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Integrated nutrient management in radish (*Raphanus sativus* L.) cv. scarlet red globe

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Abstract
A field experiment entitled **"**Integrated Nutrient Management in Radish (*Raphanus sativus* L.) *cv.* Scarlet Red Globe" was carried out at research field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, during the rabi season of (2021-2021). The design of the experiment was Randomized Block Design having 7 treatment and each replication thrice. Organic manures and inorganic fertilizer were given at 25, 35 And 45 days after sowing. On the basis of present investigation it is concluded that the treatment T_5 R.D.F 75% + 25% Vermicompost was found to be the best treatment combination in respect of plant growth and root yield parameter of Radish (*Raphanus sativus* L.) *cv.* Scarlet Red Globe grown under Prayagraj Agro-climatic conditions. This treatment also showed maximum benefit: cost ratio i.e. (1:3.61) was found in treatment T_5 R.D.F 75% + 25% FYM respectively.

Keywords: INM, growth, root yield, radish (*Raphanus sativus* L.), scarlet red globe

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). 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. Due to its high medicinal value it is prescribed for patients suffering from piles, liver troubles and jaundice (Brar *et al.*, 1972) [2]. 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) [4]. The leaves of radish are good source for extraction of protein on a commercial scale and radish seeds are potential source of non-drying fatty oil suitable for soap making illuminating and edible purposes (George, 1999) [5]. The problem of high cost of chemical fertilizers fully meet out nutrient requirement of crop by single source therefore integrated nutrient management such as organic matters like farmyard manure, vermicompost, poultry manure and biofertilizer uses has become necessary. Integrated Nutrient Management (INM) is defined as the use of inorganic, organic and biological nutrient sources in optimum condition to achieve and sustain optimum yield without harming the soil ecosystem and environment. INM helps to obtain agronomically feasible, economically viable, environmentally sound and sustainable high crop yields (Kafle *et al.*, 2019) [6]. Organic manure like farmyard manure (FYM), poultry manure and vermicompost should also be used as they also make the soil fertile and give nutrition to plant. FYM helps to improve crop growth by providing nutrition and improving the physical, chemical and biological properties of soil (Mengistu & Mekonnen, 2012) [8]. Vermicompost brings positive changes in both soil quality and productivity than chemical fertilizers (Ansari & Sukhraj, 2010) [10]. Similarly, another organic manure i.e. poultry manure has a high amount of nitrogen, phosphorus and potassium than manure of other animals (Duncan, 2005). Poultry manure also helps to improve the water holding capacity, aeration and fertility status of soil (Khatri *et al.*, 2019) [9].

Material and Method

The experiment was conducted in the Vegetable Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj, during the year 2020-2021.Allahabad is situated at an elevation of 98 meters above sea level at 25.87 degree North latitude and 81.15 degree E longitude. This region has a sub-tropical climate prevailing in the south-east part of U.P. with both the extremes in temperature, i.e. the winter and the summer. In cold winters, the temperature sometimes is as low as 4 0C – 5 0C. In December – January and very hot summer with temperature reaching up to 46 0C – 48 0C in the months of May and June. The relative humidity ranged between 20 to 94 per cent. During winter, frosts and during summer, hot scorching winds are also not uncommon. The average rainfall is around 1013.4 mm, which occurs mostly July – September, months with occasional light showers and drizzles are seen in winter also. According to Table 1, Randomized Block Design (RBD) with three replications is used to test seven different treatment combinations as Farmyard manures, Vermicompost. The Organic manures were applied on the field after field preparation as a basal dose. The seeds were sown at a spacing of 15cm x 10cm from plant to plant and row to row respectively to accommodate twelve plants per 1meter square area. Statistical analysis of variance was performed on the data collected throughout the experiment. The significance of the treatments was determined using the 'F' test at a level of significance of 5%. The objectives were to assess the To find out the best treatment combination for better growth and yield of Radish (*Raphanus sativus.* L.) *cv.* Scarlet Red Globe by application of various organic manures. The observations were recorded on the parameters like Days taken to 50% germination, Plant height, Plant height (cm), Number of leaves per plant, Leaf weight (g) Root weight (g), Root length (cm), Root diameter (cm), Root yield per plot (kg), Total root yield (q/ha)

Table 1: Show the treatments combination

SL. NO	Treatments	Treatments combination
1	T_1	R.D.F (80: 50: 80 N:P:K Kg ha^{-1})
2	T_2	R.D.F 75% + 25% FYM
3	T_3	R.D.F 50% + 50% FYM
4	T_4	R.D.F 25% + 75% FYM
5	T_5	R.D.F 75% + 25% Vermicompost
6	T_6	R.D.F 50% + 50% Vermicompost
7	T_7	R.D.F 25% + 75% Vermicompost

Result and Discussion

Effect of integrated nutrient management on Growth Parameters of Radish (*Raphanus sativus* L.) *cv.* Scarlet Red Globe: The minimum days to taken 50% germination (5.93) was observed in the treatment T_5 (R.D.F 75% + 25% Vermicompost) followed by T_6 R.D.F 50% + 50% Vermicompost, T_7 (R.D.F 25% + 75% Vermicompost) and T_2 (R.D.F 75% + 25% FYM). Where as the maximum days to taken 50% germination (8.60) was observed in Treatment T_1 (R.D.F 80: 50: 80 N:P:K Kg ha^{-1}). The maximum plant height (34.48cm) was observed in the treatment T_5 (R.D.F 75% + 25% Vermicompost) Where as the minimum plant height (25.13) was observed in Treatment T_1 (R.D.F 80: 50: 80 N:P:K Kg ha^{-1}). The present findings are supported by Mehwish Kiran**.** The maximum number of leaves plant^{-1} (21.23) was observed in the treatment T_5 (R.D.F 75% + 25% Vermicompost) and minimum number of leave plant^{-1} (14.60) was observed in Treatment T_1 (R.D.F 80: 50: 80 N:P:K Kg ha^{-1}). The maximum leaf weight (146.42gm) was observed in the treatment T_5 (R.D.F 75% + 25% Vermicompost). Where as the minimum leaf weight (106.83gm) was observed in Treatment T_1 (R.D.F 80: 50: 80 N:P:K Kg ha^{-1}). Related result have been described by Devendra Kumar Shahu *et al*.,(2020), P. Jaisankar (2020).

Effect of integrated nutrient management on Yield Parameters of Radish (*Raphanus sativus.* L.) *cv.* Scarlet Red Globe: The maximum root length (10.74cm) was observed in the treatment T_5 (R.D.F 75% + 25% Vermicompost) Where as the minimum root length (5.96cm) was observed in Treatment T_1 (R.D.F 80: 50: 80 N:P:K Kg ha^{-1}).). The maximum root diameter (20.19cm) was observed in the treatment T_5 (R. D. F 75% + 25% Vermicompost) Where as the minimum root diameter (15.39cm) was observed in Treatment T_1 (R.D.F 80: 50: 80 N:P:K Kg ha^{-1}).The results are agreement with Giraddi *et al*. (1993) [14] and Khatri, K.B.,(2019) [9]. The maximum root weight (212.39gm) was observed in the treatment T_5 (R.D.F 75% + 25% Vermicompost) and the minimum root weight (90.56gm) was observed in Treatment T_1 (R.D.F 80: 50: 80 N:P:K Kg ha^{-1}). The maximum root yield plot^{-1} (5.10kg) was observed in the treatment T_5 (R.D.F 75% + 25% Vermicompost). Where as the minimum root yield plot^{-1} (2.17kg) was observed in Treatment T_1 (R.D.F 80: 50: 80 N:P:K Kg ha^{-1}). The maximum root yield (70.80 t ha^{-1}) was observed in the treatment T_5 (R.D.F 75% + 25% Vermicompost). Where as the minimum root yield (30.19t ha^{-1}) was observed in Treatment T_1 (R.D.F 80: 50: 80 N:P:K Kg ha^{-1}). Similar report were supported by Ankita Mishra *et al.,* (2020) [1], Lalit Kushwah *et al.,* (2020) [13].

Table 2: Effect of integrated nutrient management on Growth Parameters of Radish (*Raphanus sativus.* L.) *cv.* Scarlet Red Globe

Treatments No	Treatments combination	Days to taken 50% germination	Plant height (cm)	Number of leaves per plant	Leaf weight(g)
T_1	R.D.F (80: 50: 80 N:P:K Kg ha^{-1}).	8.60	25.13	14.60	106.83
T_2	R.D.F 75% + 25% FYM	6.80	31.77	17.33	133.40
T_3	R.D.F 50% + 50% FYM	7.47	29.58	16.67	125.81
T_4	R.D.F 25% + 75% FYM	7.60	28.53	16.33	120.15
T_5	R.D.F 75% + 25% Vermicompost	5.93	34.48	21.23	146.42
T_6	R.D.F 50% + 50% Vermicompost	6.33	32.89	17.73	137.15
T_7	R.D.F 25% + 75% Vermicompost	7.13	30.10	18.27	129.25
	F-test	S	S	S	S
	C.D at 0.5%	0.258	1.066	0.562	2.089
	S.Ed. (+)	0.118	0.489	0.258	0.959

Table 3: Effect of integrated nutrient management on Yield Parameters of Radish (*Raphanus sativus.* L.) *cv.* Scarlet Red Globe

Treatments No	Treatments combination	Root length (cm)	Root weight (gm)	Root diameter (cm)	Root yield plot^{-1} (kg)	Root yield (t/ha^{-1})
T_1	R.D.F (80: 50: 80 N:P:K Kg ha^{-1}).	5.96	90.56	15.39	2.17	30.19
T_2	R.D.F 75% + 25% FYM	9.16	184.54	18.63	4.43	61.51
T_3	R.D.F 50% + 50% FYM	7.80	173.13	17.57	4.16	57.71
T_4	R.D.F 25% + 75% FYM	7.58	159.46	17.09	3.83	53.15
T_5	R.D.F 75% + 25% Vermicompost	10.74	212.39	20.19	5.10	70.80
T_6	R.D.F 50% + 50% Vermicompost	9.92	195.03	19.04	4.68	65.01
T_7	R.D.F 25% + 75% Vermicompost	8.38	177.31	18.06	4.26	59.10
	F-test	S	S	S	S	S
	C.D at 0.5%	0.316	2.716	0.393	0.065	0.905
	S.Ed. (+)	0.145	1.247	0.128	0.030	0.416

Conclusion

On the basis of present investigation it is concluded that the treatment T_5 (R.D.F 75% + 25% Vermicompost) was found to be the best treatment combination in respect of plant growth and root yield parameter of Radish (*Raphanus sativus.* L.) cv. Scarlet Red Globe grown under Prayagraj Agro-climatic conditions.

Future scope

The combined use of organic manures with reduced doses of chemical fertilizer will help to get higher yields, to maintain the soil health and reduce pollution problems created by the non-judicious use of chemical fertilizers. Similarly, the balance application of both inorganic and organic fertilizer is necessary for the optimum growth of radish roots inside the soil.

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Conflict of Interest

As a Corresponding Author, I Aswathi P, confirm that none of the others have any conflicts of interest associated with this publication.

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