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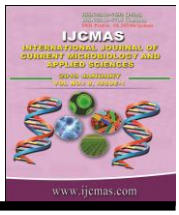

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Mean Performance of Fifty Genotypes of Fennel (*Foeniculum vulgare* Mill.) for Yield and Yield Attributing Traits

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A B S T R A C T

Fifty Fennel (*Foeniculum vulgare* Mill.) genotypes collected from different agro – climatic zones (Haryana, Rajasthan, Gujarat, Uttar Pradesh and Bihar) for their yield and yield attributing traits on pooled data (*Rabi* seasons of 2015-16 and 2016-17) recorded that there is a wide range of variability for the traits under study. The maximum plant height was recorded in HF-173 (184.90 cm), whereas the minimum plant height was recorded in JF-406 (118.07 cm). The highest number of primary branches per plant and secondary branches per plant were recorded in HF-167 (12.70) and HF-168 (24.60) respectively. Early days to 50% flowering was recorded in HF-179 (110.03). The maximum umbels per plant (71.40) and biological yield per plant (311.95 g) was recorded in genotype HF-169. And the maximum umbellates per umbel (33.37) seeds per umbellate (25.66), seeds per umbel (851.83), seed yield per plant (73.17 g), seed yield per ha (65.85 Q), harvest index (25.17 %) and test weight (9.51 g) were recorded in genotype HF-171.

Introduction

Fennel commonly known as 'saunf', an open pollinated spice crop of temperate and subtropical regions belongs to the family Umbelliferae (Apiaceae), has originated from Mediterranean region, where its high degree of genetic variability persists (Miranldi, 1999). It is a diploid species with chromosome number 2n = 22. Fennel seed consists of 6.3% moisture, 9.5% protein, 10% fat, 13.4% minerals, 18.5% fibre and 42.3% carbohydrates and also vitamins like vitamin C, thiamin, riboflavin, niacin and minerals like calcium, phosphorous, iron, sodium and potassium (Bhunia *et al.*,, 2005). The fennel seeds are aromatic, stimulant and carminative, used in diseases of cholera, bile disturbances, nervous disorders, constipation and dysentery and also used for control of diseases attacking lungs, chest, spleen and kidney stones and menopausal problems (Mohamed and Abdu, 2004). For crop improvement program presence of genetic variability in to the population is very important as it provide chance to pick the genotype having desirable trait for improvement and it also gives wide range of options to improve trait of interest. So, the evaluation of genotypes is important for further crop improvement program.

Materials and Methods

The study was conducted at Research Farm of the Department of Vegetable Science, CCCSHAU, Hisar (Haryana) during the *Rabi* seasons of 2015-16 and 2016-17. The experimental material consisted of fifty genotypes of fennel in randomized block design with three replications. Each genotype is planted at a spacing of 50 cm x 20 cm (single row of 3.0 m length for each genotype). The pooled data on thirteen 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 methods.

Results and Discussion

The results of the present investigation are presented in the Table 1. The plant height ranged from 118.07 to 184.90 cm with an overall mean of 149.28 cm. The maximum plant height was recorded in the genotypes HF-173 (184.90 cm) followed by HF-171 (183.04 cm), HF-169 (177.02 cm), NDF-42 (169.77 cm), HF-168 (169.22 cm) and NDF-28 (166.94 cm) while, the minimum plant height was recorded in the genotype JF-406 (118.07 cm).

Primary branches per plant varied from 5.08 to 12.70 with overall mean 9.11. The genotype HF-167 (12.70) recorded maximum number of primary branches per plant followed by HF- 168 (12.55), HF-169 (12.10), HF-171 (12.08), HF-173 (11.77) and HF-174 (11.20). The minimum number of primary branches per plant was recorded in the genotype JF-12 (5.08).

Secondary branches per plant varied from 10.74 to 24.60 with an overall mean 17.00. The maximum number of secondary branches per plant was recorded in the genotypes HF-168 (24.60) followed by HF-169 (22.07), HF-167 (21.23), HF-171 (20.90) and HF-173 (20.27). And minimum number of secondary branches per plant was recorded in the genotype JF- 12 (10.74).

Days to 50% flowering exhibited in the population and it ranged from 107.03 days (HF-179) to 125.80 days (RF-38) with an overall mean of 115.88 days. The minimum number of days to 50% flowering by genotypes like HF-179, HF-178, HF-168, HF-169, HF-170, HF-171, HF-167, HF-182, HF-173 and HF-180 are considered as early flowering whereas maximum number of days taken to 50% flowering by genotypes like RF-38, HF-176, RF-21, JK/RM/AF-24, JF-406 and JK/RM/AF-13 are considered as late.

Umbels per plant and the means for umbels per plant ranged from 23.67 to 71.40 with an overall mean of 44.74. The maximum numbers of umbels per plant was recorded in genotype HF-169 (71.40) followed by HF-171 (69.93), HF-167 (69.10), HF-168 (66.67) and HF-173 (62.63) and minimum number of umbels per plant was recorded in JF-12 (23.67).

Umbellates per umbel recorded ranged from 17.93 to 33.37 with an average of 25.26. Maximum number of umbellates per umbel was recorded in HF-171(33.37) followed by HF-169 (32.95), HF-168 (32.55) HF-173 (31.92) and HF-167 (29.39), while, the minimum number of umbellates per umbel was observed in JF-12 (17.93).

Seeds per umbellate ranged from 14.93 to 25.60 with an overall mean of 19.52. The maximum seeds per umbellate was observed in genotype HF-171(25.60) followed by HF-168 (24.17), HF-167 (23.67), HF-169 (22.78), NDF-28 (22.73), HF-173 (22.65) and HF-180 (22.57), while minimum number of seeds per umbellate was shown by JF-12 (14.93).

Table.1 Mean values of different characters of 50 fennel genotypes- pooled means of two years

Genotypes	PH (cm)	PBP	SBP	DFF	UPP	UTPU	SPUT	SPU	SYPP (g)	SYPH(Q)	BYPP (g)	HI (%)	TW (g)
HF-162	143.64	7.95	15.44	112.66	43.44	23.12	17.87	415.20	34.03	30.63	236.72	14.44	5.19
HF-163	141.27	7.67	15.93	114.47	36.47	24.83	18.20	452.62	38.84	34.95	254.09	15.30	5.38
HF-164	151.27	7.52	17.40	113.63	41.07	24.97	17.53	437.94	42.73	40.73	250.67	17.23	6.31
HF-165	137.62	9.57	16.97	115.97	45.50	24.45	18.78	460.47	40.80	36.72	265.93	15.35	5.55
HF-166	150.70	9.10	16.23	115.77	44.37	23.07	18.70	431.36	42.67	38.40	263.58	16.20	5.68
HF-167	163.23	12.70	21.23	111.40	69.10	29.39	23.67	694.97	63.40	53.45	283.92	22.38	7.43
HF-168	164.71	12.55	24.60	110.10	66.67	32.55	24.17	788.37	67.67	61.83	293.18	23.13	8.53
HF-169	177.02	12.10	22.07	110.20	71.40	32.95	22.78	825.43	70.10	62.76	311.95	22.51	9.27
HF-170	158.01	9.25	18.70	110.37	47.70	23.80	18.33	436.80	43.40	39.72	256.70	16.99	6.01
HF-171	183.04	12.08	20.90	111.27	69.93	33.37	25.60	851.83	73.17	65.85	290.65	25.17	9.51
HF-172	151.37	9.10	18.93	115.87	42.87	23.75	18.80	445.90	40.73	39.15	252.76	16.19	5.79
HF-173	184.90	11.77	20.27	111.90	62.63	31.92	22.65	725.13	66.17	59.55	277.11	23.84	8.22
HF-174	161.21	11.20	17.90	114.90	43.83	25.13	17.93	450.10	47.14	38.35	241.66	19.56	6.41
HF-175	164.35	10.15	16.97	113.67	46.60	24.97	17.77	442.16	41.73	37.56	250.88	16.74	6.51
HF-176	148.50	9.95	17.87	124.70	46.92	25.95	18.59	480.52	38.97	42.82	255.24	15.37	6.55
HF-177	158.05	9.30	16.77	114.03	41.57	25.27	18.65	471.53	39.85	35.88	264.97	15.04	5.84
HF-178	158.11	10.20	16.57	107.17	44.84	24.64	17.90	442.23	44.37	41.31	253.04	17.59	6.03
HF-179	160.30	10.40	17.30	107.03	43.40	25.83	18.18	470.22	39.43	35.49	252.94	15.65	6.01
HF-180	162.51	10.47	17.93	112.43	56.17	28.03	22.57	632.93	51.57	46.41	272.46	20.77	7.16
HF-182	169.22	10.38	17.83	111.50	53.87	27.72	21.59	599.94	51.49	46.34	273.67	20.35	7.08
NDF-28	166.94	9.97	18.24	112.77	47.83	28.57	22.73	651.61	51.81	46.63	260.04	19.93	7.25
NDF-38	149.90	11.05	18.84	119.03	53.64	25.92	21.35	555.62	55.77	50.19	259.36	21.66	7.37
NDF-39	149.90	10.67	15.63	113.07	53.03	27.15	19.13	521.89	47.53	38.28	246.36	19.37	5.98
NDF-41	148.33	8.25	16.57	116.73	44.23	26.65	20.33	545.20	46.00	44.68	239.56	19.20	6.23
NDF-42	169.77	10.80	17.40	119.77	44.84	25.13	21.30	533.55	42.80	47.76	236.79	18.18	6.76
NDF-43	158.39	8.67	16.57	119.20	41.23	26.37	20.80	550.50	44.53	41.76	249.34	18.06	6.40
NDF-44	146.04	9.59	16.97	116.13	45.27	26.05	20.08	524.41	43.20	40.38	242.49	17.86	6.19
JF-12	120.96	5.08	10.74	112.97	23.67	17.93	14.93	268.90	19.04	17.13	210.71	9.06	3.47

JF-382-2	120.13	5.77	12.27	118.27	33.80	22.50	17.40	393.47	28.87	27.06	231.54	12.48	4.55
JF-406	118.07	6.88	13.78	119.10	27.43	19.58	16.27	319.00	21.90	20.52	224.81	9.75	3.69
JF-421	131.10	6.52	14.37	120.40	33.80	22.47	18.20	407.82	27.97	25.17	241.67	11.72	4.42
JF-494	124.83	9.18	16.10	119.73	29.90	20.15	16.47	333.19	23.67	21.30	240.04	9.87	3.84
JF-533-2	130.54	6.84	14.63	119.80	35.20	23.08	17.27	400.16	26.43	23.79	235.85	11.21	4.23
JF-582	130.91	8.49	16.77	115.50	41.10	23.40	18.20	427.32	32.33	28.18	246.02	13.13	5.17
JK-/RM/AF-7	146.39	7.33	15.93	118.90	45.37	27.59	21.37	591.91	49.90	44.91	271.11	19.99	6.46
JK-/RM/AF-9	149.87	8.65	15.60	119.40	47.19	26.72	20.82	557.68	50.80	45.72	275.05	19.88	6.56
JK-/RM/AF-13	157.52	8.97	17.33	120.00	47.67	26.73	20.43	544.63	47.02	42.31	258.96	18.19	6.44
JK-/RM/AF-19	153.17	8.99	15.37	116.77	42.57	23.83	21.52	513.21	42.40	40.17	261.71	16.25	6.03
JK-/RM/AF-24	147.13	8.07	16.00	121.00	41.73	25.07	18.33	461.52	37.40	30.63	258.57	14.57	5.88
RF-21	127.07	8.55	16.53	124.17	31.70	20.93	18.90	397.64	29.74	26.76	249.72	11.93	4.82
RF-38	122.87	8.02	16.13	125.80	34.30	22.30	18.34	410.10	28.37	25.53	253.43	11.22	4.42
RF-54	149.95	8.02	16.37	118.23	37.30	20.63	17.74	366.13	35.77	35.28	246.04	14.61	5.45
RF-57	150.63	8.38	16.47	119.80	27.50	20.13	16.87	340.42	25.10	22.59	253.11	9.92	4.23
GF-11	146.67	7.32	15.40	113.37	39.07	24.38	20.97	513.02	39.27	35.34	266.32	14.77	5.47
GF-12	141.41	7.85	17.27	115.87	44.97	26.22	19.00	501.16	43.13	40.26	275.13	15.68	6.09
HF-33	136.23	8.33	17.87	113.70	47.97	26.73	19.10	513.73	46.47	44.73	257.22	18.09	6.26
HF-39	140.05	8.69	16.97	115.03	48.53	24.83	20.67	514.98	44.60	40.14	250.78	17.83	6.10
PF-35	144.72	9.82	16.37	118.27	44.20	25.13	20.27	511.88	44.00	40.89	252.58	17.43	6.34
GF-2	142.57	7.90	15.80	115.57	39.50	24.97	18.42	461.15	41.10	36.99	265.99	15.54	5.71
R.sourbha	153.13	9.53	16.00	116.70	44.34	26.33	18.63	492.68	43.40	40.56	242.89	17.87	6.26
Overall mean	149.28	9.11	17.00	115.88	44.74	25.26	19.52	501.60	42.77	39.07	256.11	16.70	6.05
SE(m)	3.84	0.24	0.61	1.08	1.24	0.90	0.71	10.60	2.12	1.22	6.26	0.81	0.13
C.D 5%	10.79	0.68	1.21	3.05	3.48	2.54	1.99	29.81	5.96	3.42	17.61	2.27	0.37
CV (%)	4.45	4.62	4.38	1.62	4.79	6.18	6.28	3.66	8.59	5.40	4.24	8.39	3.80

PH; Plant Height, PBP; Primary Branches per Plnat. SBP; Secondary Branches per Plant, DFF; Days to 50 % Flowering, UPP; Umbels per Plant, UTPU; Umbellates per Umbel, SPUT; Seeds per Umbellate SPU; Seeds per Umbel, SYPP; Seed Yield per Plant, SYPH; Seed Yield Per ha, BYPP; Biologiclal Yield per Plant, HI; Harvest Index, TW; Test Weight

The seeds per umbel ranged from 268.90 to 851.83 with an overall mean of 501.60. The maximum number of seeds per umbel was observed in genotype HF-171 (851.83) followed by HF- 169 (825.43), HF-168 (788.37), HF-173 (725.13) and HF-167 (694.97). And minimum number of seeds per umbel observed in JF-12 (268.90).

Seed yield per plant ranged from 19.04 g to 73.17 g with an overall mean of 42.77 g. The maximum seed yield per plant was recorded in genotype HF-171 (73.17 g) followed by HF-169 (70.10), HF-168 (67.67), HF-173 (66.17) and HF-167 (63.40), while the minimum seed yield per plant recorded was in JF-12 (19.04g).

Seed yield per ha ranged from 17.13 Q to 65.85 Q with an overall mean of 39.07 Q. The maximum seed yield per ha was recorded in genotype HF-171(65.85 Q) followed by HF-169 (62.76), HF-168 (61.83), HF-173 (59.55) and HF- 167 (53.45). And minimum seed yield per ha was recorded in JF-12 (17.13 Q).

The biological yield per plant ranged from 210.71 g to 311.95 g with an overall mean of 256.11 g. The maximum numbers of biological yield per plant was recorded in genotype HF-169 (311.95 g) followed by HF-168 (293.18), HF-171 (290.65) HF- 167 (283.92), HF-173 (277.11), GF-12 (275.13), JK/RM/AF-9 (275.05) and HF-182 (273.67), while the minimum number of biological yield per plant was recorded in JF-12 (210.71 g).

Harvest index ranged from 9.06 % to 24.16 % and the overall mean value was calculated to be 16.70 %. The maximum harvest index was recorded in genotype HF-171(24.16 %) followed by HF- 173 (23.84 %), HF-168 (23.13 %), HF-169 (22.51 %), HF-167 (22.38 %) and NDF-38 (21.66 %). And minimum harvest index was recorded in JF-12 (9.06 %).

Test weight ranged from 3.47 g to 9.51 g and the overall mean was 6.05 g. The maximum test weight was recorded in genotype HF-171 (9.51 g) followed by HF-169 (9.27 g), HF-168 (8.53 g), HF-173 (8.22 g), HF-167 (7.43 g) and NDF-38 (7.37 g). And minimum test weight was recorded in JF-12 (3.47 g).

From the study we can draw conclusion that the mean performance of all thirteen characters under study revealed a great range of mean values, which concludes that there is a wide genetic variability among the genotypes for the traits like plant height (cm), primary branches per plant, secondary branches per plant, days to 50% flowering, umbels per plant, Umbellates per umbel, seeds per umbellate, seeds per umbel, seed yield per plant (g), seed yield per ha (Q), biological yield per plant (g), harvest index (%) and test weight (g). Therefore there is a scope for selection of genotypes with desirable component characters in cross-breeding program. These results corroborate the findings of Singh and Mittal (2002), Singh *et al.,* (2004), Patel *et al.,* (2008), Yogi *et al.,* (2013), Sengupta *et al.,* (2014), Ghanshyam *et al.,* (2015) and Mamatha *et al.,* (2017).

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