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Effect of Weed and Nitrogen Management on Weed Control and Productivity of Wet Seeded Rice

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ABSTRACT

Pre-emergence application of pretilachlor with safener supplemented with one hand weeding at 40 days after sowing provided better weed control and higher grain yield than the two hand weedings done at 20 and 40 days after sowing. Intercropping of *Sesbania aculeata* and dual cropping of azolla with rice resulted in reduced density and dry weight of weeds. Regarding nitrogen management, 100% N+*S. aculeata* intercropping+azolla dual cropping had a positive impact on yield attributes and thereby produced higher grain yield.

INTRODUCTION

India is the leading rice producing country in terms of area and is the second largest producer next to China. The demand for rice in India is expected to be 100 million tonnes by 2010 and 140 million tonnes by 2025 (Mishra, 2002). Transplanting of rice has been the traditional system of rice establishment but cultivation of wet seeded rice is gaining momentum in India due to the demand of labour during peak season for transplanting and availability of water for shorter periods. In fact, wet seeding is the major system of rice cultivation in Srilanka, Australia, Italy, Portugal and the Philippines. Transforming this crop establishment technique from transplanted to wet seeded rice cultivation has resulted in dramatic changes in the type and degree of weed infestation. Exceptionally weed menace is greater in wet seeded rice than transplanted rice to the extent of 50 to 60% and even a complete crop failure at times (Govindarasu *et al.*, 1998). Intercropping suppresses weeds better than sole cropping and thus provides an opportunity to utilize crops themselves as tools of biological weed management. In recent years, soil health deterioration by the application of chemical fertilizers alone has paved the way for judicious combination of organic manures and inorganic fertilizers to improve soil fertility for sustainable rice production. Green manures and biofertilizers are potential N sources contributing towards enriching the soil nitrogen content, improving the long term productivity and enhancing ecological sustainability. Keeping in view the problems of heavy weed infestation and low nitrogen use efficiency encountered by the farmers in wet seeded rice cultivation, the present investigation was carried out to develop effective and feasible integrated nitrogen and weed management practices for wet seeded rice.

MATERIALS AND METHODS

Field experiment was conducted during **kharif** 2002 and **rabi** 2002-03 at Agricultural College and Research Institute, Coimbatore. Soil at the test site was clay loam, with pH 7.4, 0.58% organic C, available NPK 196.3, 16.5 and 480.2 kg ha^{-1}, respectively. The experiment was laid out in a split plot design with three weed management practices [unweeded control, two hand weedings (HW) at 20 and 40 days after sowing (DAS), and pretilachlor with safener+one HW at 40 DAS] as main plot treatments and seven nitrogen management methods (75% N+*Sesbania aculeata*, 75% N+azolla, 75% N+*S. aculeata*+azolla, 100% N+*S. aculeata*, 100% N+azolla, 100% N+*S. aculeata*+azolla and 100% N) as sub-plot treatments. Nitrogen was applied in the form of urea (46% N). The treatments were replicated three times. Sprouted seeds of ADT 44 (**kharif**) and Co 47 (**rabi**) were line sown at 80 kg ha^{-1} using drum seeder at 20 cm row spacing on puddled soil on July

4, 2002 and October 23, 2002. The intercrop of Dhaincha (*S. aculeata*) was also sown at 15 kg seed ha^{-1} at 2 : 1 (rice : Sesbania) ratio (with a row spacing of 40 cm). Dual crop of azolla (*Azolla microphylla*) was inoculated 15 DAS at 1.0 t ha^{-1}. The intercrop of Sesbania and azolla was trampled into the soil using conoweeder at 35 DAS. Pretilachlor with safener (Sofit 30% EC) at 0.4 kg a. i. ha^{-1} was applied 3 DAS. Recommended level of N, P and K at 150 : 50 : 50 kg ha^{-1} was followed. Nitrogen was applied as per the treatments, in four equal splits (20 DAS, active tillering, panicle initiation and flowering), a single dose of P ha^{-1} as basal and K was applied alongwith N in four equal splits. Weed samples were taken in each plot at four randomly selected spots from 0.25 m^2 area.

RESULTS AND DISCUSSION

Effect on Weeds

The major graminaceous weeds were *Echinochloa colona, E. crusgalli* and *Leptochloa chinensis*. Sedges consisted of *Cyperus difformis, C. rotundus* and *Cyperus iria*. The BLW included *Eclipta alba* (Asteraceae), *Ammania baccifera* (Lythraceae), *Ludwigia parviflora* (Onagraceae), *Marsilea quadrifolia* (Marsileaceae) and *Monochoria vaginalis* (Pontedeciaceae). In unweeded control, the relative density of grasses was more dominant (59.1%) than sedges (23.6%) and broadleaved weeds (17.3%).

The weed density in unweeded control was considerably higher in **kharif** season than in **rabi** season. Grasses were the most dominant species in both the seasons, followed by sedges and broadleaved weeds (BLW) during **kharif** and grasses were followed by BLW and sedges during **rabi** season. The broad-spectrum weed control was obtained due to pretilachlor with safener followed by one hand weeding at 40 DAS (Table 1) and it was significantly comparable with two hand weedings at 20 and 40 DAS. Pretilachlor with safener followed by one hand weeding and two hand weedings showed their superiority by reducing weed dry weight. Uncontrolled weed growth in the unweeded control resulted in higher dry weight of weeds. Sesbania intercropping and azolla dual cropping treatments recorded substantially lower density and dry weight of weeds than the 100% N alone treatment. Similar findings on the impact of Dhaincha intercropping in reducing weed density and dry weight were reported by Ravisankar (2002), while Divakaran and Sundaram (1998) reported on the reduced weed density and dry weight by azolla dual cropping.

Effect on Crops

Better control of weeds was achieved by pretilachlor with safener followed by one HW with higher number of panicles, long and slender panicles, higher number of filled grains per panicle resulting in higher grain yield of 6039 and 5814 kg ha^{-1} during **kharif** and **rabi** seasons, respectively (Table 2). The two HW treatments recorded significantly less grain yield than the pretilachlor with safener followed by one HW during both the seasons. The increased grain yield in pretilachlor with safener followed by one HW was 4.5 and 4.0% higher than the two HW treatments. These findings can effectively dictate the relative importance of using the pre-emergence herbicide, pretilachlor with safener in combating the weed menace especially during the early stages of crop growth.

The favourable influence of higher level of N (100%) through organic and inorganic (sesbania and azolla) means could be observed by higher number of panicles. Growing sesbania and azolla as intercrop followed by mechanical incorporation created a conducive atmosphere in terms of weed-free condition. All these attributes had a positive influence on the yield components viz., panicles m^{-2} panicle length and filled grains per panicle. Application of 100% N+sesbania intercropping+ azolla dual cropping produced higher grain yield of 5798 and 5502 kg ha^{-1} during **kharif** and **rabi** seasons, respectively, than the other treatments (Table 2). Application of 100% N+sesbania intercropping was the second best treatment in terms of grain yield. The treatments that included intercropping or dual cropping recorded higher grain

Table 1. Effect of weed and nitrogen management practices on weed density (No. m^{-2}) and dry weight (g m^{-2})

Treatment	Weed density (60 DAS)								Weed dry weight (60 DAS)	
	Kharif 2002				Rabi 2002-03				Kharif	Rabi
	Grasses	Sedges	BLW	Total	Grasses	Sedges	BLW	Total	2002	2002-03
Weed management										
Uweeded control	8.20	5.23	4.45	10.66	7.81	5.12	5.91	11.01	9.3	9.6
	(69)	(27)	(20)	(116)	(62)	(26)	(35)	(123)	(89.1)	(94.2)
Two HW (20 & 40 DAS)	3.70	2.56	2.26	4.96	3.86	2.21	3.73	5.75	4.4	4.7
	(13)	(6)	(5)	(24)	(15)	(5)	(13)	(33)	(18.7)	(21.5)
Pretilachlor+1 HW (40 DAS)	3.93	2.37	2.36	5.11	3.75	2.33	3.51	5.60	4.6	4.7
	(15)	(5)	(5)	(25)	(14)	(5)	(12)	(31)	(20.9)	(21.6)
LSD (P=0.05)	0.42	0.63	0.52	0.53	0.50	0.57	0.35	0.57	0.3	0.2
Nitrogen management										
75% N+Seshania	5.17	3.55	3.06	6.93	5.17	3.21	4.41	7.50	6.0	6.2
	(31)	(14)	(10)	(55)	(30)	(12)	(21)	(63)	(41.0)	(43.8)
75% N+Azolla	5.01	3.47	2.95	6.72	5.19	2.96	4.26	7.29	5.7	6.3
	(28)	(13)	(9)	(50)	(29)	(9)	(18)	(57)	(35.4)	(43.1)
75% N+Sesbania+Azolla	5.00	2.95	2.74	6.36	4.69	3.04	4.16	6.92	5.7	5.8
	(28)	(9)	(8)	(45)	(24)	(10)	(18)	(52)	(36.3)	(36.7)
100% N+Sesbania	5.27	3.40	2.95	6.90	5.26	3.42	4.44	7.67	6.1	6.4
	(31)	(14)	(10)	(55)	(31)	(14)	(21)	(66)	(41.4)	(46.2)
100% N+Azolla	4.94	3.28	3.07	6.62	4.83	3.11	4.24	7.11	5.9	6.2
	(27)	(12)	(10)	(49)	(26)	(11)	(18)	(55)	(37.3)	(41.5)
100% N+Sesbania+Azolla	5.13	3.17	2.65	6.53	4.67	2.96	3.97	6.78	5.8	5.9
	(29)	(10)	(7)	(46)	(24)	(10)	(16)	(50)	(36.1)	(38.3)
100% N (urea)	6.43	3.87	3.72	8.32	6.17	3.84	5.19	8.90	7.6	7.7
	(53)	(18)	(13)	(84)	(46)	(17)	(30)	(93)	(72.5)	(70.6)
LSD (P=0.05)	0.36	0.34	0.36	0.35	0.47	0.52	0.30	0.41	0.1	0.2

Figures in parentheses are original values. Weed density and dry weight were subjected to square root transformation.

Table 2. Effect of weed and nitrogen management on panicles m^{-2}, panicle length (cm) and grain yield of wet seeded rice

Treatment	Kharif 2002				Rabi 2002-03			
	Panicles m^{-2}	Panicle length (cm)	Filled grains $panicle^{-1}$	Grain yield (kg ha^{-1})	Panicles m^{-2}	Panicle langth (cm)	Filled grains $panicle^{-1}$	Grain yield (kg ha^{-1})
Weed management								
Unweeded control	292	20.7	76.2	3766	284	20.6	72.3	3638
Two HW (20 & 40 DAS)	428	22.4	94.6	5766	413	22.0	93.1	5583
Pretilachlor+1 HW (40 DAS)	444	22.8	95.8	6039	436	22.4	94.7	5814
LSD (P=0.05)	15.8	0.6	2.4	178	17.7	0.4	1.7	212
Nitrogen management								
75% N+Sesbania	371	21.7	87.2	5086	358	21.5	84.5	4870
75% N+Azolla	352	21.4	83.9	4772	342	20.9	81.4	4706
75% N+Sesbania+Azolla	402	22.1	91.4	5406	390	22.0	88.9	5149
100% N+Sesbania	416	22.4	92.3	5541	407	22.1	90.4	5292
100% N+Azolla	390	21.9	89.3	5238	378	21.5	87.2	5096
100% N+Sesbania+Azolla	439	22.7	95.8	5798	430	22.4	93.1	5502
100% N (urea)	345	21.3	82.1	4490	339	21.2	81.5	4467
LSD (P=0.05)	16.4	0.9	3.5	194	18.1	0.8	3.3	205

yield when compared to 100% N alone treatment. The probable reason for higher grain yield rests on the fact that intercropping and dual cropping practices, in addition to weed suppression, improved the availability of N through their contribution. Interaction effects of weed and nitrogen management practices revealed that pretilachlor with safener followed by one HW combined with 100% N+dhaincha intercropping+azolla dual cropping registered lesser weed competition. The higher N addition coupled with a relatively weed-free situation favoured the growth and yield attributes and increased the rice grain yield.

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