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

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Abstract

The present study was carried out at the research field of Spices Research Sub-Centre, Faridpur during Rabi season 2018-19. The experiment was done to determine the optimum seed rate and suitable sowing method for fennel cultivation to increase seed yield and quality of fennel. 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. All of all yield contributing parameters (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) showed better result where seeds were sown at 10 kg/ha with line sowing method. Most of all yield contributing characters showed minimum results where seeds were sown at 6 kg seed/ha.The highest seed yield (1569 kg/ha) was recorded from the treatment combination of 10 kg seed/ha with line sowing method with highest benefit-cost ratio (2.9). The lowest seed yield (985.8 kg/ha) was recorded from 6 kg seed/ha × Broadcasting method with lowest benefit-cost ratio(1.87).

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, antifungal and mosquito repellent properties” [4]. “The fruits are used in flatulence, fever, intestinal colic, burning sensation and constipation. Mentioned researcher reported that sweet fennel fruits contain 2-4% essential oil which the constituents are trans-anethole 60-80%, 5-10% fenchone, limonene, methyl chavicol, α- phellandrine, anisaldehyde, cis-anethole (due to the toxic effects, presence of cis-anethole is not desirable), anisic acid, anicketon, monoterpenes and alcohols.Farmers from all over Bangladesh are growing fennel crop mainly for their own domestic uses.Various studies were conducted on fennel by many researchers such as sowing methods and times,sowing date and seeding rate and sowing date and row spacing” [5- 7]. 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.However, to realize the full yield potential of fennel, agricultural practices will have to be optimized for its production. Seed rate is the key factor affecting the yield and yield components. 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, 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.

Chart 1:- Weather Data at Faridpur from November 2018 to April 2019

Month	Temperature			Avg. RH(%)	Rainfall (mm)
	Max. 29.64	Min. 4.9	Avg. 18.04		
November, 2018				78.36	0.4
December, 2018	34.7	6.59	17.23859	79.4	0.0
January, 2018	33	7.77	20.01417	77.89	87.6
February, 2018	36.07	10.86	24.66225	72.82	10
March 2018	38.76	18.94	27.78459	78.69	53.6

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). But the plant height was insignificant (Table-1). The highest higher number plants per m^2 (62.00) was recorded from the seed rate 12 kg/ha and the lower number of plants per m^2 (49.33) was recorded from the seed rate 6 kg/ha. "It was expected that plants grown denselywere taller because of not to be found enough space for spreading" [5]

On the other hand, the higher number of umbels per plant (28.25), umbel lets per umbel (26.73) 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/. The highest seed yield (1395kg/ha) was recorded from the seed rate 12 kg/hawhich is followed by seed rate of 10 kg/ha (1266 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 umbelsper plant is affected by plant density andwhen plantdensity increases, the umbels number decrease [8a,8b & 8c].The minimum number of umbels per plant and number of seeds per umbel in case of plant density might have been due to less number of branch per plant and less leaf area which resulted in smaller photosynthetic apparatus and thus less sink (umbels and seeds) was developed accordingly.

Table 1. Effect of seed rate on the yield and yield contributing characters of fennel

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.

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). The maximum number of plants per m^2 (64.0) and was recorded from line sowing method. The lower number of plants per m^2 (47.3)was recorded from broadcasting method.Maximum number of plants per m^2 (69.66).was recorded from broadcasting method and the minimum number of plants per m^2 (53.13)was recorded from lines owing method. “Sowing methods and plant spacing have significant effect on the number of umbels per plant” [9, 10].

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” [11]. The results indicated that because of shorter growth period the plants in late sowing were unable to make full use of the available resources which resulted in lower number of umbels per plant and number of seeds per umbel, eventually the lower yield was obtained.

Table 2. Effect of sowing methods on the yield and yield contributing characters of fennel

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	64.0a	8.35a	23.4b	23.05b	21.90a	4.35b	1082.3b
Line sowing	147.4	47.3b	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

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 highest number of plants per m^2 (71.00) was

recorded when seeds were sown in broadcast method with 12 kg seed/ha and the lower number of plants per m^2 (42) recorded from 6 kg seed/ha × line sowing method. In 2017-18 and 2018-19 The highest number of branches per plant (9.467) was recorded from 8 kg seed/ha × line sowing method and the lower number of branches (7.33) was counted from 12 kg seed/ha with broadcasting method.Different agricultural practices affect differently on the branches per plant [10] which supported the result.

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 3. Interaction effect of seed rate and sowing method on the yield and yield contributing characters of fennel

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	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	22.43c	22.76cd	21.87d	4.20e	1294bc
	Line sowing	147.8	61.00b	8.533ab	27.20abc	25.03b	25.37a	5.03a	1569a
12 kg/ha	Broadcasting	145.7	71.00a	7.333b	20.47c	21.26de	20.60e	4.02c	1317bc
	Line sowing	150.7	67.33a	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.

Economic Analysis

The economic performance of different seed rates and sowing methods are presented in Table-4. The highest gross return (Tk. 282420/ha), net return (Tk. 185206/ha) and benefit-cost ratio (2.9) was obtained from 10 kg seed/ha with Line sowing method.The lowest gross return (Tk. 177444/ha), net return (Tk. 86169/ha) and benefit-cost ratio (1.87) was obtained from6 kg seed/ha with broadcasting method.

Table 4. Economic performance of different treatments on the yield of fennel

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

Fennel is one of the important medicinal and aromatic plants because it is used in drug production and as herbal tea. Therefore, cultivation of this plant without taking proper management practices is not economically feasible.Optimum seed rate and proper sowing method is an important cultural practice for commercial fennel production.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.The highestbenefit-cost ratio (2.9) was obtained from 10 kg seed/ha with Line sowing method. The lowestbenefit-cost ratio (1.87) was obtained from6 kg seed/ha with broadcasting method. From the above discussion it can be concluded that, treatment combination of 10 kg seed/ha with line sowing method may be good for cultivation of fennel.

Authors Contribution

This work was carried out in collaboration among all authors. All authors help to prepare the article and revised the manuscript for publication.

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