Research Article

Influenced of Organic, Inorganic Manures and Plant Density on Growth and Yield of Radish (*Raphanus Sativas* L.)

Priynka Kumari Jat*, S.P. Singh, Sajana Devi and Manoj Kumar Rolaniya

Department of Horticulture, S.K.N. College of Agriculture, Jobner
Sri Karan Narendra Agriculture University, Jobner, Rajasthan-303329

Abstract

A field experiment was conducted during *rabi* season of 2014-15 on sandy loam soil to "Effect of organic, inorganic fertilizers and plant densities on performance of radish (*Raphanus sativas* L.)". The experiment consisted three treatment of organic manures (control, VC @ 5 t/ha and FYM @ 15 t/ha), three treatment of inorganic manures (control, 50% RDF of NPK and 100% RDF of NPK) and two treatment of plant densities (20 x 10 cm and 30 x 10 cm), thereby making eighteen treatment combinations tested in randomized block design with three replications. Results indicated that application of vermicompost @ 5 t/ha and 100% RDF of NPK significantly higher growth parameters, yield attributes and yield of radish over control, FYM @ 15 t/ha and control, 50% RDF of NPK, respectively. However, the application of FYM @ 15 t/ha significantly increased the root to shoot ratio and remained at par with vermicompost @ 5 t/ha over control. But, the application of 50% RDF of NPK significantly increased the root to shoot ratio and remained at par with 100% RDF of NPK over control. The result also indicated the plant spacing 30x10 cm significantly higher the growth parameters, yield attributes and yield of radish over plant spacing 20x10 cm. However, the plant spacing 20x10 cm significantly increased the root to shoot ratio and remained at par with plant spacing 30x10 cm. But, chlorophyll content unchanged under different plant densities.

Keywords: FYM, Growth, NPK, Plant density, Radish, RDF, Vermicompost and Yield

***Correspondence**
Author: Priynka Kumari Jat
Email: priyankadhaka100@gmail.com, manojetawa91@gmail.com

Introduction

Radish (*Raphanus sativas* L.) is one of the most popular root crop of *rabi* season and is widely acclaimed for its excellent nutritive and medicinal values. It belongs to family Cruciferae and it has (2n=18) chromosomes. It is popular in both tropical and temperate countries. The radish leaves are rich in minerals and vitamin A (5 IU) and vitamin C (15 mg) and are roots rich in potassium (138 mg) and calcium (50 mg). The edible part of radish is modified root which develops form both primary root and hypocotyls. The pungency in radish is due to the presence of volatile isothiocynates.

FYM being rich in organic matter is required for supplementing the nutrients provided through other manure. The organic manure not only provides nutrients to plants but also improves the soil texture by binding effect to soil aggregates. Organic manure increases CEC, water holding capacity and phosphate availability of the soil, besides improving the fertilizer use efficiency and microbial population of soil; it reduces nitrogen loss due to slow release of nutrients. Vermicompost is a slow releasing & organic manure which have most of the macro as well as micro nutrients in chelated form and fulfill the nutrients requirement of plant for longer period. Vermicompost helps in reducing C:N ratio, increasing humic acid content, cation exchange capacity and water soluble carbohydrates. It also contains biologically active substances such as plant growth regulators.

The balanced fertilization in radish is important factor to boost yield attributes. Availability of nitrogen is important for growing plant as it is major indispensable constituent of protein and nucleic acid. An adequate supply of nitrogen is associated with vigorous vegetative growth and more efficient use of available inputs, finally leading to higher productivity. The application of nitrogen with different doses increases plant growth and yield of radish.

Phosphorus is transfer of energy within the plant system and is involved in its various metabolic activities; Phosphorus has its beneficial effect on early root development, plant growth, yield and quality [1]. Phosphorus plays a key role in the formation of energy bound phosphate (ADP and ATP).

Potassium imparts vigour and disease resistance to the plant and plays an important role in crop productivity. It functions as an activator of numerous enzymes like pyruvic kinase activity, thus plays important role in. It is always involved in the movement of carbohydrate, therefore, accumulation of carbohydrates and soluble nitrogen compound points towards diminishing protein synthesis in case of potassium deficiency. There are evidences of direct involvement of potassium in photosynthesis and its involvement in leaf tissues metabolic activities of chloroplast. It regulates transpiration through opening and closing of the stomata by affecting activities of guard cells.

Optimum plant population is also another important aspect of crop production; wider plant spacing not only leads to excessive vegetative growth but also accelerates the evaporative losses of water from the bare ground. On the other hand, the struggle for existence increases with increasing plant population because of severe competition for light, water and nutrients.

Materials and Methods

A field experiment was conducted during *rabi* season of 2014-15 at Department of Horticulture, College of Agriculture, Jobner, in a randomized block design with three replications. The soil was loamy sand in texture, alkaline in reaction (pH 8.1), low in organic carbon (0.16 %), low available nitrogen (130 kg/ha), medium available phosphorus (15.1 kg P_2O_5/ ha) and medium in potassium (140 kg K_2O/ha) content. The experiment consisted three treatment of organic manures (control, VC @ 5 t/ha and FYM @ 15 t/ha), three treatment of inorganic manures (control, 50% RDF of NPK and 100% RDF of NPK) and two treatment of plant densities (20 x 10 cm and 30 x 10 cm), thereby, making eighteen treatment combinations. Fertilizers were applied as per treatment through Urea, SSP and MOP at the time of sowing as basal dose and split application of urea at top dressing. The radish cv. 'Pusa Rashmi' was sown on 8th September 2014 using seed rate of 10 kg/ha with a row spacing of 20x10 cm and 30x10 cm. The 6-10 days interval irrigations was applied during growing season. Intercultural operations *viz.*, thinning, hoeing and weeding were followed after 20 days of sowing to maintain recommended spacing and weed control. Two hand weeding during growing period and harvest maturing in 50 to 55 days after sowing and observations on tagged plants were recorded.

Results and Discussion

Effect on Growth

Organic Manures

Results revealed that application of vermicompost @ 5 t/ha significantly higher plant height, number of leaves per plant, fresh weight of leaves, chlorophyll content, plant spread and leaf area index over control and FYM @ 15 t/ha (**Table 1**). This enhancement might be due to better moisture holding capacity, supply of micronutrients and availability of major nutrients in soil due to favourable conditions created by vermicompost and FYM [2]. The physiological parameters like photosynthesis, stomatal conductance and transpiration might have improved with the application of vermicompost and FYM. It indicates that the increase in these physiological parameters might have helped in increasing the absorption of nutrients form soil, enhanced carbohydrate assimilation and production of new tissues which have ultimately increased vegetative growth. The similar result was findings of [3] and [4].

Inorganic Manures

The application of 100% RDF of NPK significantly higher the plant height, number of leaves per plant, fresh weight of leaves, chlorophyll content, plant spread and leaf area index over control and 50% RDF of NPK (Table 1). This might be due to better nutritional environment in the root zone for growth and development of the plant. N and P are considered as major nutrients required maintaining proper metabolism of the plant. Besides this, nitrogen is the main constituent of protoplasm, nucleic acids, amino acids, proteins, chlorophyll and other metabolic products. Phosphorus at early stage of growth may be involved in stimulation of root system through efficient translocation of certain growth stimulating compounds formed on account of protoplasmic leading to better have absorption of nitrogen and other nutrients and their utilization. The results are in close conformity with the finding of [2] and [5].

Table 1 Effect of organic manures, inorganic manures and plant density on growth of radish

Treatments	Plant height (cm)	No. of leaves/ plant	Fresh weight of leaves (g)	Chlorophyll content (mg/g)	Plant spread (cm^2)	Leaf area index (LAI)
Organic manures						
M_0: Control	30.12	9.15	72.15	0.99	83	267
M_1: Vermicompost @ 5 t/ha	36.70	11.47	87.45	1.81	131	364
M_2:FYM @ 15 t/ha	33.15	10.12	82.06	1.23	123	352
SEm ±	1.16	0.46	1.80	0.17	2.15	3.31
CD (P= 0.05)	3.33	1.31	5.17	0.48	6.15	9.47
Inorganic manures						
F_0: Control	28.70	8.87	72.45	0.76	83	260
F_1: 50% RDF of NPK	33.97	10.27	81.68	1.38	123	356
F_2: 100% RDF of NPK	37.31	11.61	87.54	1.90	130	367
SEm ±	1.16	0.46	1.80	0.17	2.15	3.31
CD (P= 0.05)	3.33	1.31	5.17	0.48	6.15	9.47
Plant density						
S1: (20 x 10 cm)	31.11	9.55	76.54	1.18	99	302
S2: (30 x 10 cm)	35.54	10.95	84.57	1.51	126	354
SEm ±	0.95	0.37	1.47	0.14	1.75	2.70
CD (P= 0.05)	2.72	1.07	4.22	NS	5.02	7.73

Plant Density

The plant spacing 30x10 cm significantly super over plant spacing 20x10 in case of plant height, number of leaves per plant, fresh weight of leaves, plant spread and leaf area index (Table 1). The wider spacing of 30 x 10 cm showed significant superiority over other spacings for all these growth characters. Erect growing habit of radish crop and horizontally orientation of leaves provide wider spacing which particularly at later stage is helpful in providing more nutrients, light, leaf area and number of leaves per plant. Similar result was findings of [6]. However, chlorophyll content unchanged under different spacing of plant.

Yield attributes and yield

Organic manures

Results indicated that application of vermicompost @ 5 t/ha significantly higher length of root, diameter of root, fresh weight of root and yield of radish over control and FYM @ 15 t/ha (**Table 2**). Vermicompost, might have increased the efficiency of added chemical fertilizers in the soil, activities of nitrogen fixing bacteria and increased rate of humification which enhances the availability of both native and added nutrients in soil resulting in increase yield attributes and yield of radish [7]. However, the application of FYM @ 15 t/ha significantly increased the root to shoot ratio and remained at par with vermicompost @ 5 t/ha over control. FYM also function as a source of energy for soil micro flora which bring transformation of inorganic nutrients present in soil or applied in the form of fertilizers in readily utilizable form by growing plant [8] and [9].

Inorganic Manures

The results further indicated that application of 100% RDF of NPK significantly higher the length of root, diameter of root, fresh weight of root and yield of radish over control and 50% RDF of NPK (Table 2). The application of 100% recommended dose of N and P favoured the metabolic and auxin activites in plants and ultimately resulted in increased weight of root [2]. However, the application of 50% RDF of NPK significantly increased the root to shoot ratio and remained at par with 100% RDF of NPK over control.

Plant Density

The plant spacing 30x10 cm significantly super over plant spacing 20x10 in case of plant length of root, diameter of

root, fresh weight of root and yield of radish (Table 2). The beneficial effect of spacing on yield attributes and yield might be due to enhanced supply of macro and micro nutrients during entire growing season. Growth of plants becomes more intense with an increase in the competition for light; however, as the competition for light increases further, an individual plant's growth rate become very low because of the shading effects. Similar result was finding of [10] and [11]. However, plant spacing 20x10 cm significantly increased the root to shoot ratio and remained at par with plant spacing 30x10 cm.

Table 2 Effect of organic manures, inorganic manures and plant density on yield attributes and yield of radish

Treatments	Length of root (cm)	Diameter of root (cm)	Fresh weight of root (g)	Root : Shoot ratio	Yield (q/ha)
Organic manures					
M_0: Control	21.30	3.13	139	1.93	167
M_1: Vermicompost @ 5 t/ha	30.18	4.31	200	2.28	232
M_2:FYM @ 15 t/ha	27.07	3.43	193	2.35	215
SEm ±	0.85	0.30	2.02	0.11	1.88
CD (P= 0.05)	2.43	0.86	5.78	0.31	5.37
Inorganic manures					
F_0: Control	20.36	2.67	141	1.93	167
F_1: 50% RDF of NPK	27.84	3.66	193	2.36	220
F_2: 100% RDF of NPK	30.35	4.54	199	2.26	227
SEm ±	0.85	0.30	2.02	0.11	1.88
CD (P= 0.05)	2.43	0.86	5.78	0.31	5.37
Plant density					
S1: (20 x 10 cm)	22.15	3.15	175	2.26	192
S2: (30 x 10 cm)	30.22	4.10	180	2.10	217
SEm ±	0.69	0.25	1.65	0.09	1.53
CD (P= 0.05)	1.98	0.70	4.72	0.25	4.39

Conclusion

On the basis of the results obtained in the present investigation, it may be concluded that application of vermicompost 5 t/ha and 100 % RDF of NPK and plant spacing 30x10 cm may be considered as best treatment in terms of growth parameters and yield of radish.

References

[1] Balai, R.P. 2002. Response of mungbean (Vigna radiata (L.) Wilzeck) to phosphorus and bacterial culture in loamy sand. M.Sc. (Ag) Thesis, Submitted to Rajasthan Agricultural University, Bikaner.

[2] Kumhar, R.D. 2004. Effect of NPK and vermicompost on growth and yield of cauliflower (Brassica oleracea var. botrytis L.) cv. Pusa katki. M.Sc. (Ag.) Thesis, Rajasthan Agricultural University, Bikaner, Campus-Jonber.

[3] Tomar, V.K., Bhatnagar, R.K. and Patta, R.K. 1998. Effect of vermi-compost on production of brinjal and carrot. Bhartiya Krishi Anusandhan Patrika, 13: 153-156.

[4] Singh, K., Dhaka, R.S. and Fegeria, M.S, 2004. Responce of cauliflower (Brassica oleracea var. Botrytis L.) cultvars to row spacing and N fertilization. Progressive Horticulture, 36:171-173.

[5] Choudhary, R.S., Das, A., Patnaik, U.S. and Das, P. 2006. Organic farming for vegetable production using vermi-compost and FYM in Kokriguda watershed of Orissa. Indian Journal of Soil Conservation, 31 (2): 203-206.

[6] El-Desuki., Salman, S.R., El-Nemra, E.I. and Mawgoud, A.M.R. 2005. Effect of plant density and nitrogen application on the growth, yield and quality of radish (Raphanus sativus L.), Journal of Agronomy, 4: 225-229.

[7] Oliveira, A.P., Ferreira, D.S., Casta, C.C., Silva, A.F. and Alves, E.V. 2001. Utilization of cattle manure and earthworm compost in hybrid cabbage production. Horticulture Brasileira, 13: 70-73.
[8] Yalwalker, K.S., Agrwal, J.P. and Bokde, S. 2007. Manures and fertilizer- Agri- Horticultural Publishing House, Nagpur, 490010, India.
[9] Choudhary, R. and Mukherjee, S. 2007. Effect of fertility levels and biofertilizers on growth and yield of vegetables pea (Pisumn sativum L.). M.Sc. (Ag.) Thesis, submitted to Swami Keshwanand Rajasthan Agricultural University, Campus-Jobner.
[10] Khatun, K., Saha, S. R. and Mostarin, T. 2011. Growth and yield of broccoli as influenced by plant spacing. International Journal of Sustainable Agricultural Technology; 7(12):7-12.
[11] Lavanya, A. V. N., Sudha, V. P., Reddy, S.S. and Chaitanya, K. 2014. Effect of sowing dates and spacing on growth and root yield of radish cv. Pusa chetki. Plant Archives, 4: 619-623.

Publication History
Received 07th Feb 2017
Revised 18th Feb 2017
Accepted 04th Mar 2017
Online 30th Mar 2017