

SHORT COMMUNICATION

Influence of organic enrichment and foliar feeding of nitrogen on productivity, nitrogen uptake of winter drilled fennel (*Foeniculum vulgare*)

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Fennel one of the most important seed spices crop in India grown mainly as transplanted crop, although it can also be raised profitably as a winter direct-seeded crop (Mehta *et al.*, 1990). Direct seeded fennel is very popular due to short duration than transplanted crop. Thus, direct-seeded fennel is profitable than other winter crops like mustard chickpea and wheat (Mehta *et al.*, 1990). Fennel being a wide rowed crop can be grown successfully under drip in water scarce state like Rajasthan and various experiments conducted at Swami Keshwanand Rajasthan Agricultural University, Bikaner concluded that 80% ETc is optimum level for drip irrigated fennel. Indian agriculture is facing a serious problem of declining total factor productivity and low crop response to inputs chiefly fertilizers. Declining crop response to water and fertilizer particularly nitrogen is due to deteriorating soil health and productivity. Organic matter enrichment can rejuvenate the soil health in a dramatic manner. This will lead to increased efficiency of water and fertilizers particularly nitrogen. Light soils are prone to increased losses of nitrogen in process of deep percolation loss. Split application through fertigation is therefore recommended. A less attended practice of fertilizing crop is that of foliar feeding particularly of fertilizer nitrogen. It ensures ample availability of nitrogen to crops for obtaining higher growth and yield (Arif *et al.*, 2006). Foliar nitrogen nutrition plays a crucial role in maintaining leaf nitrogen to an optimum level during reproductive growth when yield formation is often limited by low crop photosynthetic efficiency. Therefore, efforts have been made to enhance seed yield of fennel through organic enrichment and foliar feeding of nitrogen.

The field experiment was conducted during the winter seasons of 2010-11 and 2011-12 at Swami Keshwanand Rajasthan Agricultural University Farm, Bikaner in randomized block design with 3 replications. The treatments comprised of 3 organic enrichment [Recommended fertilizers (90:20:0 - RD), RD + 10 t FYM/ha and RD + 5 t vermicompost/ha] and 3 methods of nitrogen application (90 kg nitrogen/ha through drip system, 60 kg nitrogen through drip system + foliar spray of 30 kg nitrogen upto flowering stage and 60 kg nitrogen through drip system + foliar spray of 30 kg nitrogen from flowering to physiological maturity). Organic matter as per

treatment was applied at the time of land preparation and soil application of nitrogen was done as fertigation in 6 splits at 15 days interval starting from sowing. Foliar spray of nitrogen was done through urea in 3 splits during reproductive stage at 10 days interval as per treatment. The fennel variety RF 101 was sown on 11th November using 10 kg seed/ha and harvesting in 4th week of April in both the years. The crop was sown in paired row spacing of 30 cm x 60 cm i.e. 30 cm between rows in a pair and 60 cm between two pairs in 120 cm drip line spacing to reduce cost of drip system. The crop was raised at drip irrigation level of 80% ETc through out the growing period, which is recommended as optimum for the zone. The details of irrigation events and monthwise irrigation water applied are presented in table 1. The soil was sandy loam having field capacity 7.2%, permanent wilting point 1.8%, bulk density 1.51 g/cc, pH (1:2) 8.2, electrical conductivity (1:2) 0.2 dS/m, organic carbon 0.11% and available P and K 15 and 320 kg/ha, respectively.

Organic enrichment

Organic enrichment with 10 t farmyard manure/ha in addition to recommended fertilizers dose (RD) recorded the highest plant height (120.4 cm), branch/plant (17.1), umble/plant (20.3), seed/ umble (311) and test weight (7.7g) followed by RD + 5 t vermicompost/ha, where the corresponding values are 118.3 cm, 16.3, 19.4, 298 and 7.4 g, respectively and significantly superior to recommended fertilizer dose. Increased yield attributes with RD + 10 t FYM thus gave the highest seed yield (23.07 q/ha), stover yield (48.93 q/ha) and biological yield (71.5 q/ha). Vermicompost (5 t/ha) along with recommended dose of fertilizer (RD) also gave superior seed yield (22.23 q/ha), stover yield (48.72 q/ha) and straw yield (71 q/ha). The improvement of yield and yield attributes might be due to FYM / vermicompost which had supplied available plant nutrients and brought about a favourable soil environment, which ultimately increased the nutrient and water-holding capacity of soil (Khiriya and Singh, 2003 and Gupta *et al.*, 2006). Further, FYM/vermicompost improved activities of heterophilic bacteria and fungi in soil, which in turn increased the activity of soil enzymes responsible for the conversion of nutrients from unavailable to available form (Sarma *et*

al., 2007). Addition of 10 t FYM/ha along with recommended level of fertilizers recorded highest nitrogen uptake (68.3 kg/ha) followed by vermicompost (5 t/ha) + RD (65.6 kg N/ha) and RD recorded the lowest nitrogen uptake of 60.5 kg/ha. It might be due to better physical conditions of soil with organic matter which not only supplied nutrients also improved soil physical condition congenial for better root-growth and nutrient uptake (Khiriya and Singh, 2003). Organic enrichment with FYM and vermicompost also improved harvest index compared to crop grown with only recommended fertilizer dose.

Fertigation and foliar nutrition of nitrogen

Application of 60 kg N/ha through fertigation (drip) + 30 kg N/ha as foliar spray from flowering to physiological maturity recorded highest plant height (121.5 cm), branch/plant (17.5), umble/plant (21.0), umblest/umple (23.5), seed/umple (303) and test weight

(7.8 g) followed by 60 kg N/ha as fertigation + 30 N/ha foliar spray upto flowering stage where the corresponding values are 119.5 cm, 16.8, 20.8, 296 and 7.3 g, respectively. Higher yield attributes with fertigation (60 kg N/ha) + foliar nutrition (30 kg N/ha) from flowering to physiological maturity in turn contributed to highest fennel seed (2.38 t/ha) and biological yield (7.18 t/ha). This may be attributed to maintaining higher leaf nitrogen at reproductive stage which enhanced photosynthesis rate and transportation of photosynthate from source to sink. This is in conformity with Arif *et al.* (2006). Further, higher seed and biological yield taken up more nitrogen (67.5 kg/ha) which in turn gave highest nitrogen use efficiency of 35.21 kg seed/kg N. Water use efficiency was also highest (5.99 kg/ha-mm) with 60 kg N/ha (fertigation) + 30 kg N/ha as foliar feeding in reproductive stage.

Table 1. Monthwise irrigation events and irrigation water applied to fennel (mean of 2 years)

Month	Irrigation events	Irrigation water (mm) applied at 80% ETC with drip system
November (11-30)	10	51.39
December	15	74.77
January	16	76.47
February	14	67.32
March (1-31)	16	87.80
April (1-10)	5	39.02
Total	76	396.77

Table 2. Effect of organic enrichment and foliar application of nitrogen on height and yield attributes of fennel (pooled of 2 years)

Treatment	Height (cm)	Branch/plant	Umble/plant	Umblets/umple	Seed/umple	Test Weight (g)
Organic enrichment						
Recommended fertilizer (RD)	112.3	14.4	18.5	20.5	280	7.2
RD + 10 t FYM/ha	120.4	17.1	20.3	23.3	311	7.7
RD +5 t vermicompost /ha	118.3	16.3	19.4	22.4	298	7.4
CD at 5%	1.5	1.2	1.1	0.8	5	0.2
Methods of nitrogen application						
90 kg N/ha in split through drip	110.0	13.5	17.1	20.0	290	7.2
60 kg N(drip) + foliar spray (30 kg N/ha) up to flowering stage	119.5	16.8	20.8	22.8	296	7.3
60 kg N (drip) + foliar spray (30 kg N/ha) from flowering to physiological maturity	121.5	17.5	21.0	23.5	303	7.8
CD at 5%	1.5	1.2	1.1	0.8	5	0.2

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