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Genetic analysis in amaranthus

P. ARUNA **AND** P. GEETHA RANI

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See end of the article for authors' affiliations

Correspondence to :

P. ARUNA
Department of Vegetable Crops Horticulture College and Research Institute, PERIYAKULAM (E.) (T.N.) INDIA

ABSTRACT

Six genotypes of vegetable amaranth were involved in a full diallel crossing. The six parents and their 30 F1 hybrids were evaluated for genetic parameters. Predominance of additive and non-additive genes for yield per plant was observed. High heritability estimates for most of the characters indicated the suitability of the material for pedigree selection. Since overdominance was prominent for many traits, recurrent selection and heterosis breeding followed by selection in advanced generation would be most appropriate. It is also suggested to practice reciprocal recurrent selection because it utilizes both additive and non additive genetic components to the maximum possible extent.

Key words : Amaranthus, Genetic analysis, Additive gene, Dominance gene.

Genetic information on the inheritance of major quantitative characters associated with yield is more important in developing a sound breeding strategy. Hence, the present study was carried out to gather information on the nature of gene action of various quantitative traits in amaranthus. Genetic variation could arise from additive, dominance and epistatic gene effects. The present investigation was planned to asses the gene action in vegetable amaranthus, so that inference could be drawn from the study and could be utilized in forming breeding programme accordingly.

MATERIALS AND METHODS

Six genotypes of amaranthus were crossed in a diallel fashion. The crossed seeds are then planted in the main field at a spacing of 60 x 60 cm in RBD with three replications at College orchard, Horticultural College and Research Institute, Coimbatore. The recommended cultural practices as applicable to a leafy vegetable crop (Annon, 1974) were applied. Observations on yield of greens,number of leaves,weight of leaves,weight of stem, leaf area, Days for 50% flowering,plant height at maturity, thousand seed weight and total drymatter were recorded 35 days after sowing. Genetic components were analysed using diallel analysis of Hayman (1954a and 1954b) and Jinks (1955).

RESULTS AND DISCUSSION

The estimates of genetic parameters are presented in Table 1, 2 and 3.

Yield of greens :

The significance of H_1, H_2 and H^2 suggested dominance effect for this trait. It was also confirmed by the variance that D was greater than H1 which indicated the presence of additive gene action. The variance of F1 was greater than zero indicating that the dominant alleles predominant than the recessive alleles. The KD/KR ratio being more than unity(1.692) and F value being positive(226.09) indicated that the parents had more of dominant genes for this character. The $h_2/4H_1$ ratio being less than 0.25(0.20) revealed the asymmetrical distribution of positive and negative genes among the parents. Moderate heritability estimates (0.631) was observed. This reveals the action of preponderance of non additive gene action, Pandey andPal (1985), Johnson *et al*. (1955) and Ananthalakshmi (2001) reported moderate to high heritability for yield of greens in amaranthus.

Number of leaves :

The ratio of mean degree of dominance supported the presence of over-dominance. Significant values of H_1, H_2 (351.43)and h^2 proves the presence of both additive and dominance gene action. The component D was less than H1 and this confirmed the preponderance of dominant alleles. The component F was less than zero suggesting the presence of recessive alleles The parameter KD/KR (0.72) being less than unity suggested the involvement of greater proportion of recessive genes. The $H_2/4H_1$ ratio being less than 0.250 revealed the asymmetrical distribution of positive and negative genes among the parents. The mean degree of dominance (H_1/D) ½ indicated over dominance. This is in consonance with the findings of Pal (1972) and Mohanalakshmi (1993) in Amaranthus.

Table 1 : Estimates of genetic parameters for F1

Sr. No.	Characters	D			F			H1		
1.	Yield of greens	441.2306	±	45.17848	226.0872	±	110.3711	438.243	±	114.6897
2.	Number of leaves	24.7763	±	11.63688	-17.23859	±	28.4289	110.6511	±	29.54127
3.	Weight of leaves	275.9885	±	26.81998	171.5887	±	65.52123	203.233	±	68.08496
4.	Weight of stem	140.0757	±	28.82378	180.7236	±	70.41653	265.3158	±	73.1718
5.	Leaf area	72.23091	±	0.8064188	7.455785	±	1.970082	6.042925	±	2.047168
6.	Days for 50% flowering	8.212471	±	0.7003627	3.209858	±	1.710987	14.91789	±	1.777934
7.	Plant height at maturity	2483.681	±	239.9203	2350.685	±	586.1256	3140.156	±	609.0596
8.	1000 seed weight	3455.704	±	307.6944	3522.338	±	751.6978	4849.944	±	781.1134
9.	Total dry matter	28.7959	±	0.5262568	9.889452	±	1.285646	4.556942	±	1.335951

Table 2 : Estimates of genetic parameters for F1

Sr. No.	Characters	H_2			H^2			E		
1.	Yield of greens	351.483	±	102.4552	145.3764	±	68.9591	0.4256366	±	17.07586
2.	Number of leaves	92.77354	±	26.38996	65.06061	±	17.76218	0.0187717	±	4.398326
3.	Weight of leaves	146.6238	±	60.82199	57.58346	±	40.93722	0.0318165	±	10.137
4.	Weight of stem	191.3726	±	65.3662	159.2505	±	43.99576	0.05027438	±	10.89437
5.	Leaf area	4.214416	±	1.828786	1.64051	±	1.230894	0.01841001	±	0.3047977
6.	Days for 50% flowering	10.08744	±	1.588273	17.5671	±	1.069013	0.1070602	±	0.2647122
7.	Plant height at maturity	1880.263	±	544.0881	1391.502	±	366.2672	0.015625	±	90.88136
8.	1000 seed weight	3776.941	±	697.79	3954.142	±	469.6557	1.296296	±	116.2976
9.	Total dry matter	2.95485	±	1.193438	1.810312	±	0.8032627	0.02555339	±	0.1989064

Table 3 : Estimates of genetic parameters for F1

Sr. No.	Characters	(H1/D) ½	H2 / 4H1	$\frac{(4\ DH1)\ ½ + F}{(4\ DH1)\ ½ - F}$	h^2 / H_2	Heritability (NS per cent)
1.	Yield of greens	0.9966087	0.2005069	1.692053	0.414	0.6309421
2.	Number of leaves	2.113293	0.2096124	0.7173021	0.70	0.5633274
3.	Weight of leaves	0.8581271	0.1803641	2.136057	0.392	0.6870495
4.	Weight of stem	1.376259	0.1803253	2.764557	0.832	0.2579393
5.	Leaf area	0.2892425	0.1743533	1.434376	0.389	0.9688131
6.	Days for 50% flowering	1.347773	0.1690494	1.339179	1.75	0.6515887
7.	Plant height at maturity	1.124418	0.1496951	2.453415	0.74	0.5970245
8.	1000 seed weight	1.184667	0.19469	2.509968	1.05	0.3473311
9.	Total dry matter	0.3977944	0.1621071	2.518939	0.613	0.9306435

Weight of leaves :

All the genetic parameters were found significant. D was greater than H1 which confirmed the additive gene action. The ratio of genetic parameters revealed that KD/KR was more than unity (2.1361) suggesting the predominance of dominant gene. The component F suggested the preponderance of recessive alleles. Both positive and negative genes were asymmentrically distributed and it was confirmed by the ratio H2/4 H1.The ratio was not equal to 0.250 (0.1804). The ratio of (H1/D) ½ and h2/H2 were less than unity suggesting the presence of partial dominance. The results are in agreement with the findings of Rattan and Saini (1979) and Pandey and Pal (1985). Heritability in narrow sense was 68.70 per cent. KD/KR were more than unity suggesting the role of dominance and higher proportion of dominant genes. Kulakow *et al.* (1985) in Amaranthus and Bhavanishankar and Abdul Khader (1991) in

Coriander also reported similar results.

Weight of stem :

All the genetic parameters were found to be significant. The ratio of (H1/D) ½ and KD/KR were more than unity suggesting the role of dominance and higher proportion of dominant genes. The genetic parameters were significant for H_1, H_2, F, h^2 and E recording 265.32, 191.37, 180.7, 159.25 and 0.0503, respectively. The component D was less than H1 and this confirmed the preponderance of dominant gene effects. The ratio of (H_1/D) ½ and KD/ KR were greater than unity suggesting the role of dominance and higher proportion of dominant genes. The component F was greater than zero suggested the preponderance of dominant alleles. The ratio of $H_2/4H_1$ confirmed that both the positive and negative genes were asymmentrically distributed and h_2/H_2 were less than 0.250 and unity which indicated the involvement of one block of gene, respectively. Heritability in narrow sense was found to be very low (25.80 per cent).This was supported by the findings of Sivagami sundari (1991) in okra and Joshi (1998) in tomato

Leaf area :

The genetic parameters were significant for H1, H2, H^2, F and D recording 6.04, 4.21, 1.64, 7.46 and 72.231, respectively. The variance of F1 was greater than zero indicating that the dominant alleles predominant than the recessive alleles.

F value being positive suggested that dominant alleles was more frequent than recessive alleles. This was also supported by KD/KR ratio which indicated the action of dominant alleles. This was also evidenced by high heritability which indicated additive gene action for this trait. This findings was in line of Kulakow *et al.* (1985) in amaranthus and Bhavanisankar and Abdul Khader (1991) in coriander.

Days for 50 per cent flowering :

Significance of H_1 (438.24), H_2 (4.21) and H^2 (1.64) values suggested the presence of additive gene action. The component D was less than H1 and this confirmed the predominance of dominant gene effects. The h_2/H_2 ratio being more than unity indicated the involvement of more than one block of gene group. F values showed the presence of more frequent dominant alleles than recessive which was also supported by KD/KR (1.339) being more than one. The results corroborate with the findings of Ryder (1982) in lettuce, Joshi (1998) and Sharma *et al.* (1993) in bottle gourd.

Plant height at maturity :

The genetic analysis indicated involvement of both additive genes and dominance effects. The ratios of genetic parameters showed the presence of dominance. Genetic component of both additive (D) and dominance (H1 and H2) and h2 were significant which recorded 2483.681, 3140.156, 1880.263 and 1391.502, respectively which indicated additive gene action. The ratios of (H1/ D) ½ revealed over dominance for this character, KD/ KR and h2/H2 were more than unity indicating the preponderance of dominant genes and H2/4H1 was less than 0.250. The narrow sense of heritability was found to be moderate (59.70 per cent). The results are in agreement with the findings of Pal (1972) in amaranthus and Rattan and Saini (1979) in Tomato.

Thousand seed weight :

All the genetic parameters were found to be significant. The KD/KR ratio proved the presence of excess of dominant alleles(2.51) than recessive alleles, h2/H2 (1.050) were more than unity indicated the involvement of additive gene action. The ratio of $H_2/4H1$ being less than 0.250 indicated asymmetrical distribution of positive and negative alleles in the parents. The heritability was found to be low (34.73 per cent).Sivagami sundari(1991) also reported similar results in bhendi.

Total dry matter :

The parameters D, F, H1, H2 and h_2 were significant, while E was non-significant. The ratio KD/KR was more than unity (2.52), indicating the role of dominance (2.52). (H/D) ½ was less than unity. The ratio of h2/H2 was less than unity. Analysis of genetic parameters revealed that this was governed by both additive and non-additive gene action. The ratio of genetic parameters showed the presence of dominance.The resuls are in agreement with the findings of Mohanalakshmi (1995),Hauptli and Jain (1985) and Sharma *et al.* (1993) in Amaranthus.

Authors' affiliations

P. GEETHA RANI, Department of Floriculture and Medicinal Crops, Horticulture College and Research Institute, PERIYAKULAM (E.) (T.N.) INDIA

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