The Bioscan 10(1): 355-358, 2015 (Supplement on Agronomy)
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

ASSESSMENT OF YIELD COMPONENT TRAITS IN CORIANDER OVER ENVIRONMENTS

SANGEETA YADAV* AND ARUN KUMAR BARHOLIA
Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior - 474 002 M.P., INDIA
e-mail: sangeeta_379@rediffmail.com

KEYWORDS
Genotypes
Correlation
Path coefficient
Fertility status
Coriander

Received on :
11.12.2014

Accepted on :
14.02.2015

***Corresponding author**

ABSTRACT
Thirty five genotypes including the land races of Madhya Pradesh were tested in four environments to assess the yield component characters in coriander over environments using correlation and path coefficient analyses. The environments created by adjusting fertility status of the soil in two subsequent years of 2008-09 and 2009 -10. Seed yield per plant was positively and significantly correlated with branches per plant (0.219), plant height (0.602) and umbellate per umbel (0.556) but it was negatively and significantly associated with days to 50% flowering (-0.452) and maturity days (-0.452) over the environments. Plant height (0.639, 0.630, 0.620 and 0.528) and umbellate per plant (0.657, 0.693, 0.579 and 0.528) exhibited significant and positive correlation with seed yield per plant in all the environments. The direct contribution of maturity days (0.208), branches per plant (0.026), plant height (0.300) and umbels per plant (0.089) on seed yield per plant was positive over the environments. These traits thus appeared as major and stable yield component traits. It may be thus concluded that direct selection based on phenotypic performance of these traits would be advantageous for genetic improvement in seed yield of coriander.

INTRODUCTION

Genetic gain in seed yield by selection depends on existence of variability in the genetic stock. However, relationships among seed yield and its attributing traits determines the nature of selection criteria to be practiced for high selection response and genetic gain. Correlations arises due to linkages, pleiotropism and developmental genetic interaction, determines the extent of genetic advancement through simultaneous selection of several characters at a time. The relative merits of correlated characters are judged with the help of path coefficient analysis, developed by Dewey and Lu (1959) which splits the correlation coefficients into their direct and indirect effects. Some attempts have been made to know the relationship between seed yield and its attributing characters in coriander (Sharma *et al.*, 1987; Ali *et al.*, 1993 and Singh *et al.*, 2006), in tomato (Meena and Bahadur, 2014), in linseed (Rajanna *et al.*, 2014) and in green gram (Malaghan *et al.*, 2014). But these studies are based on testing of genotypes in single environment / location. Since the phenotypic expression of a gene/s depend on the surrounding environmental conditions hence, correlation and path analysis based on testing of genotypes in multi-environments would be more advantageous.The information on this aspect is scanty.Keeping these points in view, an attempt was made to determine the yield component traits by using correlation and path coefficient analyses in coriander by testing 35 genotypes in four environments,artificiallycreated by adjusting fertility status of the soil in two subsequent years.

MATERIALS AND METHODS

The material of present study comprised twenty five land races of coriander, collected from different districts of Madhya Pradesh and ten genotypes breed at different research stations in the country. These genotypes were evaluated in four environments created by adjusting fertility status of the soil (high fertility 60:30:15 kg NPK/ha and low fertility 40:20:10 kg NPK/ha) in two subsequent years of 2008-09 and 2009 - 10. The experiment was laid out in randomized complete block design with three replications in each environment. Each genotype was grown in 4 row plots of 4.0 m length with row to row distance of 25 cm on November 07, 2008 and November 11, 2009 under both high and low fertility conditions. The plant to plant distance was maintained at 10 cm in all the environments. Fertilizer was applied as basal @ 60:30:15 kg NPK/ha and 40:20:10 kg NPK/ha in high and low fertility conditions of both the years. The full doses of phosphorus and potassium along with half dose of nitrogen was given as basal at the time of sowing while, rest of the nitrogen was top dressed during the crop growth. The fertilizers were applied as per environment. Ten competitive plants were randomly selected for recording observations on days to 50% flowering, maturity days, branches per plant, plant height (cm), umbels per plant, umbellate per umbel, seed yield (q/ha)and seed yield per plant (g)in each genotype, each replication and each environment. The correlation coefficients among all character combinations at phenotypic,genotypic and environmental levels were analyzed employing formula suggested by Al-Jibouri *et al.* (1958) while, path coefficient analysis was carried out by the method of Dewey and Lu (1959).

RESULTS AND DISCUSSION

Correlation analysis

The direction of genotypic and phenotypic correlations was mostly same but, the magnitude of genotypic correlation was in general, higher than phenotypic correlations (Table 1and 2). It may be due to masking influence of environmental factors in the phenotypic expression of these characters as also reported by Yadava (1988) in barley and Rajanna *et al.* (2014) in linseed. Similarly, the nature of both genotypic and phenotypic correlations was found mostly same in four environments and pooled over environments, but, their magnitudes were considerably different. It revealed the existence of inherent relationship among various characters but, phenotypic expression of these characters was substantially influenced by fertility and climatic conditions prevailed during experimental period even at same location (Singh *et al.,* 1994).

The environmental correlations are least important to crop breeders but, they indicate to what extent different characters are influenced by the environmental conditions. The direction and magnitude of environmental correlations was found independent to genotypic and phenotypic correlations (Table 1 and 2). Majority of environmental correlations were positive in the entire environment and over the environments. It revealed that environmental correlations favoured phenotypic expression of seed yield and its attributing traits of the present study in similar manner to their genetic potential. The environmental correlations mainly include effect of heterogeneity, cultural irregularities and probability of error in experiments (Sikka and Maini, 1962 and Yadava, 1988). Such factors cause harmonic change in plant behaviour, which can be explained in terms of physiological adjustment (Choubey *et al.*, 1991). In the present study, the genotypic and environmental correlations differed in magnitude but these were mostly in the same direction revealing that genetic and environmental factors might have an influence on these traits through similar physiological mechanism as also reported by Singh *et al.* (1994).

In high fertility of 2008-09 (Environment 1), seed yield per plant showed positive and significant correlation with branches per plant (0.350**), plant height (0.639**), umbels per plant(0.657**) and umbellate per umbel (0.292**) while, its association was negative and significant with days to 50% flowering (Table 1). The association of plant height (0.630**), umbels per plant (0.693**) and umbellate per umbel (0.268**) was also found positive and significant with seed yield per plant in low fertility of 2008-09 (environment 2).In high fertility of 2009-10 (environment 3),seed yield per plant exhibited significant and positive correlation with plant height (0.620**), umbels per plant (0.579**) and umbellate per umbel (0.210*). Contrary to this, correlation between seed yield per plant and days to 50% flowering was found significant and negative (-0.269**). Rao *et al.* (1981), Shinde *et al.* (1985), Peter *et al.* (1989)and Singh *et al.* (2006)have observed positive and significant correlation of seed yield with branches per plant, plant height, umbels per plant and umbellate per umbel in coriander.

Correlation analysis over the environments (Table 2) revealed that seed yield per plant was positively and significantly correlated with branches per plant (0.219*), plant height (0.602**) and umbellate per umbel (0.556**) but it was negatively and significantly associated with days to 50% flowering (-0.452**) and maturity days (-0.452**). It is important to point out that seed yield per plant showed positive and significant correlation with plant height and umbels per plant in all the environments and over the environments. The consistency in correlations in different environments reflects the presence of linkages among these characters as also reported by Yadava (1988). The inconsistency in correlation

Table 1: Correlation coefficients between seed yield per plant and yield component traits in coriander in different environments

Characters		Correlation with seed yield per plant			
		Environment 1	Environment 2	Environment 3	Environment 4
Days to 50%	P	-0.575**	-0.743**	-0.432**	-0.269**
Flowering	G	-0.622	-0.804	-0.492	-0.545
	E	0.022	0.165	-0.106	0.142
Maturity days	P	-0.188	-0.446**	-0.182	-0.281**
	G	-0.203	-0.619	-0.219	-0.55
	E	0.023	0.099	0.111	0.024
Branches per plant	P	0.350**	0.169	0.211	0.147
	G	0.38	0.165	0.45	0.313
	E	0.213	0.246	-0.158	0.036
Plant height	P	0.639**	0.630**	0.620**	0.528**
	G	0.682	0.669	0.73	0.969
	E	0.212	0.255	-0.029	0.166
Umbels per plant	P	0.657**	0.693**	0.579**	0.493**
	G	0.692	0.733	0.662	0.919
	E	0.311	0.279	0.138	0.11
Umbellate per umbel	P	0.292**	0.268**	0.210*	-0.018
	G	0.284	0.26	0.225	0.299
	E	0.371	0.342	0.155	-0.51
Seed yield (q/ha)	P	0.669**	0.577**	0.715**	0.566**
	G	0.714	0.623	0.72	0.32
	E	0.276	-0.042	751	0.637

P = Phenotypic, G = Genotypic, E = Environmental correlations;

Table 2: Correlation coefficients between seed yield per plant and yield factors in coriander over environments

Characters	Days to 50% Flowering	Maturity days	Branches per plant	Plant height	Umbels per plant	Umbellate per umbel	Seed yield per plant	Seed yield (q/ha)
Days to 50% Flowering	P	0.826**	-0.095	-0.475**	-0.367**	-0.382**	-0.452**	-0.387**
	G	0.894	-0.112	-0.493	-0.378	-0.406	-0.625	-0.684
	E	-0.071	-0.104	0.079	0.041	-0.009	0.068	0.004
Maturity days		P	-0.014	-0.294**	-0.062	-0.382**	-0.452**	-0.335**
		G	-0.014	-0.323	-0.076	-0.512	-0.369	-0.641
		E	-0.014	0.005	0.116	-0.06	0.03	0.024
Branches per plant			P	0.228*	0.422**	0.231*	0.219*	0.191*
			G	0.312	0.548	0.312	0.376	0.443
			E	0.069	0.02	0.004	0.007	-0.011
Plant height				P	0.793**	0.326**	0.602**	0.391**
				G	0.814	0.346	0.814	0.708
				E	0.322	0.088	0.109	-0.013
Umbels per plant					P	0.175	0.566**	0.332**
					G	0.175	0.758	0.591
					E	0.209	0.132	0.006
Umbellate per umbel						P	0.151	0.236*
						G	0.274	0.518
						E	-0.187	-0.167
Seed yield per plant							P	0.610**
							G	0.628
							E	0.625

P = Phenotypic, G = Genotypic, E = Environmental correlations; * and ** Significant at 5 and 1 per cent, respectively

Table 3: Direct and indirect effects of yield factors on yield per plant in coriander over environments

Characters		Days to 50% Flowering	Maturity days	Branches per plant	Plant height	Umbels per plant	Umbellate per umbel	Seed yield (q/ha)	Correlation with seed yield per plant
Days to 50% Flowering	PG	**-0.317 -1.016**	0.172 0.620	-0.002 -0.023	-0.142 -0.349	-0.033 0.079	0.036 0.005	-0.165 0.058	-0.452** -0.625
Maturity days	PG	-0.262 -0.908	**0.208 0.693**	0.000 -0.003	-0.088 -0.228	-0.006 0.016	0.043 0.006	-0.143 0.055	-0.452** -0.369
Branches per plant	PG	0.030 0.114	-0.003 -0.010	**0.026 0.208**	0.068 0.221	0.038 -0.115	-0.022 -0.004	0.082 -0.038	0.219* 0.376
Plant height	PG	0.151 0.501	-0.061 -0.224	0.006 0.065	**0.300 0.707**	0.071 -0.171	-0.031 -0.004	0.168 -0.060	0.602** 0.814
Umbels per plant	PG	0.116 0.384	-0.013 -0.053	0.011 0.114	0.238 0.576	**0.089 -0.210**	-0.017 -0.002	0.142 -0.050	0.566** 0.758
Umbellate per umbel	PG	0.121 0.412	-0.096 -0.355	0.006 0.065	0.098 0.245	0.016 -0.037	**-0.094 -0.012**	0.101 -0.044	0.151 0.274
Seed yield (q/ha)	PG	0.123 0.695	-0.070 -0.444	0.005 0.092	0.117 0.501	0.030 -0.124	-0.022 -0.006	**0.428 -0.085**	0.610** 0.628

P = Phenotypic, G = Genotypic;* and ** Significant at 5 and 1 per cent, respectively; A bold figure denotes the direct effects. Residual effect P = 0.425, G = 0.183

of branches per plant with seed yield per plant indicates the existence of pleiotropic effects of the genes and developmental genetic interactions (Ali *et al.* (2004).

Path coefficient analysis

Correlation coefficients between seed yield per plant and its attributing characters were partitioned into their direct and indirect effects considering seed yield per plant as dependent variable using path coefficient analysis, developed by Dewey and Lu (1959).Some attempts have been made to know the yield factors in coriander (Sharma and Sharma, 1989, Ali *et al.*, 1993 and Singh *et al.,* 2006), but, these studies are based on testing of inbred lines in single environmental conditions. Hence, yield factors were assessed over environments in this study. Path analysis over environments revealed that days to maturity (0.208), branches per plant (0.026), plant height (0.300)and umbels per plant (0.089) exhibited direct positive bearing towards seed yield per plant (Table 3). Umbellate per umbel contributed indirectly via days to 50% flowering (0.121), branches per plant (0.006), plant height (0.098) and umbels per plant (0.016). Similarly, days to 50% flowering showed indirect bearing on seed yield per plant via days to maturity (0.172) and umbellate per umbel (0.036). These traits thus appeared as major and stable yield factors as also reported by Ali *et al.* (2004) in coriander. The inconsistency in direct and indirect effects of branches per plant and umbellate per umbel in different environments showed their susceptibility towards environmental variations. Hence, precaution may be taken on these traits during selection breeding programmes (Yadava, 1988 and Singh *et al.*, 2006). The direction and magnitude of residual effects (P =0.425 and G = 0.183) were also positive which may be either due to variation in environmental conditions or due to certain characters which were not taken under consideration under scope of this study.

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