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EVALUATION OF THE RELATIVE WEED COMPETITIVENESS ABILITY IN UPLAND RICE CULTIVARS

Prabharani Chaudhari, Archana Patel, Ritu R. Saxena and Satish B. Verulkar

Department of Genetics and Plant Breeding, Indira Gandhi Krishi Vishwavidyalaya, Raipur-492 012 (CG)

Email : chau.prabha@gmail.com

ABSTRACT

Weed management in rice production is a major constrain leading to low yields. Studies were conducted to assess the competitiveness of different rice varieties and to identify rice genotypes for weed competitiveness. The results showed varietal differences in their competitiveness against weeds. The presence of weed overall reduced the yield level from 172.6- 1024.3g and 52.6-223.3g in weedy and weed free conditions, respectively. In weedy environment, grain yield showed positive and significant association with panicle length and number of filled grains per plant. The two genotypes identified to be exhibiting weed competitiveness were R 1033-968-2-1 and Kakro.

Key words : *Weed competitiveness, upland condition and Rice*

In most agricultural systems, effective weed control has been one of the major problems. Worldwide a 10% loss of agricultural production can be attributed to the competitive effect of weeds, in spite of intensive control of weeds in most agricultural systems. Without weed control, yield losses range from 10-100% depending on the competitive ability of the crop. Weeds are the major constraint to productivity in direct sown upland as well as lowland ecosystem where standing water is not maintained throughout the season. In upland fields, weeding can require up to 190 person/day/ha./year (1). Therefore, weed management is one of the key elements of most agricultural systems. This has resulted in the development of strategies for integrated weed management, based on the use of alternative methods for weed control and rationalization of herbicide use, i.e. rather than trying to eradicate weeds from a field, emphasis is on the management of weed populations.

The identification and development of competitive rice varieties may be more effective in weed suppression and provide a tool for integrated weed management (2). Contrary to other weed control methods improved varieties have proven well for ease of adoption. In this view this research was carried out to assess the competitiveness of different rice varieties and to identify the superior rice genotypes for weed competitiveness under upland condition.

MATERIALS AND METHODS

Field experiment was conducted at Research Farm, Department of Genetics and Plant Breeding, IGKV, Raipur. Twelve rice cultivars that differ in morphological characteristics were evaluated. The soil type was loamy. The preceding crop was sunflower during the *Rabi* season. Before sowing, the field was ploughed, harrowed and leveled. Two adjacent trials, weed free and weedy were arranged in split plot design with three replications each was planted in the same field. Cultivars were manually drilled in plots sized 3.6 m^2 with 9 long rows per plot and row spacing of 20 cm. The seeding rate for each cultivar was 80 kg/ha. The weed free plot was kept free from weeds by hand weeding three times during the crop season. All normal agronomic practices were followed for raising a normal crop. The field was kept under non-saturated aerobic condition through the whole growing season. Trials were primarily rainfed, and drainage was conducted whenever heavy rains resulted.

Weed species and their densities were investigated at the time of harvest of the crop varieties. Weed biomass was clipped at the soil surface in each plot in the weedy trials; fresh weight and dry weight of weeds were taken. Weed biomass was also visually rated and taken in percent. Crop growth (biological yield per plant) was recorded by weighing the dry weight of above ground plants per square meter of ground area. Flowering date was recorded when 50% of the plants in a plot started to flower. Plant height was measured at 21 days of crop growth and final plant height was measured as the distance from the ground to the panicle tip of five random plants from each plot. Panicle length was measured from the base to the tip

of the panicle. Panicles were selected randomly from each plot were harvested, threshed, dried for yield and separated into filled and unfilled grains, which were then counted. From this, hundred seeds were counted and weighed. Grain yield from each plot was harvested, dried at 50°C and weighed and adjusted to a moisture content of 14%. The data was taken on the above said traits and was subjected to test for the presence of genotype x weed management interaction. A combined analysis over the genotype and weed management was conducted using split plot design with two replications. Phenotypic correlations among traits were calculated on the basis of cultivar means, within or between management treatments. Correlations between traits measured in different weed management treatments were computed as per (3).

RESULTS AND DISCUSSION

The analysis of variance indicated that the presence/absence of weed had higher significant effect on biological yield and grain yield per plant. This was expected as presence of weed drastically reduced the biological yield and grain yield. The other traits which differed significantly under the two conditions was days to flowering, number of plants per sq.mt., panicle length, total number of grains per plant and number of grains per panicle.

The genotypes exhibited significant differences for most of the traits; it indicates that the genotypes included in the present study belong to diverse genetic background. The prevalent weed species found were *Echinocloa colonum, Euphorbia hirta, Parthenium hysterophorus, Cyperus irria, Aeschynomene indica, Alternathera tendra* and others in experimental field. Weed pressure in the weedy trials revealed that the fresh weight of weeds was 2320.54 g/m and the dry weight of weeds was 1282.91 g/m (Table-1). The differences in the weed pressure were probably caused by different weed seed banks in the experimental fields. For the agronomic and yield traits evaluated in this study, the effect of weed management treatment reached to a significant level (Table-2).

Grain yield and biological yield per plant or crop biomass had high value under weed free condition as compared to weedy management. Plant height both at

Table-1: Mean for thirteen traits of upland rice evaluated under weed free (F) and weedy (W) environments.

Parameters	Weed Free environment	Weedy environment
Plant height (21 days) (cm)	21.845	23.408
Plant height (maturity) (cm)	102.257	98.979
Days to flowering	75.194	72.833
No. of plants mt^2	35.722	21.167
Panicle length (cm)	21.943	20.717
Total no. of grains/panicle	91.807	65.476
No. of Filled grains/panicle	67.792	41.141
No. of unfilled grains/panicle	26.934	26.749
Hundred grain weight (g)	2.519	2.369
Biological Yield/plant (g)	2607.00	990.550
Yield/plant (g)	613.806	91.861
Fresh wt. of weeds per mt^2	-	2320.54
Dry wt. of weeds per mt^2	-	1282.91

Table-2: Weed management and cultivar effects on yield and yield attributing traits of aerobic rice from the combined analysis of weedy and weed free trials.

ANOVA effect	Plant height (cm) (21 days)		Plant height cm (maturity)		Days to flowering		No. of plants/ mt2		Panicle length (cm)		Total no. of grains/ panicle	
	F	P	F	P	F	P	F	P	F	P	F	P
Weed (W)	0.39	-	11.09	0.07	87.67	0.01*	362.71	0.00*	18.65	0.04*	88.60	0.01*
Genotype (G)	3.89	0.00*	668.51	0.00*	1086.55	0.00*	8.95	0.00*	26.48	0.00*	39.53	0.00*
W x G	1.33	0.23	2.17	0.03*	34.50	0.00*	2.11	0.03*	1.74	0.09	7.41	0.00*

Table-2: Contd.....

ANOVA effect	No. of Filled grains/ panicle		Hundred grain weight (g)		Biological Yield/ plant (g)		Grain yield (g)		Fresh wt. of weeds		Dry wt. of weeds	
	F	P	F	P	F	P	F	P	F	P	F	P
Weed (W)	445.99	0.00*	4.95	0.15	214.80	0.00*	44.05	0.02*	1.14	0.41	1.79	0.17
Genotype (G)	13.46	0.00*	10.30	0.00*	2.90	0.00*	5.27	0.00*				
W x G	5.17	0.00*	7.01	0.00*	1.64	0.11	3.98	0.00*				

*Significant at 5% probability level.

Table 3 : Means for 12 upland rice cultivars evaluated under weed-free (F) and weedy (W) conditions at IGKV, Raipur

Cultivars	Plant height cm (21 days)		Plant height cm (maturity)		Days to flowering		No. of plants mt^2		Panicle length (cm)	
	F	W	F	W	F	W	F	W	F	W
ARB-6	21.98	25.53	114.47	107.64	74.00	72.66	40.00	25.00	22.73	21.63
Dagad Deshi	29.22	29.57	124.74	118.35	65.00	62.66	33.66	19.00	22.30	22.20
phaMahamaya	24.08	22.42	84.38	78.82	90.00	81.00	32.33	20.33	20.00	17.23
IR-64	22.90	20.93	81.29	79.81	80.66	79.33	42.66	20.66	23.83	23.13
Poornima	23.34	21.50	86.15	80.62	74.00	72.66	49.00	26.66	23.00	20.23
MTU-1010	19.97	22.02	84.30	81.48	78.00	76.33	32.66	20.66	19.90	19.70
IR64 x Mahamaya	20.90	21.83	86.17	83.35	74.66	73.00	36.00	23.00	18.30	17.43
Mahamaya x CT 9993	21.86	24.36	84.80	82.80	78.00	76.33	35.66	20.00	19.43	18.63
R 1033-968-2-1	21.46	24.19	106.04	104.48	75.00	73.00	26.66	17.00	23.67	21.93
sid6904959RR 347-5	20.14	24.70	117.18	117.23	75.00	73.00	32.00	19.66	24.33	24.60
VL 3288	23.83	20.60	123.78	122.34	64.00	62.33	35.66	21.00	18.46	18.40
Kakro	24.42	23.22	133.74	130.79	74.00	73.33	32.33	21.00	27.33	23.46
Mean	22.84	23.40	102.25	98.97	75.19	72.97	35.72	21.16	21.94	20.71

Table 3: Contd....

Cultivars	Total no. of grains/panicle		No. of filled grains/panicle		Hundred grain weight (g)		Biological yield/plant (gm)		Grain yield (gm)	
	F	W	F	W	F	W	F	W	F	W
ARB-6	140.63	66.93	113.94	33.25	2.59	2.11	2620.0	1139.0	769.0	121.0
Dagad Deshi	135.34	104.89	111.57	54.56	2.61	2.45	2376.0	1237.6	491.0	60.3
phaMahamaya	108.16	62.55	27.16	29.20	2.45	2.62	2820.6	1903.0	172.6	57.0
IR-64	81.62	69.28	61.25	45.26	2.65	2.59	2574.3	582.0	357.3	85.3
Poornima	83.53	52.46	65.93	43.93	2.35	1.55	2265.0	681.0	796.6	67.6
MTU-1010	75.40	61.53	52.63	43.86	2.39	2.52	2717.0	1115.0	435.6	112.6
IR64 x Mahamaya	43.08	46.47	41.75	20.00	2.79	2.29	2607.3	656.0	860.6	39.6
Mahamaya x CT 9993	60.00	43.91	38.66	25.86	2.35	1.74	2779	873.6	571.6	63.3
R 1033-968-2-1	94.33	70.06	86.60	48.93	2.59	2.58	3144.3	861.3	1024.3	125.3
sid6904959RR 347-5	75.43	57.33	48.73	41.86	2.37	2.60	2325.3	911.6	407.6	95.0
VL 3288	70.86	58.53	46.93	43.13	2.37	2.69	2370.6	647.6	620.3	52.6
Kakro	133.26	91.73	118.33	63.80	2.67	2.63	2684.0	1278.0	858.6	222.3
Mean	91.80	65.47	67.79	41.14	2.51	2.36	2607.0	990.5	613.8	91.8

21 days crop duration and at maturity level showed less or no differences. Similar pattern was observed in traits like, panicle length, number of unfilled grains/ panicle and hundred grain weights. Apart from this, days to flowering, number of plants per square meter, total number of grains/panicle, number of filled grains/ panicle showed high significant differences at weed free and weedy conditions.

Varietal performance : The cultivars/ varieties differed significantly in all the traits studies (Table 3). The range in varietal crop biomass or biological yield per plant under weed free was 2265 to 3144 g and in weedy condition it was 582 to 1903 g. Equivalent ranges from grain yield were about five folds (172.6–1024.3) in weedy condition. The fresh weed biomass ranged from 1061.5 to 4042.5 g whereas the dry weight of weeds ranged from 691.5 to 2626.5 g. Two varieties R 1033-968-2-1 and Kakro were the highest yielding cultivars under both weedy and weed free conditions.

Weed competition significantly reduced grain yield of rice varieties. This shows that rice varieties behave differently in their competitiveness to suppress weeds under competition. Similar work was reported by (4). The two genotypes identified to be exhibiting weed competitiveness were R1033-968-2-1 and Kakro. These two genotypes had early seedling vigour more plant height and high yield potential under both the conditions. These elite cultivars are likely to be useful as parents in breeding weed–competitive cultivars.

Table-4: Phenotypic correlations between yield and other yield attributing traits of upland rice under weed – free (F) or weedy (W) conditions.

Weeded													
	PH (21)	**PH**	**DTF**	**NPPSM**	**PL**	**TGPP**	**NFGPP**	**NUFGPP**	**HGW**	**BYP**	**GY**	**Fresh wt**	**dry wt**
PH (21)	1.00												
PH	0.42	1.00											
undDTF	-0.38	-0.68*	1.00										
NPPSM	-0.30	-0.25	0.03	1.00									
PL	0.38	0.53	-0.08	-0.21	1.00								
TGPP	0.59*	0.59*	-0.37	-0.33	0.54	1.00							
NFGPP	0.22	0.62*	-0.34	-0.27	0.69*	0.78**	1.00						
NUFGPP	0.60*	0.06	-0.23	0.18	0.08	0.62*	0.22	1.00					
HSW	-0.04	0.43	-0.08	-0.63*	0.25	0.44	0.37	-0.19	1.00				
BYP	0.34	0.06	0.26	-0.19	-0.12	0.39	0.05	0.41	0.27	1.00			
GY	0.08	0.49	0.14	-0.11	0.60*	0.47	0.65*	-0.06	0.26	0.22	1.00		
Fresh wt	-0.29	-0.17	0.04	-0.58*	-0.24	-0.22	-0.12	-0.40	0.23	-0.33	-0.27	1.00	
Dry wt	-0.43	-0.21	0.11	-0.39	-0.04	-0.11	0.00	-0.32	0.35	-0.43	-0.23	0.87**	1.00

*, ** Significant at 5 % and 1% probability level, respectively

PH (21) = Plant height (21 days) PH = Plant height (maturity) DTF = Days to flowering

NPPSM = No. of plants/ mt^2 PL = Panicle length (cm) TGPP = Total no. of grains/panicle

NFGPP = No. of filled grains/panicle NUFGPP = No. of unfilled grains/panicle HSW = Hundred grain weight (g)

BYP = Biological yield/plant (g) GY = Grain yield (g) Fresh wt. of weeds and Dry wt. of weeds

Relationship among traits under the weed management regime

In weed free environment, the studies showed that only biological yield was negatively associated with number of plants per square meter. Three characters namely, total number of grains/plant followed by panicle length and plant height at maturity showed significant and positive association with number of filled grains/plant. This indicates that increase in plant height, panicle length and total number of grains leads to increase in number of filled grains. Likewise, total grains/plant showed positive association with plant height (21 days) and panicle length. However, it was observed that when the days to flowering increase, plant height at maturity decreases indicating negative association with them. Similarly, as there is increase in days to flowering, there is simultaneous increase in number of unfilled grains per plant.

In case of weedy environment, grain yield showed positive and significant association with panicle length and number of filled grains/plant. Similar trend was observed between days to flowering and plant height *i.e.,* negative correlation as compared to weed free trials. Total number of grains/plant showed positive association with both plant height (21 days) and plant height (at maturity).

Again similar trend was found between number of filled grains/plant and plant height, panicle length and total grains/plant as compared to weed free trials. Number of unfilled grains/plant showed positive association between plant height (21 days) and total grains/plant. Hundred seed weight showed negative association with number of plants per square meter (Table-4). However, competitive ability is often negatively correlated to yield potential (5). (6) reviewed the role of plant breeding in weed management for several crops like rice, wheat and small grain cereals. In general, a high competitive ability was associated with tall plants that rapidly establish complete ground cover.

CONCLUSION

Breeding to increase the competiveness of highly productive rice plant types would be possible without significantly affecting yields. The competitiveness observed in these studies for the varieties ARB-6, 1033-968-2-1 and Kakro would be adequate to improving farmer's income and reduce herbicide use. More plant height, more tiller numbers will result in

more competitive rice varieties. The two genotypes identified to be exhibiting weed competitiveness were R 1033-968-2-1 and Kakro. These two genotypes had early seedling vigour more plant height and high yield potential under both the conditions. These elite cultivars are likely to be useful as parents in breeding weed–competitive cultivars.

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