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NF91-35 Amaranth Grain Production in Nebraska

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Amaranth Grain Production in Nebraska

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Amaranth was a primary food for Central American Indians before Columbus arrived in the New World, but amaranth production was outlawed by the Spanish Conquistadors for political and social reasons. Introduction of the crop as a human food has been slow, but today it is produced and used as a grain or leafy vegetable in India, China, Southeast Asia, Mexico, the Andean highlands in South America, and the United States. The Nebraska Panhandle has become the most concentrated area of production of grain amaranth in the U.S.

Amaranth has several unique characteristics that justify its consideration as an alternative crop in the Panhandle and adjacent areas of the High Plains. The grain is high in lysine, well balanced in other amino acids, and has a protein content of 14 to 18 percent, making it excellent for human consumption. Amaranth has a C-4 photosynthetic pathway, making it a more efficient user of production resources than most broadleaf crops when grown under high temperatures and limited rainfall conditions.

Amaranth also has production and marketing disadvantages which producers should recognize. The major limitation to increasing production is its market. Products made from amaranth currently require production from approximately 3,000 acres of amaranth annually. To justify additional acres the market will need to be expanded. Successful amaranth grain production requires a good uniform stand which can be difficult to obtain because of its small seed size. Weed control is the biggest production problem because the only methods available use cultivation and rouging. Seed shattering and plant lodging can cause severe yield losses during the dry-down period following a freeze.

Amaranth grain is used in breakfast cereals, pancakes, soup, breads, cookies, and as an ingredient in confections. South Americans parch or cook it for a gruel or porridge, or mill it to produce a light-colored flour. The flour contains little or no gluten and must be blended with wheat flour so baked goods will rise. As a snack, the grain is popped and tastes like nutty-flavored popcorn. It can also be mixed with honey. Amaranth leaves are high in protein, vitamins, and minerals and can be boiled and eaten as greens. Special leafy varieties have been developed and better suit this use than the grain types, like Plainsman, which are currently grown in Nebraska. The largest amaranth grain consumer is the health

food industry where organic and transitional production carry a market premium.

Amaranth can be ensiled for emergency livestock feed and the grain can be used for livestock feed after grinding. The limited acres and high unit value restrict its practical use by the livestock industry.

Plant Characteristics

Amaranth is bushy with thick stalks. It is a relative of pigweed and is similar in many respects. Several species and types show considerable variation and potential. Plant height ranges from three to nine feet. Predominantly self-pollinated, plant flowers are purple, red, pink, orange, or green. Grain amaranth varieties are being developed from *Amaranthus caudatus*, *A. cruentus* and *A. hypochondriacus*, and hybrids of these.

Grain-type seed colors are white, tan, gold, or pink. The plants are indeterminate but tend to have a dominant seedhead with fewer side branches than weedy amaranths. Many amaranths are sensitive to day length, which is useful in developing varieties.

Yield Performance

Grain yields in Nebraska have been variable, primarily because of stand-establishment problems, weed control, and hail. Testing at the High Plains Ag Lab near Sidney, Nebraska resulted in yields of 0 to 2,000 pounds per acre depending on variety and year. An average yield for the past 3 years is 700-800 pounds per acre. Seed shattering resulted in grain losses estimated as high as 50 percent with some varieties in 1990.

Production and Marketing Tips

Selection of variety and seed source.

There are a limited number of varieties of amaranth. Rodale Research and The American Amaranth Institute have several lines that have been made available to growers without formal release, but currently only Amont and Plainsman are available through certified seed channels.

Amont is an *A. cruentus* type selected for uniformity of flower and seed color from Montana-3. Plainsman is a selection from the hybridization of *A. hypochondriacus* by *A. hybridus*. It is generally earlier maturing than the Montana germplasm and was released jointly by the University of Nebraska and the Rodale Research Institute in 1991. Plainsman yields have been more stable and higher on the average than Amont when tested in Nebraska. Both varieties are tall and susceptible to lodging under irrigation or high rainfall. Current breeding efforts emphasize semi dwarf types.

It is important to use a seed source with as few black seed as possible to prevent excessive black seed at harvest. Certified seed should have less than 0.02 percent black seed.

Planting depth.

The optimum planting depth varies with soil type, but may range from 1/4- to 1-inch deep. Amaranth requires good seed-soil contact for rapid germination and emergence, and adequate soil moisture must be maintained at the seeding depth throughout initial establishment.

Planting date.

Amaranth is a warm-season crop. Optimum conditions for germination occur when soil temperatures at the seeding depth reach 65 to 75° F. The normal planting date is from late May to early June (similar to sorghum). Amaranth planted in late June tends to be shorter in height, with lower yields and may not mature before frost, but is less susceptible to lodging. Amaranth planted early has been found to be more competitive with weedy amaranth (pigweed).

Planting rate.

Stand establishment is a major production problem. Amaranth seed is small with varieties adapted for Nebraska having approximately 850,000 seed per pound. Most producers use a 1/2 to 2 pound per acre planting rate and expect 40 to 60 percent total emergence. The two-pound rate usually results in a higher plant population and reduced plant height and head size, and it allows a quicker dry-down. It also reduces lodging but increases drought stress. A planting rate lower than 1/2-pound per acre may be satisfactory if planting equipment can evenly space seeds at the proper depth.

Modifying planting equipment to plant low rates is difficult and experimenting may be necessary to attain the desired planting rate. Air seeders designed for vegetables such as carrots work well. A sugarbeet planter with small plates, a standard grain drill, or using insecticide in-furrow applicators on a row crop planter will work for planting amaranth. When planting with insecticide boxes, a 1/2-inch deep furrow should be opened and half of the seed should be placed at the 1/2-inch depth, with the other half being placed at or near the soil surface. If there is a hard rain, the seed near the soil surface will be driven into the soil and germinate. If there is no rain the amaranth at the 1/2-inch depth should germinate with adequate moisture. A tube should be used to drop the seed from the insecticide box to a point about three inches above the furrow in between the disc opener and the packer wheels. Under extremely windy conditions, the seed may be blown away from the furrow even though drop tubes are used.

Fertility.

Most producers apply little or no fertilizer to amaranth or they manage it as they would wheat. Nitrogen promotes vegetative growth which can result in lodging especially under irrigation. Therefore, only small amounts should be applied (20 to 40 pounds per acre). Manure is used to stay within the guidelines of organic production.

Diseases.

Although there have been no major disease problems seen in amaranth production, *Alternaria* and *Pythium* have been associated with damping-off in seedlings and root-rot, respectively. Virus symptoms have been observed in the Panhandle, but not identified at this point.

Insects.

Several insect species damage amaranth including the flea beetle, amaranth weevil, tarnished plant bug, and lygus species. Flea beetles attack young, succulent plants and can cause serious damage. The tarnished plant bug damages the crop by feeding on the immature grain, resulting in discolored, shriveled seed. Amaranth weevil larvae bore into the root and stem. Weakened plants then allow entrance of disease organisms, resulting in lodged plants. No insecticides are labeled.

Weed control.

For many producers, weed control is their biggest problem. Because herbicides are not presently

available for weed control in amaranth, weed control is accomplished with cultivation or hand weeding. For those producing amaranth for the organic market, a herbicide would not be used even if available. Many producers would like to produce amaranth in narrow rows but when first starting should plant amaranth in rows wide enough to permit cultivation. Avoid fields with heavy weed populations, especially pigweed and lambsquarters. Rotary hoeing may break the crust for the amaranth and can also be used for weed control when weeds are in the "white stage". Amaranth is planted shallow and could be easily uprooted by the rotary hoe. One to two cultivations for weed control are usually used because amaranth is slow in establishing.

Harvest and storage.

Amaranth can be combined directly and the grain separated successfully after stems and leaves are dry. A row crop head reduces harvest losses. Due to high moisture in the stem and leaves, amaranth plants do not dry well enough to allow regular harvest until after a frost. The crop should be harvested as soon as possible after a freeze (usually about 10 days) to reduce grain loss from shattering. If harvested before the stems have dried, grain may stick to the wet material and be lost or unsuitable for storage. However, amaranth has been harvested before a killing frost at 18 percent moisture with little harvest loss and then forced air dried to 12 percent moisture. The combine cylinder speed should be set at approximately 570 rpm with a concave setting of nearly 3/4 inches, and the fan should run at 500 rpm. Although the grain is extremely small, both the sieve and chaffer should be open 1/2-inch. To aid in removing trash from the amaranth, a 1/8-inch wire mesh may be attached to the top of the sieve.

For safe storage, the grain moisture level should be 10 to 12 percent. It is important to monitor grain moisture content. Plant material mixed with the grain will cause mold to develop, making the grain unsuitable for human consumption. If the grain contains excessive vegetative material it must be cleaned before storage.

Markets.

Establishing stable access to a market for amaranth grain will be the major limiting factor for most producers. Some food processors, breakfast cereal companies, and health food stores have shown interest, but each producer will have to contact potential markets individually.

Producers will need to participate more actively in marketing the crop than with more traditional crops such as wheat. Contracting the crop before planting is the only way to insure a market. Several growers have made profits growing amaranth, but a limited increase in acreage could flood the market. The size of the amaranth market is growing however, most buyers are increasing contract acreage with proven quality producers rather than increasing the number of individual contracts. Prices may range from $0.30 to $0.70 per pound.

Other management tips.

Amaranth is a crop that has potential in Nebraska. The American Amaranth Institute, Box 216, Bricelyn, MN 56014, and the University of Nebraska Cooperative Extension have additional information available on marketing and production practices.

File NF35 under FIELD CROPS
F-2, Miscellaneous Crops

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