Grain Amaranth

By James P. Shroyer, William D. Stegmeier and Merrel Mikesell

Grain amaranth belongs to the pigweed family and is a potential alternative crop for Kansas. Amaranth was a basic food for Central American Indians before Columbus' arrival. Today amaranth is produced and used as a grain or leafy vegetable in India, China, Southeast Asia, Mexico, and Andean highlands in South America.

Amaranth has advantages which make it a unique crop:

- The grain is high in lysine and contains a protein content of 14 to 18 percent, making it suitable for human and animal consumption.
- It is drought tolerant and suited to areas where grain sorghum and millet are grown.

Amaranth has disadvantages which producers should recognize:

- It has stand-establishment problems due to its small seed.
- There are few adapted varieties.
- Harvest must be delayed until a killing frost dries foliage.
- Seed shattering and lodging can be severe.
- There are no major markets.

Uses

Amaranth grain can be used in breakfast cereals or 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 glutens and must be blended with wheat flour so baked goods will rise. As a snack, the tiny grain is popped and tastes like nutty-flavored popcorn, or it is mixed with honey. The leaves which are high in protein, vitamins, and minerals are boiled and eaten as greens.

Plant characteristics

Amaranth is bushy with thick stalks, similar to native weedy species. Several species and types show considerable variation and potential. Three amaranth species grown for grain as human food and from which varieties are being developed are *Amaranthus caudatus, A. cruentus,* and *A. hypochondriacus*. Several species are grown as a leafy vegetable and for cooked greens. Plant height ranges from 3 to 9 feet tall. Predominantly self-pollinated, plant flowers are purple, red, pink, orange, or green.

Seed colors of the grain types are white, tan, gold, and pink. The plants are indeterminate, but tend to have a dominate seedhead with fewer side branches than weedy amaranths. Many amaranths are sensitive to day length, which is useful in developing varieties.

Research results

Grain yields in Kansas have been variable, primarily because of stand-establishment problems. Preliminary testing at Fort Hays Branch Experiment Station in 1985 with 6 varieties indicated yields of 1,200 to 2,000 pounds per acre, with a test average of 1,600 pounds per acre. Seed shattering resulted in grain losses of 1,000 pounds per acre with some varieties.

In another study on bottomland (Roxbury silt loam) and upland (Crete silty clay loam) soils, 2-year yield averages were 760 and 700 pounds per acre, respectively (Tables 1 and 2). Plant heights were 62 and 75 inches, and lodging was severe on both soil types.

Cultural practices

Planting depth. The optimum planting depth is dependent upon soil type, but may range from ½ to 1½ inches deep. Amaranth seed is small (600,000 to 1 million seeds per pound) and needs good seed-soil contact for rapid germination and emergence.

Planting date. Amaranth is a warm-season crop. Best germination occurs when soil temperatures range from 65 to 75 degrees. The normal range of planting dates is May to early June. Amaranth can be planted after grain sorghum planting but soil moisture may become a problem. Late planted amaranth tends to be shorter with lower yields and may not mature before frost. Early planted amaranth has been found to be more competitive with weedy amaranth.

Planting rate. Stand establishment is a major production problem. Most producers use a ½ to 1 pound per acre planting rate and expect 40 to 60 percent germination and emergence. This rate may result in a high plant population but it reduces plant height and head size, and allows a quicker dry-down. A planting rate lower than ½ pound per acre may be satisfactory if planting conditions and planting equipment can evenly space seeds at the proper depth. Modifying planting equipment to plant low rates is difficult and considerable experimenting may be necessary to attain the desired planting rate.

Fertility. Most producers apply little or no fertilizer to amaranth or they manage it as they would grain sorghum. Nitrogen promotes excessive vegetative growth which causes lodging; therefore, only small amounts should be applied (20 to 40 pounds per acre).

Diseases. Although there are no major disease problems in amaranth, *Alteranaria* and *Pythium* are suspected to be potential problems. *Pythium* causes damping-off as the seedlings emerge, and *Alteranaria* causes root rot.

Insects. Several insect species have caused damage to amaranth. These include the flea beetle, amaranth weevil, and tarnished plant bug. 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.

Harvest. Amaranth can be combined and the grain separated successfully if plant material is dry. Due to high moisture in the stem and leaves, amaranth plants do not dry sufficiently to allow harvest until a frost. The result is yield losses from shattering. The crop should be harvested as soon as possible after a freeze to minimize grain loss. If harvested before the stems have dried, grain will stick to the wet material and will be lost.

For safe storage, the grain moisture level should be l0 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 amounts of vegetative material. it should be cleaned and/or dried prior to storage.

Markets. Establishing a market for amaranth is probably the major limiting factor. Some food processors. breakfast cereal companies and health food stores have shown interest, but each producer will have to contact potential markets individually. Rodale Press in Kutztown, Pennsylvania, and local growers are contacts for exploring potential markets.

Amaranth is an interesting crop and has potential in Kansas if markets can be established. Producers interested in amaranth should plant only small acreages until comfortable with its production requirements and until a suitable market has been found.

Table 1. Agronomic results of grain amaranth cultivars planted on Roxbury silt loam, Fort Hays Branch Experiment Station, 1986 and 1987.

	Grain yield (lbs. per acre)			Plant height (inches)			Lodged plants (%)		
Cultivar	1987	1986	2-year Average	1987	1986	2-year Average	1987	1986	2-year Average
1011	996	494	745	70	78	74	75	72	74
K266	531	772	651	62	71	66	85	75	80
K283	851	815	833	60	80	70	82	82	82
K277	570	790	680	79	73	76	90	80	85
1023	466	907	686	63	75	69	90	62	76
K243	995	—	—	52	—	—	82	—	—
K366	634	—	—	45	—	—	92	—	—
K254	—	813	—	—	76	—	—	70	—
K343	—	976	—	—	67	—	—	70	—
1046	—	844	—	—	77	—	—	55	—
Test average	720	801	760	62	75	—	85	71	—
LSD 5%	173	150	—	10	NS	—	10	NS	—

Table 2. Agronomic results of grain amaranth cultivars planted on Crete silty clay loam. Fort Hays Branch Experiment Station, 1986 and 1987.

	Grain yield (lbs. per acre)			Plant height (inches)			Lodged plants (%)		
Cultivar	1987	1986	2-year Average	1987	1986	2-year Average	1987	1986	2-year Average
1011	790	568	679	70	78	74	40	45	42
K266	952	690	821	62	71	66	48	80	64
K283	1017	553	785	60	80	70	78	80	79
K277	518	341	430	79	73	76	62	68	65
1023	919	417	668	63	75	69	55	52	54
K243	1316	—	—	52	—	—	58	—	—
K366	935	—	—	45	—	—	50	—	—
K254	—	583	—	—	46	—	—	30	—
K343	—	539	—	—	38	—	—	58	—
1046	—	152	—	—	58	—	—	85	—
Test average	921	480	700	62	75	68	56	62	59
LSD 5%	212	NS	—	10	NS	—	21	25	—

References

Amaranth Grain Production Guide-1989. Rodale Research Center. Rodale Press, Inc. Kutztown. PA.

Amaranth: Modern prospects for an ancient crop. 1984. National Research Council. National Academy Press, Washington, D.C.

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