “USDA plants database Japanese millet.”

For detailed information on proso millet, search for “University of Nebraska proso millet,” and their

extension guides on proso production and varieties will be found.

For more details on pearl millet, search “University of Georgia pearl millet.”

Extension publications from a few other states are also available on various millets and can be found through a web search.