

EFFECT OF pH ON THE GROWTH AND BIOMASS OF *AZOLLA PINNATA* UNDER POT CONDITIONS

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Azolla pinnata was grown on four pH values ranging from 5 to 8 for six weeks. The observations on fresh and dry weight showed an increase with increased pH values, indicating that at high pH the biomass and N-content increased. The percentage of elements like P, Fe, Zn, Ca and Mg were also found to be high when compared to the plants grown at low pH.

Key words: *Azolla pinnata*, Pot condition, Biomass

INTRODUCTION

Azolla belongs to N.O. Salviniales and has been reported both from temperate and tropical regions of the world. The *Azolla-Anabaena* symbiosis with substantial nitrogen fixing ability has attracted the attention of many workers particularly in agriculture. As a source of nitrogen supply it bears ecological, agronomical and scientific importance [1,6]

The vegetative growth and biomass production of azolla is affected by many factors such as nutrient availability, temperature, light, salinity, turbulence and pH [4] The growth of azolla is reported to occur at pH 7, [2] whereas it shows good growth within pH range 4 to 7 and survives up to pH 10 [5]. In China reports have shown that it grows quite well on soils having pH 8. Watanable et al. [7] reported that at high pH the iron uptake by azolla plant is reduced and results in iron deficiency and ultimately in poor growth. In Pakistan no systematic work has been conducted on the ecology of the indigenous azolla species. The present work is aimed at studying response of indigenous *A. pinnata* to select optimum pH levels under controlled conditions.

MATERIALS AND METHODS

Azolla pinnata was obtained from the Rice Research Institute, Kala Shah Kaku, Lahore. The experiment was carried out in plastic pots each containing 2 Kg of garden soil and 5 litres of water. Four pH levels (pH 5, 6, 7 and 8) were established with the help of a saturated solution of KOH. Each treatment was replicated four times. The pH of all pots was checked daily in the morning and, if required, was adjusted according to the treatment. The fresh green plants of *Azolla pinnata*, weighing one gram, were added to each pot and the pots were kept in a greenhouse. The temperature of greenhouse was maintained at 28°

(32° 24° day/night) as this was an average temperature at which the maximum growth and fresh weight of *Azolla* was obtained. [7]. The relative humidity was about 67%. The plants were allowed to grow for six weeks. The fresh weight of plants was noted and then dried at 80° in an oven for 24 hr and the dry weight recorded. The plants were analyzed for total nitrogen by conventional the micro-Kjeldahl method [5]. The analyses for phosphorus (P), iron (Fe), Zinc (Zn), calcium (Ca) and magnesium (Mg) were carried out through an atomic absorption spectrophotometer.

RESULTS AND DISCUSSION

There was an increase in biomass and N content as pH changed from 5 to 8 (Table 1). The reduced biomass production at low pH was compared to pH 8 may be due to less nutrient availability. However Lumpkin and Plucknett [4] have shown that the availability of most of the micro-nutrients essential for the healthy growth of *Azolla* increases with decreasing pH and this high availability of micro-nutrients at low pH may attain a toxic level. This may justify the increase of N-content in *Azolla* which has significantly increased at high pH.

The composition of the different elements of azolla has been presented in Table 2. The phosphorus contents of *Azolla* plants grown at pH 5 is the minimum as reported by Lumpkin and Plucknett [4]. This perhaps indicates that it is the minimum level of phosphorus which is necessary for the growth of *A. pinnata*. The availability of phosphorus appears to increase with the elevation of pH, as no phosphorus was added in any of the treatments. Watanable et al. [7] found that the availability of iron for *Azolla* is affected by pH and in iron deficient plants, chlorophyll content decreased, resulting in the yellowing of the leaves.

Table 1. Biomass and N-content of *Azolla* grown at different pH levels.

pH	Fresh wt. g/pot	Dry wt. g/pot	N-Content (%)
5	4.10 ±0.07	0.186 ±0.01	2.83 ^a *
6	7.45 ±0.03	0.276 ±0.02	30.09 ^b
7	8.85 ±1.1	0.339 ±0.02	3.19 ^b
8	10.50 ±0.07	0.583 ±0.03	3.53 ^{bc}

*Treatment means having the same superscripts do not differ significantly at 5% level of significance.

Table 2. Mineral contents of *Azolla* at various pH levels (%)

pH	P	Fe	Zn	Ca	Mg
5	0.15	0.036	0.0018	0.26	0.41
6	0.20	0.038	0.0025	0.30	0.58
7	0.25	0.041	0.0029	0.37	0.59
8	0.37	0.043	0.0038	0.45	0.60

Hence dark green colour in higher pH ranges may have resulted from high rate of chlorophyll synthesis. The avail-

bility of zinc, calcium and magnesium also showed an increase towards a higher pH. The reason for this may be that as pH increased, there is a net of H ions concentration and cations are more easily absorbed which may result in high nutritive status and growth of plants.

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