Correlated Response in Amaranth

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The present study was done to test the suitability of direct and indirect selection of grain yield in amaranth through nine component traits. The selection gain among yield components was high for number of inflorescence/plant (110.55%) followed by number of nodes/plant (83.63%), leaf size (72.9%) and number of primary branches/plant (68.76%). The correlated response for grain yield was maximum on selection of plant height (4.18%), leaf size (3.25%), number of inflorescence/plant (3.14%) and number of spikelets /spike (2.90%). The estimate of correlated response (CRY) and relative selection efficiency (RSE) were in proportion with each other, though relative selection efficiencies were less than one. The selection of plant types with medium plant height, large number of inflorescence/ plant and spikelets/spike, and big leaf size is suggested to enhance the grain yield.

Key words: Amaranth, Correlated Response, Genetic Advance, Heritability

Amaranth is an important pseudocereal as human food, and has been grown by people since long. The current interest in amaranth resides in the fact that it exhibits a high nutritional value, a C_4 photosynthetic pathway, a great amount of genetic diversity and phenotypic plasticity. It has rapid growth due to its remarkable capacity for biosynthesis and low rate of photorespiration. To increase its yield potential, several efforts for genetical improvement have been done (Pandey and Pal, 1988; Gupta and Gudu, 1990, 1991; Lehmann *et al.*, 1991; Joshi and Rana, 1995; Katiyar *et al.*, 2000). The selection based on phenotypic performance does not lead to expected genetic advance. Hence, the knowledge of indirect selection is necessary to estimate the proximity of component traits favoring or linked to grain yield. The correlated response is resultant effect of heritability, genetic advance, genotypic correlation and selection intensity; it has an added advantage in selection of suitable characters over others. Studies on this aspect are meagre, though some studies on genetic association were made (Pandey, 1981; Ganeshaiah *et al.*, 1999). The present investigation is an attempt to extend the earlier studies to test the suitability of component characters for making direct and indirect selection for high grain yield.

Materials and Methods

The material comprised 66 genotypes, including 60 distinct lines obtained from two species of amaranthus *i.e. Amaranthus hypochondriacus* and *A. cruentus* and six cultivars of *A. hypochondriacus*. The crop was sown in 1997-98 in a randomized block design with 3 replications at National Botanical Research Institute, Lucknow located at 26.5^0N, 80.5^0E and 120 m above the sea level. The rows were 3m long and 45 cm apart. In each row plant to plant distance was maintained at 15 cm. Data on 5 randomly selected plants from each entry and replication were recorded for plant height (cm), number of spikelets/ spike, number of nodes/plant, leaf size $(cm)^2$ and gain yield/plant (g). The correlated response (CRY) and relative selection efficiency (RSE) were estimated as per procedure suggested by Searle (1965). Heritability (Δh) and genetic advance (ΔG) were calculated according to Allard (1960).

Results and Discussion

The different direct and indirect parameters *i.e.* heritability, genetic advance, genotypic correlation and correlated response are presented in Table 1. The heritability estimates in broad sense were high for all the characters, while genetic advance (ΔG) among yield components was high for number of inflorescence / plant (110.55%) followed by number of nodes/plant (83.63%), leaf size (72.90%) and number of primary branches/ plant (68.76%), indicating that these characters are more responsive to selection. The correlated responses for grain yield was maximum on selection of plant height (4.18%), leaf size (3.25%), number of inflorescence/plant (3.14%) and number of spikelets/spike (2.90%). These components also had medium to high heritability and positive significant genotypic correlation with grain yield. The high relative selection efficiency (RSE) of these component traits indicated that selection of genotypes for grain yield for these traits would be more effective. The high correlated response of leaf size and positive significant genotypic correlation revealed that leaves are responsible for photosynthetic activity, so increase in leaf size may increase the production of grain, as it is an end product of biochemical activity in plants.

Table 1. Correlated response for grain yield in amaranth

Characters	Grain yield				
	ΔG	Δh	rgh	CRY	RSE
Days to flowering	20.93	0.96	0.152	1.158	0.025
Days to maturity	10.32	0.80	0.172	1.190	0.026
Plant height (cm)	52.49	0.89	0.572*	4.180	0.092
No. of primary branches/plant	68.76	0.82	0.220	1.539	0.034
No. of inflorescence/ plant	110.55	0.72	0.475*	3.139	0.069
Inflorescence length (cm)	49.13	0.69	0.199	1.284	0.028
No. of spikelets/ spike	56.86	0.69	0.450*	2.904	0.064
No. of nodes/plant	83.63	0.89	0.250	1.827	0.040
Leaf size (cm^2)	72.90	0.62	0.530*	3.255	0.071
Grain yield (g)	45.57	0.53	x	x	x

*Significant at 5%
ΔG, genetic gain; Δh, heritability (coefficient value);
rgh, genotypic correlation; CRY, correlated response;
RSE, relative selection efficiency.

The high correlated response for number of inflorescence/plant towards grain yield and it's positive significant genotypic correlation with high genetic advance (110.55%) suggest that the selection of plant genotypes with multiple number of inflorescence may provide more grain yield. The relative selection efficiency of each trait towards grain yield was less than unity. It might be due to high expected selection response on grain yield and thus denominator being higher than numerator CRY/ΔG, hence the ratio will naturally be less than one.

From the present findings it is concluded that medium plant height, large number of inflorescence/ plant and number of spikelets/spike and big leaf size should be considered to build up a novel plant type in amaranth to enhance the grain yield.

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