Revised Research Article

Studies on character association in Fennel (*Foeniculum vulgar* Mill.)

Abstract: Economic yield of seed is an important character in case of seed spices. The yield of plant is a complex character and is governed by several factors. The present investigation was carried out with ninety genotypes of fennel along with three checks namely Pant Madhurika (Pantnagar, Uttarakhand), GF-11(Gujarat) and RF-125 (Rajasthan) at Pantnagar (Uttarakhand) during 2009-10 and 2010-2011 to estimate relationship between yield and yield-components by correlation coefficient analysis. The analysis shows that yield shows highly significant and positive correlation with plant height upto main umbel (0.375), plant height upto top of plant (0.446), number of primary branches (0.290), number of secondary branches (0.303), seed yield per plant (0.982), number of fruits per umbel (0.324) and number of fruits per umbellate (0.364) and positive and significant correlation with number of umbellate per umbel (0.219) indicating the importance of these traits as components for yield.

Keywords: - Character association, Yield components, Fennel, *Foeniculum vulgare*.

Introduction

Fennel [*Foeniculum vulgare* Mill. (syn) *Foeniculum officinale*] is a plant belonging to family Umbelliferae (Apiaceae) which is a large family consist of 300 genera and more than 3,000 species. Fennel a seed spices crop well known for its aromatic and medicinal properties and it is used by humans since antiquity. It is a hardy, perennial herb with yellow flowers and feathery leaves. The fruits (seeds) are used as stimulant, carminative and in cure of colic pain. It is generally considered indigenous to the shores of the Mediterranean, but has become widely naturalized in many parts of the world, especially on dry soils near the sea-coast and on river-banks.

India is a major seed spices producer in the world because of its favorable climatic and soil conditions for growing spices and other tropical herbs therefore it is known as the “Home of Spices”. The major seed spices growing area is concentrated in semi-arid to arid areas of Gujarat and Rajasthan, together contributing more than 80 % of the total seed spices produced in the country. Therefore both the states are esteemed as “Seed Spice Bowl of India”. Out of 20 seed

spices crops cumin, coriander, fennel, fenugreek, dill and ajowain contributed more than 95% towards area and production. Among seed spices fennel contribute to about 17.4% of the total seed spice production **(Annual Report, 2015)**.

Yield is a complex character which is highly influenced by environment. Selection based on yield alone will limit the improvement, where as the yield component characters are less complex in inheritance and influenced by the environment to a lesser extent. Thus, effective improvement in yield may be brought about through selection of yield component characters. Yield components characters show associations among themselves and with yield. Selection may limit genetic advance if unfavorable associations are present among the desired yield attributes. In order to initiate an effective selection programme for the genetic improvement in yield of fennel it is essential to know the importance as well as degree of association of various quantitative traits. The present study was under taken to find out the association between yield and yield components in fennel through correlation analysis.

Materials and methods

Field research was conducted at Vegetable Research Centre (VRC), G. B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand. The healthy seeds of ninety germplasm lines and three checks namely Pant Madhurika (Pantnagar, Uttarakhand), GF-11 (Gujarat) and RF-125 (Rajasthan) of *Foeniculum vulgare* were sown in field at row to row distance of 45 cm and plant to plant distance of 30 cm in the second week of November 2010 in augmented block design. Recommended cultural practices were followed. The observations were recorded on nineteen economically important traits on ten randomly selected plants of each genotype. The nineteen traits that are included in the present study are days to germination in field, plant height upto main umbel (cm), plant height upto top of plant (cm), number of primary branches, number of secondary branches, number of effective branches, duration of complete anthesis in main umbel, days to 50 percent flowering, duration of 75 percent maturity in main umbel, 1000 Seed weight (gm), diameter of main umbel (cm), size of leaf sheath (cm), length of first internode (cm), seed yield per plant (gm), number of umbel per plant, number of umbellate per umbel, number of fruits per umbel, number of fruits per umbellate and yield (quintals per hectare). The analysis of variance for augmented design was done by using method given by

Federer (1956), Federer and Raghavarao (1975). Correlation coefficients were estimated as described by **Dewey and Lu (1959)**.

Results and Discussion

Correlation coefficient is the statistics which measures the relationship between two or more variables. Correlation coefficient measures the mutual relationship between plant characters and determines the component characters on which selection can be based for improvement in yield. Mass selection has been used to improve grain yield through indirect selection of highly heritable traits associated with yields. If the association is considerably positive between two characters it will increase the rate of genetic progress, while the negative correlation will decrease the genetic progress after selection of character. Correlation among the characters arises due to linkage of genes determining the characters. However, the phenomena of pleiotrophy may also be responsible for the same.

The character association based on adjusted means estimates are presented in the Table 1 represents correlation coefficient between yield and other eighteen components. The study indicates that the yield (quintal/hectare) have highly significant and positive correlation with seed yield per plant (0.982), plant height upto top of plant (0.446), plant height upto main umbel (0.375), number of fruits per umbellate (0.364), number of fruits per umbel (0.324) number of secondary branches (0.303), number of primary branches (0.290). While it shows positive and significant correlation with number of umbellate per umbel (0.219).

Non-significant association was seen between yield and diameter of main umbel (0.168), size of leaf sheath (0.159), number of umbels per plant (0.129) and number of effective branches (0.086). While it shows negative and non-significant correlation with length of first internode (-0.196), 1000 seed weight (-0.148), duration of complete anthesis in main umbel (-0.140), days to 50 percent flowering (-0.128), duration of 75 percent maturity in main umbel (-0.099) and days to germination in field (-0.015).

The association of all other characters that influence yield was also seen. Number of fruits per umbellate showed highly significant and positive correlation with plant height upto main umbel (0.484), plant height upto top of plant (0.357), number of primary branches (0.270), seed yield per plant (0.369), number of umbellate per umbel (0.440) and number of fruits per umbel (0.755).

Number of fruits per umbel showed highly significant and correlation with plant height upto main umbel (0.486), plant height upto top of plant (0.358), seed yield per plant (0.308) and number of umbellate per umbel (0.805).

Number of umbellate per umbel showed highly significant positive correlation with plant height upto main umbel (0.382) and diameter of main umbel (0.313).

Number of umbels per plant showed highly significant and positive correlation with days to germination in field (0.504), number of primary branches (0.346), number of secondary branches (0.662), number of effective branches (0.881), duration of complete anthesis in main umbel (0.302), days to 50 percent flowering (0.414), duration of 75 percent maturity in main umbel (0.255) and 1000 seed weight (0.374).

Seed yield per plant showed highly significant and positive correlation with plant height upto main umbel (0.375), plant height upto top of plant (0.454), number of primary branches (0.277) and number of secondary branches (0.303). 1000 seed weight showed highly significant and positive correlation with number of effective branches (0.389). Positive and significant correlation was seen with days to 50 percent flowering (0.246).

Character association revealed that yield has highly significant and positive correlation with seed yield per plant, plant height upto top of plant, plant height upto main umbel, number of fruits per umbellate, number of fruits per umbel, number of secondary branches, number of primary branches. Which indicates that if the characters that are positively correlated with yield increase they would increase yield also. Thus on the basis of above characters selection of genotypes or lines could be made that have higher values of the yield contributing characters, which ultimately effect the yield of plant which is most important objective kept in mind during plant breeding programme.

All the above findings are similar to results obtained by **Coşge *et al.* (2009), Piccaglia and Marotti (2001), Sanker and Khader (1991), Singh and Mittal (2003), Sharma and Meena (2013), Meena *et al.* (2013) and Meena *et al.* (2014).**

Conclusion

Thus character association analysis revealed that seed yield per plant, plant height upto top of plant, plant height upto main umbel, number of fruits per umbellate, number of fruits per

umbel, number of secondary branches, number of primary branches was significant positive association with yield. Therefore these characters could be taken as selection criteria for achieving higher seed yield in fennel.

Acknowledgement

Authors are grateful to the NRC on Seed Spices (Tabiji), Ajmer, Rajasthan for providing germplasm accessions of fennel to carry out the experiment.

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148 **Table 1. Correlation coefficient Analysis between Yield and other eighteen characters.**

S. No.	Characters	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1.	Days to germination in field	1.000	-0.113	0.199	0.207*	0.489**	0.494**	0.306**	0.375**	0.330**	0.315	-0.129	0.207*	-0.097	0.020	0.504**	-0.398**	-0.337**	-0.200	-0.015
2.	Plant height upto main umbel (cms)		1.000	0.593**	0.028	-0.044	-0.332**	-0.092	-0.210*	-0.009	-0.349**	0.297**	-0.029	-0.030	0.375**	-0.333**	0.382**	0.486**	0.484**	0.375**
3.	Plant height upto top of plant (cms)			1.000	0.288**	0.296**	0.117	0.258*	0.242*	0.236*	-0.212*	0.312**	0.180	-0.196	0.454**	0.077	0.199	0.358**	0.357**	0.446**
4.	Number of primary branches				1.000	0.657**	0.319**	0.156	0.209*	0.250*	-0.184	0.129	0.148	-0.623**	0.277**	0.346**	-0.109	0.079	0.270**	0.290**
5.	Number of secondary branches					1.000	0.668**	0.220*	0.299**	0.251*	0.068	0.047	0.174	-0.446**	0.303**	0.662**	-0.334**	-0.163	0.075	0.303**
6.	Number of effective branches						1.000	0.367**	0.450**	0.314**	0.389**	-0.187	0.194	-0.141	0.101	0.881**	-0.514**	-0.415**	-0.206*	0.086
7.	Duration of complete anthesis in main umbel							1.000	0.900**	0.812**	0.185	0.013	0.186	-0.023	-0.134	0.302**	-0.102	-0.039	0.024	-0.140
8.	Days to 50 percent flowering								1.000	0.740**	0.246*	0.027	0.218*	-0.158	-0.116	0.414**	-0.195	-0.065	0.027	-0.128
9.	Duration of 75 percent maturity in main umbel									1.000	0.031	0.022	0.121	-0.103	-0.075	0.255**	-0.121	0.051	0.188	-0.099
10.	1000 Seed weight (gms)										1.000	-0.333**	0.084	0.339**	-0.134	0.374**	-0.441**	-0.513**	-0.423**	-0.148
11.	Diameter of main umbel (cms)											1.000	0.081	-0.187	0.185	-0.209*	0.313**	0.323**	0.207	0.168
12.	Size of leaf sheath (cms)												1.000	-0.089	0.142	0.232	-0.016	0.069	-0.007	0.159
13.	Length of first internode (cms)													1.000	-0.171	-0.111	0.019	-0.190	-0.294**	-0.196
14.	Seed yield per plant (gms)														1.000	0.146	0.199	0.308**	0.369**	0.982**
15.	Number of umbel per plant															1.000	-0.492**	-0.386**	-0.163	0.129
16.	Number of umbellate per umbel																1.000	0.805**	0.440**	0.219*
17.	Number of fruits per umbel																	1.000	0.755**	0.324**
18.	Number of fruits per umbellate																		1.000	0.364**
19.	Yield (quintals/hectare)																			1.000

149 **** Significant at 1 % level of probability**
150 *** Significant at 5 % level of probability**