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Roshani Gupta
Research Scholar, Department of Botany, Govt. P.G. College, Satna, Madhya Pradesh, India

Abha Khare
Professor, Department of Botany, Govt. P.G. College, Satna, Madhya Pradesh, India

Corresponding Author:
Roshani Gupta
Research Scholar, Department of Botany, Govt. P.G. College, Satna, Madhya Pradesh, India

Aeschynomene aspera L. used plant as green manure for rice cultivation in Rampur Baghelan, Satna (M.P.)

Roshani Gupta and Abha Khare

Abstract
The experiments were performed on microplots (4m²) using a stem used by *Aeschynomene aspera* L. to test its potency as a green fertilizer on the fruit fields of Rampur Baghelan, Satna district. *A. aspera* L. raw biomass can produce 230kgN / ha in 7 weeks of growth. Use of *A. aspera* L. as green manure increases the grain yield of rice by more than 52% above control. The yield of whole grains and grains was very high in the treatment of sites with *A. aspera* L. The stem of nodule branches as green manure alone than other treatments.

Keywords: *Aeschynomene aspera* L., green manure, rice fields. Rampur Baghelan

Introduction
Nitrogen is the most widely used fertilizer in rice. N absorbs rice to produce 1 ton of brown rice approximately 19-21 kg N (Patnaik and Rao, 1979) [1], and the plant must absorb a large amount of N to produce a high grain yield. The census forecast shows that by the year 2000 more 1.7% more rice will be needed per year (IRRI, 1989) [9]. Similarly, the need for nitrogen fertilizer for rice will increase. Mineral N is the strongest fertilizer. Therefore, it will be necessary to use more energy based on non-renewable fossil fuels to support crop production. It is therefore a concern both economically and environmentally to look at other N sources.
To produce 100kg of grain, rice needs 1.2-2kg of nitrogen regardless of soil type and planting dates (Patnaik and Rao, 1979; Dreyfus *et al.* 1985; Becker *et al.* 1991 & 1999 and Devi, 2013) [1-5]. Soil nitrogen sources are limited, it is necessary to use nitrogen fertilizer but these are expensive. Therefore, biological nitrogen fixation reveals an attractive alternative to fertilizer. Much work has been done by previous workers in implementing this process which acts as a nitrogen fertilizer called "Green Manure".

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.

T_1: *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. IR-36 and waterlogged again at a density of 200 hill/4m². Each hill consisted of three plants.

T_2: Nitrogen fertilizer application
During the first 71 days, microplots were kept in bare fallow with the same water management

as in T_1 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 (Sharma and Agarwal, 1989 and Manzoor *et al.* 2006) [6,7].

T_3: 60N:40N *A. aspera*

As treated in treatment T_1, 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 T_2 (Ming-gang *et al.* 2008) [8].

T_4: 50N:50 *A. aspera*

As treated in treatment T_3, 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 T_2.

T_5: Control

As in treatment T_2, 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. IR-36

S. No.	Treatment number	Treatments
1.	T_1	*Aeschynomene aspera* L. alone (4kg/4m²)
2.	T_2	100N urea alone (53gm/4m²)
3.	T_3	60N:40N *Aeschynomene aspera* L. (32gm:1.2kg/4m²)
4.	T_4	50N:50N *Aeschynomene aspera* L. (27gm:2kg/4m²)
5.	T_5	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.

Efficacy of N-fixing: Dry stem of *A. aspera* were ground to powder and nitrogen content was determined by micro Kjeldahl digestion (Lang, 1958) [10].

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.

Results

The effect of green manure treatment on rice 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 IR-36 (3 years mean)

Treatments	Plant height (cm)	Panicle length (cm)	Effective tiller/m²	Filled grain/panicle	1000 grain weight (g)	Grain yield (t/ha)
T_1	118.8	27.1	180	165	22.4	45.6
T_2	118.1	26.5	175	160	21.8	44.9
T_3	118.4	26.8	179	164	21.9	45.4
T_4	118.2	26.6	176	162	22.2	45.1
T_5	118.5	26.9	179	163	22.0	45.3
χ^2	0.99	0.29	11.88	14.07	0.38	3.13
t-test	34.09	10.17	14.22	10.54	7.07	2.62

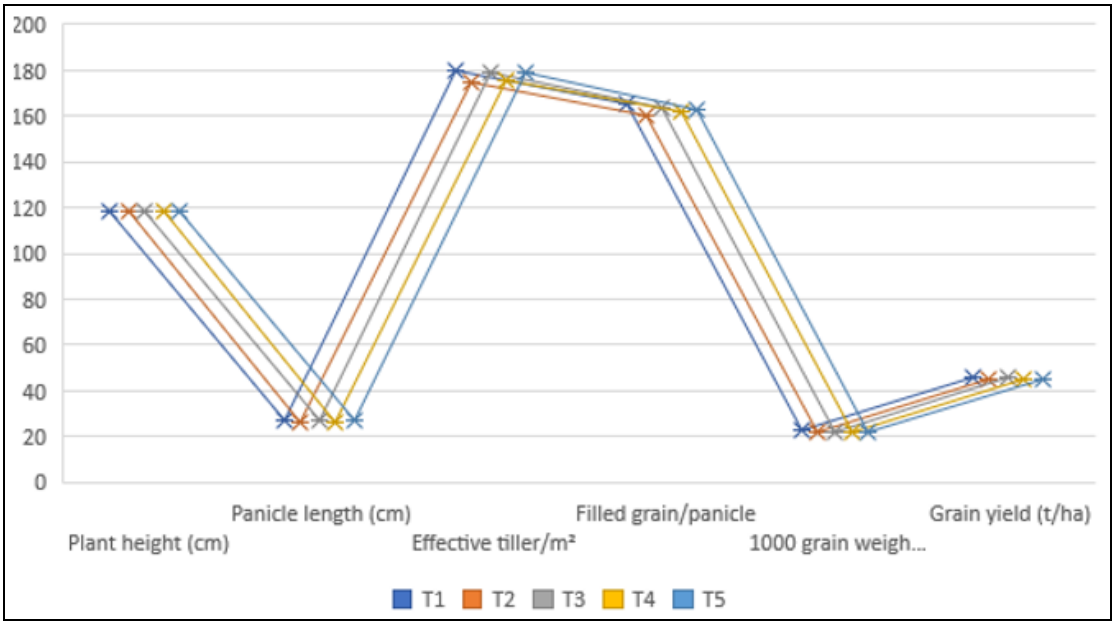

Fig 1: Graph analysis of treatment by A. aspera twigs as green manure on rice plant height, panicle length, effective tiller/m², filled grain/panicle, 1000 grain weight and grain yield of IR-36 (3 year mean)

Yield and Yield Parameters of Rice

In green manure treatment (T_1), 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 (22.4g) in T_1 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 (165g) and grain yield (45.6Q/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.

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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