Journal of crop and weed 2(2) : 52-57 (2006)

Weed management in direct seeded rice under rain fed upland eco-system

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ABSTRACT

A field experiment was conducted in sandy loam soil during wet season of 2000 and 2001 at Central Research Station, O.U.A.T, Bhubaneswar in a factorial randomised block design comprising of eighteen weed management treatment combinations of 2 seed rates (normal seed @ 75 kg/ha and higher seed @ 20% excess to normal), 3 intercultures (no interculture, interculture at 20 DAS and interculture at 30 DAS) and 3 herbicides (pre emergence spraying of butachlor @ 1kg/ha, early post emergence application of clomazone @ 0.15 kg/ha + propanil @ 0.30 kg/ha and no herbicide) in direct seeded upland rice. The weed panorama in the experimental field revealed that upland rice was associated with 67% monocot and 33%dicot weeds during critical period of crop weed competition. Use of higher seed rate effectively reduced the weed population, its dry weight, and the depletion of N, P and K by weeds. It also enhanced the tillering, LAI, CGR, grain (24.21 q/ha) and straw (24.22 q/ha) yield and nutrient uptake (40.68 kg N, 9.28 kg P and 45.55 kg K/ha). Interculture in upland rice at 20 DAS reduced the density, dry matter accumulation and nutrient removal by weeds which ultimately reflected in better crop growth, yield attributes and grain (24.29 q/ha) and straw (24.00 q/ha) yield along with higher uptake of 40.18kg N, 9.45 kg P and 46.02 kg K/ha. Similarly application of butachlor drastically lowered down the weed density, biomass and removal of nutrients by weeds and resulted in the highest grain (25.92 q/ha) and straw (25.39 q/ha) yield. Considering the economics, integration of higher seed rate with butachlor and interculture at 20 DAS registered the maximum net return in upland rice under rainfed condition

Key words: Direct seeded rice, Rainfed upland, Weed management, Nutrient uptake, Net profit

The upland rice area is around 5.5 million ha which accounts for 12.33 per cent of total rice area of the country (Singh, 2002). The productivity of upland rice is very low as weeds pose serious menace as compared with other rice ecosystem. This is because of aerobic soil condition, high temperature and dry tillage practices. With the introduction of short statured high yielding rice varieties with erectophylic leaves, the weed menace is becoming more acute. Highly competitive grassy weeds and sedges are tolerant to drought condition, thus predominant under the situations. Yield losses due to weed competition in direct seeded upland rice ranged from 15 to 90 per cent (Mishra, 1997). The weed problem in upland rice is very complex due to competitiveness and phasic emergence of weeds. Hence, an attempt has been made to devise the weed management strategy through integration of ecological, physical and chemical method of weed control under rainfed upland rice eco-system.

MATERIALS AND METHODS

The experiment was conducted at Central Research Station Orissa University of Agriculture and Technology, Bhubaneswar during *kharif* seasons of 2000 and 2001. The soil of the experimental field was sandy loam with pH 5.7 containing total N 168 kg/ha, available P_2O_5 and K_2O of 40 and 134 kg/ha, respectively. The experiment was laid out in a factorial randomized block design with three replications. The eighteen treatment combinations were two seed rates (recommended seed rate of 75 kg/ha and 20% higher to recommended), three intercultural operations (no interculture and interculture at 20 and 30 days after sowing, DAS) and three levels of herbicides (no herbicide, pre-emergence application of butachlor @ 1 kg/ha at 2 DAS and early post-emergence application of clomazone @ 0.15 kg/ha + propanil @ 0.3 kg/ha at 10 DAS). The upland rice variety Khandagiri was sown on 21st and 30th June during 2000, 2001, respectively with a row spacing of 20 cm and continuous seeding in rows. Ten kg N, 20 kg P_2O_5 and 20 kg K_2O/ha were applied as basal. The rest N was applied as top dressing at 30 (20 kg/ha) and 40 (10 kg/ha) days of crop age. Crop growth rate was

computed from the dry weight of 10 randomly selected plants from each plot. Leaf area index was calculated by using area weight relationship. The weed count and weed dry weights were taken at 20, and 60 DAS and at harvest by using the quadrate method. During harvest, the yield attributes such as number of productive tillers, fertile grains/panicle and 1000-grain weight were recorded. After threshing, the grain and straw yield from each plot were recorded on perfect drying.

RESULTS AND DISCUSSION

Floristic composition of weeds

Altogether 24 different species of weeds belonging to 11 families were observed in the experimental site. Among the monocot weeds, *Digitaria ciliaris, Cyperus esculentus* and *Cyperus rotundus* were the most dominant weeds followed by *Sporobolus diander*, *Eleusine indica, Cynodon dactylon, Echinochloa colona* and *Paspalum scrobiculatum*. The dicot weeds, *Oldenlandia corymbosa* was the most prevalent weeds followed by *Ludwigia parviflora*, *Ageratum conyzoides*, *Borreria hispida*, *Celosia argentea*, *Eclipta alba*, *Cleome viscosa* and *Commelina benghalensis*.

Weed density and dry matter

Effect of seed rate

The weed population and dry weight were influenced significantly with different seed rates throughout the growth stages of the crop (Table 1). With increasing the seed rate by 20 % both population and dry weight of weeds were reduced over the recommended (75 kg/ha) through out the growth stages of the crop. Higher density of crop plants would exhibit more competitive advantage over weeds and did not favour the weeds to come in large number. Similar effects of seed rate were reported by Angiras and Sharma, 1998.

Effect of interculture

Interculture had the remarkable effect in suppressing the weed density and dry weight (Table 1). The weed population and dry weight were reduced very effectively when interculture was performed at 20 DAS as compared with interculture at 30 DAS and no interculture. This might be due to the fact that interculture at initial growth stage provide weed free environment earlier at active growth stage ultimately favoured the crop growth. Similar favourable effect of mechanical method of weed control was reported by Pandey *et al*., 1996 and Satyanarayan *et al*., 1997.

Effect of herbicide

Application of herbicides registered a significant variation in weed population and dry matter accumulation over no herbicide treatment throughout the crop growth stages (Table 1 and 2). Pre-emergence application of butachlor @ 1 kg/ha significantly lowered down the weed population and weed dry weight as against post-emergence application of clomazone @ 0.15 kg/ha + propanil @ 0.3 kg/ha. This might be due to efficient control of weed flora from the beginning of crop growth. Butachlor had the inherent capacity to affect the cell division, cell growth, thus hampered the germination of weeds. Similar findings were recorded by Pandey and Swarnakar, 1997 and Mutanal *et al.*, 1997.

Crop growth

Effect of seed rate

The effect of seed rate was significant on crop growth at all the stages of growth except in between 0 to 30 DAS (Table 2). The highest crop growth rate and leaf area index were recorded at 20 % excess seed rate over recommended one. It might be ascribed to the effect of tillering and greater density of crop stand, thus reducing the weed crop competition and increasing crop growth.

Effect of interculture

The highest crop growth rate was recorded between 30 to 60 DAS and the greater leaf area index (LAI) was recorded at 60 DAS with interculture at 20 DASas compared to no interculture and interculture at 30 DAS treatments (Table 2). Interculture facilitated the aeration of soil thereby improved the tillering, plant height and number of leaves/tiller. Improvement in crop growth rate and LAI in interculture at 20 DAS might be also due to its favourable effect on reducing weed competition to paddy.

Effect of herbicide

Herbicide application markedly influenced the crop growth almost in all the growth stages of the crop (Table 2). Pre-emergence application of butachlor recorded the maximum crop growth followed by early post emergence application of clomazone + propanil. The reason ascribed to it that pre-emergence application of butachlor knocked down the weed growth under control just after germination of crop and thus , increased crop growth. It is in agreement with the findings of Savithri *et al*., 1994.

Yield and economics

Effect of seed rate

The use of 20% excess seed rate over the recommended produced maximum number of productive tillers/ m^2 and grain (24.21 q/ha) and straw (24.22 q/ha) yield with a net profit of Rs.3863/-/ ha) as compared with the recommended seed rate (Table 3). Higher seed rate produced more yield obviously due to increase in number of effective tillers/m^2 and also denser crop stand offered better competition with the weeds and resulted in better crop growth. But the use of normal seed rate considerably increased the number of fertile grains/panicle and test weight. The reason might be due to reduced tillering and least mutual competition among plants at normal seed rate. Similar favourable effects of seed rate were earlier reported by Angiras and Sharma, 1998.

Effect of interculture

Interculture performed at 20 DAS markedly augmented the number of productive tillers/m^2, fertile grains/panicle, 1000-grain weight and grain (24.29 q/ha) and straw (24.00 q/ha) yield along with net profit of Rs.3643.00/ha as compared with no interculture and interculture at 30 DAS (Table 3). It could be possible due to favourable effect of interculture on reducing the weed competition at early stage of crop growth facilitating greater absorption of nutrients.

Effect of herbicide

Significant increase in yield attributes along with grain (25.92 q/ha) and straw (25.39 q/ha) yield was observed in butachlor @ 1 kg/ha followed by clomazone 0.15 kg/ha + propanil 0.30 kg/ha over no herbicide (Table 3). This might be due to the fact that minimum weed competition starting from germination enhanced the crop growth and development which ultimately reflected in the yield and net return. It is in conformity with the findings of Mutanal *et al*., 1997. The consistent increase in yield with combined application of clomazone + propanil was reported by Jordan and Kending, 1998.

Nutrient removal by crop and weeds

Effect of seed rate

The depletion of N, P and K by weeds was reduced with the use of higher seed rate of 90 kg/ha over the recommended seed rate of 75 kg/h with a subsequent increase in uptake of these nutrients by upland rice (Table 4). It is mainly due to least crop-weed competition at higher seed rate than that of the recommended one.

Effect of interculture

Amongst intercultural treatments, interculture at 20 DAS recorded maximum nutrient uptake by upland rice and thereby reduced the nutrient uptake by weeds. Similar favourable effect of interculture in depressing the nutrient uptake by weeds was reported by Prasad and Rafey, 1995.

Effect of herbicide

The highest removal of nutrients (43.0 kg N, 8.09 kg P and 48.74 kg K/ha) by upland rice with the pre-emergence application of butachlor @ 1 kg/ha closely followed by clomazone + propanil. It corroborated with the findings of Prasad and Rafey, 1995.

It may be concluded that the use of 20 % excess seed rate over normal, interculture at 20 DAS and pre-emergence application of butachlor @ 1 kg/ha at 2 DAS reduced the weed population, weed dry matter and uptake of nutrients consequently improved the crop growth rate, yield parameters, yield and economics in direct seeded upland rice under rainfed condition.

Table 1 Effect of weed management treatments on total weed population and weed dry weight

Treatments	Weed population/m^2			Weed dry weight (g/m^2)		
Seed rate (kg/ha)	**20 DAS**	**60 DAS**	**At harvest**	**20 DAS**	**60 DAS**	**At harvest**
75	121.89	117.59	101.11	60.93	238.89	302.85
90	106.89	100.44	100.59	56.52	213.63	269.37
CD (P=0.05)	9.52	8.23	NS	3.46	5.95	11.80
Interculture						
No interculture	119.61	127.39	109.72	57.39	240.91	338.00
Interculture (20 DAS)	111.28	97.17	92.72	59.38	289.11	238.72
Interculture (30 DAS)	112.21	102.50	100.11	59.50	218.72	281.61
CD (P =0.05)	NS	10.10	NS	NS	7.80	14.40
Herbicide						
No herbicide	179.38	165.83	139.11	90.33	247.61	284.94
Butachlor @ 1kg/ha	76.50	74.39	75.72	36.06	202.17	226.17
Clomazone @ 0.15 kg/ha + Propanil @ 0.3 kg/ha	87.39	86.83	87.82	49.78	229.0	242.22
CD (P=0.05)	11.66	10.10	10.40	4.2	7.3	14.4

Table 2 Effect of weed management practices on crop growth rate and LAI at different growth stages

Treatments	Crop growth rate (g/m^2 /day)			Leaf area index		
	0-30 DAS	**30-60 DAS**	**60-90 DAS**	**30 DAS**	**60 DAS**	**90 DAS**
Seed rate (kg/ha)						
75	5.78	18.21	4.00	1.63	1.63	2.05
90	6.92	20.52	4.90	2.02	2.02	2.23
CD (P=0.05)	NS	0.61	0.43	NS	NS	0.06
Interculture						
No interculture	5.89	18.17	3.82	1.76	1.76	2.06
Interculture (20 DAS)	6.42	21.29	5.15	1.96	1.96	2.20
Interculture (30 DAS)	7.27	20.61	4.60	1.76	1.76	2.16
CD (P =0.05)	NS	0.77	0.55	NS	NS	0.08
Herbicide						
No herbicide	4.83	16.76	3.24	1.64	1.64	1.99
Butachlor @ 1kg/ha	7.79	21.10	5.69	2.20	2.20	2.28
Clomazone @ 0.15 kg/ha + Propanil @ 0.3 kg/ha	6.50	20.25	4.61	1.83	1.83	2.16
CD (P=0.05)	0.57	1.00	0.55	0.11	0.11	0.08

Table 3 Yield, yield attributes and economics as influenced by weed management Practices

Treatments	Days after sowing					
	Effective tillers/m^2	Fertile grains/ panicle	1000grain weight (g)	Grain yield (q/ha)	Straw yield (q/ha)	Net profit (Rs/ha)
Seed rate (kg/ha)						
75	249	85	21.27	20.40	20.53	1648
90	270	80	21.22	24.21	24.22	3863
CD (P=0.05)	3.0	3.0	NS	0.50	0.47	-
Interculture						
No interculture	248	76	20.99	19.79	19.86	1856
Interculture (20 DAS)	271	88	21.92	24.29	24.00	3643
Interculture (30 DAS)	259	83	21.02	22.83	23.27	2767
CD (P =0.05)	3.0	4.0	0.43	0.60	0.58	-
Herbicide						
No herbicide	238	73	20.69	17.66	18.63	268
Butachlor @ 1kg/ha	276	90	21.73	25.92	25.39	3773
Clomazone @ 0.15 kg/ha + Propanil @ 0.3 kg/ha	263	84	21.28	25.31	23.11	3225
CD (P=0.05)	3.0	4.0	0.43	0.60	0.58	-

Cost of Produce (Rs/q):- Grain Rs 540.00, Straw Rs 80.00

Table 4 Effect of weed management treatments on nutrient uptake(kg/ha) by upland rice and weeds

Treatments	Weed uptake			Uptake by upland rice		
	N	P	K	N	P	K
Seed rate (kg/ha)						
75	35.43	8.84	58.45	33.32	5.72	37.57
90	29.09	7.70	50.10	40.68	7.29	45.55
Interculture						
No Interculture	40.89	9.90	67.94	31.30	5.38	35.43
Interculture (20 DAS)	25.06	5.61	43.92	40.18	7.48	46.02
Interculture (30 DAS)	30.69	7.35	54.35	37.44	6.46	43.29
Herbicide						
No Herbicide	49.27	11.70	78.52	27.64	4.71	31.59
Butachlor @ 1kg/ha	22.39	5.07	41.84	43.00	8.09	48.74
Clomazone @ 0.15 kg/ha + Propanil @ 0.3 kg/ha	27.44	6.45	47.46	37.89	6.83	43.22

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