Journal of Medicinal Plants Studies
Year: **2013**, Volume: **1**, Issue: **4**
First page: (**28**) Last page: (**31**)
ISSN: **2320-3862**
Online Available at **www.plantsjournal.com**

Journal of Medicinal Plants Studies

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

W. Radhapiyari Devi [1*]

1. Medicinal and Horticultural Plant Resources Division, Institute of Bioresources and Sustainable Development, Imphal-795001, Manipur, India
(An autonomous institute under Department of Biotechnology, Govt. of India)
[E-mail: radhawang@gmail.com]

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 terming as "Green Manure".

Earlier workers had used green manures legumes such as *Astragulus 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 India [16]. 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 N_2 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 H_2SO_4 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 KH_2PO_4 + 23g K_2HPO_4 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 KH_2PO_4 + 23g K_2HPO_4 per 4m²) was in splited 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 KH_2PO_4 + 23g K_2HPO_4 per 4m² plot in splited 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 KH_2PO_4 + 23g K_2HPO_4 per 4m² plot in splited 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	*Aeschynomene aspera* L. alone (4kg/4m²)
T2	100N urea alone (53gm/4m²)
T3	60N:40N *Aeschynomene aspera* L. (32gm:1.2kg/4m²)
T4	50N:50N *Aeschynomene aspera* L. (27gm:2kg/4m²)
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/m²	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.

5. Acknowledgement

The author thanks to ICAR, North East Hill Region, Lamphalphet, Manipur for providing seedling rice plant var. Lungnila-phou (RCM-10).

6. References

1. Patnaik S, Rao MV. Sources of nitrogen for rice production. In Nitrogen and Rice. IRRI, Los Banos Philippines, 1979; 25-43.
2. Dreyfus B, Rinaudo G, Dommergues Y. Observations on the use of Sesbania rostrata as green manure in paddy fields. World Journal of Microbiology and Biotechnology 1985; 1(2):111-122.
3. Becker M, Diekmann KH, Ladha JK, De Datta SK, Ottow JCG. Effect of NPK on growth and nitrogen fixation of Sesbania rostrata as a green manure for lowland rice (*Oryza sativa* L.) Plant and Soil. 1991;132:149-158.
4. Becker M, Ladha JK and Ottow JCG. Growth and N2 fixation of two stem-nodulating legumes and their effect as green manure on lowland rice. Soil Biol. Biochem. 1999; 22:1109-1119.
5. Vachhani MV, Murty KS. Green manuring for rice. Indian Council of Agric. Res Rep Ser 1964; 17:50

6. Watanabe I, App A. Research needs for management of nitrogen fixation in flooded rice crops systems. In Nitrogen and Rice. IRRI, Los Banos, Philippines, 1979; 485-490.
7. Watanabe I. Use of green manure in North East Asia. In Organic Matter and Rice. IRRI, P.O. Box 93, Manila, Philippines, 1984; 45-56.
8. Rinaudo G, Dreyfus B, Dommergues Y. Sesbania rostrata green manure and the nitrogen content of rice crop and soil. Soil Biol Biochem 1983; 15(1):111-113.
9. Alazard D. Stem and root nodulation in Aeschynomene spp. Appl Environ Microbiol 1985; 50:732-734.
10. Alazard D, Becker M. Aeschynomene as green manure for rice. Plant and Soil 1987; 101:141-143.
11. Rinaudo G, Alazard D, Moudiongui A. Stem nodulating legumes as green manures for rice in West Africa. In Sustainable Agriculture. Green manure in Rice Farming. IRRI, P.O. Box 933, Manila, Philippines, 1988; 97-109.
12. Ladha JK, Mayon S, Garcia M. Sesbania rostrata as a green manure for lowland rice: Growth, N2-fixation Azorhizobium spp. Inoculation and effects on succeeding crop yields and nitrogen balance. Biol Fertil Soils 1989; 7:191-197.
13. Ladha JK, Pareek RP, Becker M. Stem nodulating legume Rhizobium symbiosis and its agronomic use in lowland rice. Adv Soil Sc 1992; 20:149-192.
14. Santhi P, Ponnuswamy K, Subramanian M. Sustaining rice yield with green manure. The Hindu, Online edition of India's National Newspaper, 2001.
15. Kretschmer Jr AE, Bullock RC. Aeschynomene spp. Distribution and potential use. Soil Crop Sc Soc Fla Proc 1980; 39:145-152.
16. Singh NI. Technology development and Demonstration on the use of Aeschynomene aspera as green manure for rice cultivation in North East India. Final technical report, CSIR, Govt. of India, New Delhi, 2004.
17. Sharma SD, Agarwal SK. Relative efficiency of nitrogen fertilizers in rice. Indian J Agron 1989; 34(1):101-102.
18. Manzoor Z, Ali RI, Awan TH, Khalid N, Ahmad M. Appropriate time of nitrogen application to fine rice, *Oryza sativa*. J Agric Res 2006; 44(4):261-267.
19. Ming-gang XU, Dong-Chu LI, Ju-Mei LI, Dao-zhu QUI, Yagi K, Yasukazu H. Effects of organic manure application with chemical fertilizers on nutrient absorption and yield of rice in human of Southern China. Agriculture Sciences in China 2008; 7(10):1245-1252.
20. Lang CA. Simple micro Kjeldahl nitrogen in biological materials. Advance Chemistry 1958; 30:1962-1964.