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A comparative study on growth and nutritive value of *Azolla pinneta* and common duck weed (*Lemna minor*) *under* agro climatic condition of Assam

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Abstract
Azolla pinneta and common duckweed (*Lemna minor*) were cultured in concrete tanks separately under field conditions for 30 days, at the farm of Livestock Research Station, Assam Agricultural University, Mandira, Assam. The biomass production, doubling time and relative growth rate of *A. pinneta* was recorded as 173.33±13.16g, 5.55±2.35days and 0.124±0.35 g/g/d respectively and *L. minor* was 143±11.95g, 8.15±2.85 days and 0.084±0.28 g/g/d respectively. The values significantly (P<0.05) differed between the two species. The crude protein, ether extract and crude fibre content of *L. minor* are significantly (P<0.05) lower than *A. pinneta* whereas, total ash content was significantly (P<0.05) higher. No significant difference has been observed in the case of dry matter content. It can be concluded from the study that, both *A. pinneta* and *L. minor* possess good nutritive values and suitable production behaviour in agro climatic conditions of Assam. But, *A. pinneta* showed a better results than *L. minor*.

Keywords: *Azolla pinneta*, duckweed, nutritive value, production behaviour

Introduction
Azolla is a free floating water fern that floats in water and fixes atmospheric nitrogen in association with blue green algae. It is a promising plant having good nutritive contents (23-27% protein, essential amino acids, vitamins, growth promoter intermediaries and minerals). Due to the ease of cultivation and good nutritive value, *Azolla* can be an ideal feed substitute for cattle, buffalo, sheep, goat, pigs, poultry and fish (Becerra *et al.*, 1995) [2] and can be fed as such or dried. Maintenance of pure culture free from contamination and optimal environmental temperature (25-35 ^{0}C) is essential for higher yield.
The common duckweed (*Lemna minor*), is a tiny, free floating aquatic weed, native to temperate and subtropical regions worldwide (Xu *et al.*, 2012) [13] and seen abundantly in ponds and water logging areas. It grows faster than most other plants on earth, sometimes with a doubling time of 2-3 days in ideal growth conditions (Yu *et al.*, 2014) [14]. It achieves this growth by utilizing the nutrients present in waste waters. Duckweed biomass contains organic nitrogen as protein and free amino acids (Yadav *et al.*, 2016) [15] and is relished by many livestock. Hence, keeping these points in view, the present study has been undertaken to explore the nutritive values as well as the production behaviour of *Azolla pinnata* and Common duckweed (*Lemna minor*) under the Agro-climatic condition of Assam.

Materials and Method
Azolla pinneta and common duckweed (*Lemna minor*) were cultured in concrete tanks of 1sq meter area, separately under field condition for 30 days, during December- January, 2020-21, at the farm of Livestock Research Station, Assam Agricultural University, Mandira, Assam. Fresh azolla and duck weed fronds were inoculated in cement tanks @130g per sq meter and allowed to grow under field conditions following the standard manage mental practice.
The biomass production, doubling time and relative growth rate of both the species were estimated after 30 days. The weight of the fresh biomass of both the species assessed from the weight of the initial and final biomass, the doubling time and relative growth rate were calculated as per the method described by Subudhi and Watanabe (1981) [12].

Three samples of each species were taken for estimating the nutritive values. The chemical analysis of each sample was done at Department of Animal Nutrition, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati-22.

The dry matter (DM), crude protein (CP), ether extract (EE) and crude fiber (CF) and nitrogen free extract (NFE) were estimated by the method recommended by AOAC (2007) [1].

The statistical analysis of the experimental data was carried out by using Statistical Package for Social Science (SPSS) version 23.0. Single paired't' test and all data compared with the means at 5% level of significance.

Results and Discussion

The Biomass production, doubling time and relative growth rate of *A. pinneta* and *L. minor* has been presented in the table: 1. The table reveals that, biomass production of *A. pinneta* (173.33±13.16g) is significantly ($P<0.05$) higher than *L. minor* (143±11.95g) but doubling time is significantly ($P<0.05$) lower, which recorded as 5.55±2.35 and 8.15±2.85 days in *A. pinneta* and *L. minor* respectively. Lakshmanan *et al.* (2017) reported around 5days of doubling times (5.4, 5.34, 5.02 and 5.14 days) from *A. microphylla, A. filiculoides*, *Azolla* hybrid Rong Ping and *Azolla* hybrid TNAUI respectively under field condition. However, as low as 3.1 days of doubling time from *A. Mexicana* and *A. Filiculoides* was also recorded (Kannaiyan (1988) [7]. The relative rate of growth (g/g/d) in case of *A. pinneta* and *L. minor* is 0.124±0.35 and 0.084 ±0.28 respectively, which differs significantly ($P<0.05$) between them. The relative rate of growth (g/g/d) of *A. microphylla* and *A. filiculoides* under field condition was reported as 0.127 and 0.130 respectively (Lakshmanan *et al.*, 2017) [10], which is almost similar with the relative rate of growth (g/g/d) of *A. pinneta* of the present study. Differences in growth attributes among different species of azolla recorded in the different studies might be due to species variation and cultivation practices as well.

Table 1: Biomass production, doubling time and relative growth rate of *A. pinneta* and *L. minor*

Particulars	*A. pinneta*	*L. minor*
Biomass production(g)	173.33^{a}±13.16	143^{b}±11.95
Doubling time(Days)	5.55^{a}±2.35	8.15^{b}±2.85
Relative rate of growth(g/g/d)	0.124^{a}±0.35	0.084^{b}±0.28

Fresh *A. pinneta* and *L. minor* samples were analyzed for dry matter, crude protein, ether extract, crude fibre, total ash and nitrogen free extract and presented in the table: 2. It is revealed from the study that, the dry matter content of *A. pinneta* is 4.97±2.86, which is in agreement with the findings of Giridhar *et al.* (2012) [6] and Kavya (2014) [9] whereas Parashuramulu (2013) [11] reported a higher value (8.9%) of dry matter. The crude protein content of *A. pinneta* and *L. minor* is 24.2±4.91and 22.55±4.74 respectively, which is almost similar to the findings of Cherryl *et al.* (2014) [5], Kumar *et al.* 92012) [8] and Balaji *et al.* (2009) [3]. The ether extract content of both species is higher than the value (3.7%) reported by Cherryl *et al.* (2014) [5]. The crude fibre content of *A. pinneta* and *L. minor* was observed as14.68±3.83 and 14.23±3.77, which was found to be in accord with the values obtained by cherryl *et al.* (2014) [5] and Balaji *et al.* (2009) [3] whereas, lower values were also reported by Kumar *et al.*, (2012) [8] and Bolka (2011) [4]. The total ash content of *A. pinneta* obtained in this experiment was 13.98±3.73 and *L. minor was* 14.92±3.86, which are lower than the values obtained by Cherryl *et al.* (2014) [5]. The nitrogen free extract values of both species were 37.96±6.16 and 36.53±6.04, which are less than the values reported by Cherryl *et al.*, (2014) [5].

The crude protein, ether extract and crude fibre content of *L. minor* is significantly ($P<0.05$) lower than *A. pinneta* whereas, the total ash content is significantly ($P<0.05$) higher. No significant difference has been observed in the case of dry matter content which may be due to the species difference.

Table 2: Proximate analysis values of *A. pinneta* and *L. minor*

Chemical analysis (%)	*A. pinneta*	*L. minor*
DM	4.97±2.86	6.48±3.74
CP	24.2^{a}±4.91	22.55^{b}±4.74
EE	4.2^{a}±2.42	4.27^{b}±2.46
CF	14.68^{a}±3.83	14.23^{b}±3.77
Ash	13.98^{a}±3.73	14.92^{b}±3.86
NFE	37.96±6.16	36.53±6.04

Conclusion

From this study, it can be concluded that, both *A. pinneta* and *L. minor* possess good nutritive values and production behaviour in the agro climatic conditions of Assam. However, due to the rapid biomass production, higher relative growth rate and better nutritive value, *A. pinneta* favoured its use as a livestock feed supplement as well as agricultural use than *L. minor*.

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