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## Effect of Different Sowing Seasons and Row Spacing on Seed Production of Fennel (*Foeniculum vulgare*)

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**Abstract:** The research on “Effect of different sowing seasons and row spacing on seed production of fennel (*Foeniculum vulgare*)” was carried out at Horticulture Research farm, NWFP Agricultural University Peshawar during the year 2002-2003. The experimental design was Randomized Complete Block with two factorial split plot arrangement. Two sowing seasons i.e. autumn and spring and four row spacing i.e. 40, 50, 60 and 70 cm were studied for seeing the effect on seed germination, plant height, umbel appearance, umbel maturity, seed weight/umbel and seed yield. Autumn sowing resulted in minimum days to germination (8.3), maximum plant height (134.8 cm), days to first and last umbel appearance (137 and 182), days to first and last umbel maturity (67 and 32), seed weight/umbel (2.5 g) and seed yield (418.7 kg ha<sup>-1</sup>). In row spacing 40 cm gave maximum plant height (114.7 cm), seed weight/umbel (2.2 g) and seed yield ha<sup>-1</sup> (369.7 kg), while minimum plant height (78.1 cm), seed weight/umbel (1.8 g) and seed yield ha<sup>-1</sup> (192.5 kg) was in 70 cm spacing. In interaction significantly highest seed yield (560.5 kg ha<sup>-1</sup>) was recorded in autumn sowing planted in 40 cm row spacing. On the basis of over all performance autumn crop showed excellent results.

**Key words:** Fennel, sowing season, row spacing

### INTRODUCTION

Fennel (*Foeniculum vulgare*) locally known as Sounf is a perennial herb but is grown as annual or biennial crop. It belongs to family Apiaceae (Umbellifereae). The plant has dark green or bronze wispy leaves with yellow flowers on compound umbels and is cross pollinated. It is tall, hardy and erect growing herb and grows from 90-150 cm tall<sup>[1]</sup>. Fennel is of high value medicinal crop. It relieves indigestion. It can be utilized as carminative, diuretic, expectorant and stimulant, antispasmodic and stomachic. It is also used in gastroenteritis, hernia, indigestion and abdominal pain<sup>[2]</sup>. The leaves of fennel are used with pork and fish. The fennel seed is used in the food and flavor industry for addition to meats, vegetable products, fish, sauces, soups, salad, bread, pastries, tea and alcoholic beverages. The essential oils are used in condiments, soaps, creams, perfumes and liquors. The leaves of fennel are cooked with spinach for a delicious taste<sup>[1]</sup>. Pakistan is rich in medicinal herbs, especially NWFP but still 90% of the country medicinal herbs requirement is imported. Present world market is around US\$ 800 million. China export 0.12 million tons worth US\$ 300 million. India 0.032 tons worth US\$ 80 million (both dominate world market). Iran exports these produce worth US\$ 10 million. Europe annually imports medicinal herb produce worth 1 billion dollars from Africa and Asia. More than 70%

population of our rural and remote hilly areas relies on traditional system of medicine for the primary health care. Plant species suited to local agro-climatic conditions will help in achieving sustainability of subsistence land holders, increasing employment, improving environment, providing an enormous export potential and save water for other major crops.<sup>[3]</sup> Omidbaigi and Hornok<sup>[4]</sup> found that the addition of N as top dressing after germination at 200 kg ha<sup>-1</sup> increased the seed yield by 71.95% over the control and increased the 1000 seed weight by 18.18%. Similarly Leto *et al.*<sup>[5]</sup> compared various sowing dates i.e. 20th November, 20th December, 20th January and 20th February and found highest seed yield from sowing of fennel on 20th November (439.9 kg ha<sup>-1</sup>), while seed oil yields were unaffected by sowing dates. Aiello and Bezzi<sup>[6]</sup> planted fennel at a spacing of 10, 15, 20 and 25 cm in rows and 75 cm apart and found no effect on plant establishment and survival in the first year (due to prolong autumn rains) but seed yield in the second and third years tended to be highest from plants 15 cm apart. Yadav *et al.*<sup>[7]</sup> carried out a field experiment on fennel with different irrigation and sowing dates at Haryana. In different sowing dates they got the highest seed and biological yield by sowing the fennel seed in third week of October rather than first week of October or first week of November. Yadav and Khurna<sup>[8]</sup> conducted a field experiment to find out optimum time of sowing and

appropriate planting method for fennel under Haryana conditions and got 38.7% greater yield of the transplanted crops. Among different sowing dates 5, 15 and 25 October gave the best results. They reported tallest plants from early sowing date with the highest number of primary branches, umbels per plant, seeds per umbel and seed yield. Yadav *et al.*<sup>[9]</sup> conducted a field experiment on fennel in winter season of 1999-2000 to determine optimum row and plant spacing and reported maximum plant height (182 cm), number of primary branches per plant (6.55) and no. of umbels/plant (30.5) at 40x25 cm spacing. Due to the medicinal and economic importance and other multipurpose uses of fennel, the present trend is to increase the seed production and improve the quality of this crop. Keeping in view these facts, the present project was design to enhance the seed production of fennel under the agro climatic condition of Peshawar by studying the effect of different planting seasons and row spacing on it.

### MATERIALS AND METHODS

The research study “Effect of different sowing seasons and row spacing on seed production of Fennel (*Foeniculum vulgare*) under the agro-climatic condition of Peshawar” was conducted at Horticulture Research Farm, Malakandher of Agricultural University, Peshawar. The experiment was laid out as Randomized Complete Block design with two factorial split plot arrangement. There were four replications. Sowing seasons were assigned to main plots and row spacing to sub plots. Sowing seasons were autumn (15th October) and spring (16th March) and four row spacing were 40, 50, 60 and 70 cm. The sub plot size was kept 3x3 m<sup>2</sup>. Data was taken on middle rows. Well rotten farmyard manure @ 30 t ha<sup>-1</sup> was added and well incorporated into the soil at the time of soil preparation. Seeds of a local variety were sown directly in flat beds. All the cultural practices including weeding, hoeing, irrigation and spraying against pests and diseases were carried out uniformly.

### RESULTS AND DISCUSSION

**Days to germination:** Non significant difference was observed among different row spacing and interaction for days taken to germination, while highly significant difference was observed between sowing seasons (Table 1). Seeds sown in autumn took minimum number of days (8.3) to germination compared to 14.6 days in spring sowing. The significant difference may be due to temperature. The temperatures at the time of sowing in autumn was warm and hence cause early germination

Table 1: Days to germination of fennel as affected by different seasons and row spacing

Row spacing (cm)	Sowing Seasons		Means
	Autumn	Spring	
40	8.3	15.0	11.7
50	8.3	14.3	11.3
60	8.3	14.6	11.5
70	8.3	14.5	11.4
Means	8.3A	14.6B	

Means followed by different letter(s) are significantly different from one another at 1% level of significance

Table 2: Plant height (cm) of fennel as affected by different seasons and row spacing

Row spacing (cm)	Sowing Seasons		Means
	Autumn	Spring	
40	147.9	81.5	114.7a
50	136.2	78.5	107.4ab
60	130.6	78.4	104.5b
70	124.6	78.1	101.3b
Means	134.8A	79.1B	

LSD value at 5% for row spacing: 8.07

Table 3: Days taken to first umbel appearance of fennel as affected by different seasons and row spacing

Row spacing (cm)	Sowing Seasons		Means
	Autumn	Spring	
40	134	93	114
50	137	95	115
60	138	94	115
70	139	95	116
Means	137A	94B	

Means followed by different letter(s) are significantly different from one another at 1% level of significance

Table 4: Days taken to last umbel appearance of fennel as affected by different seasons and row spacing

Row spacing (cm)	Sowing Seasons		Means
	Autumn	Spring	
40	179	117	148
50	182	118	150
60	183	119	151
70	184	118	151
Means	182A	118B	

Means followed by different letters are significantly different from one another using LSD test at 1% level of significance

Table 5: Days to first umbel maturity of fennel as affected by different seasons and row spacing

Row spacing (cm)	Sowing Seasons		Means
	Autumn	Spring	
40	64	19	42
50	67	19	43
60	68	19	43
70	69	19	44
Means	67A	19B	

Means followed by different letter(s) are significantly different from one another at 1% level of significance

while in spring due to continuous rains, the temperature was low and hence more days were taken for germination. These findings are in agreement with Hudson *et al.*<sup>[10]</sup> who

Table 6: Days to last umbel maturity of fennel as affected by different seasons and row spacing

Row spacing (cm)	Sowing Seasons		Means
	Autumn	Spring	
40	29	09	19
50	32	09	20
60	32	10	21
70	34	09	21
Means	32A	9B	

Means followed by different letter(s) are significantly different from one another at 1% level of significance

Table 7: Seed weight/umbel (g) of fennel as affected by different seasons and row spacing

Row spacing (cm)	Sowing Seasons		Means
	Autumn	Spring	
40	2.8	1.5	2.2a
50	2.7	1.4	2.1a
60	2.2	1.3	1.8b
70	2.4	1.2	1.8b
Means	2.5A	1.4B	

LSD value at 5% for row spacing = 0.2230

Table 8: Seed yield (kg ha<sup>-1</sup>) of fennel as affected by different seasons and row spacing

Row spacing (cm)	Sowing Seasons		Means
	Autumn	Spring	
40	560.5A	179.0D	369.7A
50	476.2B	122.2DE	299.2B
60	328.8C	098.30E	211.5C
70	309.4C	075.5E	192.5C
Means	418.7A	118.8B	

LSD value at 1% level of probability for row spacing = 50.87

LSD value at 1% level of probability for interaction = 71.94

reported that in seed beds that are over watered, the soil pore spaces may be so filled with water that the amount of oxygen available to the seeds becomes limiting and germination of most kind of seeds is retarded.

**Plant height:** Significant difference in plant height was found in different seasons and different row spacing. Maximum plant height (134.8 cm) was recorded in autumn crop whereas minimum plant height (79.1 cm) was found in spring crop (Table 2). In row spacing, maximum plant height (114.7 cm) was observed in 40 cm row spacing as compared to the minimum plant height (101.3) in 70 cm row spacing. Fennel plants of autumn sowing were taller due to early sowing and prolong growing season. Plants grown in close row spacing were taller which may be due to less space availability for spreading. The results are in line with the findings of Yadav and khurana<sup>[8]</sup>, Yadav *et al.*<sup>[9]</sup> who reported tallest plants from early planted crop of fennel at row spacing of 40 cm.

**Days to first umbel appearance:** It reveals from Table 3 that early sowing of fennel i.e. autumn sowing gave late umbel appearance compared to spring sowing. In autumn sowing first umbel appeared in 137 days compared to 94 days in spring sowing. As fennel is a long day plant so

these plants were looking to the specific signal from the environment regarding day length. They use to continue its vegetative growth until and unless that particular stimulus for reproduction phase from environment is arrived. Autumn was early sown crop there fore it took highest plant height and maximum number of days to first umbel appearance as compared to the spring sown crop.

**Days to last umbel appearance:** Maximum number of days (182) to last umbel appearance was recorded in autumn crop while minimum days (118) in spring crop (Table 4). Autumn crop grown vigorously produced more number of shoots and thus having prolonged blooming period as compared to spring crop.

**Days to first and last umbel maturity:** It reveals from Table 5 that significantly maximum days (67) were taken for first umbel maturity in autumn sowing as compared to the minimum days (19) in spring sowing. Similarly in autumn sown crop, last umbel was matured in 32 days as compare to 9 days in spring sowing (Table 6). The climate for autumn crop was cold as compare to spring crop and the growing period was prolonged and favorable and hence more days were taken to first and last umbel maturity. In case of spring crop, the climate for growth was not favorable, plants were weak and stunted and hence matured umbel early.

**Seed weight/umbel:** It reveals from Table 7, that Fennel planted early produced maximum seed weight/umbel (2.5 g), while late sowing resulted in least seed weight/umbel (1.4 g). In various spacing, 40 cm row spacing gave maximum seed weight/umbel (2.2 g) while minimum seed weight/umbel (1.8) was recorded in 70 cm row spacing. The maximum seed weight/umbel in early sowing is due to more seeds per umbel.

**Seed yield (kg ha<sup>-1</sup>):** Different seasons, row spacing and their interaction had significant effect on the seed yield of fennel (Table 8). Maximum seed yield ha<sup>-1</sup> (369.7 kg) was recorded in 40cm row spacing followed by 299.2 kg ha<sup>-1</sup> in 50 cm while minimum seed yield ha<sup>-1</sup> (192.5 kg) was in 70 cm row spacing. Early sowing resulted in maximum seed yield ha<sup>-1</sup> (418.7 kg). In interaction, the seed yield was maximum (560.5 kg ha<sup>-1</sup>) in 40 cm row spacing, the sowing of which was done in autumn. The maximum seed production in close spacing of autumn sowing may be due to more plants per unit area and more seed weight per umbel. Autumn crop grown vigorously produced more number of shoots, having prolonged blooming period as compared to spring crop produced maximum umbels and seed weight per umbel and hence resulted in maximum seed yield. At final stage of umbel due to unexpected temperature fluctuation and higher rainfall the autumn

crop had undergone some physiological disorder followed by fungal infection. The inoculum was isolated and cultured and its microscopic study showed the presence of a fungal sp. *Alternaria*. So the crop has potential to give more production and good quality seeds if it gets escaped from the unexpected unfavorable environmental conditions and diseases. Spring crop was sown on 6th of March rather 15th February due to continued rainfall and had delayed germination that resulted in its poor growth and development and hence less production was obtained from it. Spring crop may have the potential if planted a bit earlier and get germinated at proper time by avoiding unfavorable conditions such as continuous rains. The results are in agreement with Leto *et al.*<sup>[5]</sup> who reported maximum production from fennel crop sown earlier in winter season.

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