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Research Paper

ASSESSMENT OF MORPHOLOGICAL DIVERSITY OF SELECTED *Amaranthus* SPECIES

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Abstract

Amaranths are an important group of plants and include grain, vegetable and ornamental types. Despite the economic importance of amaranths, there is very little information available about the morphological diversity. Four *Amaranthus* species were characterized by inter specific variations using nine morphological characters. Correlation analysis revealed the significance of inflorescence length, seed yield and plant height for selecting better yielding population. The highest yielding species were *A. tricolor* and *A. viridis* for seed production and inflorescence per plant, respectively. Leaf area ranged from 2.03(*A.spinosus*)-32.88 cm^2 (*A.tricolor*). There is high diversity in *Amaranthus* species and this represents genetic resources for future conservation and breeding work.
Key words: *Amaranthus* species, diversity, correlation analysis.

INTRODUCTION

The genus *Amaranthus* consists of upto 70 species (in the form of cosmopolitan weed or cultivated plant) and are widely spread in all tropical and subtropical regions of the world (Espitia-Rangel 1994). They are usually distinguished as grain, vegetable, ornamental or weedy (Brenner et al 2000). *Amaranthus* has received considerable attention in many countries because of the high nutritional value and they are important source of food as either vegetable or grain (Srivastava 2011). *Amaranthus* seeds or oil is beneficial for those suffering from hypertension and cardiovascular diseases. Its regular consumption reduces blood pressure and cholesterol levels, while improving antioxidants status and some immunological parameters (Gonor et al 2006).

According to the available reports, members of the genus *Amaranthus* exhibit a high degree of morphological diversity and have a wide spectrum of adaptability to different ecogeographical situations. Plants are usually herbs or suffrutescent shrubs. Amaranth is a beautiful crop with brilliant colored leaves, stem and flowers of purple, red, orange and gold. In order to clarify the taxonomy of *Amaranthus*, several systematic revisions were made on the basis of leaf anatomy and morphological variations (Espara-Sandoval et al 1996), pericarp structure (Costea et al 2001b) and stem morphology-anatomy (Costea and DeMason 2001) have been developed.

However, there is little information on the diversity of amaranths and the potential of wild types in breeding programs. The aim of this study to assess the variations in morphology of selected *Amaranthus* species. These findings are expected to be a valuable contribution to amaranth breeding program.

MATERIALS AND METHODS

Four species of *Amaranthus* ie *A.viridis, A.spinosus, A.blitum* and *A.tricolor* were taken for experiments. The experiments were conducted at the Botanical garden, Banaras Hindu University, Varanasi situated at 25º78' N latitude and 83º01' longitude, at an elevation of 76.19 m above mean sea level in the eastern gangetic alluvial plains of India. Seeds of four species were sown in a randomized block design with three replications. The seeds for subsequent years were maintained by usual method of selfing (bagging of inflorescences by bags of muslin cloth) to avoid outcrossing. Each line was sown in two rows of 3 m long. The plant-to-plant and row-to-row distance was maintained at 15 and 45 cm respectively. Five random plants in each replication were selected and data on ten quantitative traits namely plant height (cm), inflorescence length (cm), leaf area (cm^2), days to flowering, stem diameter (cm), primary branch per plant, inflorescence per plant, fresh weight (g), dry weight (g) and seed yield per plant (g) were recorded.

Data analysis: Pearson correlation coefficient analysis was carried out using SPSS version 19.00.

RESULTS AND DISCUSSION

The analysis of morphological characters exhibit significant difference for nine characters, indicating the existence of variability for these traits, among the species studied. The genus *Amaranthus* is known to be a taxonomically difficult group (Joshi and Rana 1991). *A.tricolor* was the tallest overall (36 cms) (Table 1a). On the basis of data obtained plant height showed positive correlation with all characters except inflorescence length (Table 1b). *A.tricolor* also produced largest leaves (32.88 cm^2). Leaf area showed positive correlation with plant height, stem diameter, fresh weight, dry weight and seed weight (Table 1b). *A.viridis* (42 days) flowered earliest and *A.tricolor* took over 59 days to flower (Table 1a). Days to flowering showed negative correlation with leaf area, stem diameter, fresh weight and dry weight according to the data obtained (Table 1b). *A.spinosus* produced longest inflorescence (3.17 cms). This character showed negative correlation with all characters except inflorescence per plant. Maximum numbers of inflorescences were reported in *A.viridis* (15). It showed positive correlation with all characters except flowering period. This observation indicates that *A.viridis* has maximum yield in comparison to other species.

There was great variation in plant fresh weight in all four species. During the observations of biomass product, fresh weight was maximum in *A. tricolor* and it was minimum in *A. spinosus*. Dry weight was maximum in *A. tricolor* (6.15g/plant) it was minimum in *A. spinosus* (0.70g/plant). Seed weight was also maximum in *A. tricolor* (3.85g/plant) followed by *A. blitum* (2.50g/plant), *A. spinosus* (2.20g/plant) and *A. viridis* (1.99g/plant). On the basis of comparative morphological study the present results conclude that *A. tricolor* showed maximum plant height, leaf area, days of flowering, stem diameter, fresh weight, dry weight and seed yield.

The cultivated species showed better seed yield than wild species and this character showed positive correlation with leaf area, stem diameter, number of inflorescence, fresh weight and dry weight but negative correlation with inflorescence length, (Table 1b). However, the correlation analysis values sometimes do not reflect the result true to type and selection based. These values may give poor or no positive response for species selection because these characters may not direct effect on seed yield but possibly other characters might contribute in yielding.

Mlakar et al (2010) reported that amaranth grain yield strongly depends on the environment, weather conditions, species, genotypes, and production techniques, and varies in a wide range from 500-2000 kg grain per ha. High yield is one of the most important characteristics for vegetable production especially during the hot and wet summer season in tropical and sub-tropical regions (Engle 2003). In general, more than half of the morphological characters considered showed variation especially the agronomic important traits such as plant height, growth habit, leaf yield and seed yield. Some of the variation among accessions could partly be attributed to selection pressure being affected by farmers for those characters they consider to be important as they continue domesticating amaranth through cultivation. The similarity in the

characters could be attributed to the fact that accessions collected shared some genes and furthermore it is possible that farmers do not apply any selection pressure on the said characters because they are not considered of great agronomic importance in the cultivation. Mwase et al (2014) reported that morphological analysis has revealed that there is great variability of morphological traits of amaranth species found across the hot and dry low-altitude, warm and wet mid-altitude and the cold and wet high altitude agroecological zones of Central Malawi.

The availability of genetic resources and their diversity assessment is a point for the success of breeding programs for any crop, including amaranths (Hoisington et al 1999). Germplasm collections from under utilized crops can become essential resources for plant breeders to develop improved cultivars that will feed rapidly growing populations (Nelson 2011). Attempts have been made to use exotic germplasms obtained from weedy or wild relatives for crop improvement via gene introgression, cultivar selection, and conventional breeding (Sagnard et al 2011). The screening at the morphological level will serve as an initial attempt to facilitate improvement of vegetable amaranths.

Morphological analysis of four *Amaranthus* species concludes that genetic diversity is more important for selecting the better plant for breeding programs. Plant height, inflorescence length, leaf area and seed yield could be important markers for selecting better yielding genotypes, although deep understanding on genetic diversity could be more useful in this regard.

Table: 1(a): MEAN VALUES OF NINE MORPHOLOGICAL CHARACTERISTICS.

S.No.	Parameter	*A.spinosus*	*A. viridis*	*A. tricolor*	*A. blitum*
1.	Plant height (cms)	14.00±1.15	24.19±1.71	36.00±1.67	20.22±3.39
2.	Inflorescence length (cms)	3.17±0.44	2.45±0.58	0.38±0.01	0.49±0.07
3.	Leaf area (cm^2)	2.03±0.34	4.35±0.42	32.88±0.64	3.97±3.65
4.	Days to flowering	42.00±1.45	51.00±3.30	58.00±0.50	58.00±0.57
5.	Stem diameter (cms)	0.37±0.10	0.22±0.02	0.54±0.03	0.29±0.05
6.	Inflorescence per plant	14.00±1.15	15.00±2.68	14.00±0.50	13.00±1.56
7.	Fresh weight (g/plant)	1.68±0.15	2.22±0.85	10.53±0.23	2.97±1.58
8.	Dry weight (g/plant)	0.70±0.50	1.13±0.39	6.15±0.55	1.53±0.75
9.	Seed weight (g/plant)	2.20±0.60	1.99±0.24	3.85±0.25	2.50±0.63

Table 1(b): CORRELATION ANALYSIS

Characters	Plant Height	Inflorescence Length	Leaf Area	Stem diameter	Days of flowering	Inflorescences per plant	Fresh weight	Dry weight	Seed weight
Plant Height	1								
Inflorescence Length	-0.11	1							
Leaf Area	0.81**	-0.47*	1						
Stem diameter	0.56	-0.34	0.88**	1					
Days of flowering	0.11	-0.95*	0.37	0.16	1				
Inflorescences per plant	0.32	0.48	0.06	0.14	-0.53	1			
Fresh weight	0.85**	-0.29	0.94**	0.85**	0.20	0.38	1		
Dry weight	0.84**	-0.34	0.96**	0.86**	0.24	0.30	0.99**	1	
Seed weight	0.51	-0.04	0.72**	0.86**	-0.17	0.34	0.76**	0.75**	1

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