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DUS characterization of grain *Amaranthus* (*A. hypochondriacus*) for qualitative characters

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Abstract
The Amaranthus (*A. hypochondriacus*) is one of the prominent grain crop in India, diversely grown in different agro-climatic regions mostly in *rabi* season. Distinctness, Uniformity and Stability (DUS) characterization is a significant approach in identifying and evaluating diverse genotypes for quality seed production. Therefore, the present experiment was conducted during *rabi* 2022-23 at experimental research farm, Department of Agril. Botany, VNMKV, Parbhani to characterize and evaluate variation present in grain amaranthus through DUS descriptors. The qualitative and quantitative characters were tested for thirty grain Amaranthus genotypes. All thirty genotypes found differed for almost all qualitative characters *viz.* plant growth habit (Semierect, erect and drooping), leaf colour (pinkish, yellowish green, green), leaf width (narrow, medium and broad), inflorescence colour (yellowish green, pink and green), stem colour (yellowish green, pink and green), stem surface (ridged and smooth), inflorescence shape (globose, straight and semi drooping), inflorescence compactness (intermediate, dense and lax), inflorescence spininess (smooth and spiny) and seed colour (creamish, pale yellow).

Keywords: Distinctness, uniformity, quality seed production, qualitative traits, quantitative traits

Introduction
Grain *Amaranthus* belongs to the order Caryophyllales, family Amaranthaceae, sub-family *Amaranthoideae*, genus *Amaranthus* (Sauer, 1967) [4]. There are different types of species, *A. hypochondriacus* (prince's father) and *A. cruentus* (purple amaranth) which are commonly grown for grain and *A. tricolor* (tampala) grown primarily for vegetable purpose. *A. caudatus* (love-lies-bleeding) is third type of grain species, although is often grown more as an ornamental (O'Brien and Price, 1983) [3]. *Amaranthus* species are important food crops and are tolerant to heat, drought, diseases and pests (Shukla *et al.*, 2010) [8]. They grow in a wide range of agroecological zones and are found in most tropical and subtropical areas (Sauer 1967; Katiyar *et al.*, 2000; Schippers 2000) [4, 5].
Amaranth, a C_4 plant, is one of the few dicots in which the first product of photosynthesis is a four carbon compound. The combination of anatomical features in amaranth and C4 metabolism, results in increased efficiency to use CO_2 under wide range of climatic condition i.e. temperate and moisture stress environments. This contributes to the plant's wide geographic adaptability to diverse environmental conditions (Wyn. Williams *et al.*, 1985) [6]
Grain of the amaranth species is of high nutritional value. It has higher protein than other cereal grains and has significantly higher lysine content. It has more protein than maize, and the protein is of an unusually high quality (high in the amino acid lysine, which is the limiting one in cereals like maize, wheat and rice). The protein is also relatively rich in the sulphur-containing amino acids, which are normally limited in the pulse crops. The "protein complement" of grain amaranth is very near to the levels recommended by FAO/WHO. Amaranth grain consists of 6 to 10% of oil, which is higher than most other cereals. Amaranth oil contains approximately 77% polyunsaturated fatty acids which are mostly within the germ. Amaranth oil is predominantly unsaturated oil which is high in linoleic acid (about 50%), which is necessary for human nutrition.
The high nutritional value of *Amaranthus* seeds, functional potential, short life cycle, rapid growth, adaptability to unfavourable climate and soil condition, drought tolerance and the food use of the entire plant is the reason for increasing research interest in this pseudocereal. This is a food for future crop for many developing countries, particularly in drought-prone areas of Africa and Asia. However, genus *Amaranthus* consists of some of the troublesome invasive or noxious weeds of the world which are known to compete with many economic crops in different parts of the world resulting in great yield losses.

Hence, extensive research is required to choose between the good and bad Amaranths. Thus, the production of good quality seed is the challenging work for this crop as it is difficult to maintain the genetic stability. It is the need for future to increase the qualitative yield of *Amaranthus* for mitigating the nutritional need of increasing population. Keeping this view, the present investigation was carried out to morphologically characterize the grain *Amaranthus* genotypes according to DUS guidelines and to evaluate for yield and yield contributing characters.

Materials and Methods

The research work was conducted at experimental research farm, Department of Agril. Botany, VNMKV, Parbhani. during rabi 2022-2023. to study the growth, seed yield and quality of grain *Amaranthus* (*Amaranthus hypochondriacus* L.). The experiment consisted of thirty genotypes grown in Randomised Block Design with two replications. The observations were recorded on five randomly selected plants from each genotype in each replication and averages were worked out. The qualitative observations of grain *Amaranthus* was observed for plant growth habit, leaf colour, leaf width, inflorescence colour, inflorescence compactness, stem colour, stem surface, inflorescence shape, inflorescence spininess and seed colour as per the DUS guidelines developed by NBPGR-New Delhi.

Results and Discussion

Qualitative characters

The data on qualitative characters of grain *Amaranthus* are presented in Table 1 and 2. The genotypes IC-5569, IC-7930, IC-5621, IC-5917, IC-7436, IC-5916, IC-7220, IC-4201, IC-1493, IC-7924, IC-4202, IC-3599, IC-6646, IC-5576 showed erect type of growth habit whereas the IC- 1496, IC-4200, IC-7836, IC-6645, IC-7922, IC-5564, IC-7916 genotypes exhibited semi-erect type growth habit. The drooping type of growth habit was recorded in IC-5565, IC-1733, IC-7437, IC-1491, IC-385, IC-5627, IC-4207, IC-5994, IC-5575.out of the thirty genotypes fourteen were erect type seven were semi-erect type and nine genotypes showed drooping type growth habit. Maximum number of genotypes showed erect type growth habit. Similar observations were recorded by Williams and Brenner (1995) [7] in different grain *Amaranthus*. For leaf colour the genotypes IC-5569, IC-7930, IC-5621, IC-7436,IC-7836, IC-7922, IC-5564, IC-7924, IC-1733, IC-7437, IC-1491, IC-5576, IC-4207, IC-5575 showed green colour of leaf whereas yellowish green leaf colour was exhibited in the genotypes IC-5917, IC-1493, IC-4202, IC-3599, IC-6646, IC-7916. The purple colour of leaf was recorded in IC-1496, IC-4200, IC-5916, IC-7220, IC-4201, IC-5627, IC-5994. IC-6645, IC-5565, IC-385 genotypes showed pinkish leaf colour. Out of the thirty genotypes fourteen were green leaf colour six were yellowish green leaf colour eight genotypes showed purple leaf colour and two genotypes showed pinkish leaf colour. Maximum genotypes showed green leaf colour and only two genotypes showed pinkish leaf colour. Similarly, for leaf width the genotypes IC-5569, IC- 7930, IC-5621, IC-5917, IC-4200, IC-7436, IC-7836, IC-6645, IC- 5916, IC-5565, IC-7922, IC-4201, IC-5564, IC-1493, IC- 4202, IC-3599, IC-6646, IC-7916, IC-1733, IC- 7437, IC-1491, IC-385, IC-5627, IC-4207, IC-5994, IC-5575 showed medium leaf width. IC-1496, IC-7924 genotype showed narrow and IC-7220, IC-5576 showed broad leaf width. Twenty six genotypes showed medium leaf width were two genotypes showed narrow and two genotypes showed broad leaf width. Out of thirty genotypes maximum number of genotypes showed medium leaf width. for inflorescence colour the genotypes IC-5917, IC-7436, IC-7924, IC-4202, IC-3599, IC-6646, IC-7916, and IC-1733 showed yellowish green inflorescence colour whereas, IC-1496, IC-4200, IC-6645, IC-5916, IC-7220, IC-5565, IC-4201, IC-7437, IC-385, IC-5627, IC-5994 exhibited pink colour of inflorescence. The green colour of inflorescence was recorded in IC-5569, IC-7930, IC-5621, IC-7836, IC-7922, IC-5564, IC-1493, IC-1491, IC-5576, IC-4207, IC-5575. Out of the thirty genotypes, eight were yellowish green inflorescence colour eleven were pink and eleven were green inflorescence colour. Similar observations were also reported by Chatarmal and Kute (2013) [2] in grain *Amaranthus.* For stem colour the genotypes IC-5569, IC-7930, IC-5621, IC-7836, IC-7922, IC-5564, IC-7924, IC-1733, IC-7437, IC-1491, IC-5576, IC-4207 and IC-5575 showed green stem colour whereas the IC-5917, IC-7436, IC-1493, IC-4202, IC-3599, IC-6646, and IC-7916 exhibited yellowish green stem colour. The pink stem colour was observed in IC-1496, IC-4200, IC-6645, IC-5916, IC-7220, IC-5556, IC-4201, IC-385, IC-5627, IC-5994. Out of thirty genotypes thirteen showed green stem colour seven showed yellowish green and ten genotypes showed pink stem colour. Maximum number of genotypes showed green stem colour. The genotypes IC-5569, IC-7930, IC-5621, IC-5917, IC-7436, IC-7836, IC-7922, IC-1493, IC-7924, IC-4202, IC-6646, IC-7916, IC-1733, IC-7437, IC-1491, IC-5627, IC-4207 and IC-5575 showed smooth type of stem surface whereas IC-1496, IC-4200, IC-6645, IC-5916, IC-7220, IC-5565, IC-4201, IC-5564, IC-3599, IC-385, IC-5576 and IC-5994 exhibited ridged type of stem surface. Out of thirty genotypes eighteen were smooth and twelve were ridged stem surface. For inflorescence shape the genotypes IC-5569, IC-7930, IC-5621, IC-5917, IC-4200, IC-7436, IC-7836, IC-6645, IC-5916, IC-7924,IC-4202, IC-3599, IC-6646, IC-7916, IC-5576, IC-5994, IC-5575 showed straight type of inflorescence shape whereas the IC -1496, IC-5565, IC-7922, IC-4201,IC-5564, IC-1493, IC-7437, IC-1491, IC-385, IC-5627, IC-4207 genotypes exhibited semi drooping type of inflorescence shape. The globuse type of inflorescence shape was observed in IC-7220 and IC-1733 showed drooping type inflorescence shape. Out of thirty genotypes seventeen genotypes showed straight, eleven showed semi-drooping, one globose and one genotype showed drooping type of inflorescence shape. Maximum number of genotypes showed straight inflorescence shape. Similar type of observations was also recorded by Kunj Chandra and Kute (2017). Further, the genotypes IC-7930, IC-1496, IC-6645, IC-5916, IC-7220, IC- 7922, IC-1493, IC-7437, IC-5576 and IC-385 showed smooth type inflorescence spininess whereas the spiny type inflorescence was exhibited in the genotypes IC-5569, IC-5621, IC-5917, IC-4200, IC-7436, IC-7836, IC-5565, IC-4201, IC-5564, IC-7924, IC-4202, IC-3599, IC-6646, IC-7916, IC-5627, IC-4207, IC-5994, IC-1733, IC-1491 and IC-5575. Out of thirty genotypes ten were smooth type inflorescence spininess and twenty were spiny type inflorescence. Maximum number of genotypes showed spiny type inflorescence. For inflorescence compactness genotypes IC-6645, IC-7220, IC-5565, IC-4201, IC-4202, IC-3599, IC-6646, IC-7916, IC-385, IC-4207, IC-5994, IC-5575 showed intermediate compactness and IC-5569, IC-7930, IC-5621, IC-5917, IC-4200, IC-7436, IC-

7836, IC-5916, IC-7922, IC-5564, IC-1493, IC-7924, IC-7437, IC-1491, IC-5576, IC-5627 exhibited dense and genotypes IC-1496, IC-1733 showed lax type inflorescence compactness. Out of thirty genotypes twelve were intermediate compactness sixteen were dense and two genotypes showed lax type inflorescence compactness. Maximum number of genotypes showed dense type inflorescence compactness. seed colour the genotypes IC-5569, IC-7930, IC-5621, IC-4200, IC-7836, IC-7220, IC-5565, IC-1493, IC-7924, IC-3599, IC-4202, IC-6646, IC-7916, IC-4207 and IC-5575 showed pale yellow type of seed colour whereas the IC-1496, IC-5917, IC-7436, IC-6645, IC-5916, IC-7922, IC-4201, IC-5564, IC-1733, IC-7437, IC-1491, IC-385, IC-5576,IC-5627 and IC-5994 exhibited creamish type of seed colour. Out of thirty fifteen were pale yellow and fifteen were creamish type seed colour. Williams and Brenner (1995) [7] also observed different seed colour in grain *Amaranthus.* Variability was observed in all the genotype for plant growth habit, leaf colour, leaf width, inflorescence colour, inflorescence compactness, stem colour, stem surface, inflorescence shape, inflorescence spininess and seed colour.

Table 1: Characterization of thirty grain *Amaranthus* genotypes for qualitative characters.

Sr. No	Genotypes	Growth habit	Leaf colour	Leaf width	Inflorescence colour	Inflorescence compactness
c	IC-5569	Erect	green	medium	green	dense
2	IC-7930	Erect	green	medium	green	dense
3	IC-5621	Erect	green	medium	green	dense
4	IC-1496	Semi-erect	purple	narrow	pink	lax
5	IC-5917	Erect	Yellowish green	medium	Yellowish green	dense
6	IC-4200	Semi-erect	purple	medium	pink	dense
7	IC-7436	Erect	green	medium	Yellowish green	dense
8	IC-7836	Semi-erect	green	medium	green	dense
9	IC-6645	Semi-erect	pinkish	medium	pink	intermediate
10	IC-5916	Erect	purple	medium	pink	dense
11	IC-7220	Erect	purple	broad	pink	intermediate
12	IC-5565	drooping	pinkish	medium	pink	intermediate
13	IC-7922	Semi-erect	green	medium	green	dense
14	IC-4201	Erect	purple	medium	pink	intermediate
15	IC-5564	Semi-erect	green	medium	green	dense
16	IC-1493	Erect	Yellowish green	medium	green	dense
17	IC-7924	Erect	green	narrow	Yellowish green	dense
18	IC-3599	Erect	Yellowish green	medium	Yellowish green	intermediate
19	IC-4202	Erect	Yellowish green	medium	Yellowish green	intermediate
20	IC-6646	Erect	Yellowish green	medium	Yellowish green	intermediate
21	IC-7916	Semi-erect	Yellowish green	medium	Yellowish green	intermediate
22	IC-1733	drooping	green	medium	Yellowish green	lax
23	IC-7437	drooping	green	medium	green	dense
24	IC-1491	drooping	green	medium	green	dense
25	IC-385	drooping	pinkish	medium	pink	intermediate
26	IC-5576	Erect	green	broad	green	dense
27	IC-5627	drooping	purple	medium	pink	dense
28	IC-4207	drooping	green	medium	green	intermediate
29	IC-5994	drooping	purple	medium	pink	intermediate
30	IC-5575	drooping	green	medium	green	intermediate

Table 2: Characterization of thirty grain *Amaranthus* genotypes for qualitative characters.

Sr.No	Genotypes	Inflorescence shape	Inflorescence spininess	Stem colour	Stem surface	Seed colour
1	IC-5569	Straight	Spiny	Green	Smooth	Pale yellow
2	IC-7930	Straight	Smooth	Green	Smooth	Pale yellow
3	IC-5621	Straight	Spiny	Green	Smooth	Pale yellow
4	IC-1496	Semi-drooping	Smooth	Pinkish	Ridged	Creamish
5	IC-5917	Straight	Spiny	Yellowish green	Smooth	Creamish
6	IC-4200	Straight	Spiny	Pinkish	Ridged	Pale yellow
7	IC-7436	Straight	Spiny	Yellowish green	Smooth	Creamish
8	IC-7836	Straight	Spiny	Green	Smooth	Pale yellow
9	IC-6645	Straight	Smooth	Pinkish	Ridged	Creamish
10	IC-5916	Straight	Smooth	Pinkish	Ridged	Creamish
11	IC-7220	Globose	Smooth	Green	Ridged	Pale yellow
12	IC-5565	Semi-drooping	Spiny	Pinkish	Ridged	Pale yellow
13	IC-7922	Semi-drooping	Smooth	Green	Smooth	Creamish
14	IC-4201	Semi-drooping	Spiny	Pinkish	Ridged	Creamish
15	IC-5564	Semi-drooping	Spiny	Green	Ridged	Creamish
16	IC-1493	Semi-drooping	Smooth	Yellowish green	Smooth	Pale yellow

17	IC-7924	Straight	Spiny	Green	Smooth	Pale yellow
18	IC-3599	Straight	Spiny	Yellowish green	Smooth	Pale yellow
19	IC-4202	Straight	Spiny	Yellowish green	Ridged	Pale yellow
20	IC-6646	Straight	Spiny	Yellowish green	Smooth	Pale yellow
21	IC-7916	Straight	Spiny	Yellowish green	Smooth	Pale yellow
22	IC-1733	Semi-drooping	Spiny	Green	Smooth	Creamish
23	IC-7437	Semi-drooping	Smooth	Green	Smooth	Creamish
24	IC-1491	Semi-drooping	Spiny	Green	Smooth	Creamish
25	IC-385	Semi-drooping	Smooth	Pinkish	Ridged	Creamish
26	IC-5576	Straight	Smooth	Green	Ridged	Creamish
27	IC-5627	Semi-drooping	Spiny	Pinkish	Smooth	Creamish
28	IC-4207	Semi-drooping	Spiny	Green	Smooth	Pale yellow
29	IC-5994	Straight	Spiny	Pinkish	Ridged	Creamish
30	IC-5575	Straight	Spiny	Green	Smooth	Pale yellow

Conclusion

The present investigations were carried out on thirty genotypes of grain Amaranthus. As per PPV and FRA, GOI, New Delhi, 2014. Ten qualitative characters was studied i.e. plant growth habit (semi-erect, erect and drooping), leaf colour (pinkish, yellowish green, green), leaf width (narrow, medium and broad), inflorescence colour (yellowish green, pink and green), stem colour (yellowish green, pink and green), stem surface (ridged and smooth), inflorescence shape (globose, straight and semi drooping), inflorescence compactness (intermediate, dense and lax), inflorescence spininess (smooth and spiny) and seed colour (creamish, pale yellow). Present investigation concluded that for plant growth habit (semi-erect, erect and drooping), out of thirty, maximum number of genotypes (fourteen) showed erect type growth habit. For leaf colour (pinkish, yellowish green, green), maximum genotypes (fourteen) exhibited green leaf colour and only two genotypes showed pinkish leaf colour. However in leaf width (narrow, medium and broad) twenty six genotypes showed medium leaf width. In case of inflorescence colour (yellowish green, pink and green) eight genotype exhibited yellowish green colour, whereas eleven pink and eleven genotypes showed green inflorescence colour. While in stem colour (yellowish green, pink and green) Out of thirty genotypes, thirteen were green stem colour. For stem surface (ridged and smooth) maximum number of genotypes showed smooth type stem surface. However, in inflorescence shape (globose, straight and semi drooping), seventeen genotypes showed straight type, eleven showed semi-drooping and one each completely drooping and globose type inflorescence shape. While in inflorescence compactness (intermediate, dense and lax) maximum number of genotype (sixteen) exhibited dense type inflorescence compactness. For inflorescence spininess (smooth and spiny), Ten were smooth inflorescence spininess and twenty were spiny inflorescence. and seed colour (creamish, pale yellow) out of thirty, fifteen were pale yellow colour and fifteen were creamish seed colour.

References

1. Anonymous. Guidelines for the conduct of tests for DUS on grain *Amaranthus* (*Amaranthus* L. excluding ornamental or vegetable varieties). PPV and FRA, GOI, New Delhi; c2014.
2. Chatarmal SM, Kute NS. Stability analysis in grain *Amaranthus* (*Amaranthus hypochondriacus* L.). J of Agric. Res. and Tech. 2013;38(1):138-141.
3. O'Brien GK, Price ML. Amaranth grain and vegetable types. ECHO technical note published 1983 and revised in 2008, 1983.
4. Sauer JD. The grain amaranths and their relatives: a revised taxonomic and geographic survey. Annals of the Missouri Botanical Garden. 1967 Jan 1;54(2):103-37.
5. Schippers RR. African indigenous vegetables: an overview of the cultivated species. Chatham: Natural Resources Institute/ ACP-EU Technical Centre for Agricultural and Rural Cooperation; c2000.
6. Wyn. Williams, Logan RB, Lynda A. The course of research and development of alternative arable crops in New Zealand. Proc. of Agronomy Society of New Zealand. 1985;15:93-102.
7. Williams JT, Brenner D. Grain amaranth (*Amaranthus spp*). In: Williams JT (ed). Under utilized Crops: Cereals and Pseudocereals. Chapman & Hall, London, UK, 1995, 129-87.
8. Shukla S, Gupta S. Apigenin: a promising molecule for cancer prevention. Pharmaceutical research. 2010 Jun;27:962-78.