

## Original Research Article

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## Effect of Integrated Fertilization on Qualitative and Quantitative Traits of Radish (*Raphanus sativus* L.)

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### ABSTRACT

#### Keywords

INM, Organic,  
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An investigation was conducted during the Rabi season 2018-19 at main Experimental Station, Department of Horticulture, BFIT Group of Institutions, Suddhowala, Dehradun, Uttarakhand (U.K), during the Rabi season of 2018-19. The experiment was laid out in Randomized block design (RBD) thrice including ten treatments viz., T<sub>1</sub> Control-Recommended dose of fertilizer (100 Kg N, 80 Kg P<sub>2</sub>O<sub>5</sub> and 50 Kg K<sub>2</sub>O /ha), T<sub>2</sub> (100% N through FYM), T<sub>3</sub> (100% N through Vermicompost), T<sub>4</sub> (100% N through Poultry manure), T<sub>5</sub> (75 % NPK + 25% N through FYM), T<sub>6</sub> (75 % NPK + 25% N through Vermicompost), T<sub>7</sub> (75 % NPK + 25% N through Poultry manure), T<sub>8</sub> (50 % NPK + 50% N through FYM), T<sub>9</sub> (50 % NPK + 50% N through Vermicompost) and T<sub>10</sub> (50 % NPK + 50% N through Poultry manure). The significantly highest plant height (35.23 cm) at 45 days was observed in T<sub>6</sub>. The maximum number of leaves per plant (13.50) was recorded in (T<sub>6</sub>). The maximum leaf length (29.97) and the highest shoot weight (91.50) were found in treatment (T<sub>6</sub>). Highest root yield (392.83 q/ha) and highest T.S.S. (5.00) was found in treatment T<sub>6</sub> (75 % NPK + 25% N through vermicompost) which was significantly superior over all other treatments under study.

### Introduction

Radish (*Raphanus sativus* L.) is a popular root vegetable of Brassicaceae family with chromosome number 2n=18 commonly called as *Mooli*, grown all over the world. It most likely originated in the area between the Mediterranean and the Caspian Sea. Radish is grown for its young tender tuberous root which is consumed either cooked or raw. Usually, people eat radishes raw, as a crunchy vegetable, mainly in the salad, while it also

appears in many European dishes and young leaves and pods are also cooked as vegetables. Some people, at least in the Middle East prefer to drink its juice in pursuit of health benefits. In homeopathy, it is used for headache, sleeplessness and chronic diarrhoea. It is also useful in urinary complaints scale. In addition, it contains various water-soluble vitamins ie-B<sub>1</sub>, B<sub>2</sub>, B<sub>3</sub>, B<sub>5</sub>, B<sub>6</sub>, and B<sub>9</sub>. It is a good source of vitamins C (Ascorbic acid) 15-40 mg per 100g and minerals like calcium, potassium, and

phosphorus and piles. The characteristics; pungent flavour of radish is due to the presence of volatile isothiocyanates. Being a short-duration and quick-growing crop, the growth of the roots should be rapid and uninterrupted. Hence, for the production of good quality radish, optimum fertilization through organic, inorganic and biofertilizers are essential. Radishes are quick-germinating, fast-growing vegetables that can give new gardeners a sense of accomplishment without taxing their patience. Because radish is a root vegetable, fertilizer needs are for nutrients that promote strong stem and root growth without overly large leaves. Very few soils supply nutrients in the quantities needed for optimum growth of vegetables. Supplementation with organic or inorganic fertilizers allows the gardener to fine tune the amounts to the needs of each type of plant. Leafy vegetables, for instance, need more nitrogen than those grown for their fruits or roots. Both organic and inorganic fertilization have been recommended for radish crop. Fertilizers use has caused leaching and run-off of nutrients, especially nitrogen (N) and phosphorus (P), leading to environmental degradation. Therefore, there must be a balance between optimal nutrient use efficiency and optimal crop productivity. Amongst the several indicators of soil degradation, over mining of nutrients is considered to be the major concern particularly under vegetable based cropping systems, which have high irrigation requirement. This is happening so because nutrient removal by crops from soil has far exceeded their replenishment through fertilizers and manures causing the negative balance of nutrients in the soil.

The potential way to decrease negative environmental impacts resulting from the inefficient use of chemical fertilizers is to follow the integrated use of organic manures, mineral fertilizers and inoculation with

biofertilizers plant growth promoting rhizobacteria (PGPR). This will in turn help to meet out the nutrient requirement of the crops as well as maintaining sustainability in terms of productivity and soil fertility.

## **Materials and Methods**

The current investigation pertaining to the studies on the “Effect of Integrated fertilization on qualitative and quantitative traits of Radish (*Raphanus sativus* L.) was conducting during 2018-2019 at main experimental station, Department of Horticulture, BFIT Group of Institutions, Suddhowala Dehradun, Uttarakhand. The experiment will be conducted in Randomized Block Design (RBD) with three replications and 10 treatment i.e., T<sub>1</sub> Control-Recommended dose of fertilizer(100 Kg N, 80 Kg P<sub>2</sub>O<sub>5</sub> and 50 Kg K<sub>2</sub>O /ha), T<sub>2</sub> (100% N through FYM), T<sub>3</sub> (100% N through Vermicompost), T<sub>4</sub> (100% N through Poultry manure), T<sub>5</sub> (75 % NPK + 25% N through FYM), T<sub>6</sub> (75 % NPK + 25% N through Vermicompost), T<sub>7</sub> ( 75 % NPK + 25% N through Poultry manure), T<sub>8</sub> (50 % NPK + 50% N through FYM), T<sub>9</sub> (50 % NPK + 50% N through Vermicompost), T<sub>10</sub> (50 % NPK + 50% N through Poultry manure).The variance of the measure of the variability and is defined as the average of the square deviation from the mean. The analysis of variance was carried out as per methods suggested by Panse and Sukhatme (1989).

## **Results and Discussion**

A variety of treatments showed considerable changes in growth parameters viz., plant height, number of leaves per plant, length of leaves, fresh weight of shoots and dry weight of shoots. The height of the plant and the number of leaves per plant are recorded at different intervals.

### Growth parameters

Maximum plant height of 14.43, 32.37 and 35.37 cm was recorded highest in treatment T<sub>6</sub> (75 % NPK + 25% N through vermicompost) at 30, 45 DAS and at harvesting stage (Table 1). Number of leaves per plant was affected significantly with different treatments at all stages of growth under study. Treatment T<sub>6</sub> (75 % NPK + 25% N through vermicompost) recorded significantly higher number of leaves per plant i.e. 6.53, 11.03 and 13.50 at 30 and 45 DAS and at harvesting stage, respectively as compared to other treatments It was followed by T<sub>7</sub> (5.87, 10.07 and 12.47) (Table 2). Maximum length of leaves recorded at 30, 45 DAS and at harvesting stage was 11.33, 27.03

and 29.97 cm, respectively under the treatment T<sub>6</sub> (75 % NPK + 25% N through vermicompost) which was superior than other treatments (Table 3). Maximum fresh weight of shoot i.e. 12.73, 83.67 and 91.50 g was recorded at 30, 45 DAS and at harvesting stage, respectively under the treatment T<sub>6</sub> (75 % NPK + 25% N through vermicompost) (Table 4). Treatments had exerted significant influence on dry weight of shoot in radish at all the stages under study. Treatment T<sub>6</sub> (75 % NPK + 25% N through vermicompost) recorded maximum dry weight i.e. 1.24, 8.21 and 9.20 g at 30, 45 DAS and at harvesting stage, respect (Table 5). Related results have been described by Kumar *et al.*, (2014), Bhattarai and Maharjan (2013), Uddain *et al.*, (2010).

**Table.1** Effect of organic manures, inorganic fertilizers and their combinations on Plant height of radish

Symbol	Treatments	Plant height (cm) 30 DAS	Plant height (cm) 45 DAS	Plant height (cm) At harvesting (DAS)
T <sub>1</sub>	Control-Recommended dose of fertilizer (100 Kg N, 80 Kg P <sub>2</sub> O <sub>5</sub> and 50 Kg K <sub>2</sub> O /ha)	10.47	25.73	27.73
T <sub>2</sub>	100% N through FYM	9.13	22.83	25.90
T <sub>3</sub>	100% N through Vermicompost	10.20	24.97	26.93
T <sub>4</sub>	100% N through Poultry manure	9.80	23.77	26.07
T <sub>5</sub>	75 % NPK + 25% N through FYM	11.90	27.30	29.67
T <sub>6</sub>	75 % NPK + 25% N through Vermicompost	14.43	32.37	35.23
T <sub>7</sub>	75 % NPK + 25% N through Poultry manure	13.07	29.53	32.53
T <sub>8</sub>	50 % NPK + 50% N through FYM	10.63	25.83	27.90
T <sub>9</sub>	50 % NPK + 50% N through Vermicompost	11.63	26.97	29.10
T <sub>10</sub>	50 % NPK + 50% N through Poultry manure	10.97	26.70	28.20
<b>SEm±</b>		<b>0.45</b>	<b>0.94</b>	<b>0.89</b>
<b>CD at 5%</b>		<b>1.34</b>	<b>2.81</b>	<b>2.65</b>

**Table.2** Effect of organic manure, inorganic fertilizers and there combination on number of leaves per plant

Symbol	Treatments	Number of leaves per plant 30 DAS	Number of leaves per plant 45 DAS	Number of leaves per plant At harvesting (DAS)
T <sub>1</sub>	Control-Recommended dose of fertilizer (100 Kg N, 80 Kg P <sub>2</sub> O <sub>5</sub> and 50 Kg K <sub>2</sub> O /ha)	4.87	8.63	11.13
T <sub>2</sub>	100% N through FYM	4.60	7.87	10.83
T <sub>3</sub>	100% N through Vermicompost	4.77	8.23	10.93
T <sub>4</sub>	100% N through Poultry manure	4.63	8.10	10.97
T <sub>5</sub>	75 % NPK + 25% N through FYM	5.27	9.03	11.43
T <sub>6</sub>	75 % NPK + 25% N through Vermicompost	6.53	11.03	13.50
T <sub>7</sub>	75 % NPK + 25% N through Poultry manure	5.87	10.07	12.47
T <sub>8</sub>	50 % NPK + 50% N through FYM	4.97	8.70	11.23
T <sub>9</sub>	50 % NPK + 50% N through Vermicompost	5.20	8.80	11.37
T <sub>10</sub>	50 % NPK + 50% N through Poultry manure	5.10	8.77	11.30
<b>SEm±</b>		<b>0.18</b>	<b>0.32</b>	<b>0.34</b>
<b>CD at 5%</b>		<b>0.54</b>	<b>0.96</b>	<b>1.02</b>

**Table.3** Effect of organic manures, inorganic fertilizers and their combinations on length of leaves (cm) of radish

Symbol	Treatments	Length of leaves (cm) 30 DAS	Length of leaves (cm) 45 DAS	Length of leaves (cm) At harvesting (DAS)
T <sub>1</sub>	Control-Recommended dose of fertilizer (100 Kg N, 80 Kg P <sub>2</sub> O <sub>5</sub> and 50 Kg K <sub>2</sub> O /ha)	8.63	20.77	24.27
T <sub>2</sub>	100% N through FYM	6.83	18.43	21.83
T <sub>3</sub>	100% N through Vermicompost	7.80	20.03	23.19
T <sub>4</sub>	100% N through Poultry manure	7.67	19.69	23.01
T <sub>5</sub>	75 % NPK + 25% N through FYM	9.10	22.25	25.21
T <sub>6</sub>	75 % NPK + 25% N through Vermicompost	11.33	27.03	29.97
T <sub>7</sub>	75 % NPK + 25% N through Poultry manure	10.17	24.33	27.49
T <sub>8</sub>	50 % NPK + 50% N through FYM	8.70	21.70	24.45
T <sub>9</sub>	50 % NPK + 50% N through Vermicompost	9.07	22.01	25.20
T <sub>10</sub>	50 % NPK + 50% N through Poultry manure	8.80	21.95	24.56
<b>SEm±</b>		<b>0.37</b>	<b>0.90</b>	<b>0.77</b>
<b>CD at 5%</b>		<b>1.12</b>	<b>2.69</b>	<b>2.30</b>

**Table.4** Effect of organic manures, inorganic fertilizers and their combinations on fresh weight of shoot (g) of radish

Symbol	Treatments	Fresh weight of shoot (g) 30 DAS	Fresh weight of shoot (g) 45 DAS	Fresh weight of shoot (g) At harvesting (DAS)
T <sub>1</sub>	Control-Recommended dose of fertilizer (100 Kg N, 80 Kg P <sub>2</sub> O <sub>5</sub> and 50 Kg K <sub>2</sub> O /ha)	9.03	63.50	77.03
T <sub>2</sub>	100% N through FYM	8.03	59.67	74.07
T <sub>3</sub>	100% N through Vermicompost	8.63	61.07	76.67
T <sub>4</sub>	100% N through Poultry manure	8.57	60.33	75.90
T <sub>5</sub>	75 % NPK + 25% N through FYM	10.43	71.33	80.33
T <sub>6</sub>	75 % NPK + 25% N through Vermicompost	12.73	83.67	91.50
T <sub>7</sub>	75 % NPK + 25% N through Poultry manure	11.50	77.37	85.87
T <sub>8</sub>	50 % NPK + 50% N through FYM	9.40	65.17	77.18
T <sub>9</sub>	50 % NPK + 50% N through Vermicompost	10.37	70.83	80.30
T <sub>10</sub>	50 % NPK + 50% N through Poultry manure	9.67	70.00	79.33
<b>SEm±</b>		<b>0.41</b>	<b>2.12</b>	<b>1.85</b>
<b>CD at 5%</b>		<b>1.22</b>	<b>6.31</b>	<b>5.50</b>

**Table5** Effect of organic manures, inorganic fertilizers and their combinations on dry weight of shoot (g) of radish

Symbol	Treatments	Dry weight of shoot (g) 30 DAS	Dry weight of shoot (g) 45 DAS	Dry weight of shoot (g) At harvesting (DAS)
T <sub>1</sub>	Control-Recommended dose of fertilizer (100 Kg N, 80 Kg P <sub>2</sub> O <sub>5</sub> and 50 Kg K <sub>2</sub> O /ha)	0.90	6.28	7.64
T <sub>2</sub>	100% N through FYM	0.80	5.57	7.27
T <sub>3</sub>	100% N through Vermicompost	0.85	5.91	7.43
T <sub>4</sub>	100% N through Poultry manure	0.86	5.87	7.41
T <sub>5</sub>	75 % NPK + 25% N through FYM	1.00	6.80	7.87
T <sub>6</sub>	75 % NPK + 25% N through Vermicompost	1.24	8.21	9.20
T <sub>7</sub>	75 % NPK + 25% N through Poultry manure	1.11	7.50	8.47
T <sub>8</sub>	50 % NPK + 50% N through FYM	0.92	6.51	7.67
T <sub>9</sub>	50 % NPK + 50% N through Vermicompost	1.00	6.61	7.77
T <sub>10</sub>	50 % NPK + 50% N through Poultry manure	0.93	6.73	7.73
<b>SEm±</b>		<b>0.04</b>	<b>0.24</b>	<b>0.24</b>
<b>CD at 5%</b>		<b>0.12</b>	<b>0.71</b>	<b>0.72</b>

**Table.6** Effect of organic manures, inorganic fertilizers and their combinations on length of root (cm) and diameter of root (cm) of radish

Symbol	Treatments	Length of root (cm)	Diameter of root (cm)
T <sub>1</sub>	Control-Recommended dose of fertilizer (100 Kg N, 80 Kg P <sub>2</sub> O <sub>5</sub> and 50 Kg K <sub>2</sub> O /ha)	17.07	2.88
T <sub>2</sub>	100% N through FYM	15.80	2.74
T <sub>3</sub>	100% N through Vermicompost	16.97	2.81
T <sub>4</sub>	100% N through Poultry manure	16.89	2.80
T <sub>5</sub>	75 % NPK + 25% N through FYM	17.83	3.11
T <sub>6</sub>	75 % NPK + 25% N through Vermicompost	19.97	3.84
T <sub>7</sub>	75 % NPK + 25% N through Poultry manure	18.30	3.48
T <sub>8</sub>	50 % NPK + 50% N through FYM	17.30	2.96
T <sub>9</sub>	50 % NPK + 50% N through Vermicompost	17.83	3.03
T <sub>10</sub>	50 % NPK + 50% N through Poultry manure	17.67	2.99
<b>SEm±</b>		<b>0.55</b>	<b>0.12</b>
<b>CD at 5%</b>		<b>1.65</b>	<b>0.36</b>

**Table.7** Effect of organic manures, inorganic fertilizers and their combinations on weight of root (g) and root yield (q/ha) of radish

Symbol	Treatments	Average weight of root (g)	Root yield (q/ha)
T <sub>1</sub>	Control-Recommended dose of fertilizer (100 Kg N, 80 Kg P <sub>2</sub> O <sub>5</sub> and 50 Kg K <sub>2</sub> O /ha)	91.20	303.97
T <sub>2</sub>	100% N through FYM	81.48	271.57
T <sub>3</sub>	100% N through Vermicompost	90.03	300.08
T <sub>4</sub>	100% N through Poultry manure	83.10	276.97
T <sub>5</sub>	75 % NPK + 25% N through FYM	101.07	336.88
T <sub>6</sub>	75 % NPK + 25% N through Vermicompost	117.86	392.83
T <sub>7</sub>	75 % NPK + 25% N through Poultry manure	101.21	337.34
T <sub>8</sub>	50 % NPK + 50% N through FYM	93.53	311.75
T <sub>9</sub>	50 % NPK + 50% N through Vermicompost	98.80	329.30
T <sub>10</sub>	50 % NPK + 50% N through Poultry manure	93.58	311.89
<b>SEm±</b>		<b>3.33</b>	<b>11.11</b>
<b>CD at 5%</b>		<b>9.90</b>	<b>33.01</b>



**Table.8** Effect of organic manures, inorganic fertilizers and their combinations on day to harvest and harvest index

Symbol	Treatments	Day to harvest	Harvest index (%)
T <sub>1</sub>	Control-Recommended dose of fertilizer (100 Kg N, 80 Kg P <sub>2</sub> O <sub>5</sub> and 50 Kg K <sub>2</sub> O /ha)	59.00	55.45
T <sub>2</sub>	100% N through FYM	60.33	52.28
T <sub>3</sub>	100% N through Vermicompost	59.17	53.99
T <sub>4</sub>	100% N through Poultry manure	59.67	52.38
T <sub>5</sub>	75 % NPK + 25% N through FYM	57.10	54.56
T <sub>6</sub>	75 % NPK + 25% N through Vermicompost	51.57	56.80
T <sub>7</sub>	75 % NPK + 25% N through Poultry manure	54.67	54.53
T <sub>8</sub>	50 % NPK + 50% N through FYM	58.33	54.15
T <sub>9</sub>	50 % NPK + 50% N through Vermicompost	57.87	54.53
T <sub>10</sub>	50 % NPK + 50% N through Poultry manure	58.00	54.18
SEm±		<b>1.04</b>	<b>0.76</b>
CD at 5%		<b>3.09</b>	<b>2.25</b>

**Table.9** Effect of organic manures, inorganic fertilizers and their combinations on fiber content, TSS and ascorbic acid

Symbol	Treatments	Fiber Content (mg/100g)	TSS ( <sup>o</sup> Brix)	Ascorbic acid (mg/100g)
T <sub>1</sub>	Control-Recommended dose of fertilizer (100 Kg N, 80 Kg P <sub>2</sub> O <sub>5</sub> and 50 Kg K <sub>2</sub> O /ha)	549.67	4.13	32.33
T <sub>2</sub>	100% N through FYM	505.33	3.81	27.00
T <sub>3</sub>	100% N through Vermicompost	544.00	4.05	31.33
T <sub>4</sub>	100% N through Poultry manure	516.00	4.03	30.67
T <sub>5</sub>	75 % NPK + 25% N through FYM	640.00	4.47	33.67
T <sub>6</sub>	75 % NPK + 25% N through Vermicompost	763.67	5.00	37.17
T <sub>7</sub>	75 % NPK + 25% N through Poultry manure	675.33	4.55	34.33
T <sub>8</sub>	50 % NPK + 50% N through FYM	584.67	4.15	32.33
T <sub>9</sub>	50 % NPK + 50% N through Vermicompost	608.67	4.37	33.00
T <sub>10</sub>	50 % NPK + 50% N through Poultry manure	596.00	4.25	32.67
SEm±		<b>27.18</b>	<b>0.128</b>	<b>0.96</b>
CD at 5%		<b>80.75</b>	<b>0.380</b>	<b>2.87</b>

## Yield parameters

Maximum root length (19.97 cm) was observed in treatment T<sub>6</sub> (75 % NPK + 25 % N through vermicompost), which was followed by T<sub>7</sub> (50 % NPK + 50% N through poultry manure) with significant difference. Minimum root length 15.80 cm was observed in treatment T<sub>2</sub> (100 % N through FYM) (Table 6). Maximum diameter of root (3.84 cm) was recorded in treatment T<sub>6</sub> (75 %NPK + 25 % N through vermicompost), which was followed by T<sub>7</sub> (50% NPK + 50 % N through poultry manure) with significant difference (Table 6), where as minimum diameter of root (2.74 cm) was recorded under the treatment T<sub>2</sub> (100% N through FYM.) (Table 6).

Application of treatment T<sub>6</sub> (75 % NPK + 25% N through vermicompost) recorded highest harvest index (56.80) which was significantly superior over other treatments. While minimum harvest index (52.28) was observed under the treatment T<sub>2</sub> (100% N through FYM) (Table 8).

Maximum average weight of root (117.86 g) was noted under the treatment T<sub>6</sub> (75 % NPK + 25% N through vermicompost), while minimum average weight of root (81.48 g) was observed under the treatment T<sub>2</sub> (100% N through FYM) (Table 7). Highest root yield (392.83 q/ha) was recorded under the treatment T<sub>6</sub> (75 % NPK + 25% N through vermicompost), where as lowest root yield of (271.57 q/ha) was observed under the treatment T<sub>2</sub> (100% N through FYM) (Table 7). Treatment T<sub>2</sub> (100% N through FYM) had taken maximum days (60.33) to attain marketable root size. Minimum days (51.57) to attain marketable size of root was observed in treatment T<sub>6</sub> (75 % NPK + 25% N through Vermicompost). Related results have been described by Sunandarani and Malareddy (2007), Kumar *et al.*, (2014), Degwale (2016), Narayan *et al.*, (2014).

## Quality parameter

Highest fiber content (763.67 mg/100g edible portion) was observed in treatment T<sub>6</sub> (75% NPK + 25% N through vermicompost), which was followed by T<sub>7</sub> (50% NPK + 50% N through poultry manure). Minimum fiber content (505.33 mg/100g edible portion) was recorded in treatment T<sub>2</sub> (100% + N through FYM) (Table 9). Highest total soluble solid content (5<sup>0</sup>Brix) in root was determined in case of T<sub>6</sub> (75 % NPK + 25 % N through vermicompost), which was followed by T<sub>7</sub> (50 % NPK + 50 % N through poultry manure).

Minimum total soluble solid content (3.81<sup>0</sup>Brix) was found in treatment T<sub>2</sub> (100% N through FYM) (Table 9). Highest Ascorbic acid (37.17 mg/100g) was determined in treatment T<sub>6</sub> (75 % NPK + 25% N through vermicompost) which was significantly superior over other treatments. Lowest Ascorbic acid content (27.00mg/100g) treatment T<sub>2</sub> (100% N through FYM) (Table 9). Related results have been described by Sunandarani and Mallareddy (2007), Kumar *et al.*, (2014) and Degwale (2016).

In conclusion based on the present examination, it was summarised that Radish (*Raphanus sativus* L.) responded well in terms of growth, yield, and quality, by the application of combination of organic manures and inorganic fertilizers. The significantly highest plant height (35.23 cm) was recorded in treatment (T<sub>6</sub>). The maximum number of leaves per plant (13.50) was recorded in (T<sub>6</sub>). The maximum leaf length (29.97) and the highest fresh weight of shoot weight (91.50) were found in treatment (T<sub>6</sub>). Highest root yield (392.83 q/ha) and highest T.S.S. (5.00) was found in treatment T<sub>6</sub> (75 % NPK + 25% N through vermicompost) which was significantly superior over all other treatments under study.



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