Int.J.Curr.Microbiol.App.Sci (2020) *9*(3): 152-158

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 9 Number 3 (2020)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2020.903.018

Correlation and Path Coefficient Analysis for Yield and Yield Component Traits in S_6 Progenies of Fennel (*Foeniculum vulgare* Mill.)

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Keywords

Genetic variability, Correlation, Path analysis, Fennel (*Foeniculum vulgare* Mill.)

Article Info

Accepted:
05 February 2020
Available Online:
10 March 2020

A B S T R A C T

Genetic variability, heritability and correlation at genotypic and phenotypic levels and path analysis were studied for various yield and its component characters in seventy five S_6 progenies along with five checks of fennel (*Foeniculum vulgare* Mill.) during Rabi, 2009-10. Analysis of variance revealed significant difference for all the characters indicating the presence of good amount of variability in the S_6 progenies studied. The estimates of GCV along with PCV, heritability and genetic advance as percentage of mean were higher for seed yield per plant. The range and coefficient of variation indicated that the variability and genetic advance as percentage of mean was high for seed yield per plant (g), umbels per plant, seeds per umbel and umbellets per umbel. Moderate variability was found for branches per plant and plant height (cm). Low variability was observed for 1000-seed weight (g) and days to 50% flowering. Correlation studies revealed that seed yield per plant was positively and significantly associated with branches per plant, umbels per plant, seeds per umbel, 1000- seed weight and umbellets per umbel and showed negatively significant correlation with days to 50% flowering. Path coefficient analysis revealed that umbels per plant had highest positive direct effect on seed yield per plant followed by seeds per umbel, branches per plant, umbellets per umbel and 1000- seed weight. Based upon the present experiment, it is suggested that in breeding programmes major emphasis should be given to umbels per plant, seeds per umbel, branches per plant, umbellets per umbel and 1000-seed weight as these had positive correlation with seed yield with high direct effect. The Result suggested that exploitation of these S_6 progenies suitable for selection and breeding methodology to be adopted to develop high yielding types.

Introduction

Fennel (*Foeniculum vulgare* Mill; 2n=22) is a temperate and tropical important spices crop mainly grown in the countries like Romania, Russia, Hungary, Germany, France, Italy, India, Sri Lanka, Malaysia, Japan, Argentina & cultivated throughout the world belonging to family Apiaceae is an allogamous crop with (82.2 to 95.4%) cross- pollination (*Ramanujam et al.*, 1964). Fennel is widely accepted as a native of southern Europe. The plant is pleasantly aromatic and each of the parts-leaves, stalks, bulbs and seeds, is edible. The fish string-like leaves are valued as source of flavour garnish and also possess diuretic properties. Fennel fruits are used in diseases like cholera, bile disturbances, nervous disorders, constipation, dysentery and diarrhea and also used for control of diseases attacking chest, lungs, spleen, kidney and in colic pain. In India the seeds are also used for mastication and chewing either alone or with betel leaves (Girija Lakshman, 1952). The seeds contain about protein (9.5%), fat (10%) carbohydrates (42.3%) crude fibre (18.5%) and minerals (13.4%). The seeds contain about 0.7% to 6.0% volatile oil depending on the genotypes. The main constituent of the fennel oil is anethole and fenchone. The other constituents are methyl chavicol, alpha-pinene, camphene, alpha phellandrene and dipentene. The volatile oil extracted from seeds is used for scenting soaps and flavouring cakes (Stanley Redgrove, 1933). Fennel oil and fennel oleoresins are used in pizza sauces, topping, non-alcoholic beverages, liquors, Ice creams and in seasoning of processed meats. The Volatile oil is used in the manufacture of cordials and enters in to the composition of fennel water, which is commonly given to infants as medicine. The volatile oil is primarily beneficial for digestive system and also exhibits vermicidal, antispasmodic and anti-flatulence properties. Genetic variability plays an important role in selecting best progenies for making rapid improvement in yield and other desirable characters. Heritability is an index for calculating the relative influence of environment on expression of progenies. It is comprised of additive and non-additive variance which helps in the selection of elite progenies. The expected genetic advance is important to have an idea of effectiveness of selection. Estimates of heritability together with genetic advance predict the expected progress to be achieved through selection. Correlation coefficient is a statistical measure, which is used to find out the degree and direction of relationship between two or more variables. It measures the mutual relationship between various plant characters and determines the component characters on which selection can be exercised for genetic improvement in yield. Keeping in view the study was conducted to find out the extent of variability, heritability, genetic advance as percentage of mean, correlation at genotypic and phenotypic levels and path analysis for yield and its contributing traits in S_6 progenies of fennel.

Materials and Methods

The present investigation was carried out at experimental farm, Department of Plant Breeding and Genetics, S.K.N. College of Agriculture, Jobner, Jaipur (Rajasthan) during Rabi 2009-10. Jobner is located in the semi-arid tropic zone of Rajasthan. Geographically Jobner is situated at a latitude of $20^0$5' N and longitude of $75^0$20' E at an altitude of 427 M above the SML. The experimental material consisted of seventy five diverse S_6 progenies of fennel (*Foeniculum vulgare* Mill.), with 5 checks namely RF- 101, RF-125, RF-143, RF-205 and local. The experiment was laid out in randomized block design with three replications. The seeds were sown at a spacing of 3.0 x 0.50 sqm recommended agronomic practices and plant protection

measures were followed to maintain optimum plant stand. The observations were recorded on five randomly selected competitive plants from each plot in every replication for the traits viz. Days to 50% flowering, plant height (cm), Branches per plant, umbels per plant, umbellets per umbel, seeds per umbel, 1000-seeds weight (g), seed yield per plant (g). The data were averaged and statistically analyzed for analysis of variance as per the method suggested by Panse and Sukhatme (1995). The genotypic and phenotypic coefficients of variation were worked out according to Burton (1952). The genotypic and phenotypic correlation coefficients were calculated from the genotypic and phenotypic covariance and variance as described by Singh and choudhary (1997) and as per formula given by Johnson *et al.,* (1955).

Results and Discussion

The analysis of variance indicated significant differences among the S_6 progenies for all the observed characters which indicated that high amount of genetic variability were present in the genetic material. The extent of genotypic variability indicated the amenability of a given character for its improvement (Burton, 1952).The phenotypic coefficients of variation (PCV) were higher than the respective genotypic coefficients of variation (GCV) for all the characters which indicated the positive effect of environment in enhancing differences among the S_6 progenies of phenotypic level. Phenotypic coefficient of variation (PCV) was highest for seed yield per plant (25.559%) followed by umbels per plant (23.056%),seeds per umbel (22.249%), umbellets per umbel (20.041%), branches per plant (13.907%), plant height (10.179%), 1000-seed weight (8.715%), whereas, minimum value of PCV was recorded for days to 50% flowering in S_6 progenies of fennel. The genotypic coefficient of variation (GCV) for seed yield per plant was maximum (22.548%), followed by umbels per plant (21.119%), seeds per umbel (21.114%), branches per plant (9.135%), 1000-seed weight (7.977%), plant height (6.297%), while, it was lowest for days to 50% flowering in S_6 progenies of fennel. Similar results were earlier reported by Chandra *et al.*, (2008), Sastry *et al.,* (2009), Malik *et al.,* (2009) and Meena *et al.,* (2009).

The correlation studies revealed that in general estimates of genotypic correlation coefficients were higher than the corresponding phenotypic correlation coefficients, which indicated a strong inherent association among different traits under study (Table 1). The lower phenotypic values might be due to environmental interactions.

A significant positive correlation of seed yield per plant was observed with branches per plant (0.2381), umbels per plant (0.2338), seeds per umbel (0.1676), 1000- seeds weight (0.1622) and umbellets per umbel (0.1596) at phenotypic level and with branches per plant (0.3064), umbels per plant (0.2819), umbellets per umbel (0.2291), 1000-seed weight (0.2137) and seeds per umbel (0.2051) at genotypic level, which, suggested that these characters could be considered as seed yield per plant contributing characters in fennel similar results were earlier obtained by Kathiria (1980), Agnihotri *et al.,* (1997), Singh *at el*. (2004), Singh and Sastry (2005), Lal (2006), Meena *et al.,* (2009) and Pareek *et al.,* (2009). Seed yield per plant observed significant and negative correlation with days to 50% flowering (-0.2922) and plant height (-0.0100), which, indicated that selection should be practiced for less days to flowering and fruits setting (earliness). The Results were in accordance with the findings of Meena *et al.,* (2009).

The results of path analysis revealed that umbels per plant had highest positive direct

effects (0.1807) followed by seeds per umbel (0.1446), branches per plant (0.1401), umbellets per umbel (0.0842) and 1000-seed weight(0.0631) on seed yield per plant at phenotypic level whereas highest negative direct effects were recorded for days to 50% flowering(-0.2870) followed by plant height(-0.1039) on seed yield per plant at phenotypic level under study (Table 2).

The observations of path analysis at genotypic level revealed that among all the characters branches per plant (0.2781) had highest positive direct effect on seed yield per plant followed by umbellets per umbel(0.2774), umbels per plant (0.1660), seeds per umbel (0.1513), and 1000-seed weight (0.0461). Whereas, highest negative direct effects at genotypic level were recorded for days to 50% flowering (-0.4803) and plant height (0.3098) on seed yield per plant. Perusal of indirect effects at phenotypic level revealed that days to 50% flowering had positive indirect effect via seeds per umbel(0.0150) whereas, it had negative indirect effect via umbels per plant (-0.0137). Plant height had positive indirect effect via seeds per umbel (0.0387) whereas, it had negative indirect effect via days to 50% flowering (-0.0321). Branches per plant had positive indirect effect via umbels per plant (0.0503) while, it had negative indirect effect via plant height (-0.0253). Umbels per plant had positive indirect effect via branches per plant (0.0390) while, it had negative indirect effect via seeds per umbel (-0.0122). Umbellets per umbel had positive indirect effect via seeds per umbel (0.0727). While, it had negative indirect effect via plant height (-0.0327).Seeds per umbel had positive indirect effect via umbellets per umbel (0.0424) while, it had negative indirect effect via days to 50% flowering (-0.0297), 1000-seed weight had positive indirect effect via seeds per umbel (0.0304) and had negative indirect effect via plant height (-0.0164).

Table.1 Genotypic and phenotypic correlation coefficient between different characters in fennel

Characters	G/P	Days to 50% flowering	Plant height (cm)	Branches per plant	Umbels per plant	Umbellets per umbel	Seeds per umbel	1000-seed weight (g)	Seed yield per plant (g)
Days to 50% flowering	G	1	0.2565	0.1307	-0.1272	0.1933	0.2225	-0.1336	-0.4634
	P	1	0.1117	0.0108	-0.0765	0.1099	0.1034	-0.0875	-02922**
Plant height (cm)	G		1	0.5325	0.1430	0.6383	0.4069	0.2938	-0.0088
	P		1	0.2429**	0.0924	0.3144**	0.2677**	0.1575*	-0.0100
Branches per plant	G			1	0.3560	0.4577	0.4049	0.1879	0.3064
	P			1	0.2781**	0.3319**	0.2854**	0.1076	0.2381**
Umbels per plant	G				1	0.0295	-0.1178	0.2117	0.2819
	P				1	0.0460	-0.0839	0.1580*	0.2338**
Umbellets per umbel	G					1	0.6541	0.2405	0.2291
	P					1	0.5030**	0.1917*	0.1596**
Seeds per umbel	G						1	0.2651	0.2051
	P						1	0.2100**	0.1676*
1000-seed weight(g)	G							1	0.2137
	P							1	0.1622*
Seed yield per plant (g)	G								1
	P								1

Table.2 Direct and Indirect effects of different characters on seed yield per plant in fennel at genotypic and phenotypic level

Characters	G/P	Days to 50% flowering	Plant height (cm)	Branchs per plant	Umbels per plant	Umbells per umbel	Seeds per umbel	1000-seed weight(g)	Correlation with seed yield per plant (g)
Days to 50% flowering	G	-0.4803	-0.0795	0.0364	-0.0212	0.0537	0.0337	-0.0062	-0.4634
	P	-0.2870	-0.0116	0.0016	-0.0137	0.0093	0.0150	-0.0056	-02922**
Plant height (cm)	G	-0.1232	-0.3098	0.1481	0.0238	0.1771	0.0616	0.0136	-0.0088
	P	-0.0321	-0.1039	0.0341	0.0167	0.0265	0.0387	0.0100	-0.0100
Branches per plant	G	-0.0628	-0.1650	0.2781	0.0591	0.1270	0.0613	0.0087	0.3064
	P	-0.0031	-0.0253	0.1401	0.0503	0.0280	0.0413	0.0068	0.2381**
Umbels per plant	G	0.0611	-0.0443	0.0990	0.1660	0.0082	-0.0179	0.0098	0.2819
	P	0.0220	-0.0096	0.0390	0.1807	0.0039	-0.0122	0.0100	0.2338**
Umbellets per umbel	G	-0.0929	-0.1977	0.1273	0.0049	0.2774	0.0990	0.0111	0.2291
	P	-0.0316	-0.0327	0.0465	0.0084	0.0842	0.0727	0.0121	0.1596**
Seeds per umbel	G	-0.1069	-0.1261	0.1126	-0.0196	0.1815	0.1513	0.0123	0.2051
	P	-0.0297	-0.0278	0.0400	-0.0152	0.0424	0.1446	0.0133	0.1676*
1000-seed weight(g)	G	0.0642	-0.0910	0.0523	0.0352	0.0668	0.0401	0.0461	0.2137
	P	0.0252	-0.0164	0.0151	0.0286	0.0162	0.0304	0.0631	0.1622*

The seeds per umbel also had high direct effect on seeds yield per plant and had also high significant positive correlation with seed yield. Magnitude of the correlation coefficient between a causal factor and the effect is almost equal to its direct effect. Hence, correlations explained the true interrelationship and suggested that a direct selection of these traits will be effective. These findings are in accordance with the reports of Rao *et al.,* (1981), Choudhary (1987), Godara (1995), Bhandari and Gupta (1991), Sanker and Khader (1991), Srivastava *et al.,* (2000), Jain *et al.,* (2003), Sharma and Meena (2004), Rajput *et al.,* (2004), Meena *et al.,* (2009). 1000-seed weight had weak and positive direct effect on seed yield per plant. However, its results mainly due to its very low indirect effect via seeds umbel and branches per plant and also indirect negative effects via plant height (cm), which are in agreement with earlier reports of Srivastava *et al.,* (2000), Jain *et al.,* (2003), Cosge *et al.,* (2009) reported positive and highest direct effect of 1000-seed weight on seed yield in fennel. The direct effect of days to 50% flowering and plant height (cm) was negative with seed yield per plant. The highest positive direct effect of days to 50% flowering, plant height and seed yield per plant reported by Cosge *et al.,* (2009).

Therefore, it can be concluded that, during selection of high yielding genotypes in fennel for major emphasis should be given on branches per plant, umbels per plant, seeds

per umbel, 1000- seed weight and umbellets per umbel as these are significant associated with seed yield hence, these characters could be considered reliable indicates for selection, to enhance the seed yield.

References

Agnihotri, P., Dashora, S. L. and Sharma, R. K. 1997. Variability, Correlation and path analysis in fennel (*Foeniculum vulgare* Mill.). *Journal of Spices and Aromatic Crops*, 6 (1): 51-54.

Burton, G.W. 1952. Quantitative inheritance in grasses. *Proceeding of the Sixth International Grassland Congress*, Pennsylvania. 1: 227-283.

Bhandari, M.M. and Gupta, A.1991. Variation and association analysis in coriander. *Euphytica,* 58 (1): 1-4.

Choudhary, C.L. 1987. Association of development characters with grain yield in coriander (*Coriandrum sativum* L.*)* germplasm. M.Sc.(Ag.) Thesis, Sukhadia University, Campus Jobner (Rajasthan).

Chandra, R., Lal, R.K., Shankar, H., Kumar, D. and Bansal, K. 2008. Genetic and morphological variability in fennel (*Foeniculum vulgare Mill*.) Published in 4th National Interactive Meet Sonvenir held at CIMAP (CSIR) Lucknow, NIM 2008-17.

Cosge, B., Ipek A. and Gurbug, B. 2009. Some phenotypic selection criteria to improve seed yield and essential oil percentage of sweet fennel (*Foeniculum vulgare* Mill var. Dulce). *Tarim Bilimleri Dergisi*, 15 (2): 127-133.

Girija Lakshman, 1952. Taxonomical studies of a few economic genera in umbelliferae. M.Sc. Thesis, Madras University.

Godara, B.R. 1995. Assessment of variability and path analysis in coriander (*Coriandrum sativum* L.) germplasm. M.Sc.(Ag.) Thesis, Rajasthan Agricultural University, Bikaner, Campus Jobner (Rajasthan).

Jain, U.K., Singh, D. and Amrita, 2003 Correlation and path analysis for certain metric traits in coriander. Progressive Agriculture, 3(1/2): 86-88.

Johnson, H. W., Robinson, H. F. and Comstock, R.E. 1955. Estimates of genetic and environmental variability in soybean. *Agronomy Journal*, 47: 314-318.

Kathiria, K. B. 1980. Variability and correlation in a selected and unselected bulk of fennel. M.Sc.(Ag.) Thesis, University of Udaipur, Campus-Jobner (Rajasthan).

Lal, R. K. Khanuja, S.P.S. and Mishra, H. O. 2006. Genetic diversity in fennel (*Foeniculum vulgare Mill*.). *Indian Journal of Genetics and Plant Breeding*, 66 (1): 65-66.

Malik, T. P., Tehlan, S. K. and Thakral, K.K. 2009. Performance of fennel (*Foeniculum vulgare Mill.*) genotypes for seed yield. Published in National Workshop on "Spices and Aromatic Plants in 21st century India" held at S.K.N. College of Agriculture, Jobner (Rajasthan). pp.62.

Meena, R. S. Anwar, M.M. and Kakani, R.K. 2009. Correlation and path analysis studies for yield improvement in fennel (*Foeniculum vulgare Mill*.). Published in National Workshop on "Spices and Aromatic Plants in 21st century India" held at S.K.N. College of Agriculture, Jobner (Rajasthan). pp. 44.

Panse, V.G. and Sukhatme, P.V. 1955. Statistical Methods for Agriculture Workers. ICAR, New Delhi.

Pareek, B., Singh, D. and Sastry, E.V.D. 2009. Correlation studies in full sib progenies of fennel (*Foeniculum vulgare Mill*.). Published in National Workshop on "Spices and Aromatic

Plants in 21st century India" held at S.K.N. College of Agriculture, Jobner (Rajasthan).pp.45.

Ramanujam, S., joshi, B.S. and Saxena, M.B.L. 1964. Extent and randomness of cross pollination in same umbelliferous spices of India. *Indian Journal of Genetics and Plant Breeding*, 24: 62-67.

Sanker, K.B. and khader, M.A. 1991. Correlation studies and path analysis of yield and yield components in coriander. South Indian Horticulture, 39 (6): 384-386.

Sharma, K.C. and Meena, B.L. 2004. Character association and analysis in coriander (*Coriandrum sativum L.*) Published in National Seminar on New Perspective in Commercial Cultivation, Processing and Marketing of Seed Spices and Medicinal Plants held at S.K.N. College of Agriculture, Jobner (Rajasthan), pp.17.

Srivastava, J.P., Kamaluddin, Srivastava, S.B.L. and Tripati, S.M. 2000. Path analysis in coriander (*Coriandrum sativum* L.). Published in Centennial Conference on Spices and Aromatic Plants held at Calicut. pp.71-74.

Sastry, E.V.D., Pareek, B. and Singh, D. 2009. Evaluation of S_1 progenies of fennel (*Foeniculum vulgare* Mill.). Published in National Workshop on "Spices and Aromatic Plants in 21st century India" held at S.K.N. College of Agriculture, Jobner (Rajasthan), pp. 48.

Singh, R.K. and Choudhary, B.D. 1997. Variance and covariance analysis. Biometrical methods in quantitative Genetic Analysis. Kalyani publisher, Ludhiana (Red. Ed. 1985). pp: 39-68.

Singh, V.V., Singhania, D.L., Sastry, E.V.D., Sharma, K.C. and Rajput, S.S.2004. Character association in half sib and S_1 progenies of fennel (*Foeniculum vulgare* Mill.) published in National Seminar on New Perspective in Commercial Cultivation, Processing and Marketing of Seed Spices and Medicinal Plants held at S.K.N. College of Agriculture, jobner (Rajasthan) pp.12.

Singh, V.V. and Sastry, E.V.D., 2005. Association studies for seed yield and its *attributes* in biparental progenies of fennel. *Agriculture Science Digest*, 25(4): 303-304.

Stanley Redgrove, H. C. 1933. Spices and condiments. Sir Isaac Pitman and Sons Ltd. London.

Rajput, S.S., Singhania, D.L., Singh, D., Sharma, K.C. and Jakhar, M.L. 2004. Correlation and path analysis in Fennel (*Foeniculum vulgare* Mill.). Published in National Seminar on New Perspective in Commercial Cultivation, Processing and Marketing of Seed Spices and Medicinal Plants held at S.K.N. C0llege of Agriculture, Jobner (Rajasthan), pp. 10.

Rao, T., Srirama, KarunakarBabu, M. and Bavaji, T.N. 1981. Path coefficient analysis of seed yield in coriander. *Indian Journal of Agriculture Sciences*, 51: 726-728.

How to cite this article:

Suresh Kumar Kumawat, Hrish Kumar Rachhoya, Mukesh Sharma, Dhirendra Singh and Sastry, E. V. D. 2020. Correlation and Path Coefficient Analysis for Yield and Yield Component Traits in S_6 Progenies of Fennel (*Foeniculum vulgare* Mill.). *Int.J.Curr.Microbiol.App.Sci.* 9(03): 152-158. doi: https://doi.org/10.20546/ijcmas.2020.903.018