

soils, application of Zinc sulphate at the rate of 12.5 kg per hectare or foliar application at the rate of 0.5% at 30 and 60 DAS increases grain yield by 15-20%. Substitution of 50% N equivalent FYM + 50% N equivalent Bio-digester Liquid Organic Manure (BDLM) results in higher grain yield as compared to application of chemical fertilizer alone.

Thinning of seedlings: It is compulsory to maintain spacing of 15cm between plants within the row. For this, thinning of the excess seedlings at 25 - 30 days after sowing is critical. The seedlings removed through this thinning process can be used as green leafy vegetable which would fetch some income to the farmer.

Inter-cultivation & Earthing up: Intercultivation operation between rows should be completed before 25-30 days of sowing. Later, earthing up should be provided to put more soil to the base of the plant to ensure crop does not lodge at grain filling stage and harvesting stage.

Weed Control: Weeds compete with the crop for space, light, nutrients, and moisture and can cause considerable loss if not controlled in time. The period between 20-50 days after sowing has been observed to be critical for crop weed competition in grain amaranth. Weed control at early stage i.e. before earthing up should be done for better crop growth. Therefore, one hand weeding at 25 DAS followed by intercultural operations is recommended for effective weed control.

Water management: Grain Amaranth is mostly grown as rainfed crop during *Kharif* season. However, when grown during *Rabi* season, it has been found to respond favorably to application of irrigation. Depending upon soil conditions about 3-4 irrigations are adequate to realize potentiality of the crop.

Plant Protection: Pest and disease are not serious in grain amaranth. As a precautionary measure, neem oil or Dimethoate at 2.0 ml per litre water to control sucking pests. Similarly, Chloropyriphos at 2ml per litre of water is suggested to control defoliators.

Suitable intercropping systems: Amaranth is usually grown in crop mixtures. Mixing seeds of different crops and broadcasting may not give desired results. However, intercropping amaranth with finger millet (6:2), groundnut (6:1) and pigeon pea (2:1) have been found profitable.

How to use Grain Amaranth?

Grain Amaranth cannot be used directly, needs processing before use. Four different processing types are as follows

1. **Milling:** The grains are milled and flour is mixed/ blended at 10-15% with any other commonly used flours like wheat, ragi, rice.

2. **Popping:** Popping increases palatability and flavor of the seeds. Grains are placed in hot pan and heated at 175-190°C for 15-20 seconds. By this process, the grains loose water rapidly and will pop up and become light. These popped grains can be used for preparation of laddus, chikkis, biscuits and other bakery products.
3. **Roasting:** Seeds are roasted at 70 - 80°C for 10 minutes. Roasted seeds are known to have more flavor and high digestibility.
4. **Sprouting:** Seeds are soaked in water for one hour and later water is drained off. Such soaked seeds are allowed to sprout and used for malt preparation.

FOR MORE DETAILS PLEASE CONTACT

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GRAIN AMARANTH / RAJGIRA - NUTRITIONAL IMPORTANCE,
IMPROVED VARIETIES AND CULTIVATION PRACTICES



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What is Grain Amaranth / Rajgira?

Grain Amaranth plants are fast growing, dicotyledonous belonging to the genus *Amaranthus*. The genus has more than 60 species of which some are grown for leaf purpose seeds of which are black in colour. Four species are grown for grain purpose, pseudo seeds of which are golden yellow in colour. The seeds are very nutritious and popularly called as 'Dantina Beeja' in Kannada or 'Rajgira' in Hindi. *Amaranthus* is native to the New World. Pre-Columbian civilizations grew thousands of hectares of this pseudo-cereal which was used along with maize and beans. The native Aztecs of South America relied on amaranth seeds as an important staple food. After Spanish invasion, maize crop with which amaranth co-evolved, was selected and developed into a major world crop. By the middle of 20th century, cultivation of Grain Amaranth had declined to the point where it was grown only in small plots in Mexico, the Andean highlands and in the Himalayan foothills of India and Nepal. After knowing the biochemistry of grain amaranth and its nutritional qualities, especially higher protein and lysine content, the crop started gaining importance and re-emerged as one of the Health Care crops in many countries including India.

How Grain Amaranth is nutritionally potential?

Amaranth grain contains 14-16% protein (Table 1) which is other commonly used cereals like Rice, Wheat and Maize have. The protein is of higher quality due to the presence of higher lysine, an essential amino acid (Table 2). Grain is also rich in Calcium, Phosphorous and Iron. The starch component of amaranth is distinctive; has high swelling power with a distinctive gel characteristics which has interest in specialized food and industrial applications. Amaranth grain contains 6 to 10% oil, which is predominantly unsaturated oil (76%) and is high in linoleic acid which is necessary for human nutrition. Amaranth oil was found to have 7% Squalene, a high priced material, used in cosmetics and pharmaceutical industries. Thus, Grain amaranth is a high potential crop for human

Table 1: Nutritional Value of Grain Amaranth in comparison with commonly used important cereals (per 100g)

Food grain	Protein (g)	Carbohydrates (g)	Lipid (g)	Crude fibre (g)	Mineral matter (g)	Calcium (mg)	P (mg)	Fe (mg)
Grain Amaranth	16.0	62.0	8.0	2.43	3.0	490	600	17.5
Rice	6.7	79.0	0.3	0.2	0.3	45	100	3.5
Wheat	12.0	69.0	1.7	1.2	0.7	41	306	5.3
Maize	11.0	66.0	3.5	2.7	1.1	10	348	2.3
Barley	13.0	70.3	1.3	3.6	2.7	344	283	3.9

Table 2: Essential amino acid composition (g/100g protein) of Grain Amaranth in comparison to other cereals

Food grain	Lysine	Methionine	Cystine	Isoleucine	Leucine
Grain Amaranth	5.0	3.0	4.0	3.0	4.7
Rice	3.8	2.3	1.4	3.8	3.2
Wheat	2.8	1.5	2.2	3.3	6.7
Maize	2.9	3.4	3.4	4.1	13.0

How to grow Grain Amaranth?

Varieties:

- Suvarna:** This variety was developed and released in 1996 from UAS, Bangalore. This variety is tall growing (5-6 feet) with well developed stem and deep rooting capacity. Though, it grows tall it does not lodge. Earheads are light green in colour with 30-45 cm length. Seeds are golden yellow in colour. This variety matures in 85-90 days and yields about 12-15 quintals under rainfed and 15-18 quintals per hectare with protective irrigation.
- KBGA-1:** Another variety from UAS, Bangalore which matures earlier to Suvarna by 5-10 days (80-85 days). The plant is medium tall with purple colour earheads which gives an attractive look to the crop. Yield potential of this variety is 14-16 quintals under rainfed and 18-20 quintals per hectare with protective irrigation.
- KBGA-4:** This variety has been developed as superior to KBGA-1 which was used as check variety for comparison. This is medium maturing with 85-90 days of duration. The leaves are reddish green. Plant height is medium (135-145 cm) with straight compact and purple colour inflorescence. Seeds are small and golden yellow in colour. Grain yield potential of this variety is 16-18 q/ha under rainfed and 20-22 q/ha with protective irrigation.
- KBGA-15:** Newly developed Grain Amaranth variety superior to the KBGA-4. It matures in 95-100 days with a good plant height (170-180 cm) and inflorescence has double colour with pink mixed green. The variety is tolerant to leaf rust, phyllody, leaf spot diseases and insect pests. Yield potential is 18-20q/ha under rainfed condition and 22-24 q/ha under protective irrigation.



Suvarna



KBGA-1



KBGA-4

KBGA-15



Selection of site: Well drained soils with near neutral pH (6.5-7.5) are best suited for cultivation of grain amaranth. Amaranth being susceptible to acidic and alkaline conditions, soils and water affected by salts should be avoided for cultivation of grain amaranth.

Sowing time: Grain Amaranth can be grown in all the three seasons of the year, *Kharif* (June-July), *Rabi* (October - November) and in summer (January - February). However, crop sown during late *Kharif* (July - August) comes well compared to early *Kharif*.

Field preparation: Grain amaranth being a small seeded crop requires a fine seed bed to ensure proper seed soils contact and good germination. For this purpose, soil is turned with a mould board plough prior to onset of rains. This is followed by two to three ploughings and plankings on receipt of soaking rains. At the time of sowing, the filed must have fine grain structure, adequate moisture and should be free from weeds.

Seeds and sowing methods: 1.5 kg/ha seed is adequate for obtaining desired plant stand. As the seed is very small, it cannot be sown directly. Seeds are mixed with fine sand in 1:5 ratio and sown in 45 cm rows. Care should be taken that seeds are not sown very deep to ensure better germination.

Manures & Fertilizers: Approximately 7.5 tonnes of farm yard manure is applied per hectare just three weeks before sowing of the seeds. Recommended fertilizer dose is 60:40:40 NPK kg per hectare. At the time of sowing, 50% of recommended dose of nitrogen and entire dose of phosphorous and potash is applied. The remaining 50% of Nitrogen fertilizer is applied 30-40 days after sowing. In Zinc deficit