

INFLUENCE OF PLANT EXTRACTED PYROLIGNEOUS ACID ON TRANSPLANTED AMAN RICES. M. Masum¹, M. Malek², M. S. H. Mandal³, M. N. Haque³ and Z. Akther³

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Abstract

A field experiment was conducted at the experimental field of Sher-e-Bangla Agricultural University during August to December 2012 to find out the effect of plant extracted pyroligneous acid (vinegar like substance extracted from wood) with trade name PRH on T. aman rice (BRRI dhan34). There were six treatments viz., Control (no fertilizer and no PRH); 100% recommended dose of fertilizer; 100% recommended dose of fertilizer plus 100% PRH; 50% recommended dose of fertilizer plus 50% PRH; 50% recommended dose of fertilizer plus 100%PRH; and no fertilizer but 100% PRH. Results showed that at harvest the highest plant height was obtained from 100% recommended dose of fertilizer application, whereas the lowest from control (no fertilizer + no PRH). The highest tillers hill⁻¹ was obtained from 50% recommended dose of fertilizer + 50% PRH application and the lowest from control (no fertilizer + no PRH) but the highest effective tillers hill⁻¹ was obtained from 100% recommended dose of fertilizer application and the lowest from control (no fertilizer + no PRH). Grain yield was significantly the highest (5.05 t ha⁻¹) with 50% recommended dose of fertilizer + 50% PRH, whereas the lowest (2.55 t ha⁻¹) yield was obtained from control (no fertilizer + no PRH). The higher grain yield was attributed mainly due to highest number of effective tillers hill⁻¹, filled grains panicle⁻¹ and 1000-grain weight obtained from 50% recommended dose of fertilizer + 50% PRH.

Key words: PRH, Wood vinegar, Pyroligneous acid, rice.

Introduction

Rice (*Oryza sativa* L.) is the most important food crop of the world and the staple food of more than 3 billion people or more than half of the world's population. Rice is grown in more than a hundred countries with a total harvested area of nearly 160 million hectares, producing more than 700 million tons every year (IRRI, 2010). Total rice production in Bangladesh was about 10.97 million tons in 1971 when the country's population was only about 70.88 million whereas the country is now producing about 33.54 million tons rice to feed her 142.3 million people (BBS, 2011). The population of Bangladesh is still growing by two million every year and may increase by another 30 million over the next 20 years. Thus, Bangladesh will require about 27.26 million tons of rice for the year 2020. But the average yield of rice is poor (4.34 t ha⁻¹) in Bangladesh (BRRI, 2011) despite the area is decreasing day by day due to high residential pressure. The possibility of horizontal expansion of rice production area has come to stand still (Hamid, 1991). To maintain self-sufficiency in rice, Bangladesh will have to continue to expand rice production by raising yields at a rate that is at least equal to population growth until the demand for rice has stabilized. In our country, the challenge of increasing rice production area horizontally become very difficult as rice area is continuously shrinking to meet the growing demand for high-value crops, and for urban and industrial development. Therefore, it is necessary to increase the production capacity per unit area which would require high inputs.

Plant growth regulators have been used in agriculture, however, their impact has been relatively little and their application is limited to some specific objectives such as quality and quantity improvement (Pandey et al., 2001). Plant growth regulators are synthesized indigenously by plants; however, several studies show that plant can respond to exogenously applied growth hormones. Exogenous application of plant growth regulators affects the endogenous hormonal pattern of the plant, either by supplementation of sub-optimal levels or by interaction with their synthesis, translocation or inactivation of existing hormone levels (Arshad and Frankenberger, 1993).

Wood vinegar has been introduced into organic agriculture in Thailand. Wood vinegar or pyroligneous acid is a condensed liquid generated from the gas and combustion of fresh wood burning in airless condition by charcoal production. It is used in crop production towards soil quality improvement, pest elimination and plant growth stimulation (FFTC, 2005). The combined application of wood vinegar at 300 times dilution with chicken manure increased the yield components and grain yield of rice compared to other treatments with the average yield of 5.13 t ha⁻¹ (Tipparak et al.,

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2007). Wood vinegar can be applied to the soil surface to help increase the population of beneficial microbes and to promote plant root growth (Tancho, 2008). Additionally, the product can help boost crop defenses against disease. For improved plant production, wood vinegar solution can be sprayed over plant shoots. Wood vinegar, like hormones, will be absorbed into twigs, trunks, or leaves, resulting in stronger plants and leaves that are greener and more resistant to pests and diseases (Guzman, 2009). Therefore, present study was taken to increase the yield per unit area through the use of PRH and recommended dose of fertilizers and to find out the response of PRH on the yield and yield attributes of *T. aman* rice. PRH (a trade name) a liquid solution which is extracted from fruits and other natural ingredients as like as vinegar. It is 100% organic. PRH can be used in rice, wheat, maize fields along with other cereal crops. PRH can be used in crop production towards soil quality improvement, pest elimination and plant growth stimulation. It also increases the number of microorganism present in soil and thus increase root growth through microbial activity (NBAT, 2012).

Materials and Methods

The field experiment was conducted at the Agricultural farm of Sher-e-Bangla Agricultural University, Dhaka-1207 during the period from August to December, 2012. The variety used in this experiment was BRRI dhan34. The experiment was laid out in a Randomized Complete Block Design with three replications. There were six treatments viz., T_1 = Control (no fertilizer and no PRH); T_2 = 100% recommended dose of fertilizer; T_3 = 100% recommended dose of fertilizer plus 100% PRH; T_4 = 50% recommended dose of fertilizer plus 50% PRH; T_5 = 50% recommended dose of fertilizer plus 100% PRH; and T_6 = no fertilizer but 100% PRH. Recommended dose of fertilizer for *T. aman* rice were Urea, TSP, MoP, Gypsum and Zinc Sulphate @ 120 kg ha⁻¹, 90 kg ha⁻¹, 40 kg ha⁻¹, 60 kg ha⁻¹ and 10 kg ha⁻¹ respectively. The 100% PRH was prepared by 200 ml PRH in 20 liter water, whereas 50% PRH was prepared by 100 ml PRH in 20 liter water. All fertilizers were applied during final land preparation except urea that applied in three equal splits at 7, 30 and 50 DAT. Foliar application of PRH using knapsack prayer were done three times at 7, 30 and 50 DAT. Thirty day old seedlings were uprooted and transplanted in the field on August 2, 2012. Three seedlings were transplanted in each hill with a spacing of 25 cm x 15 cm. The harvesting was done on December 29, 2012 manually from each plot. The crop was harvested plot-wise at full maturity when 90% of the grains turned into golden yellow. Hills from central 5 m² area of each plot were harvested for collecting data on grain and straw yields. The harvested crop was then bundled separately, tagged properly and brought to the threshing floor and processed as usual. Prior to harvest five hills were selected at random from each plot and carefully uprooted to collect data on yield and yield contributing characters. All the collected data were analyzed following the analysis of variance (ANOVA) technique using MSTAT package and the mean differences among the treatments were compared by Duncan's Multiple Range Test (DMRT).

Results and Discussion

The plant height of *T. aman* rice varied significantly due to different treatments. It was observed from Table 1 that 100% recommended dose of fertilizer application (T_2) produced the highest plant height (150.2 cm) which was statistically similar with 100% recommended dose of fertilizer and 100% PRH application (T_3). The lowest (127.0 cm) plant height was recorded from control i.e. no fertilizer + no PRH application (T_1). Similar results were reported by Watanabe and Saigusa (2004), who reported that plant height was significantly increased by the exogenous application of growth hormones over that of control.

Significant variation of total tillers hill⁻¹ was observed due to different treatments (Table 1). The highest (24.20) total tillers hill⁻¹ was recorded from 50% recommended dose of fertilizer + 50% PRH application (T_4) which was statistically similar with 50% recommended dose of fertilizer + 100% PRH (T_5) and 100% recommended dose of fertilizer (T_2). The lowest (15.05) total tillers hill⁻¹ was recorded from control (T_1) which was statistically similar with no fertilizer + 100% PRH (T_6).

Effective tillers hill⁻¹ varied significantly due to different treatments is shown in Table 1. The highest (18.45) effective tillers hill⁻¹ was recorded from 100% recommended dose of fertilizer application (T_2) followed by 50% recommended dose of fertilizer + 100% PRH (T_5), 50% recommended dose of fertilizer + 50% PRH (T_4), 100% recommended dose of fertilizer + 100% PRH (T_3) and no fertilizer + 100% PRH (T_6) applications. The lowest (10.80) number of effective tillers hill⁻¹ was recorded from control (T_1). The results are in conformity with the findings communicated by Imam et al. (2011) who reported significant effects of various growth hormones on rice yield and yield attributing characters.

Results showed that different levels of fertilizers and PRH had no significant effect on panicle length. It is observed from table 1 that maximum (24.26 cm) panicle length was observed from 50% recommended dose of

fertilizer + 50% PRH application and minimum (22.53 cm) panicle length was recorded from 50% recommended dose of fertilizer + 100% PRH application (T₅).

Table 1. Effect of different treatments on growth of T. aman rice

Treatments	Plant height (cm)	Total tillers hill ⁻¹	Effective tillers hill ⁻¹	Panicle length (cm)
T ₁	127.0 b	15.05 b	10.80 c	24.02 a
T ₂	150.2 a	21.70 a	18.45 a	24.06 a
T ₃	149.6 a	19.45 ab	15.05 ab	22.58 a
T ₄	145.1 ab	24.20 a	15.30 ab	24.26 a
T ₅	145.2 ab	20.65 a	15.80 ab	22.53 a
T ₆	137.7 ab	15.10 b	12.00 bc	24.15 a
SE	6.022	1.579	1.173	NS
CV (%)	8.45	16.31	16.10	4.73

There were no significant variations observed in case of filled grains panicle⁻¹ of T. aman rice due to various treatments which is presented in Table 2. Numerically the maximum (194.9) number of filled grains panicle⁻¹ was recorded from 50% recommended dose of fertilizer + 50% PRH application (T₄) and the minimum (127.5) was recorded from 100% recommended dose of fertilizer + 100% PRH application (T₃). Islam et al. (2005) stated that growth hormones in two splits increased the number of normal kernels. The increase in normal kernel with application of PRH at panicle initiation stage may be due to the fact that leaves in treated plots remained functional for a longer period of time. The second reason might be the longer functionality of the vascular bundles in different parts of the panicle, which might have allowed an efficient translocation of photosynthates to grain formation (Awan et al., 1999).

Table 2. Effect of different fertilizers rate and PRH on Yield and yield components of T. aman rice BRRI dhan34

Treatments	Grain yield (t ha ⁻¹)	Yield components					
		Filled grains panicle ⁻¹	Unfilled grains panicle ⁻¹	1000-grain weight (g)	Straw yield (t ha ⁻¹)	Biological yield (t ha ⁻¹)	Harvest index (%)
T ₁	2.55 d	152.0 a	18.85 c	10.00 a	4.34 b	6.89 c	37.42 bc
T ₂	3.15 c	172.3 a	29.90 b	10.75 a	6.68 a	9.83 ab	32.08 c
T ₃	3.98 b	127.5 a	21.75 c	10.75 a	6.55 a	10.52 a	37.78 bc
T ₄	5.05 a	194.9 a	40.15 a	11.50 a	5.40 ab	10.45 a	48.32 a
T ₅	3.83 b	136.6 a	22.20 c	11.25 a	5.35 ab	9.19 ab	41.75 b
T ₆	2.88 cd	169.9 a	18.85 c	10.00 a	5.74 a	8.62 b	33.26 c
SE	0.17	NS	2.12	NS	0.41	0.49	2.20
CV (%)	9.44	28.68	16.78	14.78	15.05	10.79	11.17

Significant variation was observed in case of unfilled grains panicle⁻¹ of T. aman rice due to various treatments (Table 2). The 50% recommended dose of fertilizer + 50% PRH application (T₄) produced the highest (40.15) unfilled grains whereas, No fertilizer + 100% PRH (T₆) application produced the lowest (18.85) unfilled grains panicle⁻¹ which was statistically similar with 100% recommended dose of fertilizer + 100% PRH application (T₃) and 50% recommended dose of fertilizer + 100% PRH application (T₅).

The 1000-weight was not significantly influenced by the various treatments (table 2) as it is mostly governed by genetic makeup of the variety. Similar results were reported by Islam et al. (2008) and Ibrahim et al. (2004). Numerically the maximum (11.50 g) 1000-grain weight was observed from 50% recommended dose of fertilizer + 50% PRH application (T₄) and the minimum (10.00 g) from control i.e. no fertilizer + no PRH application (T₁).

Significant variation was observed in case of grain yield of T. aman rice due to various treatments (Table 2). The highest (5.05 t ha⁻¹) grain yield was recorded from 50% recommended dose of fertilizer + 50% PRH application (T₄). This might be due to increased tillers hill⁻¹, effective tillers hill⁻¹, highest panicle length and highest filled grains panicle⁻¹. Using PRH enhanced grain yield by increasing filled grain weight. This finding was similar with Tipparak et al. (2007) and Hok et al. (2009). The lowest (2.55 t ha⁻¹) grain yield was recorded from control i.e. no fertilizer + no PRH application (T₁).

Straw yield varied significantly due to various treatments (Table 2). The highest (6.68 t ha⁻¹) straw yield was recorded from 100% recommended dose of fertilizer application (T₂) and lowest (4.32 t ha⁻¹) straw yield was recorded from 50% recommended dose of fertilizer + 50% PRH application (T₄) which was statistically similar with control i.e. no fertilizer + no PRH application (T₁). Biological yield of T. aman rice varied significantly due to various treatments. From the table 2 the highest (10.52 t ha⁻¹) biological yield was recorded from 100% recommended dose of fertilizer + 100% PRH application (T₃) which was statistically similar with 50% recommended dose of fertilizer + 50% PRH application (T₄). The lowest (6.89 t ha⁻¹) biological yield was recorded from control i.e. no fertilizer + no PRH application (T₁).

The harvest index varied significantly due to various treatments presented in table 2. The highest (48.32 %) harvest index was recorded from 50% recommended dose of fertilizer + 50% PRH application (T₄). The lowest (32.08 %) harvest index was found from 100% recommended dose of fertilizer application (T₂) which was statistically similar with no fertilizer + 100% PRH application (T₆).

Conclusion

From the results of this study it might be concluded that 50% recommended dose of fertilizer plus 50% PRH (T₄) showed better performance over other treatments in respect of yield and other attributes.

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