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## Effect of different levels of nitrogen and manganese on growth performance and yield of Radish (*Raphanus sativus* L.) cv. Pusa Reshmi

**Saurabh Singh, Nirbhaya Asthana, Maneesh Pandey, Rohit K Singh, Manish Kumar Singh and Diwakar Singh**

### Abstract

An investigation was under taken at Research Field, Department of Horticulture, Udai Pratap Collage, Affiliated to Mahatma Gandhi Kashi Vidyapith, Varanasi) India. During Rabi season of 2015-16. The experiment was laid out in randomized block design with 16 treatments, each replicated thrice. The treatments consisted of different combinations levels of nitrogen and manganeseom. Among 16 treatments under study, it is concluded that treatment combination of Effects of micro-nutrients on height of the plant are not very evident. However, the number of leaves per plant. The highest values were noted as 8.42, 11.45 and 14.72 observed under  $N_3M_3$  level at 15, 30 and 45 days of plant life. The length of main root per plant The highest values were noted as 12.68, 20.68 and 32.52 observed under  $N_3M_3$  level at 15, 30 and 45 days of plant life The fresh weight of root per plant The highest values were noted as 1.75, 66.88 and 300.99 observed under  $N_3M_3$  level at 15, 30 and 45 days of plant life The girth/thickness of main root per plant The highest values were noted as 0.76, 3.77 and 5.63 observed under  $N_3M_3$  level at 15, 30 and 45 days of plant life The fresh weight of leaves per plant The highest values were noted as 7.74, 73.63 and 181.24 observed under  $N_3M_3$  level at 15, 30 and 45 days of plant life The number of root fibers per plant The highest values were noted as 12.40, 13.47 and 15.23 observed under  $N_3M_3$  level at 15, 30 and 45 days of plant life The dry matter percent of leaves per plant The highest values were noted as 8.79 observed under  $N_3M_3$  level at 45 days of plant life. Yield of root (q) per hectares the yield of root (q) per hectares was highest yield (220.18) of root was recorded with treatment  $N_3M_3$  where as the lowest yield of root (q) per hectares (167.37) was found with treatment  $N_0M_0$ .

**Keywords:** Radish (*Raphanus sativus* L.), nitrogen and manganese

### Introduction

Radish (*Raphanus sativus* L.) is a favourite vegetable crop of kitchen garden. This vegetable plant belong from the family cruciferae with chromosome number  $2n=18$ . Radish is endemic species of entire Europe and Asia. Radish are grown and consumed throughout the world being mostly eaten raw as a crunchy salad vegetable. They have numerous varieties, varying in size, fiovor colour and length of time they take to mature.

India is now, the second largest producer of vegetable in the world next to China. The total production of 173.321 Million tonnes of vegetable fram stood at 9.754 Million hectare area and grown in 2.9% of total cultivated land and share 15% of world production with a productivity of 17.32 tonne per hectare (National Horticulture Data Based During 2014-15)

Radish are annual or biennial brassicaceous crops grown for their swollen tap roots which can be globular, tapering or cylindrial. The root skin colour range from through pink, red, purple, yellow and green to black, but the flesh is usually white smaller types have a few leaves about 13cm. (5in) long with round root upto 2.5cm (1in) in diameter or mores lender, long root up to 7cm (3in) long. Both of these are normally eaten raw in salads. The major component in the edible portion of radish of per 100gram is water that amounts 94.5 futher it contains protein (g)-0.68, fat(g)-0.1, carbohydrates (g)-3.4, dietary fiber (g)-1.6, ash(g)-0.80 and sugars(g)-1.56. Respectively the Vitamins and minearals (100gram) that consists in radish are fallows Vitamin A (IU)-10, ThiamineB1 (mg)-0.012, Riboflavin B2 (mg)-0.036, NiacianB3 (mg) - 0.25, Pantothenic acid B5 (mg) -0.16, Vitamin B6 (mg) -0.071, Ascorbic acid (mg)-14.7, Calcium (mg)-25, Iron (mg)-0.34, Manganese (mg)-0.069, Phosphorous (mg)-20, Potassium (mg)-233, Sodium (mg)-18, Zinc (mg)-0.28 and other constituents Fluorid (ug)-0.6 (Source, Department of food and nutrition American medical association, future publishing co. 1974).

Nitrogen and manganese play an important role in plant life. Nitrogen enters into the formation of many compounds made by plant it is part of the molecule of all protein and enzymes of chlorophyll a and chlorophyll b of certain acids of the nucleus and certain hormones for these reasons Nitrogen is an essential element, plant absorbs the nitrogen in the form of nitrate. As far as nitrogen is concerned it is an essential constituent of plant proteins, generally, absent to the extent of 15 to 17 percent. Deficiency of N becomes evident in different ways, absence of sufficient N results in retarded growth of root and foliage. In extreme deficiency of this element the leaves become small and yellow and roots become pungent and small, on the other hand excess supply increases the growth of foliage in comparison to growth of root. Much higher quantity of N produces toxic effect on the plant. Marginal burning of leaves and reduced quality of root are common toxic results of N.

Mn deficiency causes chocolate brown lesions in barley white necrotic streaks in wheat on rye and "gray speck" in oats. The effect of Mn excess plants may be revealed in two apparently quite distinct ways. These are described here as Mn induced iron deficiency and direct Manganese toxicity. Direct Mn toxicity has been shown in sand culture experiment to be a major factor responsible for the injurious effects of many acid soils.

### Materials and Methods

An experiment was conducted at Horticultural Experimental field, Department of Horticulture, Udai Pratap College (Autonomous), affiliated to Mahatma Gandhi Kashi Vidyapeeth, Varanasi India. During Rabi season of 2015-16. The experiment was laid out in randomized block design with 16 treatments and each replicated thrice. The following treatments were the part of experiment (where RDF: nutrients,

M <sub>0</sub> N <sub>0</sub>	T <sub>1</sub>
M <sub>0</sub> N <sub>1</sub>	T <sub>2</sub>
M <sub>0</sub> N <sub>2</sub>	T <sub>3</sub>
M <sub>0</sub> N <sub>3</sub>	T <sub>4</sub>
M <sub>1</sub> N <sub>0</sub>	T <sub>5</sub>
M <sub>1</sub> N <sub>1</sub>	T <sub>6</sub>
M <sub>1</sub> N <sub>2</sub>	T <sub>7</sub>
M <sub>1</sub> N <sub>3</sub>	T <sub>8</sub>
M <sub>2</sub> N <sub>0</sub>	T <sub>9</sub>
M <sub>2</sub> N <sub>1</sub>	T <sub>10</sub>
M <sub>2</sub> N <sub>2</sub>	T <sub>11</sub>
M <sub>2</sub> N <sub>3</sub>	T <sub>12</sub>
M <sub>3</sub> N <sub>0</sub>	T <sub>13</sub>
M <sub>3</sub> N <sub>1</sub>	T <sub>14</sub>
M <sub>3</sub> N <sub>2</sub>	T <sub>15</sub>
M <sub>3</sub> N <sub>3</sub>	T <sub>16</sub>

An area of 27.35m × 7.00m size was divided into 48 plots having the size of 1.35m × 1.00m and arranged in the three replication of 16 plots. The experiment was laid out in R.B.D. under 16 treatments. Healthy and uniform seeds were sown on 02<sup>nd</sup> Sept. 2015. Light irrigation was given after transplanting. The organic manures were applied one week before transplanting, for proper decomposition, full dose of phosphorus and potassium and half dose of nitrogen as per treatment were applied just before the transplanting. All cultural practices were followed regularly during crop growth and observations were recorded on growth characters i.e., No. of leaves, length of main root, fresh weight of roots, Girth/Thickness of main root, Fresh weight of leaves, Number of root fibers and yield per hectare, Dry matter percent of

leaves. Dry matter percent of roots were recorded from time to time. The data on these parameters were subjected to statistical analysis to draw logical conclusions.

### Results and Discussion

#### Growth parameters

Among morphological characters, the number of leaves per plant was greatly influenced by various treatments and combinations at various stages of development. The highest values were noted as 8.42, 11.45 and 14.72 observed under N<sub>3</sub>M<sub>3</sub> level at 15, 30 and 45 days of plant life respectively. The minimum values were noted as 4.35, 8.15 and 11.12 observed under N<sub>0</sub>M<sub>0</sub> level at 15, 30 and 45 days after sowing respectively.

The length of main root per plant was greatly influenced by various treatments and their combinations at various stages of development. The interaction of nitrogen and manganese were found significant at 15, 30 and 45 days after sowing. The highest values were noted as 12.68, 20.68 and 32.52 observed under N<sub>3</sub>M<sub>3</sub> level at 15, 30 and 45 days of plant life respectively. The minimum values were noted as 7.65, 12.92 and 20.89 observed under N<sub>0</sub>M<sub>0</sub> level at 15, 30 and 45 days after sowing respectively.

The fresh weight of root per plant was greatly influenced by various treatments and their combinations at various stages of development. The interaction of nitrogen and manganese were found significant at 15, 30 and 45 days after sowing. The highest values were noted as 1.75, 66.88 and 300.99 observed under N<sub>3</sub>M<sub>3</sub> level at 15, 30 and 45 days of plant life respectively. The minimum values were noted as 0.54, 27.18 and 125.59 observed under N<sub>0</sub>M<sub>0</sub> level at 15, 30 and 45 days after sowing respectively.

The girth/thickness of main root per plant was greatly influenced by various treatments and their combinations at various stages of development. The interaction of nitrogen and manganese were found significant at 15, 30 and 45 days after sowing. The highest values were noted as 0.76, 3.77 and 5.63 observed under N<sub>3</sub>M<sub>3</sub> level at 15, 30 and 45 days of plant life respectively. The minimum values were noted as 0.11, 0.98 and 4.13 observed under N<sub>0</sub>M<sub>0</sub> level at 15, 30 and 45 days after sowing respectively.

The fresh weight of leaves per plant was greatly influenced by various treatments and their combinations at various stages of development. The interaction of nitrogen and manganese were found significant at 15, 30 and 45 days after sowing. The highest values were noted as 7.74, 73.63 and 181.24 observed under N<sub>3</sub>M<sub>3</sub> level at 15, 30 and 45 days of plant life respectively. The minimum values were noted as 3.27, 35.75 and 152.11 observed under N<sub>0</sub>M<sub>0</sub> level at 15, 30 and 45 days after sowing respectively.

The number of root fibers per plant was greatly influenced by various treatments and their combinations at various stages of development. The interaction of nitrogen and manganese were found significant at 15, 30 and 45 days after sowing. The highest values were noted as 12.40, 13.47 and 15.23 observed under N<sub>3</sub>M<sub>3</sub> level at 15, 30 and 45 days of plant life respectively. The minimum values were noted as 7.96, 9.34 and 12.38 observed under N<sub>0</sub>M<sub>0</sub> level at 15, 30 and 45 days after sowing respectively.

The dry matter percent of leaves per plant was greatly influenced by various treatments and their combinations at various stages of development. The interaction of nitrogen and manganese were found significant at 45 days after sowing. The highest values were noted as 8.79 observed under N<sub>3</sub>M<sub>3</sub>

level at 45 days of plant life respectively. The minimum values were noted as 5.99 observed under  $N_0M_0$  level at 45 days after sowing respectively

The matter percent of root per plant was greatly influenced by various treatment their combination at various stages of development. The interaction of nitrogen and manganese were found significant at 45 days after sowing. The highest values were noted as 9.13 observed under  $N_3M_3$  level at 45 days of plant life respectively. The minimum values were noted as 5.98 observed under  $N_0M_0$  level at 45 days after sowing respectively

Yield of root (q) per hectares were greatly influenced by various treatment and their combination at various stages of development shows that the yield of root (q) per hectares at 45 days after sowing increase in the application of nitrogen and manganese gave better result of compared to control. Critical analysis of data revealed that various treatment combination significantly increase the yield of root (q) per hectares was highest yield (220.18) of root was recorded with treatment  $N_3M_3$  where as the lowest yield of root (q) per hectares (167.37) was found with treatment  $N_0M_0$

**Table 1:** Effect of different levels of nitrogen and manganese on the number of leaves per plant at radish

Treatment	15DAS	30DAS	45DAS	Mean
$N_0M_0$	4.35	8.15	11.12	7.87
$N_0M_1$	5.22	8.42	12.02	8.55
$N_0M_2$	6.25	8.62	12.15	9.01
$N_0M_3$	6.38	8.98	12.52	9.29
$N_1M_0$	6.75	9.25	13.12	9.71
$N_1M_1$	6.08	9.05	11.97	9.03
$N_1M_2$	7.22	9.38	12.28	9.63
$N_1M_3$	6.98	9.78	12.95	9.90
$N_2M_0$	7.45	9.02	13.05	9.84
$N_2M_1$	6.98	9.28	12.38	9.55
$N_2M_2$	7.25	10.05	12.98	10.09
$N_2M_3$	7.45	10.38	13.02	10.28
$N_3M_0$	8.05	9.38	13.95	10.46
$N_3M_1$	7.62	10.12	13.42	10.38
$N_3M_2$	7.95	10.38	14.18	10.84
$N_3M_3$	8.42	11.45	14.72	11.53
Mean	6.90	9.48	12.86	
S.Em $\pm$	0.60	0.35	0.56	
CD% ( $P < 0.05$ )	1.74	1.00	1.61	

**Table 2:** Effect of different levels of nitrogen and manganese on the length of main root (cm) per plant at radish

Treatment	15DAS	30DAS	45DAS	Mean
$N_0M_0$	7.65	12.92	20.89	13.82
$N_0M_1$	8.33	14.01	22.06	14.80
$N_0M_2$	8.95	16.63	23.33	16.31
$N_0M_3$	9.27	17.14	24.01	16.81
$N_1M_0$	9.08	15.10	22.38	15.52
$N_1M_1$	9.91	16.27	23.56	16.58
$N_1M_2$	10.58	17.22	24.21	17.34
$N_1M_3$	10.31	17.70	24.92	17.64
$N_2M_0$	9.22	16.36	26.25	17.27
$N_2M_1$	10.61	17.02	27.53	18.38
$N_2M_2$	10.97	17.98	28.17	19.04
$N_2M_3$	11.13	19.00	29.28	19.81
$N_3M_0$	10.47	18.12	30.12	19.57
$N_3M_1$	11.51	19.20	30.33	20.35
$N_3M_2$	11.96	19.14	31.43	20.84
$N_3M_3$	12.68	20.68	32.52	21.96
Mean	10.16	17.16	26.31	
S.Em $\pm$	0.75	0.72	0.61	
CD% ( $P < 0.05$ )	2.16	2.08	1.76	

**Table 3:** Effect of different levels of nitrogen and manganese on the fresh weight of root (g) per plant at radish

Treatment	15DAS	30DAS	45DAS	Mean
$N_0M_0$	0.54	27.18	125.59	51.11
$N_0M_1$	0.70	27.25	136.50	54.82
$N_0M_2$	0.98	34.73	135.02	56.91
$N_0M_3$	0.94	41.86	135.56	59.45
$N_1M_0$	0.94	40.68	138.28	59.96
$N_1M_1$	1.01	44.18	143.07	62.75
$N_1M_2$	0.99	44.08	158.55	67.87
$N_1M_3$	0.98	43.97	198.26	81.07

N <sub>2</sub> M <sub>0</sub>	1.03	44.82	207.28	84.37
N <sub>2</sub> M <sub>1</sub>	1.05	48.11	208.31	85.82
N <sub>2</sub> M <sub>2</sub>	1.07	53.60	214.15	89.61
N <sub>2</sub> M <sub>3</sub>	1.11	51.92	250.71	101.24
N <sub>3</sub> M <sub>0</sub>	1.11	57.28	267.97	108.78
N <sub>3</sub> M <sub>1</sub>	1.16	53.75	269.08	107.99
N <sub>3</sub> M <sub>2</sub>	1.26	61.56	300.27	121.03
N <sub>3</sub> M <sub>3</sub>	1.75	66.88	300.99	123.21
Mean	1.04	46.37	199.35	
S.Em±	0.14	1.07	0.81	
CD% ( <i>P</i> < 0.05)	0.40	3.08	2.33	

**Table 4:** Effect of different levels of nitrogen and manganese on the girth\thickness of main root per plant at radish

Treatment	15DAS	30DAS	45DAS	Mean
N <sub>0</sub> M <sub>0</sub>	0.11	0.98	4.13	1.74
N <sub>0</sub> M <sub>1</sub>	0.18	2.17	4.29	2.21
N <sub>0</sub> M <sub>2</sub>	0.17	2.92	4.28	2.45
N <sub>0</sub> M <sub>3</sub>	0.26	3.19	4.31	2.58
N <sub>1</sub> M <sub>0</sub>	0.26	2.21	4.40	2.29
N <sub>1</sub> M <sub>1</sub>	0.25	2.57	4.44	2.42
N <sub>1</sub> M <sub>2</sub>	0.25	2.92	4.41	2.53
N <sub>1</sub> M <sub>3</sub>	0.28	2.94	4.10	2.44
N <sub>2</sub> M <sub>0</sub>	0.35	3.13	4.36	2.61
N <sub>2</sub> M <sub>1</sub>	0.34	3.18	4.19	2.57
N <sub>2</sub> M <sub>2</sub>	0.42	3.23	4.51	2.72
N <sub>2</sub> M <sub>3</sub>	0.41	3.32	4.14	2.62
N <sub>3</sub> M <sub>0</sub>	0.37	2.32	4.65	2.45
N <sub>3</sub> M <sub>1</sub>	0.39	3.32	4.89	2.86
N <sub>3</sub> M <sub>2</sub>	0.68	3.10	5.06	2.94
N <sub>3</sub> M <sub>3</sub>	0.76	3.77	5.63	3.38
Mean	0.34	2.83	4.49	
S.Em±	0.12	0.40	0.50	
CD% ( <i>P</i> < 0.05)	0.30	1.15	1.43	

**Table 5:** Effect of different level of nitrogen and manganese on the fresh weight of leaves (g) per plant at radish

Treatment	15DAS	30DAS	45DAS	Mean
N <sub>0</sub> M <sub>0</sub>	3.27	35.75	152.11	63.71
N <sub>0</sub> M <sub>1</sub>	4.09	54.20	154.67	70.98
N <sub>0</sub> M <sub>2</sub>	4.62	67.97	173.33	81.97
N <sub>0</sub> M <sub>3</sub>	4.43	59.12	168.03	77.19
N <sub>1</sub> M <sub>0</sub>	4.70	56.35	169.68	76.91
N <sub>1</sub> M <sub>1</sub>	4.99	55.89	171.95	77.61
N <sub>1</sub> M <sub>2</sub>	5.19	68.90	170.85	81.64
N <sub>1</sub> M <sub>3</sub>	5.01	65.10	173.86	81.32
N <sub>2</sub> M <sub>0</sub>	5.16	60.88	173.69	79.91
N <sub>2</sub> M <sub>1</sub>	4.46	66.76	170.53	80.58
N <sub>2</sub> M <sub>2</sub>	4.96	59.49	173.84	79.43
N <sub>2</sub> M <sub>3</sub>	5.37	67.09	174.34	82.26
N <sub>3</sub> M <sub>0</sub>	4.92	63.27	177.68	81.95
N <sub>3</sub> M <sub>1</sub>	4.85	64.30	174.95	81.36
N <sub>3</sub> M <sub>2</sub>	6.82	68.72	173.49	83.01
N <sub>3</sub> M <sub>3</sub>	7.74	73.63	181.24	87.54
Mean	5.04	61.71	170.89	
S.Em±	0.46	0.66	0.83	
CD% ( <i>P</i> < 0.05)	1.33	1.91	2.38	

**Table 6:** Effect of different levels of nitrogen and manganese on the number of root fibers per plant at radish

Treatment	15DAS	30DAS	45DAS	Mean
N <sub>0</sub> M <sub>0</sub>	7.96	9.34	12.38	9.89
N <sub>0</sub> M <sub>1</sub>	8.71	9.58	13.58	10.62
N <sub>0</sub> M <sub>2</sub>	8.41	9.34	13.53	10.42
N <sub>0</sub> M <sub>3</sub>	8.35	8.68	12.52	9.85
N <sub>1</sub> M <sub>0</sub>	8.88	9.52	13.55	10.65
N <sub>1</sub> M <sub>1</sub>	9.19	10.68	14.05	11.30
N <sub>1</sub> M <sub>2</sub>	9.13	9.95	13.71	10.93
N <sub>1</sub> M <sub>3</sub>	9.32	10.45	14.41	11.39

N <sub>2</sub> M <sub>0</sub>	9.88	10.62	14.78	11.76
N <sub>2</sub> M <sub>1</sub>	9.88	11.03	14.33	11.74
N <sub>2</sub> M <sub>2</sub>	9.82	11.18	13.10	11.36
N <sub>2</sub> M <sub>3</sub>	9.90	11.35	13.26	11.51
N <sub>3</sub> M <sub>0</sub>	10.30	11.37	13.44	11.71
N <sub>3</sub> M <sub>1</sub>	10.58	11.19	13.88	11.88
N <sub>3</sub> M <sub>2</sub>	11.46	12.64	14.44	12.84
N <sub>3</sub> M <sub>3</sub>	12.40	13.47	15.23	13.70
Mean	9.64	10.65	13.76	
S.Em±	0.51	0.50	0.38	
CD%(P< 0.05)	1.47	1.45	1.10	

**Table 7:** Effect of different levels of nitrogen and manganese on the dry matter percent of leaves, dry matter percent of root, yield of root (q) at radish

Treatment	45DAS	45DAS	45DAS
N <sub>0</sub> M <sub>0</sub>	5.98	5.99	167.37
N <sub>0</sub> M <sub>1</sub>	7.34	7.13	198.04
N <sub>0</sub> M <sub>2</sub>	7.58	7.26	199.70
N <sub>0</sub> M <sub>3</sub>	7.68	7.61	201.38
N <sub>1</sub> M <sub>0</sub>	7.18	7.21	202.00
N <sub>1</sub> M <sub>1</sub>	7.51	7.43	202.49
N <sub>1</sub> M <sub>2</sub>	7.78	7.61	203.77
N <sub>1</sub> M <sub>3</sub>	7.50	7.96	204.38
N <sub>2</sub> M <sub>0</sub>	7.90	7.67	203.65
N <sub>2</sub> M <sub>1</sub>	8.34	7.92	206.02
N <sub>2</sub> M <sub>2</sub>	8.34	8.15	207.97
N <sub>2</sub> M <sub>3</sub>	8.28	8.28	208.96
N <sub>3</sub> M <sub>0</sub>	8.50	8.40	209.95
N <sub>3</sub> M <sub>1</sub>	8.44	8.19	211.19
N <sub>3</sub> M <sub>2</sub>	8.80	8.60	213.00
N <sub>3</sub> M <sub>3</sub>	9.13	8.79	220.18
Mean	7.89	7.76	203.75
S.Em±	0.42	0.41	0.94
CD%(P< 0.05)	1.22	1.16	2.71

## Conclusion

Field trial involving four level of nitrogen i.e. 0, 40, 80 and 120kg per hectare, four levels of manganese i.e. 0, 1, 2, and 3 kg per hectare and their interaction making 16 treatment combination was carried out on radish variety "Pusa Reshmi" at vegetable research form, Department of Horticulture, Udai Pratap College (An Autonomous Institution) Varanasi in the year 2015. The experiment was conducted in Randomized Block Design with three replications.

Application of nitrogen and manganese levels exhibited marked effect on various growth characters and yield of radish at different stages of growth and development. The treatment condition of these elements showed significant effects on the fresh weight of root and leaves per plant. All the growth characters such as fresh weight root, leaves, numbers of leaves, root fibers per plant, length of main root, girth of root, dry matter percentage in roots, dry matter percentage in leaves and yield of roots increased with the increase in nitrogen and manganese levels at different stages of growth and development. The highest doses of these elements gave the best results as compared to other treatment. The interaction of nitrogen and manganese showed significant response only with fresh weight of root and leaves, However, the best results in regard to various growth characters and yield was noted under the treatment combination of N<sub>3</sub>M<sub>3</sub> i.e. 120kg N/ha with 3 kg Mn/ha. The highest yield of root under N<sub>3</sub>M<sub>3</sub> was 220.18 quintal per hectare.

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