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Effect of organic manures practices on growth and yield of Palak (*Beta vulgaris* var. Begalensis Hort)

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Abstract
The present study was aimed at studying the Effect of organic manures practices on growth and yield of Palak (*Beta vulgaris* var. Begalensis Hort). The field experiment was conducted during the Rabi season, 2024-2025 at the experimental unit of the Horticulture Research Farm, Faculty of Agricultural Sciences and Allied Industries, Rama University, Kanpur (U.P.), Kanpur. The experiment was laid out in a randomized block design with ten treatment combinations, which were replicated three times. The treatments comprised FYM (100%), FYM (75%)+ Poultry manure (25%) FYM (75%) + Vermicompost (25%), FYM (50%) + Poultry manure(50%), FYM (50%) + Vermicompost (50%), FYM (25%) + Poultry manure(75%), FYM (25%) + Vermicompost (75%), FYM (50%) + Poultry manure(25%)+ Vermicompost (25%), FYM (25%) + Poultry manure(50%)+ Vermicompost (25%) and FYM (25%) + Poultry manure(25%)+ Vermicompost (50%). The green leaf yield of palak from different treatment combinations was studied for growth, yield and quality attributes. The critical evaluation of the results of the present investigation clearly showed the beneficial effect of organic manures on growth, yield and quality of palak. The treatment receiving T_8 FYM (50%) + Poultry manure(25%)+ Vermicompost (25%) has produced significantly superior results in terms of growth, yield and quality of palak *viz*., plant height (52.05), number of leaves per plant (33.57), leaf length (cm) (14.47), leaf width (cm) (8.55), leaf area (cm2) (107.92), fresh green yield per plant (g) (106.36), fresh green yield per plot (kg) (4.36), fresh green yield (q ha^{-1}) (218.01) and ascorbic acid (content) (109.02)

Keywords: Organic manures, growth, yield, quality and palak

Introduction
Indian spinach (*Beta vulgarisvar*. *bengalensis* L.) is one of the most common leafy vegetables of tropical and subtropical region and is widely grown in India. It is commonly known as Palak or beet leaf or spinach beet. Palak or Spinach beet belongs to family Chenopodiaceae, genus Beta and species vulgaris var. bengalensis. It has chromosome number of 2n =18. Indian spinach or palak is most probably native of Indo-Chinese region. It is extensively grown in Uttar Pradesh, West Bengal, Punjab, Haryana, Dehli, Madhya Pradesh, Bihar, Maharastra and Gujarat. However, it is not very popular in southern part of India. In the plains of India, this crop normally grown during autumn and spring season but it can be cultivated throughout the year in the region where relatively mild climate prevails. This crop can withstand frost and tolerate warm weather but high temperature leads to early bolting without giving sufficient leaf cuttings Bose *et al.*, (2003) [5]. The yield of Indian spinach depends on vegetative growth it may expressed in terms of number of leaves per plant, size of leaf and plant height etc. For obtaining more vegetative growth cutting of crop is important due to cutting of crop side shoots are arises which increases the number of leaves per plant and ultimately increased the yield which demands higher amount of nutrients from the soils and nutrients applied through the organic sources *viz*., FYM, poultry manure, vermicompost, sheep and goat manure contains nutrients in form that are readily taken up by the plants such as nitrates, exchangeable phosphorus, and soluble potassium, calcium, and magnesium. The water soluble components of vermicompost such as humic acid, growth regulators, vitamins and micronutrients increases the availability of plant nutrients resulting in increased growth, higher yield and better quality produce. In addition to this it also plays vitalrole as organic nutrient sources for sustainable soil health and crop growth.

Nitrogen is a primary plant nutrient that plays an important role in achieving the maximum economic yields. Nitrogen is essential for the plants because it is present in all living mater constituent of protoplasm. Application of nitrogen to increase yield in leafy vegetables is a well recognized practice. Cutting management is found beneficial for improving green yield, number of branches and number of leaves. Since, most of the leafy vegetables several cuttings are possible, they require a good amount of nitrogenous fertilizer for their quick growth, good vegetative growth and as well as for reproductive growth Sarker *et al*., (2014) [10]. Phosphorusis also one of the most essential macro-nutrient; it is present in plasma membrane, nucleic acids, nucleotides, many co-enzymes and organic molecules. It plays an important role in energy metabolism. Phosphorous promotes healthy root growth. Phosphorous also has vital importance in increase plant height, better root, development and also improve the yield of Indian spinach Fouda *et al*., (2016) [8]. Potassium activates plant physiology, improves fruit quality, increase disease resistance, prevents lodging and makes the plant capable of surviving moisture stress. Potassium activates plant physiology, improves fruit quality, increase disease resistance, prevents lodging and makes the plant capable of surviving moisture stress Fouda *et al*., (2016) [8]. It is highly nutritious, contains higher fibrous matter, which provides necessary roughage in the diet that stimulates intestinal action and prevents constipation. It is an excellent source of vitamin-K, magnesium, manganese and calcium, heart healthy folate, potassium and vitamin B6; energy producing iron and vitamin B2, free radical scavenging vitamin A and vitamin C Bhattacharjee *et al*., (2017) [4]. On an average it's leaves contain moisture 86.49%, fiber 0.7 g, protein 3.4 g, minerals 2.2 g, carbohydrates 6.5 g, riboflavin 0.5 g, calcium 380 mg, iron 16.2 mg, thiamin 0.26 g, Vitamin-A 9770 IU, Vitamin-C 70 mg/100 g of edible portion Vishnu *et al.*, (2014) [12].

Materials and Methods

The experiment was conducted in the Horticulture Research Farm, Faculty of Agricultural Sciences and Allied Industries, Rama University, Kanpur (U.P.), Kanpur during 2024-2025. All the facilities necessary for cultivation, including labor were available from the department. The farm is situated at 20°16' North latitude and 80°08' East longitude in the southwestern plains of Uttar Pradesh. It sits at an altitude of 180 meters above sea level, falling within the subtropical zone. The field was effectively leveled, equipped with adequate irrigation and drainage facilities. Prior to the current study, any stubble from the previous crop and weeds were manually removed from the field. The site is situated within the alluvial belt of the Indo-Gangetic central plain zone of Uttar Pradesh, falling within agro-climatic zone-V. Typically, the climate is semi-arid, characterized by hot, dry summers and moderate to severe cold winters. The average annual rainfall ranges from 800 to 900 mm, with a mean annual precipitation of approximately 818 mm. Rainfall primarily occurs during the monsoon season from June to the last week of September, with occasional frost and showers during the winter season from the North- East monsoon in December and January. The design followed was RBD with ten treatments and three replications. The ten treatment combinations were T_1 FYM (100%), T_2 FYM (75%)+ Poultry manure (25%), T_3 FYM (75%) + Vermicompost (25%), T_4 FYM (50%) + Poultry manure(50%), T_5 FYM (50%) + Vermicompost (50%), T_6 FYM (25%) + Poultry manure(75%), T_7 FYM (25%) + Vermicompost (75%), T_8 FYM (50%) + Poultry manure(25%)+ Vermicompost (25%), T_9 FYM (25%) + Poultry manure(50%)+ Vermicompost (25%) and T_{10} FYM (25%) + Poultry manure(25%)+ Vermicompost (50%). Seeds were sown by opening the small chari or furrows of 3 cm depth at a distance of 15mc, 30 cm and 45 cm as per the treatment with the help of sickle. And seeds were sown by hand drilling and covered with fine soil. Following pre and post harvest observations were recorded during the course of investigation.

Results and Discussion

The vegetative growth parameters is presented in table 1 indicated that, there were significant differences in the plant height (cm), number of leaves per plant, leaf length (cm), leaf width (cm) and leaf area (cm^2) among the different treatment. It is evident from the data that, significantly maximum plant height (52.05) of palak was recorded with the treatment of T_8 FYM (50%) + Poultry manure (25%) + Vermicompost (25%) and it was followed by treatment T_9 FYM (25%) + Poultry manure (50%) + Vermicompost (25%), T_2 FYM (75%) + Poultry manure (25%) and T_{10} FYM (25%) + Poultry manure(25%)+ Vermicompost (50%). However, the minimum plant height (40.82) was recorded with the soil application of T_1 FYM (100%). It is evident from the data that, significantly maximum number of leaves per plant (33.57) of palak was recorded with the treatment of T_8 FYM (50%) + Poultry manure(25%)+ Vermicompost (25%) and it was followed by treatment T_9 FYM (25%) + Poultry manure(50%)+ Vermicompost (25%), T_{10} FYM (25%) + Poultry manure(25%)+ Vermicompost (50%), T_4 FYM (50%) + Poultry manure(50%) and T_3 FYM (75%) + Vermicompost (25%). However, the minimum number of leaves per plant (18.48) was recorded with the soil application of T_1 FYM (100%). It is evident from the data that, significantly maximum leaf length (cm) (14.47) of palak was recorded with the treatment of T_8 FYM (50%) + Poultry manure(25%)+ Vermicompost (25%) and it was followed by treatment T_9 FYM (25%) + Poultry manure(50%)+ Vermicompost (25%), T_{10} FYM (25%) + Poultry manure(25%)+ Vermicompost (50%), T_7 FYM (25%) + Vermicompost (75%) and T_6 FYM (25%) + Poultry manure(75%). However, the minimum leaf length (cm) (8.72) was recorded with the soil application of T_1 FYM (100%). It is evident from the data that, significantly maximum leaf width (cm) (8.55) of palak was recorded with the treatment of T_8 FYM (50%) + Poultry manure(25%)+ Vermicompost (25%) and it was followed by treatment T_9 FYM (25%) + Poultry manure(50%)+ Vermicompost (25%), T_{10} FYM (25%) + Poultry manure(25%)+ Vermicompost (50%), T_3 FYM (75%) + Vermicompost (25%), T_7 FYM (25%) + Vermicompost (75%) and T_2 FYM (75%)+ Poultry manure (25%). However, the minimum leaf width (cm) (6.51) was recorded with the soil application of T_1 FYM (100%). It is evident from the data that, significantly maximum leaf area (cm2) (107.92) of palak was recorded with the treatment of T_8 FYM (50%) + Poultry manure (25%)+ Vermicompost (25%) and it was followed by treatment T_9 FYM (25%) + Poultry manure(50%)+ Vermicompost (25%), T_{10} FYM (25%) + Poultry manure(25%)+ Vermicompost (50%). However, the minimum leaf area (cm2) (80.43) was recorded with the soil application of T_1 FYM (100%). Similar results were given by Dadiga *et al*. (2015) [6] and Bahavand *et al*. (2014) [2] when they experimented on coriander and Indian spinach with the use of FYM, vermicompost, and compost mixtures. However, due to a lack of moisture and an increase in temperature after the second cutting, the length of leaves per plant decreased. Dadiga *et al*. (2015) [6], and Bharad *et al*. (2007) [3] also obtained similar results when they carried out experiments on coriander. However, after the second cutting, the width of the leaves per plant decreased due to a lack of moisture, decreased nutrient uptake, and an increase in temperature. This result supported the findings of Dadiga *et al.* (2015). Bharad *et al.* (2007) [3], Baharvend *et al.* (2014) [2], Gautam *et al.* (2022) [1] and Türkkan *et al.* (2022) [11] found similar results when they experimented on coriander, Indian spinach, FYM, and vermicompost. The leaf yield and quality parameters is presented in table 1 indicated that, there were significant differences in the leaf yield per plant (g), leaf yield per plot (kg), leaf yield (q ha-1) and ascorbic acid (mg/100 g) among the different treatment. It is evident from the data that, significantly maximum fresh green yield per plant (g) (106.36) of palak was recorded with the treatment of T_8 FYM (50%) + Poultry manure (25%)+ Vermicompost (25%) and it was followed by treatment T_9 FYM (25%) + Poultry manure(50%)+ Vermicompost (25%) an d T_{10} FYM (25%) + Poultry manure(25%)+ Vermicompost (50%). However, the minimum fresh green yield per plant (g) (92.04) was recorded with the soil application of T_1 FYM (100%). It is evident from the data that, significantly maximum fresh green yield per plot (kg) (4.36) of palak was recorded with the treatment of T_8 FYM (50%) + Poultry manure (25%)+ Vermicompost (25%) and it was followed by treatment T_9 FYM (25%) + Poultry manure(50%)+ Vermicompost (25%) an d T_{10} FYM (25%) + Poultry manure(25%)+ Vermicompost (50%). However, the minimum fresh green yield per plot (kg) (3.52) was recorded with the soil application of T_1 FYM (100%). It is evident from the data that, significantly maximum fresh green yield (q ha^{-1}) (218.01) of palak was recorded with the treatment of T_8 FYM (50%) + Poultry manure (25%)+ Vermicompost (25%) and it was followed by treatment T_9 FYM (25%) + Poultry manure(50%)+ Vermicompost (25%) an d T_{10} FYM (25%) + Poultry manure(25%)+ Vermicompost (50%). However, the minimum fresh green yield (q ha^{-1}) (176.15) was recorded with the soil application of T_1 FYM (100%). It is evident from the data that, significantly maximum ascorbic acid (content) (109.02) of palak was recorded with the treatment of T_8 FYM (50%) + Poultry manure (25%)+ Vermicompost (25%) and it was followed by treatment T_9 FYM (25%) + Poultry manure(50%)+ Vermicompost (25%) an d T_{10} FYM (25%) + Poultry manure(25%)+ Vermicompost (50%). However, the minimum ascorbic acid (content) (102.49) was recorded with the soil application of T_1 FYM (100%). This result supported the findings of Marak *et al*., (2024) [9] and Dange *et al.*, (2011) [7].

Table 1: Effect of organic manures practices on growth and yield of Palak (*Beta vulgaris* var. Begalensis Hort)

Notation	Treatment combinations	Vegetative growth parameters					Leaf yield attributes			Ascorbic acid (content)
		Plant height (cm)	Number of leaves per plant	Leaf length (cm)	Leaf width (cm)	Leaf area (cm2)	Fresh green yield per plant (g)	Fresh green yield per plot (kg)	Fresh green yield (q ha^{-1})	
T_1	FYM (100%)	40.82	18.48	8.72	6.51	80.43	92.04	3.52	176.15	102.49
T_2	FYM (75%)+ Poultry manure (25%)	48.34	24.25	10.34	7.15	99.16	97.03	3.87	193.42	106.80
T_3	FYM (75%) + Vermicompost (25%)	46.86	26.62	10.43	7.76	94.26	94.05	3.79	189.43	106.30
T_4	FYM (50%) + Poultry manure(50%)	44.65	27.26	12.10	7.15	93.80	92.44	3.61	180.25	106.42
T_5	FYM (50%) + Vermicompost (50%)	47.33	24.47	11.18	6.83	94.88	93.70	3.75	187.44	105.80
T_6	FYM (25%) + Poultry manure(75%)	47.53	23.97	12.53	6.84	93.63	94.12	3.83	191.57	106.81
T_7	FYM (25%) + Vermicompost (75%)	47.76	22.11	12.43	7.33	95.30	97.98	3.88	194.19	104.28
T_8	FYM (50%) + Poultry manure(25%)+ Vermicompost (25%)	52.05	33.57	14.47	8.55	107.92	106.36	4.36	218.01	110.12
T_9	FYM (25%) + Poultry manure(50%)+ Vermicompost (25%)	50.89	31.43	14.34	8.24	105.83	104.42	4.18	208.75	109.02
T_{10}	FYM (25%) + Poultry manure(25%)+ Vermicompost (50%)	48.23	27.65	13.40	7.50	95.37	103.04	4.11	205.47	106.30
	F-test	S	S	S	S	S	S	S	S	S
	S.Ed.	0.677	0.845	0.130	0.059	1.349	1.453	0.118	5.913	0.993
	C.D. 0.5%	1.421	1.775	0.274	0.125	2.834	3.054	0.248	12.423	2.086

Conclusion

The critical evaluation of the results of the present investigation clearly showed the beneficial effect of organic manures on growth, yield and quality of palak. The treatment receiving T_8 FYM (50%) + Poultry manure(25%)+ Vermicompost (25%) has produced significantly superior results in terms of growth, yield and quality of palak *viz*., plant height (52.05), number of leaves per plant (33.57), leaf length (cm) (14.47), leaf width (cm) (8.55), leaf area (cm2) (107.92), fresh green yield per plant (g) (106.36), fresh green yield per plot (kg) (4.36), fresh green yield (q ha^{-1}) (218.01) and ascorbic acid (content) (109.02).

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