Nutrient Status of Soils of Vegetable and Floating Gardens in and around Dal Lake, Kashmir

Shazia Bashir Punjoo and G. A. Bhat
Centre of Research for Development, University of Kashmir, Srinagar 190006, India

ABSTRACT

Availability and maintenance of nutrients in suitable quantities in soil is important for the production of any type of agricultural or horticultural crops. In this paper physico-chemical properties of composite surface stratum (0-10cm deep) soils of vegetable and floating gardens inside and around Dal lake (34° 5 N latitude and 75° 5' E longitude) is presented. The soil at almost all the sites was highly fertile which as was revealed by high values of organic matter, total nitrogen, phosphorus and C/N ratio.

Key words: Floating gardens, Dal lake, nutrients, fertile

INTRODUCTION

Vegetable gardens around Dal lake of Kashmir, comprising a unique suburban agro ecosystem, are famous for rich vegetable production and are a source of livelihood for a large number of people in Kashmir valley. Due to modern techniques of cultivation these gardens receive many contaminants including pesticides and fertilizers which have affected the soil ecology as well as the ecology of the Dal Lake also. Besides, periodic manuring of the floating gardens by mulch also adds to their nutrient status. No data are available on the physico-chemical features and nutrient status of soil of the floating and vegetable gardens around the Dal Lake are available. The present report is an attempt in this direction.

STUDY AREA

Eight different vegetable gardens falling within the Dal lake area were selected for the present study. The sites included:

1. Two vegetable gardens on the shore of Nigeen Lake separated from each other by a distance of 1 km.
2. Nigeen side floating garden,
3. Babadamb side vegetable garden,
4. Two vegetable gardens on northwest side of Dal Lake, 1 km apart from each other (Mir mohalla and Gadu mohalla vegetable gardens).

5. Botapora vegetable gardens approximately in the center of Dal lake, and
6. Floating garden behind Nehru Park.

The climatic conditions of the vegetable gardens are temperate characterized by warm summer having a maximum temperature of 32C and cold winter with sub zero or freezing temperatures.

The sampling areas were generally cultivated with both kharief and rabi crops. The kharief crops included: *Brassica aleracae* var. *acephala* (Kales), *B. oleracae* (Knol-Khol), *Phaseolus* spp. (Beans), *Lycopersicum lycopersicum* (Tomato), *Cucumis sativus* (Cucumber), *Zea mayz* (Maize) and *Cucumis melo* (Gourd). The rabi crops included *B. rapa* (Turnip), *Raphanus sativus* (Raddish), *Allium cepa* (Onion) and *Allium sativa* (Garlic). The floating gardens were cultivated only with *Cucumis sativus* (Cucumber) and *Cucumis melo* (Gourd).

MATERIAL AND METHODS

Composite soil samples from surface stratum (0-10 cm depth) were collected during March 2004 to October 2004 from all the eight selected sites on monthly basis but the results have been computed as average of the three months for each season. The soil temperature was recorded as average of three readings with a soil thermometer with its probe buried into the surface soil (0-10cm deep). The soil analysis was carried out as per Jackson (1973), Gupta (2002) and Walkley and Black (1934).

RESULTS AND DISCUSSION

Soil fertility refers to the nutrient - supplying properties of the soil and from the stand point of agricultural production soil fertility is best understood by considering it under four subdivisions: the nutrient requirements of the plants; the supply of nutrients in the soil; ways in which nutrients are lost from the soil and the methods by which soil fertility may be maintained or restored (Raychaudhuri, 1981). It is worth mentioning that the fertility of the soils in vegetable and floating gardens around Dal lake is maintained by the method of periodical addition of manually or mechanically gathered semidecomposed macrophytes (mulch). The data on the physico - chemical analysis of soil samples are presented in Table 1 and discussed further as under

PH

Based on the pH values, soils of the study sites were found to be slightly alkaline in general. The highest pH of 7.66 and 7.86 at the Nigeen floating garden and Dal floating garden respectively can be attributed to the deposition of mulch used in the preparation of floating gardens for the cultivation of vegetables. Stevenson(1986), Brady and Weil (1996) and Miller and Gardiner (1998) believed that the ammonia gas was produced by

decomposing plant and animal residue and the foliage of living plants which on coming in contact with moisture of soils forms ammonium hydroxide. This inorganic compound consequently increased pH of the soil towards alkaline side.

Moisture content

During summer the moisture content (%) in the processed soil samples of all the study sites in general was minimum than in other seasons as the evaporation of water is greatly influenced by temperature. Consequently during warm or hot days, the evapo-transpiration at the leaf surface or surface of the moist soil is quite high. The moisture content exhibited higher values for floating garden soils (both Dal and Nigeen) especially for the spring season when the cultivators prepare the floating gardens by dumping macrophytes as moisture retention capacity for soils gets enhanced by its rich organic matter content which has also been reported by Tan (2000).

Loss on ignition

It is in a way an expression of the organic matter content of the soil. It showed comparatively higher values for the floating gardens (Dal and Nigeen) having large quantities of decomposing vegetation/mulch. The values in floating gardens ranged between 32.40% and 62.50%. In general the values for loss on ignition were fairly high and ranged between 11.62% and 62.50%.

Organic matter

The organic matter content in the soils typically ranges between 0.10% and 0.5% (Bear, 1964). However, in the soils under investigation it ranged between 3.61 % and 11.0 % which was significantly higher. The values of organic matter and organic carbon were low during the summer season which could be attributed to the use by growing crops. Russell and Russell (1950) have also reported that the decomposition rates of organic matter do increase as the weather warms and furnishes maximum plant growth conditions. The high values were observed during the spring season when the soil was being prepared for the cultivation by adding sediments rich in dead plant matter.

Exchangeable calcium and magnesium

During the present study the Ca^{++} content in the soils was found to vary in the range of 156.60 and 444.20meq./100g while as Mg^{++} content varied between 110.0 and 326.60meq./100g. Calcium and Magnesium levels declined generally during late summer for all sites quite likely as a result of soil leaching and uptake by the developing vegetation. Higher values of Nigeen floating garden and Dal floating garden could be due to the addition of dead macrophytes during the preparation of these gardens in early spring season.

Total phosphorus

The average content of phosphorus in soils ranged between 662 and 1191μg/g which was fairly higher in concentration than general soils. However, total phosphorus appeared to be in higher amounts during spring months and in lower quantity during summer season. According to Katznelson (1977) the values of total phosphorus go on decreasing during the peak cultivation period of summer. Lower values of total phosphorous at both the floating gardens of Dal as well as Nigeen can also be attributed to the prevalence of leaching which may be occurring there occurring there. Steveson (1986) have also reported that soils with minimum leaching were known to contain high amounts of phosphorus as compared to soils with maximum leaching.

Potassium

The concentration of potassium occurred in the range of 55.9 and 126.98mg/g. The values of potassium at almost all sites appeared to follow the trend spring>autumn>summer. Interventions in the form of addition of potassium fertilizers by cultivators can also be a reason for the increased values in Nigeen vegetable garden (2) and in Botapora vegetable garden in summer season as compared to autumn season because during early, growth potassium requirement are high as it is important to have adequate potassium available at seedling stage. Interpretation of the findings can be attributed to the removal of potassium from the soil by the growing crops during summer season and return of potassium to the soils by the vegetative parts and roots between the growing seasons that have an effect similar to that of potassium fertilization. Grimes (1966) verified that potassium diffused from dead plant residues under moist condition and that plants absorbed it. Potassium is likely to be taken up in excess with need (Stinner *et al., 1984).*

Total nitrogen

The quantity of nitrogen in surface generally ranges between 0.02% and 0.25% and is as a rule related to the amount of soil organic matter (Bear, 1964). In the soils of the floating and vegetable gardens under study, the amount of total nitrogen, which ranged between 0.16% and 0.50%, was in general found to be in fairly higher amounts as these soils are in receipt of high amount of organic matter in the form of microflorae/mulch. The nitrogen levels were seen to increase with the onset of rains in the late fall and reached peak in spring. The concentrations dropped through the spring and remained low during summer. This would suggest that more soil nitrogen is used in the earlier growing season.

Table 1. Physico-chemical characterization of soils of vegetable gardens and floating gardens around Dal lake

S.No.	Parameters	Nigeen Veg Garden (1)			Nigeen Floating Garden			Nigeen Veg Garden (2)			Babadam Veg Garden		
		Spring	Summer	Autumn	Spring	Summer	Autumn	Spring	Summer	Autumn	Spring	Summer	Autumn
1	Temperature (°C)	16.60	24.50	18.70	18.60	27.10	20.70	16.00	24.30	17.50	15.60	24.10	17.70
2	Moisture Content (%)	31.90	18.30	51.81	81.30	77.40	79.30	28.72	24.30	24.20	27.50	23.40	25.40
3	pH	7.62	7.44	7.61	8.00	7.69	7.74	7.37	7.12	7.57	7.20	7.28	7.28
4	Conductivity (dS/m)	0.77	0.35	1.59	0.80	1.08	2.06	0.44	1.63	1.31	0.64	1.14	1.23
5	Loss on ignition (%)	17.81	14.06	14.69	62.50	37.03	32.40	26.50	18.01	16.95	14.70	11.62	12.30
6	Calcium (meq.)	323.33	283.33	270.00	364.20	299.00	315.00	270.00	186.66	165.00	273.30	200.00	140.00
7	Magnesium (meq.)	223.33	213.33	205.00	245.00	200.00	189.00	170.00	153.30	105.00	260.00	179.00	165.00
8	Organic Carbon (%)	4.67	2.46	2.88	5.94	3.21	3.40	5.05	3.03	3.29	5.13	2.10	2.78
9	Organic Matter (%)	8.03	4.23	4.95	10.21	5.52	5.84	8.68	5.21	5.65	8.82	3.61	4.78
10	Phosphorus (µg/g)	1201.00	1057.00	1020.00	870.00	745.00	665.00	1254.00	1076.00	1093.00	1020.00	700.00	656.00
11	Potassium (mg/g)	115.80	61.50	70.92	104.87	79.69	85.43	128.50	84.22	81.71	126.66	52.91	68.95
12	Total nitrogen (%)	0.35	0.16	0.19	0.36	0.19	0.23	0.49	0.21	0.26	0.34	0.16	0.19
13	Carbon nitrogen ratio	13.34	15.37	15.15	14.02	16.29	14.78	12.12	14.42	12.65	15.08	13.12	14.63

Table 1. (Continued)

S.No.	Parameters	Mir Mohalla Veg Garden			Kadu Mohalla Veg Garden			Botapora Veg Garden			Dal lake Floating Garden		
		Spring	Summer	Autumn	Spring	Summer	Autumn	Spring	Summer	Autumn	Spring	Summer	Autumn
1	Temperature (°C)	15.00	24.00	17.70	14.60	24.00	17.50	15.30	24.00	17.00	18.00	26.60	20.00
2	Moisture Content (%)	34.50	26.20	24.90	29.60	24.80	25.60	42.40	26.90	27.60	78.40	74.80	54.00
3	pH	7.36	7.30	7.37	7.26	7.19	7.31	7.50	7.28	7.38	7.96	7.64	7.80
4	Conductivity (dS/m)	0.42	0.92	1.62	0.70	0.96	1.23	0.39	1.08	1.26	0.34	1.06	1.89
5	Loss on ignition (%)	15.12	13.55	14.70	13.78	12.18	12.47	27.18	22.00	21.00	44.26	44.00	37.40
6	Calcium (meq.)	326.66	233.33	185.00	226.00	156.60	190.00	296.20	220.00	215.00	444.20	306.00	395.00
7	Magnesium (meq.)	243.33	173.33	150.00	186.60	143.90	110.00	226.60	176.60	155.50	326.30	276.00	284.00
8	Organic Carbon (%)	5.12	2.23	3.02	4.85	2.59	2.76	6.30	3.49	3.16	6.40	4.27	3.51
9	Organic Matter (%)	8.80	3.83	5.21	8.34	4.45	4.74	10.83	6.00	5.43	11.00	7.34	6.03
10	Phosphorus (µg/g)	1021.00	920.00	889.00	1191.00	1079.00	1014.00	1116.00	1005.00	996.00	870.00	693.00	662.00
11	Potassium (mg/g)	126.98	55.79	75.02	120.28	63.89	68.06	100.59	86.34	78.00	118.36	106.15	87.17
12	Total nitrogen (%)	0.40	0.16	0.23	0.39	0.18	0.20	0.50	0.26	0.24	0.46	0.29	0.27
13	Carbon nitrogen ratio	12.80	13.93	13.13	12.43	14.38	13.80	12.60	13.42	13.16	13.91	14.72	13.00

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Carbon: Nitrogen ratio

On the whole C/N ratio, which is related to the high values of both organic carbon and total nitrogen, was found to vary between a minimum of 13.0 and a maximum of 16.89 in case of floating gardens while as in vegetable gardens the ratio fluctuated between a minimum of 12.12 and maximum of 15.37. However, there were no significant variations of C/N ratio between the two types of gardens and these values fall in the category of highly fertile soils.

Temperature

The surface soil temperature of Mir mohalla, Gadu and Botapora vegetable gardens was always found to be lower as compared to floating garden site. The soils of these gardens were found to be not retaining as much moisture as the floating gardens retained. The soils were thus cooler Floating garden at Nigeen and Dal were always exhibiting higher temperature compared to all other sites probably due to warming of epilimnetic water beneath and around these floating gardens which keeps them at higher temperature than other vegetable gardens not surrounded by water.

CONCLUSIONS

It may be concluded that the soils of both vegetable gardens and floating gardens in and around Dal lake seem to be highly fertile organic soils as various analyzed major nutrients (nitrogen, phosphorus, organic carbon) except potassium, were present in fairly higher amounts as compared to average values for soils under cultivation.

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