Effect of nitrogen fertilization on nitrate accumulation in radish (*Raphunus sativus*) and beetroot (*Beta vulgaris*)

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Introduction

Nitrate is one of the most frequent utilized forms of N from soil and it is the major form of nitrogen taken up by plants. Through root they reach stem and leaf where in photosynthetic processes they convert into proteins. Due to exposure to stress situations and excessive nitrogen fertilization, nitrate accumulation in plant tissues and organs occurs (Krnjaja, 2008). Excess amount of nitrate caused health hazards. Vegetables are the major source of daily intake of nitrate by human beings, supplying about 72 to 94% of the total intake. The Acceptable Daily Intake (ADI) of nitrate ion has been given 3.65 mg kg^{-1} body weight (Santamaria, 2006). Higher concentration of nitrate is badly affected to environment, animals, and humans. Main objectives of this research are to investigate the effect of nitrogen fertilization on nitrate accumulation in radish and beetroot and to determine plant part where the maximum nitrate accumulations take place.

Methodology

The current study was carried out at Horticultural Crop Research and Development Institute, Gannoruwa. Five different N levels of DOA (Department of Agriculture) recommended dosages together full recommended TSP and MOP levels were applied as treatments. No fertilizer treatment used as a control. Field trail was arranged according to Randomized Complete Block Design with three replicates. Recommended spacing used for each crop.

Table 01. Treatments

Treatment	Fertilizer Levels
T 1	No fertilizer
T 2	0% of urea (N) + Full recommend MOP and TSP
T 3	50% of urea (N) + Full recommend MOP and TSP
T 4	100% of urea (N) + Full recommend MOP and TSP
T 5	150% of urea (N) + Full recommend MOP and TSP
T 6	200% of urea (N) + Full recommend MOP and TSP

Radish samples were taken two times. Beetroot samples were taken at the time of harvesting stage. Samples were thoroughly washed and there after samples were oven dried at 60 ^{0}C until constant weight is reached. Dried samples were ground. By using dried samples plant nitrate accumulation levels were measured dry weight basis and fresh weight basis.Used distillation method. Data was analyzed using analysis of variance (ANOVA) using the General Linear

Model (GLM) procedure of MINITAB 17. Significant means of treatments were separated using Tukey test ($P< 0.05$).

Result and Discussion

Four weeks after planting nitrate accumulation level in radish fresh weight (FW) basis is given in Table 02.

Table 02. Nitrate Accumulation Level in Radish in Root Parts and Leaf Parts

	Mean NO_3^- mg/kg FW basis	
Treatment	Root	Leaf
T_1 (No Fertilizer)	25.69^{d}	233.7^{d}
T_2 (0% Urea)	79.85$^{c\,d}$	113.2^{e}
T_3 (50% Urea)	135.97$^{c\,d}$	211.1^{de}
T_4 (100% Urea)	175.40^{c}	419.6^{c}
T_5 (150% Urea)	435.30^{b}	1173.5^{a}
T_6 (200% Urea)	589.80^{a}	1005.2^{b}

Values followed by the same letters are not significantly different at $p\leq0.05$

Harvesting stage nitrate accumulation level in radish fresh weight (FW) basis is given in Table 03.

Table 03. Nitrate Accumulation Level in Radish in Root parts and Leaf Parts.

	Mean NO_3^- mg/kg FW basis	
Treatment	Root	Leaf
T_1 (No Fertilizer)	170.2^{bc}	260.1^{bc}
T_2 (0% Urea)	106.0^{c}	150.8^{c}
T_3 (50% Urea)	187.5^{bc}	205.1^{bc}
T_4 (100% Urea)	277.47^{b}	485.4^{b}
T_5 (150% Urea)	463.3^{a}	1410.4^{a}
T_6 (200% Urea)	454.1^{a}	1236.0^{a}

Values followed by the same letters are not significantly different at $p\leq0.05$

When increasing nitrogen fertilization significantly ($p<0.05$) increased nitrate accumulation in root part and leaf part. Higher amount of nitrate accumulation was recorded in leaf part than root part in radish and beetroot. This finding is also supported by PietroSantamaria (2006) who stated that nitrate content differs in the various parts of a plant. Indeed, the vegetable organs can be listed by decreasing nitrate content as follows, petiole > leaf > stem > root > inflorescence > tuber > bulb > fruit > seed.

Harvesting stage nitrate accumulation level in beetroot fresh weight basis is given in Table 04

Table 04. Nitrate Accumulation Level in Beetroot in Root Parts and Leaf Parts

	Mean NO_3^- mg/kg FW basis	
Treatment	Root	Leaf
T_1 (No Fertilizer)	160.3 [a]	387.0 [a]
T_2 (0% Urea)	311.7 [a]	389.0 [a]
T_3 (50% Urea)	315.3 [a]	490.0 [a]
T_4 (100% Urea)	261.1 [a]	496.0 [a]
T_5 (150% Urea)	341.0 [a]	462.6 [a]
T_6 (200% Urea)	266.0 [a]	439.0 [a]

Values followed by the same letters are not significantly different at $p \leq 0.05$

There was no significant difference in nitrate accumulation in root part among the treatments ($p > 0.05$). Leaf nitrate accumulation was no significant difference with other treatments but it was comparatively higher than the root part nitrate accumulation in beetroot. Similar results reported by Maynard & Barker (1972).Which showed that petioles and stems were generally the sites of maximum nitrate accumulation in beetroot (Vityakon, 2012).

Conclusions

Higher rate of nitrate accumulation was occurred in leaf parts than the root parts in radish and beetroot. Higher rates of nitrogen fertilizer levels were caused to higher level of nitrate accumulation in radish and beetroot. But through the application of recommended level of fertilizer doses can obtain optimum yield with minimum nitrate accumulation.

References

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