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# EFFECT OF WEED MANAGEMENT AND SULFUR APPLICATION ON YIELD AND YIELD ATTRIBUTES OF BRRI dhan29

**M. S. Akter, M. M. Aktar and M. S. I. Sikdar ***

## ABSTRACT

An experiment was conducted at Agronomic research field of Hajee Mohammad Science and Technology University to evaluate the effect of weed management options and different levels of sulphur application on the yield and yield attributes of BRRI dhan29. The experiment comprises two factors where weed control measurement consisting of $W_1$= No weeding, $W_2$= Superhit 500EC (pretilachlor) + one hand weeding (HW) at 40 days after transplanting (DAT), $W_3$= Superpower 10WP (Pyrazosulfuron ethyl) + 1HW at 40 DAT and $W_4$= Two hand weeding at 20 and 40 DAT and another factor comprised of three doses of Sulphur (kg $ha^{-1}$) application including 25, 50 and 75 kg $ha^{-1}$ gypsum. Growth parameters indicated their highest values in $W_2$= superhit 500EC + 1HW at 40 DAT with $S_2$= 50 kg $ha^{-1}$ of gypsum while their corresponding lowest values were found in no weeding ($W_1$). The highest grain yield (6.52 t $ha^{-1}$) was obtained from $W_2$ treatments + 1HW at 40 DAT with 50 kg $ha^{-1}$ of gypsum. From the experimental result, it is suggested that BRRI dhan29 may be grown with the application of superhit 500EC as pre-emergence herbicide + 1HW at 40 DAT ($W_2$) combined with 50 kg $ha^{-1}$ of gypsum.

**Keywords:** Pre-emergence, post emergence herbicides, sulphur, yield, rice

## INTRODUCTION

Bangladesh is mainly an agricultural country and agriculture is the single largest producing sector of the economy and it contributes about 13.10% to the total Gross Domestic Product (GDP) of the country (BBS, 2017). Geographical and agronomic conditions of Bangladesh are favorable for rice (*Oryza sativa* L.) cultivation and it is consumed as the staple food in our country. In the year of 2016-17, the total cropped area of Bangladesh was 38,256 thousand acres and rice are the most extensively cultivated cereal crops which cover about 77.5% of the total cropped area (BBS, 2016). The total production, area and yield of rice in the year of 2019-2020 was 36.60 million tons, 11.42 million ha in Bangladesh respectively (BBS, 2021). The area and production of boro rice were about 4.76 million hectares and 19. 64 million tons, respectively (BBS, 2021). The population of Bangladesh is still growing by two million every year and may increase by another 30 million over the next 20 years. But the average yield of rice is poor (3.01 t $ha^{-1}$) in Bangladesh (BBS, 2021).

The average yield of rice in Bangladesh is very low due to several constraints. Among the yield limiting factors, severe weed infestation is the most important. Infestation of weed is one of the most important causes for low yield of rice. There is no doubt that maximum benefit from costly inputs like fertilizers and pesticides in rice can fully be derived when the crop is kept free from weed infestation. The present weed management system which is done manually is laborious, time consuming, expensive and cannot be done in time due to various reasons. Herbicides are effective in controlling weeds alone or in combination with hand weeding (Ahmed *et al*., 2005). Weed competition at early growth stage can be eliminated through application of herbicide. Replacement of traditional weeding in Boro rice by pre-emergence herbicide and early postemergence herbicide or herbicides in combination with hand weeding would help to obtain higher crop yield (Afroz *et al*., 2019).

The prevailing climatic and edaphic conditions are highly favorable for luxuriant growth of numerous species of weeds which offer a keen competition with rice crop. Weeds are the greatest threat under upland or aerobic rice systems, resulting in yield losses between 30 and 98 percent (Ramana *et al*., 2014). To reduce the cost

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of rice production, it has been urgently needed to adopt alternative method of weed control viz., mechanical, biological and chemical weed control in combination with manual weeding. Herbicides are now gaining popularity among the farmers. Now a good number of pre and post emergence herbicides are available in the market with different chemical family and trade names. These herbicides are effective in controlling weeds along with hand weeding (Ahmed *et al*., 2003).

Sulphur (S) is one of the essential macronutrients and ranks fourth major nutrient next to N, P, and K. For rice cultivation, next to nitrogen, S application is very important. Recently, S deficiency has been receiving much attention as a major limiting factor for wetland rice. Sulphur deficiency affects not only the growth and yield of rice but also the protein quality through its effect on the synthesis of certain amino acids such as cysteine, cysteine and methionine and also some plant hormone and some vitamins. Sulphur deficiency can alone reduce the crop yield by 10-20% (Bhuiyan and Islam, 1990). Sulphur and nitrogen are both constituents of plant protein and its critical N: S ratio of rice plant at the maximum tillering stage has been estimated to be 15:1 (Islam and Ponnamperuma, 1982). From above information, it is imperative to evaluate the chemical fertilizer and weed management to attain the sustainable rice production in Bangladesh. Therefore, the present experiment was conducted to achieve the following objectives:

To find out the proper weed management methods for maximum yield of boro rice cv. BRRI dhan29 in according with identifying the optimum sulphur dose that give higher yield of boro rice and to find out the suitable combination of sulphur doses and weed management methods to get higher yield and yield attributes of BRRI dhan29.

## MATERIALS AND METHODS

The research work was carried out at the Experimental Field of Agronomy, Department of Hajee Mohammad Danesh Science and Technology University, Dinajpur to evaluate the effect of sulphur and weed management on yield and yield attributes of BRRI dhan29. The research work was conducted during the boro season. The experiment consisted with two factors: Factor A: four levels of weed management viz., W1= No weeding (Control), W2= Pretilachlor (Superheat 500 EC) + One hand weeding at 40 DAT, W3= Pyrazosulfuron-ethyl (Superpower 10 WP) + One hand weeding at 40 DAT, W4= Two hand weeding at 20 and 40 DAT and Factor B: three levels of sulphur (kg $ha^{-1}$) viz., S1= 25, S2= 50 and S3= 75. The experiment was laid out in randomized complete block design (RCBD) replicated thrice. The size of the plot was 10 $m^2$. The name of different types weed and weed density $m^{-2}$ were recorded as experimental data. Ten hills were randomly selected from each plot to record the yield and yield attributes such as number of effective tillers $hill^{-1}$, total number of tillers $hill^{-1}$, grain $panicle^{-1}$, unfilled grain, weight of 1000-grains (g), grain yield (t $ha^{-1}$) and straw yield (t $ha^{-1}$) etc. The data were analyzed statistically using the analysis of variance (ANOVA) technique with the help of computer using MSTAT-C program. The treatment means were compared using Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

## RESULTS AND DISCUSSION

### Infested weed species and weed density in the experimental field

It was a general observation that conditions favorable for growing boro rice were also favorable for exuberant growth of numerous weeds that compete with crop plants. This competition of weeds tends to increase when the weed density increased. There were twelve weed species belonging to their specific families were found to infest the experimental plot. Local name, scientific name, family, morphological type and life cycle of the weed species have been presented in Table 1. The density of weeds varied considerably in different weed control methods treatments and nitrogen doses. The most important weeds of the experimental plot were *Echinochloa colonum, Cyperus rotundus, Scirpus mucronatus, Cynodon dactylon, Echinochloa cruss-galli, Commelina bengalensis, Paspalum distichum* etc. Among the all weed species *Digitaria ischaemum* and

*Paspalum distichum* were the major important weed species at the total growth period and *Ludwigia parviflora* and *Paspalum distichum* were the major weed species at harvest. Among the twelve species six were grasses and two were sedge (Table 1). Weed density was significantly influenced by weeding regimes at 25, 50, 75 and 100 DATs (Table 2). At 25 DAT, the highest weed density (86.33 $m^{-2}$) was found in $W_1$ (No weeding) and the lowest one (21.33 $m^{-2}$) was found in $W_2$ (Pre-emergence herbicide Pretilachlor followed by one hand weeding at 40 DAT) treatment. At 50 DAT, the highest weed density (133.00 $m^{-2}$) was found in $W_1$ (No weeding) and lowest one (12.00 $m^{-2}$) was found in $W_2$ (Preemergence herbicide Pretilachlor followed by one hand weeding at 40 DAT). At 75DAT, the highest weed density (161.67 $m^{-2}$) was found in $W_1$ (No weeding) and the lowest one (22.67 $m^{-2}$) was found in $W_2$ (Preemergence herbicide Pretilachlor followed by one hand weeding at 40 DAT). At 100 DAT, the highest weed population (182.4 $m^{-2}$) was found in $W_1$ (No weeding) and the lowest one (30.33 $m^{-2}$) was found in W2 (Preemergence herbicide Pretilachlor followed by one hand weeding at 40 DAT) (Table 2).

**Effect of weed management on yield and yield attributes of BRRI dhan29**

Effective number of tillers $hill^{-1}$ (19.20) was highest in the treatment of Superheat 500 EC and lowest number of effective tillers $hill^{-1}$ (11.96) was found in weedy treatment (Table 3). The severe weed infestation might be main fact to reduce the number of tillers in the experimental plots. But different weed management practices reduced weed population and thereby reduced weed-crop competition during entire growth stage. Table 3 shows that the highest number of effective tillers $hill^{-1}$ recorded in $W_2$ treatment whereas the lowest number of effective tillers $hill^{-1}$ found in $W_1$ treatment. Thus, increases the productive tillers and other yield attributes due to less weed-crop competition. The results of different treatment were shown the significant variation among the treatments at 1% level of probability. Similar findings were reported by Khan and Tarique (2011) who observed that the highest number of tillers $plant^{-1}$ was observed in completely weed free condition throughout the crop growth period. The highest number of grains $panicle^{-1}$ (183.69) was found in Superheat 500 EC treated plots mainly due to weed free conditions in this treatment ($W_2$). Weeds always compete with crop for different growth factors such as light, water, nutrient which are essential for growth and development of rice plants to produce more grains. So, the grains $panicle^{-1}$ was recorded the highest value from $W_2$ treatment. The lowest number of grains $panicle^{-1}$ (131.69) was found in weedy plot due to more crop-weed competition. These results corroborated with the results of Ahmed *et al.* (2005). Similar findings were also reported by Sanjoy *et al.* (1999) where the number of filled grains $panicle^{-1}$ was increased due to weed control over no weeding. The 1000-grain weight was significantly affected by weed management practices. However, the highest 1000-grain weight (22.29 g) was recorded from recommended dose of Superheat 500 EC treatment and the lowest one (21.50 g) was obtained from weedy control treatment (Table 3). This result revealed that control of weeds promoted the yield and yield attributes including productive tillers $hill^{-1}$, number of filled grains $panicle^{-1}$ and 1000-grain weight in rice. Zannat (2014) and Rabbani (2012) also obtained that no weeding reduced 1000-grain weight significantly. This finding agreed with Khan and Tarique (2011), and Raju *et al.* (2003) who showed that weeding regime had significant effect on 1000-grain weight. Grain yield was considerably affected by weed control treatments. Significant variation was observed in grain yield due to different weed control treatments. The maximum grain yield (6.52 t $ha^{-1}$) was produced by the treatment of Superheat 500 EC @ 1.0 L $ha^{-1}$ which is followed by the treatment $W_3$ (post-emergence herbicide of Super Power 10 WP (6.15 t $ha^{-1}$) while the lowest grain yield (3.90 t $ha^{-1}$) was produced by no weeding (Table 3). The highest grain yield might be the result of effects of highest tillers $hill^{-1}$, panicle length and grains $panicle^{-1}$. The lowest grain yield was also due to severe competition for moisture, spaces, light and nutrients between weed and crop in no weeding condition. The highest grain yield was produced from weed free plot as a result of less competition with weeds. Straw yield of rice was significantly influenced by different weed control treatments. The highest straw yield (7.956 t $ha^{-1}$) was obtained from post-emergence Superpower 10 WP followed by pre-emergence herbicide Superheat 500 EC (7.40 t $ha^{-1}$). The lowest straw yield (6.79 t $ha^{-1}$) was observed in the no weeding treatment. In the treatment where weeds were controlled effectively, higher straw yield was recorded due to less competition between weeds and crops

for nutrient, water and light. In Table 3, Biological yield was significantly influenced by different weed control treatments and consequences the same trend of results. Harvest index was significantly influenced by weed management practices. The highest harvest index (47.02%) was observed in recommended dose of Superheat 500 EC treatment which was superior to other treatments (Table 3) and the lowest harvest index (36.47 %) was observed in weedy check treatment. Ahmed *et al*. (2005) also found similar results.

**Table 1. Weed species found in the experimental fields in boro rice**

| Bengali Name | English Name | Scientific Name | Family name | Life cycle | Type |
|---|---|---|---|---|---|
| Durba | Bermuda grass | *Cynodon dactylon* | Poaceae | Perennial | Grass |
| Boro Shama | Barnyard grass | *Echinochloa cruss-galli* | Poaceae | Annual | Grass |
| Choto Shama | Jungle rice | *Echinochloa colonum* | Poaceae | Annual | Grass |
| Khude Anguli | Smooth scrab | *Digitaria ischaemum* | Poaceae | Annual | Grass |
| Gitla Grass | Joint grass | *Paspalum distichum* | Poaceae | Annual | Grass |
| Mutha | Nutsedge | *Cyperus rotundus* | Cyperaceae | Perennial | Sedge |
| Chechra | Bog bulrush | *Scirpus mucronatus* | Cyperaceae | Perennial | Sedge |
| Kanaibashi | Spider wort | *Commelina bengalensis* | Commelinaceae | Annual | Broad leaf |
| Malanch | Aligator weed | *Alternanthera philoxeroides* | Amaranthaceae | Annual | Grass |
| Keshuti | White eclipta | *Eclipta prostrata* | Asteraceae | Annual perennial | Broad leaf |
| Sushni Shak | Four leaved water clover | *Marsilea quadrifolia* | Marsileaceae | Annual | Grass |
| Panilong | Water primerose | *Ludwigia parviflora* | Onagraceae | Annual | Broad leaf |

**Table 2. Interaction effects of weed management methods and sulphur of weeding on weed density $m^{-2}$ at different days after transplanting (DAT)**

| Treatments | | 25 DAT | 50 DAT | 75 DAT | 100 DAT |
|---|---|---|---|---|---|
| W1 | S1 | 86.33a | 127.00a | 151.33 a | 177.00a |
| | S2 | 87.67b | 124.00a | 158.33a | 183.33a |
| | S3 | 95.00ab | 133.00a | 161.67a | 182.00a |
| W2 | S1 | 22.67d | 14.33ef | 22.67fg | 30.33f |
| | S2 | 21.33d | 12.00ef | 26.33g | 31.67f |
| | S3 | 21.67d | 13.67ef | 27.67fg | 31.33f |
| W3 | S1 | 22.00cd | 17.67def | 39.67cde | 53.33cd |
| | S2 | 26.67c | 21.33def | 32.33ef | 47.00de |
| | S3 | 27.00cd | 25.67de | 38.00de | 48.33ef |
| W4 | S1 | 84.67b | 39.67bc | 52.33bcd | 62.67bcd |
| | S2 | 81.67b | 41.67bc | 56.33bc | 70.67b |
| | S3 | 89.00b | 42.33bc | 63.67b | 69.33bc |
| CV (%) | | 12.46 | 17.66 | 15.35 | 12.22 |
| LS | | * | * | * | * |

In a column, figures with same letters or without letter do not differ significantly whereas figures with dissimilar letter differ significantly as per DMRT. $W_1S_1$= (No Weeding-Control and 25 kg $ha^{-1}$ gypsum), $W_1S_2$= (No Weeding-Control and 50 kg $ha^{-1}$ gypsum), $W_1S_3$= (No Weeding-Control and 75 kg $ha^{-1}$ gypsum), $W_2S_1$= (Pre-emergence herbicide + One hand weeding at 40 DAT and 25 kg $ha^{-1}$ gypsum), $W_2S_2$= (Pre-emergence herbicide + One hand weeding at 40 DAT and 50 kg $ha^{-1}$ gypsum), $W_2S_3$= (Pre-emergence herbicide + One hand weeding at 40 DAT and 75 kg $ha^{-1}$ gypsum), $W_3S_1$= (Post-emergence herbicide + One hand weeding at 40 DAT and 25 kg $ha^{-1}$ gypsum), $W_3S_2$= (Post-emergence herbicide + One hand weeding at 40 DAT and 50 kg $ha^{-1}$ gypsum), $W_3S_3$= (Post-emergence herbicide + One hand weeding at 40 DAT and 75 kg $ha^{-1}$ gypsum), $W_4S_1$= (Two hand weeding at 20 and 40 DAT and 25 kg $ha^{-1}$ gypsum), $W_4S_2$= (Two

hand weeding at 20 and 40 DAT and 50 kg ha$^{-1}$ gypsum), $W_4S_3$ = (Two hand weeding at 20 and 40 DAT and 75 kg ha$^{-1}$ gypsum), CV= coefficient variation, LS = Level of Significance
* = Significant at 5% level of probability

**Table 3. Effect of weed management on number of grains panicle$^{-1}$, panicle length (cm) and 1000-grain weight (g) of BRRI dhan29**

| Weeding method | Effective tillers hill$^{-1}$ | Grains panicle$^{-1}$ | Panicle length (cm) | 1000-grain weight (g) | Grain yield (t ha$^{-1}$) | Straw yield (t ha$^{-1}$) | Biological yield (t ha$^{-1}$) | Harvest Index (%) |
|---|---|---|---|---|---|---|---|---|
| $W_1$ | 11.96 c | 131.69 c | 17.96 c | 21.50 c | 3.90 d | 6.79 c | 10.69 c | 36.47 c |
| $W_2$ | 19.20 a | 183.69 a | 28.08 a | 22.29 a | 6.52 a | 7.40 b | 13.93 a | 47.02 a |
| $W_3$ | 18.01 a | 174.44 ab | 25.81 b | 22.19 a | 6.15 b | 7.96 a | 14.11 a | 43.60 b |
| $W_4$ | 16.00 b | 165.02 b | 24.74 b | 21.80 b | 5.58 c | 7.51 b | 13.09 b | 42.64 b |
| CV (%) | 9.12 | 7.90 | 6.50 | 7.47 | 3.61 | 6.09 | 4.41 | 3.20 % |
| LS | ** | ** | ** | ** | ** | ** | * | * |

In a column, figures with same letters or without letter do not differ significantly whereas figures with dissimilar letter differ significantly as per DMRT. $W_1$= No weeding (Control), $W_2$=Pre-emergence herbicide + One hand weeding at 40 DAT, $W_3$= Post-emergence herbicide + One hand weeding at 40 DAT, $W_4$=Two hand weeding at 20 and 40 DAT, CV= coefficient variation, LS = Level of Significance
** = Significant at 1% level of probability
* = Significant at 5% level of probability

**Effect of sulphur application on yield and yield attributes of BRRI dhan29**

The number of effective tillers hill$^{-1}$ (17.12) was highest in the treatment 50 kg ha$^{-1}$ of gypsum ($S_2$) and lowest number of effective tillers m$^{-2}$ (15.33) was found in 25 kg ha$^{-1}$ gypsum ($S_1$). It was concluded that different treatment was shown the significant variation at 5% level of probability. Increased number of tillers 50 kg ha$^{-1}$ of gypsum than others might be due to uniform and moderate supply of S nutrient in the plant. The improvement in the formation of tillers with gypsum application as a source of S in the present experiment might be due to increase of sulphur availability which enhanced tillering. The highest number of effective tillers hill$^{-1}$ observed in $S_2$ treatment whereas the lowest number of effective tillers hill$^{-1}$ was found in $S_1$ treatment which was shown in Table 4. The increase in plant height due to application of sulphur, because it improves the soil particles by binding of other plant nutrient which has stimulating effect on various physiological processes including cell division and cell elongation of the plant. The tallest plant was observed in $S_2$ treatment whereas the shortest plant was found in $S_1$ treatment which was shown in Table 4. Smith and Siregar (1983) reported that amino acids which containing sulphur is important in the synthesis of other compounds within the cell, such as S adenosyl methionine serves as a methyl donor in biosynthesis of many component including chlorophyll, flavonoids and sterols which help to optimum growth of plant. Haque and Khan (1981) reported that application of S produced the marked increase of grain number per panicle in rice plant. Islam *et al*. (2009) also reported the same results where the effective tillers hill$^{-1}$ was significantly influenced due to application of sulphur. Application of S increased the effective tillers was reported by several researchers Patra *et al*. (1998) and Chandel *et al*. (2002).

The highest number of grains panicle$^{-1}$ (168.31) was found in 50 kg ha$^{-1}$ gypsum and the statistically similar value (165.08) were found in the treatment of 75 kg ha$^{-1}$ of gypsum. The lowest number of grains panicle$^{-1}$ (157.74) was found in $S_1$ treatment at 25 kg ha$^{-1}$ gypsum. So, different treatments exhibited significant variation at 5% level of significance. Moderate and adequate applicatiom of sulphur which contributed to grain formation and probably increased number of grains panicle$^{-1}$ with increasing sulphur level. The significant effect of S application on the number of grains panicle$^{-1}$were reported by Haque and Chowdhury (2004). Similar trend was also observed by Islam *et al*. (2009) who reported that the highest grain yield was obtained from the application of S as a source of gypsum. The 1000-grains weight was significantly affected by sulphur application. However, the highest 1000-grains weight (22.81 g) was recorded from recommended

dose of 50 kg $ha^{-1}$ gypsum ($S_2$ treatment) and the lowest one (21.41 g) was obtained from 25 kg $ha^{-1}$ gypsum ($S_1$ treatment) which was shown in Table 4. The variation in 1000-grain weight might be due to differences of length and breadth of the grains that were partly controlled by genetic makeup of the variety under study. The moisture in the grain which has a great effect for the variation of the grain weight. Tiwari *et al.* (2003) observed that sulphur is required for the synthesis of proteins, vitamins, chlorophyll and also required for the synthesis of the S-containing amino acids which are essential components of proteins and it has significant effect of the grain development. Grain yield was considerably affected by proper sulphur nutrient management. Significant variation was observed in grain yield due to different sulphur application. The maximum grain yield (5.70 t $ha^{-1}$) was produced by the treatment of $S_2$ with the recommended dose of 50 kg $ha^{-1}$ gypsum. The second highest grain yield (5.51 t $ha^{-1}$) was produced by $S_3$ treatment (75 kg $ha^{-1}$ gypsum) which was statistically similar with $S_1$ treatment (25 kg $ha^{-1}$ gypsum), while the lowest grain yield (5.41 t $ha^{-1}$) was produced by 25 kg $ha^{-1}$ gypsum. The highest grain yield might be the resultant effects of highest tillers $hill^{-1}$, panicle length and grains $panicle^{-1}$ with those treatments (Table 4). Increasing levels of S brought about noticeable increment in the percentage of unsaturated fatty acids improvement in the quality of grain. It was stated that the highest number of grain yield (5.70 t $ha^{-1}$) observed in $S_2$ treatment whereas the lowest number of grain yield (5.41 t $ha^{-1}$) was found in $S_1$ treatment which was shown Table 4. Deng *et al.* (1989) found that 23.9% of rice yield increased due to application of S as a source of gypsum. Oliveira *et al.* (2003) reported the increased yield of rice by the proper application of S fertilizers in the field. Straw yield of rice was significantly influenced by proper management of Sulphur fertilizer. The highest straw yield (7.47 t $ha^{-1}$) was obtained from $S_2$ treatment with the recommended dose of 50 kg $ha^{-1}$ gypsum (Table 4) which was statistically similar with $S_3$ treatment (75 kg $ha^{-1}$ gypsum), while the lowest straw yield (7.35 t $ha^{-1}$) was produced by 25 kg $ha^{-1}$. The reasons for higher straw yield was due to its higher plant height and total tillers $hill^{-1}$ i.e. the combined effect of plant height and tiller number. Similarly, Islam *et al.* (2009) reported that the highest straw yield was obtained from the increasing level of S application as gypsum and the lowest straw yield was recorded with S control treatment. Shivay *et al.* (2014) also reported that N concentration in paddy straw was highest with application of Sulphur @ 45 kg $ha^{-1}$. Biological yield was considerably affected by proper Sulphur nutrient management. Significant variation was observed in grain yield due to different Sulphur application. The maximum biological yield (13.18 t $ha^{-1}$) was produced by the treatment of $S_2$ with the recommended dose of 50 kg $ha^{-1}$ gypsum. The second highest biological yield (12.93 t $ha^{-1}$) was produced by $S_3$ treatment (75 kg $ha^{-1}$ gypsum) which was statistically similar (12.77 t $ha^{-1}$) with $S_1$ treatment (25 kg $ha^{-1}$ gypsum) which was given in the Table 4. So, different treatments exhibited significant variation at 5% level of significance. The reasons for higher biological yield in the variety of was due to its higher grain yield and straw yield. The data on harvest index was significantly influenced by the S application in this study. The highest harvest index (42.85 %) was observed in $S_2$ treatment when the recommended dose of 50 kg $ha^{-1}$ gypsum was applied which was superior to other treatments (Table 4) and the lowest harvest index (42.03 %) was observed in 25 kg $ha^{-1}$ gypsum of $S_1$ treatment. When the plant uptake proper amount of S nutrient, it produces more plants $area^{-1}$, more tillers which helps to produce healthy seed and ultimately increased the biological yield which increase the harvest index. It was concluded that different treatment was shown the significant variation at 5% level of probability. These results revealed that harvest index differed significantly due to the significant differences of the studied sulphur application and also the variation of grain and straw yield as well as biological yield.

**Interaction effect of weed management and sulphur application on yield and yield attributes of BRRI dhan29**

The interaction of weeding treatments and S application was statistically significant. Interaction of weed management and application of sulphur exhibited significant influence on number of effective tillers $hill^{-1}$. The highest number of effective tillers $hill^{-1}$ was found from the interaction of $W_2S_2$ (20.40) due to pre-emergence application of herbicide and the proper uptake of sulphur nutrient. The lowest number of effective tillers $m^{-2}$ was noticed at $W_1S_1$ (10.87) which were identical with $W_1S_2$ and $W_1S_3$ (Figure 1). So, different treatments exhibited significant variation at 5% level of significance. Interaction of weeding treatments and

application of sulphur exhibited non-significant influence on number of non-effective tillers hill$^{-1}$. The lowest number of effective tillers hill$^{-1}$ was noticed at $W_2S_2$ (0.40) due to proper weed management and fertilizer application (Table 5). The longest panicle length was found from the interaction of $W_2S_2$ (29.28 cm) due to pre-emergence application of herbicide and the proper uptake of sulphur nutrient. The shortest panicle length was noticed at $W_1S_1$ (16.08 cm) which was identical with $W_1S_2$ and $W_1S_3$ (Table 5). So, different treatments exhibited significant variation at 5% level of probability.

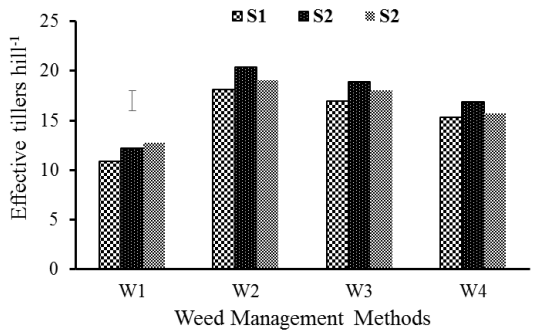



Fig.1. Interaction effect of weed management and sulphur application on number of effective tiller hill$^{-1}$ of BRRI dhan29 at harvest

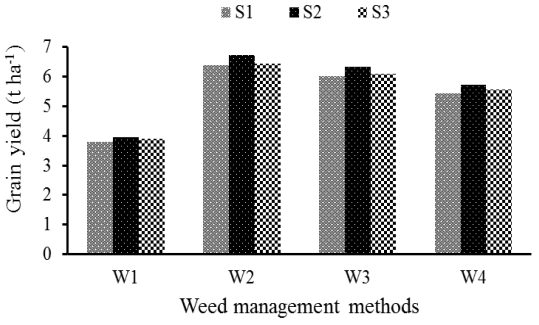



Fig.2. Interaction effect of weed management and sulphur application on grain yield of BRRI dhan29 at harvest

**Table 4. Effect of sulphur application on plant height (cm), number of effective tillers hill$^{-1}$ and number of non-effective tillers hill$^{-1}$ of BRRI dhan29**

| Sulphur Application | Effective tillers hill$^{-1}$ | Grains panicle$^{-1}$ | Panicle length (cm) | 1000-grain weight (g) | Grain yield (t ha$^{-1}$) | Straw yield (t ha$^{-1}$) | Biological yield (t ha$^{-1}$) | Harvest Index (%) |
|---|---|---|---|---|---|---|---|---|
| $S_1$ | 15.33 b | 157.74 b | 22.86 b | 21.41 b | 5.41 b | 7.35 b | 12.77 b | 42.03 b |
| $S_2$ | 17.12 a | 168.31 a | 25.08 a | 22.81 a | 5.70 a | 7.47 a | 13.18 a | 42.85 a |
| $S_3$ | 16.43 ab | 165.08 a | 24.20 a | 22.72 ab | 5.51 b | 7.42 a | 12.93 b | 42.41 ab |
| CV (%) | 9.12 | 7.90 | 6.50 | 7.47 | 3.61 | 6.09 | 4.41 | 3.20 |
| LS | * | * | ** | * | ** | ** | * | * |

In a column, figures with same letters or without letter do not differ significantly whereas figures with dissimilar letter differ significantly as per DMRT. $S_1$= 25 kg ha$^{-1}$ (Gypsum), $S_2$= 50 kg ha$^{-1}$ (Gypsum), $S_3$= 75 kg ha$^{-1}$ (Gypsum), CV= coefficient variation, LS = Level of Significance

** = Significant at 1% level of probability

* = Significant at 5% level of probability

Table 5 shows the interaction effect of weeding and S application exhibited significant influence on number of grains panicle$^{-1}$ in BRRI dhan29. The highest number of grains panicle$^{-1}$ (190) was recorded from the treatment combination of $W_2S_2$ (Pre-emergence herbicide + One hand weeding at 40 DAT and 50 kg ha$^{-1}$ gypsum). The lowest number of grains panicle$^{-1}$ (125) was observed from the treatment combination of $W_1S_1$ (no weeding and 25 kg ha$^{-1}$ of S application). The highest 1000-grain weight was observed in interaction of $W_2S_2$ (24.53 g) with the pre-emergence herbicide + One hand weeding at 40 DAT and 50 kg ha$^{-1}$ gypsum. The lowest 1000-grain weight was found in interaction of $W_1S_1$ (21.58 g) with the no weeding and 25 kg ha$^{-1}$ gypsum application which was given in the Table 5. Interaction effect of weeding treatments and S application had significant influence on grain yield. Result showed that ($W_2S_2$) pre-emergence treatment with S application through 50 kg ha$^{-1}$ of Gypsum produced the highest grain yield (6.73 t ha$^{-1}$). The lowest grain (3.81 t ha$^{-1}$) yield was obtained from the interaction of $W_1S_1$ with the similar statistical value of $W_1S_2$ (3.97

t ha$^{-1}$) and $W_1S_3$ (3.92 t ha$^{-1}$). The highest grain yield (6.73 t ha$^{-1}$) observed in $W_2S_2$ treatment the lowest grain yield (3.81 t ha$^{-1}$) was found in $W_1S_1$ treatment which was shown in Figure 2. The interaction of weeding method and S application showed significant influence on straw yield (Table 5). The highest straw yield (8.01 t ha$^{-1}$) was found from the interaction of $W_2S_2$ due to application of post-emergence herbicide and proper sulphur nutrient which was similar to $W_3S_3$ while the lowest straw yield (6.73 t ha$^{-1}$) was found from $W_1S_1$. The biological yield was observed as the highest in interaction of $W_3S_2$ (14.36 t ha$^{-1}$) with the post-emergence herbicide + One hand weeding at 40 DAT and 50 kg ha$^{-1}$ gypsum. It might be also high because the straw yield was highest in the treatment combination of $W_3S_2$. The lowest biological yield was found in interaction of $W_1S_1$ (10.54 t ha$^{-1}$) with the no weeding and 25 kg ha$^{-1}$ gypsum application with the similar statistical value of $W_1S_2$ (10.78 t ha$^{-1}$) and $W_1S_3$ (10.76 t ha$^{-1}$) which was stated in the Table 5. The significant influence on the interaction of weed management and S application was shown in case of harvest index (Table 5). Highest harvest index was found from $W_2S_2$ (47.47) treatment combination. This was significantly identical to $W_2S_1$ (46.60) and $W_2S_3$ (46.99). While the lowest one was observed from the interaction of $W_1S_1$ (36.13) and similar statistical value was also found in the treatment combination of $W_1S_2$ (36.80) and $W_1S_3$ (36.47).

**Table 5. Interaction effect of weed management and sulphur application on number of effective tillers hill$^{-1}$, panicle lenth (cm), thousand grain weight, Straw yield, Biological yield, and harvest index (%) of BRRI dhan29**

| Treatments | | Grains panicle$^{-1}$ | Panicle length (cm) | 1000-grain weight (g) | Straw yield (t ha$^{-1}$) | Biological yield (t ha$^{-1}$) | Harvest index (%) |
|---|---|---|---|---|---|---|---|
| | S1 | 124.70 e | 16.08 e | 21.58 e | 6.73 c | 10.54 d | 36.13 c |
| W1 | S2 | 132.50 e | 18.29 e | 22.35 cde | 6.81 bc | 10.78 d | 36.80 c |
| | S3 | 137.87 de | 18.31 e | 23.56 de | 6.84 bc | 10.76 d | 36.47 c |
| | S1 | 176.80 abc | 26.79 abc | 23.98 abc | 7.30 abc | 13.69 abc | 46.60 a |
| W2 | S2 | 189.53 a | 29.28 a | 24.53 a | 7.45 abc | 14.22 a | 47.47 a |
| | S3 | 184.73 ab | 28.18 ab | 24.35 ab | 7.43 abc | 13.87 abc | 46.99 a |
| | S1 | 170.70 abc | 24.97 cd | 23.56 abcd | 7.93 a | 13.94 abc | 43.13 b |
| W3 | S2 | 178.53 abc | 26.89 abc | 24.33 ab | 8.01 a | 14.36 a | 44.20 b |
| | S3 | 174.10 abc | 25.58 bcd | 24.31 abc | 7.93 a | 14.03 ab | 43.43 b |
| | S1 | 158.77 cd | 23.60 d | 23.73 cde | 7.45 abc | 12.90 c | 42.21 b |
| W4 | S2 | 172.67 abc | 25.86 bcd | 23.02 abcd | 7.61 ab | 13.34 abc | 42.95 b |
| | S3 | 163.63 bc | 24.75 cd | 22.66 bcde | 7.47 abc | 13.05 bc | 42.76 b |
| CV (%) | | 7.90 | 6.50 | 7.47 | 6.09 | 4.41 | 3.20 |
| LS | | ** | ** | ** | ** | ** | ** |

In a column, figures with same letters or without letter do not differ significantly whereas figures with dissimilar letter differ significantly as per DMRT. $W_1S_1$= (No Weeding-Control and 25 kg ha$^{-1}$ gypsum), $W_1S_2$= (No Weeding-Control and 50 kg ha$^{-1}$ gypsum), $W_1S_3$= (No Weeding-Control and 75 kg ha$^{-1}$ gypsum), $W_2S_1$= (Pre-emergence herbicide + One hand weeding at 40 DAT and 25 kg ha$^{-1}$ gypsum), $W_2S_2$= (Pre-emergence herbicide + One hand weeding at 40 DAT and 50 kg ha$^{-1}$ gypsum), $W_2S_3$= (Pre-emergence herbicide + One hand weeding at 40 DAT and 75 kg ha$^{-1}$ gypsum), $W_3S_1$= (Post-emergence herbicide + One hand weeding at 40 DAT and 25 kg ha$^{-1}$ gypsum), $W_3S_2$= (Post-emergence herbicide + One hand weeding at 40 DAT and 50 kg ha$^{-1}$ gypsum), $W_3S_3$= (Post-emergence herbicide + One hand weeding at 40 DAT and 75 kg ha$^{-1}$ gypsum), $W_4S_1$= (Two hand weeding at 20 and 40 DAT and 25 kg ha$^{-1}$ gypsum), $W_4S_2$= (Two hand weeding at 20 and 40 DAT and 50 kg ha$^{-1}$ gypsum), $W_4S_3$ = (Two hand weeding at 20 and 40 DAT and 75 kg ha$^{-1}$ gypsum), CV= coefficient variation, LS = Level of Significance

** = Significant at 1% level of probability

* = Significant at 5% level of probability

## CONCLUSIONS

From the present study it is observed that weeding treatment Superhit 500EC (Pretilachlor) followed by one hand weeding at 40 DAT produced the highest grain yield for BRRI dhan29. For the result of the present study showed that weed management treatments showed their superiority over no weeding in the production

of grain and straw yields. Among the weeding treatments $W_2$ (Pre-emergence herbicide + 1HW at 40 DAT) treatment obtained the grand performance of all the crop characteristics. From the present study it was observed that 50 kg $ha^{-1}$ of sulphur application as a source of gypsum exhibited the best result than other treatment of boro rice. From this experiment, it can be concluded that application of pre-emergence herbicide Pretilachlor followed by one hand weeding at 40 DAT and 50 kg $ha^{-1}$ sulphur might be the best treatment combination for controlling weed effectively as well as obtaining highest grain yield of BRRI dhan29.

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