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Effect of supplementation of azolla (*Azolla pinnata*) on productive performance in cattle and economics of farmers: A field study

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Abstract

Present field studies were conducted in six adopted villages by establishing Azolla production units. The six samples one from each adopted village of Azolla (*Azolla pinnata*) were collected and used for chemical composition analysis. On Farm Trail (OFT) was conducted to assess the effect on productive performance in cattle and economics of farmers. The proximate composition i.e. DM, OM, CP, EE and TA content (% DM) of *Azolla pinnata* were 8.61±0.02, 81.27±0.16, 24.15±0.07, 3.81±0.11 and 18.78±0.16 respectively while the fibre fractions i.e. NDF, ADF, Hemicellulose, Lignin and cellulose content (% DM) of *Azolla pinnata* were 46.29±0.11, 36.41±0.04, 14.00±0.31, 7.00±0.11 and 26.00±0.31 respectively. The average values of Ca (%), Mn (ppm), Zn (ppm), Cu (ppm) and Fe (ppm) was 1.56±0.08, 617.21±6.18, 35.09±2.21, 34.19.12±1.26 and 714.16± 25.11 respectively. 4.12±0.51 kg milk yield was recorded in azolla supplemented group as compared to control group 3.51±0.36. Under Field conditions the farmer by investing just Rs. 1611/- on Azolla production can earn additional returns of Rs. 6344 /- per dairy cow. The B: C ratio was calculated to be 2.93:1, indicating high income utility of this Azolla supplemental feeding.

Keywords: azolla, milk yield, fat, proximate composition, economics

Introduction

Ruminants play a major role in providing nutritional and livelihood security for millions of rural households in India. Among many factors governing the livestock productivity, feeding accounts for more than 60-70 per cent of the total recurring cost and hence qualitative and quantitative improvement in this aspect will usually improve productivity. Conventional sources of feeds are not enough to mitigate the shortage of feeds and fodder and to make animal production viable and profitable in tropical countries. Net deficit of green fodder is around 60 per cent, apart from the feed deficit of around 64 per cent. In order to fulfil this gap and to ensure optimum production of livestock throughout the year, we have to use of unconventional feed resources as supplement or replacement of conventional feed, but without compromising the quality of nutrient supply. Many researchers (Khutan and Ali, 1999; Satish and Ustuge, 2009; Tamang and Samanta, 1993) ^[13] have identified many unconventional feed and fodder to maintain the milk production particularly in off season. The search of alternatives to green fodder and concentrates led to a wonderful plant Azolla, which holds the promise of providing a sustainable feed for livestock. Azolla has attracted the attention of scientists as a feed resource for livestock and even called it as Green gold mine or super plant due to its high nutritive value and faster growth. Azolla is a small free floating aquatic fern. Azolla is very rich in proteins, essential amino acids, vitamins (vitamin A, vitamin B12, Beta Carotene), growth promoter intermediaries and minerals including calcium, phosphorous, potassium, ferrous, copper, magnesium. Azolla has been reported as one of the most economic and efficient feed substitutes for livestock, particularly as can be easily digested by livestock due to its high protein and low lignin content. Azolla is called "Green Gold" due to these characteristics (Wagner, 1997) ^[23]. Its nutrients composition makes it an efficient and ideal feed supplement for livestock, Goat, poultry, pigs and fish (Lumpkin, 1984) ^[15]. Ambade *et al.*, (2010) ^[2] reported that milk yield was increased by 15 to 20% after feeding azolla in the diet of dairy cows. Sanginga and Van Hove (1989) ^[20] reported that the main character influencing the value of azolla as its feed is its amino acid composition.

Materials and Methods

Present field studies were conducted in six adopted villages Paraswada, Jhunkar, Chater, Paliya Pipariya, Sobhapur and Kothari of Hoshangabad district in Madhya Pradesh by establishing Azolla production units of 8×3×2 feet size with silpaulin sheet and mesh covering in. First of all Livestock owners were properly trained by on and off campus practical trainings programme on Azolla production technology. Five progressive farmers were selected in each village who kept lactating cattle and total 30 Azolla Production units were established in six adopted villages by providing 1 Kg Azolla Culture as critical input. Regular monitoring was done and suggestions were given by Krishi Vigyan Kendra scientists to rectify the problems arise in Azolla Production under different villages. The six samples one from each adopted village of Azolla (*Azolla pinnata*) were collected and used for chemical composition analysis. The percentage of Dry Matter (DM), Organic matter (OM), Crude Protein (CP), Ether Extract (EE) and Total Ash in Azolla were determined according to AOAC (2005) [4]. The fibre fractions of cell wall constituents such as NDF, ADF, Cellulose, Hemicellulose and Lignin were estimated as per Van Soest *et al.* (1991) [22]. The important trace minerals (Cu, Zn, Mn and Fe) and Ca were estimated by Atomic absorption Spectrophotometer. AAS uses acetylene as a fuel and air as an oxidant, specific hollow cathode lamp were used for determination of each element. The procedures described in AAS data book (1988) was followed. On Farm Trail (OFT) was conducted to assess the supplementation Azolla (*Azolla pinnata*) on productive performance in cattle and economics of farmers. For this purpose initially 30 lactating desi cows of second to third lactation of 5 to 6 years old at mid-lactation were selected from 6 adopted villages. These 30 lactating cows were selected for the study and randomly distributed into two groups of fifteen animals in each group. The Control (C) group (n=15 Cows) which was farmers practice in study area which was fed Maize grain, cottonseed cake, paddy straw and berseem and Napier grass. Whereas, the Treatment (T) group (n=15 cows) was fed with same quantity of roughages and concentrate with supplementation of 1.5 Kg fresh green azolla (*Azolla pinnata*). The cows were hand-milked twice daily. Daily milk yield of each animal was recorded a period of 120 days. The fat% of collected sample was determined by the Gerber method- IS 1224-1 (1977). The economics were worked out by using debit and credit side during the study period. The Data were analyzed for statistical differences by Analysis of Variance (Snedecor and Cochran, 1989) and Duncan's Multiple Range Tests (Duncan, 1995).

Results and Discussion

The proximate composition and fiber fractions of *Azolla pinnata* was presented in Table 1 while a mineral content of was presented in Table 2. The wide variation in CP, EE, TA, OM, TDN, NDF, ADF, Hemicellulose, Cellulose and Lignin content *Azolla pinnata* may be due to soil structure, environmental conditions and management.

Proximate composition and fibre fractions *Azolla Pinnata*

The proximate composition and fibre fractions of *Azolla pinnata* was presented in Table 1. The proximate composition i.e. DM, OM, CP, EE and TA content (% DM) of *Azolla pinnata* were 8.61±0.02, 81.27±0.16, 24.15±0.07, 3.81±0.11 and 18.78±0.16 respectively. The results of the presents study are in agreement with the Anitha *et al.* (2016) [3], Cherryl *et*

al. (2014) [6] and Chatterjee *et al.* (2013) [5] who reported close values to this earlier. Also fibre fractions i.e. NDF, ADF, Hemicellulose, Lignin and cellulose content (% DM) of *Azolla pinnata* were 46.29±0.11, 36.41±0.04, 14.00±0.31, 7.00±0.11 and 26.00±0.31 respectively which were similar to the values reported by Gupta *et al.* (2018) [10].

Table 1: Proximate composition and Fibre Fractions of Azolla (*Azolla pinnata*) on DMB

I] Proximate Composition	
Components	Percent (DM%)
DM%	8.61±0.02
OM (% DM)	81.27±0.16
CP (% DM)	24.15±0.07
EE (% DM)	3.81±0.11
TA (% DM)	18.78±0.16
II] Fibre Fractions	
Components	Percent (DM%)
NDF (% DM)	46.29±0.11
ADF (% DM)	36.41±0.04
Hemicellulose (% DM)	14.00±0.31
Lignin (% DM)	7.00±0.11
Cellulose (% DM)	26.00±0.31

Mineral composition of *Azolla pinnata*

The average mineral content of *Azolla pinnata* is presented in Table 2. The average values of Ca (%), Mn (ppm), Zn (ppm), Cu (ppm) and Fe (ppm) was 1.56±0.08, 617.21±6.18, 35.09±2.21, 34.19.12±1.26 and 714.16± 5.11 respectively which were similar to the values reported by Anitha *et al.* (2016) [3] and Alalade and Iyayi (2006) [1].

Table 2: Mineral Composition Azolla (*Azolla pinnata*)

Minerals	Present Value
Calcium (%)	1.56± 0.08
Manganese (ppm)	617.21±6.18
Zinc (ppm)	35.09±2.21
Copper (ppm)	34.19±1.26
Ferrous (ppm)	714.16±25.11

Effect of supplementation Azolla (*Azolla pinnata*) on Milk Yield and Fat (%)

The data pertaining to Milk yield (kg) and Fat (%) presented in Table 3. 4.12±0.51 kg milk yield was recorded in azolla supplemented group as compared to control group 3.51±0.36. The milk yield shows an increasing trend and it increased to 4.12 kg/day from 3.51 kg/day after 120 days of supplementation azolla per day with conventional feed like-cottonseed cake and maize grain, an average milk yield increased by 0.61 kg/day. About 17.37% increase in the milk yield is a tremendous improvement. The milk yield improvement was most probably due to supplementation of essential amino acids and huge protein through Azolla. Sanginga and Van Hove (1989) [20] stated that the main character influencing the value of Azolla as its feed is its amino acids composition. Pillai *et al.* (2002) [18] also reported that substantial improvement in the quantity (15-20%) and quality of milk produced when livestock were fed fresh Azolla @ 1.5 to 2 kg /animal /day. It is in conformation with Singh *et al.* (2017) [21]; Mathur *et al.* (2013) [16] and Kamalasanana *et al.* (2002) [12] in buffaloes. Whereas, Kololgi *et al.* (2009) [14] reported 10 per cent increase in milk yield in lactating buffaloes. Gouri *et al.* (2012) [8]; Ambade *et al.* (2010) [2]; Rawat *et al.* (2015) [19] and Gowda *et al.* (2015) [9] found similar results in cross bred cows. Murthy *et al.*, (2013)

[17] found no significant difference among the groups with respect to milk yield in crossbred cows. In different studies it was revealed that the Azolla can be fed to the animals without any adverse effects. Therefore, it can be used as a valuable green feed supplement for cows, particularly under low input livestock production system, where livestock owners fed only cottonseed cake as concentrate or unbalanced concentrate ration, because the only unbalanced concentrate ration cannot

fulfil the nutrient requirement of animal. Azolla can fulfill the requirement of nutrients of animal with cottonseed cake. Azolla is important for feeding to buffaloes for milk production. So we can produce more milk from indigenous cows at low cost by feeding azolla with cottonseed cake. $4.37 \pm 0.26\%$ fat was recorded in azolla supplemented group as compared to control group $4.13 \pm 0.32\%$. This might be due to the as milk production is inversely proportional to the fat%.

Table 3: Effect of supplementation Azolla (*Azolla pinnata*) on Milk Yield and Fat (%)

Parameters	Control	Treatment
Milk Yield (kg)	3.51 ± 0.36	4.12 ± 0.51
Fat (%)	4.37 ± 0.26	4.13 ± 0.32

Economics of supplementation Azolla (*Azolla pinnata*) per cow-

In the experimental villages on an average the per day milk yield of indigenous cows enhance from 3.51 to 4.12 kg, an increase of 0.61 kg per cow with the supplementation of Azolla. This low cost Azolla supplementation improved the mean returns from a single cow, through milk sale, by 732 /-

per month in the villages. Partial budgeting was done to access the economics and impact of Azolla feeding in cows (Table 4). It showed that the farmer by investing just Rs. 1611/- on Azolla production can earn additional returns of Rs. 6344 /- per dairy cow. The B: C ratio was calculated to be 2.93:1, indicating high income utility of this Azolla supplemental feeding.

Table 4: Economics of supplementation Azolla (*Azolla pinnata*) per cow-

Sr. No.	Debit side	Rupees	Credit Side	Rupees	B:C Ratio
1	Digging charge of Azolla Pit size (8X3X2) ft	Family labour			
2	Cost of Silpauline sheet	670.00			
3	Green Net	725.00			
4	Single super phosphate (SSP) 600 gm @ 50 gm/month	16.00			
5	Azolla 2 Kg. @Rs.100/kg	200			
6	15 Kg. Black Soil	Available with farmer	Extra milk 0.61lit./cow	260 days of lactation with azolla	
7	10 kg. Cow Dung	Available with farmer			
		Total Rs. 1611/-		Total Rs. 6344/-	2.93:1

Conclusion

The present findings indicate that Azolla is a rich source of protein, minerals and other essential nutrients also the supplemental feeding of fresh green Azolla has positive effect on the milk production and economics. The low cost supplementation of Azolla can also improve the mean economic returns from single cow through additional milk yield per month in the village.

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