LYSIMETER EXPERIMENT FOR THE ANALYSIS OF NITRATE-N LEACHING IN ROOT CROPS: CARROT AS A TEST CROP

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Introduction

Nitrogen is an essential plant nutrient for growth and development of the crop. Mean times the nitrogen can loss from the soil to groundwater through the leaching and pollute the valuable natural resource. The extents of agricultural lands were reduced and the demand for the vegetable production is increased due to the pressure of population growth. Intensification of agricultural activity by application of nitrogen has dramatically increased. Hadas *et al.* 1999 sated that any enhancement of productive activity leads to the environmental contamination if it is improperly managed. Podgornik, and Pintar, 2007 pointed out that excessive use of nitrogenous fertilizers and irrigation increase the risk of percolation and leaching of nitrates to ground water. Jeyaruba and Mikunthan, 2010 studied the concentration of the nitrate- N in the groundwater of the Jaffna peninsula in intensified agricultural areas and expressed their environmental concern related to the increase of nitrate-N. Kuruppuarachchi and Fernando, 1999 stated that the buildup of nitrate is quite dramatic and has been estimated at 1-2 mgN /l through the lysimeter studies.

Carrot (*Daucus carota* L.) is one of the important vegetable crops in Jaffna peninsula. It represents 65.75 ha of arable land within which the New kuroda variety covers 53 ha in 2011 (Department of Agriculture, Thirunelvali). It is inspired to estimate the leaching of nitrate-N into the groundwater due to the cultivation of carrot in this region. Lysimeters were adopted normally to investigate fertilizer losses from agricultural and non-agricultural soil. The experiment was carried out with the objectives of to estimate the nitrate-N losses through leaching into the ground water with different level of nitrogen fertilizer application and the effect of nitrogen on yield of carrot on 77 days after sowing.

Methodology

The Lysimeter experiment was conducted in Maha season 2011/12. Six lysimeters were prepared using plastic buckets with 50 cm diameter and 66 cm height with the size of the unit plot as 0.1790 m^2. The effective depth of lysimeter or root zone was maintained as 60 cm.

The treatments were arranged in a complete randomized block design with two treatments and three replicates. The recommended total fertilizer application rate for Carrot was 207 kg N/ha. Hence, to study the effect of fertilizer dosage on nitrate leaching, a half of the recommended fertilizer (103.5 kg N/ha) and the recommended level of fertilizer (207 kg N/ha) was added in the form of urea. All lysimeters received the same agronomic practices including irrigation water except fertilizer application. Each lysimeter was maintained with twenty plants. All other agronomic practices like spacing, thinning-out, irrigation and fertilizer application was done according to the recommendation of Department of Agriculture, Sri Lanka. The soil was kept under saturated condition during the cropping period.

The leachate from each individual lysimeter was collected continuously into the plastic bottles and the total volume was measured. The leachate samples were collected 5-7 days

interval for nitrate -N analysis by pooling sub-samples of 25 ml of each sampling, which represent the composite sample collected from each samples. Nitrate-N in the leachate was determined spectrophotometrically by Cadmium reduction Method (Keeny & Nelson, 1982) using DR/HACH 2000 spectrophotometer. The vegetative parameters and yield parameters were taken after 77 days of sowing by averaging the values of twenty plants from each replicates.

Discussion and conclusion

Yield parameters

Table 1 shows the yield parameters of carrot for recommended and half of the recommended fertilizers.

Table 1: Yield parameters of carrot for two levels of fertilizer

Stage	Recommended	Half of the recommended
Mass of shoot (g)	27.48^{a}	22.35^{b}
Mass of root (g)	29.47^{a}	21.91^{a}
Shoot height (cm)	26.70^{a}	30.86^{a}
Root length (cm)	12.03^{a}	10.52^{a}
Root diameter (cm)	2.47^{a}	2.32^{a}

**Same letters shows no significant different between treatment at ∞=0.05

There was a significant difference found in shoot weight between recommended and half of the recommended level of fertilizer application. Nitrogen has the significant effect on the vegetative growth and accumulation of the mass in the vegetative part. But all other parameters shoot height, root length and root diameter was not significant between fertilizer treatment levels.

Nitrate leaching

Figure 1 shows the nitrate-N concentration of leachate after seven days (after germination), 30DAS (after thinning out) and on harvesting. The initial sample of leachate consist high amount of nitrate- N and more or less equal in both treatments. This is because of low rate of intake by plants and high amount of rainfall during this period. The concentration of nitrate-N in the leachate reduces in the later part due to the increase in consumption by plant to vegetative growth and to accumulation of tuber size.The concentration of nitrate-N reduces in 30 days due to intensive vegetative growth because; the active growth of plants was occurred within this period. In final stage, the concentration in the recommended level of fertilizer was observed as high since the growth of the plants becomes decreased and consumption by plant was reduced.But in case of half of the recommended level of fertilizer application the absorption of plant increases due to the delay in growth. When considering the percentage total loss of nitrate-N with application, recommended level consist average of 6.04% and half of the recommended fertilizer level consist 9.18%. Reduction in nitrogen fertilizer application would appear to be an obvious method of reducing the potential for groundwater degradation by nitrate. This results may not be achieved if the reduce nitrogen application also reduces the plant growth. Finally it was concluded that half of the fertilizer treatment high loss of leachate with comparatively low yield than the recommended fertilizer. Since the concentration of nitrate-N is high during early vegetative phase, best

management practices are important in early stage. The data of nitrate-N in the leachate could be used to predict the leaching of nitrogen to shallow groundwater aquifer with hydrous–1D model.

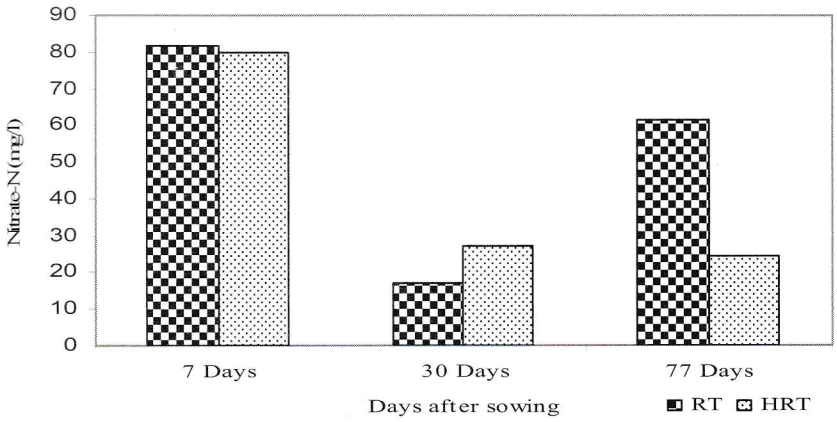

Figure 1: Nitrate-N concentration in leachate

It can be concluded that pollution of the water can be economically reduced by appling the recommended level of fertilizer than the half of the recommended level of fertilizer.

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