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Aeschynomene aspera L., a Potential Stem Nodulated Plant as Green Manure for Rice Cultivation in Manipur

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Experiment was conducted in microplots (4m²) using stem nodulated *Aeschynomene aspera* L. to evaluate its potential as green manure on the yield of rice variety Lungnila -phou (RCM-10) in Manipur condition. *A. aspera* L. green biomass can yield 230kgN/ha in 7 weeks of its growth. Application of *A. aspera* L. as green manure increases rice grain yield by more than 52% over the control. The yield of grain and filled grain was significantly higher in the plots treatment with *A. aspera* L. stem nodulated twigs as green manure alone than in other treatments.

Keyword: *Aeschynomene aspera* L., Green Manure, Rice Variety Lungnila-Phou (RCM-10), Manipur.

1. Introduction

In order to produce 100kg of grains, rice requires 1.2-2kg of nitrogen regardless of the soil types and the dates of planting^[1-4]. Soil nitrogen reserves are limited, it is necessary to use nitrogen fertilizers but these are expensive. So, biological nitrogen fixation presents an appealing alternative to the fertilizers. Much work had been devoted by previous workers to harnessing this process serving as an organic nitrogen fertilizer termed as “Green Manure”.

Earlier workers had used green manures legumes such as *Astragalus sinicus*, *Sesbania paludosa*, *S. rostrata*, *S. aculeata*, *S. cannabina*, *S. sesban*, *Crotalaria juncea*, *C. striata*, *C. anagyroides*, *Vicia cracca*, *Medicago hispida*, *M. officinalis*, *Aeschynomene americana*, *A. indica*, *A. afraspera*, *A. nilotica* in rice cultivation^[1-14]. Growing a legume as a green manure crop before rice plantation could be a way to increase the available nitrogen content in the soil.

Of the 150-250 species of *Aeschynomene*, nodules in the stem have been reported in *A. indica*, *A. aspera*, *A. elaphroxylon*, *A. afraspera*, *A. villosa*, *A. evenia* and *A. paniculata*^[15]. In India, *A. indica* and *A. aspera* occur widely in waterlogged situation. *A. aspera* L. also grow abundantly in the North-East states of India¹⁶. In Manipur valley, the plant is found growing in wet and wastelands during rainy season (May-Sept.). In the present study, the quantity of nitrogen accumulated by growing *A. aspera* L. as green manure for 50 days and the response to the N₂ accumulated was determined.

2. Materials and Methods

The experiments were carried out in consecutively three years during the rainy season at the experimental plots on five microplots (2x2m², 45cm deep) being constructed with bricks plastered with cement. To each microplots added with 560 kg of soil (dry weight). The soil type was sandy loam with pH 6.4. Four

treatments with control were replicated three times in a randomized block design.

T1: *Aeschynomene aspera* as green manure

A. aspera seeds were immersed in 0.1N H₂SO₄ for 3 min and rinsed in tap water thoroughly before germination. These seeds were sowed in microplots and kept waterlogged for 50 days. The stems were inoculated by spraying them with broth culture of *Rhizobium* strain (MTCC-10038) on 21st and 30th days after sowing. Irrigation was stopped for 7 days, and then the stems of *A. aspera* were cut off just above the soil, chopped off in 15-20 cm long containing nodules. 4kg/4m² of *A. aspera* twigs were incorporated into the soil at a depth of 20 cm a week before transplanting. After incorporation, plots were treated with PK (33g KH₂PO₄ + 23g K₂HPO₄ per 4m²) and planted with three week-old rice seedling var. Luningla-phou (RCM-10) and waterlogged again at a density of 200 hill/4m². Each hill consisted of three plants.

T2: Nitrogen fertilizer application

During the first 71 days, microplots were kept in bare fallow with the same water management as in T1 treatment. Then the microplots were treated

with NPK, then planted with rice and waterlogged. The NPK application (53g urea @ 60kgN/ha, 33g KH₂PO₄ + 23g K₂HPO₄ per 4m²) was in split doses, 50% being given before transplantation and remaining 50% at suckering stage of rice^[17,18].

T3: 60N:40N *A. aspera*

As treated in treatment T1, 1.2kg/4m² chopped off stem of *A. aspera* were incorporated along with 32g urea, 33g KH₂PO₄ + 23g K₂HPO₄ per 4m² plot in split doses as in treatment T2^[19].

T4: 50N:50 *A. aspera*

As treated in treatment T3, 2kg/4m² of chopped stem of *A. aspera* were incorporated along with 27g urea, 33g KH₂PO₄ + 23g K₂HPO₄ per 4m² plot in split doses as in treatment T2.

T5: Control

As in treatment T2, but the microplots were applied only with PK fertilizers before rice transplantation.

The treatment details were provided (Table 1).

Table 1: Treatment details for rice var. Luningla-phou (RCM-10)

Treatment number	Treatments
T1	<i>Aeschynomene aspera</i> L. alone (4kg/4m ²)
T2	100N urea alone (53gm/4m ²)
T3	60N:40N <i>Aeschynomene aspera</i> L. (32gm:1.2kg/4m ²)
T4	50N:50N <i>Aeschynomene aspera</i> L. (27gm:2kg/4m ²)
T5	Control (No nitrogen fertilizer)

The rice crop was harvested when plants were 135 days old. The plants were cut off just above the crown and panicle number, length was determined. Grains were separated and weighed.

2.1 Efficacy of N-fixing

Dry stem of *A. aspera* were ground to powder and nitrogen content was determined by micro Kjeldahl digestion^[20].

2.2 Statistical analysis

For each sample of plant material three replications were taken. Statistical analyses were carried out using the mean of the three individuals analysis related to each microplots. Significance of the data was determined by the χ^2 test at the degree of freedom level 5%, t-test.

3. Results

The effect of green manure treatment on rice var. Lungnila-phou (RCM-10) on plant height, panicle

length, effective tiller, filled grain, grain weight and yield were studied (Table 2).

Table 2: Effect of treatment by *A. aspera* twigs as green manure on rice plant height, panicle length, effective tiller/m², filled grain/panicle, 1000 grain weight and grain yield of Luningla-phou (RCM-10) (3 years mean)

Treatments	Plant height (cm)	Panicle length (cm)	Effective tiller/m ²	Filled grain/ panicle	1000 grain weight (g)	Grain yield (t/ha)
T1	95.8	24.1	183	170	29.9	16.0
T2	92.2	23.0	175	165	28.7	14.4
T3	93.6	22.8	173	160	28.9	12.8
T4	92.9	22.9	156	145	26.5	9.7
T5	89.0	21.5	130	110	25.2	7.6
χ^2	0.86	0.25	11.93	15.67	0.59	3.82
t-test	35.99	10.16	14.68	11.54	7.67	3.12

3.1 Yield and Yield Parameters of Rice

In green manure treatment (T1), the plant height (cm), panicle length (cm) and effective tiller/m² were significantly higher than those treated with urea.

1000-grain weight was also significantly higher (29.9g) in T1 over the control. Significance in grain weight may be due to efficient nitrogen uptake which ultimately resulted in maximum 1000-grain weight.

Maximum number of filled grain/panicle (170g) and grain yield (15.93t/ha) were also recorded in *A. aspera* L. treatment as green manure which was statistically higher than all other treatments. The maximum yield might be attributed to healthy plant growth due to efficient nitrogen uptake and having higher grain weight, which ultimately resulted in higher production of rice grain.

The nitrogen efficiency of *A. aspera* L. was estimated @230kgN/ha by micro Kjeldahl method.

Green manure treated plot yielded more rice grain than control plot and significantly more than plot applied with equivalent of 60kgN/ha.

4. Discussion

Green manuring is generally recognized as the most efficient way to transferring biologically fixed nitrogen to the soil. We can expect that the use of *A. aspera* as green manure would allow us

to obtain yield of rice grain as high as 11t/ha a much higher value than that obtained with *S. rostrata* (6t/ha), *A. afraspera* and *A. nilotica* (9t/ha) ^{8,9}. Use of *A. aspera* green manure provides a large input of nitrogen to the soil which contributes to the rice yield increase providing an important of input of organic matter.

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