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Genetic association in fennel grown on sodic soil

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Abstract

Correlation and path analysis of 30 genotypes of fennel (*Foeniculum vulgare* Mill.) grown in sodic soils of Banthra Research Station of NBRI, Lucknow, India, were worked out. Results showed significant genotypic association of seed yield with plant height and stover yield. The stover yield had a positive direct path with seed yield followed by branches plant^{-1}. Plant height exhibited significant positive genotypic association with all the traits, which suggests that plant height is mainly responsible for increase of each trait, ultimately contributing in the enhancement of seed yield. The plant height, number of branches per plant and stover yield were found important components to build an ideal plant type to increase seed yield. Hence selection should be based on these traits.

Key words: *Foeniculum vulgare*, path analysis, selection criteria, sodic soils

Fennel (*Foeniculum vulgare* Mill.), an aromatic herb (biennial with potency of regeneration), is chiefly cultivated in arid and semi arid regions of India for production of seed as spice or essential oil for commercial uses. In India it is chiefly grown in the states of Rajasthan, Gujarat and Uttar Pradesh in an area of about 17,400 ha (including sodic soil) with an annual production of about 18,100 tones (Agnihotri *et al.* 1997). However, one third area of these states is under salt affected soils. Despite of its great national and international demand for seed and herb, the crop remained neglected as far as genetic improvement is concerned particularly for sodic soils. The seed yield is a polygenically controlled character, but is not an efficient trait for selection, since it is governed by many physiological changes within the plant and influenced by many environmental factors in which plant is being grown. Interrelationship among various agronomic traits alongwith direct and indirect influence of component characters of yield is important, which may be used in the prediction of the correlated responses to directional selection and in the detection of traits as useful markers. Very meager work on this aspect has so far been done to obtain such estimates (Agnihotri *et al.* 1997). Hence, an experiment was conducted on sodic soil to elucidate the interrelationship among different agronomic traits in fennel by correlation and path analysis.

The material comprised of 30 distinct genotypes of fennel. They were raised in a randomized block design with 3 replications in the cropping year 2000-2001 at Banthra Research Station of NBRI , Lucknow, India, situated at 26^0 40′ to 26^0 45′ N latitude and 80^0 45′ to 80^0 53′ E longitude. Each entry was sown at 25 ESP (an

index of sodicity) in the last week of October with row to row distance of 45 cm and plant to plant distance of 30 cm in a plot size of 4 m x 3 m. Normal cultural practices were followed and irrigated as and when required. The crop was harvested in the first week of May. The experimental site soil belongs to the family of Typic Halaquepts having silt loam texture in the surface soil with pH ranging from 8.6 to 10.0 and electrical conductivity (EC) seldom exceeding 2dSm^{-1}. Soils are extremely saturated with exchangeable sodium having more than 25 ESP and predominant in carbonate and bicarbonate ions. The observations were recorded on 5 plants from each entry and replication for the traits viz. plant height, branches plant^{-1}, umbel plant^{-1}, umbellets umbel^{-1}, stover yield plant^{-1} and seed yield. The genotypic and phenotypic correlations were computed as suggested by Singh & Chaudhary (1995) and path coefficient as described by Dewey & Lu (1959).

The analysis of variance of treatments was significant for all the characters suggesting scope for further genetic studies. In general, genotypic correlations were higher than their corresponding phenotypic correlations in all the cases (Table 1) thereby, suggesting strong inherent association between various characters at genetic level. At phenotypic level, seed yield exhibited a significant positive association with plant height and stover yield plant^{-1}; plant height with branches plant^{-1}, umbels plant^{-1}, umbellets umbel^{-1} and stover yield and branches plant^{-1} with umbels plant^{-1} and umbellets umbel^{-1}. However, the seed yield showed a strong positive genotypic association with plant height (0.496) and stover yield (0.873) indicating that selection for this trait would lead to an improvement in yield. It is interesting to note that plant height showed significant positive genotypic association with all the traits under study, which suggests that plant height plays a major role in the enhancement of seed yield through other contributing traits. The branches plant^{-1} had significant positive association with umbels plant^{-1} and umbellets umbel^{-1}, but had negative and significant association with stover yield. The umbels plant^{-1} had significant positive association with stover yield.

Table 1. Genotypic and phenotypic (in parenthesis) correlation coefficient among six agronomic traits in fennel

Character	Plant height	Branches plant^{-1}	Umbels plant^{-1}	Umbellets umbel^{-1}	Stover plant^{-1}
Seed yield	0.496**	0.014	0.219	0.164	0.873
	(0.467)**	(0.059)	(0.203)	(0.166)	(0.815)**
Plant height		0.399**	0.539**	0.357**	0.587**
		(0.351)**	(0.520)**	(0.333)**	(0.528)**
Branches plant^{-1}			0.761**	0.368**	-0.249*
			(0.638)**	(0.323)*	(-0.109)
Umbels plant^{-1}				0.114	0.253*
				(0.105)	(0.231)
Umbellets umbel^{-1}					0.029
					(0.039)

**, * Significant at 1% and 5%, respectively.

Table 2. Path coefficient analysis for five agronomic traits of seed yield in fennel

Character	Plant height	Branches plant^{-1}	Umbels plant^{-1}	Umbellets umbel^{-1}	Stover plant^{-1}	Genotypic correlation seed yield
Plant height	-0.771	0.858	-0.833	-0.085	1.326	0.496**
Branches plant^{-1}	-0.308	2.149	-1.176	-0.088	-0.563	0.014
Umbels plant^{-1}	-0.415	1.635	-1.546	-0.027	0.573	0.219
Umbellets umbel^{-1}	-0.275	0.789	-0.177	-0.239	0.066	0.164
Stover yield	-0.453	-0.535	-0.392	-0.007	2.259	0.873**

Residual effect = 0.541.

The genotypic correlations were partitioned into direct and indirect effects to know the relative importance of the components. The plant height had a significant positive genotypic correlation with seed yield but showed a negative direct path, which was nullified via high indirect path of branches plant^{-1} and stover. The trait, branches plant^{-1} showed low positive correlation with seed yield but had good direct path which is in agreement of the general expectation i.e. if the plant bears larger number of branches, the seed yield would be definitely higher. Agnihotri *et al.* (1997) also reported high positive direct path for branches plant^{-1} with seed yield under normal soil. In contrast to this, umbels plant^{-1} and umbellets umbel^{-1} showed positive correlation with seed yield and had negative direct path but were indirectly affected via branches plant^{-1} and stover yield. In the present study the difference in the contributing traits towards seed yield under normal and sodic soil may be due to different genetic material, agro climatic conditions or soil texture. The stover yield showed significant positive association with seed yield and also had high direct path which is clearly understandable. When the stover yield increased, the plant would be healthy and vigorous, bearing more branches and umbels which result in increased yield. The high value of residual effect indicated that there might be some other secondary components that should not be ignored.

It is evident from the present study that the yield potential in fennel can be enhanced by making the selection of ideal plant type, with higher plant height, more number of branches plant^{-1} and larger stover yield, which may bear more number of umbels and umbellets umbel^{-1}.

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