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Weed suppression ability of rice genotypes under low-input condition in Chhattisgarh

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ABSTRACT

Eastern part of India the state Chhattisgarh receives higher rainfall which favours the growth of weeds particularly in upland rice ecosystem and limits the yields due to increased rice weed competition for nutrients and light. Weeds are major constraints to upland rice production in Chhattisgarh. The objectives of this investigation were to study difference in weed suppression ability among upland rice cultivars and to determine the morpho-physiological traits involved. Twelve contrasting cultivars of *oryza sativa* were selected to form a range of distinctly different plant types in terms of growth duration cultivated in two seasons. Significant differences between cultivars were observed in weed biomass at 90 DAT in both the years indicating differences in their competitive ability. Weed biomass was negatively correlated with plant height, plant shoot biomass, photosynthesis, leaf area, LAI, CGR and RGR. Rice genotype Safri-17, Vasumati and Dubraj were most competitive against weeds. In general, the difference in grain yield in hand weeding twice and weedy check were remarkably higher in most of the rice genotypes. However, the lowest difference in grain yield was observed in Safri-17 followed by Dubraj and Vasumati during both years.

Key words : Genotypes competitiveness, Rice, Morpho-physiological traits, Weed suppression.

INTRODUCTION

The state Chhattisgarh is the eastern part of India, is relatively underdeveloped with regards to agricultural productivity as compared to most of the Indian states. The state is spread in 13.51 million hectares area with a cultivable land of 5.88 million ha. The productivity of rice in state is 1.55 t ha, which is far behind from the productivity level of India 3.03 t ha, (Anonymous, 2007). Weeds are constant constraints to rice production and cause yield losses in all rice production systems and in all seasons (Zoschke, 1990).

Apart from direct weed management interventions, weed growth is also determined by the physical and chemical interference between plants of the same or different species in the field. Plant interference can be divided into competition (the unequal sharing of resources such as nutrition, light and water) and allelopathy (the direct regulation of the growth of one plant as a response to chemicals released from another). Several authors found that tall rice (*Oryza sativa* L.) cultivars with high tillering ability, high leaf number, high leaf area index (LAI), high shoot biomass, high root biomass and long and lose leaves are more competitive than those of short structure, fewer tillers, short and eract leaves (Fischer *et al.,*1995 and Fofana and Rauber, 2000). Therefore, an attempt was made to study the plant height, no. of tillers, no. of leaves, shoot biomass, photosynthesis, leaf area (LA), leaf area index (LAI), crop growth rate (CGR), relative growth rate (RGR) and associated weed biomass.

MATERIALS AND METHODS

Two identical field experiments were conducted in 2006 and 2007 at the Instructional Farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). Twelve *Oryza sativa* genotypes were selected to form a range of distinctly different plant type in terms of growth duration and morpho-physiological traits. The trials were conducted in wet season (June-November), with rainfall during the rice-growing period of 945 mm in 2006 and 1310 mm in 2007. The experiments were conducted under irrigated conditions. The genotypes were grown with two levels of weeding; weedy check and hand weeding twice. The design was a factorial randomized block, with two replications. Sampling of morpho-physiological traits on rice were carried out at 30, 60 and 90 DAT. Plant height, tiller number, leaf number and shoot biomass were recorded in each plot on three different hills randomly selected plants and its average value was used for analysis. The leaf photosynthesis rate (umol CO_2 $m^{-2}s^{-1}$) and transpiration rate (mmol H_2O m^{-2} s^{-1}) were measured on fully developed leaf from top at flowering stage using portable photosynthesis system (IRGA) model (LI-COR-6400.USA). The leaf area index (LAI), crop growth rate (CGR) and relative growth rate (RGR) were used to determine as described by (Yosida *et al.*, 1976). At 30,60 and 90 DAT of rice, weeds were uprooted in a sampling area of 1m and principal species and total weed biomass were determined. At maturity, the grain yield was obtained from net plot area. Simple correlation analysis was used

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to draw inferences on relationship between the recorded morpho-physiological traits of rice and weed biomass.

RESULTS AND DISCUSSION

The major weed species in experimental field of rice during the both the years were *Echinochloa colona* and *Cyperus* spp. and minor weeds *Ischamum rougosum, cynotis axillaries, fimbristylis* spp. and *Commelina benghalensis*. Rice morpho-physiolocal traits and weed biomass are presented in Table 1 and 2. Weed biomass at 90 DAT in both years differ significantly among cultivars. The cultivars Safri-17 had lowest weed biomass, followed by the Vasumati and Dubraj. The cultivar R-548-89-6, R-

Table 1 : Weed biomass and morpho-physiological traits of rice genotype at 90 DAT during *Kharif*-2006

Rice Genotype	Weed biomass (g)	Plant height (cm)	No.of tiller	No.of leaves	Shoot Biomass (g)	LAI	CGR	RGR	Photosynthesis
R-1037-649-1-1	44.43	111.40	12.08	51.91	27.09	3.5	0.115	0.0072	16.35
Danteshwari	43.67	94.65	12.75	43.66	25.55	3.42	0.121	0.0071	18.37
R-979-1528-2-1	42.12	96.20	13.41	60.99	21.72	3.37	0.131	0.0052	18.67
Vasumati	31.24	134.46	13.66	52.99	24.47	4.10	0.249	0.0127	18.20
R-1182-167-2-157-1	44.15	91.11	12.99	50.41	25.72	3.39	0.151	0.0085	16.60
R-1072-360	43.18	101.57	14.00	59.24	27.93	3.10	0.212	0.0107	18.20
Indira Sugandhit Dhan	39.69	101.29	14.08	56.33	28.42	3.64	0.250	0.0092	18.37
R-548-89-6	47.06	96.71	13.24	42.99	26.09	3.21	0.169	0.0062	17.55
Safri-17	28.76	150.13	15.16	57.74	30.73	4.91	0.325	0.0208	21.70
Dubraj	37.01	138.65	12.08	42.24	28.43	4.08	0.277	0.0151	19.80
R-1249-1196-2-1	44.64	104.19	10.66	40.74	27.67	3.17	0.171	0.0077	19.40
R-1060-1674-1-1	43.97	97.00	14.74	54.16	28.29	3.97	0.143	0.0071	19.40
S. E. ±	0.560	1.266	0.776	0.453	0.461	0.121	0.009	0.0009	0.141
C.D. (P=0.05)	1.638	3.710	2.271	1.325	1.349	0.354	0.026	0.0010	0.414
Weedy check	71.66	110.23	12.17	50.02	25.76	3.64	0.195	0.0096	18.03
H.W Twice	9.80	110.66	12.80	50.38	27.25	3.69	0.191	0.0100	18.10
S. E. ±	0.229	0.518	0.317	0.185	0.188	0.049	0.013	0.0007	0.058
C.D. (P=0.05)	0.669	NS	NS	NS	0.551	NS	NS	NS	NS

NS = Non significant

Table 2: Weed biomass and morpho-physiological traits of rice genotype at 90 DAT during *Kharf*-2007

Rice genotype	Weed biomass (g)	Plant height (cm)	No. of tiller	No. of leaves	Shoot biomass	LAI	CGR	RGR	Photoosynthesis
R-1037-649-1-1	42.05	111.09	11.99	53.24	22.79	3.35	0.102	0.0042	17.95
Danteshwari	44.28	95.75	8.91	44.49	22.27	3.09	0.117	0.0039	16.62
R-979-1528-2-1	41.43	100.20	15.32	61.41	26.43	3.14	0.111	0.0045	17.87
Vasumati	32.34	132.93	9.74	54.24	25.86	4.20	0.235	0.0107	19.30
R-1182-167-2-157-1	45.86	95.59	10.33	49.24	21.81	3.27	0.139	0.0091	16.89
R-1072-360	45.15	100.85	12.16	53.66	29.07	3.27	0.224	0.0112	18.22
Indira Sugandhit Dhan	41.05	97.64	13.99	50.74	30.72	3.55	0.246	0.0090	17.82
R-548-89-6	49.05	95.44	9.16	45.24	22.56	3.32	0.174	0.0055	17.67
Safri-17	26.85	155.26	14.99	60.49	35.47	4.99	0.323	0.0191	19.80
Dubraj	36.18	143.71	10.33	45.99	26.57	4.19	0.298	0.0177	18.72
R-1249-1196-2-1	46.79	108.96	8.83	48.91	23.72	3.11	0.178	0.0067	17.82
R-1060-1674-1-1	44.48	98.17	12.58	45.74	32.88	3.75	0.133	0.0055	19.22
S.E. ±	0.634	1.445	0.350	0.385	0.383	0.140	0.008	0.0009	0.115
C.D. (P=0.05)	1.856	4.228	1.024	1.127	1.121	0.409	0.024	0.001	0.336
Weedy Check	69.98	110.15	12.28	51.52	26.17	3.53	0.186	0.0092	18.25
H.W.Twice	12.61	111.11	12.27	52.38	27.85	3.67	0.196	0.0095	18.28
S.E. ±	0.259	0.590	0.143	0.157	0.156	0.057	0.003	0.0006	0.047

Table 3: Green yield kg/ plot during *Kharif*-2006 and *Kharif*-2007

Rice genotype	2006			2007		
	Weedy check	H.W. twice	Mean	Weedy check	H.W. twice	Mean
R-1037-649-1-1	2.39	2.94	2.67	2.44	2.97	2.70
Danteshwari	2.49	2.82	2.66	2.59	2.90	2.75
R-979-1528-2-1	2.21	2.67	2.44	2.26	2.66	2.46
Vasumati	2.11	2.13	2.12	2.19	2.21	2.20
R-1182-167-2-157-1	2.66	3.21	2.83	2.78	3.11	2.95
R-1072-360	2.43	2.80	2.61	2.64	3.00	2.82
Indira Sugandhit Dhan	2.10	2.25	2.17	2.12	2.30	2.21
R-548-89-6	2.00	2.48	2.24	2.10	2.69	2.39
Safri-17	2.80	2.81	2.80	2.80	2.81	2.81
Dubraj	2.01	2.02	2.02	2.10	2.11	2.10
R-1249-1196-2-1	2.93	3.64	3.29	3.10	3.89	3.49
R-1060-1674-1-1	2.43	3.35	2.89	2.83	3.53	3.18
Treatment Mean	2.38	2.76		2.50	2.85	
	Genotype (G)		Treatments		Interaction	
	2006	2007	2006	2007	2006	2007
S. E ±	0.009	0.008	0.004	0.003	0.013	0.012
C.D. (P=0.05)	0.0026	0.024	0.011	0.010	0.037	0.034

Table 4 : Correlation Coefficient (r) between weed biomass at 90DAT and eight morpho-physiological traits of rice genotype sampled in weedy plots at 30 60 and 90 DAT averaged over 2 years (*Kharif*-2006 and 2007)

Traits	Growth period		
	30	60	90
Plant height	-0.891**	-0.933**	-0.923**
No. of tiller	-0.372 NS	-0.384 NS	-0.376 NS
No. of leaves	-0.274 NS	-0.236 NS	-0.236 NS
Shoot biomass	-0.846**	-0.581*	-0.583*
LAI	-0.956**	-0.943*	-0.917*
CGR	-0.924**	-0.933**	-0.768**
RGR	-0.797**	-0.882**	-0.869**
Photosynthesis	-0.680*	-0.702*	-0.752**

* and ** indicates significance of values at P=0.05 and 0.01, respectively and N.S.-Non significant

1249-1196-2-1 and R-1182-167-2-157-1, had the highest weed biomass. This highlights the fact that the rice cultivars differed significantly in their ability to suppress weed growth. Safri-17 and Vasumati had the most vegetative growth and the lowest weed biomass across both years, while R-548-89-6 and R-1249-1196-2-1 had the highest weed biomass. In general, as rice growth increased weed biomass decreased, indicating that rapid and vigorous growth conferred weed competitiveness. This is an agreement with the results reported by Garrity *et al.* (1992) in Asia and Johnson *et al.* (1998) in West Africa in upland rice. The cultivars with lower weed biomass were those that possessed highest plant height, high vegetative growth, high LAI, CGR, RGR and photosynthesis, such as Safri-17 and Vasumti, showed the lowest weed biomass. Cultivars with reduced these traits such as, R-548-89-6 and R-1249-1196-2-1 had inversely the highest weed biomass.

In general, grain yield differences, in hand weeding twice and weedy check were remarkably higher in most of the rice genotypes. However, the lowest difference in grain yield was observed in Safri-17 followed by Dubraj and Vasumati during both years (Table 3). This is agreement with the results reported by Fofana and Rauber (2000). Weed biomass at 90 DAT was negatively correlated with rice growth traits recorded at 30, 60 and 90 DAT (Table 4). Except for no. of tiller and no. of leaves which were poorly correlated with weed biomass. Plant height, shoot biomass, growth parameters LAI, CGR, RGR and photosynthesis were significantly negatively correlated with weed biomass.

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