

Original Research Article

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Influence of Selective Combination of City Compost and NPK Fertilization on Growth and Yield of Spinach (*Spinacia oleracea* L.)

Nilesh Nirgude¹, D. K. Mishra^{2*}, Raj Kumar Dhakad¹ and Deepak Singune¹

¹Dr. B.R. Ambedkar University of Social Science, Mhow - 453441, (M.P), India

²Krishi Vigyan Kendra, Kasturbagram, Indore, (M.P.) 452020, India

*Corresponding author

ABSTRACT

The present investigation was carried out at Dr. B.R. Ambedkar University of Social Sciences, Mhow, Madhya Pradesh to find out the effects of city compost on growth and yield of spinach during 2018-19. Spinach cv. All Green was used for the experiment with of different doses (5, 10, 15 and 20 t/ha) of city compost along with recommended dose of NPK fertilizers (100:60:60 kg NPK/ha). Maximum growth parameters (germination percentage, plant height, leaf length, leaf width and petiole length) were recorded with city compost @ 10 t/ha + 50% of RDF (T₄) followed by city compost @ 15 t/ha + 25% of RDF (T₅). Whereas, the maximum average number of leave per plant and yield were recorded under city compost @ 10 t/ha + 50 % of RDF followed by city compost @ 15 t/ha + 25 % of RDF. This treatment has also registered the superior from economic point of view. Furthermore, the minimum values of growth and yield were recorded under control.

Keywords

Spinach, City compost, Growth and Yield

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Introduction

Spinach (*Spinacia oleracea* L.) is an important leafy vegetable crop and gaining its popularity to all kinds of people due to its high carotene and vitamin C contents. Like other vegetable crops spinach also require fertilization for better yield and economics. Adequate fertilization, as a source of almost all the essential nutrients, is an important factor in crops growth (Ogunlela *et al.*, 2005). The role of macronutrient particularly nitrogen (N),

phosphorus (P) and potassium (K) are very essential for proper growth; yield and quality produce throughout its life. Indiscriminate use of inorganic fertilizers affects the soil texture and structure, decreases the soil organic matter content and hinders the microbial activities in soil. Similarly increasing use of chemical fertilizers for growing vegetables such as spinach has caused numerous problems related to the environment and human health. On the other hand, organic agriculture is a production system that sustains the health of soils and

ecosystems. Organic manures are source of macro and micronutrient in addition to plant growth molecules, which collectively lead to better crop yields (Masder *et al.*, 2002). Moreover, manure enhances soil organic matter which consequently improves microbial activity, aeration, water holding capacity and finally, plant growth and yield (Mooleki *et al.*, 2002 and Schoenau, 2006). Indore city compost is a organic manure being manufactured by Indore Municipal Corporation by door to door kitchen waste collection project under 'Swatcha Bharat Mission' programme. Keeping above in view an investigation on Effects of city compost on growth and yield of spinach (*Spinacia oleracea* L.) was formulated.

Materials and Methods

The present experiment was carried out at department of Horticulture, Dr. B.R. Ambedkar University of Social Sciences, Mhow, Madhya Pradesh during Rabi 2019 under protected condition. Six treatments including, T₀: Control (No fertilization), T₁: city compost @ 20 t/ha, T₂: 100% of RDF, T₃: city compost @ 5 t/ha + 75% of RDF, T₄: city compost @ 10 t/ha + 50% of RDF and T₅: city compost @ 15 t/ha + 25% of RDF, were analyzed with spinach cultivar All Green. The experiments was formulated and replicated four times under randomized block design. Plant height, leaf length, leaf width and petiole length of plants were measured at 30, 45 and 60 days after sowing. Further, leaves were harvested from each plot and average number of leaves per plant and subsequently, yield in quintal per hectare was calculated. The total expenditure per hectare was worked out for all the treatments by adding all the costs (fertilizers and intercultural operations) for the purpose of experiment and values were expressed in rupees. The gross income was worked out after selling the harvested produce at prevailing market price (Rs. 20 per kg),

subsequently, the net income was calculated by subtracting the total expenditure from the gross return. Finally, the return per rupees invested *i.e.*, benefit: cost ratio was calculated for all the treatments and compared with control. The statistical analysis was carried out for each observed character under the study using MS-Excel (2010), ICAR-Goa, Web Agri Stat Package (WASP 2.0) and OPSTAT software (Sheoran *et al.*, 1998).

Results and Discussion

Influence of city compost on growth parameters of spinach plant

The data presented in Table 1. Clearly pointed out significant variation in growth parameters due to different treatments in spinach *i.e.* city compost and their combination with RDF. The maximum mean germination percentage (86.76%) was recorded in city compost @ 10 t/ha + 50% of RDF (T₄) and found significantly superior than rest of the treatments, followed by 82.25% in city compost @ 15 t/ha + 25% of RDF (T₅) and 79.00% in city compost @ 5 t/ha + 75% of RDF (T₃), whereas, minimum germination percentage (56.83%) was recorded in control (T₀). The plant height (22.03, 30.72 and 35.36 cms), leaf length (11.14, 13.40 and 15.58 cms), leaf breadth (7.42, 7.84 and 10.23 cms) and petiole length (11.34, 13.90 and 15.70 cms) were recorded in city compost @ 10 t/ha + 50% of RDF (T₄), followed by in city compost @ 15 t/ha + 25% of RDF (T₅) at 30, 45 and 60 DAS respectively and found statistically non-significant among each other. Whereas, the minimum values of plant height (19.47, 23.67 and 24.57 cms), leaf length (7.58, 8.88 and 11.68 cms), leaf breadth (6.17, 7.26 and 8.41 cm) and petiole length (8.91, 10.24 and 12.89 cms) were recorded in control (T₀). The observation made on leaf: petiole ratio revealed that there was non-significant effect on this parameter due to different

treatments which might be attributed to slow release source of nutrients using organic source, this could have affected the growth of the plants during growth period of spinach, hence, the non-significant results obtained.

The results obtained can be justified from the fact that germination of seed is genetical behavior and it does not directly affects by addition of fertilizers or manures but the balanced application of organic and inorganic fertilizers results in higher germination. On the other hand, minimum germination of spinach seeds under control (T_0) plot might be due to direct effect of climate, soil moisture percentage and the characteristics of seed *i.e.*, vitality and seed dormancy. Nitrogen, phosphorus and potassium are the primary plant nutrients affecting plant growth.

Soil amended of organic manure in combination with inorganic fertilizer could probably be attributed to NPK availability which promoted higher biomass during vegetative development and also helped to maintain functional leaf growth. As we know that organic matter of soil is important factor for receiving nutrients from soil to the plants, application of city compost in combination with recommended dose of fertilizer (T_4 and T_5) have found to improve all the growth parameter studied, which might be attributed to fact that the available nutrients in soil as well as given nutrient in different treatments might have get accelerate due to improve soil physical condition using organic compost and resulted in improved growth of spinach plant. The above findings were found in conformity with results of Chat *et al.*, (2005) and Roy *et al.*, (2009) in spinach. Similarly, Akinbile *et al.*, (2016), Sanni (2016) and Jakhro *et al.*, (2017) noticed that application of organic manure in addition to chemical fertilizers increased growth of amaranthus and spinach plants. Further, Hossain and Ryu (2017) who found that application of organic fertilizer

(6.5, 13 and 26 t/ha) and the recommended dose of chemical fertilizer significantly increased leaf length and breadth of lettuce.

Effects of city compost on yield and economic attributes in spinach

The data pertaining to yield attributing characters and economic observation of experiment are presented in Table 2. Which shows that there was significant difference due to different treatments in spinach during period of experiment. The maximum average number of leaves per plant at 30, 45 and 60 DAS (12.35, 16.88 and 15.98) was recorded in city compost @ 10 t/ha + 50% of RDF (T_4) and found significantly superior than rest of the treatments during period of experiment, followed by 10.85, 14.50 and 13.69 leaves at 30, 45 and 60 DAS respectively in city compost @ 15 t/ha + 25% of RDF (T_5). Subsequently, maximum yield at first, second and third cuttings (24.08, 35.83 and 32.32 q/ha) and total yield of 92.24 q/ha was recorded with city compost @ 10 t/ha + 50% of RDF (T_4) and found significantly superior than rest of the treatments, followed by 18.91, 29.40 and 27.37 q/ha at first, second and third cuttings, respectively as well as 75.67 q/ha as total yield with application of city compost @ 15 t/ha + 25% of RDF (T_5). Further, the statistically analysis of data revealed that the treatments T_2 , T_3 and T_5 had no difference and hence, reported to be non-significant among each other's.

The maximum average number of leaves per plant in T_4 followed by T_5 might be attributed to precise application and distribution of city compost and inorganic fertilizers sources in soil, thereby, increasing the availability of nutrients which promoted protein synthesis and might have accelerated the mobility of photosynthates from source to the sink to induced higher vegetative growth in the form of leaves in spinach.

Table.1 Effects of Selective combination of City compost and NPK Fertilization on growth of Spinach cv. All Green

Treatments	Germination %	Plant height (cm)			Leaf length (cm)			Leaf width (cm)			Petiole length (cm)			Leaf: petiole (Length basis)		
		30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS
<i>T₀: Control</i>	56.83 ^d	19.47 ^c	23.67 ^d	24.57 ^c	7.58 ^c	8.88 ^d	11.68 ^c	6.17 ^b	7.26	8.41 ^d	8.91 ^d	10.24 ^d	12.89 ^c	0.85	0.87	0.91
<i>T₁: City compost @ 20 t/ha</i>	69.89 ^c	20.02 ^{bc}	25.02 ^{cd}	26.55 ^{bc}	8.40 ^{bc}	10.47 ^c	12.70 ^{bc}	6.97 ^b	7.72	9.09 ^{bcd}	9.78 ^{cd}	11.61 ^c	13.50 ^{bc}	0.88	0.90	0.95
<i>T₂: 100% of RDF</i>	72.23 ^c	20.52 ^{abc}	26.61 ^{bc}	28.98 ^{bc}	9.38 ^{bc}	11.66 ^{bc}	13.68 ^{ab}	6.18 ^{ab}	7.47	8.73 ^{cd}	9.79 ^{bc}	12.70 ^{bc}	14.38 ^{ab}	0.96	0.92	0.95
<i>T₃: City compost @ 05 t/ha + 75% of RDF</i>	79.00 ^b	20.83 ^{abc}	27.09 ^{bc}	29.13 ^{bc}	9.84 ^{ab}	12.61 ^{ab}	14.60 ^a	7.03 ^a	7.75	9.23 ^{bc}	10.21 ^b	13.40 ^{ab}	15.23 ^a	0.96	0.94	0.96
<i>T₄: City compost @ 10 t/ha + 50% of RDF</i>	86.76 ^a	22.03 ^a	30.72 ^a	35.36 ^a	11.14 ^a	13.40 ^a	15.58 ^a	7.42 ^a	7.84	10.23 ^a	11.34 ^a	13.90 ^a	15.70 ^a	0.98	0.96	0.99
<i>T₅: City compost @ 15 t/ha + 25% of RDF</i>	82.25 ^b	21.37 ^{ab}	29.06 ^{ab}	30.14 ^b	10.24 ^{ab}	12.80 ^{ab}	14.75 ^a	7.33 ^a	7.76	9.50 ^{ab}	10.63 ^{ab}	13.52 ^{ab}	15.27 ^a	0.97	0.95	0.97
S.Em.±	1.21	0.53	0.89	1.64	0.37	0.42	0.82	0.27	0.52	0.25	0.42	0.39	0.46	0.06	0.03	0.10
C.D. at 5%	3.66	1.60	2.68	4.94	1.11	1.27	2.47	0.83	N.S.	0.74	1.26	1.17	1.37	N.S.	N.S.	N.S.
C.V.	3.26	5.14	6.58	11.26	7.84	7.22	11.83	8.00	13.51	5.35	8.30	6.16	6.28	12.17	5.92	13.44

*Within a column, means followed by the same letter are not significantly different at $P \leq 0.05$ using Duncan's multiple range test.

Table.2 Effects of Selective combination of City compost and NPK Fertilization on yield attributes and economics of spinach cv. All Green

Treatments	Average no. of leaves/ plant			Yield (q/ha)				Total expenditu re (Rs.)	Gross income (Rs.)	Net income (Rs.)	B: C ratio
	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS	Total				
<i>T₀: Control</i>	7.35 ^d	7.93 ^e	8.45 ^d	8.15 ^d	10.35 ^e	11.75 ^d	30.25 ^e	19450.00	60502.18	41052.18	1: 2.11
<i>T₁: City compost @ 20 t/ha</i>	8.85 ^c	10.54 ^d	11.00 ^c	12.56 ^c	18.82 ^d	20.40 ^c	51.77 ^d	80950.00	103537.95	22587.95	1: 0.28
<i>T₂: 100% of RDF</i>	8.90 ^c	11.20 ^c _d	11.05 ^c	13.51 ^c	20.04 ^d	20.88 ^c	54.41 ^c _d	25877.47	108822.89	82945.42	1: 3.21
<i>T₃: City compost @ 05 t/ha + 75% of RDF</i>	9.13 ^c	12.25 ^c	11.85 ^b _c	14.32 ^c	24.58 ^c	23.68 ^{bc}	62.57 ^c	39647.08	125145.87	85498.79	1: 2.16
<i>T₄: City compost @ 10 t/ha + 50% of RDF</i>	12.35 ^a	16.88 ^a	15.98 ^a	24.09 ^a	35.83 ^a	32.32 ^a	92.24 ^a	53413.74	184477.62	131063.88	1: 2.45
<i>T₅: City compost @ 15 t/ha + 25% of RDF</i>	10.85 ^b	14.50 ^b	13.69 ^b	18.91 ^b	29.40 ^b	27.37 ^{ab}	75.68 ^b	67181.87	151345.47	84163.61	1: 1.25
S.Em.±	0.40	0.50	0.88	1.44	1.47	1.93	2.93	-	-	-	-
C.D. at 5%	1.19	1.51	1.88	4.33	4.42	5.81	8.81	-	-	-	-
C.V.	8.26	8.19	10.38	18.84	12.66	16.95	9.57	-	-	-	-

*Within a column, means followed by the same letter are not significantly different at P ≤ 0.05 using Duncan's multiple range test

Further, it is narrated by (Saeed *et al.*, 2001) that the optimum plant height is claimed to be positively correlated with productivity of plants. The findings of present investigation showed that treatment T₄ followed by T₅ recorded higher yield which might be due to efficient utilization of NPK fertilizers in combination with city compost which could have improved C: N ratio, more organic matter build up, enhanced microbial activity, better root proliferation and accelerated transport of plant nutrients in higher concentration. The above findings are in conformity with Kansal *et al.*, (1981), Ansari (2008), Canali *et al.*, (2008) and Patel *et al.*, (2008) who observed that application of organic manure in combination with inorganic fertilizer produced higher yield in spinach plants. Lim and Vimala (2012)

The data pertaining to economic of the experiment *viz.*, total expenditure, gross income, net income and benefit: cost ratio under different treatments has been presented in Table 2. The scrutiny of data revealed that total expenditure was Rs. 80950.00/ha with city compost @ 20 t/ha (T₁) followed by Rs. 67181.87 with city compost @ 15 t/ha + 25% of RDF (T₅), whereas, lowest expenditure (Rs. 19450.00/ha) was in control (T₀). The maximum yield was recorded in T₄ followed by T₅, therefore, based on yield obtained in individual treatments, the highest gross income (Rs. 184477.62/ha) was recorded in T₄, followed by Rs. 151345.47/ha in T₅, whereas, lowest gross income (Rs. 60502.18/ha) was calculated in T₀. Hence, after deducting the total expenditure from the gross income of corresponding treatments, the highest net income (Rs. 131063.88/ha) was calculated in T₄, whereas it was found lowest (Rs. 41052.18/ha) under T₀. Finally, after considering the all inputs, the benefit: cost ratio was calculated maximum (3.21) under T₂ followed by 2.45 under T₄, probably due to addition of low inputs under T₂, however,

treatment T₄ reported to appear superior in all parameters studied and hence, T₄ could be considered as best treatment for spinach cultivation. On the other hand, lowest B: C ratio obtained under T₁ (0.28) and T₀ (2.11) treatments might be attributable to least performance of plant under study because of incomplete and no fertilization respectively.

It can be concluded that spinach cv. All Green is highly responsive to combined application of city compost and inorganic source of nutrition. Application of city compost @ 10 t/ha + 50% of RDF (T₄) followed by city compost @ 15 t/ha + 25% of RDF (T₅), were found superior for improving growth and yield of spinach. Thus, based on overall performance, it can be concluded that fertilization with city compost @ 10 t/ha + 50 % of RDF (T₄) found best in spinach cv. All Green under protected condition.

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