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Nutrient management in Indian spinach (*Beta vulgaris var. bengalensis*)

DH Paithankar and AM Gore

Abstract
Integrated use of nutrition plays vital role for yield and quality as well as judicious use of chemical fertilizers, which is more important for soil health. The role of organic nutrition sources in the form of organic manures and biofertilizers is much imperative in leafy vegetable production, since leaves are ultimate produce used for human consumption. In view of that an experiment on integrated nutrient management in spinach using various organic sources, biofertilizers in combination with chemical fertilizers was conducted at Department of Horticulture, Dr. PDKV, Akola during year 2012-13. The results indicated application of 75% RDF through fertilizers + vermicompost 0.825 t per ha + *Azotobacter* 5 kg per ha + PSB 5 kg per ha was most beneficial in order to obtain higher yield of better quality in Indian spinach.

Keywords: nutrient management, Indian spinach, beta vulgaris

Introduction
Vegetables play important role in human diet by providing nutritious compounds like carbohydrates, proteins, fats, vitamins and minerals etc. which are essential constituents of balanced diet. In tropical countries, green leafy vegetables constitute an excellent component of diet. The important leafy vegetables which are grown in India are amaranthus, spinach, fenugreek and coriander.

Indian spinach (*Beta vulgaris var. bengalensis*) is one of the most important leafy vegetable consumed all over the country. In the production of Indian spinach, with the help of INM system approach which is economically cheap, technically sound, practically feasible and paying way for sustainable cultivation. Hence, keeping the same approach in view the the investigation was initiated in the year 2011-12 with application of organics, inorganic and biofertilizer in production of Indian spinach with objective to study the effect of reduced dozes chemical fertilizers along with application of organic manures and biofertilizers on growth, yield and quality of Indian spinach. And to find out the suitable combinations of integrated use of chemical fertilizers, organic manures and biofertilizers for obtaining yield and quality of Indian spinach.

Materials and Methods
The experiment was carried out during Rabi 2012-13 at Main Garden, Department of Horticulture, Dr. PDKV, Akola using All green variety of Indian spinach in Randomized Block Design with fourteen treatments in three replications. The treatments included various organic sources i.e. FYM, vermicompost, biofertilizers i.e. *Azatobactor* and *PSB* in combination with chemical fertilizers applied as 75%, 50% and 25% RDF. The treatments were T_{1}- RDF (50 kg N +50 kg P_2O_5 + 0 kg K_2O kg per ha), T_{2}-5 t per ha FYM, T_{3}-3.3 t per ha vermicompost, T_{4}-5 t per ha FYM + 5 kg per ha *Azotobacter* + 5 kg per ha PSB, T_{5}-3.3 t per ha vermicompost + 5 kg per ha *Azotobacter* + 5 kg per ha PSB, T_{6}-75% RDF + 1.25 t per ha FYM +5 kg per ha *Azotobacter* + 5 kg per ha PSB, T_{7}-75% RDF + 0.825 t per ha vermicompost +5 kg per ha *Azotobacter* + 5 kg per ha PSB, T_{8}-50% RDF + 2.5 t per ha FYM +5 kg per ha *Azotobacter* + 5 kg per ha *PSB*, T_{9}-50% RDF + 1.65 t per ha vermicompost +5 kg per ha *Azotobacter* + 5 kg per ha *PSB*, T_{10}-25% RDF + 3.75 t per ha FYM +5 kg per ha *Azotobacter* + 5 kg per ha PSB, T_{11}-25% RDF + 2.48 t per ha vermicompost +5 kg per ha *Azotobacter* + 5 kg per ha PSB, T_{12}- RDF + 5 kg per ha *Azotobacter* + 5 kg per ha *PSB*, T_{13}-50% RDF + 1.25 t per ha FYM +0.825 t per ha vermicompost + 5 kg per ha *Azotobacter* + 5 kg per ha *PSB*, T_{14}- control.

FYM, vermicompost along with biofertilizers were applied prior sowing, while half N and complete P and K dose of chemical fertilizer under different treatment was applied as basal and remaining half N after cutting.

Results and Discussion

Table 1: Effect of Integrated Nutrient Management on growth parameters, yield and quality of Indian spinach

Treatment	Plant Height (cm)	Root Length (cm)	Average Leaf Area (cm^2)	Days required for first cutting	Chlorophyll Content (mg/g)	Fresh weight of plant per plot (kg)	Fresh Yield (q/ha)	Dry weight of plant (g)
T_1	30.87	10.01	354.90	42.0	15.24	3.59	89.74	7.88
T_2	29.47	9.92	345.45	43.40	15.30	3.31	82.56	6.83
T_3	29.72	9.93	346.50	43.20	15.31	3.34	83.51	7.32
T_4	30.24	9.96	350.70	42.60	15.33	3.37	84.11	7.70
T_5	30.45	9.98	351.75	42.50	15.35	3.39	84.42	7.70
T_6	34.26	11.10	368.55	39.50	16.17	3.97	99.23	9.77
T_7	36.33	12.18	373.10	35.50	16.88	4.22	105.56	10.19
T_8	31.08	10.06	357.00	41.60	15.39	3.68	91.77	8.19
T_9	32.13	10.49	364.00	39.90	15.62	3.89	97.02	8.75
T_{10}	31.57	10.09	362.95	41.10	15.50	3.75	93.66	8.33
T_{11}	33.88	10.64	365.75	39.30	15.77	3.91	97.55	8.82
T_{12}	33.67	10.92	367.15	38.90	15.80	3.93	98.18	8.93
T_{13}	31.82	10.23	362.25	40.30	15.56	3.81	95.34	8.40
T_{14}	25.76	8.81	338.45	46.20	14.29	2.84	70.88	5.32
'F' test	Sig.	Sig.	Sig	Sig	Sig	Sig	Sig	Sig
SE (m)	1.11	0.35	2.02	0.72	0.20	0.02	0.43	1.50
CD at 5%	3.03	0.98	5.95	2.01	0.62	0.06	1.25	4.50

The significantly maximum plant height (36.33 cm) was recorded in T_7. The treatment T_6 (34.26 cm), T_{11} (33.88 cm) and T_{12} (33.67 cm) were at par with treatment T_7 whereas, minimum plant height was recorded in T_{14}. The results obtained are in close confirmation with findings of Jat *et al*. (2006) [3] in fenugreek and Jha and Jana (2009) [4] in Indian spinach. Similarly, significantly maximum root length (12.18 cm) was recorded in T_7 followed by T_6 (11.10 cm) which was at par with T_{12} (10.92 cm), T_9 (10.49 cm). An application of biofertilizers and vermicompost significantly increased root length of the plant. The results are in agreement with the findings of Dhage and Kachare (2008).

Similarly, significantly maximum leaf area (373.10 cm^2) was recorded in T_7 which was at par with T_6 (368.55 cm^2) and T_{12} (367.15cm^2). The results are in close agreement with Bhaskar *et al*. (1996) [1] in Amranthus, Mehta *et al*. (2010) [5] in Fenugreek, Chaudhary *et al*. (1974) [2] in Spinach. In respect of chlorophyll content at harvest T_7 recorded maximum chlorophyll content (16.88 mg/g). However, it was found at par with treatment T_6 (16.17 mg/g). From above data it was found that, increased nutrient level also increased the chlorophyll content. Similar results were recorded by Subbiah and Ramanathan (1983) [8], Muthaura *et al*. (2010) [6] in Amranthus. The treatment T_{12} recorded minimum days (38.90) for first cutting, whereas treatment T_{14} recorded minimum days (46.20) for first cutting.

In case of fresh weight of plant treatment T_7 recorded maximum fresh weight of plant per plot (4.22 kg) and per ha (105.56 q), whereas the treatment T_{14} was recorded minimum (2.84 kg/ plot and 70.88 q/ha). Maximum dry weight (10.19 g) was found in T_7 which was at par with T_{12} (8.93 g) and T_{11} (8.83 g). Whereas, T_{14} (control) showed the minimum dry weight (5.32g).

The results in present investigation suggested the application of fertilizers in combination with vermicompost and biofertilizers suggested that, vemicompost besides micro and micro nutrient provided growth hormones eased in uptake of nutrient along with biofertilizers viz. *Azatobactor* and PSB which could have made respectively N and P available to the plant, which in turn resulted in higher production of assimilates and their portioning to different reproductive structures. These results are in agreement with the findings of Shrivastava and Ahlawat (1995), and Rahate (1985) [7] in cowpea.

Hence it can be concluded that, integrated use of chemical fertilizers along organic manures and biofertilizers is beneficial for growth, yield and quality parameters over the sole use of any of the source of nutrition. The integrated nutrition containing 75% RDF through fertilizers + vermicompost 0.825 t per ha + *Azotobacter* 5 kg per ha + PSB 5 kg per ha is best suited in order to obtain higher yield of better quality in Indian spinach.

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