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Response of leafy vegetables under organic and integrated nutrient management

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Abstract
A field experiment was carried out at Agronomy Farm, Dr. PDKV, Akola during *Rabi* season of 2017-18 on clayey soil. The experiment was laid out in factorial randomized block design with nine treatment combinations and four replications. Treatments consist of three nitrogen sources *viz*., 100% N through urea, 50% N through FYM + 50% N through urea and 50% N through FYM + 50% N through Vermicompost + Biofertilizers and three vegetables *viz*., Coriander, Fenugreek and Spinach. The growth characters of all vegetables were significantly higher with the application of 50% N through FYM + 50% N through urea followed by 50% N through FYM + 50% N through Vermicompost + Biofertilizers. Maximum green biomass yield of all vegetables was recorded with INM application of 50% N through FYM + 50% N through urea followed by application of 50% N through FYM + 50% N through Vermicompost + Biofertilizers.

Keywords: Organic, INM, urea, FYM, vermicompost, vegetable, biomass

Introduction
Vegetables constitute an important item for providing essential health promoting and protective substances; hence vegetables are also called as health capsules. Vegetables are rich source of important minerals (iron and calcium), vitamins (A, C, and riboflavin) and fiber sources with lower calories. Adequate vegetable consumption can be protective some chronic diseases such as diabetes, cancer, obesity, metabolic syndrome, cardiovascular diseases, as well as improve risk factors related with these diseases. India is a second largest producer of vegetables after China in the world. Several vegetables are grown in India out of these spinach, coriander, fenugreek are important and regular ones. Coriander *(Coriandrum sativum* L.*)* seeds as well as fresh green leaves are utilized in many culinary preparations. Fenugreek (*Trigonella foenum-graecum*) is considered to be poor people's nutritive vegetable. It is cheap to buy and easy to grow in kitchen garden and in field and can be cooked quickly. Among all leafy vegetables, Indian Spinach *(Beta vulgaris.* L.) is one of the most important leafy vegetable consumed all over the country. It is native of Indo-Chinese region.
Excessive use of chemical fertilizers creates a multiple nutrients deficiency, deteriorating soil structure and texture along-with undesirable crop yield. The gap between the nutrient demand and supply cannot be bridged by fertilizes alone. It can be filled only through integrated nutrient management (INM) which refers to appropriate combination of mineral fertilizers, organic manures, compost, N-fixing crops and micro-organisms [2]. Recently, increased attention has been devoted to utilization of organic manures for increasing vegetables production. The INM approach therefore, could be a rational way to increase yield and profit from any crop. INM has spin offs as well. The most crucial is reduces the incidence of disease and pest attacks [3]. Now a day, the chemical fertilizers are very costly. To apply these chemical fertilizers effectively in right manner, lot of time and labour are requiring which ultimately results into increase in the cost of production. Considering the all facts, the present investigation is therefore planned to explore efficient organic source from available resources improving possibilities of effective nutrient management in leafy vegetables to get sustainable yield and soil health.

Material and Methods
The field experiment was conducted in the experiment field of Department of Agronomy, Dr Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the academic year 2017. The experiment was laid out in factorial randomized block design with nine treatment combinations and four replications. Treatments consist of three nitrogen sources *viz*., 100% N

through urea, 50% N through FYM + 50% N through urea and 50% N through FYM + 50% N through Vermicompost + Biofertilizers and three vegetables *viz.*, coriander, fenugreek and spinach. The gross and net plot size 3 m X 3m and 2.7m X 2.7m respectively. Fertilizers and manures are applied as per recommended fertilizer dose.

Result and Discussion

Plant height (cm)

The yield attributes plant height, number of leaves per plant, leaf area per plant, dry matter per plant and green biomass is recorded in table No. 1. All these observations recorded significant influence due to various nitrogen sources at all stages of the crop growth. Significantly highest plant height (25.83 cm) was recorded, with the application of 50% N through FYM + 50% N through urea from initial to harvest. Among vegetables Spinach recorded significantly highest plant height (30.78 cm) over Fenugreek (25.97 cm) and Corriander (14.08 cm) at the time of harvesting. These observations showed significant differences due to different species characters. Interaction effect between nitrogen sources and vegetable regarding plant height was found non-significant.

Pronounced influence of inorganic fertilizers in combination with organic manures might be due optimum supply of nutrient particularly nitrogen. Impact of combined application of organic and inorganic nutrient on growth parameters might be due to increased assimilation of protoplasm resulting in greater cell division, formation of more tissues and vigor of plant. Similar results were obtained by Vitwel and Kanaujia [8] who revealed that the application of 50% NPK + 50% FYM + Biofertilizers recorded maximum plant height in carrot. Rani *et al.* [4] reported that application of neem cake and castor cake in combination with recommended half dose of nitrogen, phosphorus and potassium resulted maximum growth characters in carrots.

Number of leaves

Data pertaining to number of leaves was significantly influenced due to various nitrogen sources on plant growth. Among three Nitrogen sources significantly highest number of leaves was recorded with the application of 50% N through FYM + 50% N through Urea which was found significantly superior over application of 100% N through urea. Coriander produced a maximum leaf which was statistically superior over Fenugreek and Spinach at harvest. None of the interaction was found to be significant in respect to number of leaves per plant at harvest.

Table 1: Growth and yield of leafy vegetables as influenced by various treatments

Treatments	Plant height (cm)	No. of leaves	Leaf area (cm^2)	Dry matter (g)	Green biomass kg ha^{-1}
Factor A (Nitrogen sources)					
N_1 - 100% N through urea	21.17	26.08	55.47	8.74	9984
N_2 - 50% N through FYM + 50% N through Urea	25.83	30.75	56.83	9.53	14188
N_3 - 50% N through FYM + 50% N through Vermicompost + Biofertilizers	23.83	27.00	55.71	9.36	12574
SE (m)±	0.67	0.69	0.30	0.21	415
CD (P=0.05)	1.95	2.02	0.86	0.60	1210
Factor B (Vegetables)					
V_1 - Coriander	14.08	40.58	8.24	6.90	7500
V_2 - Fenugreek	25.97	29.50	40.43	8.96	10253
V_3 - Spinach	30.78	13.75	119.35	11.77	18993
SE (m)±	0.67	0.69	0.30	0.21	415
CD (P=0.05)	1.95	2.02	0.86	0.60	1210
Interaction (N x V)					
SE (m)±	1.16	1.20	0.51	0.36	718
CD (P=0.05)	NS	NS	NS	NS	NS
GM	23.61	27.94	56.00	9.21	12249

The production of maximum number of leaves might be due to higher metabolic activity because of optimum N supply resulting in higher production of Carbohydrates and Phytoharmones. These results are in line with Sentiyangla *et al.* [5] who reported significant increase in number of leaves in radish, when applied integrated application of chemical fertilizers, organic manures and biofertilizers (50% NPK + 50% FYM + biofertilizers).

Leaf area-1 (cm^2)

The leaf area $plant^{-1}$ difference as among the nitrogen sources was significant at all stages of crop growth. Significantly maximum leaf area was observed with the application of 50% N through FYM + 50% N through urea which was superior over all treatments i.e. application of 50% N through FYM + 50% N through Vermicompost + Biofertilizers and 100% N through urea. It was observed that spinach has maximum leaf area than Fenugreek and Coriander at all the growth stages of crops. Interaction effect among nitrogen sources and vegetables was found to be non-significant at all growth stages of crop in respect of leaf area $plant^{-1}$.

The increase in leaf area might be due to application of integrated nutrient supply enhances availability of nutrient in soil, reflected as in increase of leaf area. These results are in accordance with Sunanda *et al.* (2014) [6] concluded that maximum leaf area was obtained in 75% N + RD PK + FYM 75 t ha^{-1} + Rhizobium 1.5 t ha^{-1} + Azospirilum 5 kg ha^{-1} + PSB 5 kg ha^{-1} in Kasurimethi.

Dry weight (g)

Dry weight per plant increased significantly and showed differences in dry weight of plant among various treatments. Maximum dry weight was noted with 50% N through FYM + 50% N through urea at 15 DAS. However, 50% N through FYM + 50% N through urea were found at par with 50% N through FYM + 50% N through vermicompost + Biofertilizers. The results are in close agreement with Sunanda *et al.* (2014) [6] maximum total dry weight $plant^{-1}$

was noticed in 75% N + RD PK + 75 t ha^{-1} FYM + Rhizobium 1.5kg ha^{-1} + Azospirillum 1.5 kg ha^{-1} + PSB 5 kg ha^{-1} in Kasurimethi. Spinach has recorded maximum dry weight $plant^{-1}$ than Fenugreek and Coriander at all stages of growth from initial stage to at harvest. Interaction was not found significant among all treatment combinations.

Dry matter production and its partioning towards reproductive parts is an important yield attributing character. It is a basic vegetative phase is essential for the development of reproductive parts. Increased dry weight with INM could be due to application of balanced nutrients in integrated manner which promotes photosynthetic activity and transport of photosynthetic from source to sink which resulted in better plant growth.

Green biomass (kg ha^{-1})

Green biomass yield gets significantly differed due to various sources of nutrients. Highest green biomass yield was obtained with the application of 50% N through FYM + 50% N through urea which is followed by application of 50% N through FYM + 50% N through Vermicompost + Biofertilizers. The least biomass yield was obtained in 100% N through urea. In vegetables maximum yield was obtained in Spinach than Fenugreek and Coriander at harvest. Interaction effect was non-significant in respect to biomass.

Increase in dry matter production and its partitioning into different plant parts was might be due to due to application of urea and FYM in integrated manner. Similarly, same effect was recorded in Tomato [1] and Chilli [7].

Conclusion

Experimental results revealed that growth characters i.e. plant height, number of leaves, number of branches, leaf area per plant and dry matter of all vegetables were significantly higher with the application of 50% N through FYM + 50% N through urea followed by 50% N through FYM + 50% N through Vermicompost + Biofertilizers. Maximum green biomass yield of all vegetables was recorded with application of 50% N through FYM + 50% N through urea followed by application of 50% N through FYM + 50% N through Vermicompost + Biofertilizers.

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