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Analysis of Genetic Variability and Correlation in Fennel (*Foeniculum Vulgare Mill.*) Germplasm

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Abstract

Fifty germplasm were used to study the genetic variability, heritability, genetic advance and correlation for growth and yield contributing characters in fennel. Experiment laid out in an Augmented Block Design at National Research Centre on Seed Spices, Ajmer for yield and its yield attributing characters in 2014-15. The analysis of variance revealed significant differences among the germplasms for number of primary branches, number of umbels per plant, number of umbellate per umbel, number of seed per umbellate, test weight (g) and seed yield (5 plant g). The phenotypic coefficient of variance (PCV) was higher than genotypic coefficient of variance (GCV) for most of the characters. Nnumber of umbels per plant, number of umbels per umbellate per umbel, number of seed per umbellate, test weight, seed yield and number of secondary branches exhibited high genetic advance as percentage of mean along with high heritability. Nnumber of primary branches (0.75***), number of secondary branches (0.63***), umbel per plant (0.87***), umbellate per umbel (0.63***), seeds per umbellate (0.70***) and test weight (0.52***) exhibited positive and significant correlated with the seed yield. Therefore, greater emphasis should be given on these characters for genetic improvement of fennel.

Keywords: Variability; Heritability; Genetic advance; Correlation; Fennel

Introduction

Fennel (*Foeniculum vulgare Mill.*), belongs to family Apiaceae. It is a diploid species with chromosome number, 2n=22 and native of Europe and Mediterranean region Agarwal et al. [1]. It's mainly cultivated for its seeds in the state of Rajasthan and Gujarat. The leaves and seeds of fennel are used in many culinary traditions Ehsanipour et al. [2]. Mature fennel fruits and essential oil are used as flavouring agents in food products such a liqueurs, bread, pickles, pastries, and cheese Zoubiri et al. [3]. The root is regarded as a purgative. 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, and kidney and in colic pain. 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 starting point of any systemic breeding programs is the collection of a large germplasm. Furthermore, information on association among different morphological characters and with seed yield is necessary for formation of suitable selection criteria for producing high yielding varieties.The volatile oil is used in the manufacture of cordials and enters into the composition of fennel water, which in commonly given to infants as medicine.

Keeping this in view, the present investigation was made to explore the genetic variability, by determining the magnitude of genetic coefficient of variation, heritability estimates and expected genetic advance of different biometric traits, their correlation and effects in 54 fennel genotypes including checks.

Materials and Methods

Fifty four germplasm of fennel include checks were evaluated in Augmented Block Design at National Research Centre on Seed Spices, Tabiji, Ajmer (Rajasthan). The centre lies on 74° 35' 39" E to 74° 36' 01" longitude and 26° 22' 12" to 26° 22' 31" N latitude at an altitude of 460.17 m above mean sea level. In each single line genotype were sown in a plot of 3m x 2m size accommodating 6 row of 2 m length spaced 50 cm maintained. All the recommended package of practices was followed to raise a good crop. Five competitive plants were marked in each single line and observations were recorded on these plants for days to germination, days to 50% flowering, king umbel anthesis, plant height (cm), number of primary branches, number of secondary branches, number of seed per umbellate, number of umbel per plant, number of umbellate per umbel, king umbel diameter,

test weight (g) and seed yield g (5 plants). Analysis of variance was done by the method suggested by Panse & Sukhatme [4]. Genotypic coefficients of variation (GCV) were computed according to Burton [5].

Results and Discussion

Table 1: Analysis of variation for different characters in fennel germplasm.

Source of Variation	DF	Days to Germination	King Umbel Anthesis	50% Flowering	King Umbel Diameter	Plant Height (Cm)	Number of Primary Branches	Number of Secondary Branches	Number of Umbels Per Plant	Number of Umbellate Per Umbel	Number of Seeds Per Umbellate	Test Weight (G)	Seed Yield (5 Plant) G
Block (eliminating Check + Germplasm	4	0.05	0.9	288.6	5.7	23.4	0.3	5.8	18.6	10.8	3.7***	0.1	12.4
Entries (ignoring Blocks)	53	0.2	3	87	6.3	102.2	0.9***	13***	63.3***	14.7***	16.6***	0.4***	431.5***
Checks	3	0.1	0.6	68.2	1.03	33.2	1.3***	28.4***	85***	16.4***	17.8***	0.8***	409.1***
Germplasm	49	0.2	2.8	89.8	6.7	108.1	0.8***	10.7	63.2***	14.7***	16.7***	0.4***	427.2***
Checks vs. Germplasm	1	0.02	18.9	5.3	2.6	17.03	5.3***	76.1***	5.04	7.9	7.4***	0.3	706.2***
ERROR	12	0.2	2.3	34.3	2.4	88.7	0.1	1.9	5.9	1.4	0.3	0.04	6

*** Significant at p =0.001

Analysis of variance indicated significant for these characters are given viz., number of primary branches, number of umbels per plant, number of umbellate per umbel, number of seed per umbellate, test weight (g) and seed yield (5 plant g) was found significant (Table 1). The observed general mean for plant height was (180.7) and ranged from 160 to 201.8, seed yield (5 plant g) (146) and ranged from 112.5 to 178.1 while 50% flowering (114.4) and ranged from 102-132 (Table 2).

Table 2: Genetic variability component in fennel.

Character	Mean	Range	Genotypic Coefficient of Variation (GCV)	Phenotypic Coefficient of Variation (PCV) (%)	Heritability in Broad Sense (%)	Genetic Advance (%)
Days to germination	10.8	10-11	3.9	4.1	12	1.0
King umbel anthesis	25.8	22-30	2.3	6.3	12	1.8
50% flowering	114.4	102-132	5.7	7.6	55	8.6
King umbel diameter (cm)	16.5	13-27.8	10.8	14.3	57	16.8
Plant height (cm)	180.7	160-201.8	2.1	5.6	14	1.6
Number of primary branches	7.3	6-9.4	9.6	10.6	81	17.8
Number of secondary branches	20.2	11.6-28.4	12.3	14.0	78	22.4
Number of umbels per plant	42.1	28.2-58.4	15.7	16.7	88	30.3
Number of umbellate per umbel	30.2	22.1-37.9	10.4	11.1	87	20.1
Number of seeds per umbellate	29.2	21.2-37	11.9	12.1	98	24.3
Test weight (g)	6.0	4.7-7	8.1	8.9	85	15.6
Seed yield (5 plant) g	146.0	112.5-178.1	12.4	12.5	98	25.3

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The extent of variability present in 50 germplasm of fennel was measured in terms of range, mean, PCV, GCV, heritability in broad sense and genetic advance. All the germplasm differed significantly with respect to different characters studied. Wide range of variation was observed in all the characters. Munshi & Behra [6], Warshamana et al. [7] and Gupta et al. [8] also reported wide range of variation for most of the characters.

The GCV and PCV were high for number of umbels per plant (15.7 & 16.7) and number of secondary branches (12.3 & 14), number of umbellate per umbel (10.4 &11.1) and number of primary branches (9.6 & 10.6) indicating greater diversity for these traits. GCV in general, were lower than the PCV which indicated close association between phenotype and genotype. These results are in agreement with those reported by Munshi & Behra [6], Singh et al. [9] and Gupta et al. [8]. Low GCV and PCV were recorded for test weight (8.1 & 8.9) and Kumar et al. [10], 50 % flowering (5.7 & 7.6).These results are in conformity with the findings of Singh et al. [9] and Samadia [11].

Heritability is parameter of tremendous significance to the breeders as its magnitude indicates the reliability with which a genotype can be recognized through its phenotypic expression. Johnson et al. [12] stresses that for estimating the real effect of selection, heritability estimates along with genetic advance are more meaningful. Heritability in broad sense was observed to be high for all the traits studied. High heritability estimates were also reported earlier by Verma et al. [13] and Samadia [11]. Heritability estimates alone are not an ideal parameter for predicting the effect of selecting the desired individual. Heritability estimates alone with genetic advance are more useful than heritability values alone in predicting the selection of best individuals. In the present investigations number of umbels per plant, number of umbels per umbellate per umbel, number of seed per umbellate, test weight, seed yield and number of secondary branches exhibited high genetic advance as percentage of mean along with high heritability. These results indicated the influence of additive gene action. Similar results were also recorded earlier by Dashora et al. [14], Jain et al. [15], Shukla et al. [16], Lal [17], Dashora & Sastry [18], Abou [19].

The data on correlation showed that most of the correlation coefficients at genotypic level were greater than the corresponding phenotypic correlation coefficients. This suggested the predominate of genotypic correlation of nine yield and yield attributing characters presented (Table 3) indicated thatseed yield was positively correlated with number of primary branches (0.75***), number of secondary branches (0.63***), umbel per plant (0.87***), umbellate per umbel (0.63***), seeds per umbellate (0.70***) and test weight (0.52***).

Table 3: Genotypic correlation coefficient between different characters in fennel.

Characters	King Umbel Diameter (Cm)	Plant Height (Cm)	Number of Primary Branches	Number of Secondary Branches	Number of Umbels Per Plant	Number of Umbellate Per Umbel	Number of Seeds Per Umbellate	Test Weight (G)	Seed Yield (5 Plant) G
50 % flowering	0.09	0.19	-0.03	0.19	-0.08	-0.11	-0.31*	0.01	-0.01
King umbel diameter (cm)		0.07	-0.04	0.07	-0.12	0.11	-0.06	-0.23	-0.12
Plant height (cm)			-0.15	-0.04	-0.25	-0.29*	-0.22	0.08	-0.24
Number of primary branches				0.53***	0.71***	0.57***	0.61***	0.42**	0.75***
Number of secondary branches					0.66***	0.42**	0.56***	0.38**	0.63***
Number of umbels per plant						0.64***	0.75***	0.44**	0.87***
Number of umbellates per umbel							0.71***	0.39**	0.63***
Number of seeds per umbellate								0.43**	0.70***
Test weight (g)									0.52***

*** Significant at p =0.001 ** Significant at p =0.01 * Significant at p =0.05

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50 % flowering was found significant and negative correlated with number of seeds per umbellates (-0.31), while it was also found non-significant but positively correlated with king umbel diameter (0.09), plant height (0.19), no of secondary branches (0.19) and test weight (0.01). Diameter of king umbel was found non-significant positive correlated with plant height (0.07), number of secondary branches (0.02) and no. of umbellate per umbel. Plant height (cm) had found significant and negative correlation number of umbellates per umbel (0.29), while it was also found non-significant but positively correlated with test weight (0.08). Primary branches had found significant and positive correlation with number of secondary branches per plant (0.53), number of umbels per plant (0.71), number of umbellate per umbel (0.57), number of seeds per umbellates (0.61), test weight (0.42) and seed yield (gm) (0.75). Number of secondary branches per plant had found significant and positive correlation with number of umbels per plant (0.66), number of umbellate per umbel (0.42), number of seeds per umbellates (0.56), test weight (0.38) and seed yield (gm) (0.63). Number of umbels per plant had also recorded significant and positive correlated with number of umbellate per umbel (0.64), number of seeds per umbellates (0.75), test weight (0.44) and seed yield (gm) (0.87). Number of umbellates per umbel was found significant and positively correlated with number of seeds per umbellates (0.71), test weight (0.39) and seed yield (gm) (0.63). Number of seeds per umbellates had also recorded significant positive correlated with test weight (0.43) and seed yield (gm) (0.70).

The association analysis at both genotypic and phenotypic level revealed that the seed yield was significantly and positively correlated with umbel per plant, number of primary, number of secondary branches, number of umbellates per umbel and number of seeds per umbellates. Similar results were found in the findings of Meena et al. [20], Dashora & Sastry [18], Meena et al. [21]. While the correlation of test weight showed positive but non-significant correlation with seed yield. Similar result was found in the findings of Abou [19], Yogi [22-26].

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