Effect of Nitrogen and Phosphorus on Growth, Yield Attributes and Yields of *rabi* Fennel (*Foeniculum vulgare* Mill.)

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ABSTRACT

A field experiment was conducted during rabi season of 2011-12 at Junagadh to find out the optimum requirement of nitrogen and phosphorus for direct seeded rabi fennel. The results indicated that the higher plant height, maximum number of branches per plant, number of umbels per plant, number of seeds per umbel, test weight, seed and stover yields of fennel and higher content of N and P and higher uptake of N, P and K of seed and stover were recorded with fertilizing the crop with 120 kg N/ha and 60 kg P_2O_5/ha, which was at par with fertilizing the crop with 90 kg N/ha and 30 kg P_2O_5/ha. However, the higher economics along with B : C ratio was obtained with fertilizing the crop with 90 kg N/ha and 30 kg P_2O_5/ha owing to less cost of fertilizers.

Keywords: Fennel, Foeniculum vulgare Mill., Nutrient content and uptake, Economics

1. INTRODUCTION

Fennel (*Foeniculum vulgare* Mill.) is an important seed spice. India occupies prime position in seed spices and plays very important role in earning foreign exchange through export of seed spices. India is the world's largest producer, consumer and exporter of the spices. Gujarat ranks first with respect to production and productivity in India. Area under *rabi* direct seeded fennel is increasing day by day, because it is more profitable than other *rabi* crops like wheat, gram, cumin, mustard etc. Lake of production technologies and nutrient doses particularly for *rabi* drilled fennel are important constraints in boosting up the production. Therefore, an attempt was made to evaluate the effect of nitrogen and phosphorus on growth, yield attributes and yields of direct seeded *rabi* fennel.

2. MATERIALS AND METHODS

A field experiment was conducted at Instructional Farm, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh (Gujarat, India) during *rabi* season of 2011-12. The soil of the experimental field was clayey in texture, slightly alkaline in reaction (pH 8.0 and EC 0.56 dS/m), medium in available N (278 kg/ha), P_2O_5 (54.80 kg/ha) and K_2O (221

kg/ha). The experiment comprised treatments, viz., four levels of nitrogen (0, 60, 90 and 120 kg/ha) and three levels of phosphorus (0, 30 and 60 kg/ha) were laid in Factorial Randomized Block Design with three replications. The mean maximum and minimum temperature during the crop growth and development period ranged between 27.5 to 39.9^{0}C and 9.4 to 22.1^{0}C, respectively. The range of average relative humidity, bright sun shine, wind speed and daily evaporation was 25.6-57.0%, 4.8-10.2 h, 2.4-6.9 km/h and 3.8-10.7 mm, respectively. The fennel variety 'GF-11' was sown in second week of November at a spacing of 45 × 15 cm using seed rate of 8 kg/ha and by applying half dose of N and full doses of P as basal application in form of urea and DAP at sowing and remaining half dose of N was top-dressed in two equal splits in form of urea at 45 and 75 DAS as per treatment and crop harvested at first week of April. All the standard package of practices including appropriate plant protection measures were followed throughout the cropping season. The experimental data recorded for growth parameters, yield attributes and yield parameters and economics were statistically analyzed for level of significance.

3. RESULTS AND DISCUSSION

Crop growth, yield attributes and yields

The different nutrient levels significantly influenced the growth, yield attributes and yields of fennel crop. Growth, yield attributes and yield parameters increased with increase in nitrogen and phosphorus levels from 0 to 120 kg N/ha and 0 to 60 kg P_2O_5/ha, respectively. Perusal of data revealed that higher plant height, number of branches/plant, number of umbels/plant, number of seeds/umbel, 1000-seed weight, and seed and stover yields were recorded with application of 120 kg N/ha and 60 kg P_2O_5/ha, which was remained at par with 90 kg N/ha and 30 kg P_2O_5/ha, respectively (Table 1). The seed and stover yields recorded with application of 90 kg N/ha was 1865 and 2435 kg/ha, which was 38.24 and 27.48 per cent higher than that recorded with control (0 kg N/ha). This might due to positive response of nitrogen and phosphorus increased availability of phosphorus in soil, being a major structural element of cell and helped in cell elongation, greater availability of photosynthates, metabolites and nutrients to develop reproductive structures which ascribed to increased growth parameters and lead to higher yield attributes and yields of fennel crop. These findings are in agreement with those of Amin *et al.* (2005), Sammauria and Yadav (2008), Sanjeet *et al*. (2010), Jagdale and Dalve (2011), Ayub *et al.* (2011), Goswami (2011), Tuncturk *et al.* (2011) and Ehsanipour *et al.* (2012).

Nutrient content and uptake

The content and uptake of N and P in seed and stover and uptake of NPK by plant were significantly influenced by nitrogen and phosphorus levels. Significantly the higher values of these parameters were recorded with application of 120 kg N/ha and 60 kg P_2O_5/ha over the other levels of nitrogen and phosphorus but it was found statistically at par with treatment 90 kg N/ha and 30

kg P_2O_5/ha, respectively (Table 2). Higher photosynthetic activity in plant as evident from increase in biomass accumulation at successive duration and plant height reveals higher availability of metabolites from shoot to root. 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.

Significantly, the higher uptake of NPK by seed and stover was recorded with 120 kg N/ha and 60 kg P_2O_5/ha, which was found statistically at par with 90 kg N/ha and 30 kg P_2O_5/ha. However, lowest N and P concentration and uptake of N, P and K were observed under treatment control. The nutrient uptake is a function of yield and nutrient concentration in plant. Thus, significant improvement in uptake of NPK might be attributed to their concentration in seed and stover and associated with higher seed and stover yield. This might also be attributed to better availability of nutrients in the soil under these treatments. The results confirm the findings of Patel *et al*. (2000), Amin and Patel (2001), Thapa and Maity (2003) and Sammauria and Yadav (2008).

Interaction effect

The interaction effect due to nitrogen and phosphorus were not found significant in all observations.

Economics

It was evident that application of 90 kg N/ha gave the maximum net return (` 81993/ha) and B:C ratio (3.22) and with regard to phosphorus, application of 30 kg $P_2O_5$/ha gave the highest net returns (` 71598/ha) and B:C ratio (3.08). The lower net returns and B:C ratio found with application of 120-90 kg N and P_2O_5/ha, respectively might be due to more cost required (Table 2). The findings are in close conformity with results of Patel *et al*. (2000) and Naghera *et al*. (2000).

4. CONCLUSION

It is concluded that profitable production from direct seeded *rabi* fennel can be obtained by fertilizing the crop with 90-30 kg N-P_2O_5/ha (half dose of N and full doses of P as basal and remaining half dose of N in two equal splits at 30 DAS and 60 DAS) on clayey soil having medium fertility under South Saurashtra Agro-climatic zone.

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Table 1: Effect of nitrogen and phosphorus levels on growth, yield attributes and yields of *rabi* fennel

Treatments	Plant height at harvest (cm)	Branches /plant	Umbels/ plant	Umbellate/ umbel	Seeds/ umbel	Test weight (g)	Seed yield (kg/ha)	Stover yield (kg/ha)
Nitrogen levels (kg/ha)								
0	104.76	6.69	8.00	13.65	267.73	5.76	1152	1766
60	118.97	7.88	9.37	17.06	325.67	7.47	1449	2107
90	125.00	9.43	10.81	20.67	432.27	9.27	1865	2435
120	131.67	9.61	11.08	21.34	442.87	9.61	1867	2469
CD at 5%	12.29	0.45	0.49	1.26	29.92	0.60	132	204

Phosphorus levels (kg/ha)								
0	110.69	7.71	9.05	16.27	328.55	7.07	1361	1953
30	121.48	8.66	10.07	18.82	385.50	8.34	1691	2283
60	127.93	8.85	10.33	19.46	387.35	8.66	1697	2347
CD at 5%	10.64	0.39	0.42	1.09	25.91	0.52	114	176

Table 2: Effect of nitrogen and phosphorus levels on NPK content and uptake and economics of *rabi* fennel

Treatments	Nutrient content in seed (%)			Nutrient content in stover (%)			Nutrient uptake by plant (kg/ha)			Gross return (`/ha)	Cost of cultivation (`/ha)	Net return (`/ha)	B:C ratio
	N	P	K	N	P	K	N	P	K				
Nitrogen levels (kg/ha)													
0	1.21	0.278	0.494	0.609	0.204	0.337	32.33	8.56	14.73	72652	32828	39824	2.21
60	1.25	0.284	0.501	0.729	0.210	0.344	41.91	10.51	17.87	91154	33644	57510	2.71
90	1.67	0.282	0.499	0.884	0.208	0.342	62.23	11.99	20.43	116770	34053	82717	3.43
120	1.73	0.289	0.506	0.903	0.215	0.349	65.72	12.60	21.28	116958	34460	82498	3.39
CD at 5%	0.03	0.004	0.005	0.015	0.004	0.005	2.46	0.53	0.82	72652	32828	39824	2.21
Phosphorus levels (kg/ha)													
0	1.44	0.265	0.493	0.767	0.191	0.336	43.73	8.94	16.23	85566	32828	52738	2.61
30	1.47	0.289	0.502	0.779	0.215	0.345	52.55	11.56	19.39	106026	34428	71598	3.08
60	1.49	0.296	0.505	0.798	0.222	0.348	55.37	12.25	20.11	106514	36018	70496	2.96
CD at 5%	0.03	0.003	0.005	0.013	0.003	0.005	2.13	0.46	0.71	85566	32828	52738	2.61

Market price: Commodity: Urea SSP Seed Stover
`/kg : 5.50 7.50 60.00 2.00