Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2021; 10(1): 1755-1760
Received: 02-11-2020
Accepted: 06-12-2020

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Genetic variability studies in fennel (*Foeniculum vulgare* Mill.) under Rayalaseema Region of Andhra Pradesh

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DOI: https://doi.org/10.22271/phyto.2021.v10.i1y.13605

Abstract
In the present investigation, sixteen fennel varieties were evaluated at the Department of Plantation, Spices, Medicinal and Aromatic Crops at the College of Horticulture, Anantharajupeta, Dr. Y.S.R. Horticultural University, Kadapa district of Andhra Pradesh during *rabi* season, 2019-20 for variability, heritability and genetic advancement in nineteen traits, such as plant height, number of primary branches per plant, number of secondary branches per plant, days to first flowering, days to 50 percent flowering, days to maturity, number of umbels per plant, number of umbellets per umbel, number of seeds per umbellet, number of seeds per umbel, fresh weight of umbel (g), dry weight of umbel (g), fresh weight of the plant at harvest (g), dry weight of the plant at harvest (g), seed yield per plant (g), seed yield per plot (g), seed yield per hectare (Kg/ha), harvest index (%) and test weight (g). The studies on variation showed that, there was a significant amount of variability in the material. Phenotypic coefficients of variants are of a degree greater than those of the genotypic coefficient of variation for test weight and days to maturity. The maximum PCV and GCV were observed for number of seeds per umbel (20.24 & 21.16 % respectively) and seed yield per plot (16.59 and 16.22%). High estimates of heritability were observed for number of seeds per umbel (99.20%) followed by seed yield per hectare (98.85%), seed yield per plot (96.50%), seed yield per plant (95.61%), number of umbels per plant (87.19%), number of umbellets per umbel (86.43%) and number of primary branches per plant (86.27%) and it was recorded medium for days to first flowering (57.19%) and days to fifty percent flowering (50.86%). High heritability coupled with high genetic advance as percentage of mean for traits like number of seeds per umbel and seed yield per plant indicated that selection for improving these characters will be more effective as these characters are governed by additive gene action.

Keywords: Genetic variability, Fennel, PCV, GCV, heritability, GAM

Introduction
Fennel (*Foeniculum vulgare* Mill, 2n = 22) is a member of Apiaceae family. It is an allogamous crop where cross-pollination takes place up to 82.2 to 95.40% (Ramanujam *et al.*, 1964) [22]. It is native to the Southern Europe. It is a long duration crop that takes 170-175 days to harvest, favoured by cool and dry climate, can be cultivated easily in all types of soil. In fennel all umbels do not mature at the same time.

Fennel, with yellow flowers and aromatic seeds, is a tall, upright, glabrous glaucous biennial or perennial herb grown as an annual. The inflorescence is terminal bearing compound umbel subtended by involucre of bracts. It produces yellow colour flowers which are small, hermaphrodite, complete, regular and pentamerous. Flowers are bisexual, actinomorphic and free. The fruit is light green to dark brown, lens-shaped schizocarp with a long pedicel and narrow stylopodium, oblong-oval to elliptical 2-3 mm. A fruit that is fully grown is 4 to 8 mm long. The leaves and seeds of fennel are used in many culinary traditions (Ehsanipour *et al.*, 2012) [5]. Fennel seeds are aromatic, relaxing and carminative, used in cholera, nervous disorders, constipation, dysentery and also used to regulate lung, chest, spleen and kidney stone diseases and menopausal problems (Mohamed and Abdu, 2004) [17]. The presence of genetic diversity in the population offers a chance to choose a genotype with a suitable trait for improvement and also provides a wide variety of choices for improving the trait of interest. The assessment of genotypes is therefore essential for further crop improvement programme.

Material and Methods
The experiment was conducted in an open field condition located at College of Horticulture, Anantharajupeta in Southern Agro Climatic Zone of Andhra Pradesh. The experimental site is located at an altitude of 162m (531 feet) above mean sea level lying between the 130.59º

North latitude and 790.19º East longitude. The experimental material consisted of sixteen varieties of fennel in randomized block design with three replications. Each variety is planted at a spacing of 50 cm × 20 cm. The pooled data on ninteen morphological and yield attributing traits was taken in five plants which were tagged at random in all three replications to record the pooled data and analyzed by the standard statistical method (Panse and Sukhatme, 1985) [19].

Results and Discussion

Analysis of variance for growth and yield related traits in fennel varieties presented in Table:1 revealed the existence of abundant variability in the experiment material and disclosed significant alterations among the varieties for the traits studied *viz*., plant height, number of primary branches per plant, number of secondary branches per plant, days taken to blossoming, days to 50 percent blossoming, days to maturity, number of umbels per plant, number of umbellets per umbel, number of seeds per umbel, number of seeds per umbellet, umbel fresh weight, umbel dry weight, fresh weight of plant at harvest, dry weight of plant at harvest, seed yield per plant, seed yield per plot, seed yield per hectare, harvest index and test weight. Availability of ample amount of variation in the experiment material is of utmost importance for the triumph of any breeding program. Similar results were reported by Meena *et al.* (2019) [15], Patel *et al.* (2018) [20], Kumar *et al.* (2017) [10] and Sengupta *et al.* (2014) [26]. A broad range of means for yield attributing characters showed that few of its contributing traits had an improved chance of upgrading yield performance through direct selection or by shifting desired traits. The MSS (mean sum of squares) of varieties were extremely important for the characters showed that the presence of ample genetic variability within the material. The average performance of sixteen fennel varieties for various characters under investigation were presented in Table 3 and 4. The maximum height of the plant was recorded in GF-11 (186.40 cm) followed by RF-145 (186.00 cm) and the minimum height of the plant was ascertained in RF-205 (132.45cm) with overall average of 162.72 cm. The extreme plant height was recorded in the variety RF-145 at all the growth stages. This variation might be due to differences in genetic characters or due to ecological interaction. The existing results are in harmony with the previous reports of variability for various characters provided by Singh *et al.* (2004) [30] and Malik *et al.* (2009) [12]. Maximum number of primary branches were registered in RF-145 (11.78) followed by RF-281 (8.86) while, the minimum recorded by HF-33 (7.12) and local variety (7.12) with overall average of 8.15. The wider range of variation might be due to their distinct genetic architecture. These results are in line with Agnihotri *et al.* (1997) [2], Meena *et al.* (2019) [15] and Shukla *et al.* (2003) [28]. Maximum number of secondary branches were observed in RF-145 (23.24) followed by RF-143 (16.77) while, the minimum branches recorded in RF-205 (14.45) with the average of 16.29 branches per plant. Variety,, RF-143 "followed by,, RF-145 "were conjointly ascertained superior for number of secondary branches per plant. Additional number of branches per plant in these varieties may be because of endogenous hormonal secretion and less apical dominance. Similar findings were obtained by Sengupta *et al.* (2014) [26], Kumawat (2010) [11] and Malik *et al.* (2009) [12].

The average number of days to 50 % flowering was ranged from 65.22 days (HF-33) to 75.19 days (RF-143) with overall mean value of 69.02 days. Minimum days taken to 50 % flowering were found in HF-33 variety (65.22 days) followed by AF-1 (65.75) whereas RF-143 took maximum days for fifty per cent flowering (75.19 days). Early genotypes will infuse more variability in plant breeding programme. These findings are parallel with that of Dashora and Sastry (2011) [4], Kumawat (2010) [11], Alam *et al.* (2003) [3] and Shukla *et al.* (2003) [28]. The mean days to maturity recorded as 140.50 days while minimum maturity days were observed in RF-125 (130.56 days) followed by RF-178 (134.97 days) and noted as early maturing varieties. While, local variety (146.00 days) and AF-01 (146.09) took longer duration to mature and considered as late maturing varieties. Early maturing varieties and late maturing varieties are having great importance in crop breeding since these extremely ranged genotypes for days to maturity could be used as complementary parents for crossing programme. The variation in days to maturity is also evidenced by Alam *et al.* (2003) [3], Kumawat (2010) [11] and Dashora and Sastry (2011) [4]. The maximum number of umbels per plant was documented in RF-145 (30.36) followed by AF-1 (22.27) while, the minimum number of umbels per plant was registered by native variety (16.09) with an average value of 20.50. The conclusions of the current investigation ensure well with the results of Singh *et al.* (2003) [39] and Yogi *et al.* (2014) [33].

The varieties exhibited higher significant differences with respect to number of umbellets per umbel. The range was 23.16 to 35.46 with an average value of 27.37 (Table 4). The highest number of umbellets per umbel were recorded in the variety RF-145 (35.46) followed by AF-02 (32.34) and AF-01 (31.05) while, it was observed minimum in the variety RF-281 (22.63). The results confirm the findings of Malik *et al.* (2009) [12] and Singh *et al.* (2003) [39]. The number of seeds per umbellet significantly ranged from 25.00 to 32.47 among the genotypes with an average value of 28.58. The maximum number of seeds per umbellet was recorded in RF-145 (32.47) followed by GF-11 (32.23) while, the minimum number of seeds per umbellets was registered by local variety (24.95). The results confirm the findings of Telugu *et al.* (2018), Yogi *et al.* (2013) [34] and Rawat *et al.* (2013) [23]. The average value for number of seeds per umbel was 797.98 and ranged from 586.24 to 1146.49 (Table 4). The maximum number of seeds per umbel were pragmatic in the variety RF-145 (1146.49) followed by AF- 02 (1032.88) and AF-01 (938.24), these results are in line with Meena *et al.* (2019) [15] and Gurjar *et al.* (2016) [7] in fenugreek, Sengupta *et al*. (2014) [26] in fennel. The variety,, GF-12 (11.78 g) followed by RF-145 (11.36 g) were observed greater for dry weight of umbel. While, the least dry weight of umbel was recorded in the local variety (8.15 g). The extreme dry weight of umbel might be due to high number of branches per plant and comparatively longer crop duration, which results in accumulation of more amount of photosynthates. Similar results were found by Shaktawat *et al.* (2016) [7] and Meena and Singh (2013) [11]. Harvest index demonstrated highly statistical changes which ranged from 18.00 to 26.41 percent with average value of 22.00 percent. Further, the higher harvest index (27.41 %) was pragmatic in the variety RF-145 after that GF-12 (25.95 %), RF-143 (24.03 %) and RF- 125 (24.00 %) whereas, it was registered minimum in RF-101 (17.96 %). Similar results were found by Shaktawat *et al.* (2016) [7] and Meena and Singh (2013) [11].

The data regarding test weight ranges from 8.11 to 10.47 g with an average value of 9.01 g. The supreme test weight was observed in RF-281 (10.47 g) followed by RF-125 (9.77 g) while, it was observed minimum in Local variety (8.11g). These conclusions are in agreement with Abou *et al.* (2013) [11] and Rohit *et al.* (2017) [24]. The range for seed yield per

plant were observed from 19g to 31g with an average of 22 g. The higher seed yield per plant (31.33 g) was recorded with RF-145 variety, which was significantly better to rest of the varieties and was followed by GF-12 (26.93 g) whereas, it was lowest in RF-101 (18.08 g). Similar results were found by Meena *et al.* (2019) [15] and Thakral *et al.* (2006) [38] in fennel, Jyothi and Hedge, (2018) [9] in case of fenugreek. The data concerning PCV (Phenotypic Coefficient of Variation), GCV (Genotypic Coefficient of Variation), broad sense heritability, GA and GAM are presented in Table 2 & Fig 1 which showed considerable variation among varieties for each character. Effectiveness of selection depends on the magnitude of genetic variability in certain character. The absolute differences in values which were found in genotypic variance cannot be used for comparing magnitude of variability for different characters since the mean and units of measurement of the two characters may be different. Hence the coefficients of variation expressed at phenotypical and genotypical values were compared for assessing the variability observed for different characters.

High PCV was identified only for the number of seeds per umbel. The characters such as plant height, number of primary branches, number of secondary branches, number of umbels per plant, number of umbellets per umbel, fresh weight of umbel, dry weight of umbel, fresh weight of plant at harvest, dry weight of plant at harvest, harvest index, seed yield per plant, seed yield per plot and seed yield per hectare exhibited a moderate phenotypic coefficient which suggested that it would be rewarding to select based on phenotypic results. Similar conclusions were defined by Agnihotri (1997) [2], Meena *et al.* (2010) [36], Yogi *et al.* (2014) [33] and Shaktawat *et al.* (2015) [40]. The GCV was high only for number of seeds per umbel. The traits such as plant height, number of primary branches per plant, number of secondary branches per plant, number of umbels per plant, number of umbellets per umbel, fresh weight of plant at harvest, harvest index, seed yield per plant, seed yield per plot and seed yield per hectare exhibited moderate genotypic coefficient of variation. Low GCV was found for the characters *viz*., days taken to flowering, days to 50 % flowering, days to maturity, number of seeds per umbellet, fresh weight of umbel, dry weight of umbel, dry weight of plant at harvest and test weight. Alike findings have also been reported by Megeji and Korla (2002) [41] and Singh *et al.* (2006) [29].

In the present investigation, heritability was found to be extreme for number of seeds per umbel (99.20%) followed by seed yield per hectare (98.85%), seed yield per plot (96.50%) and seed yield per plant (95.61%), number of umbels per plant (87.19%), number of umbellets per umbel (86.43%) and number of primary branches (86.27%). Similar findings were reported by Yadav *et al*., (2013) [32], Ghanashyam *et al.* (2015) [6], Choudhary *et al.* (2017) [35] and Mamatha *et al.* (2017) [13] in fenugreek. Moderate heritability was observed for days taken to flowering, days to 50 % flowering and test weight which suggested that choice based on phenotypic achievement would be rewarding. These findings are in close concord with earlier reports of Shaktawat *et al.* (2015) [40], Patel *et al.* (2018) [20], Dashora *et al.* (2011) [4] and Rajput *et al.* (2004) [29]. GAM ranged from 2.32 percent (days to maturity) to 41.36 percent for number of seeds per umbel. High GAM has been estimated for the characters like number of primary branches, number of secondary branches, number of umbels per plant, number of umbellets per umbel, number of seeds per umbel, fresh weight of plant at harvest, harvest index, seed yield per plant, seed yield per plot and seed yield per hectare, which is in agreement with earlier reports of Agnihotri (1997) [2], Singh *et al.* (2004) [30], Lal (2007) [37], Rawat *et al.* (2013) [23], Saxena *et al.* (2016) [25] and Kumar *et al.* (2017) [10].

Moderate GAM was observed for plant height, number of seeds per umbellet, fresh weight of umbel, dry weight of umbel and dry weight of plant at harvest. Similar reports were done by Agnihotri (1997) [2], Singh *et al.* (2004) [30], Meena *et al.* (2010) [36], Yogi *et al.* (2014) [33] and Shaktawat *et al.* (2015) [40]. Whereas, low GAM was observed for days taken to blossoming, days to 50 % blossoming, days taken to maturity and test weight. These outcomes are in accordance with the initial reports of Meena *et al.* (2010) [36], Sengupta *et al.* (2014) [26], Jeeterwal *et al.* (2015) [8] and Kumar *et al.* (2017) [10]. High heritability along with high GAM for characters such as number of seeds per umbel, seed yield per plant, seed yield per plot and seed yield per hectare. High heritability followed by modest genetic improvement as a percentage of the mean for characteristics such as harvest index, fresh and dry weight of the plant, number of seeds per umbellet, number of umbellets per umbel. Modest heritability coupled with low GAM for characters such as days to first blossoming, days to fifty percent blossoming and days to maturity. This shows the effect of non-additive gene action on the countenance of these characteristics and the substantial impact of the environment.

Table 1: Analysis of variance (mean sum of squares) for growth and yield parameters in fennel varieties

Sl. No.	Parameters	Treatments	Replication	Error	CV (%)
	Degrees of freedom	**15**	**2**	**30**	
1	Plant height (cm)	830.52**	90.47	28.20	3.26
2	Number of primary branches per plant	3.89**	0.61	0.20	5.52
3	Number of secondary branches per plant	12.70**	0.55	0.93	5.92
4	Days to first flowering	11.89**	8.26	2.32	2.68
5	Days to 50% flowering	20.07**	22.85	4.89	3.20
6	Days to maturity	49.96*	50.01	23.06	3.42
7	Number of umbels per plant	32.77**	1.99	1.53	6.08
8	Number of umbellets per umbel	42.05**	5.28	2.09	5.28
9	Number of seeds per umbellet	16.30**	2.78	2.01	4.96
10	Number of seeds per umbel	16.60**	5.23	5.33	8.00
11	Fresh weight of umbel (g)	18.80**	4.82	0.93	3.90
12	Dry weight of umbel (g)	2.77**	1.07	0.23	4.73
13	Fresh weight of the plant at harvest (g)	4767.45**	224.82	68.24	2.32
14	Dry weight of plant at harvest (g)	492.88**	14.00	19.56	3.50
15	Seed yield per plant (g)	36.90**	2.91	0.56	3.47
16	Seed yield per plot (g)	167255.40**	147042.20	31818.70	13.69
17	Seed yield per hectare ($kgha^{-1}$)	464615.70**	408404.90	88387.60	13.69
18	Harvest index (%)	21.15**	0.75	1.15	4.99
19	Test weight (g)	1.30**	0.24	0.33	6.36

Table 2: Estimates of variability and genetic parameters for growth and yield traits in fennel varieties

Character	Range		Mean	Variation		Heritability (%)	GA	GAM
	Min.	Max.		PCV (%)	GCV (%)			
Plant height (cm)	132.45	186.4	162.72	10.57	10.05	90.46	32.04	19.69
Number of primary branches	7.12	11.78	8.03	14.89	13.83	86.27	2.12	26.46
Number of secondary branches	14.45	23.24	16.29	13.52	12.16	80.84	3.67	22.52
Days to first flowering	52.97	59.61	56.79	4.13	3.14	57.90	2.80	4.93
Days to 50 per cent flowering	65.22	75.19	69.02	4.57	3.26	50.86	3.31	4.79
Days to maturity	130.56	146.09	140.50	4.03	2.13	28.00	3.26	2.32
Number of umbels per plant	16.09	30.36	20.35	16.98	15.86	87.19	6.21	30.50
Number of umbellets per umbel	22.63	35.46	27.37	14.34	13.33	86.43	6.99	25.54
Number of seeds per umbellet	24.95	32.47	28.58	9.11	7.64	70.32	3.77	13.19
Number of seeds per umbel	586.24	1146.49	797.98	20.24	20.16	99.20	330.08	41.36
Fresh weight of umbel (g)	21.51	30.62	24.81	10.58	9.84	86.43	4.67	18.84
Dry weight of umbel (g)	8.15	11.78	10.10	10.27	9.11	78.80	1.68	16.67
Fresh weight of the plant at harvest (g)	298.95	444.18	355.32	11.39	11.13	95.41	79.58	22.40
Dry weight of the plant at harvest (g)	106.57	157.52	126.31	10.54	9.94	88.97	24.41	19.32
Seed yield per plant (g)	18.08	31.33	21.46	16.59	16.22	95.61	7.01	32.67
Seed yield per plot (g)	1084.93	1880	1291.22	16.83	16.53	96.50	431.91	33.45
Seed yield per hectare (kg ha^{-1})	1796.19	3133.33	2132.44	16.36	16.27	98.85	710.54	33.32
Harvest index (%)	17.96	26.41	21.43	13.04	12.05	85.34	4.91	22.93
Test weight (g)	8.11	10.47	9.01	8.97	6.32	49.69	0.83	9.18

Table 3: Mean performance of plant height, number of primary branches, number of secondary branches and flowering parameters in fennel varieties

Treatment	Plant height (cm)				Number of primary branches			Number of secondary branches			Days to first flowering	Days to 50% flowering
	30 DAS	60 DAS	90 DAS	120 DAS	60 DAS	90 DAS	120 DAS	60 DAS	90 DAS	120 DAS		
AF-1	16.25	95.44	154.85	185.00	4.82	6.31	7.53	9.80	13.04	15.05	57.08	65.75
AF-2	15.75	105.58	147.85	178.00	5.02	6.08	7.32	10.78	14.05	15.74	55.96	68.47
GF-2	15.98	102.47	142.86	167.00	4.75	6.31	7.83	8.82	12.60	15.64	55.45	66.44
GF-11	15.58	99.73	153.18	186.40	5.22	6.78	7.48	9.81	13.55	14.75	59.61	68.47
GF-12	14.51	100.26	139.55	155.48	4.91	7.26	8.53	10.00	14.66	17.23	57.95	68.79
RF-101	14.71	90.50	143.83	152.46	4.84	6.40	7.80	9.80	12.73	15.76	58.83	72.10
RF-125	11.97	74.38	114.81	134.86	4.84	6.06	7.33	9.60	12.26	14.81	54.16	69.35
RF-143	14.18	77.86	140.82	164.00	5.18	7.40	8.20	10.00	14.69	16.77	57.78	75.19
RF-145	18.27	109.96	154.93	186.00	7.21	9.64	11.78	12.12	20.54	23.24	52.97	71.65
RF-178	13.22	82.65	132.93	149.50	5.58	6.75	8.46	11.17	13.89	16.39	58.73	71.29
RF-205	14.35	82.78	121.13	132.45	4.91	5.82	7.31	9.96	11.82	14.45	53.46	66.96
RF-281	13.81	82.32	126.80	153.48	5.11	6.42	8.86	10.36	13.03	17.48	58.65	69.47
RF-157	12.71	81.93	134.55	156.79	5.17	6.60	8.36	10.40	13.16	16.55	57.37	68.72
HF-33	16.09	92.48	144.52	165.23	4.87	6.10	7.12	9.80	12.16	15.77	55.69	65.22
HF-143	17.14	107.16	147.51	174.88	4.47	6.25	7.42	10.00	13.11	15.99	57.22	67.14
Local variety	16.39	76.45	129.57	161.95	4.37	5.50	7.12	9.12	12.20	15.00	57.76	69.33
Mean	15.06	91.37	139.00	162.72	5.08	6.60	8.13	10.10	13.59	16.29	56.79	69.02
SE(m) ±	0.34	1.55	2.23	3.07	0.16	0.28	0.26	0.46	0.37	0.56	0.88	1.28
CD at 5%	1.00	4.48	6.44	8.86	0.46	0.82	0.74	1.32	1.07	1.61	2.54	3.69

Table 4: Mean performance of yield parameters in fennel varieties

Treatment	Number of umbels per plant	Number of umbellets per umbel	Number of seeds per umbellet	Number of seeds per umbel	Days to maturity	Fresh weight of the plant at harvest (g)	Dry weight of plant at harvest (g)	Seed yield per plant (g)	Seed yield per plot (g)	Seed yield per hectare (kg/ha)	Test weight (g)	Harvest index (%)	Fresh weight of umbel	Dry weight of umbel
AF-1	22.27	31.05	30.02	938.24	146.09	325.64	120.25	22.17	1395.82	2119.60	9.48	21.19	23.27	10.08
AF-2	21.59	32.34	31.72	1032.88	144.15	323.21	122.55	21.89	1355.19	2107.12	9.71	22.94	24.27	10.22
GF-2	20.26	30.83	28.27	877.17	142.27	327.82	115.61	21.00	1265.04	2101.38	9.18	20.72	25.13	10.35
GF-11	21.27	27.67	32.23	897.76	142.27	373.65	132.04	21.48	1293.90	2149.30	8.49	21.55	25.60	10.73
GF-12	23.21	29.62	29.44	875.00	140.86	362.92	130.59	26.93	1615.97	2675.48	9.17	25.95	28.73	11.78
RF-101	17.72	24.69	25.50	631.75	139.86	330.63	120.11	18.08	1084.93	1796.19	9.64	17.96	21.51	8.90
RF-125	18.52	23.16	26.43	614.27	130.56	298.95	106.57	18.76	1124.74	1862.10	9.77	23.99	22.31	9.20
RF-143	21.47	27.60	27.47	760.59	136.54	397.02	141.10	24.16	1449.82	2400.27	9.01	24.03	26.26	10.83
RF-145	30.36	35.46	32.47	1146.49	141.90	444.18	157.52	31.33	1880.00	3133.33	8.60	26.41	30.62	11.36
RF-178	19.46	23.64	28.20	692.23	134.97	402.98	143.55	19.91	1195.00	1991.66	8.68	20.26	25.70	10.57
RF-205	19.67	24.86	26.46	682.86	137.27	326.44	115.70	21.69	1303.33	2172.20	8.43	22.54	26.14	10.81
RF-281	19.26	22.63	26.28	617.54	140.00	342.56	121.33	19.82	1189.33	1982.20	10.47	19.59	24.59	10.13
RF-157	16.87	25.31	29.01	741.52	140.33	410.31	130.59	18.86	1128.33	1911.84	8.68	18.53	25.64	9.19
HF-33	18.50	28.13	29.03	834.58	141.23	345.18	126.30	19.17	1129.85	1944.17	8.48	19.12	23.23	10.15
HF-143	19.06	27.68	29.80	838.50	143.66	348.56	123.87	19.92	1130.00	1942.09	8.28	19.86	22.29	9.18
Local variety	16.09	23.26	24.95	586.24	146.00	325.12	113.34	18.18	1118.20	1830.10	8.11	18.25	21.63	8.15
Mean	20.35	27.37	28.58	797.98	140.50	355.12	126.31	21.46	1291.22	2132.44	9.01	21.43	24.81	10.10
SE(m) ±	0.71	0.83	0.82	360.97	2.77	4.77	2.55	0.43	391.76	21.60	0.33	0.62	0.56	0.28
CD at 5%	2.06	2.41	2.36	1042.6	8.01	13.77	7.38	1.24	1131.5	62.39	0.96	1.78	1.61	0.8

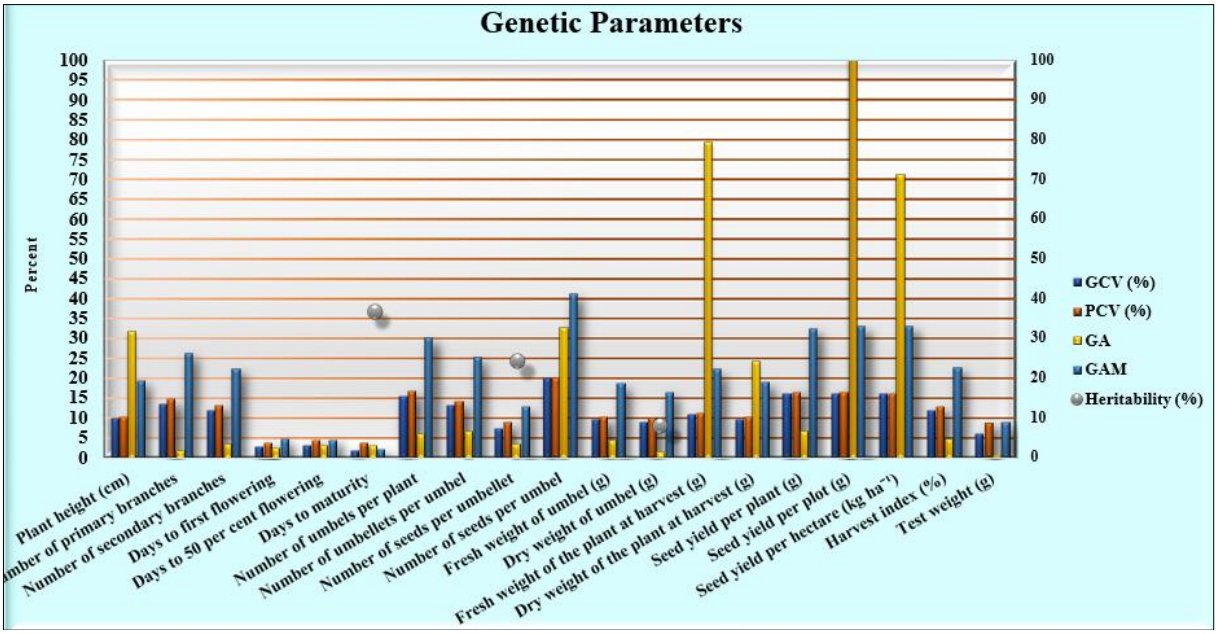

Fig 1: Estimates of variability and genetic parameters for growth and yield traits in fennel varieties

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