Original Research Article

EFFECT OF SEED RATE AND SOWING METHOD ON SEED YIELD OF FENNEL

Abstract

The research was carried out at the research field of Spices Research Sub-Centre, Faridpur during Rabi season, 2017-18 and 2018-19 to determine the optimum seed rate and suitable sowing method for Fennel cultivation. The experimental field belongs to high land of Low Ganges River Floodplain (AEZ 12) with clay loam in texture having 7.6-8.1 soil p^H. The experiment was laid out in a Randomized Complete Block Design (factorial) with three replications. Four different seed rates viz., 6, 8, 10 and 12 kg seed/ha and two sowing methods viz., Broadcasting and Line sowing method were evaluated. The highest seed yield (1569 kg/ha) was recorded from the treatment combination of 10 kg seed/ha × line sowing method. The lowest seed yield (985.8 kg/ha) was recorded from 6 kg seed/ha × Broadcasting method.

Key words: Plant population, Sowing method, Cultural management, Fennel crop

Introduction

Fennel (*Foeniculum vulgare)* belongs to family Apiaceae or Umbelliferae is a strong aromatic biennial perennial. Cultivated worldwide and extensively used as a traditional medicine since ancient times. It is also utilized for the flavouring of a number of food products and in cosmetics [1a & 1b]. Fennel has antifungal, antioxidental, antibacterial and mosquito repelent properties [2] Fennel cures asthma, windy colic useful in diseases of chest, spleen and kidney [3]. In addition, fennel has carminative, flavoring, antioxidant, antibacterial, antifungaland mosquito repellent properties [4].The fruits are used in flatulence, fever, intestinal colic, burning sensation and constipation. Farmers from all over Bangladesh are growing fennel crop mainly for their own domestic uses. The product obtained from such a lesser area is insufficient to meet the commercial requirements of the country and unable to cover the gap between demand and production.So, there is dire need to increase the fennel production in Bangladesh. Proper cultural management practices needed to increase seed yield of fennel. Therefore, the trial was designed to find out the best suited optimum seed rate and sowing method affecting the growth, yield and yield components of fennel.

Materials and Methods

The experiment was conducted at the research field of Spices Research Sub- Centre, Faridpur during Rabi season, 2017-18 and 2018-19 to determine the optimum seed rate and suitable sowing method for fennel cultivation. The experimental field belongs to high land of Low Ganges River Floodplain (AEZ 12) with clay loam in texture having 7.6-8.1 soil p^H.The experiment was laid out with a Randomized Complete Bock Design (factorial) with three replications. Four seed rates (viz. 6, 8, 10 and 12 kg/ha) and two sowing methods (viz. broadcasting and line sowing method) were evaluated. BARI Mouri-1 was used as a test crop. The seeds were continuously sown on 09 November in 2017. The single plot size was 3m x 2m. Plant spacing was 40cm x 15cm. The land was fertilized with cow dung 5 tons, N_{80} P_{35} $K_{70}S_{20}$ kg/ha. The entire quantity of cow dung, P and K were applied during final land preparation. Nitrogen was applied in two equal splits one at 15 days after germination and the other half at flowering stage followed by irrigation. Four weeding were done at 10, 25, 40 and 55 DAE. Four irrigations were done at 15, 30, 45 and 60 DAE. A slight irrigation was given three days after sowing to ensure optimum soil moisture for germination. Two spraying with Rovral 50wp @ 2g/L of water were applied at flowering and maturity stage to escape from Alternaria leaf and umbel blight disease. The crop was harvested on 12 April, 2018.

Data on the number of plants per m^2, plant height (cm), number of primary branches per plant, number of umbels per plant, number of umbel lets per umbel, number of seeds per umbel let, 1000-seed weight (g) and seed yield (kg/ha) were recorded. The collected data were analyzed by MSTAT-C statistical package and mean values were analyzed by Duncan's Multiple Range test.

Results and Discussion

Effect of seed rate

Different seed rates had significant effect on number of plants per m^2, number of branches per plant, number of umbels per plant, number of umbel lets per umbel , number of seeds per umbel let and seed yield (kg/ha) during 2016-17. But the plant height was insignificant (Table-1). In 2017-18 and 2018-19 higher number plants per m^2 (62.00) and (65.16) was recorded from the seed rate 12 kg/ha and the lower number of plants per m^2 (49.33) and (51.83) was recorded from the seed rate 6 kg/ha. It was expected that plants grown densely were taller because of not to be found enough space for spreading [5]

On the other hand, In 2017-18 the higher number of umbels per plant (28.25), umbel lets per umbel (26.7) and number of seeds per umbel let (24.08) was recorded when 8kg/ha seeds were sown respectively. The lower number of umbels per plant (26.23), umbel lets per umbel (22.4) and seeds per umbel let (21.82) was recorded from the seed rate 12 kg/ha. The highest seed yield (1395kg/ha) was recorded from the seed rate 12 kg/ha and the lowest seed yield (1140 kg/ha) was recorded from the seed rate 6 kg/ha.

In 2018-19 the higher number of umbels per plant (31.28), umbel lets per umbel (30.83) and number of seeds per umbel let (27.48) was recorded when 8kg/ha seeds were sown respectively. The lower number of umbels per plant (25.28), umbel lets per umbel (24.70) and seeds per umbel let (24.73) was recorded from the seed rate 12 kg/ha. The highest seed yield (1395kg/ha) was recorded from the seed rate 12 kg/ha and the lowest seed yield (1140 kg/ha) was recorded from the seed rate 6 kg/ha.

Several researchers revealed that the number of umbels per plant is affected by plant density and when plant density increases, the umbels number decrease [6a,6b & 6c].

Table.1 Effect of seed rate on the yield and yield contributing characters of fennel during 2017-18

Treatments	Plant height (cm)	No. of Plants/ m^2	No. of Branches/ plant	No. of Umbels/ plant	No. of Umbel lets/Umbel	No. of Seeds/ Umbel let	1000 seed wt.(g)	Yield (kg/ha)
6 kg/ha	146.6a	49.33c	8.367	27.00ab	23.78b	22.13b	4.10c	1140c
8 kg/ha	145.8a	51.50b	8.167	28.25a	26.73a	24.08a	4.71a	1161c
10 kg/ha	146.6a	59.83b	8.400	27.32ab	26.25ab	22.08b	4.70a	1266b
12 kg/ha	143.9a	62.00a	7.967	26.23b	22.48c	21.82b	4.50b	1395a
Level of sigf.	NS	**	*	**	**	**	*	**
CV (%)	7.74	5.08%	10.29	14.89	3.50	2.26	2.10	5.40

In a column, means followed by the same letter did not differ significantly.
NS = Non significant, ** = 1% level of significance. * = 5% level of significance.

Table.2 Effect of seed rate on the yield and yield contributing characters of fennel during 2018-19

Treatments	Plant height (cm)	No. of Plants/ m^2	No. of Branches / plant	No. of Umbels/ plant	No. of Umbel lets/Umbel	No. of Seeds/ Umbel let	1000 seed wt.(g)	Yield (kg/ha)
6 kg/ha	161.4a	51.83d	9.583ab	27.83b	25.38bc	25.02b	4.10c	1140c
8 kg/ha	160.8a	53.66c	10.43a	31.28a	30.83a	27.48a	4.71a	1161c
10 kg/ha	161.6a	62.50b	9.767ab	27.68b	26.03b	24.73b	4.70a	1266b
12 kg/ha	159.0a	65.16a b	9.433ab	25.28c	24.70c	24.20b	4.50b	1395a
14 kg/ha	169.3a	73.83a	8.500b	23.92d	23.57d	22.20c		
Level of sigf.	NS	**	**	**	*	*	*	**
CV (%)	6.31	5.21	11.40	3.84	3.36	3.31	2.10	5.40

In a column, means followed by the same letter did not differ significantly.
NS = Non significant, ** = 1% level of significance. * = 5% level of significance.

Effect of sowing method

Different sowing methods had significant effect on the number of plants per m^2, number of primary branches per plant, number of umbels per plant, number of umbel lets per umbel , number of seeds per umbel let and seed yield (kg/ha). But the plant height was insignificant (Table-2). In 2017-18 and 2018-19 the higher number of plants per m^2 (64.0) and (69.66).was recorded from line sowing method. The lower number of plants per m^2 (47.3) and (53.13)was recorded from broadcasting method In 2017-18 the higher number of plants per m^2 (69.66).was recorded from line sowing method and the lower number of plants per m^2 (53.13)was recorded from broadcasting method.

In 2017-18 the higher number of umbels per plant (30.9) was recorded from line sowing method. The higher number of umbel lets per umbel (26.5) and (26.26), number of seeds per umbel let (23.01) and (24.74) was recorded from line sowing method in 2017-18 and 2018-19 respectively, while in 2018-19 higher number umbels per plant (27.02) was recorded from broadcasting method. In 2017-18 the lower number of umbels per plant (23.4), number of umbel lets per umbel (23.05), number of seeds per umbel let (21.9) was observed from broadcasting method. The lower number of umbel lets per umbel (25.94) and number of seeds per umbel let, (24.70) was recorded from broadcasting method in 2018-19. In 2018-19 lower number of umbels plant (27.02) was observed at line sowing method. Sowing methods and plant spacing have significant effect on the number of umbels per plant [7] and [8].

The highest seed yield (1398.7 kg/ha) was recorded from line sowing method and the lowest seed yield (1082.3 kg/ha) was recorded from broadcasting method. Ashiq&Shah have also reported significant effect of sowing methods on fennel seed yield [9].

Table 3 Effect of sowing methods on the yield and yield contributing characters of fennel during 2017-18

Treatments	Plant height (cm)	No. of Plants/m^2	No. of Branches/plant	No. of Umbels/ plant	No. of Umbel lets/Umbel	No. of Seeds/ Umbel let	1000 seed wt (g)	Yield (kg/ha)
Broadcasting	144	47.3b	8.35a	23.4b	23.05b	21.90a	4.35b	1082.3b
Line sowing	147.4	64.0a	8.10ab	30.9a	26.50a	23.01b	4.65a	1398.7a
Level of sigf.	NS	**	*	**	**	**	*	**
CV (%)	7.74	5.08	10.29	14.89	3.50	2.26	2.10	5.40

In a column, means followed by the same letter did not differ significantly.
NS = Non significant, ** = 1% level of significance. * = 5% level of significance.

Table 4 Effect of sowing methods on the yield and yield contributing characters of fennel during 2018-19

Treatments	Plant height (cm)	No. of Plants/m^2	No. of Branches/plant	No. of Umbels/ plant	No. of Umbel lets/Umbel	No. of Seeds/ Umbel let	1000 seed wt (g)	Yield (kg/ha)
Broadcasting	160.6 a	53.133b	9.76a	27.37a	25.94b	24.70a	4.35b	1082.3b
Line sowing	164.2 a	69.667a	9.32ab	27.02ab	26.26a	24.74a	4.65a	1398.7a
Level of sig.	NS	**	**	**	*	*	*	**
CV (%)	6.31	5.21	11.40	3.84	3.36	3.31	2.10	5.40

In a column, means followed by the same letter did not differ significantly.
NS = Non significant, ** = 1% level of significance. * = 5% level of significance.

Interaction effect

The interaction effect of seed rates and sowing methods had significant effect on the number of plants per m^2, number of primary branches per plant, number of umbels per plant, number of umbel lets per umbel, number of seeds per umbel let and seed yield (kg/ha). But the plant height was insignificant (Table-3). The higher number of plants per m^2 (71.00) and (70.33) was recorded when seeds were sown in line with 12 kg seed/ha and the lower number of plants per m^2 (42) and (44.0) was recorded from 6 kg seed/ha × line sowing and 6 kg seed/ha × broadcasting method in 2017-18 and 2018-19 respectively. In 2017-18 and 2018-19 The higher number of branches per plant (9.467) and (10.47) was recorded from 8 kg seed/ha × line sowing method and the lower number of branches (7.33) and (9.13) was counted from 12 kg seed/ha with broadcasting method.Different agricultural practices affect differently on the branches per plant [10].

On the other hand, both in 2017-18 and 2018-19 the higher number of umbels per plant (34.07) and (31.30) was obtained from line sowing method when seeded with 6 kg seed/ha. The higher number of umbel lets per umbel (30.3) and (31.87) was recorded from line sowing method when seeded with 8 kg seed/ha. In 2017-18 the lower number of umbels per plant (20.47) and number of umbel lets per umbel (21.26) was recorded from broadcasting method when seeded with 12 kg seed/ha. In 2018-19 the lower number of umbels per plant (24.07) and number of umbel lets per umbel (23.93) was recorded from broadcasting method when seeded with 10 kg seed/ha. In 2017-18 the highest number of seeds per umbel let (25.37) was obtained from line sowing method with 10 kg/ha seed. The lower number of seeds per umbel let (20.03) was obtained from line sowing method with 12 kg/ha seed. In 2018-19 the highest number of seeds per umbel let (28.03) was obtained from line sowing method with 8 kg/ha seed and the lower number of seeds per umbel let (24.13) was obtained from broadcasting method with 12 kg/ha seed.

The highest seed yield (1569kg/ha) was recorded from treatment combination of 10 kg seed/ha × line sowing method. The lowest seed yield (985.8 kg/ha) was recorded from 6 kg seed/ha × broadcasting method, which was more or less identical to 6 kg seed/ha × broadcasting (1006 kg/ha).

Table 5 Effect of seed rate and sowing method on the yield and yield contributing characters of fennel during 2017-18

Treatments		Plant height (cm)	No. of Plants/ m^2	No. of Branches/plant	No. of Umbels/ plant	No. of Umbel lets/ Umbel	No. of Seeds/ Umbel let	1000 seed wt. (g)	Yield (kg/ha)
6 kg/ha	Broadcasting	147.7	42.00d	8.267ab	26.80abc	24.80c	22.40cd	4.00f	985.8e
	Line sowing	143.8	42.00d	7.800b	34.07a	27.46b	22.80bc	4.40d	1006e

8 kg/ha	Broadcasting	147.4	52.33c	9.467a	30.93ab	23.70c	23.57b	4.80b	1117de
	Line sowing	137.1	53.00c	7.867ab	32.00a	30.33a	23.60b	4.20e	1221cd
10 kg/ha	Broadcasting	145.4	56.67bc	8.46ab	27.20abc	22.76cd	21.87d	4.20e	1294bc
	Line sowing	147.8	61.00b	8.533ab	22.43c	25.03b	25.37a	5.03a	1569a
12 kg/ha	Broadcasting	145.7	67.33a	7.333b	20.47c	21.26de	20.60e	4.02c	1317bc
	Line sowing	150.7	71.00a	8.067ab	23.70bc	23.13d	20.03e	4.80b	1415b
Level of sigf.		NS	**	*	**	**	**	*	**
CV (%)		7.74	5.08	10.29	14.89	3.50	2.26	2.10	5.40

In a column, means followed by the same letter did not differ significantly.
NS = Non significant, ** =1% level of significance. * = 5% level of significance.

Table 6. Effect of seed rate and sowing method on the yield and yield contributing characters of fennel during 2018-19

Treatments		Plant height (cm)	No. of Plants/ m^2	No. of Branches/plant	No. of Umbels/ plant	No. of Umbellets/ Umbel	No. of Seeds/ Umbellet	1000 seed wt. (g)	Yield (kg/ha)
6 kg/ha	Broadcasting	162.7a	44.33g	9.33ab	26.57c	24.90de	24.27b	4.00f	985.8e
	Line sowing	158.8a	44.00g	10.40a	31.30a	29.80b	26.93a	4.40d	1006e
8 kg/ha	Broadcasting	162.3a	54.67f	10.00a	29.37b	27.30c	25.37b	4.80b	1117de
	Line sowing	152.5a	55.33f	10.47a	31.27a	31.87a	28.03a	4.20e	1221cd
10 kg/ha	Broadcasting	167.0a	63.33de	9.933ab	24.07de	23.93ef	24.73b	4.20e	1294bc
	Line sowing	160.1a	59.33ef	9.83ab	29.10b	25.87cd	25.30b	5.03a	1569a
12 kg/ha	Broadcasting	162.8a	67.33cd	9.13ab	25.57c-e	25.40de	24.13b	4.02c	1317bc
	Line sowing	161.1a	70.33bc	9.60ab	25.00c-e	24.00ef	24.10b	4.80b	1415b
14 kg/ha	Broadcasting	165.5a	75.00ab	8.86ab	26.00cd	24.77def	22.00c		
	Line sowing	171.6a	80.33a	7.86b	23.77e	23.20f	22.40c		
Level of sigf.		NS	**	**	**	**	*	*	**
CV (%)		6.31	5.88	11.40	3.84	3.36	3.31	2.10	5.40

In a column, means followed by the same letter did not differ significantly.
NS = Non significant, ** =1% level of significance. * = 5% level of significance.

Table 7 Economic performance of different treatments on the yield of Fennel during 2017-2018

Treatments		Seed yield (kg/ha)	Gross return (Tk./ha)	Total cultivation cost (Tk./ha)	Net return (Tk./ha)	Benefit-cost ratio
6 kg/ha	Broadcasting	985.8	177444	86169	91275	2.05
	Line sowing	1006	181080	96509	84571	1.87
8 kg/ha	Broadcasting	1117	201060	86522	114538	2.32
	Line sowing	1221	219780	96862	122918	2.26
10 kg/ha	Broadcasting	1294	232920	86874	146046	2.68
	Line sowing	1569	282420	97214	185206	2.9
12 kg/ha	Broadcasting	1317	237060	87227	149833	2.53
	Line sowing	1415	254700	97567	157133	2.61

Urea-Tk.16/kg, TSP-Tk. 22/kg, MoP-Tk. 15/kg, Gypsum-Tk. 10/kg, Zinc sulphate-Tk. 100/kg, Boric acid-Tk. 100/kg, Labour-Tk. 220/man day, Irrigation-2000/ha/irrigation, Lease value-Tk. 20800/ha for 5 months, Seed-Tk 200/kg. Sale price-Tk. 180/kg seed

Table 8. Economic performance of different treatments on the yield of Fennel during 2018-2019

Treatments		Seed yield (kg/ha)	Gross return (Tk./ha)	Total cultivation cost (Tk./ha)	Net return (Tk./ha)	Benefit-cost ratio
6 kg/ha	Broadcasting	985.8	177444	86169	91275	2.05
	Line sowing	1006	181080	96509	84571	1.87
8 kg/ha	Broadcasting	1117	201060	86522	114538	2.32
	Line sowing	1221	219780	96862	122918	2.26
10 kg/ha	Broadcasting	1294	232920	86874	146046	2.68
	Line sowing	1569	282420	97214	185206	2.9
12 kg/ha	Broadcasting	1317	237060	87227	149833	2.53
	Line sowing	1415	254700	97567	157133	2.61

Urea-Tk.16/kg, TSP-Tk. 22/kg, MoP-Tk. 15/kg, Gypsum-Tk. 10/kg, Zinc sulphate-Tk. 100/kg, Boric acid-Tk. 100/kg, Labour-Tk. 220/man day, Irrigation-2000/ha/irrigation, Lease value-Tk. 20800/ha for 5 months, Seed-Tk 200/kg. Sale price-Tk. 180/kg seed

Conclusion

From the above discussion it can be concluded that, treatment combination of 10 kg seed/ha × line sowing method may be good for cultivation of fennel.

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