Journal of Spices and Aromatic Crops
Vol. 17 (1) : 29–32 (2008)

Indian Society for Spices

Studies on variability of some morphological characters in fennel (*Foeniculum vulgare* Mill.)[1]

D G Patel, P S Patel & I D Patel[2]

All India Coordinated Research Project for Dryland Agriculture
Sardarkrushinagar Dantiwada Agricultural University
Sardarkrushinagar–385 506, Gujarat, India

Received 28 October 2007; Revised 29 January 2008; Accepted 15 March 2008

Abstract

Analysis of variability carried out for 15 characters in 36 diverse genotypes of fennel (*Foeniculum vulgare*) at Jagudan (Gujarat) revealed highly significant differences among genotypes for all the characters studied. High genotypic and phenotypic variances were observed for days to 50% flowering, days to 50% maturity, plant height, plant height up to main umbel, total branches plant^{-1}, number of seeds main umbel^{-1} and seed yield plant^{-1}. The highest genotypic coefficient of variation was observed for volatile oil content in seed followed by total branches plant^{-1} and number of seeds main umbel^{-1}. Heritability estimates were high for seed yield plant^{-1}, days to 50% flowering, number of primary branches plant^{-1}, total branches plant^{-1}, test weight and volatile oil content. High genetic advance as percentage of mean was recorded for seed yield plant^{-1}, days to 50% flowering, primary branches plant^{-1}, total branches plant^{-1}, effective umbels plant^{-1}, number of umbellates umbel^{-1}, number of seeds main umbel^{-1}, test weight and volatile oil content, suggesting that phenotypic selection for these traits would be effective. Overall, it is suggested that for improving yield in fennel, more emphasis should be given to plant height, primary branches plant^{-1}, total branches plant^{-1} and effective umbels plant^{-1}.

Keywords: fennel, *Foeniculum vulgare*, variability.

Very few efforts have been made to improve fennel (*Foeniculum vulgare* Mill.) through genetic manipulation. Since most of the yield attributing characters are quantitatively inherited and highly affected by environment, it is difficult to judge whether the observed variability is heritable or not. The primary parameters, namely, genotypic and phenotypic variances, genetic advance / genetic gain and heritability are useful in understanding the nature of inheritance of different traits. Therefore, the present study was undertaken to elicit information on the nature and magnitude of variability present in fennel for yield and its attributes.

The study was conducted on 36 diverse genotypes collected from germplasm material

[1]Part of MSc (Agri.) Thesis submitted to S D Agricultural University, Sardarkrushinagar, Gujarat, India.
[2](Retired) S D Agricultural University, Jagudan, Gujarat, India.

maintained at the Main Spices Research Station, Sardarkrushinagar Dantiwada Agricultural University, Jagudan (Gujarat). The experiment was laid out in a randomized block design replicated thrice during *kharif* 2003. Each entry was grown in a single row of 9 m length having an inter and intra row spacing of 90 cm x 60 cm. The observations were recorded on 5 randomly selected plants for 15 traits namely, seed yield plant^{-1}, days to 50% flowering, days to 50% maturity, plant height up to main umbel, total plant height, number of primary branches plant^{-1}, total branches plant^{-1}, number of effective umbels plant^{-1}, diameter of main umbel, number of umbellates umbel^{-1}, number of seeds umbellate^{-1}, number of seeds main umbel^{-1}, length of internode, test weight and volatile oil content of seeds. The mean data were statistically analysed to study the variability components (Burton 1952; Panse & Sukhatme 1978).

The analysis of variance for all the traits showed highly significant differences among the genotypes, indicating sufficient amount of variability in the materials. A wide range of variability for different characters was also observed by Agnihotri (1990), Madhu (1995), Agnihotri *et al.* (1997) and Rajput *et al*. (2004) in fennel. The genotypic and phenotypic variances were higher for seed yield plant^{-1}, days to 50% flowering, days to 50% maturity, plant height up to main umbel, plant height, total branches plant^{-1}, number of effective umbels plant^{-1}, number of umbellates main umbel^{-1}, number of seeds umbellate^{-1} and number of seeds main umbel^{-1} (Table 1).

The highest genotypic and phenotypic coefficient of variations were observed for volatile oil content in seeds followed by total branches plant^{-1}, number of effective umbels plant^{-1} and number of seeds main umbel^{-1}. High genotypic and phenotypic coefficient of variation for umbels plant^{-1} and seed yield plant^{-1} were reported by Rajput *et al*. (2004) in fennel. The results suggested that characters showing high value of genotypic and phenotypic coefficient of variation can easily be improved by careful selection.

Table 1. Analysis of variance of various characters in fennel

Character	Replication MS(2 df)	Treatment MS(35 df)	Error MS(70 df)	SEm	CD P=0.05	CD P=0.01	CV %
Seed yield plant^{-1}	424.06**	2023.26**	139.50	9.64	27.21	35.78	9.10
Days to 50% flowering	389.59**	351.35**	6.06	1.42	4.01	5.27	2.33
Days to 50% maturity	345.34**	941.03**	300.24	10.00	28.23	347.10	8.74
Plant height up to main umbel	26.78**	585.18**	162.39	7.36	20.76	27.30	10.71
Plant height	136.15**	965.86**	133.36	6.67	18.81	24.75	7.13
No. of primary branches plant^{-1}	2.00	10.34	0.63	0.46	1.29	1.71	7.95
Total branches plant^{-1}	5.64**	310.17**	19.34	3.59	10.15	13.32	10.58
No. of effective umbels plant^{-1}	96.35**	165.54**	33.94	3.36	9.49	12.47	17.65
Diameter of main umbel	5.75**	11.51**	2.68	0.95	2.67	3.52	9.77
No. of umbellates umbel^{-1}	3.05**	142.57**	17.05	2.38	6.73	8.83	8.83
Number of seeds umbellate^{-1}	2.98**	77.96**	17.06	2.38	6.72	8.83	10.43
No. of seeds main umbel^{-1}	112.00**	479353**	39199	144.31	322.51	535.39	10.74
Length of internode	2.50**	14.98**	4.17	1.18	3.33	4.38	9.76
1000-seed weight	0.59	3.39	0.12	0.20	0.55	0.74	4.00
Volatile oil	0.0195	0.445	0.0106	0.06	0.17	0.23	6.53

*, **Significant at P=0.05 and 0.01, respectively

High heritability estimates (broad sense) were found for days to 50% flowering, volatile oil content in seeds, 1000-seed weight, number of primary branches plant^{-1}, total branches plant^{-1} and seed yield plant^{-1} indicating that these characters were less influenced by the environment and direct selection for these traits would be effective for further improvement (Table 2). These findings are in agreement with the results obtained by the high heritability estimates in fennel for number of seeds umbellate umbel^{-1}, number of umbels plant^{-1}, plant height, number of umbellates umbel^{-1}, 1000-seed weight and seed yield plant^{-1} (Mehta & Patel 1983; Jindal & Allah-Rang 1986; Agnihotri *et al.* 1997; Rajput *et al*. 2004). High heritability estimates coupled with moderate genetic advance as per cent of mean was recorded for volatile oil content in seeds, number of primary branches plant^{-1}, seed yield plant^{-1}, test weight, days to 50% flowering and total branches plant^{-1} indicating the predominance of additive gene action for these characters. The higher estimates of heritability indicate that these characters were comparatively less affected by environment. The characters namely, number of primary branches plant^{-1}, total effective branches plant^{-1}, seed yield plant^{-1} and volatile oil content in seeds displayed high heritability estimates along with high genetic coefficient of variation.

Johnson *et al.* (1955) suggested that heritability together with genetic advance is a more useful parameter in choice of the best genotype by selection. Mehta & Patel (1983) reported high heritability with moderate to high genetic advance for majority of characters except test weight; Jindal & Allah-Rang (1986) high heritability with high genetic advance for number of umbellates umbel^{-1}; Agnihotri *et al.* (1997) high heritability with high genetic advance for umbels plant^{-1} and seed yield plant^{-1}; Rajput *et al*. (2004) high heritability with high genetic advance for number of umbels plant^{-1} and seed yield plant^{-1} in fennel.

The study indicated that sufficient variability for different yield attributing characters in fennel, which can be utilized for further improvement in this crop. It is also suggested

Table 2. Estimates of mean, range, genotypic (GCV) and phenotypic (PCV) coefficient of variation, heritability (h^2) and genetic advance for various characters in fennel

Character	Mean	Range	GCV (%)	PCV (%)	h^2 (Broad sense) (%)	GA as % of mean
Seed yield plant^{-1}	129.8	82-213	19.31	21.34	81.80	35.97
Days to 50% flowering	105.6	79.0–129.3	10.15	10.42	95.00	20.39
Days to 50% maturity	198.3	138.3–230.3	7.37	11.43	41.60	9.79
Plant height up to main umbel	119.0	92–144	9.99	14.64	46.46	14.01
Plant height	161.9	111.7–200.3	10.29	12.52	67.54	17.42
No. of primary branches plant^{-1}	9.9	6.4–13.5	18.07	19.76	83.81	34.12
Total branches plant^{-1}	41.56	23.7–62.7	23.69	25.95	83.40	44.56
No. of effective umbels plant^{-1}	33.0	17.3–50.8	20.07	26.73	56.38	31.04
Diameter of main umbel	16.7	11.7–19.8	10.24	14.16	52.33	15.26
No. of umbellates umbel^{-1}	46.7	31.3–62.6	13.84	16.42	71.04	24.03
No. of seeds umbellate^{-1}	39.6	29.8–50.2	11.39	15.43	54.33	17.27
No. of seeds main umbel^{-1}	1843.1	1074–2650	20.78	23.39	78.92	38.03
Length of internode	20.9	15.9–24.3	9.07	13.32	46.33	12.71
1000-seed weight	8.5	5.9–10.2	12.29	12.92	90.42	24.06
Volatile oil	1.6	1.2–3.0	24.13	25.00	93.17	47.99

that for improving seed yield in fennel, more emphasis should be given to plant height, primary branches plant^{-1}, total branches plant^{-1} and effective umbels plant^{-1}.

References

Agnihotri P 1990 Genetic divergence in the germplasm of fennel (*Foeniculum valgare* Miller). MSc (Agri.) Thesis, Rajasthan Agricultural University, Jobner.

Agnihotri P, Dashora S L & Sharma R K 1997 Variability, correlation and path analysis in fennel (*Foeniculum vulgare* Mill.). J. Spices Aromatic Crops 6: 51–54.

Burton G W 1952 Quantitative inheritance in grasses. Proc. 6th Int. Grassland Congress 1: 227–283.

Jindal L N & Allah-Rang 1986 Variability and association analysis in fennel. Res. Dev. Rep. 3 (1): 50–54.

Johnson H W, Robinson H F & Comstock R E 1955 Estimates of genetic and environmental variability in soyabean. Agron. J. 47: 314–318.

Madhu P 1995 Genetic variability, correlation and path coefficient analysis in fennel. MSc (Agri.) Thesis, Gujarat Agricultural University, Sardarkrushinagar.

Mehta D K, Punjari M M, Saha B C, Brahmachari V S, Jain B P & Maurya K R 1993 Correlation and path analysis in fennel (*Foeniculum vulgare* Miller). Res. Dev. Rep. 7 (1–2): 145–149.

Mehta K G & Patel R H 1983 Variability in fennel (*Foeniculum vulgare* P. Miller) under North Gujarat conditions. J. Plantn. Crops 11**:** 21–23.

Panse V G & Sukhatme P V 1978 Statistical Methods for Agricultural Workers 2nd Edn. Indian Council of Agricultural Research, New Delhi.

Rajput S S, Singhania D L, Singh D, Sharma K C & Rathore V S 2004 Assessment of genetic variability in fennel (*Foeniculum vulgare* Mill.) germplasm. In: Contributory Paper: National Seminar on New Perspectives in Commercial Cultivation, Processing and Marketing Seed spices and Medicinal Plants (p. 11), 25–26 March 2004, Jobner.