International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; SP4: 110-113

Devendra Kumar Shahu
Department of Horticulture, AKS University Satna, Madhya Pradesh, India

LP Bhardwaj
1) Department of Horticulture, AKS University Satna, Madhya Pradesh, India
2) Faculty of Agriculture Science and Technology, AKS University Satna, Madhya Pradesh, India

Khiromani Nag
1) Department of Horticulture, AKS University Satna, Madhya Pradesh, India
2) Assistant Professor, Deptt. Of Horticulture, AKS University Satna, Madhya Pradesh, India

JS Rajput
Department of Horticulture, AKS University Satna, Madhya Pradesh, India

Correspondence
Devendra Kumar Shahu
Department of Horticulture, AKS University Satna, Madhya Pradesh, India

(Special Issue -4)
International Conference on Food Security and Sustainable Agriculture
(Thailand on 21-24 December, 2018)

To investigate the effect of integrated nutrient management on growth and yield of Radish. (*Raphanus sativus* L.)

Devendra Kumar Shahu, LP Bhardwaj, Khiromani Nag and JS Rajput

Abstract
Experiment was conducted during rabi season of 2015-16 at research farm of AKS University, Sherganj Satna, The experiment entitled "To investigate the influence of integrated nutrient management on growth and yield of radish (*Raphanus sativus* L)". The experiment consisting of ten treatment combination with NPK, Vermicompost, FYM, as well as poultry manure was laid out in randomize block design with three replications. Growth parameter differed significantly at all the stages of crop growth. Maximum plant height (33.93cm), number of leaves per plant (12.9), were recorded in the treatment (T_7) NPK 50% + poultry manure1.5t/ha. Maximum length of root (28.03), diameter of root (4.52cm), fresh weight of leaves (128.41g), dry weight of leaves(6.43g), fresh weight of root (150.81g), dry weight of root (12.78.46q/h), root yield per plot (13.35 kg), root yield per hectare (22.82 q), were recorded in the same treatment. Combined Application of NPK 50% + poultry manure also increased the growth and yield parameter of radish. It was observed that integrated nutrient management significantly helped to improve growth and yield of radish.

Keywords: Radish (*Raphanus sativus* L), INM, growth and yield

Introduction
Radish (*Raphanus sativus* L) is a popular root vegetable grown all over the world. It is native of Europe and Asia and belongs to family Cruciferae (Gill 1993) [3]. In India it is grown in several areas of the country throughout the year. Its edible fusiform roots are eaten raw as salad or cooked vegetable. Its leaves are rich in minerals and vitamins A and C and are also cooked as leafy vegetable. Besides this its immature pods usually called 'mongree' are either eaten raw or cooked as vegetable alone or mixed with other vegetables. Due to its high medicinal value it is prescribed for patients suffering from piles, liver troubles and jaundice (Brar *et al.*, 1972) [1]. Radish is grown for its young tender tuberous root which is consumed either cooked or raw. It is a good source of vitamin C (ascorbic acid) and minerals like calcium, potassium and phosphorus. It has got refreshing and diuretic properties. In homeopathy, it is used for neurological, headache, sleeplessness and chronic diarrhea. The roots are also useful in urinary complaints and piles. Radish is predominantly a cool season vegetable crop. But, Asiatic types can tolerate higher temperature than European varieties. Being a cool season crop, it is sown during winter from September to January in northern plains. In the mild climate of peninsular India, radish can be grown almost all the year round except for few months of summer. It is an annual or biennial depending upon the type for the purpose it is grown. The growth and yield of radish greatly depends on soil and climatic conditions. (Coogan, 2001) [2]. India is the second largest producer of radish in the world and occupies 183.26 area in (000) ha, with a production in 2489.74 ('000) metric tones, and productivity of 12.77 metric tones/ ha^{-1}. West Bengal is a leading state in area 40.95 ('000 hectares) and production 502.05 ('000) metric tones. Haryana is the leading state in productivity 22.4 metric tones/ha^{-1} followed by Punjab Bihar, Assam, Chhattisgarh, Odisa

Andhra Pradesh, In Madhya Pradesh the crop occupies 3.14 (‘000) hectare area with the production 47.00 (‘000) metric tones and productivity 88.4 metric tones/ ha^{-1} during 2014-15. (*Source*: Horticulture Statistics Division, DAC&FW).The important radish growing districts in Madhya Pradesh are Chhattarpur, Tikamgarh, Katni, Balaghat, Dewas, Panna, Hoshangabad, Khargon The maximum Area (in 000 ha.) under radish is occupied is Chhattarpur (0.4 ha) followed by Tikamgarh (0.305 ha), Katni (0.3 ha), Balaghat (0. 15 ha), Dewas (0.152 ha), Panna (0.167 ha.) Hoshangabad (0.106 ha.) and, Khargon (0.082 ha) districts of the state (H. S. Glance, 2015). Farmyard manure being a bulky organic material releases the soil compaction and improves the aeration in addition to the supply of essential plant nutrients and organic matter, thereby increasing the soil microbial establishment along with accumulation of excess humus content. Vermi-Compost provides vital macronutrients (N, P_2O_5, K_2O, Ca and Mg) and micronutrients Fe, Mn, Zn and Cu). The chemical analysis of vermin-compost reveals that the N, P_2O_5, K_2O content was 0.8, 1.1, 0.5, respectively. The poultry manure estimated, contains 60 per cent of organic N due to rapid mineralization poultry manure was recognized as a valuable source of plant nutrient for all crops. (Giraddi *et al*, 1993). Under normal agro-climatic conditions, the variety which is most suitable and which organic manure is supplied are the two chief factors which influence yield and quality of radish.

Material and Methods

The present research works “To investigate the effect of integrated nutrient management on growth and yield of Radish. (*Raphanus sativus* L.)*”* have been undertaken in the Department of Horticulture, AKS University, Satna (M.P.) during 2015-2016.

Treatments combinations;

T_1. Recommended dose of fertilize (RDF) NPK 50:60:80 kg/ha.
T_2. Vermicompost 5t/ha
T_3. FYM 20t/ha
T_4. Poultry Manure 3t/ha
T_5. Vermicompost 2.5t/ha + NPK 50%
T_6. NPK 50% + FYM 10t/ha
T_7. NPK 50 % + Poultry Manures 1.5t/ha
T_8. Vermicompost 2.5t/ha + FYM 10t/ha
T_9 Poultry 1.5t/ha + Vermicompost 2.5t/ha
T_{10}. FYM 10t/ha + poultry manure 1.5t/ha

Observation assessment

(I) Plant height: The plant height was measured with the help of a meter scale from the ground level of the root up to the tip of leaf at 30, 45 and 60 days after sowing.

(II) Number of leaves per plant: Number of leaves was counted 15 days interval and was started from 30 days after sowing and continued to harvest, *i.e.* 30, 45 and 60 DAS. Five plants in each plot were used to count number of leaves per plant.

(III) Fresh weight of leaves per plant: Leaves of five fresh plants in each plot were detached by sharp knife and fresh weight was taken by using a balance and recorded in gram (g).

(IV) Dry weight of leaves per plant: Fresh leaves of l00g as per treatment sample were weight and cut into small pieces. After sun drying for 3 days the samples were oven dried at 72 hours.

(V) Length of root per plant: five plants are uprooted and detached from foliage parts. Then the length of modified roots was measured by scale and recorded in centimetre.

(VI) Diameter of root per plant: Root diameter was measured at the time of harvesting from the middle portion with slide callipers and recorded in centimetre (cm).

(VII) Fresh weight of root per plant: five selected radish roots were used to determine the fresh weight of root. Modified roots were detached by knife from the foliage part and fresh weight was taken by using balance and recorded in gram (g).

(VIII) Total yield of roots per plot (kg): After removal of cracked roots, branched root and rotten root, the fresh weight of roots per plot was taken and recorded in kilogram (kg).

(IX) Yield per hectare (quintal): The weight of roots was recorded treatment-wise from each net plot and from each replication. Radish crop utilized only 80 percent of the land and the remaining 20 percent of the land was used for irrigation channels and bund.

Results and Discussion

(A) Growth parameters:

(I) Plant height (cm): Data collected on account of plant height (cm) at 30 DAS, 45 DAS, and at harvest of radish have been influenced by the use of integrated nutrient management and results are presented in various heads;

(a) Plant height at 30 days after sowing: The plant height was recorded at 30 days after sowing (DAS). The plant height varied significantly due to using of different (INM) integrated nutrient management treatment at 30 DAS. The highest plant height (13.76 cm) was found on NPK 50% +poultry manure 1.5t/h and the lowest plant height (8.71 cm) was found when FYM 20t/ha was applied.

(b) Plant height at 45 days after sowing: Plant height (cm) showed significant variations due to the (INM) integrated nutrient management treatment at 45 DAS. The maximum plant height (25.45cm) received when integrated nutrient management treatment NPK 50% + poultry manure 1.5t/ha, was applied and minimum plant height (16.12cm) was noted when FYM 20t/ha was incorporated.

(c) Plant height at harvest: The height of plant (cm) at harvest was significantly influenced by use of different integrated nutrient management (INM). The largest plant height (33.93 cm.) was found when NPK 50% + poultry manure1.5t/ha was used and shortest plant height (21.28 cm) was found in application of FYM 20t/ha.

(II) Number of leaves per plant: Data collected on account of number of leaves per plant at 30 DAS, 45 DAS, and also at harvest of radish as influenced by integrated nutrient management treatments and results are presented in following heads;

(a) Number of leaves per plant 30 days after sowing: Number of leaves per plant was significantly influenced by the different integrated nutrient management combination at 30 DAS. The maximum number of leaves per plant (4.36) was found in NPK 50%+poultry manure1.5t/ha and minimum number of leaves (2.80) was noted from the Farm yard manure 20t/ha.

(b) Number of leaves per plant 45 days after sowing: The number of leaves were significantly increased due to use of different INM treatment. The maximum number of leaves (6.15) at 45 days after sowing in application of NPK 50% + poultry manure 1.5t/ha and minimum number of leaves (3.88) was recorded with application of farm yard manure 20t/ha.

(c) Number of leaves per plant at harvest: Using different integrated nutrient management (INM) combination was also significantly influenced the number of leaves at harvest. The highest number of leaves per plant (12.09) was recorded from the NPK 50% + poultry manure 1.5t/ha and lowest number of leaves (7.53) was obtained from the farm yard manure 20t/ha.

(III) Length of Root (cm);Data assembled in connection with length of root (cm) at harvest as affected by different INM show significant effect on root length of radish. The longest root length (28.03 cm) was observed in NPK 50% + poultry manure 1.5t/ha and shortest root length (18.00 cm) was found in FYM 20t/ha.

(IV) Diameter of root per plant (cm): Data collected on account of root diameter per plant (cm) at harvest of radish have been influenced by integrated nutrient management and results are presented in diameter of root varied significantly due to different integrated nutrient management (INM). The maximum root diameter (4.52 cm) was recorded in NPK 50% + poultry manure 1.5t/ha and minimum root diameter (3.00) was recorded when (FYM) Farm yard manure 20t/ha was applied.

(V)Fresh weight of leaves per plant (g): Data noted in reference of fresh leaves weight per plant (g) at harvest of radish crop have been influenced by integrated nutrient management and results are presented in fresh weight of leaves was significantly influenced by different INM. The maximum fresh weight of leaves per plant (128.41 g) was recorded due to NPK 50% + poultry manure1.5t/ha and minimum fresh weight of leaves per plant (86.65 g) was found in the farm yard manures 20t/ha

(VI) Dry weight of leaves per plant (g): Data assemble in connection with dry weight leaves per plant (g) at harvest of radish have been displayed due to use of integrated nutrient management and results are tabulated in varies different integrated nutrient management (INM) treatment was significantly influenced dry weight of leaves. The highest dry weight of leaves (6.43 g) was obtained from NPK 50% + poultry manure 1.5t/ha and lowest dry weight of leaves (3.72g) was found with application of farm yard manures 20t/ha.

(VII)Fresh weight of root (g): Data collected on fresh weight root per plant (g) as influenced by different INM have been presented in fresh weight of root was significantly influenced by the use of different INM. The high weight of root (150.81g) was recorded with NPK 50% + poultry manure 1.5t/ha and low fresh weight of root (96.18g) was recorded in farm yard manures 20t/ha was applied.

(VIII) Dry weight of root per plant (g): Data pertaining to dry weight of root per plant (g) at harvest of radish as influenced by various integrated nutrient management and results are given in the dry weight of root per plant was found significant due to different INM. The maximum dry weight of root (12.78g) was recorded in NPK 50% + poultry manure 1.5t\ha and minimum dry weight of root (8.02g) was obtained in farm yard manures (FYM 20t/ha).

(IX) Root yield per plot (kg): The persual of mean data on root yield per plot (kg) at harvest of radish crop have been influenced different integrated nutrient management and results are presented in yield per pot of root was significantly varied due to using different INM treatments. The highest root yield per plot (13.35kg) was obtained in NPK 50%+poultry manure 1.5t/ha. Where the lowest (8.58 kg) root yield per plot was obtained from FYM 20t/ha.

(X) Root yield per hectare (q/ha): Data pertaining to root yield per hectare at harvest of radish as influenced by various integrated nutrient management treatment and results are presented in Table 1.0 and graphically depicted in Fig. 1.0

Table 1: Sowing the root yield per plot (kg) of radish as influenced by integrated nutrient management

Treatments	Root yield per plot (kg)
T_1 (RDF) NPK 50:60:80 kg/ha.	10.24
T_2 (Vermicompost 5t/ha)	10.04
T_3 (FYM 20t/ha)	8.58
T_4 (poultry Manures 3t/ha)	10.08
T_5 (Vermicompost 2.5t/ha +NPK 50%)	11.22
T_6 (NPK 50% + FYM 10t/ha)	10.09
T_7 (NPK 50 % + Poultry Manures 1.5t/ha)	13.35
T_8 (Vermicompost 2.5t/ha +FYM 10t/ha)	9.41
T_9 (Poultry 1.5t/ha + Vermicompost 2.5t/ha)	9.98
T_{10} (FYM 10t/ha + poultry manure 1.5t/ha)	9.73
SEm ±	0.29
CD (P=0.05)	0.87

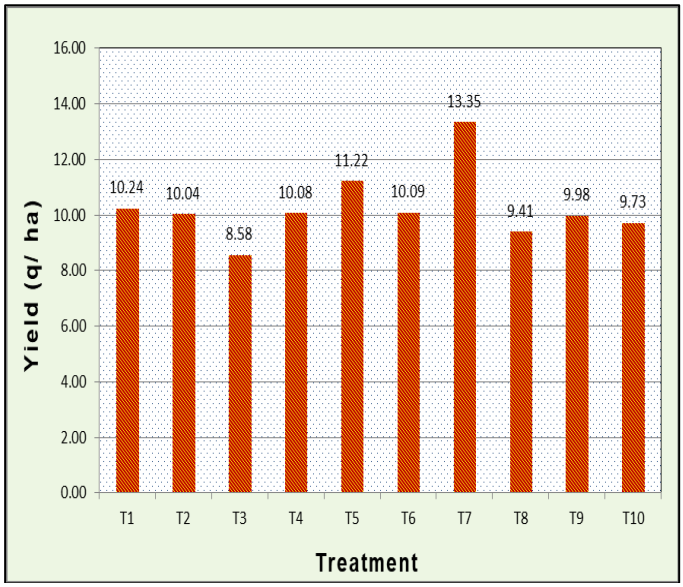

Fig. 1. Root yield per ha. (q) of radish as influenced by integrated nutrient management.

(A) Growth parameters: Application of different nutrient management significantly influenced plant height at 30, 45 DAS and also at harvest. At 30 DAS, the tallest plant height (13.76cm) was found in use of (T_7) NPK 50% + poultry manure 1.5t/ha and shortest plant height 8.71cm was found in (T_3) FYM 20t/ha. At 45 DAS tallest plant were obtained due to use of NPK 50% + poultry manure 1.5t/ha and also at harvest. Similar result was also reported by Jadhav et *al*. (1999) and revealed that the NPK+ poultry manure1.5t/ha significantly increased plant height. The data clearly indicated that the number of leaves per plant of radish responded significantly to various treatment of nutrient management at all the growth stages (*i.e.*, 30, 45 DAS and at harvest). The

maximum numbers of leaves per plant were recorded in the treatments (T_7) NPK 50% + poultry manure 1.5t/ha.

(B) Yield Attributes: The root length of radish was significantly influenced with the differential application of nutrients. The root length was observed to be gradually increased with the use of NPK (50%+poultry manure 1.5t\ha). The highest root length per plant (28.03) by the use of T_7 (NPK 50%+poultry manure 1.5t/ha) and the lowest root length (18.00cm) was obtained in T_3 (FYM 20t/ha). Nutrient management helps in nutrients uptake by promoting root growth and thereby increases root length. Significant difference in root diameter of radish was found due to use of different nutrient management. Maximum root diameter (4.52cm) was recorded at harvest when applied (T_7) NPK 50%+poultry manure 1.5t/ha. When crop having FYM 20t/h root diameter (3.00cm) was found lowest. The fresh weight of leaves increased significantly by the use of different nutrient management. The significantly maximum fresh weights of leaves were recorded in the treatments (T_7) NPK 50%+poultry manure 1.5t/ha. However, the minimum leaves per plant (86.65 g) was noted in (T_3) FYM 20t/ha. Different nutrient management were significantly affected dry weight of leaves. The Maximum dry weight of leaves (6.43 g) was found in use of NPK 50 %+poultry manure 1.5t/ha and lowest dry weight of leaves (3.72g) was found in farm yard manure (FYM 20t/ha). Fresh weight of root per plant was also different significantly by using different nutrient management. The maximum fresh weight of root (150.81) per plant was obtained in treatment (T_7) NPK 50% poultry manure, while the minimum fresh weight of root (96-18g) was noted in (T_3) FYM 20t/ha. The dry weight of root was significantly influenced by the use of different nutrient management. The maximum dry weight of root (12.78) was obtained in (T_7) NPK 50%+poultry manure 1.5t/ha while the minimum dry weight of root (8.02) was obtained in (T_3) FYM 20t/ha. The dry weight of root was increased gradually with use of NPK and also in nutrients uptake by promoting root growth and thereby increases in total dry matter. Root yield per hectare was significantly increased due to use of different nutrient management in radish crop. The highest root yield of radish per hectare (22.82q/h) was obtained in (T_7) (NPK 50%+poultry manure, while lowest root yield (14.48q) in this respect was obtained by using FYM 20t/ha.

Reference

1. Brar JS, Nandpuri KS. Cultivation of root crops. Punjab Agriculture University Bulletin, 1972, 10-15.
2. Coogan. Effect of poultry manure and post-production application of fungicide on the shelf life of radish. *Crop Res*., Hissar. 2001; 20(1):87-92.
3. Gill HS. Improvement of root crops. In: Advances in horticulture: Volume 5. Vegetable crops (eds) KL Chadha and G Kalloo, Malhotra Book Depot, New Delhi, 1993, 201-206.
4. Giraddi *et al.* Organic manure as a substitute for chemical fertilizers for high yielding radish varieties. *Ind. J. Agric. Sci.* 1993; 49(3):188-192.
5. Jadhav BJ, Kulwal LV, Mahakal KG. Effect of nitrogen, phosphorus and potassium on growth and seed yield of radish (*Raphanus sativus* L.). *VegetableSci*. 1999; 26(1):95-96.