GAU Res. J. 1993, 19 (1) : 83-87

# Effect of Plant Density, Nitrogen and Phosphorus on Growth Parameters of Radish (*Raphanus sativus* L.)*

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ABSTRACT

**The wider inter and intra-row spacings significantly increased the number of leaves, root length and root diameter, while the plant height was not affected by plant density. The application of higher levels of nitrogen resulted into significantly favourable responses in plant height, number of leaves and root length, while root diameters was not affected. Contrarily the phosphorus application could not significantly affected any growth parameters. The treatment combinations, $W_1N_3P_3$, $S_3N_3P_2$, $S_3W_2N_3P_2$ and $W_2P_2$ were found significant in increasing plant height, number of leaves, root length and root diameter, respectively.**

*(Received on 12th Dec., 1992)*

## INTRODUCTION

Radish (*Raphanus sativus* Linn.) is a popular root vegetable in India and abroad because of its food and medicinal value. Moreover it is a favourite crop of the kitchen garden. Because it can be easily grown and available for use within 3 to 6 weeks of sowing.

Not much work has been done so far regarding spacings and nutrition requirements of radish crop under Indian conditions. No doubt, a good deal of research information is available from foreign countries. But the results obtained in other countries are hardly applicable under our conditions. Hence, an experiment was conducted in *rabi* season, with a view to find out optimum inter and intra-row spacings, nitrogen and phosphorus for better growth character.

## MATERIALS AND METHODS

The experiment was carried out in *rabi* season during the year 1987-88 at Instructional Farm, Department of Horticulture, Gujarat Agricultural University, Sardar Krushinagar in Banaskantha District, on 'Japanese White' variety of radish using split plot design with three randomized blocks. The main treatments comprised of 3 inter-row spacings (10, 20 and 30 cm) and 2 intra-row spacings (5 and 10 cm) while sub-treatments were 3 levels of nitrogen (30, 60 and 90 kg/ha) and also of phosphorus (0, 15 and 30 kg/ha). The half dose of nitrogen and full dose of phosphorus were applied as basal dose. The remaining half dose of nitrogen was applied during fourth week after sowing. The composite soil sample was drawn from the plot to a depth of 21 cm for chemical

*A part of the thesis submitted by the first author to Gujarat Agricultural University, Sardar Krushinagar Campus.
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determination. The soil was sandy-loam having PH 7.9. Available nitrogen, phosphorus and potash were 134.50, 42.24 and 179.41 kg/ha, respectively. Observation on growth parameters (plant height, number of leaves, root length and root diameter) were recorded after the harvest.

## RESULTS AND DISCUSSION

### Effect of spacings

The inter and intra-row spacings had significantly affected almost all the growth parameters except plant height (Table-1). Increased inter as well as intra-row spacings en-

*TABLE 1*

**Effect of plant density, nitrogen and phosphorus on growth parameters of radish.**

| *Treatments* | *Plant height (cm)* | *Number of leaves* | *Root length (cm)* | *Root diameter (cm)* |
|---|---|---|---|---|
| **(i) Main-plot** | | | | |
| $S_1$ | 35.74 | 11.32 | 12.43 | 2.20 |
| $S_2$ | 35.78 | 12.60 | 14.21 | 2.58 |
| $S_3$ | 34.27 | 13.84 | 15.35 | 2.67 |
| S. Em. ± | 0.57 | 0.19 | 0.20 | 0.04 |
| C. D. at 5% | NS | 0.60 | 0.62 | 0.12 |
| $W_1$ | 35.68 | 11.87 | 12.96 | 2.30 |
| $W_2$ | 34.85 | 13.30 | 15.04 | 2.67 |
| S. Em ± | 0.46 | 0.16 | 0.16 | 0.03 |
| C. D. at 5% | NS | 0.49 | 0.51 | 0.10 |
| C. V. % | 11.82 | 11.18 | 10.31 | 11.59 |
| **(ii) Sub-Plot** | | | | |
| $N_1$ | 31.63 | 12.20 | 13.58 | 2.40 |
| $N_2$ | 35.67 | 12.35 | 13.83 | 2.53 |
| $N_3$ | 38.50 | 13.21 | 14.58 | 2.53 |
| S. Em. ± | 0.36 | 0.14 | 0.17 | 0.05 |
| C. D. at 5% | 1.02 | 0.38 | 0.47 | NS |
| $P_1$ | 34.84 | 12.48 | 14.11 | 2.44 |
| $P_2$ | 35.50 | 12.76 | 13.89 | 2.53 |
| $P_3$ | 35.46 | 12.52 | 13.99 | 2.49 |
| S. Em. ± | 0.36 | 0.14 | 0.17 | 0.05 |
| C. D. at 5% | NS | NS | NS | NS |
| C. V. % | 7.53 | 7.92 | 8.68 | 13.71 |

hanced the number of leaves, and root size in length and diameter (Table-1). Thus, lower plant density as reflected by wider spacing improved the growth of radish. Comparatively more availability of soil water, nutrients, air and light under wider spacing might have resulted into better growth. Similarly significant effect of spacing was reported earlier on number of leaves in garlic (Purewal and Dargan, 1961) root length in onion (Singh, 1972) and root diameter in radish (Reimhers and Batz, 1971).

**Effect of Fertilization**

Except root diameter, all the growth parameters showed significantly favourable response to higher levels of nitrogen application (Table-1). There was an increase of 6.87, 1.01 and 1.00 cm in plant height, number of leaves and root length, respectively by increasing the levels of nitrogen application from 30 to 90 kg/ha. The present findings were comparable with those reported for plant height and number of leaves in radish (Roy and Seth, 1970) and root length in onion (Pandey and Mundra, 1971).

The important role of nitrogen in plant metabolism and thereby in plant growth is further confirmed from these results.

There was no significant effect of phosphorus application. Hence, all the growth parameters remained also unchanged over three levels of phosphorus.

**Interaction**

The interactions N X P, W X N and W X N X P were found significant in affecting plant height. The maximum plant height (40.19 cm) was for $W_1N_2P_3$ (Table-2) which was at par with treatments $W_1N_3P_2$ (39.55 cm), $W_2N_3P_1$ (39.31 cm), $W_2N_3P_2$ (39.01 cm) and $W_2N_3P_3$ (38.94 cm).

**Interaction effect**

*TABLE 2*

**Character plant height (cm).**

| *Treatment* | $P_1$ | $P_2$ | $P_3$ |
|---|---|---|---|
| $W_1N_1$ | 33.72 | 31.99 | 32.20 |
| $W_1N_2$ | 36.27 | 37.68 | 35.52 |
| $W_1N_3$ | 34.02 | 39.55 | 40.19 |
| $W_2N_1$ | 30.29 | 31.55 | 30.00 |
| $W_2N_2$ | 35.42 | 33.24 | 35.88 |
| $W_2N_3$ | 39.31 | 39.01 | 38.94 |

S. Em. = 0.89, C. D. at 5% = 2.49

The number of leaves per plant were significantly affected by the interactions of N X P, S X N, W X P and S X N X P. The maximum number of leaves (15.73) were recorded for $S_3N_3P_2$ (Table-3) which was significantly superior to all other combinations of S X N X P. The significant increase may be only due to wider inter-row spacings and higher dose of nitrogen.

*TABLE 3*

**Character - Number of leaves.**

| *Treatment* | $P_1$ | $P_2$ | $P_3$ |
|---|---|---|---|
| $S_1N_1$ | 11.40 | 12.50 | 10.50 |
| $S_1N_2$ | 10.93 | 11.17 | 11.53 |
| $S_1N_3$ | 10.73 | 11.87 | 11.23 |
| $S_2N_1$ | 12.43 | 11.87 | 11.87 |
| $S_2N_2$ | 11.93 | 12.50 | 12.33 |
| $S_2N_3$ | 13.37 | 13.10 | 14.03 |
| $S_3N_1$ | 14.00 | 13.10 | 12.17 |
| $S_3N_2$ | 13.27 | 13.03 | 14.43 |
| $S_3N_3$ | 14.23 | 15.73 | 14.57 |

S. Em = 0.41, C. D. at 5% = 1.15

The interactions S X W, S X N, S X W X P, S X W X N, W X N X P, S X N X P and S X W X N X P were found significant in effecting root length. The highest root length (17.43 cm) was noted for $S_3W_2N_3P_2$ (Table-4). It might be due to the combined effect of wider spacings with maximum nitrogen and minimum phosphorus application.

*TABLE 4*

**Character - Root length (cm).**

| *Treatment* | $P_1$ | $P_2$ | $P_3$ |
|---|---|---|---|
| $S_1W_1N_1$ | 11.44 | 10.25 | 10.91 |
| $S_1W_1N_2$ | 10.33 | 11.15 | 10.95 |
| $S_1W_1N_3$ | 9.95 | 10.96 | 11.85 |
| $S_1W_2N_1$ | 13.26 | 14.56 | 15.28 |
| $S_1W_2N_2$ | 11.33 | 13.47 | 13.71 |
| $S_2W_1N_1$ | 16.61 | 14.87 | 12.45 |
| $S_2W_1N_1$ | 12.38 | 12.27 | 13.80 |
| $S_2W_1N_2$ | 11.87 | 13.47 | 11.91 |
| $S_2W_1N_3$ | 14.26 | 13.93 | 15.36 |
| $S_2W_2N_1$ | 15.70 | 14.14 | 14.69 |
| $S_2W_2N_2$ | 15.76 | 15.77 | 13.82 |

| 1. | 2. | 3. | 4. |
|---|---|---|---|
| $S_3W_2N_3$ | 17.35 | 13.50 | 15.76 |
| $S_3W_1N_1$ | 13.47 | 14.93 | 12.44 |
| $S_3W_1N_2$ | 15.59 | 13.47 | 15.11 |
| $S_3W_1N_3$ | 16.45 | 13.76 | 17.05 |
| $S_3W_2N_1$ | 15.37 | 14.31 | 14.76 |
| $S_3W_2N_2$ | 16.37 | 17.31 | 17.50 |
| $S_3W_2N_3$ | 16.03 | 17.43 | 14.86 |

S. Em. = 0.70, C. D. at 5% = 1.97.

The significant increase in root diameter was found with the treatment $W_2P_2$ (2.76 cm) given in Table-5, which was at par with $W_2P_1$ (2.69 cm).

*TABLE 5*

**Character - Root diameter (cm).**

| *Treatment* | $P_1$ | $P_2$ | $P_3$ |
|---|---|---|---|
| $W_1$ | 2.20 | 2.30 | 2.41 |
| $W_2$ | 2.69 | 2.76 | 2.57 |

S. Em = 0.07, C. D. at 5% = 0.18

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