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Evaluation of green manure intercropping in wet seeded and transplanted rice under island ecosystem

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ABSTRACT

Green manure intercropping of Sesbania aculeata (dhaincha) and Sesbania rostrata led to slight smothering effect on rice growth at early stages. Under wet seeded condition, both the green manures registered, on an average 8.1 t ha^{-1} of fresh biomass, where as under transplanted condition green manures have registered lower fresh biomass. Wet seeded and transplanted rice registered comparable grain yield under green manure inter cropping. It was observed that incorporation of green manure intercrop mechanically could achieve profitability, higher economic returns and energetics.

Key words: *Green manures, intercropping, wet seeding, transplanted rice, energetics*

In island ecosystem, rice is mostly grown in valley areas and plays a vital role in food security. It occupies 8500 ha in bay islands out of 50,000 ha cultivable area. Rice tolerates intense shading during its vegetative phase with least unfavorable effect on yield (Yoshida and Parao, 1976), which can be exploited for *in situ* green manuring practices. Hence, an attempt has been made to evaluate the possibility of intercropping green manure crops with rice under wet seeded and transplanted condition.

MATERIALS AND METHODS

Field experiments were conducted during the wet seasons 2004 and 2005 at the field crop research farm of Central Agricultural Research Institute, Port Blair. The soil was sandy loam with pH 6.5 having 217.3, 16.4 and 328.3 kg ha^{-1} available N, P_2O_5 and K_2O, respectively. Six treatments *viz*, Wet seeded sole rice (T_1), Wet seeded rice + *S. aculeate* (*dhaincha*) (T_2), Wet seeded rice + *S .rostrata* (T_3), Transplanted sole rice (T_4), Transplanted rice + *S. aculeate* (*dhaincha*) (T_5), and Transplanted rice + *S.rostrata* (T_6) were laid out in randomized block design with four replications. Sowing of sole wet seeded rice and concurrent sowing of rice, *S. aculeate* and *S. rostrata* were done by using rice + green manure seeder developed at Tamil Nadu Agricultural University, Coimbatore. Pre germinated seeds (40 kg ha^{-1}) of rice, *S. aculeate* (*dhaincha*) (8 kg ha^{-1}) and acid treated seeds of *S. rostrata* (8 kg ha^{-1}) were sown on 18th and 24th June during 2004 and 2005 respectively. Nursery of rice, *S. aculeate* (*dhaincha*) and *S. rostrata* were raised and 24 days old seedlings of paddy and 12 days old seedlings of *S. aculeate* (*dhaincha*) and *S. rostrata* were transplanted on the same date for the treatments under transplanted conditions. Intercropping of green manure in transplanted condition was done in additive series. Green manures were incorporated on 37 DAS using Cono weeder. Seventy five per cent (67.5: 45: 30 kg N, P_2O_5 and K_2O ha^{-1}) of the recommended dose of fertilizer (90:60:40 kg N, P_2O_5 and K_2O ha^{-1}) was applied as Urea, Single Super phosphate and Muriate of Potash. N was applied in 4 equal splits at basal, active tillering, panicle initiation and flowering stages for transplanted and 21 DAS, 37 DAS, panicle initiation and flowering stages for wet seeded rice. Entire dose of P_2O_5 and K_2O were applied as basal. Growth and biomass of green manures, yield and yield attributes of rice were recorded. Economics were computed. Energetics of all the treatments was worked out using the method prescribed by Rautaray and Mathankar (1999).

RESULTS AND DISCUSSION

Growth attributes both of green manures and rice are presented in Table 1. At the time of incorporation (37 DAS), *S. aculeate* (*dhaincha*) and *S. rostrata* registered 8.5 t ha^{-1} of fresh biomass while under transplanted condition, both the green manures registered lower fresh biomass due to lower population. Green manure inter cropping led to slight smothering effect on rice growth at 20 and 45 DAS resulting in shorter rice plants in inter cropping treatments compared to sole wet seeded rice. This might be due to mutual shading of *S. aculeate* (*dhaincha*) and *S. rostrata* on rice at initial stage. However, at flowering stage, rice +*S. aculeate* and rice + *S. rostrata* registered taller plants of rice compared to sole rice. Yoshida and Parao (1976) also reported that rice growth was initially suppressed due to shading by green manure, but at later stage, after incorporation of green manure, the biomass, picked up and the rice plant had a higher N concentration and recorded increased yield. In general transplanted rice registered more number of tillers m^{-2} and panicles m^{-2} and it was at par with wet seeded rice. Intercropping *S. aculeate* (*dhaincha*) and *S. rostrata* led to higher number of tillers and panicles m^{-2} compared to sole rice. Urkurkar *et al.* (1994) found intercropping with *dhaincha*, in general was not detrimental to rice.

Intercropping of green manures registered significantly higher yield than the sole rice under both wet seeded and transplanted condition (Table 1). Intercropping of *S. aculeate* in wet seeded rice registered higher grain yield of 4562 kg ha^{-1} which was on par with rice + *S. aculeata* under transplanted condition and rice + *S. rostrata* under both wet seeded and transplanted conditions. The increase in yield under green manure intercropping might be due to effective suppression of weeds in wet seeded condition, restriction of nutrient drain by weeds besides additional nutrient supply from green manures and weeds when it is incorporated on 37 DAS using cono weeder. The results are in agreement with findings of Solaiappan and Veerabadran (1997). Straw yield also exhibited similar trend.

Wet seeded rice + *S. aculeate* (*dhaincha*) was significantly better in terms of net returns and benefit cost ratio (Table 2) followed by wet seeded rice + *S .rostrata* as compared to inter cropping of green manures under transplanted conditions as the cost of cultivation was more under transplanting compared to wet seeded rice. Though gross returns were more under transplanted rice, it is not significantly different from wet seeded rice. Benefit cost ratio also reflected similar trend.

Wet seeded sole rice registered lower input energy compared to transplanted rice (Table 2). However, energy output was higher under green manure intercropping condition due to higher grain yield. Energy ratio also exhibited similar trend. The specific energy (energy required to produce one kg of grain) is significantly lower under wet seeded rice compared to transplanted rice. Inter cropping of green manures led to significantly lower specific energy compared to sole rice. Increased energy output as a result of increase in grain and straw yield was attributable for this. Similar

Table 1. Influence of green manure intercropping on green manure biomas, growth and yield of rice (mean of two years)

Treatments	Green manures		Rice Plant height			Tillers	Panicles	Yield (kg ha^{-1})	
	Population (no. m^{-2})	Fresh biomass (t ha^{-1})	20 DAS	45 DAS	Flowering	m^{-2}	m^{-2}	Grain	Straw
Wet seeded sole rice	-	-	19.3	49.4	73.5	445	324	3716	6184
Wet seeded Rice + *S. aculeate* (*dhaincha)*	62	8.2	18.7	47.3	76.4	498	352	4562	6846
Wet seeded Rice + *S. rostrata*	64	8.1	18.8	47.8	76.3	490	345	4328	6524
Transplanted sole rice	-	-	22.3	52.4	82.4	466	329	3926	6424
Transplanted Rice + *S. aculeate* (*dhaincha)*	35	3.8	20.6	48.9	84.6	494	358	4620	6947
Transplanted Rice + *S. rostrata*	34	3.4	20.5	48.5	84.7	498	347	4410	6948
CD (P=0.05)	-	-	6.1	2.8	6.1	31	17	319	538

Table 2. Influence of green manure intercropping on economics per ha energetics of rice (mean of two years)

Treatments	Economics ha^{-1}			B: C ratio	Energetics ha^{-1}			
	Gross returns (Rs)	Cost of cultivation (Rs)	Net returns (Rs)		Energy input (MJ)	Energy out put (MJ)	Energy ratio	Specific energy (MJkg-1)
Wet seeded sole rice	22290	14082	8208	0.58	16728	131925	7.89	4.50
Wet seeded Rice + *S. aculeate* (*dhaincha)*	26918	13418	13500	1.00	17030	152636	8.96	3.73
Wet seeded Rice + *S. rostrata*	25554	13418	12136	0.90	17030	145172	8.52	3.93
Transplanted sole rice	23484	17082	6402	0.48	17042	138012	8.10	4.34
Transplanted Rice + *S. aculeate* (*dhaincha)*	27268	16521	10747	0.65	17344	154752	8.92	3.75
Transplanted Rice + *S. rostrata*	26219	16521	9698	0.59	17344	151677	8.75	3.93
CD (P=0.05)	1643	-	900	0.06	1025	10927	0.73	0.39

observations were earlier made by Govindarajan *et al.* (2002).

Thus it can be concluded that, inter cropping of *Sesbania aculeata* (*dhaincha*) in wet seeded rice and its incorporation on 37 DAS using cono weeder can be recommended under island ecosystem in order to realize higher productivity, profitability and saving of energy. *Sesbania rostrata* needs acid treatment at the time of sowing which may not be feasible at farmers field.

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