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Investigating the Effectiveness of Herbicides for Weed Suppression in Late *Boro* Rice

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Abstract

The experiment was carried out at the Agronomy Field Laboratory, Bangladesh Institute of Nuclear Agriculture, Mymensingh during February to June 2019 to study the efficacy of herbicides on weed suppression of late boro rice (cv. Binadhan-14). The experiment was consisted of 20 treatments such as Control (T1), Hand weeding (T2), Bensulfuran methyl 8% +Acetachlor 14% (T3) , 2-4, D Amine 72SCL (T4), Pretilachlor 500EC (T5), Bispyriback sodium 300WP (T6), Pyrazosulfuran ethyl 10WP (T7), Trisulfuron 40WP (T8), Pendimethyline 33EC (T9), Metsulfuran methyl 20WDG (T10), Butachlor 5G (T11), Ethoxysulfuron 150WG (T12), Carfentrazol ethyl 24EC (T13), Fenoxpro-p-ethyl 9EC (T14), Glyphosate 480SL (T15), Paraquate dichloride 27.6% (T16), Bensulfuran methyl 120 gm+ Bispyriback sodium 180, 300WP (T17), Triafemon 240SC (T18), Penoxsulum 240SC (T19), Pyrazosulfuran ethyl 100gm+ Pretilachlor 100gm 20WP (T20). The experiment was laid out in a randomized completely block design with three replications. Fourteen weed species belonging to six families infested the experimental plots. The lowest weed density (3.00), weed dry weight (4.80) and the highest weed control efficiency (86.60) were recorded from treatment Ethoxysulfuron 150WG (T12). From the findings of the study, it can be concluded that herbicide Ethoxysulfuron 150WG

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followed by Bispyriback-sodium 300WP, Hand weeding and Pyrazosulfuran ethyl 10WP would be the most effective weed management practice for late transplanting boro rice (cv. Binadhan-14).

Keywords: Investigating, Effectiveness, Herbicides, Weed Suppression, Late boro rice, Binadhan-14

INTRODUCTION

Bangladesh has ideal geographic and agronomic conditions for the production of rice (*Oryza sativa* L.). In Bangladesh, rice is a staple food for the people. The production of food grains in Bangladesh comes mainly from rice. 95% of the Bangladeshi food grains are rice (BBS, 2020). In a daily average, the meals consumed by individuals consist of approximately 75% calories and 55% protein that come from rice. Rice is the cereal crop that is grown most widely in Bangladesh. 36.28 million metric tons of rice are produced annually from an area of 11.45 million per hectares, or over 75% of its cropped land. (Islam *et al.,* 2023). Rice has three different growing seasons such as *Aus, Aman, and Boro*. These seasons contribute to approximately 7%, 38%, and 55% of the total amount of rice produced annually, respectively. The fact that *boro* has the highest average yield of any single crop (3.96 t ha^{-1}) and covers almost 41.94% of the total rice the amount of land is remarkable. (BBS, 2018).

Weeds compete with crops for nutrients, space and water and thus reduce crop yield. Weeds infestation in rice field is always subjected to agro-ecological conditions and growing seasons (Saravanane, 2020). Weeding in Bangladesh is commonly done manually; however, this is becoming less common because of the non-availability of labor at the critical time of weeding and high labor wage (Ghosh, 2014). Manual weeding is very costly as well as time consuming method. Besides, the present weed management system which is done manually is laborious, time consuming, expensive and cannot be done on time due to various reasons (Farhat *et al*., 2023). For the last few decades, herbicides have been tremendous contributor to agriculture. In large scale rice farming, herbicide-based weed management has become the smartest and most viable option as against the scarcity and high costs of labor (Singh *et al*., 2006). Weeding regime influences on the performance of rice. World-wide food demand is raising accompanying with the rapidly growth of world economic, increase of population, mainly in developing countries. Rice is one of the most important foods for the world populations, especially in Asia, almost 90% of the global rice production is consumed (Bandumula, 2017).

In addition to significantly reducing agricultural yields, weeds also increase production costs, decrease the effectiveness of fertilizer and pesticide utilization, lower grain quality, provide substitute hosts for pests, take away from the ecosystem's aesthetic value, lower biodiversity, and have an adverse effect on animal and human health (Mia *et al*.,2023). In terms of weed shift, weed dispersal, herbicide resistance in weeds, and environmental pollution, Gnanavel and Natarajan (2014) and Sharma (2014) observed that continuous use of a comparable number of herbicides over a given amount of time on a same piece of land develops an ecological imbalance. Herbicides are an effective weed control strategy for rice fields because they are rapid to act, easier to use, and are less costly than hand weeding, which is a more traditional method (Bzour *et al*., 2018). Additionally, weeds in important field crops have been managed worldwide through the use of synthetic herbicides. (Bo *et al*., 2017). Herbicides are a promising

alternative for weed control in such a situation. Many research investigations have found the influence of herbicides on weed management; however, very little is known about the efficacy of the mentioned herbicides in controlling weeds in rice, especially in Bangladesh when it comes to the late *boro* cultivar rice Binadhan-14. The present study has been undertaken to find out the weed control efficacy of different herbicides on late transplanted *boro* rice (Binadhan-14).

MATERIALS AND METHODS

Experimental site

The experimental field was medium high land belonging to non-calcareous dark grey flood plain soil under the Old Brahmaputra Floodplain Agro-ecological Zone-9. The experimental site is located at 240 75N' latitude and 900 50' E longitude at an elevation of 18 m above the mean sea level.

Experimental design

The experiment was laid out in a randomized complete block design. Each treatment was replicated 3 times. Total numbers of unit plots were 20 × 3 = 60. Each plot size was 4.0 m× 2.5 m. The distance maintained between the main plot and the replications were 0.5 m and 1.0 m, respectively.

Experimental treatments

The treatment consisted of 20 herbicides as follows: T_1 = Control, T_2 = Hand weeding, T_3 = Bensulfuran methyl 8% +Acetachlor 14%, T_4 = 2-4, D amine 72SCL, T_5 = Pretilachlor 500ec, T_6 = Bispyriback-sodium 300WP, T_7 = Pyrazosulfuran ethyl 10 WP, T_8 = Trisulfuron 40WP, T_9 = Pendimethyline 33EC, T_{10} = Metsulfuran methyl 20WDG, T_{11} =Butachlor 5G, T_{12} = Ethoxysulfuron 150WG, T_{13} = Carfentrazol ethyl 24EC, T_{14} = Fenoxpro-p-ethyl 9EC, T_{15} = Glyphosate 480SL, T_{16} =Paraquate dichloride 27.6%, T_{17} = Bensulfuran methyl 120 gm+ Bispyriback sodium 180 gm,300WP, T_{18} = Triafemon 240SC, T_{19} = Penoxsulum 240SC, T_{20} = Pyrazosulfuran ethyl 100 gm+ Pretilachlor 100 gm 20WP

Preparation of seedling nursery bed and seed sowing

A piece of land was selected for raising seedlings. The land was puddled well with country plough followed by leveling with a ladder. The sprouted seeds were sown in the nursery bed on 12 February 2019. Proper care was taken to raise the healthy seedlings in the nursery bed. Weeds were removed and irrigation was given in the nursery bed as and when necessary.

Main land preparation

The field was opened with a power tiller and subsequently ploughed four times with country plough followed by laddering. The layout of the field was made after final land preparation. Weeds and stubbles were removed and cleaned from individual plots.

Transplanting of seedlings

After uprooting healthy and similar sized seedlings were selected for transplanting. Seedlings were transplanted in the well-prepared puddle field on 12 March 2019 at the

rate of two to three seedlings hill^{-1}, maintained row and hill distance of 25 cm and 15 cm, respectively.

Fertilizer application

The land was fertilized with urea, triple superphosphate, muriate of potash and gypsum as per recommendation of BINA for Binadhan-14. The entire amounts of triple superphosphate, muriate of potash and gypsum were applied at the time of final land preparation. Urea was applied in three installments at 15, 30 and 45 days after transplanting (DAT).

Weed parameter

Number of weed species (no. m^{-2}), Weed density (no. m^{-2}), Weed dry weight (g m^{-2}), Weed control efficiency (%)

Weed control efficiency:

Weed control efficiency was calculated by using the following formula,

$$\text{Weed Control Efficiency (WCE)} = \frac{\text{DWC}-\text{DWT}}{\text{DWC}} \times 100$$

Here,
WCE = Weed control efficiency
DWC = Dry weight of weeds in weedy check
DWT = Dry weight of weeds in each treatment

Statistical analysis

Data recorded for different parameters were tabulated in proper form. The recorded data on various plant characters were statistically analyzed. The mean of all treatments was calculated and the Analysis of variance (ANOVA) for each of the parameters under study was done with the help of computer package MSTAT. The differences among treatment means were compared by Duncan's New Multiple Range Test (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Composition of the weeds found in the experimental plot

Fourteen weed species belonging to six families infested the experimental field. Among fourteen species of weeds five were grasses, seven sedges and two broad leaves. Local name, english name, scientific name, family, morphological type and life cycle of those weeds of the experimental plot have been presented in Table 01. Results showed that number of weed species were least when Ethoxysulfuron 150WG (T_{12}) was applied in the plot followed by Carfentrazol ethyl 24EC (T_{13}), Bispyriback-sodium 300WP (T_6) and Trisulfuron 40WP (T_8).

Table 01: Infesting weed species found growing in the experimental field

Sl. No.	Local name	Scientific name	Family	Morphological type	Life Cycle
1.	Shama	*Echinochloa colomum*	Poaceae	Grass	Annual
2.	Gaicha	*Paspalum distichum*	Poaceae	Grass	Perennial
3.	Khude Shama	*Echinochloa colona*	Poaceae	Grass	Annual
4.	Arail	*Leersia hexandra L.*	Poaceae	Grass	Perennial
5.	Angta	*Panicum repens L.*	Poaceae	Grass	Perennial
6.	Chechra	*Scirpus maritimus*	Cyperaceae	Sedge	Perennial
7.	Joyna	*Fimbristylis miliacea L.*	Cyperaceae	Sedge	Annual

8.	Holdemutha	*Cyperus difformis*	Cyperaceae	Sedge	Perennial
9.	Baro chucha	*Cyperus iria*	Cyperaceae	Sedge	Annual
10.	Sabuj Nakful	*Cyperus difformis L.*	Cyperaceae	Sedge	Annual
11.	Panikachu	*Monochoria vaginalis*	Pontederiaceae	Broad leaf	Perennial
12.	Zheelmorich	*Sphenoclea zeylanica*	Sphenocleaceae	Broad leaf	Annual
13.	Keshuti	*Eclipta alba*	Asteraceae	Sedge	Annual
14.	Shushnishak	*Marsilea quadrifolia*	Marsileaceae	Sedge	Annual

Effect of herbicide on weed control

Number of weed species

Effects of herbicide was found significant on number of weed species in the rice field. The higher number of weed species (11.33) was observed in association with Binadhan14 when no herbicide was applied in the field. While lowest number of weed species (1.0) was observed in the Binadhan-14 when Ethoxysulfuron 150WG was applied in the field (Figure 01). Similar findings were reported by Sohel *et al.* (2020), who found significant variation on number of weed species.

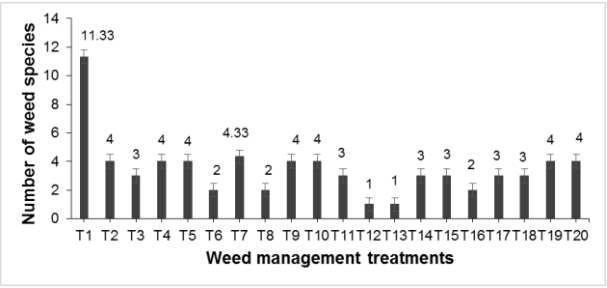

Figure 01: Effect of number of weed species on weed control in rice cultivated field

T_1=Control, T_2=Hand weeding, T_3=Bensulfuran methyl 8% +Acetachlor 14%, T_4=2-4, D amine 72SCL, T_5=Pretilachlor 500EC, T_6=Bispyriback-sodium 300WP, T_7=Pyrazosulfuran ethyl 10WP, T_8=Trisulfuron 40WP, T_9=Pendimethyline 33EC, T_{10}=Metsulfuran methyl 20WDG, T_{11}=Butachlor 5G, T_{12}=Ethoxysulfuron 150WG, T_{13}=Carfentrazol ethyl 24EC, T_{14}=Fenoxpro-p-ethyl 9EC, T_{15}=Glyphosate 480SL, T_{16}=Paraquate dichloride 27.6%, T_{17}=Bensulfuran methyl 120 gm+ Bispyriback sodium 180 gm, 300WP, T_{18}=Triafemon 240SC, T_{19}=Penoxsulum 240SC, T_{20}=Pyrazosulfuran ethyl 100 gm+ Pretilachlor 100 gm 20WP

Weed density

Effects of herbicide was found significant on number of weed density in the rice field. The highest weed density (18.00 no. m^{-2}) was observed in association with Binadhan14 when no herbicide was applied in the field. While the lowest weed density (3.00 no./m^2) was observed in the Binadhan-14 when Ethoxysulfuron 150WG was applied in the field (Figure 02). Similar findings were reported by Zahan *et al.* (2017), who found significant variation on weed density.

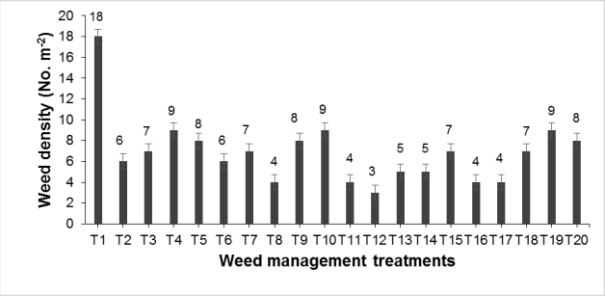

Figure 02: Effect of weed density on weed control in rice cultivated field

T_1=Control, T_2=Hand weeding, T_3=Bensulfuran methyl 8% +Acetachlor 14%, T_4=2-4, D amine 72SCL, T_5=Pretilachlor 500EC, T_6=Bispyriback-sodium 300WP, T_7=Pyrazosulfuran ethyl 10WP, T_8=Trisulfuron 40WP, T_9=Pendimethyline 33EC, T_{10}=Metsulfuran methyl 20WDG, T_{11}=Butachlor 5G, T_{12}=Ethoxysulfuron 150WG, T_{13}=Carfentrazol ethyl 24EC, T_{14}=Fenoxpro-p-ethyl 9EC, T_{15}=Glyphosate 480SL, T_{16}=Paraquate dichloride 27.6%, T_{17}=Bensulfuran methyl 120 gm+ Bispyriback sodium 180 gm, 300WP, T_{18}=Triafemon 240SC, T_{19}=Penoxsulum 240SC, T_{20}=Pyrazosulfuran ethyl 100 gm+ Pretilachlor 100 gm 20WP

Weed dry weight

Effects of herbicide was found significant on weed dry weight in the rice field. The highest weed dry weight (35.70 g) was observed in association with Binadhan-14 when no herbicide was applied in the field. While the lowest weed dry weight (4.80 g) was observed in the Binadhan14 when Ethoxysulfuron 150WG was applied in the field (Figure 03). Similar findings were reported by Pramanik *et al.* (2020), who found significant variation on weed dry weight.

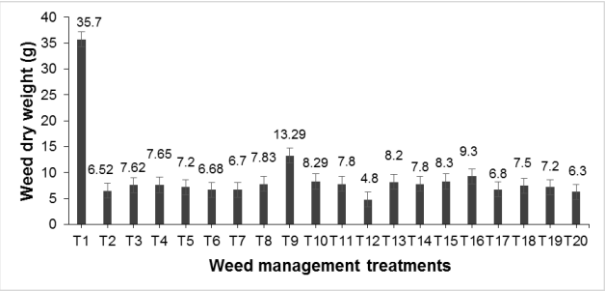

Figure 03: Effect of weed dry weight on weed control in rice cultivated field

T_1=Control, T_2=Hand weeding, T_3=Bensulfuran methyl 8% +Acetachlor 14%, T_4=2-4, D amine 72SCL, T_5=Pretilachlor 500EC, T_6=Bispyriback-sodium 300WP, T_7=Pyrazosulfuran ethyl 10WP, T_8=Trisulfuron 40WP, T_9=Pendimethyline 33EC, T_{10}=Metsulfuran methyl 20WDG, T_{11}=Butachlor 5G, T_{12}=Ethoxysulfuron 150WG, T_{13}=Carfentrazol ethyl 24EC, T_{14}=Fenoxpro-p-ethyl 9EC, T_{15}=Glyphosate 480SL, T_{16}=Paraquate dichloride 27.6%, T_{17}=Bensulfuran methyl 120 gm+ Bispyriback sodium 180 gm, 300WP, T_{18}=Triafemon 240SC, T_{19}=Penoxsulum 240SC, T_{20}=Pyrazosulfuran ethyl 100 gm+ Pretilachlor 100 gm 20WP

Weed control efficiency

Effects of herbicide was found significant on weed control efficiency in the rice field. The highest weed control efficiency (86.60) was achieved in the Binadhan-14 when Ethoxysulfuron 150WG was applied in the field. The second highest weed control efficiency (82.13) was obtained in the Binadhan-14 when Bispyriback-sodium 300WP

was applied in the field. While the lowest weed control efficiency (0.00) was observed in the control condition followed by Pendimethyline 33EC (62.50) (Figure 04). Similar findings were reported by Heisnam *et al.* (2015), who found significant variation on weed control efficiency.

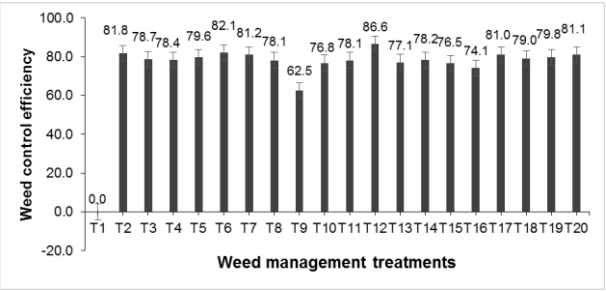

Figure 04: Weed control efficiency of different herbicides on Binadhan-14

T_1=Control, T_2=Hand weeding, T_3=Bensulfuran methyl 8% +Acetachlor 14%, T_4=2-4, D amine 72SCL, T_5=Pretilachlor 500EC, T_6=Bispyriback-sodium 300WP, T_7=Pyrazosulfuran ethyl 10WP, T_8=Trisulfuron 40WP, T_9=Pendimethyline 33EC, T_{10}=Metsulfuran methyl 20WDG, T_{11}=Butachlor 5G, T_{12}=Ethoxysulfuron 150WG, T_{13}=Carfentrazol ethyl 24EC, T_{14}=Fenoxpro-p-ethyl 9EC, T_{15}=Glyphosate 480SL, T_{16}=Paraquate dichloride 27.6%, T_{17}=Bensulfuran methyl 120 gm+ Bispyriback sodium 180 gm, 300WP, T_{18}=Triafemon 240SC, T_{19}=Penoxsulum 240SC, T_{20}=Pyrazosulfuran ethyl 100 gm+ Pretilachlor 100 gm 20WP

CONCLUSION

From the study it was found that the variety Binadhan-14 with Ethoxysulfuron 150WG exhibited the superior performance among the most traits under this study. So, it could have concluded that herbicide Ethoxysulfuron 150WG would be most effective weed management practice for controlling the weed infestation of Binadhan-14 under the AEZ– 9. Further study may be needed for ensuring the present performance in different AEZs of Bangladesh.

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