Int.J.Curr.Microbiol.App.Sci (2018) Special Issue-6: 1300-1306

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7692 **Special Issue-6 pp. 1300-1306**
Journal homepage: http://www.ijcmas.com

Original Research Article

Effect of Integrated Nutrient Management on Yield, Quality and Soil Fertility Status of Fennel

R. S. Kalasare*, M. V. Patel and S. M. Bibe

Department of Agronomy, B.A. College of Agriculture, Anand Agricultural University, Anand, Gujarat, India
**Corresponding author*

Keywords

Vermicompost, Fertilizer, Fennel

A B S T R A C T

Field experiment was conducted during 2011-12 and 2012-13 in the College Agronomy Farm, Anand Agricultural University, Anand to study the effect of integrated nutrient management on fennel. Twelve treatment combinations comprising of integrated nutrient management with a randomized block design with four replications were applied. Result indicated that differences in seed and haulm yields as influenced due to residual effect of integrated nutrient management were found significant. Treatment T4 (100%RDN + Azospirillum + PSB + Vermicompost @ 2 t ha-1) produced significantly higher seed and haulm yields among all except treatment T2 (100%RDN +Azospirillum + Vermicompost @ 2 t ha-1) and T11 (100 % RDN + NADEP @ 5 t ha-1). In pooled basis, treatment T4 (100%RDN + Azospirillum + PSB + Vermicompost @ 2 t ha-1) was at par with treatment T2 (100%RDN + Azospirillum + Vermicompost @ 2 t ha-1) and recorded significantly higher protein content as compared to rest of the treatments.

Introduction

Fennel, (*Foeniculum vulgare)* belongs to Family *Apiaceae*, a native of Southern Europe and Mediterranean area, is an important seed spices. India is the world's largest producer, consumer and exporter of the spices and among all spices fennel is one of the most important spice. India occupies prime position in seed spice and plays very important role in earning foreign exchange through export of seed spice. It is commonly known as '*Saunf*' or '*Badi saunf*' and in Gujarat it is known as '*Variari'*.

In India, area under fennel was 41368 ha with production of 58265 t and productivity of 1.40 t ha^{-1} in 2010-11 (SBI, 2011).

Gujarat occupies 26300 ha area with production of 35800 t and productivity of 1.36 t ha^{-1} in 2010-11. Mehsana district ranks first with growing area of 8200 ha, production of 11600 t and productivity of 1.41 t $ha^{-1,}$ followed by Patan district with the area of 7300 ha, production of 9900 t and productivity of 1.36 t ha^{-1} (DOA, 2011).

Fennel is the most important condiment of Gujarat and Rajasthan. Fennel is raised profitably as a drilled crop in Gujarat. Area under *rabi* direct seeded fennel is increasing day by day, because it is more profitable as a winter direct seeded crop. In spite of this fact, the productivity of *rabi* fennel is low as

compared to its potential yield (2500 kg/ha). The reason for low productivity is lack of ideal agronomic practices including fertilizer management for *rabi* drilled fennel.

In the light of these considerations, present study was planned to study the effect of integrated nutrient management in fennel.

Materials and Methods

To study the effect of integrated nutrient management in fennel. Field experiment was conducted during two consecutive *rabi* seasons of 2011-12 and 2012-13 at College Farm, Anand Agricultural University, Anand Campus, Anand. The study involved Twelve treatment combinations comprising of integrated nutrient management *viz.*, T_1-Recommended Dose of Fertilizer (RDN-90:30:00 NPK kg ha^{-1}), T_2-100% RDN+ *Azospirillum* + Vermicompost @ 2 t ha^{-1}, T_3-50% RDN + *Azospirillum* + Vermicompost @ 2 t ha^{-1}, T_4-100% RDN + Azospirillum + PSB + Vermicompost @ 2 t ha^{1}, T_5-50% RDN + *Azospirillum* + PSB + Vermicompost @ 2 t ha^{-1}, T_6-100% RDN + Two spray of vermiwash @ 50 lit ha^{-1} at 45 and 75 DAS, T_7-50 % RDN +Two spray of vermiwash @ 50 lit ha^{-1} at 45 and 75 DAS, T_8- 100% RDN + 15 kg Humic acid ha^{-1}, T_9-50% RDN + 15 kg Humic acid ha^{-1}, T_{10}- 50 % RDN+ NADEP @ 5 t ha^{-1}+ 15 kg Humic acid ha^{-1}, T_{11}-100% RDN + NADEP @ 5 t ha^{-1}, T_{12}- 50 % RDN + NADEP @ 5 t ha^{-1} with four replications.

The soil was watered to field capacity when necessary. Data on germination, plant height and dry weight of plant, yield, quality and fertility of the soil were recorded. For recording dry matter, plants were removed from the base and first sun dried and then in oven at 60ºC till constant weight was obtained. Soil samples were taken at the time of harvest of crop from 0-15 and 15-30 cm soil depths. All other agronomic practices were adopted as per university recommendations. At harvesting, data on grain yield and various yield attributes were recorded.

Results and Discussion

Seed yield (kg ha^{-1})

The data pertaining seed yield (kg/ha) and stover yield (kg/ha) was influenced by the integrated nutrient management practices are presented in Table 1. Results revealed that effect of integrated nutrient management on seed yield of fennel was found significant treatment T_4 (100% RDN + *Azospirillum* + PSB+ Vermicompost @ 2 t ha^{-1}) being at par with treatment T_2 (100 % RDN + *Azospirillum* + Vermicompost @ 2 t ha^{-1}) and T_{11} (100 RDN + NADEP @ 5 t ha^{-1}) recorded significantly higher seed yield over rest of the treatment during 2011-12, 2012-13 and in pooled basis. The seed yield recorded under treatment T_4 was 2655, 2785 and 2719 during 2011-12, 2012-13 and in pooled basis, respectively.

The important reason responsible for better production of yield components and yield could be the supply of nutrients in balanced amount and available form. The increased growth in term of plant height, branches per plant, expansion of leaf lamina and chlorophyll content provided greater sites for photosynthesis and diversion of photosynthates towards sink (umbels and seed). The beneficial effect on yield attributes might be also due to increased supply of all the essential nutrients by vermicompost which might have resulted in higher manufacture of food and its subsequent partitioning to sink. The findings of present investigation are supported by those of Selvarajan and Chezhiyan (2001a) and Khoja (2004).

Fiber content (%)

The data pertaining fiber content (%) influenced by the integrated nutrient management practices are presented in Table 1.

Results revealed that effect of integrated nutrient management on fiber content of fennel seed was found significant lower under treatment T_4 (100% RDN + *Azospirillum* + PSB+ Vermicompost @ 2 t ha^{-1}) being at par with treatment T_2 (100 % RDN + *Azospirillum* + Vermicompost @ 2 t ha^{-1}) and treatment T_{11} (100 % RDN + NADEP @ 5 t ha^{-1}) recorded significantly lower fiber content during the year 2011-2012.

Whereas during the year of 2012-13 and in pooled basis treatment T_4 (100% RDN + *Azospirillum* + PSB+ Vermicompost @ 2 t ha^{-1}) being at par with treatment T_{11} (100 % RDN + NADEP @ 5 t ha^{-1}) T_5 (50% RDN + *Azospirillum* + PSB+ Vermicompost @ 2 t ha^{-1}) recorded lower fiber content (except T_5 in pooled basis)). The fiber content (%) recorded under treatment T_4 was 11.83, 11.69 and 11.76 during 2011-12, 2012-13 and in pooled basis, respectively.

Oil content (%)

The data pertaining oil content (%) influenced by the integrated nutrient management practices are presented in Table 1.

Results revealed that effect of integrated nutrient management on oil content of fennel seed did not exert any significant influence during the year of 2011-12 and 2012-13, but in pooled basis treatment T_4 (100% RDN + *Azospirillum* + PSB+ Vermicompost @ 2 t ha^{-1}) being at par with treatment T_2 (100 % RDN + *Azospirillum* + Vermicompost @ 2 t ha^{-1}) and T_{11} (100 % RDN + NADEP @ 5 t ha^{-1}) recorded significantly higher oil content (%) over rest of the treatment. The oil content (%) recorded under treatment T_4 was 1.93, 2.01 and 1.97 during 2011-12, 2012-13 and in pooled basis, respectively. Darzi *et al.*, (2013) reported that essential oil yield of fennel seeds increased significantly by increasing the vermicompost, they demonstrated that vermicompost supplied phosphate and nitrogen to the soil, giving a more balanced nutritional status than mineral fertilizers.

Effect on available nitrogen

The data on available nitrogen in the soil just after harvest of the fennel as influenced by the integrated nutrient management practices are presented in Table 2.

Data given shows that difference in available nitrogen in soil due to different combinations of integrated nutrient management practices were found to be significant during 2011-12, 2012-13 and in pooled basis.

Treatment T_4 (100% RDN + *Azospirillum* + PSB+ Vermicompost @ 2 t ha^{-1}) being at par with T_2 (100 % RDN + *Azospirillum* + Vermicompost @ 2 t ha^{-1}) $T_{11,}$ T_{10} and T_5 recorded significantly maximum available nitrogen in soil over rest of the treatment during the year of 2011-12 and 2012-13.Whereas, treatment T_4 (100% RDN + *Azospirillum* + PSB+ Vermicompost @ 2 t ha^{-1}) being at par with treatment $T_{2,}T_{11}$ and T_{10} recorded significantly maximum available nitrogen in soil over rest of the treatment in pooled basis. The available nitrogen in soil (kg ha^{-1}) recorded under treatment T_4 was 320.28, 305.01 and 312.65 during 2011-12, 2012-13 and in pooled basis, respectively.

Table.1 Yield and quality of fennel at harvest by various treatments of integrated nutrient management (Pooled basis)

Treatments	Seed yield (kg/ha)	Stover yield (kg/ha)	Fibre Content (%)	Oil Content (%)
T_1- Recommended Dose of Fertilizer (RDN-90:30:00 NPK kg ha^{-1})	1676	2205	18.51	1.73
T_2-100% RDN+ *Azospirillum* + Vermicompost @ 2 t ha^{-1}	2601	2914	14.20	1.89
T_3-50% RDN + *Azospirillum* + Vermicompost @ 2 t ha^{-1}	2291	2738	15.33	1.82
T_4-100% RDN + *Azospirillum* + PSB + Vermicompost @ 2 t ha^{1}	2719	3084	11.76	1.97
T_5-50% RDN + *Azospirillum* + PSB + Vermicompost @ 2 t ha^{-1}	2339	2785	12.09	1.82
T_6-100% RDN + Two spray of vermiwash @ 50 lit ha^{-1} at 45 and 75 DAS	1889	2229	17.86	1.73
T_7-50 % RDN +Two spray of vermiwash @ 50 lit ha^{-1} at 45 and 75 DAS	1619	2085	19.20	1.73
T_8- 100% RDN + 15 kg Humic acid ha^{-1}	2082	2542	16.81	1.78
T_9-50% RDN + 15 kg Humic acid ha^{-1}	1952	2417	17.62	1.74
T_{10}- 50 % RDN+ NADEP @ 5 t ha^{-1}+ 15 kg Humic acid ha^{-1}	2263	2672	16.47	1.81
T_{11}-100% RDN + NADEP @ 5 t ha^{-1}	2516	2860	12.03	1.89
T_{12}- 50 % RDN + NADEP @ 5 t ha^{-1}	1983	2535	17.34	1.78
S.Em.±	73	87	0.33	0.05
C.D. (P=0.05)	207	247	0.94	0.13
C.V. %	9.6	9.56	5.95	7.44

Table.2 Available nutrient status of soil after harvest 0f fennel by various treatments of integrated nutrient management (Pooled basis)

Treatments	**Available N (kg ha^{-1})**	**Available P_2O_5 (kg ha^{-1})**	**Available K_2O (kg ha^{-1})**
T_1- Recommended Dose of Fertilizer (RDN-90:30:00 NPK kg ha^{-1})	245.6	46.89	287.9
T_2-100% RDN+ *Azospirillum* + Vermicompost @ 2 t ha^{-1}	264.0	57.67	311.2
T_3-50% RDN + *Azospirillum* + Vermicompost @ 2 t ha^{-1}	253.5	54.21	303.4
T_4-100% RDN + *Azospirillum* + PSB + Vermicompost @ 2 t ha^{1}	266.5	58.66	312.6
T_5-50% RDN + *Azospirillum* + PSB + Vermicompost @ 2 t ha^{-1}	256.3	54.75	304.1
T_6-100% RDN + Two spray of vermiwash @ 50 lit ha^{-1} at 45 and 75 DAS	246.8	48.34	294.0
T_7-50 % RDN +Two spray of vermiwash @ 50 lit ha^{-1} at 45 and 75 DAS	245.9	47.87	291.9
T_8- 100% RDN + 15 kg Humic acid ha^{-1}	249.4	50.67	298.0
T_9-50% RDN + 15 kg Humic acid ha^{-1}	245.6	49.03	296.6
T_{10}- 50 % RDN+ NADEP @ 5 t ha^{-1}+ 15 kg Humic acid ha^{-1}	259.3	54.84	308.4
T_{11}-100% RDN + NADEP @ 5 t ha^{-1}	263.1	56.66	310.7
T_{12}- 50 % RDN + NADEP @ 5 t ha^{-1}	251.4	51.73	299.4
S.Em.±	2.77	0.77	3.72
C.D. (P=0.05)	7.82	2.16	10.49
C.V. %	3.09	4.11	3.48

Effect on available phosphorus

The data on available phosphorus content in the soil just after harvest of the fennel as influenced by the integrated nutrient management practices are presented in Table 2.

Data given shows that difference in available phosphorus in soil due to different combinations of integrated nutrient management practices were found to be significant during 2011-12, 2012-13 and in pooled basis. Treatment T_4 (100% RDN + *Azospirillum* + PSB+ Vermicompost @ 2 t ha^{-1}) being at par with T_2 (100 % RDN + *Azospirillum* + Vermicompost @ 2 t ha^{-1}) T_{11} (100 % RDN + NADEP @ 5 t ha^{-1}) recorded significantly maximum available phosphorus in soil over rest of the treatment during the year of 2011-12, 2012-13 and in pooled basis. The available phosphorus in soil (kg ha^{-1}) recorded under treatment T_4 was 57.14, 60.19 and 58.66 during 2011-12, 2012-13 and in pooled basis, respectively.

Effect on available potassium

The data on available potassium content in the soil just after harvest of the fennel as influenced by the integrated nutrient management practices are presented in Table 2.

Data given shows that differences in available potassium in soil due to different combinations of integrated nutrient management practices were found to be significant during 2011-12, 2012-13 and in pooled basis. Treatment T_4 (100% RDN + *Azospirillum* + PSB+ Vermicompost @ 2 t ha^{-1}) being at par with T_2 (100 % RDN + *Azospirillum* + Vermicompost @ 2 t ha^{-1}) T_{11} (100 % RDN + NADEP @ 5 t ha^{-1}) T_{10} (50 % RDN + NADEP @ 5 t ha^{-1} + 15 kg Humic acid) T_5 (50% RDN + *Azospirillum* + PSB+ Vermicompost @ 2 t ha^{-1}) T_3(50% RDN +Azospirillum + Vermicompost @ 2 t ha^{-1}) T_{12}(50% RDN + NADEP @ 5 t ha^{-1}) T_8(50% RDN + 15 kg Humic acid ha^{-1} recorded significantly maximum available potassium in soil over rest of the treatment during the year of 2011-12 and 2012-13. Treatment T_4 (100% RDN + *Azospirillum* + PSB+ Vermicompost @ 2 t ha^{-1}) being at par with T_2 (100 % RDN + *Azospirillum* + Vermicompost @ 2 t ha^{-1}) T_{11} (100 % RDN + NADEP @ 5 t ha^{-1}) T_{10} (50 % RDN + NADEP @ 5 t ha^{-1} + 15 kg Humic acid) T_5 (50% RDN + *Azospirillum* + PSB+ Vermicompost @ 2 t ha^{-1}) T_3(50% RDN + *Azospirillum* + Vermicompost @ 2 t ha^{-1}) in pooled basis. The available potassium in soil (kg ha^{-1}) recorded under treatment T_4 was 320.28, 305.01 and 312.65 during 2011-12, 2012-13 and in pooled basis, respectively. This might be due to reduced nutrient loss when inorganic and organic fertilizers were applied in combinations which improved the availability of soil nutrients. Similar results were obtained by Adak *et al.,* (2006) and Patel *et al.,* (2013b).

References

Adak, T., Singh, S. and Sachan, R.S. 2006. Influence of integrated management of bio-fertilizers and chemical fertilizer on post-harvest soil fertility status in fenugreek on mollisol. Environment and ecology 24 (4): 796-802.

Darzi, M. T., Shirkhodaei, M. and Mohammadreza H.H. 2013. Effects of vermicompost and Azotobactr and azospirillum bacteria on quantity and quality of essential oil of coriander (*Coriandrum sativum* L.). *International Journal of Farming and Allied Sciences* 2 (5): 1277-1283.

DOA. 2011. "District-wise Area, Production and Productivity of Spices Crops. Directorate of Agriculture, Gujarat

state, Gandhinagar.

Khoja, J.R. 2004. Effect of sowing time and sources of nitrogen on growth, thermal requirement, yield and quality of coriander [*Coriandrum sativum* (L.)]. Ph.D. Thesis Rajasthan Agricultural University, Campus-Jobner.

Patel, S.G., Amin, A.V., Patel, S.P. Agalodiya and Patel, S.M. 2013 a,b. Effect of different sources of organic manures and without bio fertilizers in cumin (*Cuminum cyminum* L.) Sardar Krushinagar, Dantiwada Agriculture University. *International Journal of Seed Spices* 3 (2).

SBI. 2011. "Statistics: Production of Major Spices. Spices Board of India, Ministry of Commerce and Industry, Government of India, New Delhi (*http://www. indianspices.com*).

Selvarajan, M. and Chezhiyan, N. 2001_a. Effect of Azospirillum in combination with different levels of nitrogen on growth and yield of fenugreek (*Trigonella foenum-graecum* L.) *South Indian Horticulture* 49: 173-174.