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**Effect of different sowing dates and different spacing
on morphology, yield contributing characters and yield
of fennel (*Foeniculum vulgare*)**

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Abstract

An experiment was conducted at Botanical Garden, Department of Agriculture, D.A.V. College, Abohar, Punjab during Academic year 2017-2018 to study the effect of different sowing dates and different spacing on morphology, yield contributing characters and yield of Fennel. The different sowing dates were 2nd week of November and 2nd week of January and the different spacing were 30cm, 45cm and 60 cm respectively. The effect of these factors on plant height, number of umbels, fresh weight of plants, dry weight of plants and yield per plot was observed. Out of these treatments, the combination of 45 cm on 2nd November sowing showed best results. The results revealed that there was decrease in height and weight as the sowing delayed. As observations was recorded, the parameters such as plant height, number of umbels, fresh weight of plants, dry weight of plants and yield per plot were decreased with denser plant population.

Keywords: Sowing dates, nitrogen, morphology, *Foeniculum vulgare*

Introduction

Fennel (*Foeniculum vulgare*) is a flowering plant species in the celery family Apiaceae or Umbelliferae. It is the sole species in the genus *Foeniculum*. It is a hardy, perennial herb with yellow flowers and feathery leaves. Fennel is a native of the Mediterranean region (Southern Europe, Western Asia, and North Africa), but has been naturalized throughout much of Europe. It is widely distributed in temperate and tropical regions. Propagation is done by seeds, direct sowing about 9 to 12 kg per hectare. Fennel requires cool and dry climatic conditions for its best growth and yield. The best time for sowing fennel is mid October to mid November. Avoid delaying the sowing reduces the yield of crop. A 100-gram portion of fennel seeds provide 345 kcal of food energy, and it is a rich source of protein, dietary fiber, B vitamins and several dietary minerals, especially calcium, iron, magnesium and manganese. Fennel seeds contain 52% carbohydrates, 15% fat, 40% dietary fiber, 16% protein and 9% water. (<https://www.nutrition-and-you.com/fennel-seed.html>). The optimum sowing date paves the way for better use of time, light, temperature, precipitation and other factors. (Moosavi). Khorshidi studied that different density of planting had significant effect on seed yield of fennel with decreased space among plants, seed yield per plot increased.

Materials and Methods

The experiment was carried out at the Botanical garden of D.A.V. College, Abohar, District Fazilka, Punjab, India. The location coordinates are 30.14'53"N and 74.19'93° E. The crop was grown in *rabi* season of 2017-18. The seeds of Fennel were brought to the botanical garden and firstly sown on 2nd week of November 2017 and then second sowing was done on 2nd week of January 2018 to study the effect of optimum sowing and delayed sowing. A pre-sowing irrigation or rauni was given followed by field preparation with spade (manually) to loosen the soil and uproot the weeds. A local variety was sown at the rate of 4 kg seed per acre with spacing of 45cm × 45cm in plots of 3m × 3.5m at a depth of 3-4 cm. Seeds should be

sown at rate of 10 g per plot. Each plot consists of 5 rows. Sowing was done by Kera method on November 13, 2017 and January 8, 2017. Plant height was measured with the help of measuring tape from soil surface to the top leaf of the plant at an interval of 15 days. Dry weight of plants were observed as plants were kept in oven for oven drying for 72 hours at temperature of 60°C. Harvesting index was calculated by using formula- Economic yield (seeds) / Biological yield (seeds + plant straw) × 100. Flower initiation time is recorded manually.

Treatments

Date of sowing

D₁: Normal sowing time (2nd week of November)

D₂: Late sowing time (2nd week of January)

Different spacing

S₁: 30 cm

S₂: 45cm

S₃: 60 cm

Results and Discussions

Plant height (cm)

Results showed that maximum plant height was recorded in D1S3 i.e. 63 cm after 150 days of sowing so the results are similar to the research of Pariari *et al.* which concluded that maximum plant height was noticed under 45×35 cm spacing i.e. 166.21 cm at 100 days after sowing whereas minimum plant height i.e. 137.77 cm was observed with 35×25 cm spacing.

Number of umbels

Results showed that maximum number of umbels per plant were recorded in D1S3 at 45 days after sowing and minimum

number of umbels were observed D2S1. Singh and Amin observed that maximum number of umbels per plant were recorded in 45 cm row spacing which were significantly higher in comparison to 30 cm and 60 cm row spacing.

Fresh weight of plants (g)

As from the experiment, it was observed that maximum fresh weight of plants was obtained in the treatment D1S3 which is 31 g and minimum was recorded in D2S2. Selim *et al.* observed the effect of plant spacing on fresh weight of plants with delayed sowing (1st November) produce the lowest weight 396.70 and 476.89 gm/ plant in the first and second seasons, respectively, with 687.96 and 838.70 g per plant in October sown and 661.67 and 751.70 g per plant respectively September sown crop.

Dry weight of plants (g)

It was observed that maximum dry weight was obtained from the plot D1S3 at 150 days after sowing similarly Diwan observed the wider row spacing 50 cm produce maximum dry weight of plant at 30, 60 and 90 days after sowing were 0.43, 3.28 and 18.18 g respectively whereas minimum dry weight was obtained in 30 cm row spacing i.e. 0.33, 2.33 and 10.55 g at 30, 60 and 90 days of sowing.

Yield per plot (kg)

Results showed that maximum yield per plot was recorded in D1S3 i.e. 0.280 kg per plot similarly, Amin *et al.* recorded higher seed yield in 45 cm row spacing i.e. 1521 kg per hectare which is superior over 30 and 60 cm row spacing having yield 1099 kg per hectare and 1307 kg per hectare respectively.

Observations and Tables

Table 1: Plant height of fennel as affected by the different spacing and different sowing date. At normal sowing (D₁)

Days interval/	30 days	45 days	60 days	75 days	90 days	105 days	120 days	135 days	150 days
S ₁	5	9	12	24	35	43	48	48	49
S ₂	4	8	12	30	44	60	60	61	61
S ₃	5	10	14	28	41	60	61	63	63

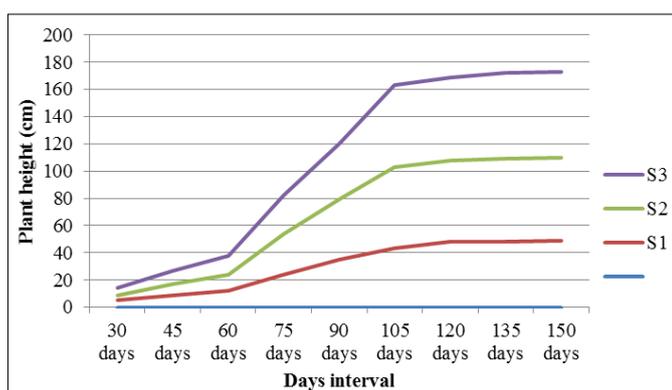


Fig 1: Normal Sowing (D₁)

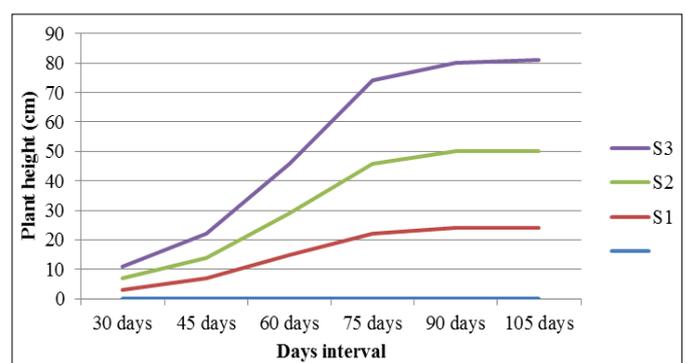


Fig 2: Late Sowing (D₂)

Table 2: At Late sowing (D₂)

Days interval/	30 days	45 days	60 days	75 days	90 days	105 days
S ₁	3	7	15	22	24	24
S ₂	4	7	14	24	26	26
S ₃	4	8	17	28	30	31

Table 3: Number of umbels of fennel as affected by the different spacing and different sowing date. At 15 days of sowing

Spacing/ Sowing time	S ₁	S ₂	S ₃	Average
D ₁	3.0	3.0	5.0	3.6
D ₂	3.0	2.0	4.0	3.0
Average	3.0	2.5	4.5	

Fig 4: At 30 days of sowing

Spacing/Sowing time	S ₁	S ₂	S ₃	Average
D ₁	7.0	7.0	9.0	7.6
D ₂	4.0	4.0	6.0	4.6
Average	5.5	5.5	7.5	

Fig 5: At 45 days of sowing

Spacing/Sowing time	S ₁	S ₂	S ₃	Average
D ₁	9.0	10.0	12.0	10.33
D ₂	6.0	7.0	8.0	7.0
Average	7.5	8.5	10.0	

Table 6: Fresh weight of plants (g) of fennel as affected by the different spacing and different sowing date. At 60 days of sowing

Spacing/Sowing time	S ₁	S ₂	S ₃	Average
D ₁	0.223	0.611	0.650	0.494
D ₂	0.250	0.520	0.550	0.440
Average	0.236	0.565	0.600	

Table 7: At 90 days of sowing

Spacing/Sowing time	S ₁	S ₂	S ₃	Average
D ₁	8.0	11.0	23.4	14.1
D ₂	6.0	11.0	13.0	10.0
Average	7.0	11.0	18.2	

Table 8: At 120 days of sowing

Spacing/Sowing time	S ₁	S ₂	S ₃	Average
D ₁	21.0	25.0	29.0	25.0
D ₂	18.0	22.0	27.0	22.3
Average	19.5	23.5	28.0	

Table 9: At 150 days of sowing

Spacing/Sowing time	S ₁	S ₂	S ₃	Average
D ₁	26.0	29.0	31.0	28.6
D ₂	-	-	-	-
Average	-	-	-	

Table 10: Dry weight of plants (g) of fennel as affected by the different spacing and different sowing date. At 60 days of sowing

Spacing/Sowing time	S ₁	S ₂	S ₃	Average
D ₁	0.110	0.530	0.570	0.403
D ₂	0.120	0.475	0.480	0.353
Average	0.115	0.520	0.525	

Table 11: At 90 days of sowing

Spacing/Sowing time	S ₁	S ₂	S ₃	Average
D ₁	1.6	2.2	5.5	3.1
D ₂	1.2	2.3	5.1	2.8
Average	1.4	2.25	5.3	

Table 12: At 120 days of sowing

Spacing/Sowing time	S ₁	S ₂	S ₃	Average
D ₁	6.0	6.2	6.9	6.3
D ₂	4.2	4.9	5.2	4.7
Average	5.1	5.5	6.0	

Table 13: At 150 days of sowing

Spacing/Sowing time	S ₁	S ₂	S ₃	Average
D ₁	7.4	7.5	8.0	7.6
D ₂	-	-	-	-
Average	-	-	-	

Table 14: Yield per plot (kg) of fennel as affected by the different spacing and different sowing date

Spacing/Sowing time	S ₁	S ₂	S ₃	Average
D ₁	0.225	0.280	0.234	0.246
D ₂	0.227	0.253	0.222	0.234
Average	0.226	0.265	0.228	

Conclusion

The result of this experiment showed that influence of different densities of planting on seed yield and number of umbels per plant was significant. As the results revealed that sowing date and different spacing both effect plant height as maximum height was 63cm in D1S3 plot and minimum was in D2S1 i.e. 24 cm, observed in normal sown crop due to elongated vegetative growth period compared to short height plants of delay sowing crop. As the number of umbels per plant, it is concluded that with delayed sowing number of umbels in D2S1 was 6 as compared to D1S3 was 12 and decreases compared to normal sown crop and maximum umbels observed in 45 cm row spacing compared to 30 and 60 cm row spacing.

The maximum yield was observed in early sowing plots. Also the fresh weight and dry weight was maximum in D1S3 was 31 g and 8 g respectively, normal sown crop because of elongated vegetative period and plot with 60 cm spacing have maximum fresh weight and dry weight. Planting date have positive effects on traits such as grain yield, planting date of November had highest grain yield in D1S2 was 0.280 kg compared to planting date of January. Plant spacing of 45 cm has highest grain yield in November. From above result it is concluded that normal sown plot with 45 cm plant spacing i.e. D1S2 gives better results.

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