

Effect of conjunctive use of bio-organics and inorganic fertilizers on growth, yield and economics of *Rabi* fennel (*Foeniculum vulgare* Mill.) under south Gujarat conditions

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ABSTRACT

Field experiment was conducted during *Rabi* season with cv. Gujarat Fennel -11, at college farm, N.M. College of Agriculture, N.A.U., Navsari to study the effect of conjunctive use of bio-organics and inorganic fertilizers on growth, yield and economics of *Rabi* fennel under vertisol of South Gujarat. Five treatment of bio-organics (B_1 : Castor cake @ 0.5 t ha⁻¹, B_2 : Neem cake @ 0.5 t ha⁻¹, B_3 : bio-fertilizer seed inoculation, B_4 : Castor cake @ 0.5t ha⁻¹ + bio-fertilizer seed inoculation and B_5 : Neemcake @ 0.5 t ha⁻¹ + bio-fertilizer seed inoculation) and three levels of inorganic fertilizer (F_1 : 100 per cent RDF (90:30:00 NPK kg ha⁻¹), F_2 : 75 per cent RDF and F_3 : 50 per cent RDF) were evaluated in factorial randomized block design with three replications. Result revealed that higher and profitable yield of *Rabi* fennel can be secured by application of either castor cake @ 0.5 t ha⁻¹+ bio- fertilizer seed inoculation or neem cake @0.05 t ha⁻¹+ bio- fertilizer seed inoculation along with 100 per cent RDF (i.e. 90:30:00 NPK kg ha⁻¹) under South Gujarat conditions.

Key words : *Rabi* fennel (Drilled), Bio-organics, Bio- fertilizers, Inorganic fertilizers, Growth, Yield, Economics

INTRODUCTION

Fennel belongs to the family Umbelliferae is one of the most important spices and it is grown as a cash crop in Gujarat, commanding an area of 36094 hectares with an annual production of 46799 tonne and productivity of 1297 kg ha⁻¹. However, fennel is raised profitably as a (winter) *Rabi* drilled crop in Gujarat. Area under winter drilled fennel is increasing because of its short duration nature, remunerative prices and low input requirement. Thus, winter fennel is profitable than other common winter crops like bean, gram, mustard and wheat in South Gujarat area (Mehta *et al.*, 1990 and Patel *et al.*, 2000).

Among the various factors contributing towards the attainment of potential yield and economics of fennel, bio-organics, bio- fertilizer and inorganic fertilizer has considerable practical importance. The conjunctive use of all these nutrient sources may helpful to maintain the soil and crop productivity on sustainable basis. With a view to find out the ideal combination of bio-organics and inorganic fertilizer and to maximize the production of *Rabi* fennel, an attempt was made to evaluate the response of conjunctive use of bio organics and inorganic fertilizers on growth, yield and economics of winter fennel.

MATERIALS AND METHODS

The field experiment was conducted during the *Rabi* season of 2004-2005 at the College Farm, N.M. College

of Agriculture, NAU, Navsari. The experiment was laid out in Factorial Randomized Block Design with three replications. Total fifteen treatment combinations consisting of five treatment of bio-organics (B_1 : Castor cake @ 0.5 t ha⁻¹, B_2 : Neem cake @ 0.5 t ha⁻¹, B_3 : Bio-fertilizer seed inoculation, B_4 : Castor cake @ 0.5t ha⁻¹ + bio-fertilizer seed inoculation and B_5 : Neemcake @ 0.5 t ha⁻¹ + bio-fertilizer seed inoculation) and three levels of inorganic fertilizer (F_1 : 100 per cent RDF (90:30:00 NPK kg ha⁻¹), F_2 : 75 per cent RDF and F_3 : 50 per cent RDF) were evaluated on fennel cv. GUJARAT FENNEL -11. The soil was clayey in texture with pH 7.8 having 0.35 per cent organic carbon, 176 kg ha⁻¹ available N, 32 kg ha⁻¹ available P₂O₅ and 350 kg ha⁻¹ available K₂O. Gujarat Fennel-11 was sown (drilled) on 26th October, 2004 with seed rate of 5 kg ha⁻¹ and harvested between 20th March, 2005 and 15th April, 2005. Row to row spacing was 45 cm by keeping intra row spacing of 15 cm. Common irrigation was given uniformly to all the treatments just after sowing the crop for proper germination. Total number of irrigation were five.

The required quantity of castor cake, neem cake, urea and single super phosphate were calculated as per treatments and the mixture of organic manure and inorganic fertilizers were applied in previously opened furrow to the respective plots. Total quantity of castor cake, neem cake and ssp were applied as basal, where as required quantity of urea was applied in three splits

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viz., 50 per cent as basal dose, 25 per cent at branching and 25 per cent at seed formation stage of the crop. *Azotobacter* and PSB culture (bio-fertilizer) was used to perform the seed treatment as per standard procedure. As a preventive measure one spray of 0.2 per cent Dithan M-45 75 WP and one spray of 0.03 per cent Diamethoate 30 EC were made to protect the crop against powdery mildew and aphid population, respectively. To protect the crop from weed infestation pre emergence application of Pendimethalin (3.33 litres of stomp dissolved in 500 litres of water) was made followed by one hand weeding and interculturing at 45 DAS. Five plants were selected at random from each net plot and tagged for recording observations on growth and yield attributing parameters. The data recorded on various characters during the period of investigation were statistically analyzed by appropriate procedure to factorial randomized block design as describe by Panse and Sukhatme(1967).

RESULTS AND DISCUSSION

The results obtained from the present investigation are summarized under following heads :

Effect of bio-organics:

On growth attributes :

Among the various growth attributes, plant height at harvest, total number of branches plant⁻¹ (Table 1) were significantly influenced by various treatments of bio-organics. At harvest treatments receiving either neem cake @ 0.5 t ha⁻¹ or castor cake @ 0.5 t ha⁻¹ along with bio-fertilizer seed inoculation (B₅ and B₄) recorded higher values of plant height (185.44 cm and 183.16 cm) as well as total number of branches plant⁻¹ (13.60 and 13.33) and found significantly superior to the rest of treatments. The treatments receiving bio-fertilizer seed inoculation only (B₃) recorded lowest plant height (164.83 cm) as well as total number of branches (10.18). The results are in accordance with the finding reported by Patel and Meisheri (1997), Patel and Shelke (1998) and Khiriya and Singh (2003).

On yield attributes :

Various yield attributes *viz.*, number of umbels per plant, number of umbellets per umbel, number of seeds per umbellet and test weight were significantly influenced by various treatments of bio-organics (Table 1).

The data revealed that the maximum values for number of umbels per plant (21.98), number of umbellets per umbel (22.60), number of seeds per umbellets (21.44), and test weight (7.60) were recorded when the crop was

fertilized with neem cake @ 0.5 t ha⁻¹ + bio-fertilizer seed inoculation (B₅) being at par with castor cake @ 0.5 t ha⁻¹ along with bio-fertilizer seed inoculation (B₄) in most of the cases. Almost similar findings were also reported by Patel and Shelke (1998) as well as Khiriya and Singh (2003).

The treatment receiving bio-fertilizer seed inoculation only (B₃) recorded minimum values of all yield attributes.

On yield and economics :

Seed and stover yield in fennel as well as economics (Table 2) were significantly influenced under various treatments of bio-organics. The treatments receiving either neem cake @ 0.5 t ha⁻¹ or castor cake @ 0.5 t ha⁻¹ along with bio-fertilizer seed inoculation (B₅ or B₄) recorded higher seed yield (1682 or 1674 kg ha⁻¹) as well stover yield (3683 or 3613 kg ha⁻¹). Both these treatments B₅ and B₄ were found statistically at par but significantly superior to rest of the treatments. The results are in agreement with those of Patel *et al.* (1996), Patel and Shelke (1998) and Khiriya and Singh (2003).

From the economic point of view the maximum net realization of Rs. 30401 with BCR 3.53 was observed in castor cake @ 0.5 t ha⁻¹ + bio-fertilizer seed inoculation (B₄) which was closely followed by Rs. 29925 net realization with BCR 3.43 under neem cake @ 0.5 t ha⁻¹ + bio-fertilizer seed inoculation (B₅). Almost similar findings were reported by Sarawgi *et al.* (1999) and Patel and Shelke (1998).

Significantly the values of both the characters were found minimum with only bio-fertilizer seed inoculation treatment (B₃).

Interaction effect :

Interaction effect of bio-organics and inorganic fertilizer was found to be non significant with respect to most of the growth and yield attributing characters except number of umbels per plant and test weight in fennel.

Effect of inorganic fertilizers:

On growth attributes :

Among the different growth attributes studied, plant height at harvest, total number of branches per plant (Table 1) was significantly influenced by different levels of inorganic fertilizer. Crop fertilized with 100 per cent RDF (F₁) recorded the maximum values for both the characters *i.e.* plant height (194.01cm) and total number of branches per plant (14.61) and found significantly superior to rest of the levels. This result confirms the finding of Randhawa *et al.* (1978) and Bhati *et al.* (1988) in fennel.

Table 1 : Growth and yield attributing characters of fennel as influenced by application of bio organics and inorganic fertilizers

Treatment	Characters					
	Plant height at harvest (cm)	Total branches/plant at harvest	Umbels/plant	Umbellets/umbel	Seeds/umbellets	Test weight (g/1000 seed)
Bio-organics (B)						
B ₁ : Castor cake @ 0.5 t ha ⁻¹	173.28	11.18	19.53	20.44	19.53	7.31
B ₂ : Neem cake @ 0.5 t ha ⁻¹	173.14	11.29	20.42	20.43	19.16	7.36
B ₃ : Seed inoculation with <i>Azotobacter</i> + PSB	164.83	10.18	17.47	19.60	19.09	7.11
B ₄ : Castor cake @ 0.5 t ha ⁻¹ + B ₃	183.16	13.33	21.56	22.11	21.31	7.57
B ₅ : Neem cake @ 0.5 t ha ⁻¹ + B ₃	185.44	13.60	21.98	22.60	21.44	7.60
S. E. ±	2.88	0.52	0.68	0.56	0.64	0.11
C. D. (P=0.05)	8.35	1.50	1.97	1.63	1.86	0.30
Inorganic fertilizer (F)						
F ₁ : 100 % RDF	194.01	14.61	23.88	25.00	23.40	7.84
F ₂ : 75 % RDF	168.55	10.92	18.65	19.70	18.20	7.29
F ₃ : 50% RDF	165.35	10.21	18.04	18.40	16.92	7.04
S. E. ±	2.23	0.40	0.53	0.44	0.50	0.08
C. D. (P=0.05)	6.47	1.16	1.53	1.27	1.44	0.24
Interaction (BXF)	NS	NS	Sig.	NS	NS	Sig.
C.V. %	4.92	13.02	10.10	8.04	9.87	4.27

NS = Non significant, Sig. = Significant

On yield attributes :

Various attributes on yield *viz.*, number of umbels per plant; number of umbellets per umbel, number of seeds per umbellets and test weight were significantly influenced by various levels of inorganic fertilizer (Table 1).

Crop fertilized with 100 per cent RDF (F₁) recorded the maximum value for all the yield parameters *viz.*,

number of umbels per plant (23.88), number of umbellets per umbel (25.00), number of seeds per umbellets (23.40) and test weight (7.84 g) and found significantly superior to lower levels. Positive response of fennel crop in terms of yield attributes to inorganic fertilizer has also been reported by Randhawa *et al.* (1978) and Bhati *et al.* (1988).

Table 2 : Influence of different treatments of bio-organic and inorganic fertilizers on seed yield and economics of *Rabi* fennel

Treatment	Characters					
	Seed yield (kg ha ⁻¹)	Stover yield (kg ha ⁻¹)	Gross realization (Rs. ha ⁻¹)	Cost of production (Rs. ha ⁻¹)	Net realization (Rs. ha ⁻¹)	BCR
Bio-organics (B)						
B ₁ : Castor cake @ 0.5 t ha ⁻¹	1492	3366	37628	11901	25727	3.16
B ₂ : Neem cake @ 0.5 t ha ⁻¹	1430	3424	36092	12201	23891	2.96
B ₃ : Seed inoculation with <i>Azotobacter</i> + PSB	1330	3214	33563	9701	23861	3.46
B ₄ : Castor cake @ 0.5 t ha ⁻¹ + B ₃	1682	3613	42403	12001	30401	3.53
B ₅ : Neem cake @ 0.5 t ha ⁻¹ + B ₃	1674	3683	42227	12301	29925	3.43
S. E. ±	57.68	68.93	-	-	-	-
C. D. (P=0.05)	167.05	199.65	-	-	-	-
Inorganic fertilizer (F)						
F ₁ : 100 % RDF	1954	3957	49246	12021	37225	4.10
F ₂ : 75 % RDF	1403	3463	35416	11621	23795	3.05
F ₃ : 50% RDF	1207	2959	30486	11222	19264	2.72
S. E. ±	44.68	53.39	-	-	-	-
C. D. (P=0.05)	129.40	154.65	-	-	-	-
Interaction (BXF)	Sig	NS	-	-	-	-
C.V. %	11.37	5.98	-	-	-	-

NS = Non significant, Sig. = Significant

On yield and economics :

The data (Table 2) revealed that inorganic fertilizer had remarkable effect on seed yield of fennel. Significantly the highest seed yield (1954 kg ha⁻¹) was obtained with the application of 100 per cent RDF (F₁) and it was found superior to 75 per cent and 50 per cent RDF (F₂ and F₃) treatments. The treatment with 100 per cent RDF (F₁) increased the seed yield of fennel to the tune of 39.27 and 61.89 per cent over 75 per cent and 50 per cent RDF treatments (F₂ and F₃), respectively. Likewise, stover yield of fennel was also significantly influenced by levels of inorganic fertilizer. An increased in stover yield with 100 per cent RDF was 14.35 and 33.73 per cent over 75 and 50 per cent RDF treatments (F₂ and F₃), respectively. Almost similar findings were also reported by Randhawa *et al.* (1978), Randhawa *et al.* (1981), Randhawa and Gill (1985), Bhati *et al.* (1988), Bhati (1990), Patel *et al.* (2000) and Patel *et al.* (2003) with respect to seed yield in fennel.

The data of economics of fennel under different combination of bio-organics and inorganic fertilizer are furnished in Table 2.

So far economics is concerned the treatment receiving 100 per cent RDF (F₁) secured maximum net realization of Rs. 37225 with BCR 4.10. Almost similar findings were reported by Patel *et al.* (2003) on fennel.

Interaction effect :

Interaction between bio-organics and inorganic fertilizer was found to be significant with respect to seed yield in fennel.

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