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Genetic Variability for Quantitative Characters in Vegetable Amaranthus (*Amaranthus tricolor* L.)

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Abstract

The present investigation on genetic variability in amaranthus (*Amaranthus tricolor* L.) Genotypes under Chhattisgarh plains was carried out at Pt. KLS College of Horticulture and Research Station, Rajnandgaon, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during *kharif* season 2015-16. The experiment was comprised of twenty three genotypes of amaranthus, laid out in Randomized Block Design (RBD) with three replications. Significant variations were recorded for the various characters studied. Widest range of variation was observed in Foliage yield (kg/plot) followed by harvest index(%), Leaf area, plant height and number of leaves per plant. Maximum genotypic and phenotypic coefficient of variation (GCV and PCV) was observed for Dry stem weight followed by Dry plant weight, harvest index (%), leaf stem ratio, Fresh stem weight. High magnitude of heritability was observed for Dry stem weight (91.7%) followed by Fresh stem weight (84.7%), Dry plant weight (84.6%), harvest index (83.3%) and leaf stem ratio (79.7%). The maximum genetic advance as percentage of mean was observed high for Dry stem weight (66.66%) followed by Dry plant weight (56.66%) and leaf stem ratio (50.57%). The highest heritability was recorded for the characters dry stem weight (91.7 %), fresh stem weight (84.7 %), dry plant weight (84.6 %), harvest index % (83.3 %), On the basis of this investigation selection criteria are Dry stem weight bringing out the improvement in amaranthus because they appearance with high value of GCV, PCV, heritability and genetic advance.

Keywords: Amaranthus, genetic variability, heritability, genetic advance, leaf yield

1. Introduction

Amaranthus is one of the important and popular leafy vegetable of india. Amaranthus (Amaranthus *spp.*), popularly known as"Chaulai". The edible amaranth belongs to the family Amaranthaceae. The genus Amaranthus includes 50-60 species, cultivated for leaf as well as for grains and few are wild species. The vegetable amaranth species (2n=34) include *A. tricolor*, *A. dubius, A. lividus, A. blitum, A. hypochondiacus*, *A. spinosus*, and *A. viridis*, while (2n=32) includes *A. cruentus* and *A.tristis*, *A. graecizans* and *A. caudatus*. Centres of diversity for amaranth are Central and South America, India and South East Asia with secondary centres of diversity in West and East Africa. Main vegetable type of leaf amaranth is *Amaranthus tricolor L.*, originated in south East Asia, particularly in india. (Rai and Yadav, 2005). India is well-known for its vegetable growing areas. India is second largest producer of vegetable next to China. India produced 162896.9 thousand MT of vegetable from 9205.2 thousand hectare area (Anon., 2013-14). In Chhattisgarh, 377212 hectare area is under the vegetable cultivation and production is 4965339 MT out of 6680 hectare area are under leafy vegetables cultivation and production is 62897 ha (Anon., 2013-14). Amaranthus is a rich source of nutrients it serves as an alternative source of nutrition for people in developing countries. (Prakash and Pal, 1991 and Shukla et al., 2003). Tender stems and leaves contains moisture (85.70 %), protein (4.0 g), fat (0.50 g), carbohydrates (6.30 g), calcium (397.0 mg), iron (25.5mg), phosphorus (83.0 mg), vitamin A (9200IU), and vitamin C (99 mg), (Rai and Yadav, 2005). It is also a good source of dietary fiber.

The correlation between yield and a component character may sometimes be misleading. Thus splitting of total correlation into direct and indirect effects would provide a more meaningful interpretation of such association. Path coefficient, which is a standard partial egression coefficient, specifies the cause and effect relationship and measures the relative importance of each variable. Therefore, correlation in combination with path coefficient analysis will be an important tool to find out the association and quantify the direct and indirect influence of one character upon another and in Chhattisgarh state available wide genetic variability of amaranths in the local land races there is urgent need to develop or identify with categorized high yielding varieties. Therefore present investigation under taken to find out the

Genetic Studies in Amaranthus Germplasm between various component characters and their showing the possibilities of further genetic improvement in amaranthus. Considering adverse effect of changing climatic conditions, amaranth is a promising agricultural crop with the ability to withstand negative effects of growing conditions (Alemayehu et al., 2014). However, despite the nutritional and agricultural importance of this crop (Bhuvaneswari et al., 2001), it is still one of the underexploited crops in Africa (Dubois and Stoilova 2015). For effective genetic improvement of grain yield, it is important to understand how the proportion of genetic component (Hamdi et al., 2003). Reported significant genotype × environment interaction for yield and its component traits in grain amaranth. This study was carried out with the objective to determine the magnitude of genetic parameters and association of traits in grain amaranth at two environments.

2. Materials and Methods

The present investigation in amaranthus genotypes was conducted at Pt. KLS College of Horticulture and Research Station, Rajnandgaon, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during *kharif* season 2015–16. The experiment was comprised of twenty three genotypes of amaranthus, laid out in Randomized Block Design (RBD) with three replications. Genotype seeds are grown in plot size (1x1 m^2) and spacing between 15x5 cmrow and plant. Observation was recorded plant height, number of branch per plant, Stem base diameter, number of leaves per plant, leaf length, leaf width, Leaf area, petiole length, Plant fresh weight, Fresh leaf weight, Fresh stem weight, Dry leaf weight, Dry stem weight, Dry plant weight, Foliage yield (kg/plot). The genetic parameters such as genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability and genetic advance in broad sense. Genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were calculated by the method suggested by Singh and Choudhary (1985). The estimates of PCV and GCV were classified as low, moderate and high according to Sivasubramanian and Madhavamenon (1973). Heritability estimates (Broad sense) for fruit yield and its components of hybrids were worked out by Singh and Choudhary (1985). Genetic advance was estimated by using the method suggested by Johnson *etal.* (1955).

3. Results and Discussion

The analysis of variance of all the characters under study is presented in Table 1 This analysis of variance revealed that mean sum of squares due to genotypes was highly significant for all the studied characters. This is an indication of existence of sufficient variability among the genotypes for leaf yield and its component traits. Significant mean sum of squares due to leaf yield and attributing characters revealed existence of considerable variability in material studied for improvement of various traits. These findings are in general agreement with the findings of Varalakshmi (2004), Shukla et al. (2005) and Joshi et al. (2011).

Table 1: Analysis of variance for leaf yield and its quantitative characters in amaranthus

Sl. No.	Character	Mean sum of square		
		Replication	Treatment	Error
	(df)	2	22	44
1.	Plant height (cm)	8.162	6.489**	2.648
2.	No. of branches plant^{-1}	7.708	0.116**	5.528
3.	Stem base diameter (cm)	207.901	18.018**	489.003
4.	No. of leaves per plant	0.595	0.804**	0.331
5.	Leaf length (cm)	5.810	0.963**	0.252
6.	Leaf width (cm)	0.156	0.609**	0.162
7.	Leaf area (cm^2)	0.302	40.470**	4.977
8.	Petiole length (cm)	0.341	0.433**	0.139
9.	Plant fresh weight (g)	2.246	0.989**	0.125
10.	Fresh leaf weight (g)	4.555	0.222**	5.005
11.	Fresh stem weight (g)	4.026	0.487**	2.762
12.	Dry leaf weight (g)	3099.441	98.002**	987.98
13.	Dry stem weight (g)	9864.568	52.477**	153.034
14.	Dry plant weight (g)	2.541	2.536**	14.538
15.	Foliage yield (kg plot^{-1})	655.000	8822.181**	2539.002
16.	Leaf stem ratio	2.079	0.183**	1.432
17.	Harvest index (%)	23.671	723.211**	45.320

*: Significant at (p=0.05), **: Significant at (p=0.01).

Genotypic and phenotypic coefficient of variation are simple measure of variability, these measures are commonly used for the assessment of variability. The relative value of these types of coefficients gives an idea about the magnitude of variability present in a genetic population. Thus, the component of variation such as genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were computed. The phenotypic coefficient of variation was marginally higher than the corresponding genotypic coefficient of variation indicated the influence of environment in the expression of the character under study.

Genotypic and phenotypic coefficients of variation of are different characters presented in Table 2. High magnitude of genotypic as well as phenotypic coefficient of variations were recorded for traits *viz*., dry stem weight (32.00 and 33.41 %), dry plant weight (28.88 and 31.41%), harvest index % (28.32 and 20.07%), leaf stem ratio (27.14 and 30.39%), fresh stem weight (25.60 and 27.81%), suggested the substantial improvement on amaranthus through selection for these traits. Moderate GCV and PCV were recorded for dry leaf weight (18.41 and 21.29%), leaf area (18.38 and 21.91%) fresh leaf weight (15.85 and 21.67 %), plant fresh weight (15.68 and 18.78%), petiole length (10.73 and 16.71%), leaf length (10.60 and 15.23%) and leaf width (10.28 and 14.85). Suggested existence of considerable variability in the population. Selection for these traits may also be given the importance for improvement programme. Low GCV and PCV were recorded for leaf yield (9.64 and 14.34), plant height (7.13 and 12. 48), stem base diameter (5.85 and 8.51), number of leaves plant^{-1} (5.32 and 9.36) and number branches plant^{-1} (4.59 and 8.83).

Table 2: Genetic parameter of variability for leaf yield and its quantitative *charactersin amaranthus*

Sl. No.	Character	Mean	Range		Coefficient of variation (%)		Heritability (h^2 %)	GA as percent of mean
			Min.	Max.	GCV	PCV		
1.	Plant height (cm)	15.88	12.89	17.96	7.13	12.48	32.6	8.37
2.	No. of branches plant^{-1}	3.11	2.67	3.53	4.59	8.83	27.0	4.82
3.	Stem base diameter (cm)	0.35	0.30	0.40	5.85	8.51	47.2	8.57
4.	No. of leaves per plant	7.46	6.40	8.13	5.32	9.36	32.3	6.30
5.	Leaf length (cm)	4.59	3.82	6.10	10.60	15.23	48.4	15.25
6.	Leaf width (cm)	3.75	3.05	4.82	10.28	14.85	47.9	14.66
7.	Leaf area (cm^2)	18.70	14.13	26.86	18.38	21.91	70.4	31.76
8.	Petiole length (cm)	2.91	2.27	3.47	10.73	16.71	41.2	14.08
9.	Plant fresh weight (g)	3.42	2.35	4.76	15.68	18.78	69.8	26.90
10.	Fresh leaf weight (g)	1.51	0.95	2.06	15.85	21.67	53.5	23.84
11.	Fresh stem weight (g)	1.52	0.95	2.37	25.60	27.81	84.7	48.68
12.	Dry leaf weight (g)	0.29	0.22	0.43	18.41	21.29	74.8	34.48
13.	Dry stem weight (g)	0.12	0.07	0.19	32.00	33.41	91.7	66.66
14.	Dry plant weight (g)	0.30	0.21	0.49	28.88	31.41	84.6	56.66
15.	Foliage yield (kg plot^{-1})	474.68	360.67	602.87	9.64	14.34	45.2	13.35
16.	Leaf stem ratio	0.87	0.57	1.63	27.14	30.39	79.7	50.57
17.	Harvest index (%)	82.06	57.93	122.98	28.32	20.07	83.3	34.43

Phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV) for all the traits indicating that environmental factors were influencing their expression. Wide difference between phenotypic and genotypic coefficient of variations indicated their sensitiveness to environmental fluctuations whereas narrow difference showed less environmental interference on the expression of these traits. The traits which showed high phenotypic and genotypic coefficient of variations are of economic importance and there is scope for improvement of these traits through selection. Similar findings were also reported earlier by Varalakshmi and Reddy (1994), Revanappa and Madalgeri (1998), Anuja and Mohideen (2007a) and Venkatesh et al. (2014b).

In the present investigation high magnitude of heritability was recorded for most of characters. The highest heritability was recorded for the characters dry stem weight (91.7%), fresh stem weight (84.7%), dry plant weight (84.6 %), harvest index % (83.3%), Leaf stem ratio (79.7%), dry leaf weight (74.8%), leaf area (70.4%). Similar results reported by Varalakshmi and Reddy (1994) for number of leaves, leaf weight, stem weight, leaf-stem ratio and yield of greens per plant, Rani and

Veraragavathatham (2003) for green yield plant^{-1}, stem weight plant^{-1}, leaf number plant^{-1}, leaf weight plant^{-1}, plant height, leaf length, leaf breadth and stem girth. Similar results were also reported by Shukla et al. (2006), Anuja and Mohideen (2007a), Das and kumar (2012). The moderate heritability was observed for Plant fresh weight (69.8%) and Fresh leaf weight (53.5%). Low heritability was observed for leaf length (48.4%), leaf width (47.9), stem base diameter (47.2), foliage yield (45.2), petiole length (41.2), plant height (32.6), numberof leaves plant^{-1} (32.3) and number of branches plant^{-1} (27.0 %), high heritability characters are suggesting the important role of genetic constitution in the expression of the characters and these traits are considered to be dependent from breeding point of view. All the estimated heritable characters are less influence by environmental factors and control by additive gene. similar result was also reported by Ahammed*et al.* (2013).

Heritability estimates along with genetic advance are more useful than the heritability value alone for selecting the best individual. High heritability coupled with high genetic advance was observed for dry stem weight, dry plant weight, leaf stem ratio, fresh stem weight, dry leaf weight, harvest index, leaf area, plant fresh weight, fresh leaf weight. indicating that most likely the heritability is due to additive gene effects and selection may be effective. Therefore, selection based on phenotypic performance of these traits would be effective to select desirable plant type. Similar results were also reported Varalakshmi and Reddy (1994), Rani and Veeragavathathan (2003), Shukla et al. (2005), Anuja and Mohideen (2007a) and Pan et al. (2008).

The study revealed sufficient genetic variability for quantitative traits among the varieties, which can be exploited for varietal improvement. Therefore, a gene pool can be generated by crossing the variety of interest which can be further used as a source material to develop promising varieties in amaranths.

4. Conclusion

The highest genotypic and phenotypic coefficient of variation was recorded for quantitative characters dry stem weight (32.00 and 33.41%) and Dry plant weight (28.88 and 31.41%), The phenotypic coefficients of variation were higher than the genotypic coefficient of variation. The highest heritability was recorded for the quantitative characters *viz.* Dry stem weight (91.7 %), Fresh stem weight (84.7%), Dry plant weight (84.6%), Harvest index (83.3 %), Leaf stem ratio (79.7%), Dry leaf weight (74.8%), Leaf area (70.4%). Whereas, highest heritability coupled with highest genetic advance were observed for quantitative characters viz., Dry stem weight (66.66), Dry plant weight (56.66 %), leaf stem ratio (50.57%), Fresh stem weight (48.68%), Dry leaf weight (34.48%), harvest index (34.43%), Leaf area (31.76%), Total Chlorophyll (28.42 mg), Plant fresh weight (26.90%), Fresh leaf weight (23.84%). Hence, these characters might be improved by simple selection.

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