Some agronomic characters as affected by the application of different levels of nitrogen in Radish (Raphanus sativus L.)

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Abstract

An experiment was conducted to study the impact of different levels of nitrogen on growth and yield of radish in the Crop Farm, Faculty of Agriculture, and Eastern University, Sri Lanka during the period October to November 2017. Radish variety 'Beeralu rabu' was used in this study. This experiment was laid out in a Complete Randomized Design (CRD). There were six treatments with five replications. Urea was used as a source of nitrogen. The treatments were T_1 - No fertilizer (Control), T_2- 90 kg urea/ha, T_3-120 kg urea/ha, T_4-180 kg urea /ha (Recommended rate), T_5-210 kg urea /ha, T_6 - 240 kg urea /ha. Agronomic practices were carried out as per Department of Agriculture, Sri Lanka. Samplings were done at fortnight intervals.

The results showed the highest LAI at 240, 210 and 180kg N/ha. Maximum length and diameter were obtained at 240 and 210 kg N/ha. Highest dry weight and marketable tubers were recorded at 210 and 180 kg N/ha. Control was the lowest in LAI, length, diameter, dry weight per plant and the marketable yield of the tuber. The results suggest that marketable yield could be increased by five (5) and four and three quarter (4.75) folds the application of nitrogen at 210 and 180 kg N/ha, respectively and the further increase in nitrogen will decrease the marketable yield.

Keywords— Radish, Raphanus sativus L., Nitrogen, Marketable yield

Introduction

Vegetables are rich and cheaper source of vitamins and minerals. They are necessary for the maintenance of good health and beneficial in protecting against some degenerative diseases. They also play a key role in neutralizing acids produced during digestion and also provide valuable roughages which promote digestion and help in preventing constipation.

Radish (Raphanus sativus L.) is a root vegetable. All the parts are edible (leaves, root, flowers and seeds). The edible part of roots arises from both primary root and hypocotyls. The leaves and roots are used for salad and a vegetable. The radish roots are the good appetizer. They are useful in curing liver and gallbladder problems. Roots are used in treating urinary complaint and piles. The juice of fresh leaves is used as diuretic and laxative. It's a cheaper vegetable for the poor people (Sankari et al., 2006).

As a macronutrient, nitrogen plays an important role in the growth and development of plants, especially, to the vegetables. However, little is known about the quantity of nitrogen used in this crop (Quadros et al., 2010). On the other hand, lack of nitrogen resulted in low yield. Studies have reported that excessive application of N fertilizer produced low quality and quantity of agricultural produce (Chen et al., 2004). This could be overcome by the application of optimum level of nitrogen at correct time. Nitrogen at the optimum rate is vital to enhance the photosynthetic processes, leaf area production and leaf area duration and net assimilation rate (Ahmad et al., 2009).

An oversupply N fertilization encourages vegetative growth and may negatively affect the crop's nutritional value by limiting the synthesis of sugars, enhancing the nitrates accumulation and contributing to high nitrogen leaching from the soil (Sorensen (1993), Rahn (2000), Neeteson and Carton (2001), Dzida et al., 2013). Yield could be obtained through the proper application of fertilizers. Therefore, the present study was conducted to find out the effect of different levels of nitrogen on certain characters of radish.

Materials and Methods

An experiment was carried out at the Crop Farm, Eastern University, Sri Lanka during the period October 2017 to November 2017 to study the effect of the application of different levels of nitrogen on Some agronomic characters in Radish (Raphanus sativus L.). Batticaloa falls under the Agro-ecological zone of the Low Country Dry Zone (DL). The mean annual rainfall is 2056 mm which varies from 864 mm to 3881 mm and the mean annual temperature is 28.5^0C which varies from 25^0C to 35.4^0C. Plastic buckets with the dimension of 30 cm height and 21 cm diameter were used. The experiment was laid out in a Complete Randomized Design (CRD) with six treatments and replicated five times. Potting media used was red soil: rotted Cattle manure: sand @ 1:1:1. Urea was applied at the rate of 0, 90, 120, 180, 210 and 240 kg/ha. Urea was used

as a source of nitrogen fertilizer and applied in two split doses, first half at the time of sowing and remaining half at three weeks after sowing (topdressing). Triple Superphosphate was applied at the rate of 110 kg/ha (basal) and Muriate of Potash was applied at the rate of 65 kg/ha (as basal and top dressing). All the agronomic practices were carried out as per the recommendation by the Department of Agriculture, Sri Lanka. The crop was harvested when to yellow and after attaining full-size root. Data were statistically analyzed using SAS 9.1 and means were separated using Duncan's Multiple Range Test (DMRT) test at 5% significant level.

Leaf Area Index

LAI showed significant differences ($p<0.05$) with the levels of nitrogen at 15 and 30 DAP (Table 1). Increasing levels of nitrogen increased the leaf area index (Table 1). Application of 210 and 240 kg N/ha showed the highest LAI and control treatment showed lowest LAI at 15 and 30. The increase in LAI was mainly due to the increased in the number of leaves per plant and decreased in LAI was due to the reduced number of leaves per plants. At 45 DAP, LAI ranges from 1.36-7.32. LAI ranges from 1 to 8 according to species and the habitat of the plant. This is in agreement with El-Desuki et al. (2005) and Kazemeini and Sadeghi (2012) who reported that nitrogen fertilization increased the number of leaves per plant and leaf area which was the main course for increasing in LAI.

Table 1: Effects of different levels of nitrogen on LAI

Levels of Nitrogen (kg/ha)	DAP	
	15	**30**
0	0.14 ± 0.13^{c}	1.36 ± 0.49^{c}
90	0.24 ± 0.18^{bc}	2.50 ± 0.52^{bc}
120	0.29 ± 0.14^{bc}	2.82 ± 0.68^{bc}
180 (Recommended)	0.44 ± 0.21^{b}	5.02 ± 1.30^{ab}
210	0.49 ± 0.10^{ab}	5.34 ± 0.98^{ab}
240	0.72 ± 0.44^{a}	7.02 ± 1.02^{a}
P value	**	**

F test: *P<0.05; **: P<0.01. Means followed by the same letter in each column

are not significantly different according to Tukey's test at 5% significant level.

Length of tuber

The length of roots at different stages is given in Fig. 2. There was a significant ($p<0.05$) effect of levels of nitrogen on the length of tuber at 15, 30 and 45 DAP. At 15 DAP, the highest length of tuber was observed in the 240 kg N/ha and 180 kg N/ha treatment and the lowest was found in the control (Fig. 2). At 30 DAP, the highest length of tuber was observed in 240 kg N/ha and 120 kg N/ha treatments. Control treatment showed the lowest root length. At 45 DAP, the highest length of tubers was observed in 210 kg N/ha treatment and it was on par with the treatment 180 and 210 kg N/ha treatment (Fig. 2). The lowest length of tuber was observed in the control treatment. In this study maximum length of tuber roots was observed at 180, 210 and 240 kg N/ha which is in close to the level (200 kg N/ha) reported by Prevez et al. (2004) and Asghar et al. (2006). It was on par with the study of Kumar et al. (2012), Silva (2016) and Tripathi et al. (2017).

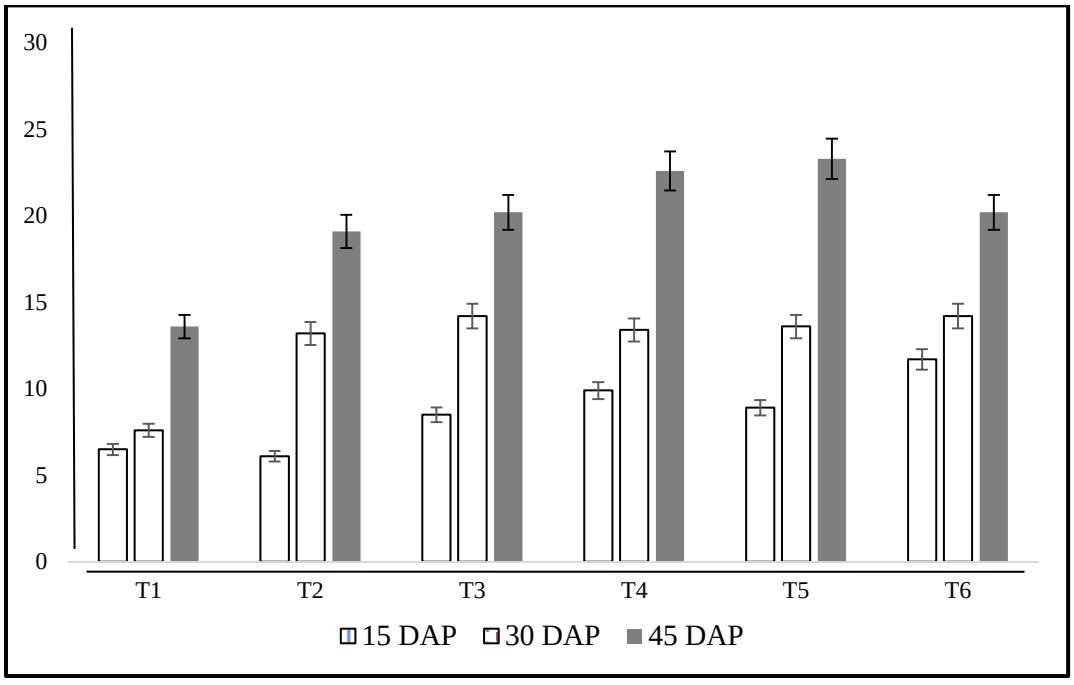

Figure 2: Length of roots is a function of the different levels of nitrogen of radish at 15, 30 and 45 days after planting

Diameter of the tubers

Levels of the nitrogen significantly ($p<0.05$) increased the diameter of tuber at different stages of growth (Table 2). Increasing level of nitrogen increased the diameter of the tuber. It was shown that highest diameter of the tuber was observed in 240 kg N/ha and lowest was observed with control treatment (0 kg N/ha). At 30 DAP, the diameter of tuber was the highest at 210 and 240 kg N/ha than that of others at 0, 90 and 180 kg N/ha (Table 2). This result is concurrence with Jilani et al. (2010) (250 kg N/ha) and Tripathi et al. (2017) and Muthuswamy and Muthukrishnan (1984) who reported that increased levels of nitrogen increased the diameter of the tubers. The application of nitrogen promotes the growth and yield parameters of radish while, at higher levels of nitrogen root size as well as yield is improved (Akoumianakis et al., 2011). This might be due to the fact that higher nitrogen encourages the vegetative growth; that, inturn, increases more photosynthesis and more accumulation of assimilates in the roots. In contrast, Silva and Silveira (2012) reported that application of nitrogen did not affect the diameter of roots of the radish. This might be due to the mineralization of nitrogen from the organic matter and the addition of urea at sowing.

Table 2: Effects of different levels of nitrogen on diameter of the tuber

Levels of Nitrogen (kg/ha)	DAP	
	30	**45**
0	0.22 ± 0.31^{b}	1.54 ± 0.27^{d}
90	0.38 ± 0.67^{b}	3.33 ± 0.35^{c}
120	0.32 ± 0.91^{b}	4.10 ± 0.05^{b}
180 (Recommended)	0.52 ± 0.96^{b}	4.16 ± 0.03^{b}
210	0.62 ± 1.54^{ab}	4.42 ± 0.07^{ab}
240	1.00 ± 1.88^{a}	4.72 ± 0.07^{a}
P value	**	**

F test: *P<0.05; **: P<0.01. Means followed by the same letter in each column are not significantly different according to Tukey's test at 5% significant level.

Dry weight of tubers

Levels of nitrogen did not affect the dry weight of the tuber per plant at 15 and 30 DAP (Table 4). However, at 30 DAP, the values are closer to the significance level. At 45 DAP, the highest dry weight of tuber per plant ($p < 0.0001$) was recorded in 210 kg N/ha (10 g) and 180 kg N/ha (9.5g), followed by 240 kg N/ha (8.5g) and then by 90 kg N/ha. Lowest dry weight per plant was observed in 0 kg N/ha (Table 3). This result was on par with Ibrahim et al. (2017) who reported that increased level of nitrogen, P and K increased the tuber weight. However, Jilani et al. (2010) reported that tuber weight decreased with the decrease in nitrogen levels and the lowest tuber weight was recorded in the control.

Table 3: Effects of different level of nitrogen on dry weight of tubers

Levels of Nitrogen (kg/ha)	DAP		
	15	**30**	**45**
0	0.020±0.07	0.04±0.12	2.0 ± 0.7^{e}
90	0.034±0.11	0.11±0.12	8.0 ± 0.2^{d}
120	0.028±0.14	0.16±0.4	8.6 ± 0.1^{cd}
180 (Recommended)	0.042±0.13	0.26±0.27	9.5 ± 0.2^{ab}
210	0.046±0.14	0.60±1.17	10.1 ± 0.1^{a}
240	0.052±0.17	1.00±0.78	8.9 ± 0.1^{bc}
P value	**NS**	**NS**	**<0.0001**

F test: *P<0.05; **: P<0.01. Means followed by the same letter in each column are not significantly different according to Tukey's test at 5% significant level.

Marketable Tubers

Marketable tuber yield is presented in Table 4. Marketable tuber weight was significantly varied ($P<0.05$) among the treatments tested. Among the treatments, maximum marketable tuber yield was obtained in 210 kg N/ha (40.2 t/ha). This is on par with 180 kg N/ha (38.1 t/ha) followed by 240 kg N/ha (35.6 t/ha) and 120 (35.3 t/ha). Minimum marketable tuber yield was achieved in the control (8.1 t/ha). Therefore, the highest marketable tuber was due to the effect of high LAI. Higher photosynthesis at the highest LAI helps to translocate the photosynthates which were

utilized after the respiration and maintenance of the plants. These results are confirmed by the findings of Tripathy et al. (2017) and Kumar et al. (2012).

Table 4: Effect of different levels of nitrogen on marketable tubers

Levels of Nitrogen (kg/ha)	Tuber Yield (t/ha)
0	8.1 ± 2.1^{d}
90	32.1 ± 0.68^{c}
120	35.3 ± 0.36^{b}
180 (Recommended)	38.1 ± 0.70^{ab}
210	40.2 ± 0.68^{a}
240	35.6 ± 0.31^{b}
P value	**

F test: *P<0.05; **: P<0.01. Means followed by the same letter in each column are not significantly different according to Tukey's test at 5% significant level.

Conclusion

This study was carried out to study the effect of different levels of nitrogen on certain agronomic characters of radish variety 'Beeralurabu'. The results showed the highest LAI at 240, 210 and 180kg N/ha. Maximum length and diameter were obtained at 240 and 210 kg N/ha. Highest dry weight and marketable tubers were recorded at 210 and 180 kg N/ha. Control was the lowest in LAI, length, diameter, dry weight per plant and the marketable yield of the tuber. The results suggest that marketable yield could be increased by five (5) and four and three quarter (4.75) folds by the application of nitrogen at 210 and 180 kg N/ha, respectively and further increase in nitrogen will decrease the marketable yield.

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