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Quantification of leaf leachates from *Nymphoides cristata*

Dr. Prasannarani Tanneru
Department of Botany, Lal bahadur shastri mahavidyalaya, Dharmabad Dist Nanded (MS) 431809 India

Abstract
Leaching is a natural phenomenon. Substances leached from plants include great diversity of nutrients. Most of the experimental work on leaching has been done on terrestrial plants but a very insignificant amount of work is available on aquatic macrophytes. The present investigation has been carried out in order to quantify the leaching of nutrients from an aquatic plant-Nymphoides crostata in an experimental Lentic system supplied with superphosphate fertiliser with different doses. Ten gram phosphate fertiliser was found to be optimum for maximum leaching of nutrients from the leaves of the plants. The possibility of using Nymphoides spp. For the upwelling of nutrients is also discussed.

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I. Introduction

Leaching is defined as the removal of substances from plants by the action of aqueous solutions. The term "leaching" is described as the removal of mineral nutrients from leaves soaked in water a process similar to leaching of mineral ions in soil and extraction of soluble materials from leaves by rain (Dalbro,1956; Long et al, 1956). Substances leached from plants include a great variety of nutrients (Tukey, 1966; Tukey and Morghan, 1963).

Most of the experimental work on leaching has been done on terrestrial plants (Cummins et at. 1972; Rice, 1977; Konar and Kushari, 1989) but a very significant amount of work is available on aquatic macrophytes. Robson (1977) and Szczepanski (1977) suggested independently the possibility for using allelopathy as means of control of water weeds. Woke (1974) investigated interferences between L*emon minor, Spirodela polyrhiza and Wolffia polyrhiza.* Sinhababu and Khushali (1984;1986), Kushari and Sinhababu (1987) and Kushari and Thaeruzzaman (1990) studied the effect of leaches of several terrestrial trees on *Azolla pinnata*. Thaeruzzaman and Kushari (1991) quantified the leaches of two terrestrial trees on the growth *Eichhornia crassipes.* However no attempt has so far been undertaken in regard to the quantification of leaf leachates from aquatic macrophytes. The quantification of leaf leaching of aquatic macrophytes must be done if we wish to understand their roles in the functioning of aquatic ecosystems. Our object, therefore, is to quantify the leaf leaches of *Nymphoides cristata* is an experimental Lentic system in order to understand the role of the plant towards the enrichment of aquatic ecosystem.

II. Materials And Methods

Nymphoides cristata (family Gentianaceae)is a rooted floating aquatic macrophytes, commonly found in different Lentic water bodies in Jankampet, Nizamabad. Fresh *Nymphoides* plants of the vegetative developmental stage were collected from the adjacent Jankampet pond, cleaned thoroughly with 0.01 Mercuric chloride solution and thereafter kept 2 to 3 days in a concrete pond with the tap water. Those plants were later used as experimental plants. Two plants weighing 100g having 50cm* cm leaf area were planted in each of the 24 earthen pots (area 0.125 m*m) containing 100 g oven dry soil (N= 0.4%, P = 0.3%, Ca= 0.01% K = 0.04%, Na-= 0.06%) and 3 1 tapwater. 5 g of single super phosphate fertiliser were added to 6 earthen pots and named as "A". Similarly 10 and 15g of superphosphate were added to each of 6 earthen pots and named as "B" and "C " respectively.

The remaining earthen pots without the addition of fertiliser were named as "D". Similar type of 24 earthen pots were taken and filled up with 1.51 of distilled water (pH 6.8, 0 nutrient). Each of the earthen pot was kept by side by one pots of A,B,C,D and A1,B1,C1 and D1 respectively. Only the leaves of each plant were kept floating in the adjacent earthen pot containing only distilled water. The long petiole of the plant which remained outside the water, was wrapped with wet tissue paper, in order to save it from desiccation. So A1,B1,C1 and D1 were used for the quantification of leaf leachates from the plants corresponding to a A, B, C and D respectively. The experiment was conducted from July-August 2020 (when the growth of aquatic plants is maximum). In the NET house of Department of Botany, LBS College Dharmabad. The average air temperature humidity and light intensity of the net house ranged between 26-30°C, 76-90% and 61.02-71.1 Wm respectively

The physico-chemical characteristics of fertiliser enriched (A,B,C), Control (without fertiliser D) and leachate receiving pots of distilled water (A1, B1, C1 and D1) were measured three times in a month according to the methods outlined by American Public Health Association 1980. The pH was measured in situ by a portable digital pH meter (pHep-Hanna), conductivity by systronkcs conductivity meter (model number SR099), PO_4P by EC Digital spectrophotometer (model number GS5700A) Na,K and Ca by systronkcs flame photometer (model serial number 484). statistical analyses was done according to Mishra and Mishra in 1983

III. Observations

With increase of different doses of fertilisers, Na, K, Ca, conductivity and PO_4 P content of the waters of the experimental pots increase (Table 1). Contrast to this the pH of the waters declined with the addition of more fertiliser. In the control pots virtually there was no fluctuation in the characteristics of water. The Na, K, Ca, conductivity and PO_4P of the different fertiliser enriched waters ranged between 35-40ppm, 5.07-10.5 ppm, 26.0-28.75 ppm, 297.0-730.0 µ S cm and 5.8-15.5 ppm respectively. The pH of the water is ranged between 6.9-7.8.

The leaching of different nutrients from Nymphoides leaves is presented in table 1. The waters of the earthen pots for quantifying leaf leachates corresponding to A,B,C, D (control) varied considerably. Initially before the onset of experiment there was no nutrient in these waters. However it is quite interesting to note that there was no profound change as regards the quality of leachate water. The pH of leachate waters in all the months decreased from the initial value. The pH of the leachate decreased gradually from A1 to C1 and the value ranged between 6.7 to 6.4. The conductivity of leachate waters increased with the increases of the application of fertiliser. However the value is increased until a certain dose i.e 10 g per pot. The conductivity ranged between 84.0-115.0 µ S cm^{-1}. The conductivity of the leachate water however did not increase further unlike conductivity the PO_4P content of the leachate water did not increase it with the addition of the fertiliser application to the plants. The PO_4Pcontent of the leachate water was found to be high in September while low in July. The PO_4P content of leachate water range between 0.169-0.370 ppm. The considerable amount of Na, K and Ca were found in the leachate waters. Like conductivity the Na, K and Ca content of the leachate increase up to the addition of 10 g fertiliser. Beyond this dose Na, K and Ca contents of leaf leachates did not increase rather declined. The Na, K and Ca content of leaf leachates were in the range of 3.00 to 6.30, 2.67- 5.02 and 3.0023.3 5ppm respectively. The amount of leaching from control plants were very low. Na, Ca and conductivity of the leachate control sets ranged between 1.5-1.6, 0.50-0.72ppm and 20.3-25.0 µ S cm^{-1} respectively. Potassium, PO_4P content of the control sets were beyond the detection range. The pH of control water remain unchanged.

IV. Discussion

The chemistry of the distilled water in the different earthen pots (A1,B1,C1) altered considerably. Evidently it is due to leaching of different nutrients from the floating leaves of *Nymphoides.* Many studies have shown that rain drops hanging on foliage briefly before dropping the ground lead a surprising quantity of nutrients and organic compounds from the leaves. Foliage drop may remain as much or more P or K to the soil and it has been demonstrated that a luxuriant growth of *Hyloecomium splendenson* the ground directly beneath the canopies of *Picea*, *Abies* can be attributed to Ca, N, P and K that are leached from the tree-foliage (Parker, 1983). The acidic pH of leachate water maybe argued on the leaching of different metabolites of acidic nature (Tukey, 1966). Dalbro (1956) reported losses from apple foliage of 20 to 30 kg of K, 10.5 kg of Ca and 9 kg of Na per hectare in one year. In the present experiment the losses of Na, K, Ca and PO_4P in the optimum condition were 4.68, 3.43, 2.58 and 0.25ppm respectively. There are many factors which influence the quantity and quality of substance leached from foliage including factors associated directly with the plant as well as those associated with the environment (Schoch, 1955. The leaching of more nutrients with the availability of 10g fertiliser may be argued to be dependent on optimum concentration for the plant. Addition of more nutrients may have inhibitory effects on the growth of various aquatic plants (Barko, 1982; 1983). As a matter of fact the rate of leaching not only dependent on the lower concentration (as in control of water) but also on the higher concentration of nutrient supply to the plant concerned. *Nymphoides* maybe used in the Lentic water bodies for upwelling of nutrient to the surface water. Sometimes it has been seen that the rapid growth of a free-floating fern *Azolla* near the vicinity of the leaves of *Nymphoides*, presumably due to the supply of available P (Khushari and watnabe,1991)

Table 1: Physicochemical characteristics of fertilise enriched water of earthen pots wit *Nymphoides cristata*

Parameter	**Month**	**Earthen pots supplied with fertilizer**			
		A	B	C	D
pH	July	7.6	7.4	6.9	7.8
	August	7.5	7.4	6.9	7.8
	September	7.6	7.5	7.0	7.8
Conductivity (μScm^{-1})	July	297.00	407.00	730.00	201.50
	August	300.15	409.00	720.00	200.00
	September	298.00	402.00	714.00	197.50
PO_4P (ppm)	JULY	5.90	10.50	14.50	0.25
	August	5.80	10.60	15.00	0.28
	September	5.85	11.25	15.50	0.25
Na (ppm)	July	35.0	39.0	40.5	27.0
	August	35.0	39.0	40.0	27.0
	September	35.0	39.0	40.0	27.0
K (ppm)	July	5.17	6.27	10.20	1.81
	August	5.07	6.50	10.40	1.80
	September	5.12	6.50	10.50	1.80
Ca (ppm)	July	26.00	26.00	28.00	6.00
	August	26.00	26.00	28.00	6.00
	September	26.30	26.25	28.75	6.00

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