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Influence of Integrated Nutrient Management on Growth, Yield, Quality and Economics of Palak (*Spinacia oleracea* L.)

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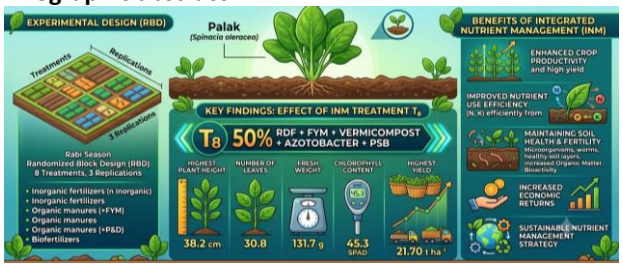
Abstract

Integrated Nutrient Management (INM) is an effective approach for enhancing crop productivity while maintaining soil health. The present study evaluated the effect of different combinations of inorganic fertilizers, organic manures, and biofertilizers on the growth and yield of palak (*Spinacia oleracea* L.). The experiment was conducted during the Rabi season using a Randomized Block Design (RBD) with eight treatments and three replications. Observations were recorded on growth, yield, quality, and soil fertility parameters. The treatment comprising **50% Recommended Dose of Fertilizers (RDF) + Farmyard Manure (FYM) + Vermicompost +Azotobacter + Phosphate Solubilizing Bacteria (PSB) (T_8)** recorded the highest plant height (38.2 cm), number of leaves (30.8), fresh weight (131.7 g), chlorophyll content (45.3 SPAD), and yield (21.70 t ha^{-1}). The study demonstrated that integrated nutrient management significantly improves nutrient use efficiency, crop productivity, soil fertility, and economic returns, making it a sustainable nutrient management strategy for commercial palak cultivation.

Infographic abstract



Keywords: Integrated Nutrient Management, Palak, Spinacia oleracea, Vermicompost, FYM, Biofertilizers, Yield, Soil Fertility.

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1. Introduction

Palak (*Spinacia oleracea* L.) is an important leafy vegetable rich in vitamins, minerals, antioxidants, and dietary fiber. Due to its rapid vegetative growth, it requires a continuous supply of nutrients for optimum productivity. Excessive dependence on chemical fertilizers often leads to soil degradation, nutrient imbalance, and environmental pollution. Integrated Nutrient Management (INM), which combines inorganic fertilizers with organic manures and biofertilizers, offers a sustainable alternative by improving soil fertility, nutrient availability, and crop productivity. Therefore, the present investigation was undertaken to evaluate the influence of different INM practices on the growth, yield, and quality of palak.

2. Materials and Methods

The field experiment was conducted during the **Rabi season (2025–2026)** using a **Randomized Block Design (RBD)** with **eight treatments** and **three replications**. The crop variety used was **'All Green'**. Treatments included different combinations of RDF, FYM, Vermicompost, and biofertilizers **Azotobacter** and **Phosphate Solubilizing Bacteria (PSB).** Standard agronomic practices were followed throughout the crop season. Growth parameters (plant height, number of leaves, leaf size), yield attributes (fresh weight, dry weight, yield per plot, yield per hectare), quality parameters (chlorophyll content), and soil fertility parameters were recorded. Data were analyzed statistically using ANOVA following Panse and Sukhatme (1985).

3. Results and Discussion

Integrated nutrient management significantly improved all growth, yield, and quality parameters of palak. Among all treatments, **T_8 (50% RDF + FYM + Vermicompost + + Azotobacter + Phosphate Solubilizing Bacteria (PSB)** produced the best performance. It recorded the maximum plant height (38.2 cm), number of leaves (30.8), leaf length (18.2 cm), fresh weight (131.7 g plant^{-1}), chlorophyll content (45.3 SPAD), and green leaf yield (21.70 t ha^{-1}), compared with the control (10.70 t ha^{-1}). The enhanced performance was attributed to balanced nutrient availability, improved microbial activity, better nutrient uptake, and enhanced photosynthetic efficiency. Integrated nutrient application also improved soil organic carbon and available nitrogen, phosphorus, and potassium, indicating its positive impact on long-term soil fertility. The highest Benefit–Cost ratio (3.19) further confirmed the economic advantage of integrated nutrient management.

Table 4.1: Effect of different treatments on germination (%) a fter sowing of Palak (*Spinacia oleracea L.*)

Treatments	Germination(%)
T_1-Control	56.24
T_2-NPK(80:40:50)kgha^{-1}	84.58
T_3-N(80)kg ha^{-1}	78.22
T_4-P (40)kg ha^{-1}	75.75
T_5-NP(80:40)kgha^{-1}	82.76
S.Em.±	3.01
C.D.at 5 %	9.13
C.V. %	1.99

Table 4.2: Effect of different treatments on plant height at different growth stages of Palak (*Spinacia oleracea L.*)

Treatments	Plant heightat(cm)		
	30 DAS	45 DAS	60 DAS
T_1-Control	7.02	18.79	23.10
T_2-NPK(80:40:50)kgha^{-1}	13.36	27.12	33.68
T_3-N(80)kg ha^{-1}	11.61	25.16	30.49
T_4-P (40)kg ha^{-1}	10.99	24.28	29.71
T_5-NP(80:40)kgha^{-1}	11.68	26.47	31.63
S.Em.±	0.93	2.78	2.41
C.D.at 5 %	2.83	8.43	7.32
C.V. %	4.27	5.70	4.06

Table 4.3:Effect of different treatments on leaf length at different growth stage of Palak (*Spinacia oleracea L.*)

Treatments	Leaf lengthat(cm)		
	30 DAS	45 DAS	60 DAS
T_1-Control	4.50	12.49	13.53
T_2-NPK(80:40:50)kgha^{-1}	7.58	17.20	19.30
T_3-N(80)kg ha^{-1}	6.41	16.33	18.52
T_4-P (40)kg ha^{-1}	5.97	15.96	17.75
T_5-NP(80:40)kgha^{-1}	7.01	16.95	18.96
S.Em.±	0.35	0.61	0.92
C.D.at 5 %	1.06	1.86	2.80
C.V. %	2.77	1.94	2.62

Table 4.4 Effect of different treatments on number of leaves/plant at different growth stage of Palak (*Spinacia oleracea L.*)

Treatments	Number of leaves/plantat		
	30 DAS	45 DAS	60 DAS
T_1-Control	6.68	16.29	23.18
T_2-NPK(80:40:50)kgha^{-1}	9.23	24.94	36.43
T_3-N(80)kg ha^{-1}	8.93	23.61	33.86
T_4-P (40)kg ha^{-1}	8.66	22.70	32.75
T_5-NP(80:40)kgha^{-1}	9.09	24.22	34.47
S.Em.±	0.36	1.21	1.14
C.D.at 5 %	1.11	3.69	3.46
C.V. %	2.16	2.72	1.77

Table 4.5 Effect of different treatments on leaf width at different growth stage of Palak (*Spinacia oleracea L.*)

Treatments	Leafwidthat(cm)		
	30 DAS	45 DAS	60 DAS
T_1-Control	2.56	6.74	9.39
T_2-NPK(80:40:50)kgha^{-1}	3.94	9.72	11.88
T_3-N(80)kg ha^{-1}	3.45	7.85	10.24
T_4-P (40)kg ha^{-1}	3.08	7.44	10.09
T_5-NP(80:40)kgha^{-1}	3.72	8.83	11.06
S.Em.±	0.19	0.47	0.36
C.D.at 5 %	0.57	1.45	1.10
C.V. %	2.84	2.95	1.73

Table 4.6 Effect of different treatments on petiole length at different growth stage of Palak (*Spinacia oleracea L.*)

Treatments	Patiole length at(cm)		
	30 DAS	45 DAS	60 DAS
T_1-Control	3.15	8.42	11.26
T_2-NPK(80:40:50)kgha^{-1}	6.85	15.74	21.48
T_3-N(80)kg ha^{-1}	5.72	14.26	19.62
T_4-P (40)kg ha^{-1}	5.31	13.85	18.94
T_5-NP(80:40)kgha^{-1}	6.42	15.08	20.75
S.Em.±	0.18	0.72	0.84
C.D.at 5 %	0.55	2.19	2.55
C.V. %	1.82	2.74	2.31

Table4.7 Effect of different treatments on averagel eaves/plant at different interval of Palak (*Spinacia oleracea L.*)

Treatments	Average leaves/plant at different interval		
	30 DAS	45 DAS	60 DAS
T_1– Control	8.25	10.48	11.62
T_2–NPK(80:40:50)kgha^{-1}	15.42	21.86	24.73
T_3–N(80)kgha^{-1}	13.24	18.95	21.34
T_4–P(40)kgha^{-1}	12.68	17.86	19.92
T_5–NP(80:40) kgha^{-1}	14.57	20.42	23.16
S.Em.±	0.34	0.58	0.72
C.D.at5%	1.03	1.76	2.18
C.V.(%)	1.96	1.84	1.92

Table4.8 Effect of different treatments on yield (kg/plot) at harvest of Palak (*Spinacia oleracea L.*)

Treatments	Yield (Kg/plot)
T1-Control	4.25
T2-NPK(80:40:50)kgha^{-1}	18.64
T3-N(80)kg ha^{-1}	13.42
T4-P (40)kg ha^{-1}	10.38
T5-NP(80:40)kgha^{-1}	16.85
S.Em.$\pm$	0.22
C.D.at 5 %	0.67
C.V. %	1.15

Table4.9 Effect of different treatments on yield(q/ha) at harvest of Palak (*Spinacia oleracea L.*)

Treatments	Yield(q/ha)
T_1– Control	17.00
T_2–NPK(80:40:50)kgha^{-1}	74.56
T_3–N(80)kgha^{-1}	53.68
T_4–P(40)kgha^{-1}	41.52
T_5–NP(80:40) kgha^{-1}	67.40
S.Em.±	0.88
C.D.at5%	2.67
C.V.(%)	1.15

Table4.10 Effect of different treatments on economics

Treatments	Rs./ha		
	Gross Return	Net Return	B:C Ratio
T_1-Control	36400	4275	1.15
T_2-NPK(80:40:50)kgha^{-1}	153575	81700	2.14
T_3-N(80)kg ha^{-1}	96700	20950	1.28
T_4-P (40)kg ha^{-1}	72125	10375	1.17
T_5-NP(80:40)kgha^{-1}	83675	16425	1.24

4. Conclusion

The study concluded that Integrated Nutrient Management significantly enhances the growth, yield, quality, and profitability of palak while maintaining soil fertility. Among the evaluated treatments, **50% RDF + FYM + Vermicompost +Azotobacter + Phosphate Solubilizing Bacteria (PSB)** proved to be the most effective nutrient management practice, producing the highest yield and economic returns. Adoption of this integrated approach can reduce dependence on chemical fertilizers and promote sustainable commercial cultivation of palak.

References

Arancon, N. Q., Edwards, C. A., Atiyeh, R., & Metzger, J. D. (2004). *Bioresource Technology*, 93(2), 139–144.

Atiyeh, R. M., Edwards, C. A., Subler, S., & Metzger, J. D. (2000). *Soil Biology and Biochemistry*, 32(14), 1997–2005.

Bian, Z., Wang, Y., Zhang, X., & Li, T. (2020). *Scientia Horticulturae*, 270, 109440.

Choudhary, M., Singh, R., & Kumar, P. (2017). *International Journal of Agricultural Sciences*, 13(2), 220–228.

Dange, S. R., et al. (2011). *Asian Journal of Horticulture*, 6(2), 450–454.

Panse, V. G., & Sukhatme, P. V. (1985). *Statistical Methods for Agricultural Workers*. ICAR, New Delhi.

Sharma, A., Kumar, S., & Singh, P. (2016). *Indian Journal of Agronomy*, 61(3), 345–352.

Vishwakarma, S., & Chauhan, A. (2023). *The Pharma Innovation Journal*, 12(6), 1490–1495.

Yadav, R., Singh, V., & Sharma, K. (2019). *Journal of Soil Science*, 67(4), 210–218.