

## Effect of Fenoxyprop-P-Ethyl 10% + Ethoxysulfuron 10% WP on Annual Weeds Suppression and Yield of Transplanted Rice in Bangladesh

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**Abstract:** Weeds cause major problem in rice production, which do not only compete with crop yield but also impair quality. Fenoxyprop-p-ethyl 10% + Ethoxysulfuron 10% WP is a new post-emergence herbicide in Bangladesh. Field trials were conducted at Bangladesh Rice Research Institute (BRRI), Gazipur during Boro, 2016-17 and Aman, 2017 to evaluate the efficacy of the weedicide on weed suppression and performance of transplanted rice. Fenoxyprop-p-ethyl 10% + Ethoxysulfuron 10% WP @ 15, 20 and 25 g a.i. ha<sup>-1</sup> were applied along with Pyrazosulfuran Ethyl WP @ 12.5 g a.i. ha<sup>-1</sup>, weed free and unweeded control was used for assessment. Visual inspection indicated that this herbicide possesses high selectivity and not toxic to rice plants. The results revealed that the major weed flora associated with the transplanted rice was mainly comprised of two grasses, two sedges and four broadleaves in Aman, 2017 and two grasses, two sedge and two broad leaves in Boro, 2016-17. The most dominant weeds were *Cyperus difformis*, *Echinochloa crus-galli*, *Scirpus maritimus* and *Monochoria vaginalis* in both the growing seasons. Application of Fenoxyprop-p-ethyl 10% + Ethoxysulfuron 10% WP @ 20 g a.i. ha<sup>-1</sup> was most effective to suppress weed density and dry masses in both the seasons resulting increased grain yield more than 30% as compared to unweeded control. Therefore, Fenoxyprop-p-ethyl 10% + Ethoxysulfuron 10% WP @ 20 g a.i. ha<sup>-1</sup> should apply at one to two leaf stage of weed may be recommended for effectively control weeds in transplanted rice.

**Key words:** Fenoxyprop-P-Ethyl 10% + Ethoxysulfuron 10% WP • Transplanted Rice • Weed Density • Weed Control Efficiency

### INTRODUCTION

Among the cereals, rice (*Oryza sativa* L.) is the most important and extensively grown in tropical and subtropical regions of the world and is staple food for more than 60 per cent of the world population. The average yield of rice in Bangladesh is 4.5 tha<sup>-1</sup> [1]. Rice production needs to be increased by 50% or more above the current production level to meet the rising food demand [2]. Weed infestation and interference is a serious problem in rice fields that significantly decreases yield. In Bangladesh weed infestation reduces rice grain yield by 70-80% in Aus rice, 30-40% in transplanted aman rice and 22-36% for modern Boro rice cultivars [3, 4]. According to [5, 6] the losses due to infestation of weeds are greater than the combined losses caused by insect, pest and diseases in rice. Weeds not only cause huge

reductions in rice yields but also increase cost of cultivation, reduce input efficiency, interfere with agricultural operations, impair quality, act as alternate hosts for several insect pests, diseases, they affect aesthetic look of the ecosystem as well as native biodiversity, affect human and cattle health. Weeds compete for nutrient, space, sunlight and consume the available moisture with crop plant resulting in crop yield reduction [7]. Weed management in rice production is a major constraint and is expensive. Since hand weeding and other weed control methods are difficult, chemicals are the obvious and cost efficient weed control practices [8]. Chemical weed control has become popular in Bangladesh mainly due to scarcity of labour during peak growing season and lower weeding cost. In Bangladesh the annual consumption of herbicides grew over 3420 metric tons in 2014 [9] compared to only 108 tons

during 1986-87 [10] and the growth is almost exponential. In Bangladesh the traditional methods of weed control practices include preparatory land tillage, hand weeding by hoe and hand pulling. Mechanical and cultural weed control in transplanted rice is an expensive method. Especially at the time of peak period of labor crisis sometimes weeding becomes late causing drastic losses in grain yield [11]. Nowadays use of herbicides is gaining popularity in rice culture due to their rapid effects and less cost involvement compared to traditional methods. Quite a lot of pre and post emergence herbicides such as Butachlor, Pretilachlor, Oxadiazon, Pyrazosulfuron ethyl, Ethoxysulfuron alone or supplemented with one hand weeding have been found to be useful for weed management in transplanted paddy. Use of single herbicide might be effective for only sedges or only grass or broad leaf weeds. Fenoxyp-ethyl 10% + Ethoxysulfuron 10% WP has been recently developed for post emergence control of weeds in rice field. It is a selective herbicide, absorbed mainly by the shoots of germinating plants. It can effectively control most important perennial and annual species of broad leaf weeds, grasses and sedges in transplanted rice. Furthermore such type of herbicide is almost new perception in Bangladesh for control of weeds. So to give farmers a wider choice of effective herbicide there is a need to develop environmental friendly molecules of newer chemistries with different mode of action. The present study was, therefore, planned to evaluate the efficacy of Fenoxyp-ethyl 10% + Ethoxysulfuron 10% WP for annual weed suppression and find out an appropriate dose of the herbicide and its impacts on transplanted rice.

## MATERIALS AND METHODS

The experiments were conducted at the Bangladesh Rice Research Institute, Gazipur, situated at 23°59'33" N and 90°24'19" E at an elevation of 8.4 m from the mean sea level and is characterized by sub-tropical climate during Boro, 2016-17 and Aman, 2017 seasons to evaluate the efficacy of Fenoxyp-ethyl 10% + Ethoxysulfuron 10% WP for weed suppression and to find out an appropriate dose of this herbicide by with its impacts on transplanted rice. The soil of the experimental site was non-calcareous dark grey flood plain [12] with pH around 6.2 and low in organic matter (1.2%). The experiment was carried out with six (6) treatments viz. i) T<sub>1</sub> = Fenoxyp-

p-ethyl 10% + Ethoxysulfuron 10% @ 75 g ha<sup>-1</sup> (15 g a.i. ha<sup>-1</sup>), ii) T<sub>2</sub> = Fenoxyp-ethyl 10% + Ethoxysulfuron 10% WP @ 100 g ha<sup>-1</sup> (20 g a.i. ha<sup>-1</sup>), iii) T<sub>3</sub> = Fenoxyp-ethyl 10% + Ethoxysulfuron 10% WP @ 125 g ha<sup>-1</sup> (25 g a.i. ha<sup>-1</sup>), iv) T<sub>4</sub> = Pyrazosulfuron Ethyl @ 125 ha<sup>-1</sup> (12.5 g a.i. ha<sup>-1</sup>), v) T<sub>5</sub> = Weed free by hand weeding and vi) T<sub>6</sub> = Control (Unwedded). All treatments were laid out in a randomized complete block design with three replications. Twenty five days of BRRRI dhan56 for Aman, 2017 and thirty five days old seedlings of BRRRI dhan28 for Boro, 2016-17 were transplanted at 20 x 20 cm spacing with 2 seedlings hill<sup>-1</sup>. Fertilizer was applied following BRRRI recommended dose Aman: N:P:K:S= 69:10:41:11 kg/ha and Boro; N:P:K:S= 120:19:60:24 kg/ha [13]. Herbicides were sprayed 7 days after transplanting with the help of a knapsack sprayer. In weed free treatment, the plots were kept weed free up to 50 DAT by hand weeding and check herbicide was Pyrazosulfuron Ethyl which commercial name is Sathi 10 WP. Fenoxyp-ethyl 10% + Ethoxysulfuron 10% WP herbicide is innovative in Bangladesh and its phytotoxicity needs to be evaluated on rice crop. The commercial name of the herbicide is Sunjute plus 20 WG. The phytotoxicity of the herbicide to rice plants was determined by visual observations (yellowing leaves, burring leaf tips, stunting growth etc). The degree of toxicity on rice plant was measured by the following scale used by IRRRI [14].

- No toxicity
- Slightly toxicity
- Moderate toxicity
- Severe toxicity
- Toxic (plant kill)

The rating of toxicity was done within 7 days after application of herbicides. It was observed three times at 3, 5 and 7 days after application of herbicide and the mean rate was calculated from 10 sample plants of a unit plot.

Data on weed density and dry weight were taken from each plot on 40 DAT. The weeds were identified species-wise. Dry weights of weeds were taken by drying them in electric oven at 60° C for 72 hours followed by weighing by digital balance. Relative weed density (RWD), relative weed biomass (RWB) and weed control efficiency (WCE) of different weed control treatments were calculated with the following formulas [15]:

$$\text{RWD (\%)} = \frac{\text{Density of individual weed species in the community}}{\text{Total density of all weed species in the community}} \times 100$$

$$\text{RWB (\%)} = \frac{\text{Dry weight of a given oven dried weed species}}{\text{Dry weight of all oven dried weed species}} \times 100$$

$$\text{SDR (\%)} = \frac{\text{RWD (\%)} + \text{RWB (\%)}}{2}$$

$$\text{WCE (\%)} = \frac{(\text{Dry weight of weeds in weedy check plots} - \text{Dry weight of weeds in treated plots})}{\text{Dry weight of weeds in weedy check plots}} \times 100$$

$$\text{Weed Index} = \frac{\text{Yield in weed free plot} - \text{Yield in treated plot}}{\text{Yield in weed free plot}} \times 100$$

Data on panicle  $\text{m}^{-2}$ , grains panicle $^{-1}$ , sterility and grain yield were collected. Yield attributes data were analyzed with analysis of variance and also graphical presentation by using STAR 2.0.1 software.

## RESULTS AND DISCUSSION

**Phytotoxicity of Herbicides on Rice Plant:** The degree of toxicity of the herbicide to rice plants and the symptoms produced on plant are presented in Table 1. It is observed that Fenoxyp-rop-p-ethyl 10% + Ethoxysulfuron 10% WP @ 75 and 100  $\text{g ha}^{-1}$  showed no toxicity while 125  $\text{g ha}^{-1}$  showed temporary yellowing of leaves. It is observed that phytotoxicity symptoms were not more prominent for using this herbicide. Phytotoxicity of rice plant by combined herbicide is less which is similar to the findings of [16].

### Weed Infestation

**Boro Season, 2016-17:** The number of infesting weed species was slightly different in Boro season than Aman season. These weed flora were ecologically categorized into two broad leaved species, two sedge and two grasses (Table 2). The major weed was *Cyperus difformis* which relative weed density (RWD) and relative weed biomass (RWB) was 33.50% and 34.90%, respectively. The second top weed was *Echinochloa crus-galli* which RWD was 31.40% and relative weed biomass (RWB) was 32.70%. So in Boro season broad leaf weeds were less dominating than Aman season. Combination of different herbicides effectively control *Echinochloa* and *Cyperus* sp. which found by [17].

**Aman Season, 2017:** In this experiment the rice field was infested with different types of weeds. The relative density of these weed species was also different (Table 3). Eight different weed species were observed in unweeded

(control) plot where most dominating weeds were sedges and broad leaf. Among the infesting different categories of weeds, two were grasses, two sedges and four broadleaves. The weed species were belonging to the families of Poaceae, Cyperaceae, Pontederiaceae, Marsileaceae, Sphenocleaceae and Asteraceae. The broad leaved were: *Monochoria vaginalis*, *Marsilea minuta*, *Sphenoclea zeylanica* and *Eclipta alba*; grasses were: *Echinochloa crus-galli*, *Cynodon dactylon*; and sedges were *Cyperus difformis* and *Scirpus maritimus*. Among the weed species maximum relative weed density (RWD) was observed for *Cyperus difformis* (32.40%) followed by *Echinochloa crus-galli* (30.50%) but highest relative weed biomass (RWB) observed for *Echinochloa crus-galli* (33.80%) followed by *Cyperus difformis* (32.10%). Among the weeds *Eclipta alba* was the minor weed with 1.60% RWD and 1.20% RWB. In this study it was also observed that broad leaf were less dominating weed species. Bhuiyan *et al.* [18] revealed that efficacy of combined herbicide reduce the weed infestation.

**Weed Ranking:** The summed dominance ratio (SDR) is an important pointer of showing ranking of weeds. The most dominant weeds in Aman season, 2017 were *Cyperus difformis*, *Echinochloa crus-galli*, *Scirpus maritimus* and *Monochoria vaginalis* (Figure 1). *Cyperus difformis*, *Echinochloa crus-galli*, *Scirpus maritimus* and *Monochoria vaginalis* were also the most dominant weeds in Boro season, 2016-17. [19] showed that SDR of a weed against same herbicide is more or less similar in different seasons.

**Weed Control Efficiency (WCE):** Lower weed biomass as well as higher weed control efficiency in all the growing seasons exhibited by Fenoxyp-rop-p-ethyl 10% + Ethoxysulfuron 10% WP. Weed control efficiency improved with increases of herbicide dose irrespective of

Table 1: Rating of herbicide toxicity on rice plant under different treatments

Treatments	Rating		
	Boro, 2016-17	Aman, 2017	Symptom observed in rice field
Fenoxypop-p-ethyl 10% + Ethoxysulfuron 10% WP @ 75 g ha <sup>-1</sup> (15 g a.i. ha <sup>-1</sup> )	1.15	1.10	No toxicity
Fenoxypop-p-ethyl 10% + Ethoxysulfuron 10% WP @ 100 g ha <sup>-1</sup> (20 g a.i. ha <sup>-1</sup> )	1.40	1.30	Sometimes slight yellowing of leaves
Fenoxypop-p-ethyl 10% + Ethoxysulfuron 10% WP @ 125 g ha <sup>-1</sup> (25 g a.i. ha <sup>-1</sup> )	2.90	2.70	Slight yellowing of leaves which required 5-7 days to recover
Pyrazosulfuran Ethyl @ 125 ha <sup>-1</sup> (12.5 g a.i. ha <sup>-1</sup> )	1.10	1.10	No toxicity

Table 2: Weed composition, Relative weed density (RWD) and Relative weed biomass (RWB) in the untreated control plots in Boro, 2016-17 at BRRI, Gazipur

Name of Weed Species	Family	Class	RWD (%)	RWB (%)
<i>Cynodon dactylon</i>	Poaceae	Grass	2.70	2.50
<i>Echinochloa crus-galli</i>	Poaceae	Grass	31.40	32.70
<i>Cyperus difformis</i>	Cyperaceae	Sedge	33.50	34.90
<i>Scirpus maritimus</i>	Cyperaceae	Sedge	26.10	28.70
<i>Monochoria vaginalis</i>	Pontederiaceae	Broad leaf	11.30	10.80
<i>Marsilea minuta</i>	Marsileaceae	Broad leaf	3.60	4.20

Table 3: Weed composition, Relative weed density (RWD) and Relative weed biomass (RWB) in the untreated control plots in Aman, 2017 at BRRI, Gazipur

Name of Weed Species	Family	Class	RWD (%)	RWB (%)
<i>Cynodon dactylon</i>	Poaceae	Grass	3.50	2.90
<i>Echinochloa crus-galli</i>	Poaceae	Grass	30.50	33.80
<i>Cyperus difformis</i>	Cyperaceae	Sedge	32.40	32.10
<i>Scirpus maritimus</i>	Cyperaceae	Sedge	23.60	21.80
<i>Monochoria vaginalis</i>	Pontederiaceae	Broad leaf	12.50	11.70
<i>Marsilea minuta</i>	Marsileaceae	Broad leaf	6.50	7.10
<i>Sphenoclea zeylanica</i>	Sphenocleaceae	Broad leaf	2.50	3.60
<i>Eclipta alba</i>	Asteraceae	Broad leaf	1.60	1.20

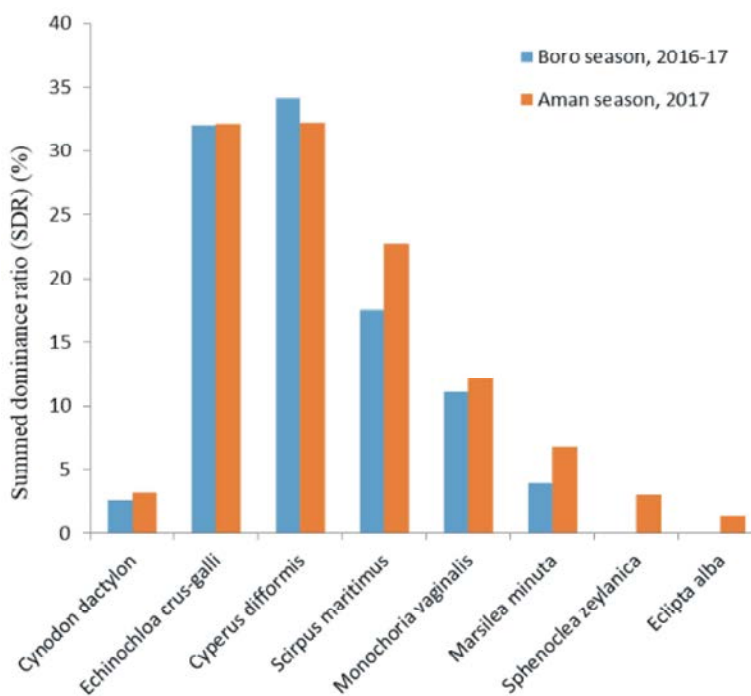


Fig. 1: Summed dominance ratio (SDR) of infesting weeds in transplanted rice

Table 4: Effect of Fenoxyp-ethyl 10% + Ethoxysulfuron 10% WP on weed control efficiency in transplanted rice in Boro, 2016-17 at BRRI, Gazipur

Name of weeds	Weed control efficiency (%)				
	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	
<i>Cynodon dactylon</i>	31.30	43.40	47.30	45.40	
<i>Echinochloa crus-galli</i>	62.50	81.70	84.60	83.30	
<i>Cyperus difformis</i>	71.50	82.30	85.70	84.60	
<i>Scripus maritimus</i>	63.50	80.70	84.50	82.60	
<i>Monochoria vaginalis</i>	61.30	70.50	76.20	78.40	
<i>Marsilea minuta</i>	52.70	80.90	83.20	82.30	
CV (%)	7.42	5.28	4.85	5.12	
LSD <sub>0.05</sub>	3.58	4.65	4.92	4.24	

T<sub>1</sub>= Fenoxyp-ethyl 10% + Ethoxysulfuron 10% WP @ 15 g a.i. ha<sup>-1</sup>, T<sub>2</sub>= Fenoxyp-ethyl 10% + Ethoxysulfuron 10% WP @ 20 g a.i. ha<sup>-1</sup>, T<sub>3</sub>= Fenoxyp-ethyl 10% + Ethoxysulfuron 10% WP @ 25 g a.i. ha<sup>-1</sup> and T<sub>4</sub>= Pyrazosulfuran Ethyl WP @ 12.5 g a.i. ha<sup>-1</sup>

Table 5: Effect of Fenoxyp-ethyl 10% + Ethoxysulfuron 10% WP on weed control efficiency in transplanted rice in Aman, 2017 at BRRI, Gazipur

Name of weeds	Weed control efficiency (%)				
	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	
<i>Cynodon dactylon</i>	30.50	41.50	44.30	40.20	
<i>Echinochloa crus-galli</i>	61.40	81.70	83.50	83.40	
<i>Cyperus difformis</i>	67.50	81.40	84.10	81.20	
<i>Scripus maritimus</i>	70.30	83.20	85.60	83.50	
<i>Monochoria vaginalis</i>	62.30	71.50	76.40	80.70	
<i>Marsilea minuta</i>	54.20	80.70	82.60	82.60	
<i>Sphenoclea zeylanica</i>	50.60	73.50	76.90	71.60	
<i>Eclipta alba</i>	52.50	61.80	66.90	61.70	
CV (%)	8.16	6.47	5.34	5.27	
LSD <sub>0.05</sub>	4.25	3.90	4.38	4.97	

T<sub>1</sub>= Fenoxyp-ethyl 10% + Ethoxysulfuron 10% WP @ 15 g a.i. ha<sup>-1</sup>, T<sub>2</sub>= Fenoxyp-ethyl 10% + Ethoxysulfuron 10% WP @ 20 g a.i. ha<sup>-1</sup>, T<sub>3</sub>= Fenoxyp-ethyl 10% + Ethoxysulfuron 10% WP @ 25 g a.i. ha<sup>-1</sup> and T<sub>4</sub>= Pyrazosulfuran Ethyl WP @ 12.5 g a.i. ha<sup>-1</sup>

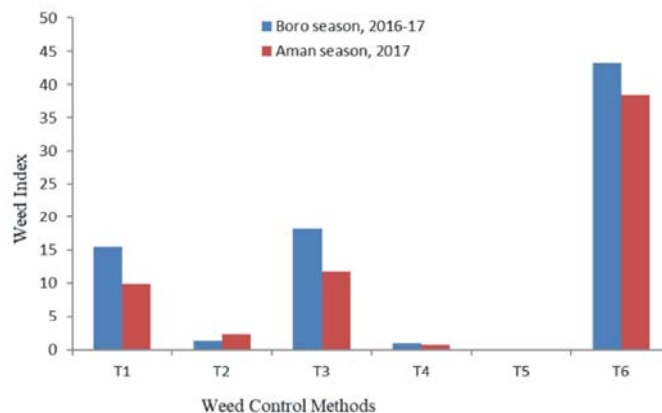


Fig. 2: Weed index of transplanted rice at BRRI, Gazipur

T<sub>1</sub>= Fenoxyp-ethyl 10% + Ethoxysulfuron 10% WP @ 15 g a.i. ha<sup>-1</sup>, T<sub>2</sub>= Fenoxyp-ethyl 10% + Ethoxysulfuron 10% WP @ 20 g a.i. ha<sup>-1</sup>, T<sub>3</sub>= Fenoxyp-ethyl 10% + Ethoxysulfuron 10% WP @ 25 g a.i. ha<sup>-1</sup>, T<sub>4</sub>= Pyrazosulfuran Ethyl WP @ 12.5 g a.i. ha<sup>-1</sup>, T<sub>5</sub>= Weed free and T<sub>6</sub>= control (unweeded)

weed species. Treatment, T<sub>1</sub> controls all the weeds less than 80% due to lower dose of application, whereas T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> (check) control *Echinochloa crus-galli*, *Cyperus difformis*, *Scripus maritimus* and *Marsilea minuta* more than 80% in Boro season (Table 4). The trend of weed

control efficiency in Aman, 2017 was almost similar as Boro, 2016-17. All treatment controls most of the weeds more than 80% except T<sub>1</sub>. Treatment, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> controls *Echinochloa crus-galli*, *Cyperus difformis*, *Scripus maritimus* and *Marsilea minuta* more than 80% (Table 5).

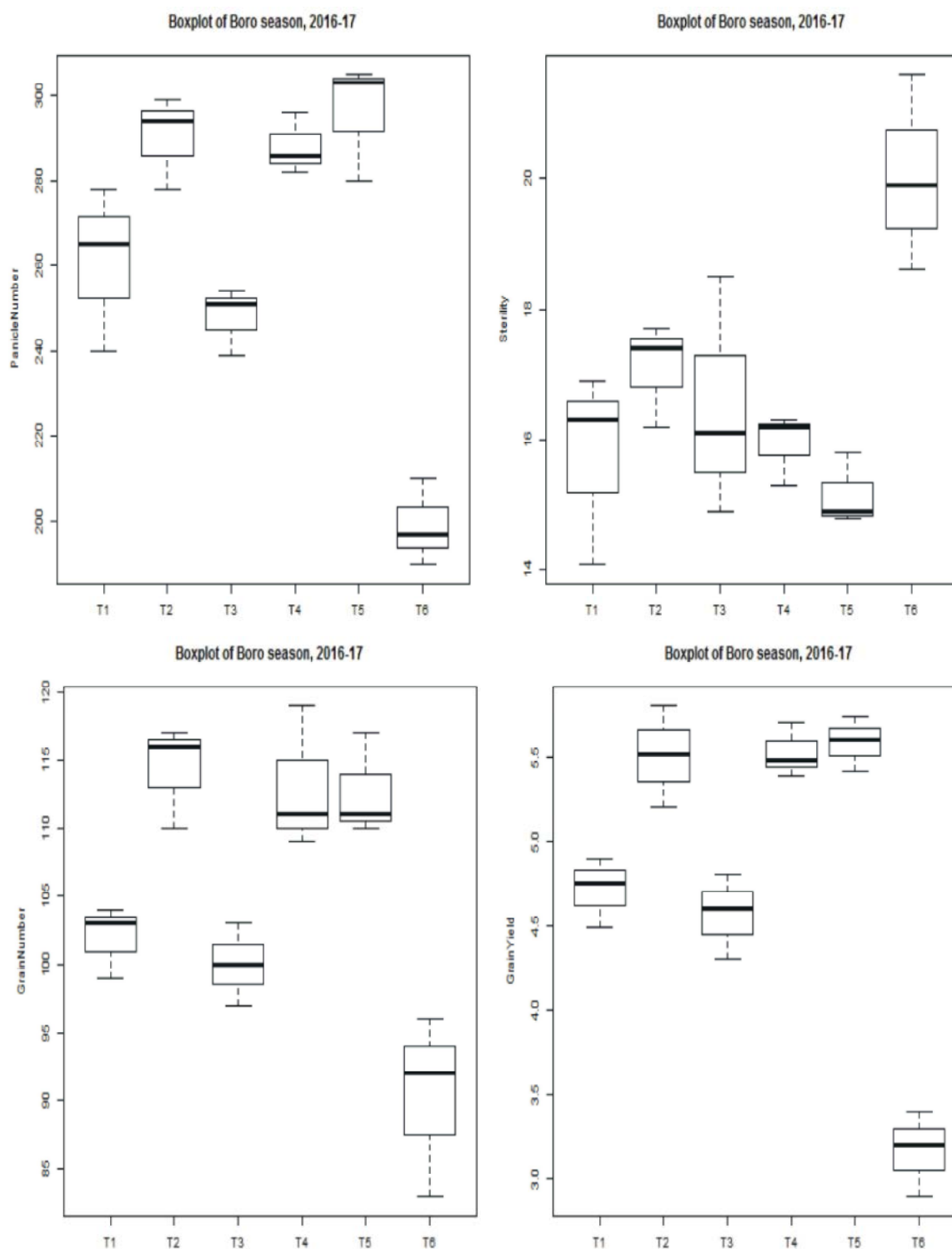


Fig. 3: Boxplot of yield attributes in Boro season, 2016-17 at BRRI, Gazipur

T<sub>1</sub>= Fenoxypop-p-ethyl 10% + Ethoxysulfuron 10% WP @ 15 g a.i. ha<sup>-1</sup>, T<sub>2</sub>= Fenoxypop-p-ethyl 10% + Ethoxysulfuron 10% WP @ 20 g a.i. ha<sup>-1</sup>, T<sub>3</sub>= Fenoxypop-p-ethyl 10% + Ethoxysulfuron 10% WP @ 25 g a.i. ha<sup>-1</sup>, T<sub>4</sub>= Pyrazosulfuran Ethyl WP @ 12.5 g a.i. ha<sup>-1</sup>, T<sub>5</sub>= Weed free and T<sub>6</sub>= control (unweeded)

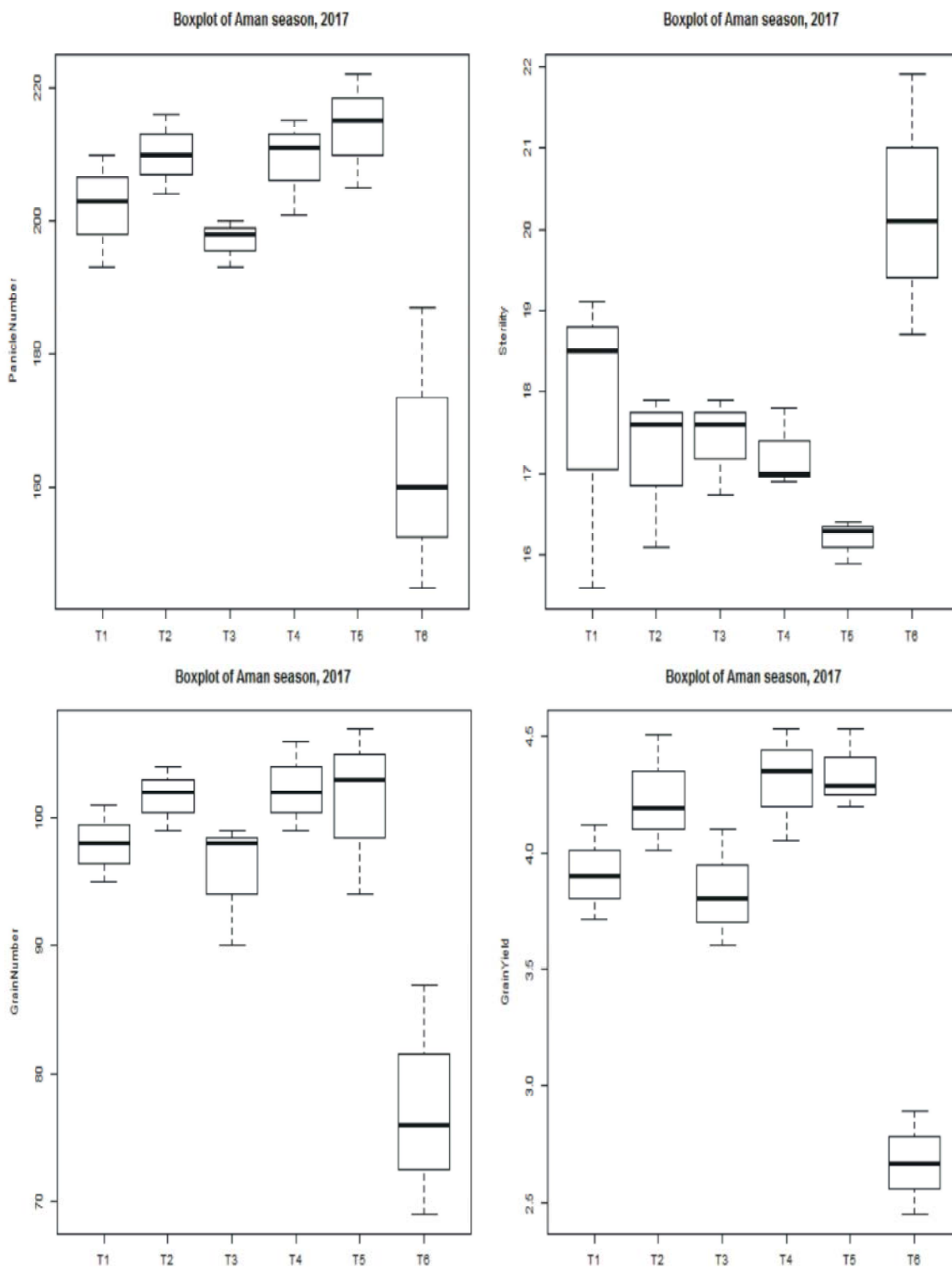


Fig. 4: Boxplot of yield attributes in Aman season, 2017 at BRRI, Gazipur

T<sub>1</sub>= Fenoxypop-p-ethyl 10% + Ethoxysulfuron 10% WP @ 15 g a.i. ha<sup>-1</sup>, T<sub>2</sub>= Fenoxypop-p-ethyl 10% + Ethoxysulfuron 10% WP @ 20 g a.i. ha<sup>-1</sup>, T<sub>3</sub>= Fenoxypop-p-ethyl 10% + Ethoxysulfuron 10% WP @ 25 g a.i. ha<sup>-1</sup>, T<sub>4</sub>= Pyrazosulfuran Ethyl WP @ 12.5 g a.i. ha<sup>-1</sup>, T<sub>5</sub>= Weed free and T<sub>6</sub>= control (unweeded)

Table 6: Effect of Fenoxyp-ethyl 10% + Ethoxysulfuron 10% WP on yield attributes of transplanted rice at BRRI, Gazipur

Treatments	Panicles m <sup>-2</sup>		Grains panicle <sup>-1</sup>		Sterility (%)		Grain yield (t ha <sup>-1</sup> )	
	Boro, 2016-17	Aman, 2017	Boro, 2016-17	Aman, 2017	Boro, 2016-17	Aman, 2017	Boro, 2016-17	Aman, 2017
T <sub>1</sub>	261	202	102	98	15.77	17.73	4.71	3.91
T <sub>2</sub>	290	210	114	102	17.10	17.20	5.50	4.24
T <sub>3</sub>	248	197	100	95	16.50	17.41	4.57	3.83
T <sub>4</sub>	288	209	113	102	15.93	17.23	5.52	4.31
T <sub>5</sub>	296	214	112	101	15.17	16.20	5.58	4.34
T <sub>6</sub>	199	164	90	77	20.03	20.23	3.17	2.67
CV (%)	5.06	5.70	4.47	5.69	6.71	5.68	5.00	6.09
LSD <sub>0.05</sub>	24.26	20.67	8.56	9.93	2.04	1.82	0.44	0.41

T<sub>1</sub>= Fenoxyp-ethyl 10% + Ethoxysulfuron 10% WP @ 15 g a.i. ha<sup>-1</sup>, T<sub>2</sub>= Fenoxyp-ethyl 10% + Ethoxysulfuron 10% WP @ 20 g a.i. ha<sup>-1</sup>, T<sub>3</sub>= Fenoxyp-ethyl 10% + Ethoxysulfuron 10% WP @ 25 g a.i. ha<sup>-1</sup>, T<sub>4</sub>= Pyrazosulfuran Ethyl WP @ 12.5 g a.i. ha<sup>-1</sup>, T<sub>5</sub>= Weed free and T<sub>6</sub>= control (unweeded)

It was evident from the study that the post emergence herbicide Fenoxyp-ethyl 10% + Ethoxysulfuron 10% WP @ 20 g a.i. ha<sup>-1</sup> and 25 g a.i. ha<sup>-1</sup> was effective for controlling weed than other doses of that herbicide. [15, 18] reported that the mixture of herbicides gave 80% control of annual and perennial weeds.

**Weed Index:** The efficiency of various treatments with respect to weed control efficiency fluctuated to a greater extent under the influence of various weed control treatments (Table 4 & 5). Lower weed index was noted with Pyrazosulfuran Ethyl WP @ 12.5 g a.i. ha<sup>-1</sup> and was followed by Fenoxyp-ethyl 10% + Ethoxysulfuron 10% WP @ 20 g a.i. ha<sup>-1</sup> at both Boro and Aman season (Figure 2). Weedy check recorded the highest weed index in both seasons which indicated the losses caused due to weeds.

**Yield and Yield Attributes:** Grain yield is the function of an interaction among various yield components, which are affected differentially by the growing conditions and crop management practices. From Table 6 it was found that all the treatments significantly increased rice grain yield over unweeded control plot. In Boro season, 2016-17 the highest grain yield (5.58 t ha<sup>-1</sup>) was recorded in the T<sub>5</sub> treatment which was statistically similar to treatments T<sub>2</sub> and T<sub>4</sub> producing grain yields of 5.50 and 5.52 t ha<sup>-1</sup>, respectively. Minimum grain yield (3.17 t ha<sup>-1</sup>) was found in weedy check plots as compared to weed free treatment due to high weed density which resulted less number of panicle m<sup>-2</sup>, grains panicle<sup>-1</sup> and high sterility. Treatment wise boxplot of yield attributes in Boro season, 2016-17 confirm that most of the yield contributing characters are showed similar range in T<sub>2</sub>, T<sub>4</sub> (check) and T<sub>5</sub> (weed free) treatments; whereas T<sub>6</sub> was outside of the

normal range and its data was also in disperse condition than other treatments due to severe weed infestation (Figure 3).

Similar trend of results was observed during the Aman, 2017 where unweeded control (T<sub>6</sub>) produced minimum number of panicles m<sup>-2</sup>, grains panicle<sup>-1</sup> and high sterility which resulting lowest grain yield (2.67 t ha<sup>-1</sup>). The minimum number of panicles m<sup>-2</sup> in the control plot was the result of higher competition for nutrient, air space, light and water between crop plants and weeds. [20, 21] reported similar results. Maximum grain yield of 4.34 t ha<sup>-1</sup> that was recorded with T<sub>5</sub> treatment could be due to lower weed-crop competition at crop growth stages. In Aman season, 2017; T<sub>2</sub>, T<sub>4</sub> (check) and T<sub>5</sub> (weed free) treatments are in similar range in boxplot of yield attributes (Figure 4). Fenoxyp-ethyl 10% + Ethoxysulfuron 10% WP @ 20, 25 g a.i. ha<sup>-1</sup> gave effective control of grass, sedge and broad leaf weeds lead to increased grain yield. Herbicide treatments contributed to higher yield performance compared to control in all the growing seasons.

## CONCLUSION

Based on the results, yield and yield attributing parameters and weed dynamics were greatly influenced by different weed management practice. Fenoxyp-ethyl 10% + Ethoxysulfuron 10% WP @ 25 g a.i. ha<sup>-1</sup> showed a good weed control efficiency but phytotoxicity found in this dose. So it may be suggested from this study that Fenoxyp-ethyl 10% + Ethoxysulfuron 10% WP @ 20 g a.i. ha<sup>-1</sup> applied during one to two leaf stage of weed may be effective for annual weed control option instead of hand weeding at peak period of labor to increase yield in transplanted rice.



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