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**Effect of different sowing dates and doses of nitrogen
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 doses of nitrogen 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 nitrogen doses were 50% N, 100% N and 150% N. 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 150% N on 2nd November sowing showed best results. The results revealed that there was decrease in height and weight as the sowing delayed. As observations were 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 lowering the dose of Nitrogen and minimum with 50% Nitrogen dose.

Keywords: Nitrogen, fertilizer, fennel, sowing

Introduction

Fennel (*Foeniculum vulgare*) is a native of the Mediterranean region but has been naturalized throughout much of Europe. It is widely distributed in temperate and tropical regions. Fennel is cultivated in a variety of countries, but India is the major producer of Fennel seed. Fennel 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, reaching up to 2 m in height. The leaf segments (1 to 5 cm in length) are thread-like; the basal sheath may be up to 10 cm in length. The tiny fruits (seeds) are around 4 mm long, oblong-ovoid, flattened, and greenish or yellowish brown or greyish, with yellow ridges. The main constituent of the essential oil is anethole. Fennel is an excellent source of vitamin C. Fennel seeds contain 52% carbohydrates, 15% fat, 40% dietary fiber, 16% protein and 9% water (<https://www.nutrition-and-you.com/fennel-seed.html>)^[2] Generally seed rate required for direct sowing is about 9 to 12 kg/ha. Sowing should be carried out deep in rows with distance of 45 to 60 cm apart. Bohreininejad *et al.*^[1] studied that sowing date is a very important parameter in crop production. The optimum sowing date paves the way for better-use of time, light, temperature, precipitation and other factors. Nitrogen fertilization is important to optimize crop production. Nitrogen is one of the most important nutrients needed for plant growth and development, because it affects photosynthetic efficiency and leaf development, which leads to dry matter production. Nitrogen fertilization leads to increase in plant height, yield and yield components and also increases the photosynthesis rate and enables the plant to grow rapidly (Waskela *et al.*)^[3]

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)

Fertilization Application

F₁: 50% of recommended dose of Nitrogen

F₂: 100% of recommended dose of Nitrogen

F₃: 150% of recommended dose of Nitrogen

Results and discussions

Plant height (cm)

As from experiment, maximum height was recorded in plots having 150% nitrogen i.e. in D₁F₃ and D₂F₃, but as the effect of sowing date D₂F₃ resulted in lower plant height than plot D₁F₃. So Muvel *et al.* [4] also concluded there was maximum plant height observed in the plots having maximum application of nitrogen dose i.e. 123 cm from plot having 120 kg of nitrogen per hectare. So the results are similar to the research of Muvel *et al.* Similarly, Ayub *et al.* [5] concluded that delayed sowing results in the decrease of plant height from 151.93 cm to 114.5 cm as similar in D₂F₃ plot.

Number of umbels

As from the experiment, it was observed that maximum number of umbels per plant was recorded in plots having 150% nitrogen i.e. in D₁F₃ and D₂F₃, but as the effect of sowing date D₂F₃ resulted in lower umbels per plant than plot D₁F₃. Singh and Amin [6] observed that number of umbels in fennel increases with increase in level of nitrogen. The maximum number of umbels was 19.86 whereas minimum number of umbels observed was 15. Ghobadi and Ghobadi [7] concluded that the maximum number of umbels per plant observed at 5th May was 50.7 and minimum observed at 19th June was 6.7.

Fresh weight of plants (g)

It is observed that maximum fresh weight was obtained from the plot D₁F₃ as nitrogen application with early sowing was maximum which leads to increase the biomass of fennel plants. It was concluded that in delayed sowing fresh weight is less than early sowing and among nitrogen doses as there is maximum fresh weight where maximum nitrogen dose was applied. Similarly the results of Selim *et al.* [8] observed that the latest date 1st November produced the lowest weight 396.70 gm/plant as compared to 1st September sowing. Anitha *et al.* [9] also gave the similar results of the maximum fresh

weight at maturity was 21.07 g was found in the plants sown on 15th October followed by 1st November sown plants was 19.46 g. The minimum fresh weight at maturity was 15.80 g was observed in the 15th December sown plots.

Dry weight of plants (g)

It was observed that maximum dry weight was obtained from the plot D₁F₃ as nitrogen application with early sowing was maximum which leads to increase the biomass of fennel plants. Azizi S [10] gives the similar observations as the maximum dry weight at maturity 15.33 g was recorded by the plants sown on 15th October followed by 1st November sown plants 13.79 g. Kuri *et al.* [11] also gives the similar results that revealed that the normal crop sown gives 23.3, 14.5, 37.9, and 27.7% of dry matter at 30, 60, 90 days after sowing and at harvest, respectively over late sown crop.

Yield per plot (kg)

It was observed that maximum yield was in early sowing plots and in the plots having maximum nitrogen dose. The maximum yield per plot was obtained from the D₁F₃ plot. Moosavi *et al.* [12] revealed the similar results showing that with the delay in sowing from 19th March to 30th April, fennel seed yield decreased from 1019.77 to 146.62 kg/ha. The seed yield per plant decreased from 9.61 g to 1.28 g. Similarly, Lotfi *et al.* [13] also studied the similar results showing that planting date of on 5th March with average of 704.7 kg.ha-1 and planting date of on 5th April with average of 477.9 kg.ha-1 had the highest and lowest grain yield, respectively.

Observations and tables

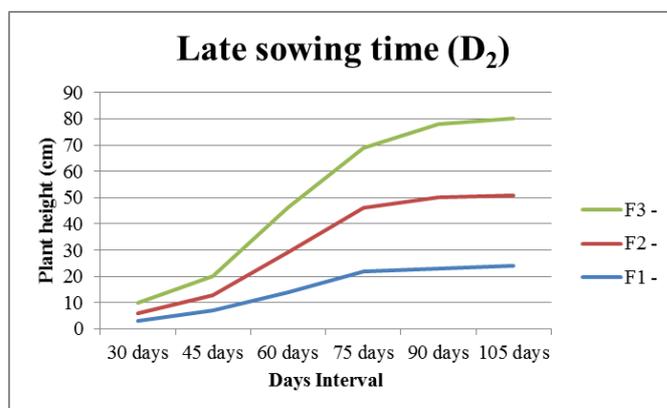
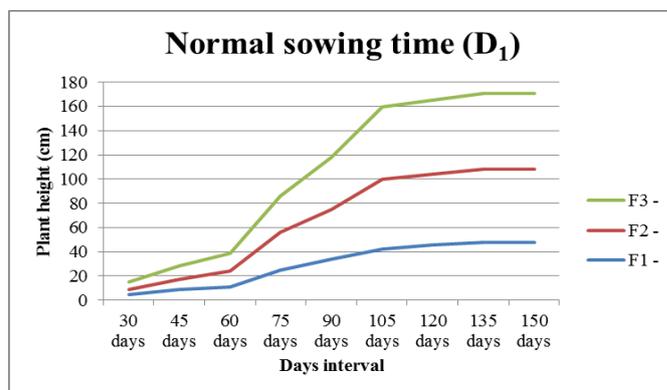


Fig: Plant height (cm) of fennel as affected by the different doses of nitrogen and different sowing date.

Table 20: Number of umbels per plant of fennel as affected by the different doses of nitrogen and different sowing date.**At 15 days after sowing**

Fertilizer application/ Sowing time	F ₁	F ₂	F ₃	Average
D ₁	4	4	6	4.66
D ₂	3	3	5	3.6
Average	3.5	3.5	3.6	-

At 30 days after sowing

Fertilizer application/ Sowing time	F ₁	F ₂	F ₃	Average
D ₁	6	9	9	8
D ₂	5	5	6	5.3
Average	5.5	7	7.5	-

At 45 days after sowing

Fertilizer application/ Sowing time	F ₁	F ₂	F ₃	Average
D ₁	9	9	11	9.66
D ₂	5	6	7	6
Average	7	7.5	9	-

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

Fertilizer application/ Sowing time	F ₁	F ₂	F ₃	Average
D ₁	0.350	0.620	0.650	0.540
D ₂	0.270	0.530	0.560	0.450
Average	0.310	0.575	0.605	-

At 90 days after sowing

Fertilizer application/ Sowing time	F ₁	F ₂	F ₃	Average
D ₁	8.0	10.0	23.3	13.7
D ₂	6.0	13.0	24.4	14.4
Average	7.0	11.5	23.8	-

At 120 days after sowing

Fertilizer application/Sowing time	F ₁	F ₂	F ₃	Average
D ₁	22.0	25.0	27.0	24.6
D ₂	18.0	22.0	26.0	22.0
Average	20.0	23.5	26.5	-

At 150 days after sowing

Fertilizer application/Sowing time	F ₁	F ₂	F ₃	Average
D ₁	24	28	32	28
D ₂	-	-	-	-
Average	-	-	-	-

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

Fertilizer application/Sowing time	F ₁	F ₂	F ₃	Average
D ₁	0.148	0.540	0.560	0.416
D ₂	0.135	0.465	0.470	0.356
Average	0.141	0.502	0.515	-

At 90 days after sowing

Fertilizer application/ Sowing time	F ₁	F ₂	F ₃	Average
D ₁	1.7	2.9	5.2	3.2
D ₂	1.2	2.5	3.7	2.4
Average	1.4	2.7	4.4	-

At 120 days after sowing

Fertilizer application/ Sowing time	F ₁	F ₂	F ₃	Average
D ₁	6.8	7.2	6.8	6.9
D ₂	4.2	4.8	5.2	4.7
Average	5.5	6.0	6.0	-

At 150 days after sowing

Fertilizer application/ Sowing time	F ₁	F ₂	F ₃	Average
D ₁	7.2	7.4	8.4	7.6
D ₂	-	-	-	-
Average	-	-	-	-

Table: Yield per plot (kg) of fennel as affected by the different doses of nitrogen and different sowing date.

Fertilizer application/ Sowing time	F ₁	F ₂	F ₃	Average
D ₁	0.235	0.298	0.240	0.257
D ₂	0.205	0.210	0.208	0.207
Average	0.220	0.254	0.224	-

Conclusion

In this concept, higher nitrogen doses leads to higher plant heights. Maximum height was reported in plots having 150% nitrogen i.e. in D₁F₃ is 63 cm and D₂F₃ is 29 cm, but as the effect of sowing date in plot D₂F₃ height was less than plot D₁F₃. In plots D₁F₃ and D₂F₃ number of umbels were 11 and 7 respectively in early and delay sowing plots, maximum as with 150% nitrogen applied in these plots.

It was concluded that maximum fresh weight was obtained from the plot D₁F₃ is 32g and maximum dry weight was also obtained from the plot D₁F₃ as nitrogen application was maximum which leads to increase the biomass of fennel plants. It was observed that maximum yield was in early sowing plots and in the plots having maximum nitrogen dose. As the increase in nitrogen dose there was increase in yield and as there was delay in sowing leads to decrease in yield.

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