Studies on genetic variability, heritability and genetic advance in fennel (*Foeniculum vulgare* Mill.)

Abstract

The present investigation was carried out with a view to study the extent of variability, heritability in broad sense, genetic advance in per cent of mean in fennel at Main Experimental Station of Department of Vegetable Science, ANDUA&T, Kumarganj, Ayodhya (U.P.) during *Rabi*, 2018-19 in Augmented Block Design. Plant spacing of 60cm x 40cm and each genotypes were grown in the plot size of 2.0 m x 1.2 m. Observations were recorded on twelve characters. In Analysis of variance, the variances due to checks, treatments and genotypes were highly significant for all the characters, while, the variance due to blocks were significant for days to 50% flowering, number of umbels per plant and number of umbellets per umbel. Based on mean performance NDF-1, NDF-2, NDF-58, NDF-59, NDF-55, NDF-60 and NDF-76 were observed as significant and most promising genotypes for seed yield per plant and its component traits. The estimates of phenotypic coefficients of variation (PCV) were higher than genotypic coefficient of variation (GCV) for all traits. High magnitudes of ~~variability~~ PCV and GCV were observed in case of seed yield per plant (37.12, 36.95) followed by number of umbels per plant (30.89, 29.78), number of branches per plant (28.25, 22.92), weight of grains per umbel (26.02, 24.01) and number of umbellets per umbel (21.29,19.80). High heritability was observed for all the characters except number of branches per plant (65.83%) having moderate heritability. While, high genetic advance in per cent of mean was estimated for seed yield per plant (75.76) followed by number of umbels per plant (59.13). The high heritability coupled with high genetic advance in per cent of mean was estimated for maximum characters which indicated opportunity for selection response.

***Key words*:** Genetic variability, GCV, PCV, heritability (h^2), genetic advance.

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Introduction

Historically, India has always been recognized as a "Home of Spices". Fennel (*Foeniculum vulgare* Mill., 2n=2x=22) is most emerging and medicinal seed spices crops which belong to family Apiaceae (Umbelliferae). It is native of Southern Europe and Mediterranean region where it has been grown since ancient times. Seed spices “High value low volume crops” are the most remunerative commodities of arid and semi- arid regions of India. Spices have a characteristics aroma and taste and they are widely used to season and flavour various food preparations, ~~and~~ as well as in the medicine, pharmaceuticals, perfumery, cosmetics and several other industries. Fennel is a cool season crop~~s~~, with dry and cool weather favouring high seed production. 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 1.575 MT/ha (Anonymous, 2018).

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Genetic variability forms the basis for crop improvement. Selection and hybridization approaches are easily followed in bringing about the quantitative improvement in order to bring about the desired improvement. Knowledge of heritability is essential for selection based improvement as it indicates the extent of transmissibility of character into future generation.

Correlation studies coupled with path coefficient analysis are a powerful tool to study the character association and their final impact on yield, which helps the selection procedure accordingly. Yield ~~is~~ directly or indirectly influences the growth of plant. The correlation coefficient gives an idea about ~~the~~ various associations existing between the yield and yield components. 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 components.

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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 mechanical composition of soil was 60.9 per cent sand, 27.8 per cent silt and 11.3 per cent clay with soil pH 8.5.The annual rainfall was received about 1200mm.

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The experiment was conducted in Augmented Block Design with ~~replicated thrice~~ three replications to assess the performance of 94 genotypes of fennel including four checks. The crop was planted at 40cm x 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 and 80:40:40 (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 observed data were subjected to analysis of variance, genetic variability for different parameters, heritability and expected genetic advance as per the procedure suggested by Federer, (1956), Burton and De Vane (1953) and Hanson (1963), respectively.

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Result and Discussion:

The analysis of variance are presented in Table-1 and revealed that the variances due to checks were highly significant for all the characters, while, the variance due to blocks were significant for days to 50% flowering, number of umbels per plant and number of umbellets per

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umbel. The variability among the genotypes considered in this study due to diverse genetic makeup of the genotypes. Reports of Yogi *et al.* (2013), Meena and Dhakar (2017) and Kumar *et al.* (2017) suggested better scope for selection in the available germplasm of fennel.

In the Table-2, highest value of PCV and GCV were obtained for seed yield per plant, number of umbels per plant, number of branches per plant and weight of grains per umbel. While, the lowest value of PCV and GCV were observed for days to 50% flowering followed by days to maturity. Therefore, the characters with high PCV may improve through selection based on its phenotypic performance of the genotypes. Similar reports were also proposed by Meena and Dhakar (2017), Yadav *et al.* (2013) and Rawat *et al.* (2013) which observed high PCV for number of umbels per plant, seed yield per plant and weight of grains per umbel. High GCV and PCV values facilitate many opportunities for improvement through selection and its differences reflects the effect of environment on the phenotypic expression.

The highest heritability was recorded for all the characters except number of branches per plant (65.83%) having moderate heritability. Patel *et al.* (2008), Rawat *et al.* (2013), Yadav *et al.* (2013) and Meena and Dhakar (2017) also found high heritability estimates for most of the characters. Expected genetic advance in per cent of mean was high for all the traits except days to 50% flowering and days to maturity which have lower values of genetic advance. Yadav *et al.* (2013) also proposed same result as found in our experiment. The magnitude of high heritability coupled with high genetic advance were obtained for seed yield per plant (99.07, 75.76), number of umbels per plant (92.91, 59.13), plant height (92.61, 22.21), 1000-seed weight (91.54, 28.39), number of grains per umbel (91.52, 37.92), number of umbel per umbellets (86.54, 37.95) and weight of grains per umbel (85.20, 45.66) as same proposed by Kumar *et al.* (2017. It indicated that selection for these characters should be very effective to improvement of economic seed yield of fennel.

Conclusion

The analysis of variance due to checks were highly significant for all ten characters representing the variability among the genotypes considered in this study due to diverse genetic makeup of the genotypes. The selection of these characters may improve through selection based on their phenotypic performance. High heritability along with high expected genetic advance in per cent of mean will provide good scope for further improvement in advance generations.

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Table-1: Analysis of variance for ten characters in fennel genotypes

Characters	Source of variation		
	Blocks	Checks	Error
	(b-1)	(c-1)	(b-1)(c-1)
df	**5**	**3**	**15**
Days to 50% flowering	1.94 **	481.81 **	0.18
Days to maturity	0.21	451.22 **	0.34
Plant height (cm)	22.2	342.05 **	10.37
Number of branches per plant	0.34	4.68 **	0.33
Number of umbels per plant	25.19 *	674.77 **	6.94
Number of umbellets per umbel	35.37 **	53.22 **	2.46
Number of grains per umbel	1.2	27 **	1.61
Weight of grains per umbel (g)	0.01	0.97 **	0.04
1000-seed weight (g)	0.1	2.12 **	0.07
Seed yield per plant (g)	7.48	3019.54 **	5.27

*- Significant at 5 per cent probability level, **- Significant at 1 per cent probability level

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Table 2.: Estimates of range, grand mean, phenotypic (PCV) and genotypic (GCV) coefficient of variation, heritability in broad sense [$h^2_{(bs)}$%], genetic advance in per cent of mean ($\overline{Ga}$ %) for ten characters in fennel genotypes

Character	Range		Grand Mean ($\bar{x}$)	PCV (%)	GCV (%)	ECV (%)	Heritability broad sense [h^2%]	Genetic advance	Genetic advance in per cent of mean ($\overline{Ga}$ %)
	Min.	Max.							
Days to 50% flowering	94.59	103.72	99.78	4.666	4.647	0.421	99.19	9.51	9.53
Days to maturity	158.27	165.15	160.91	2.622	2.597	0.360	98.12	8.52	5.29
Plant height (cm)	84.16	142.73	101.65	11.643	11.204	3.165	92.61	22.59	22.21
Number of branches per plant	0.79	5.82	3.47	28.255	22.924	16.517	65.83	1.33	38.31
Number of umbels per plant	13.67	64.97	32.01	30.895	29.780	8.227	92.91	18.93	59.13
Number of umbellets per umbel	11.16	40.18	20.07	21.288	19.804	7.811	86.54	7.61	37.95
Number of grains per umbel	13.08	39.26	21.71	20.115	19.243	5.858	91.52	8.20	37.92
Weight of grains per umbel (g)	1.10	4.13	2.07	26.021	24.018	10.011	85.20	0.94	45.66
1000-seed weight (g)	3.68	9.08	5.90	15.060	14.409	4.380	91.54	1.68	28.39
Seed yield per plant (g)	17.74	149.00	63.27	37.122	36.949	3.580	99.07	48.57	75.76

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