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Concurrent growing of green manure with wet-seeded rice for cost-effective weed management

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ABSTRACT

Field experiments were conducted during 2004-06 at Agricultural Research Station, Mannuthy, Thrissur, Kerala to find out the effect of concurrent growing of dhaincha (*Sesbania aculeata*) and its methods of incorporation on weed management in wet seeded rice. Sowing of rice and dhaincha was done in alternate rows using the rice-cum-green manure seeder. Treatments consisted of incorporation of dhaincha at 20 and 30 days after sowing (DAS) by using cono weeder, spraying 2, 4-D 1.0 kg/ha, and metsulfuron-methyl 5 .0 g/ha. Two levels of N (100 and 75% of recommended dose of 90 kg N/ha) were superimposed. Rice alone with 5 t/ha FYM and recommended dose of 90-45-45 kg N-P-K/ha was taken as control. Concurrent growing of dhaincha and its incorporation at 30 DAS resulted in a weed suppression of 70% with an yield enhancement to the tune of 0.840 t/ha and increased profitability of ₹ 12520/ha). Application of 2,4–D resulted in maximum reduction of weeds without any adverse effect on rice. Nitrogen at different levels had no significant influence of weed incidence.

Key words: 2,4-D, Cono weeding, Metsulfuron-methyl, Rice, *Sesbania aculeata*, Weed management

Rice cultivation in Kerala has become less profitable in recent years due to increasing production cost. High labour cost, particularly for labour intensive operations like crop establishment and weeding, significantly contributes to increase production cost. Wet seeding of rice in lowlands is a cost effective and labour-saving crop establishment method followed by the farmers. However, excessive weed growth is a major constraint in wet-seeded rice. Intercropping green manure crops in dry-seeded rice and its subsequent incorporation is very effective in supplying the required quantity of organic manures to rice with additional benefit of weed suppression (Mathew *et al.* 1996). In wet seeded rice, the system involves raising dhaincha as a green manure crop concurrently with wet-seeded rice using rice-cum-green manure seeder and subsequent incorporation of dhaincha (*Sesbania aculeata*) using a cono weeder. The possibility of intense rainfall immediately after sowing may adversely affect the establishment of rice and dhaincha in lines, thus posing problems in the incorporation of dhaincha by using cono-weeder. Thus, it is essential to identify alternate methods of incorporation of dhaincha without any adverse effects on rice plants. The present study was undertaken to find out optimum stage and effective method of incorporation of dhaincha on weed control and productivity of wet-seeded rice.

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MATERIALS AND METHODS

Field experiments were conducted at the Agricultural Research Station, Mannuthy, Thrissur, Kerala during the rainy (*Kharif*) season of 2004-05 and 2005-06. The experimental site was sandy loam in texture with pH 5.6, low in available N (247.7 kg/ha), medium in available P_2O_5 (66.1 kg/ha) and high in available K_2O (616 kg/ha). The experiments were laid out in factorial randomized block design with one control replicated thrice. '*Aiswarya*' was used as the test variety. Sowing of rice and dhaincha was done simultaneously into puddled soil using the rice-cum-green manure seeder. Rice seeds (60 kg/ha), with radicle just emerging and unsprouted dhaincha seeds (20 kg/ha) were used for sowing with the seeder. Treatments consisted of incorporation of dhaincha at two stages *i.e.* 20 and 30 days after sowing (DAS) by using one of the three methods *viz.*, using cono weeder, by spraying 2,4-D 1.0 kg/ha, and metsulfuron-methyl 5.0 g/ha. Two levels of N (100 and 75% of recommended dose of 90 kg N/ha) were superimposed. Wet-sown rice without dhaincha receiving 5 t FYM/ha and recommended dose of nutrients (90 - 45 - 45 kg N- P- K/ha) was taken as control. FYM was applied to control plots alone and incorporated by digging before sowing. Nitrogen fertilizer 100 and 75% of the recommended dose were applied according to the treatment

schedule ($^1/_{3^{rd}}$ basal, 45 DAS, and 60 DAS). Fertilizers P and K were applied uniformly to all the treatments. Irrigation was given as and when required. One weeding was given at 50 DAS to all the treatments. Observations on weed incidence and weed dry matter was recorded from $1m^2$ area by placing a quadrate of 50 x 50 cm randomly at four places in each plot before weeding at 50 DAS. Growth and yield attributes were measured from 10 randomly selected hills. Labour charges, cost of inputs, and the additional cost of incorporating dhaincha were worked out to compute the gross expenditure.

RESULTS AND DISCUSSION

Weed flora and growth

Weed flora were *Echinochloa colona*, *Isachne miliacea, Panicum repens* and *Ischaemum rugosum* among grasses; *Monochoria vaginalis*, *Ludwigia parviflora*, *Marsilea quadrifoliata, Nymphaea nouchali* and *Spenoclea zeylanica* among broad-leaved weeds; and *Cyperus rotundus*, *Schoenoplectus* sp. and *Fimbristylis miliacea* among sedges.

Concurrent growing of dhaincha along with wet-seeded rice significantly reduced the weed count and dry weight of grasses, broad-leaved weeds and sedges, and dry matter production compared with rice grown alone (Table 1). Beneficial effects of concurrent growing of dhaincha in reducing the weed population and weed biomass were reported by Sankar *et al.* (2003). The decline in total weed count due to concurrent growing of dhaincha was 72%, while that in weed dry matter production was 57% compared to rice grown alone (Table 2). The reduction in weed population and dry matter may be attributed to shading effect exerted by the canopy of dhaincha. The co-cropping system reduced the weeding cost by 59% due to saving in labour requirement by 38 man-days/ha. This indicated that dhaincha grown at the expense of weeds by using the growth resources which weeds would have otherwise utilized,. Reduced weed population in treatments involving co-cropping of dhaincha created a competition free environment for growth resources for rice, and might have resulted in increased nutrient uptake and yield of rice compared with pure crop of rice. Stage of incorporation of dhaincha had no significant influence on weed incidence.

Methods of incorporation

In this investigation, dhaincha was incorporated at 20 and 30 DAS by using cono-weeder, or spraying 2,4-D 1.0 kg/ha, or spraying metsulfuron-methyl 5.0 g/ha. Results revealed that grassy weeds were significantly less in cono-weeded treatments. Accordingly, incorporation of dhaincha by cono-weeder resulted in reduction of total weed count by 65% and weed dry matter by 55% compared to control. Rajendran *et al.* (2002) reported that weeds were controlled by adoption of concurrent growing of dhaincha and rice using rice cum green manure seeder and the subsequent incorporation of dhaincha by using cono weeder. Broad-leaved weeds and sedges were significantly higher in cono-weeded plots compared to other methods of incorporation but less than control. Incorpo-

Table 1. Effect of stages and methods of incorporation of concurrently grown dhaincha and N levels on weed count (no./m^2) at 50 DAS

Treatment	Grass weeds		Broad-leaved weeds		Sedges		Total	
	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06
Stage of incorporation								
20 DAS	4.33	8.61	7.28	12.72	15.33	23.11	26.94	44.44
30 DAS	3.11	6.50	8.17	11.67	16.44	22.39	27.72	40.67
LSD (P=0.05)	1.45	NS	NS	NS	NS	NS	NS	NS
Method of incorporation								
Conoweeding	2.33	4.25	11.25	17.33	22.67	28.42	36.25	50.00
2,4-D spray	4.25	11.50	5.33	11.33	9.50	13.42	19.08	36.00
Metsulfuron-methyl spray	4.58	6.92	6.58	7.92	15.50	26.42	26.67	41.67
LSD (P=0.05)	1.77	3.23	3.73	5.80	5.61	7.94	8.76	10.42
N levels								
100% N	3.83	7.33	7.17	11.94	16.06	21.67	27.06	41.44
75% N	3.61	7.78	8.28	12.44	15.72	23.83	27.61	43.67
LSD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS
Rice alone	25.00*	23.33*	18.00*	38.33*	80.67*	72.33*	123.67*	127.67

* Rice alone vs. treatments significant

Table 2. Effect of stages and methods of incorporation of concurrently grown dhaincha and N levels on dry weight of weeds (g/m^2) at 50 DAS

Treatment	Grass weeds		Broad-leaved weeds		Sedges		Total	
	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06
Stage of incorporation								
20 DAS	6.15	10.33	6.07	8.52	7.67	10.90	19.89	29.75
30 DAS	5.32	9.37	7.09	9.05	7.73	12.01	20.13	30.43
LSD (P=0.05)	0.70	NS	0.77	NS	NS	NS	NS	NS
Method of incorporation								
Conoweeding	4.24	8.67	7.37	10.94	8.68	11.92	20.29	31.53
2,4-D spray	6.47	10.62	5.89	8.65	6.33	9.68	18.69	28.94
Metsulfuron-methyl spray	6.50	10.27	6.48	6.78	8.08	12.76	21.56	29.81
LSD (P=0.05)	0.86	1.55	0.95	1.23	1.78	2.82	2.06	NS
N levels								
100% N	5.71	9.36	6.33	8.75	6.99	11.07	19.03	29.18
75% N	5.76	10.34	6.83	8.83	8.40	11.84	21.00	31.01
LSD (P=0.05)	NS	NS	NS	NS	1.46	NS	1.68	NS
Rice alone	9.94*	19.24*	19.00*	17.97*	21.70*	27.76*	50.63*	64.97*

* Rice alone vs. treatments significant

ration of dhaincha by spraying 2,4-D resulted in 78% reduction in total weed count and 59 % in weed dry matter production. Application of 2,4-D for incorporation of dhaincha controlled broad-leaved weeds and sedges substantially because 2,4-D is a selective herbicide recommended against broad-leaved weeds and sedges in rice. Gupta *et al*. (2006) reported that co-culture of *Sesbania* in rice and its subsequent knock down by 2,4-D ester reduced the weed population by nearly half without any adverse effect on rice yield. Reduction in total weed population and weed dry matter by metsulfuron-methyl spray was 72 and 56% respectively. Metsulfuron-methyl is also a selective herbicide for broad-leaved weeds and sedges in rice, and resulted in reduced count and dry matter of total weeds. In plots, where infestation of weeds like *Marsilea quadrifolia* and *Ludwigia parviflora* was serious, application of metsulfuron-methyl was more effective.

N levels

Nitrogen application at 100 and 75% of the recommended dose had no significant influence on the count and dry matter of weeds at 50 DAS. Weed incidence was comparatively more in rice alone plots which received 100% of the recommended N dose along with FYM. Presence of weed seeds in FYM might here increased weed incidence in FYM applied treatments.

Yield and economics

Incorporation of concurrently grown dhaincha at 30 DAS was found beneficial as this resulted in an enhancement in yield and profitability with weed suppression compared to incorporation of dhaincha at 20 DAS (Table 3). Methods of incorporation of dhaincha by all the three methods were found to be equally effective in terms of productivity. Hence in places where it is difficult to use cono weeder for incorporation of dhaincha, it can be effectively incorporated by spraying 2,4-D or metsulfuron-methyl without affecting the yield. Rice+dhaincha receiving 100% of the recommended N recorded significantly higher grain yield (5.17 t/ha), compared to the lower dose of N (75%). Rice yield in dhaincha intercropped plots which received either 100% or 75% of recommended N fertilizer also was significantly higher than the control plots, which received 5 t FYM /ha and full dose of N. Growing dhaincha along with rice and its subsequent incorporation reduced the use of N fertilizers by about 25% without affecting grain yield.

Concurrent growing of dhaincha and its incorporation at 30 DAS resulted in weed suppression of 70% with yield enhancement to the tune of 0.84 t/ha and profitability of ₹ 12520/ha. Application 2,4-D resulted in maximum reduction of weeds without any adverse effect on rice. Concurrent growing of dhaincha and its incorporation using 2,4-D is a low-cost weed management alternative for wet-seeded rice.

Effectiveness of herbicides for incorporating dhaincha without any adverse effect revealed the possibility of direct broadcasting of dhaincha with rice seeds rather than line sowing by using rice-cum-green manure seeder and incorporating dhaincha by cono weeder.

Table 3. Effect of stages and methods of incorporation of concurrently grown dhaincha and nitrogen levels on the yield and economics of wet-sown rice (pooled data)

Treatment	Grain yield (t/ha)	Cost of treatments (x10^3 ₹/ha)	Gross returns (x10^3 ₹/ha)	Net returns (x10^3 ₹/ha)	B: C ratio
Stage of incorporation					
20 DAS	4.91	4.42	41.09	25.24	2.59
30 DAS	5.18	4.39	43.33	27.47	2.73
LSD (P=0.05)	0.202	-	1.615	1.615	0.10
Method of incorporation					
Conoweeding	5.12	4.75	42.75	26.53	2.64
2,4-D spray	5.03	4.15	42.13	26.55	2.70
Metsulfuron-methyl spray	4.99	4.33	41.75	25.98	2.65
LSD (P=0.05)	NS	-	NS	NS	NS
N levels					
100% N	5.12	4.41	43.17	27.19	2.70
75% N	4.93	4.40	41.25	25.52	2.62
LSD (P=0.05)	0.202	-	1.615	1.615	0.10
Rice alone	4.50*	9.60	37.83*	16.14*	1.74*

* Rice alone vs. treatments significant, Cost of operation – conoweeding - ₹ 1300/ha; 2,4-D application - ₹ 660/ha; Metsulfuron-methyl application - ₹ 850/ha, Price of Produce – Rice - ₹ 8/kg; Straw - ₹ 0.5/kg

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