

## Critical Period of Crop-weed Competition in Transplanted and Wet-seeded Kharif Rice (*Oryza sativa* L.) under Terai Conditions

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### ABSTRACT

A field experiment was conducted during the **kharif** seasons of 2005 and 2006 at the research farm of Uttar Banga Krishi Viswavidyalaya with the objectives to study weed dynamics and yield reduction due to weed-crop competition as well as to determine critical period of crop-weed competition in transplanted and wet seeded rainfed rice. Ten treatments comprising weedy condition for first 20 days after transplanting (DAT)/15 days after sowing (DAS) then weed free, first 40 DAT/30 DAS then weed free, first 60 DAT/45 DAS then weed free, first 80 DAT/60 DAS then weed free, weed free condition for first 20 DAT/15 DAS then weedy, first 40 DAT/30 DAS then weedy, first 60 DAT/45 DAS then weedy, first 80 DAT/60 DAS then weedy, season long weed free and complete weedy conditions were tested in randomized block design with three replications for transplanted/wet seeded rice, respectively. Among the weeds appeared in transplanted rice, the broadleaved weeds *Monochoria hastata*, *Ludwigia parviflora* and *Nymphoides indicum* and grass weed *Echinochloa crusgalli* were dominant and aggressive because of their long emergence profile. In wet seeded rice field, the broadleaved weeds *Monochoria hastata*, *Ludwigia perennis* and the sedges *Cyperus flavidus*, *Cyperus difformis*, *Fimbristylis miliacea*, *Scirpus juncooides* and grass *Cynodon dactylon* were aggressive and continuously emerged throughout the crop growth. Critical period of weed-crop competition in transplanted and wet seeded rice was from 20 to 40 DAT and 15 to 60 DAS, respectively. Weedy situation throughout the crop growth caused yield reduction to the tune of 57 to 61% in case of transplanted rice and 64 to 66% in case of wet seeded rice in comparison to season long weed free situation.

**Key words :** Critical period of weed-crop competition, wet direct seeded rice, transplanted rice, weed dynamics

### INTRODUCTION

The reduction in yield of transplanted rice was estimated to the tune of 15-45% due to weed infestation depending on the soil type, rainfall and season (Pillai and Rao, 1974). IRR (1997) suggested that weed growth in unweeded plots reduced yield by as much as 34% in transplanted rice, 45% in direct-seeded rice and 67% in upland rice. Moody (1980) reported that the extent of yield reduction due to unchecked weed growth has been estimated around 20-25% for transplanted rice and 40-50% for direct seeded rice. Rice grain production in India suffers yearly loss of 15 million tonnes due to weed competition (Chatterjee and Maity, 1981). Terai agro-climatic region is characterized with high rainfall especially during **kharif** season resulting in profuse weed growth which becomes aggressive during the crop growth. High yield losses due to weeds warrant information on periodicity of weeds emergence at different stages of crop growth and competition. There was also a need to find out critical period of crop-weed competition as it facilitates in working out the strategies

on integrated weed management to combat adverse effects of weed in terms of yield reduction. An experiment was carried out with the objectives to study weed dynamics, assessment of yield loss due to weeds and to determine critical period of weed-crop competition in transplanted and wet seeded **kharif** rice under Terai conditions.

### MATERIALS AND METHODS

A field experiment was conducted during **kharif** seasons of 2005 and 2006 at Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal. The soil was sandy to sandy loam in texture with 6.08 pH, 0.58% organic carbon and 162.6, 17.3 and 79.5 kg/ha of available N, P and K, respectively. Treatments especially for critical period of weed-crop competition have been formulated on the basis of methodology suggested by Nieto *et al.* (1968). Four treatments comprising weedy condition upto 20 days after transplanting (DAT)/15 days after sowing (DAS), 40 DAT/30 DAS, 60 DAT/45 DAS and 80 DAT/60 DAS

then weed free afterwards, another four treatments comprising weed free up to 20 DAT/15 DAS, 40 DAT/30 DAS, 60 DAT/45 DAS and 80 DAT/60 DAS then weedy afterwards in case of transplanted and wet seeded rice, respectively. Remaining two treatments comprised season long weed free and weedy situation. These treatments were tested in a randomized block design with three replications. The rice variety 'Swarnamasuri (M. T. U 7029)' was grown both in transplanted and wet seeded rice culture. In case of wet seeded rice, seed (40 kg/ha) was sown with the help of drum seeder. Important value index (IVI) of the weeds was calculated by the formula suggested by Raju (1997). Weed count was made in quadrat having the size of 0.25 m<sup>2</sup> from four randomly selected points of individual plot and total dry weight of the weeds was measured.

## RESULTS AND DISCUSSION

### Effect on Weeds

Weed flora of transplanted **kharif** rice was comprised of eight weed species of which one belonged to grass, three to sedge and four to broadleaved weed. At the initial phase of crop growth, the broadleaved weeds *Monochoria hastata*, *Ludwigia parviflora*, *Nymphoides indicum* and grass *Echinochloa crus-galli* were dominant and continuously emerged upto 60 DAT. The sedges *Cyperus iria*, *Scirpus maritimus*, *Fimbristylis miliacea* and broadleaved weed *Sphenochlea zeylanica* appeared at the later part of the crop growth. *Monochoria hastata*, *Ludwigia parviflora*, *Nymphoides indicum* and *Echinochloa crus-galli* became aggressive in transplanted rice because of their long emergence profile (Table 1).

Weed flora of wet seeded **kharif** rice was comprised of broadleaved, sedges and grasses of which one belonged to grass, several sedges and four broadleaf weeds. At the early crop growth phase, the broadleaf weeds *Monochoria hastata* and *Nymphoides indicum* became dominant upto 40 DAS. However, *Ludwigia perennis*, *Cyperus flavidus*, *Cyperus difformis*, *Scirpus juncooides* and *Cynodon dactylon* became aggressive and continuously emerged throughout the crop growth. Another sedge, *Fimbristylis miliacea* and broadleaved weed *Oldenlandia umbellata* appeared at later part of crop growth (Table 1).

### Critical Period of Crop-weed Competition

In case of transplanted **kharif** rice culture, data on yield attributing characters like effective spikelets/panicle, number of panicles/m<sup>2</sup>, test weight and ultimate grain yield (Table 2) revealed that highest values of these parameters were obtained in complete weed free situation during the crop growth, which was statistically at par with the treatment of weed free upto 80 DAT then weedy, weed free upto 60 DAT then weedy, weedy upto 20 DAT then weed free and weed free upto 40 DAT then weedy. The results showed that weed free period upto 80 DAT, 60 DAT and 40 DAT did not differ significantly with complete weed free situation in terms of yield and yield attributing characters. The results also revealed that weed growth upto 20 DAT did not make significantly adverse impact on crop performance in comparison to weed free situation. The critical period of crop-weed competition in transplanted rice was 20 to 40 DAT when weeding resulted in highest economic return (Fig. 1).

In wet seeded rice, highest yield and yield attributing characters obtained in complete weed free situation during the crop growth (Table 3) were statistically at par with the treatment where plots were kept weed free upto 60 DAS then weedy and weedy upto 15 DAS then weed free and the critical period of crop-weed competition varied from 15 to 60 DAS when weeding resulted in highest economic return (Fig. 2).

### Yield Reduction due to Weeds

In transplanted rice, weedy situation throughout the crop growth caused yield reduction to the tune of 57 to 61% in comparison to complete weed-free condition. However, weeding during the critical period i. e. from 20 to 40 DAT minimized weed-crop competition and only yield reduction of 2 to 4% was recorded, whereas weedy situation during the critical period resulted in yield reduction on account of 31 to 38% (Table 2).

In wet seeded rice, weed growth throughout the season caused yield reduction of 64 to 66 % as compared to complete weed-free situation. Weeding only during the critical period i. e. from 15 to 60 DAS improved crop performance and only 0.44 to 3% yield reduction was observed in comparison to complete weed-free condition. Yield reduction of 55 to 60% resulted from the weed pressure during this critical period of weed-crop competition (Table 3).

Table 1. Important value index (IVI) of weeds appearing at different growth stages of transplanted and wet seeded rice

Weed species	Family	IVI for transplanted rice (%)								IVI for wet direct seeded rice (%)							
		20 DAT		40 DAT		60 DAT		At harvest		20 DAS		40 DAS		60 DAS		At harvest	
		2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
<i>Monochoria hastata</i> Prest.	Pontederiaceae	73.53	71.77	39.37	40.47	9.14	20.44	-	-	57.86	60.40	37.99	36.67	-	-	-	-
<i>Nymphoides indicum</i>	Alismataceae	38.97	32.26	28.52	28.57	9.87	16.85	-	-	28.57	31.59	25.04	25.33	-	-	-	-
<i>Ludwigia parviflora</i> Roxb.	Onagraceae	47.06	58.87	90.40	94.94	60.03	52.75	37.65	31.24	-	-	-	-	-	-	-	-
<i>Echinochloa crus-galli</i>	Poaceae	40.44	37.09	41.72	36.01	56.41	40.95	54.31	40.56	-	-	-	-	-	-	-	-
<i>Cyperus iria</i> L.	Cyperaceae	-	-	-	-	12.76	27.10	8.63	28.00	-	-	-	-	-	-	-	-
<i>Scirpus maritimus</i> L.	Cyperaceae	-	-	-	-	21.91	17.87	37.65	32.05	-	-	-	-	-	-	-	-
<i>Fimbristylis miliacea</i> (L.) Rahl.	Cyperaceae	-	-	-	-	29.88	24.02	18.23	26.78	-	-	-	-	59.73	54.92	58.30	59.78
<i>Sphenochlea zeylanica</i>	Campanulaceae	-	-	-	-	-	-	43.53	41.36	-	-	-	-	-	-	-	-
<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	-	-	-	-	-	-	-	-	51.07	42.18	44.46	42.66	45.89	40.31	45.89	44.38
<i>Cyperus</i> sp.	Cyperaceae	-	-	-	-	-	-	-	-	22.86	24.97	25.04	26.67	34.29	35.24	33.83	32.90
<i>Ludwigia perennis</i> Roxb.	Onagraceae	-	-	-	-	-	-	-	-	39.64	40.86	67.48	68.66	36.07	45.07	34.89	36.13
<i>Oldenlandia umbellata</i> L.	Rubiaceae	-	-	-	-	-	-	-	-	-	-	-	-	24.02	24.45	27.09	26.80

Table 2. Weed dry weight at harvest, yield attributing characters, yield and per cent yield reduction of transplanted rice due to weeds

Treatment	Weed dry weight (g/m <sup>2</sup> )		Test weight (g)		Filled grains/panicle		Panicles/m <sup>2</sup>		Yield (kg/ha)		Yield reduction (%)	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
Weedy upto 20 DAT then weed free	0.00	0.00	20.38	20.41	71.33	70.86	178.67	170.03	2746	2638	2.17	3.37
Weedy upto 40 DAT then weed free	0.00	0.00	20.72	20.56	57.67	51.60	147.00	143.35	1878	1684	33.08	38.33
Weedy upto 60 DAT then weed free	0.00	0.00	20.91	20.84	48.00	46.44	140.67	138.34	1347	1195	52.02	56.24
Weedy upto 80 DAT then weed free	0.00	0.00	20.72	20.15	47.33	45.05	124.67	122.41	1266	1200	54.91	59.35
Weed free upto 20 DAT then weedy	152.46	138.25	20.60	20.17	61.67	60.90	148.67	144.62	1945	1688	30.70	38.17
Weed free upto 40 DAT then weedy	70.38	61.24	20.36	20.32	70.67	70.64	177.33	170.70	2701	2642	3.78	3.24
Weed free upto 60 DAT then weedy	36.17	34.16	20.46	20.25	71.33	72.27	178.67	170.64	2771	2714	1.28	0.57
Weed free upto 80 DAT then weedy	16.43	18.32	20.79	20.16	72.00	73.45	179.33	172.22	2798	2729	0.31	0.05
Season long weed free	0.00	0.00	20.55	20.45	73.00	73.52	179.67	173.02	2807	2730	-	-
Season long weedy	202.13	210.47	20.65	20.17	43.33	38.74	121.67	114.93	1209	1066	56.93	60.96
LSD (P=0.05)			NS	NS	3.13	3.04	4.42	3.17	117.00	100.79		

NS–Not Significant.

Table 3. Weed dry weight at harvest, yield attributing characters, yield and per cent yield reduction of wet seeded rice due to weeds

Treatment	Weed dry weight (g/m <sup>2</sup> )		Test weight (g)		Filled grains/panicle		Panicles/m <sup>2</sup>		Yield (kg/ha)		Yield reduction (%)	
	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
Weedy upto 15 DAS then weed free	0.00	0.00	20.75	20.24	73.67	71.70	161.67	152.60	2638	2476	2.69	1.20
Weedy upto 30 DAS then weed free	0.00	0.00	20.46	20.18	50.33	48.35	122.00	117.12	1225	1161	54.83	53.67
Weedy upto 45 DAS then weed free	0.00	0.00	20.83	20.43	46.00	43.94	120.67	113.96	1197	1134	55.84	54.75
Weedy upto 60 DAS then weed free	0.00	0.00	20.74	20.22	45.67	41.29	117.67	111.04	1082	1014	60.10	59.54
Weed free upto 15 DAS then weedy	178.95	175.92	20.87	20.63	46.00	44.12	121.67	119.35	1218	1134	55.07	54.75
Weed free upto 30 DAS then weedy	83.52	79.60	20.65	20.29	66.00	63.98	141.00	134.06	2053	1975	24.28	21.19
Weed free upto 45 DAS then weedy	31.47	28.57	20.41	20.32	68.00	65.04	150.00	147.50	2257	2002	16.75	20.11
Weed free upto 60 DAS then weedy	14.50	13.39	20.79	20.68	76.33	72.32	161.67	152.70	2689	2495	0.81	0.44
Season long weed free	0.00	0.00	20.84	20.79	76.67	72.98	164.33	153.66	2711	2506	-	-
Season long weedy	233.03	223.08	20.62	19.98	42.33	40.07	117.67	108.00	988	857	63.56	65.80
LSD (P=0.05)			NS	NS	3.15	1.42	2.92	1.25	126.84	49.97		

NS–Not Significant.

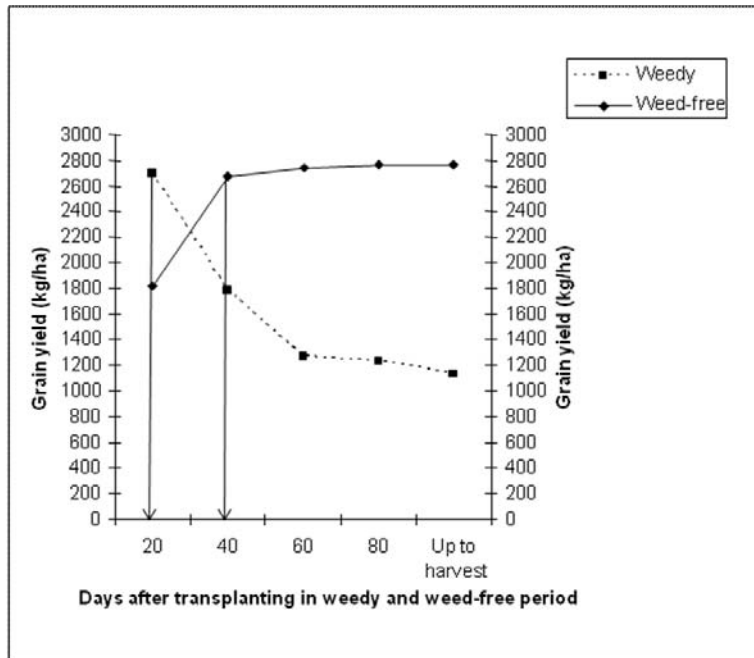


Fig. 1. Critical period of crop-weed competition in transplanted rice.

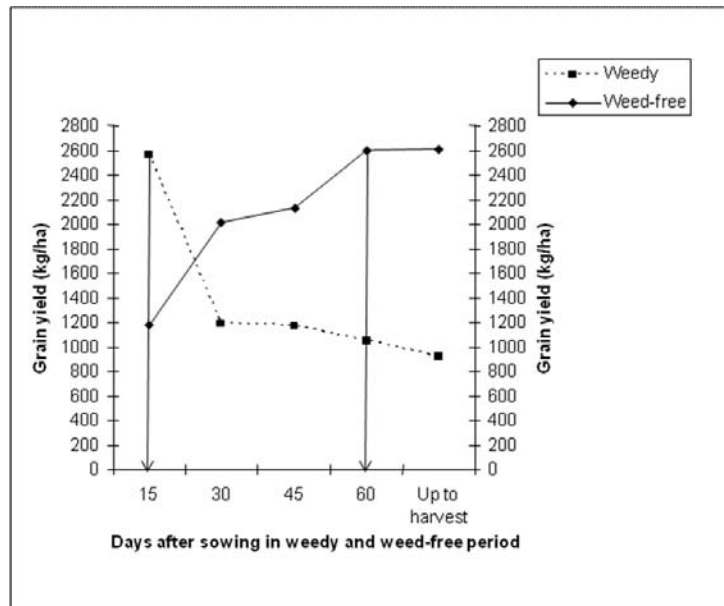


Fig. 2. Critical period of crop-weed competition in wet-seeded rice.

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