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ESTIMATION OF CORRELATION AND PATH COEFFICIENT ANALYSIS IN FENNEL (*FOENICULUM VULGARE* MILL.)

Kalyan Singh[1]*, C.N. Ram[1], Neetu[2], D.K. Singh[3], Nishakant Maurya[1], Anurag Singh[4] and Mohit Kumar[4]

[1]Department of Vegetable Science, College of Horticulture and Forestry, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya, Uttar Pradesh, India.

[2]Department of Vegetable Science, College of Horticulture, Banda University of Agriculture & Technology, Banda - 210 001 (U.P.), India.

[3]Department of Basic & Social Sciences, College of Horticulture Banda University of Agriculture & Technology, Banda - 210 001 (U.P.), India.

[4]Departments of Genetics & Plant Breeding, College of Agriculture, Banda University of Agriculture & Technology, Banda - 210 001 (U.P.), India.

*Corresponding author E-mail : kalyansingh9628@gmail.com

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ABSTRACT

The present investigation was carried out with a view to study the correlation and path coefficient analysis in fennel (*Foeniculum vulgare* Mill.) at Main Experimental Station of Department of Vegetable Science, ANDUA&T, Kumarganj, Ayodhya (U.P.) during *Rabi*, 2018-19 in Augmented Block Design. Observations were recorded on twelve characters of ninety-four genotypes with three checks. Correlation studies revealed that the most important trait, seed yield per plant had exhibited highly significant and positively phenotypic correlation with 1000-seed weight (0.839**) followed by number of umbels per plant (0.664**), number of grains per umbel (0.597**), number of umbellets per umbel (0.568**) and weight of grain per umbel 90.5098*). The higher magnitude of positive direct effect on seed yield per plant was exerted by number of umbellets per umbel 90.575) followed by 1000-seed weight (0.335), number of umbels per plant (0.332), number of grains per umbel (0.134) and days to 50 % flowering (0.129). This indicates the attributing characters among the genotypes evaluated and will be improved by selection and breeding programme for yield and attributing characters.

Key words : Fennel, Augmented Block Design, Correlation coefficient, Path coefficient analysis.

Introduction

Among the spices crops fennel *(Foeniculum vulgare* Mill. 2n=2x=22) is most emerging and medicinal seed spices crops which belong to family Apiaceae (Umbelliferae). Its commonly vernacular names are sauff (in Hindi), Variari (in Gujarati), Badishep (in Marathi). It is allogamous (cross-pollinated) crops with cross pollination up to 82.2 to 95.40% (Ramanujam *et al*., 1964). The flowers are produced terminal, compound umbel 5-50 cm in diameter. Flower is yellow, bisexual, actinomorphic and open centripetally. The leaves grow up to 40 cm long; they are finally dissected with ultimate filiform (thread like). The fruit (schizocarp) is light green to dark brown, lens shaped pedicel and short stylopodium. A fully grown fruit is 4 to 8 mm long. The seed of fennel contains approximately carbohydrates (42.3%), crude fibre (18.5%), minerals (13.4%), fat (10%) and protein (9.5%). The seed contains 0.7% to 6.0% volatile oil depends on the varieties (Kumawat *et al*., 2020). Anethole (70%) and fenchone (12-15%) are main constituents of the fennel seeds which are responsible for sweetness and bitterness respectively. It is now extensively cultivated on large scale in temperate and subtropical regions of the worlds like Romania, Russia, Germany, France, Italy, India, Argentina and United States. It is also grown in Bulgaria, China, Denmark, Egypt, Syria and Japan. Fennel seeds, leaves and roots have medicinal properties. The roots are regarded as a purgative. Fennel fruits are also used in flatulence, fever, intestinal colic, burning sensation and constipation and made into gripe

water for babies. Its extract is used in oral composition, such as toothpaste, for preparation of dental caries and periodontal disease, compresses of an infusion of leaves and fruits relieve sore eyes. A hot infusion of fruits is useful in amenorrhoea. They are a constituent of liquorice power and of preparation for allaying griping. The fennel oil is used as a flavouring agent in culinary preparation, confectionary, cordials and liqueurs. It is stimulant and carminative and useful in infantile colic and flatulence, and is also a good vermicide against hookworms.

In India, the major fennel producing states like Gujarat, Rajasthan and Uttar Pradesh, while many other states grown it on a small scale such as Bihar, Madhya Pradesh, Punjab, and Haryana. Gujarat is the leading state in fennel production, which contributes about 80-85% of total production in India (Anonymous, 2020). In India, present area under fennel cultivation is greatly increases from previous years with offering 90.0 thousand hectares with 157 thousand MT and productivity 1.575MT/ha.

The knowledge of the associations of yield and its components enables breeder to know how the selections pressure exerted on one trait will cause changes in other traits (Aliyu, 2006). Correlation studies combined with path coefficient analysis are a strong tool for studying character associations and their final influence on yield, allowing for appropriate selection techniques. The correlation coefficient gives an idea about the various associations existing between the yield and yield component. It only reveals the direction and magnitude of association between any two characters but the path coefficient analysis helps in partitioning the correlation into direct and indirect effects of various yields and yield component.

Materials and Methods

The experiment was conducted at Main Experiment Station, Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Ayodhya (U.P.), India in well leveled field having proper drainage facilities. This Farm is situated in the main campus of this university on left side of Ayodhya-Raebareli road at a distance of 42 km away from main city of Ayodhya district. Geographically, Narendra Nagar is located in between 24.47^0 and 26.56^0 N latitude and 82.12^0 and 83.98^0 E longitude at an altitude of 113 m above the mean sea level in the Gangetic Alluvial Plains of Eastern Uttar Pradesh of Ayodhya district.

The experiment was conducted in Augmented Block Design with replicated thrice to assess the performance of 94 genotypes of fennel including four checks. The crop was planted at 40cm × 60cm spacing. The experiment was sown in during winter 2019. All the recommended agronomic practices and plant protection measures were adopted to raise a better crop stand. The fertilizer was applied @ 10 tonnes FYM and80:40:40 (NPK kg/ha) were given. Plant protection measures were followed and the subsequent irrigation was given as required. The observations were recorded for 10 different characters viz., days to 50% flowering, plant height (cm), days to maturity, primary branches per plant, number of umbels per plant, number of umbellets per umbel, number of grains per umbellate, weight of grains per umbels (g), 1000-seed weight (g) and seed yield per plant (g). The data were statistically analyzed for estimation of correlation coefficient was using formula by Searle (1961) and analysis of path coefficients was done using Dewey and Lu (1959).

Results and Discussion

Perusal of Table 1 : The most important trait seed yield per plant (g) had exhibited highly significant and positive phenotypic correlation with 1000-seed weight (0.839**) followed by number of umbels per plant (0.664**), number of grains per umbel (0.597**), number of umbellets per umbel (0.568**) and weight of grains per umbel (0.509**). Whereas, number of branches per plant (0.068) exhibited low significant positive phenotypic correlation with seed yield per plant. While, plant height (-0.116) followed by days to 50% flowering (-0.124) and days to maturity (-0.166) exhibited significant negative association with seed yield per plant. Days to 50% flowering showed significant positive correlation with days to maturity (0.953**) followed by number of umbellets per umbel (0.310**) and number of grains per umbel (0.289**). While, it was negatively associated with 1000-seed weight (-0.023) and plant height (-0.078). Days to maturity had significant positive association with number of umbellets per umbel (0.339**) and number of grains per umbel (0.237*) but negatively correlated with plant height (-0.034) and 1000-seed weight (-0.039). Plant height (cm) showed significant positive association with number of branches per plant (0.492**) followed by number of umbellets per umbel (0.483**), number of grains per umbel (0.405**) and weight of grains per umbel (0.239*). However, 1000-seed weight (-0.435**) was highly significant and negatively correlated with plant height. Number of branches per plant showed highly significant and positive correlation with number of grains per umbel (0.409**) followed by number of umbels per plant (0.386**), weight of grains per umbel (0.383**) and number of umbellets per umbel (0.364**). While, 1000-seed weight (-0.080) was negatively correlated with number of branches per plant. Number of umbels per plant was highly significant and positively correlated with all the characters such as number of grains per umbel (0.534**) followed by 1000-seed weight (0.445**),

Table 1 : Estimates of phenotypic correlation coefficient between different characters in fennel genotypes.

Characters	Days to maturity	Plant height	Number of branches per plant	Number of umbels per plant	Number of umbellets per umbel	Number of grains per umbel	Weight of grains per umbel	1000-seed weight	Seed yield per plant
Days to 50% flowering	0.953**	-0.078	0.162	0.133	0.310**	0.289**	0.134	-0.023	**-0.124**
Days to maturity		-0.034	0.078	0.088	0.339**	0.237*	0.103	-0.039	**-0.166**
Plant height (cm)			0.492**	0.109	0.483**	0.405**	0.239*	-0.435**	**-0.116**
Number of branches per plant				0.386**	0.364**	0.409**	0.383**	-0.080	**0.068**
Number of umbels per plant					0.415**	0.534**	0.230*	0.445**	**0.664****
Number of umbellets per umbel						0.814**	0.747**	0.330**	**0.568****
Number of grains per umbel							0.780**	0.352**	**0.597****
Weight of grains per umbel (g)								0.332**	**0.509****
1000-seed weight (g)									**0.839****

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

number of umbels per umbellets (0.415**) and weight of grains per umbel (0.230*). Number of umbellets per umbel had highly significant positive correlation with number of grains per umbel (0.814**) followed by weight of grains per umbel (0.747**) and 1000-seed weight (0.330**). Number of grains per umbel showed significant positive association with weight of grains per umbel (0.780**) and 1000-seed weight (0.352**). Weight of grains per umbel had significant positive correlation with 1000-seed weight (0.332**). Similar results were also given by Yadav *et al.* (2013), Sefidan *et al.* (2014) and Meena and Dhakar (2017).

Path coefficient analysis reveals that the higher magnitude of positive direct effect at phenotypic level on seed yield was exerted by number of umbellets per umbel (0.575) followed by 1000-seed weight (0.335), number of umbels per plant (0.322), number of grains per umbel (0.134) and days to 50% flowering (0.129). While, substantial negative direct effect on seed yield per plant was exerted by days to maturity (-0.524) followed by plant height (-0.273), number of branches per plant (-0.115) and weight of grains per umbel (-0.066). In case of indirect contribution of the characters toward seed yield per plant indicated that 1000-seed weight (0.149) via number of umbels per plant, followed by number umbels per plant (0.172, 0.143 and 0.134) via number of grains per umbel, 1000-seed weight and number of umbellets per umbel, respectively. Number of grains per umbel exerted substantial positive indirect effect (0.109 and 0.105) on seed yield per plant via number of umbellets per umbel and weight of grains per umbel. Number of umbellets per umbel showed substantial positive indirect effect (0.468, 0.430) on seed yield per plant via number of grains per umbel and weight of grains per umbel. While, considerable indirect effect on seed yield per plant were showed by days to maturity (-0.178, -.0.124) and plant height (-.0.132, -0.110) via number umbellets per umbel and number of grains per umbel, respectively. Similar results were also reported by Cosge *et al.* (2009) and Sefidan *et al.* (2014), Jeeterwal (2015), Yadav *et al.* (2013), Meena and Dhakar (2017).

Table 2 : Direct and indirect effects of different characters on seed yield per plant at phenotypic level in fennel genotypes.

Characters	Days to 50 % flowering	Days to maturity	Plant height	Number of branches per plant	Number of umbels per plant	Number of umbellets per umbel	Number of grains per umbel	Weight of grains per umbel	1000-seed weight	Correlation with seed yield/plant
Days to 50% flowering	**0.129**	0.123	-0.010	0.021	0.017	0.040	0.037	0.017	-0.003	**-0.124**
Days to maturity	-0.500	**-0.524**	0.018	-0.041	-0.046	-0.178	-0.124	-0.054	0.020	**-0.166**
Plant height (cm)	0.021	0.009	**-0.273**	-0.134	-0.030	-0.132	-0.110	-0.065	0.118	**-0.116**
Number of branches per plant	-0.019	-0.009	-0.057	**-0.115**	-0.045	-0.042	-0.047	-0.044	0.009	**0.068**
Number of umbels per plant	0.043	0.028	0.035	0.124	**0.322**	0.134	0.172	0.074	0.143	**0.664****
Number of umbellets per umbel	0.178	0.195	0.278	0.210	0.239	**0.575**	0.468	0.430	0.189	**0.568****
Number of grains per umbel	0.039	0.032	0.054	0.055	0.072	0.109	**0.134**	0.105	0.047	**0.597****
Weight of grains per umbel (g)	-0.009	-0.007	-0.016	-0.025	-0.015	-0.049	-0.051	**-0.066**	-0.022	**0.509****
1000-seed weight (g)	-0.008	-0.013	-0.146	-0.027	0.149	0.111	0.118	0.111	**0.335**	**0.839****

Residual effect = 0.19047

Conclusion

The characters number of umbellets per umbel followed by 1000-seed weight, number of umbels per plant, number of grains per umbel and days to 50% flowering have highest positive direct effect on seed yield per plant. While, substantial negative direct effect on seed yield per plant was exerted by days to maturity followed by plant height, number of branches per plant and weight of grains per umbel.

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