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Umesh Kumar Verma
Janta College Bakewar Etawah Janta Mahavidiyalaya Ajeetmal, Auraiya, Uttar Pradesh, India

Rajeev Kumar
Janta College Bakewar Etawah Janta Mahavidiyalaya Ajeetmal, Auraiya, Uttar Pradesh, India

Anil Kumar
Janta College Bakewar Etawah Janta Mahavidiyalaya Ajeetmal, Auraiya, Uttar Pradesh, India

Sanjeev Kumar
Janta College Bakewar Etawah Janta Mahavidiyalaya Ajeetmal, Auraiya, Utter Pradesh, India

Manoj Kumar Prajapati
Janta College Bakewar Etawah Janta Mahavidiyalaya Ajeetmal, Auraiya, Utter Pradesh, India

Correspondence
Rajeev Kumar
Janta College Bakewar Etawah Janta Mahavidiyalaya Ajeetmal, Auraiya, Utter Pradesh, India

Integrated effect of organic manures and inorganic fertilizers on growth, yield and yield attributes of Radish CV. Kalyanpur safed

Umesh Kumar Verma, Rajeev Kumar, Anil Kumar, Sanjeev Kumar and Manoj Kumar Prajapati

Abstract
A field experiment was conducted in the Department of Horticulture, Janta College Bakewar, Etawah (C.S.J.M. University, Kanpur) during 2013-14, to evaluate the integrated effect of various levels of organic manures and inorganic fertilizers on growth, yield and yield attributes of Radish *cv*. Kalyanpur Safed. 10 treatments were taken up along with control. Plant height, number of leaves, length and width of leaves, leaf area at various growth stages increased with increasing levels of organic manures and inorganic fertilizers as compared to control. Length of root, diameters of root, weight of root and leaf, total weight plant^{-1}, yield plot^{-1}, yield q ha^{-1} were also found increasing with increasing levels of organic manures and inorganic fertilizers.

Keywords: radish, organic manures, NPK, growth, yield

Introduction
Vegetables are the most important crops which are grown and used throughout the world. India is second largest producer of vegetable after china; the share of the total vegetable production is almost 13.82 percent (Anonymous 2016) [1]. Radish (*Raphanussativus* L, 2n=18.) belongs to the family Brasicacceae. It is a popular root vegetable in both tropical and temperate regions. It can be cultivated under cover for early production but large scale production in field is more common in India. Radish is grown for its young tender tuberous root which is consumed either cooked or raw. It is a good source of vitamin-c and minerals like calcium, potassium and phosphorus. It has refreshing and diuretic properties. It is also used for neurological headache, sleeplessness and chronic diarrohea. The roots are also useful in urinary complaints and piles. The leaves of radish are good source for extraction of protein on a commercial scale and radish seeds are potential source of nondrying fatty oil suitable for soap making illuminating and edible purposes. Being a short duration and quick growing crop, the root growth should be rapid and uninterrupted.
Farmyard manure Nadep compost and vermicompost are conspicuous organic manures of an integrated nutrient supply system, which improve soil health, water holding capacity, soil texture, organic matter and releases macro and micro nutrient. Integrated application of chemical fertilizers (like N,P,K in the form of Urea, DAP and Muriate of Potash) and organic fertilizers produce some growth promoting substances like IAA, gibberellins, cytokinin, vitamins, etc. which help in germination, root and shoot development; resulting enhancement in yield.
Hence, for the production of good quality radish, optimum nutrition through organic, inorganic and biofertilizers is essential for sustainable production. Organic agriculture practice rely upon recycling of crop residues, animal manure, farm organic residues and wastes etc. (Choudhary *et al.,* 2002; Stockdale *et al.,* 2001 and Bhuma, 2001) [3, 12, 2]. In view of higher cost of synthetic fertilizers and its contribution to poor health of soil and water it becomes imperative to go for alternative and cheaper source like organic manures.

Materials and Methods
A field experiment was conducted in the Department of horticulture, Janta College Bakewar, Etawah (C.S.J.M. University, Kanpur) during 2013-14, to evaluate the integrated effect of various levels of organic manures and inorganic fertilizers on growth, yield of Radish *cv*. Kalyanpur Safed, by adopting Randomized Block design, with three replications; having a net plot size of 5.0 m x 1.0 m with row to row distance of 20 cm and plant to plant 15 cm.

10 treatments were taken along with control were as follows:
T_0 Control
T_1 F.Y.M. 10 t ha^{-1}
T_2 F.Y.M. 20 t ha^{-1}
T_3 F.Y.M. 10 t ha^{-1}
T_5 Nadep compost 10 t ha^{-1}
T_6 Nadep compost 20 t ha^{-1}
T_7 Nadep compost 30 t ha^{-1}
T_8 Vermi compost 10 t ha^{-1}
T_9 Vermi compost 20 t ha^{-1}
T_{10} Vermi compost 30 t ha^{-1}
T_{11} NPK 120:60:120 kg ha^{-1}
The crop was sown during the third week of October 2013, in the pattern of 15x20 cm spaced in the lines using seed rate 10 kg ha^{-1}. Before sowing of crops the soil was tested in laboratory. The soil was light sandy loam with a good water holding capacity, having pH range 7.2 to 7.6. The desired doses of organic manure were applied 15 days before sowing; and half of nitrogen along with full dose of phosphorous (60 Kg ha^{-1}) and potash (60 kg ha^{-1}) was applied at the time of sowing, while remaining half of nitrogen was applied at 20 DAS. All agronomic practices were kept uniform for all the treatments. All the observations *viz.* plant height (cm), number of leaves, length of leaf (cm), width of leaf (cm), leaf area per plant (cm^2), diameter of root (cm), weight of plant (g), weight of root (g), weight of leaves (g), and yield per plot (Kg) were recorded during the course of study by using the standard methods. The crop was harvested in January, 2014. The collected data were statistically analyzed by using Fisher's analysis of variance technique and the treatment means were compared by least significant difference (LSD) test at 0.05 % level of probability, Panse, V.G. and Sukhatme, P.V. (1967) [8].

Table 1: Effect of organic manures and inorganic fertilizers on growth and growth attributes of Radish cv. Kalyanpur Safed

Treatments	Plant height (cm)			Number of leaves			Length of leaf			Width of leaf			Leaf area (cm^2)		
	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS
T_0	15.69	31.60	47.22	5.28	8.72	12.18	13.97	28.76	24.63	5.05	7.89	8.86	70.66	226.98	218.08
T_1	16.01	33.64	56.09	5.60	9.64	13.90	14.27	31.12	29.03	5.62	8.06	9.50	80.18	250.84	276.08
T_2	17.50	34.70	61.18	5.95	10.58	15.21	15.77	31.82	32.16	5.94	8.46	10.06	93.68	269.36	323.82
T_3	18.75	35.77	67.64	6.19	11.00	15.81	16.76	32.43	33.91	6.10	8.93	11.66	102.36	289.66	395.99
T_4	16.85	32.67	57.53	5.61	9.93	14.25	15.15	30.80	29.97	5.15	7.84	9.33	78.01	241.69	279.51
T_5	17.76	35.26	60.77	5.79	10.56	15.34	16.11	32.17	30.22	5.33	8.56	10.73	85.96	275.51	324.05
T_6	18.54	35.94	65.62	6.52	11.30	16.09	16.78	32.80	33.28	5.72	8.91	11.43	95.94	293.37	380.51
T_7	17.97	34.24	62.56	6.31	10.66	15.00	16.15	31.60	29.90	5.50	8.63	10.86	89.23	270.33	324.95
T_8	18.84	35.78	66.16	6.44	11.21	15.99	16.90	33.22	33.09	6.12	9.10	12.00	103.34	302.36	397.07
T_9	19.75	36.99	68.66	6.71	11.85	17.00	16.58	35.33	34.56	6.57	9.52	12.43	107.33	321.47	429.90
T_{10}	18.72	37.39	69.29	5.98	11.43	16.88	17.84	34.23	42.86	7.52	9.92	13.23	124.48	352.81	567.24
CD at 5%	0.584	1.148	2.053	0.333	0.359	1.155	0.662	0.959	2.502	0.271	0.327	0.911	5.124	7.360	25.098

Table 2: Effect of organic manures and inorganic fertilizers on yield and yield attributes of Radish cv. Kalyanpur Safed

Treatments	Length of root (cm)	Diameters of root (cm)	Weight of root (g)	Weight of leaf (g)	Total weight plant^{-1} (g)	Yield plot^{-1} (kg)	Yield q ha^{-1}
T_0	23.197	1.83	63.91	55.70	119.60	2.51	418.50
T_1	27.060	2.40	87.34	71.75	159.19	3.34	557.16
T_2	29.013	2.66	93.11	77.99	171.10	3.59	598.83
T_3	33.730	3.13	102.78	101.86	204.65	4.29	716.11
T_4	28.863	2.44	86.36	74.09	160.46	3.36	561.50
T_5	30.523	2.84	97.50	80.26	177.76	3.73	622.00
T_6	32.340	3.43	103.44	95.99	199.44	4.18	698.00
T_7	32.220	2.80	97.39	81.04	178.49	3.74	624.66
T_8	33.080	3.07	103.28	95.07	198.35	4.16	694.16
T_9	34.097	3.46	106.03	110.54	216.57	4.54	757.83
T_{10}	26.433	2.64	73.91	167.96	241.87	5.07	846.50
CD at 5%	1.7658	0.299	3.795	3.950	6.306	0.217	53.122

Result and Discussion
A significant enhancement was reported with the application organic manures and inorganic fertilizers on plant height at various stages of crop growth (Table 1). The maximum plant height was noted in T_{10} (19.75 cm, 37.39 and 69.29 cm) followed by T_9, T_8 and T_6 at 15, 30, 45 DAS, respectively. While minimum plant height was recorded in T_0 (15.69, 31.60 and 47.22 cm). Number of leaves range between 5.28 to 6.71, 8.75 to 11.85 and 12.18 t0 17.00 at various stages of growth. The maximum number of leaves 6.71 reported in T_9 followed by T_{10} and T_6. While minimum number of leaves was reported in T_0 (5.28). A similar result was also reported by Giraddi, (1930). A significant enhancement was reported with the application organic manures and inorganic fertilizers on length of leaf at various stages of crop growth. The treatment T_{10} (17.84, 35.33, 42.68). The lowest leaf was reported in T_0 13.97, 28.76 and 24.63. The maximum width of leaf was recorded in T_{10} (7.52, 9.92 and 13.23) followed by T_9 (6.57, 9.52 and 12.43) and T_8 (6.12, 19.10 and 12.00). The minimum width of leaf was reported under control (5.05, 7.89 and 8.86). Leaf area range between 70.66 to 124.48, 226.98 to 352.81 and 218.08 to 567.24 cm at 15, 30 and 45 DAS. Similar result was also reported by Lingaiah *et al*., (1992) [6], Sharma (2000) [11] and Islam *et al.,* (2011) [5]. The maximum leaf area was noted in treatment T_{10} (124.48, 352.81 and 567.24) followed by T_9 (107.34, 321.47 and 429.90), T_8 (103.34, 302.36 and 397.07). The minimum leaf area was noted in control (70.66, 226.98 and 218.08 cm). The results are in conformity with the finding of Lingaiah *et al*., (1992) [6] in respect of leaf area.
A significant enhancement was reported with the application

organic manures and inorganic fertilizers on yield and yield attributes (Table 2). The maximum length of root was reported in T_9 (34.097 cm) followed by T_8 (33.080 cm), T_3 (33.730 cm) and T_7 (932.220). The minimum length of root was noted in T_0 (23.197 cm). The diameter of roots was directly correlated with yield. The diameter of root was maximum in reported in T_9 (3.46 cm). While the lowest diameters of root in reported in control (1.83 cm). Weight of root was maximum reported in T_9 (106.03 g) followed by T6 (103.28 g) T_8 (103.28 g) and T_3 (102.78 g), while lowest weight of root was noted in T_0 (63.91 g). Weight of leaf was maximum recorded in treatment T_{10} (167.96 g). However, lowest leaf weight was reported in T_0 (55.70 g). The treatment T_{10} (241.87 g) showed highest total weight plant^{-1} followed by T_9 (216.57 g), T_6 (199.44 g). The treatment T_0 (119.60 g) showed poor performance in this regards the increase in fresh weight of roots and whole plant may be due to higher level of nitrogen. The nitrogen is also synthesized in to amino acids which are built into complex proteins and help in promoting the luxurious growth of crop (Muthuswamy and Muthukrishnan, 1971) [7]. Sendur *et al.,* (1998) also indicated that the application of organic and inorganic fertilizers recorded higher growth yield and quality of tomato.

A significant enhancement in yield plot^{-1} was reported in treatment T_{10} (5.07 kg) followed by treatment T_9 (4.54 kg), T_6 (4.18 kg) and T_8 (4.16 kg). The lowest yield plot^{-1} was reported in treatment T_0 (2.51 kg). The yield q ha^{-1} was maximum reported in treatment T_{10} (846.50 q ha^{-1}). The lowest yield was noted in treatment T_0 (418.50 q ha^{-1}). Thanunathan *et al.,* (1997) [13] also related the good root length of onion with vermicompost application. This might be due to favorable physical conditions of soil and availability of plant nutrients in sufficient quantities. These finding were also corroborated with the finding of Panwar *et al.,* (2001) [9].

Thus, the assessment of the effect of organic manures and inorganic fertilizers on growth, yield and yield attributes of radish lead to conclude that all the considered parameters were significantly affected by the integrated application of organic and inorganic fertilizers. The individual application of NPK showed better results in comparison to organic fertilizers but quality and cost of cultivation was higher and longtime excess use of chemicals create environmental problems. So; integrated application of organic and inorganic fertilizers may be used for better health and environment.

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