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Effect of rice bran application for eco- friendly weed control, growth and yield of lowland rice in Bangladesh

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Abstract

Experiments were conducted during dry season of 2006 and 2007 at BRRI farm Gazipur and Bhanga,Faridpur to determine the effectiveness of rice bran against weed suppression, rice growth and its impact on rice yield. Treatments comprise of rice bran applied at the rate of 1.0, 2.0, 3.0, 4.0 and 5.0 tha^{-1} and compared with unweeded, weed free and two hand weeding in RCBD design with three replications. Different rates of rice bran significantly controlled the number and drymatter weight of weeds. Weed control efficiency was increased by increased application rate of rice bran in both years. Application of 5.0 tha^{-1} rice bran reduced weed number and weight about 65% in 2006 and about 61% in 2007 compared with unweeded condition. Leaf area index varied due to different rates of rice bran application and at panicle initiation stage. Rice bran applied at the rate of 5.0 t ha^{-1} observed optimum leaf area index of 3.35 and 3.37 during 2006 and 2007 years. Panicle number, grains $panicle^{-1}$ and grain yield were significantly higher in weed free and two hand weeded plots followed by rice bran application at the rate of 0 and 4.0 tha^{-1} in both years. Grain yield of rice increased by the application of 4.0 and 5.0 tha^{-1} rice bran over unweeded plot and it appear 27% and 37% increased in 2006 and also shown 26% and 35% yield increased in 2007. This research finding indicates rice bran suppressed weed growth and increased grain yield of rice which have the potential of being used as pre emergence organic herbicides.

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Introduction

Weed is a major yield limiting factor in rice culture and yield losses are numerous. Globally, actual yield losses due to pests have been estimated ~ 40%, of which weeds caused the highest loss (32%) (Rao *et al.*, 2007). Yield losses are largely dependent on the season, weed species, weed density, rice ultivars, growth rate, management practices and rice cosystem. In Bangladesh, the traditional methods of weed control practices of smallholders include hand weeding by hoe and hand pulling (Alam *et al.*, 2002). Usually, two or three hand weeding are done for growing a rice crop depending upon the nature of weeds, their intensity of infestation and the nature of the crop grown. But manual weeding is very costly and time consuming and during the pick period of weeding labors are not available. Considering this issues farmers are now using herbicide to control the weeds. Since the introduce of herbicide in rice field in early 90s in Bangladesh, farmers have used these chemicals to eradicate weeds from their field. Because the cost of herbicide and the labor to apply them are lower than the cost of other control measure. Therefore farmers have become depended on chemical control. But long term herbicide users can have a potential negative impact on the environment. Thus the current trend of weed control is to find out a non-chemical and eco-friendly solution to minimize perceived hazardous impacts from herbicides in Agriculture production specially on rice. Rice is the most important food crop in Bangladesh with a largest involvement to the GDP of the country. Rice bran, derived from the outer layers of the caryopsis during milling, including the pericarp, seed coat, nucellus and part of the sub aleurone layer of the starchy endosperm, accounts for 5 to 8% of the rough rice weight. It is reported by Barber *et al.* (1980) that rice bran contain valuable components such as oil, protein, macro and micro nutrients, vitamins some essential minerals as well as enzymes, microorganisms, natural toxicant constituent Several reports have been published on rice bran allelopathy for controlling weeds in rice field. Both Korea and Japan already using rice bran for suppressing weed in the rice field for protect their environment. The use of rice bran compost for eco friendly weed control in organic farming system was successfully evaluated by Khan *et al.* (2007) at Japan. Considering the above facts the use of rice bran could be a useful way for eco-friendly and non chemical weed control in organic farming systems. No work has been done in Bangladesh for weed control in rice using rice bran application.Therefore the purpose of the study was to evaluate the weed control potentially and growth enhancing ability of rice bran that might be useful for eco-friendly weed control in rice organic systems.

Materials and methods

Experimental site, design and treatments

The experiment was conducted at BRRI farm,Gazipur and Bhanga, Faridpur,Bangladesh during the season of Boro 2006 and 2007 respectively to observe the effectiveness of rice bran against wed suppression and its impact on rice yield. The treatments were rice bran applied at the rate of 1.0 ,2.0, 3.0, 4.0, and 5.0 tha^{-1} ,Un weeded (control), Weed free and Two hand weeding.The experiment was laid out in RCB design with three replications. Forty days old seedling of BRRI Dhan29 were transplanted on 15th January , 2006 at BRRI, Gazipur and 10 th January at BRRI Faridpur farm with 20cm×20cm spacing and 2 seedlings per hill.

Rice bran application, intercultural operations and data collection

Rice bran was applied after final land preparation by broadcasting with respective doses in both locations. Two hand weeding have done at 15 and 45 DAT. Weed biomass and number of weeds were assessed at 45 DAT. Random samples were taken from within each plot using a 0.5 x 0.5 m quadrate (Kim and Moody, 1983) Fertilizer was applied following BRRI (Bangladesh Rice Research Institute) recommanded doses. Data on weed infestation were collected from each unit plot before hand weeding done at 45 DAT. Weed control efficiency was calculated using weed dry matther weight data following the formula of Rao (1985).

Statistical analysis

The data were analyzed following analysis of variance(ANOVA) technique and mean differences were adjusted by multiple comparison test (Gomez and Gomez,1984) using the statistical program MSTAT-C. (Russell,1986).

Results and discussion

Effect of weed

Weed occurrence in lowland rice was inhibited by the application of rice bran as shown in Table 1. Higher weed control efficiency (92%) was observed in two hand weeded plot at both location and year. Application of 5.0,4.0, 3.0, 2.0, and 1.0 t /ha rice bran controlled 75%,61%, 40%, 34%, and 33% weed in the year of 2006 at Gazipur and 75%,70%, 56%, 30% and 22% weed at Faridpur in the year of 2007 respectively. Highest weed number and weight was observed in unweeded plot and the lowest was in two hand weeded plot at both locations. Rice bran application at the rate of 5 t/ha produced intermediate weed number and weight. Higher rates of rice bran application produced lower number of weed and weed weight. (Table1). Thus rice bran application showed effective suppression of different weed species. Significant weed suppression was obtained with rice bran application which was reported by Yang *et al.* (2005) at Korea. Figure 1 indicated there is negative linear relationship (R^2= 0.92 and 0.89) between weed weight and grain yield and provide evidence that lower the weed weight higher the grain yield.

Table 1. Effect of rice bran application on weed occurrence in boro rice.

Treatment	*Weed number (m-²)*		*Weed weight (g/m²)*		*WCE(%)	
	L_1	L_2	L_1	L_2	L_1	L_2
T1	51.00	41.33	21.25	5.1	33	22
T2	48.00	33.33	20.94	4.83	34	30
T3	44.00	24.67	19.17	3.79	40	56
T4	25.00	16.33	12.46	3.21	61	70
T5	17.67	12.67	7.8	2.95	75	75
T6	61.00	53.33	31.72	5.83	-	-
T8	7.33	8.67	2.38	1.60	92	92
CV (%)	30.50	22.45	10.80	20.78	-	-
$Lsd_{(0.05)}$	20.08	9.72	10.24	1.44	-	-

L_1= BRRI Farm Gazipur,2006, L_2= BRRI Farm Bhanga, Faridpur, 2007

* indicates % control of weed regarding the treatment over no weeding

T1= Rice bran applied @ 1.0 t ha^{-1} ;T2= Rice bran applied @ 2.0 t ha^{-1} ,T3= Rice bran applied @ 3.0 t ha^{-1} ; T4= Rice bran applied @ 4.0 t ha^{-1} , T5= Rice bran applied @ 5.0 t ha^{-1} ; T6= Control plot (Unweeded), T8= Two hand weeding.

Table 2. Plant height and LAI of rice as affected by rice bran application.

Treatment	*plant ht(cm) at harvest*		LAI at PI stage	
	L_1	L_2	L_1	L_2
T1	76.93	99.67	2.19	3.11
T2	82.66	100.00	2.35	3.16
T3	81.93	100.86	2.41	3.19
T4	84.60	101.53	3.00	3.24
T5	86.13	102.26	3.35	3.37
T6	77.60	98.20	2.1	2.99
T7	86.20	105.72	3.5	4.05
T8	86.16	103.00	3.43	4.00
CV(%)	3.61	3.38	5.89	5.75
$Lsd(0._{05})$	5.23	ns	0.094	0.34

L_1= BRRI Farm Gazipur,2006, L_2= BRRI Farm Bhanga, Faridpur, 2007.

Table 3. Yield and yield components as affected by rice bran in boro season.

Treatment	Panicle/ m²		Grain/ Panicle		1000 grain weight (g)		Grain yield (t /ha)	
	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2
T1	216	285	58	94	19.43	19.31	3.77	5.10
T2	250	290	60	98	19.79	19.72	3.84	5.57
T3	267	306	62	100	19.30	20.16	4.29	5.74
T4	310	313	65	103	19.69	20.62	5.01	6.07
T5	338	338	68	107	20.32	20.74	5.80	6.94
T6	213	257	55	83d	18.77	18.59	3.63	4.52
T7	352	369	76	127	19.52	21.06	6.65	8.34
T8	347	357	71	115	19.94	20.54	6.42	8.18
CV(%)	11.94	10.60	10.41	7.18	3.38	6.17	12.98	8.82
$Lsd_{(0.05)}$	59.95	58.39	11.73	13.06	ns	ns	1.12	0.98

L_1= BRRI Farm Gazipur,2006, L_2= BRRI Farm Bhanga, Faridpur, 2007.

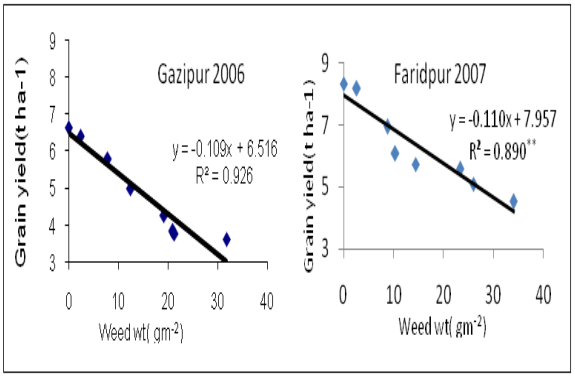

Fig. 1. Dependence of weed weight on grain yield during 2006 at Gazipur and 2007 at Faridpur district.

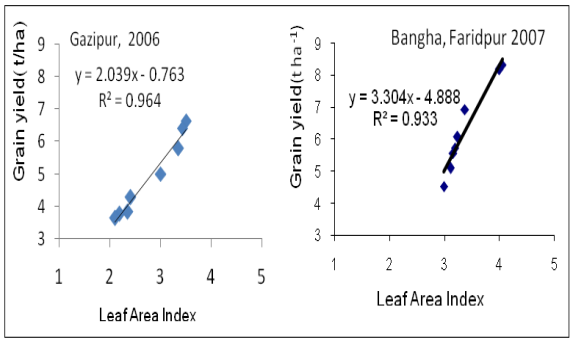

Fig. 2. Depandence of LAI at PI stage on grain yield at Gazipur 2006 and Faridpur 2007.

Rice growth and yield

Plant height (cm) differs significantly with the application of different rates of rice bran at Gazipur during 2006.Lowest plant height was observed in 1.0 t /ha applied rice bran plot which is statistically similar with control plot (Table 2) may be due to higher weed occurrence in these plots. Highest plant height was observed in weed free plot, two hand weeded plot and rice bran applied at the rate of 5, 4 and 3 tha^{-1} plot. But Plant height did not differ significantly at Faridpur region even as higher plant height was observed in weed free plot and un weeded plot found lower (Table 2).Leaf area index of a plant is one of the major determinants of its growth and productivity. Weed control treatment showed significant variation in LAI during PI stage at both location and year. Leaf area index increased up to panicle initiation stage for all the weed control treatments. For both location and year weed free treatments maintained the peak LAI during all over the growing period followed by two hand weeded plot which was significantly higher than other treatments. Unweeded plot performed the poorest LAI (Table 1).Figure 2 showed dependence of LAI (at PI stage) on grain yield of rice.R^2 value of 0.964 and 0.933 indicate positive linear relationship of LAI and grain yield irrespective of locations. Number of panicle/ m^2 and grain/panicle was highest in weed free plot which is statistically similar with 2 hand weeded plot resulted highest grain yield in weed free plot that is statistically similar with 2 hand weeded plot followed by rice bran applied at the rate of 5 t/ha treated plot at both locations.(Table 3).Rice bran applied at the rate of 4 t /ha also produced more than 5 and 6 t/ha grain yield at gazipur and Faridpur respectively.Thousand grain weight was not significantly differ by the application of different rates of rice bran. Figure 3 indicated that grain yield of rice increased with the increased application different rates of rice bran over control plot and it come into view 27% and 37% grain yield increased during 2006 and also shown 26% and 35% yield increased during 2007. The results indicated that rice bran apply is

beneficial to rice growth and yield as well as it reduced weed growth due to the negative effect of phenolic compounds produced during the decomposition process. The results supported by the previous result obtain from park (2002).

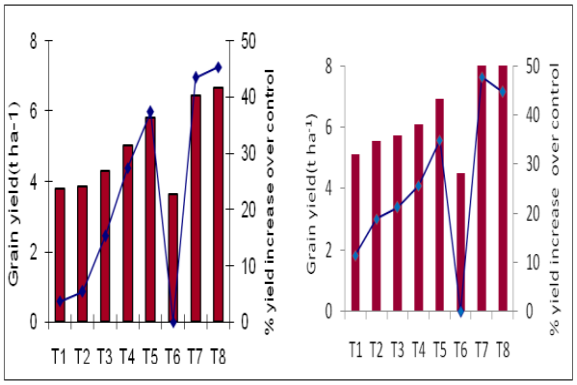

Fig. 3. Yield increase due to application of rice bran during 2006 and 2007 at Gazipur and Faridpur respectively.

Conclusion

Application of rice bran suppressed weed growth and increased grain yield of rice. Rice bran would be used as organic weed suppressing agent. Further evaluation is needed how much micronutrient and other chemicals are released during the decomposition period of rice bran which influenced growth and development of rice plant and suppressed weed growth.

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