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# Effect of different levels of nitrogen and potassium on soil nutrient status of fennel seed production

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**Abstract**
The experiments designed to investigate the effect of different levels of nitrogen and potassium on soil nutrient status of fennel seed production. Experiments was carried out during *rabi* 2018-2019, at Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola under Factorial Randomized Block Design, with 4 levels of nitrogen (60 kg $ha^{-1}$, 80 kg $ha^{-1}$, 100 kg $ha^{-1}$ and 120 kg $ha^{-1}$) and 3 levels of potassium (40 kg $ha^{-1}$, 60 kg $ha^{-1}$ and 80 kg $ha^{-1}$) thus making 12 treatment combinations replicated thrice. It was revealed that in an increase in the levels of N i.e.120 kg $ha^{-1}$ there was a significant and positive increase in the soil nutrient status. Whereas, Available nitrogen (205.85 kg $ha^{-1}$), Available phosphorus (18.41 kg $ha^{-1}$), Available potassium (228.86 kg $ha^{-1}$), plant nitrogen uptake (60.28 kg $ha^{-1}$) and plant potassium uptake (20.05 kg $ha^{-1}$) was recorded significantly maximum with $K_3$-80 kg K $ha^{-1}$. Hence, an application of 120 kg $ha^{-1}$along with 60 kg $ha^{-1}$ K could be useful for obtaining optimum soil nutrient status of fennel seed production.

**Keywords:** Fennel seed, nitrogen, potassium, available nitrogen, available phosphorus

## Introduction
Fennel is a well-known spice and aromatic medicinal plant used in traditional medicine and also as and substrate for different industrial purpose (Telci *et al*., 2009) [7]. Fennel fruit had a sweet taste and spicy odour that may be used in soups, sauces, pickles, confectioneries, perfumery, cosmetics, scenting soaps, pharmaceutical and phytotherapy industries (Blumenthal *et al*., 2000) [2]. Fennel seed contain 3-4% oil that is composed of anethole, fenchone, pinene, comphene, sabenine and camphor is used in pharmaceutical industry (Bentley and Trimen, 1999) [1]. Plant nutrition is one of the key factors influences the growth, yield and quality of crop plants. Similarly, it is largely influenced by the fertility status of the soil. Therefore, altering the soil nutrients and fertility status by providing balanced and adequate nutrients as per the crop requirement is one of the ways to boost the crop productivity of fennel. Among the major nutrients nitrogen and potassium provide nutrients to the plant with beneficial effects on physio chemical and biological properties of soil. Hence the judicious use of fertilizers plays an important role in the soil nutrient status of fennel seed production.

## Materials and Methods
Said experiment was conducted at Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *rabi* season of 2018-19. The experiment was laid out in Factorial Randomized Block Design (FRBD) with 4 levels of nitrogen (60 kg $ha^{-1}$, 80 kg $ha^{-1}$, 100 kg $ha^{-1}$ and 120 kg $ha^{-1}$) and 3 levels of potassium (40 kg $ha^{-1}$, 60 kg $ha^{-1}$ and 80 kg $ha^{-1}$) thus making twelve treatment combinations with which were replicated three times. As per the initial soil samples. Available nitrogen, phosphorus and potash was (215.12, 13.65 and 293.34 kg $ha^{-1}$ respectively). The fennel crop was sown with spacing of 45 × 30 cm. Urea and MOP fertilizers were applied to all the plots for supply of N and K. Half a dose of N and full doses of K were applied as basal application. The crop was top dressed with the remaining half dose of N applied at 30 days after sowing. The observations soil nutrient status was recorded and the data were statistically analysed for level of significance as per Panse and Sukhatme (1985).

## Results and Discussion

### Effect of nitrogen

**Available nitrogen**

The data presented in Table 1 indicated that, the maximum available nitrogen (213.00 kg $ha^{-1}$) after harvesting was recorded in $N_4$-120 kg $ha^{-1}$.The maximum available nitrogen was found in the treatment where maximum dose of nitrogen was applied i.e.120 kg $ha^{-1}$.

**Available phosphorus**

The data presented in Table 1 indicated that, significantly the maximum available phosphorus (18.10 kg $ha^{-1}$) after harvesting was recorded in $N_4$-120 kg $ha^{-1}$ which is at par with (17.72 kg $ha^{-1}$) in $N_3$-100 kg $ha^{-1}$.

**Available potassium**

Significantly the maximum available potassium after harvesting was recorded in (229.46 kg $ha^{-1}$) in $N_4$-120 kg $ha^{-1}$ which was at par with the (225.06 kg $ha^{-1}$) in $N_3$-100 kg $ha^{-1}$.

**Plant nitrogen uptake**

The data revealed that, significantly the maximum plant nitrogen uptake (65.02 kg $ha^{-1}$) after harvesting was recorded in $N_4$-120 kg $ha^{-1}$. Results are in the conformity with that of Mehta *et al.* (2011) [4] in fennel.

**Plant phosphorus uptake**

Significantly maximum plant phosphorus uptake (13.12 kg $ha^{-1}$) after harvesting was recorded in $N_4$-120 kg $ha^{-1}$ which was at par with (12.14 kg $ha^{-1}$) in $N_3$-100 kg $ha^{-1}$. Results are in the conformity with that Koyani *et al.* (2014) [3] in fennel.

**Plant potassium uptake**

The data presented in Table 1 indicated that, significantly the maximum plant potassium uptake (21.83 kg $ha^{-1}$) after harvesting was recorded in $N_4$-120 kg $ha^{-1}$.

### Effect of Potassium

**Available nitrogen**

The data presented in Table 1 indicated that, significantly maximum available nitrogen (205.85 kg $ha^{-1}$) after harvesting was recorded in $k_3$-80 kg $ha^{-1}$ which was at par with (203.77) that of recorded in $k_2$-60 kg $ha^{-1}$.

**Available phosphorus**

The data presented in Table 1 indicated that, significantly maximum available phosphorus (18.41 kg $ha^{-1}$) after harvesting was recorded in $k_3$-80 kg $ha^{-1}$.

**Available potassium**

The data presented in Table 1 also indicated that, significantly maximum available potassium (228.86 kg $ha^{-1}$) after harvesting was recorded in $k_3$-80 kg $ha^{-1}$.

**Plant nitrogen uptake**

The data presented in Table 1 indicated that, significantly maximum plant nitrogen uptake (60.28 kg $ha^{-1}$) after harvesting was recorded in $k_3$-80 kg $ha^{-1}$. The plant nitrogen uptake after harvesting was increased subsequently with the increased in potassium levels.

**Plant phosphorus uptake**

The differences in plant phosphorus uptake after harvesting by different levels of potassium found to be statistically significant. Significantly maximum plant phosphorus uptake (11.43 kg $ha^{-1}$) after harvesting was recorded in $k_3$-80 kg $ha^{-1}$. This might have promoted growth of root as well as their functional activity resulting in higher extraction of nutrients from soil environment to aerial parts.

**Plant potassium uptake**

The data revealed that, significantly maximum plant potassium uptake (20.05 kg $ha^{-1}$) after harvesting was recorded in $K_3$-80 kg $ha^{-1}$. This might be due to the potassium helps in several physiological processes and uptake of other nutrients. Potassium is known to play a vital role in photosynthesis and carbohydrate formation in fennel (Sadanandan *et al.*, 2002) [6].

**Interaction effect of nitrogen and potassium**

The data showed that, the interaction effect due to the different levels of nitrogen and potassium was found to be the significant. Treatment combination ($N_4$ x$K_3$) i.e. nitrogen 120 kg $ha^{-1}$ and 80 kg $ha^{-1}$ recorded significantly maximum available nitrogen, available phosphorus, available potassium, plant nitrogen uptake, Plant potassium uptake.

**Table 1:** The effect of different levels of nitrogen and potassium on soil nutrient status of fennel seed

| Treatments | Available nitrogen (kg $ha^{-1}$) | Available phosphorus (kg $ha^{-1}$) | Available potassium (kg $ha^{-1}$) | Plant nitrogen uptake (kg $ha^{-1}$) | Plant phosphorus uptake (kg $ha^{-1}$) | Plant potassium uptake (kg $ha^{-1}$) |
|---|---|---|---|---|---|---|
| **Factor A - Nitrogen levels (kg $ha^{-1}$)** | | | | | | |
| $N_1$(60 kg/ha) | 192.11 | 15.53 | 212.32 | 46.54 | 7.32 | 14.50 |
| $N_2$(80 kg/ha) | 200.13 | 16.43 | 218.16 | 55.68 | 8.88 | 17.65 |
| $N_3$(100 kg/ha) | 202.73 | 17.72 | 225.06 | 62.26 | 12.14 | 18.60 |
| $N_4$(120 kg/ha) | 213.00 | 18.10 | 229.46 | 65.02 | 13.12 | 21.83 |
| SE(m)± | 2.43 | 0.39 | 2.21 | 0.85 | 0.34 | 0.34 |
| CD at 5% | 7.20 | 1.15 | 6.54 | 2.51 | 1.03 | 1.01 |
| **Factor B- Potassium levels (kg $ha^{-1}$)** | | | | | | |
| $K_1$ (40 kg/ha) | 196.33 | 15.63 | 212.87 | 55.07 | 9.42 | 16.09 |
| $K_2$ (60 kg/ha) | 203.77 | 16.79 | 222.02 | 56.78 | 10.25 | 18.29 |
| $K_3$(80 kg/ha) | 205.85 | 18.41 | 228.86 | 60.28 | 11.43 | 20.05 |
| SE(m)± | 2.11 | 0.34 | 1.92 | 0.73 | 0.30 | 0.29 |
| CD at 5% | 6.23 | 1.00 | 5.67 | 2.18 | 0.89 | 0.88 |

**Table 2:** Interaction effects of different levels of nitrogen and potassium on soil nutrient status of fennel seed

| Treatments Combinations | Available nitrogen (kg ha$^{-1}$) | Available phosphorus (kg ha$^{-1}$) | Available potassium (kg ha$^{-1}$) | Plant nitrogen uptake (kg ha$^{-1}$) | Plant phosphorus uptake (kg ha$^{-1}$) | Plant potassium uptake (kg ha$^{-1}$) |
|---|---|---|---|---|---|---|
| $N_1$ $K_1$ | 180.75 | 14.36 | 201.50 | 43.06 | 6.46 | 11.60 |
| $N_1$ $K_2$ | 203.50 | 14.53 | 209.86 | 50.10 | 6.96 | 16.03 |
| $N_1$ $K_3$ | 192.10 | 17.70 | 225.60 | 46.46 | 8.53 | 15.86 |
| $N_2$ $K_1$ | 185.53 | 13.13 | 203.83 | 53.03 | 7.86 | 14.10 |
| $N_2$ $K_2$ | 201.90 | 16.70 | 222.90 | 53.43 | 9.23 | 18.83 |
| $N_2$ $K_3$ | 212.96 | 19.46 | 227.76 | 60.60 | 9.56 | 20.03 |
| $N_3$ $K_1$ | 207.63 | 17.33 | 220.80 | 62.16 | 11.13 | 18.06 |
| $N_3$ $K_2$ | 192.76 | 17.10 | 221.53 | 59.33 | 11.86 | 17.86 |
| $N_3$ $K_3$ | 207.80 | 18.73 | 232.86 | 65.30 | 13.43 | 19.86 |
| $N_4$ $K_1$ | 211.43 | 17.70 | 225.36 | 62.03 | 12.23 | 20.60 |
| $N_4$ $K_2$ | 216.93 | 18.83 | 233.80 | 64.26 | 12.95 | 20.43 |
| $N_4$ $K_3$ | 210.53 | 17.76 | 229.23 | 68.76 | 14.20 | 24.46 |
| **Interaction (A × B)** | | | | | | |
| S.E(m)± | 4.22 | 0.68 | 3.84 | 1.47 | - | 0.59 |
| CD at 5% | 12.47 | 2.00 | 11.34 | 4.36 | - | 1.76 |

## Conclusion

Based on the results, it can be concluded that the application of 120 kg ha$^{-1}$ N and 80 kg ha$^{-1}$K significantly superior in respect of improving soil nutrient status of fennel. Hence it may be recommended for farmers to get maximum return with minimum use of inputs.

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