

Genetic variability, heritability and genetic advance studies in Amaranthus (*Amaranthus tricolor* L.)

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ABSTRACT

The experiment was conducted during 2016-17 at Horticulture Research Farm, Department of Applied Plant Science (Horticulture), BabasahebBhimraoAmbedkar University, Lucknow to study the "genetic variability, heritability and genetic advance in Amaranthus (*Amaranthus tricolor* L.)". The experiment was laid out in randomized block design with three replications. The analysis of variance revealed significant difference among all the genotypes for the attributes. Higher genotype coefficient of variation (GCV) was observed for seed weight per plot, spikes per plant, leaves per plant and branches per plant. The phenotype coefficient of variation (PCV) was also found higher in leaves per plant followed by branch, spike per plant and seed weight per plant. Maximum heritability (broad sense) was obtained for seed weight per plot followed by test weight, green leaves yield per plant and days to full maturity. The genetic advance was found maximum for length of leaves followed by test weight, days to full maturity and percent dry matter.

Keywords: Heritability, genetic variability, genetic advance and amaranthus

INTRODUCTION

Amaranthus is one of the important and popular leafy vegetable in India. It is popularly known as "Chaulai" and grown throughout the year in tropical and subtropical areas. It has very fast growth habit in short duration and large producer of edible matter per unit area. The edible amaranthus belongs to family Amaranthaceae, subfamily amaranthoideae and genus amaranthus. The vegetable amaranthus species ($2n=34$) include *A. tricolor*, *A. dubius*, *A. lividus*, *A. blitum*, *A. hypochondriacus*, *A. spinosus*, and *A. viridis*, while ($2n=32$) include *A. cruentus* and *A. tristis*, *A. graecizans* and *A. caudatus*. Amaranthus is also considered to be the cheapest leafy vegetable in market and it could be rightly described as a "poor men's vegetable". It is also well established that genetic homogeneity leads to genetic vulnerability to biotic and abiotic stresses. In any crop-breeding programme, germplasm serves as the most valuable reservoir in providing variability for various traits. When initiating breeding programmes with any crop having genetic variation, it is important to gather information on the traits of agronomic importance. The existence of sufficient level of genetic variability is a

prerequisite for variety development, hence, detailed appraisal of the accessions for different morphological traits is necessary in order to identify useful traits either for direct use or pave a way for other improvement programs (Mengesha and Alemaw 2010, Kumar *et al.* 2020). Studies of genetic variances and genetic gain in the juvenile plant stage can variances and genetic gain in the juvenile plant stage can cycle (Adams *et al.* 2007 and Kumar *et al.* 2017). Present experiment was executed to find out suitable genotype for Lucknow conditions, evaluate amaranthus germplasm for green leaf yield and its component characters and association (correlation and path analysis) in between green leaf yield and yield parameters of amaranthus.

MATERIALS AND METHODS

The experiment was conducted at Horticulture Research Farm, Baba saheb Bhimrao Ambedkar University, Lucknow (U.P.) in well leveled field having proper drainage. Geographically, Lucknow is situated at an elevation of 111 m above mean sea level (MSL), in the sub-tropical tract of central Uttar Pradesh. The sowing of experimental material was done

on 20 February 2017. The seeds were sown in field at the distance of 25cm for row to row and 15 cm for plant to plant and the plot size was 1.5m x 0.9 m. Recommended dose of fertilizers, seed treatment and other cultural package of practices were adopted for better crop growth. Three competitive plants were selected randomly from each plot to record observations on various characters. The average value of each character was calculated on the basis of three plants for each genotype in every replication. The experimental data was compiled by taking the mean value of the 17 genotypes i.e. Pusabadichaulai, Pusachottichaulai, Pusakirti, Pusakiran, Pusalalchaulai, Arkasuguna, Arka arunima, VRAM-1, VRAM-4, VRAM-6, VRAM-7, VRAM-8, VRAM-9, VRAM-10, VRAM-11, VRAM-12 and VRAM-13. The characters viz. width of leaves, length of leaves, number of branches per plant, number of leaves per plant, height of plant, stem girth, number of spikes per plant, moisture content in leaves, weight of 1000 seeds, green leaf yield per plot, days to full maturity, dry matter, seed yield per plot were recorded. The ascorbic acid content was determined as per procedure outlined by Ranganna (1977). The data were analysed using standard procedures (Panse and Sukhatme, 1967).

RESULTS AND DISCUSSION

The analysis of variance revealed that significant variability was present in the germplasm for all the characters studied. Width of leaves ranged from 2.04 cm (VRAM-4) to 4.96cm (VRAM-6) with an overall mean of 3.52cm. The GCV and PCV were 27.8 and 25.2 per cent, respectively. The magnitude of broad sense heritability was 83 % with corresponding genetic advance of 60.7 per cent Wu *et al.* (2000) observed wide variability for plant height, maturity, leaf number and colour, stem colour, branch number and yield per plant. Leaf length ranged from 4.97 (VRAM-4) to 13.14 (VRAM-6) with a mean of 8.97 cm. The GCV and PCV were 25.4 and 33.1 %, respectively. The magnitude of broad sense heritability was 59 % with corresponding genetic advance of 51.7%. Number of branches per plant ranged from 1.67 (VRAM-10) to 11.11 (VRAM-13) with a mean of 8.97. The GCV and PCV were 41.6 and 68.9 %, respectively. The magnitude of broad

sense heritability was 37 % with corresponding genetic advance of 94%. Mandale *et al.*, (2012) observed significant difference among the entries for all the studied characters i.e. plant height and stem girth. Highest number of leaves per plant ranged from 15.3 (Pusakiran) to 105.0 (VRAM-13) with an overall mean of 35.8. The GCV and PCV were 51.0 and 82.8% respectively. The magnitude of broad sense heritability was 38 per cent with corresponding genetic advance of 83.1 per cent. Vara Lakshmi (2004) reported similar results. The minimum (33.7 cm) and maximum (89.1 cm) values were recorded in Pusachottichulai and VRAM-12, respectively. The mean value of plant height was 53.3cm. The GCV and PCV were 22.8 and 39.4 per cent, respectively. The magnitude of broad sense heritability was 33 per cent with corresponding genetic advance of 34.8 per cent, stem girth ranged from 7.87 mm (VRAM -11) to 24.67mm (VRAM-12) with an overall mean of 16.79 mm. The GCV and PCV were 24.8 and 42.2 per cent, respectively. The magnitude of broad sense heritability was 35 per cent with corresponding genetic advance of 38.7 per cent. The results indicated that increasing plant height caused the plant to increase stem weight and leaf weight. These findings were in agreement with those of Rahman *et al.* (2000).

Number of spikes per plant ranged from 2.0 (VRAM -10) to 11.6 (VRAM-7) with an overall mean of 5.8. The GCV and PCV were 52.4 and 68.2 per cent, respectively. The magnitude of broad sense heritability was 59 per cent with corresponding genetic advance expressed as percentage of mean being 106.5 per cent (Yadav *et al.* 2008). There was significant variation for the moisture content among genotypes and highest value was found in the strain Pusachottichaulai (86.5%) and minimum in the strain Arkaarunima (83.9%) with a mean value of 85.1%. The phenotypic and genotypic coefficients of variation were recorded to be 1.01% and 0.55% respectively (Table 2). The heritability for this trait was 0.29% whereas the value of genetic advance was 0.61 percent. Test weight ranged from 0.39 g (VRAM-8) to 0.99 g (VRAM-11) with a mean of 0.67 g. The GCV and PCV were 20.8 and 21.6% respectively. Thousand seed weight was within the range of 0.5–1.0 g, which is similar to seed weights of *A. hypochondriacus* and *A. cruentus* genotypes tested by Jamriska (1996).

Table 1: Mean performance of 17 genotypes for characters in amaranthus crop

Verities	leaf Width (cm)	Leaf length (cm)	Branch/ plant	Plant height (cm)	Stem diameter (cm)	Spike/ plant	Moisture (%)	Test weight (g)	Wt. of green leaves /plant (g)	Day to full maturity	Dry matter (%)	Seed weight per plot(g)	VitaminC (mg/100g)
Pusabadichaulai	2.86	9.02	2.34	42.3	21.8	2.67	84.2	0.65	58.4	82.3	18.0	53.0	96.3
Pusachottichaulai	3.19	9.49	2.55	33.7	20.4	3.00	86.5	0.65	52.2	83.3	19.0	67.6	90.3
Pusakirti	3.74	9.87	3.00	43.7	18.5	2.67	85.4	0.56	58.0	95	17.6	63.1	91.6
Pusakiran	3.78	7.29	5.45	38.3	12.7	6.00	84.8	0.54	53.5	81.3	18.6	10.5	92.3
Pusalalchaulai	3.58	8.95	4.89	41.2	12.7	3.00	85.2	0.67	57.3	88.3	16.6	47.4	96.6
Arkasuguna	3.88	9.28	5.78	41.1	13.5	6.67	85.2	0.6	47.1	91.6	17.6	52.3	92.6
Arkaarunima	3.74	10.1	3.44	73.5	19.3	3	83.9	0.75	53.3	85.3	17.0	72.2	92.3
VRAM -1	4.67	12.8	6.0	45.4	22.9	4.33	85.3	0.85	46.6	74.6	19.0	22.4	94.3
VRAM-4	2.04	4.97	9.67	63.1	8.6	11.3	85.1	0.63	57.0	95.3	17.3	114.0	95.0
VRAM-6	4.96	13.1	5.67	59.1	16.9	5.00	85.4	0.80	43.2	100.0	16.0	11.9	94.3
VRAM-7	2.51	6.56	9.89	55.3	10.5	11.6	85.8	0.70	56.5	97.0	17.0	60.0	93.3
VRAM-8	4.35	9.67	3.89	37.4	19.7	5.0	85.3	0.76	60.6	91.6	16.0	22.9	96.6
VRAM-9	4.14	8.40	2.89	44.6	22.9	4.0	84.7	0.71	58.5	89.6	16.3	9.38	94.6
VRAM-10	3.57	9.18	1.67	71.0	19.6	2.0	84.6	0.90	58.6	84.3	16.6	56.8	97.6
VRAM-11	2.17	5.51	8.11	57.1	7.88	11.0	84.3	0.99	62.0	86.0	17.0	122.0	93.0
VRAM-12	4.63	12.9	5.78	89.1	24.6	7.33	85.3	0.90	59.1	97.6	18.6	56.0	96.0
VRAM-13	2.10	5.21	11.1	69.8	12.0	11.0	85.1	0.40	45.8	70	19.0	128.6	94.6
MEAN	3.52	8.97	5.42	53.33	16.7	5.86	85.1	0.71	54.62	87.86	17.51	57.10	94.2
C.V.	11.5	21.1	54.9	32.15	34.1	43.6	0.85	5.77	3.42	3.65	9.76	11.73	1.23
S.E	0.24	1.10	1.72	9.9	3.31	1.48	0.42	0.02	1.08	1.85	0.99	3.87	0.67
C.D.(P=0.05)	0.68	3.16	4.95	28.52	9.52	4.26	1.20	0.07	3.11	5.33	2.84	11.15	1.93

Table 2: Range, meanphenotype, genotypic coefficient of variation, heritability in broad sense, genetic advance (GA) in percent for the characters in amaranthus

Characters	Range		Mean	Variability		h ² (Broad Sense)	G A	
	Min.	Max.		PCV (%)	GCV (%)		as % of mean 5%	as % of mean 1%
Width of leaves (cm)	2.04	4.96	3.52	27.8	25.2	0.83	3.58	60.7
Length of leaves(cm)	4.97	13.1	8.97	33.1	25.4	0.59	130.7	51.7
Branch/ plant	1.67	11.1	5.42	68.9	41.6	0.37	0.94	66.5
Height of plant(cm)	33.7	89.1	53.3	39.4	22.8	0.33	20.0	34.8
Stem diameter(cm)	7.88	24.6	16.7	42.2	24.8	0.35	9.24	38.7
Spike per plant	2.00	11.6	5.8	68.2	52.4	0.59	41.4	106.5
Moisture Content (%)	83.9	86.5	85.1	1.01	0.55	0.29	0.61	0.78
Test weight (g)	0.40	0.99	0.71	21.6	20.8	0.93	83.1	53.0
Wt. of Green leaves/ plant	43.2	62.0	54.6	10.8	10.2	0.90	27.2	25.6
Day to full maturity	70.0	100.0	87.8	9.7	9.0	0.86	64.9	22.2
Dry matter (%)	16.0	19.0	17.5	9.9	2.1	0.05	51.9	1.20
Seed weight per plot (g)	9.38	128.6	57.1	65.5	64.5	0.97	40.3	167.6
Vitamin C(mg/100g)	128.6	97.6	94.2	2.38	2.03	0.73	47.3	4.5

The magnitude of broad sense heritability was 93 per cent with corresponding genetic advance of 53 per cent (Rathiet *al.* 2006). This maximum weight of green leaves was recorded in the trait VARM-11 (62.0 g) and minimum in the trait VRAM-6 (43.2g) with a mean of 54.67 g. The phenotypic and genotypic coefficients of variation were recorded to be 10.8% and 10.2%, respectively. The heritability for this trait was 0.9% whereas the value of genetic advance was 27.2%. Minimum maturity days were recorded in the genotype VRAM-13(70 days) and maximum in VRAM-6 (100 days). The phenotypic and genotypic coefficients of variation were recorded to be 9.7% and 9.0%, respectively. The heritability for this trait was 86% and genetic advance was 64.9 per cent. The dry matter of plant ranged from 16.0% (VRAM-8) to 19.0 % (VRAM-13) with a mean of 17.5%. The phenotypic and genotypic coefficients of variation were recorded to be 9.9% and 2.1%, respectively (Table 2). The heritability and genetic advance for this trait were 0.05% and 91.93 per cent, respectively. The mean performance of all genotypes indicated that the maximum seed yield was recorded in the trait VRAM-13 (128.6g) and minimum in the VRAM-9 (9.3g) with a mean of 57.1g. The phenotypic and genotypic coefficients of variation were 65.5 and 64.5, respectively. The heritability was 0.97% percent. The highest Ascorbic acid was found in the strain VRAM- 10 (97.6mg/100g) and minimum Pusachottichaulai (90.3mg/100g). The phenotypic and genotypic coefficients of variation were 2.3% and 2.0%, respectively. The heritability and genetic advanced for this trait were 0.73%. and 47.3 percent, respectively (Shuklaet *al.*2006).

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