

Effect of Weeding and Foliar Urea Spray on the Yield and Yield Components of *Boro* Rice

Shahnaj Parvin, Shihab Uddin, Salma Khanum and M.S.U. Bhuiya

Department of Agronomy, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

Abstract: Weed is the one of the most harmful enemy of rice that causes drastically yield reduction by competing with essential resources. On the other hand, nitrogen is the yield limiting nutrient (element) and foliar urea ensure higher yield of rice without loss of nutrient. Therefore, an experiment was conducted at Bangladesh Agricultural University, Bangladesh to investigate the effect of weeding and foliar application of urea on the yield and yield components of *Boro* rice cv. BRRI dhan 29. The experiment included four weeding e.g. no weeding (W_0), one weeding (W_1), two weeding (W_2) and three weeding (W_3) and six methods of urea application viz., foliar spray @ 0, 60, 80, 100 and 120 kg ha⁻¹ and soil application @ 220 kg ha⁻¹. The experiment was laid out in a split plot design with three replications each. Weeding treatments were allocated in main plots while methods of urea application were placed in sub-plots. Weeding had significant influence on yield and yield contributing characters of *Boro* rice cv. BRRI dhan29. Three weeding produced the highest number of total tillers hill⁻¹, effective tillers hill⁻¹ and grains panicle⁻¹, which eventually contributed to the highest grain yield in this treatment. All the yield contributing characters were the most inferior in case of no weeding and thus this treatment gave the lowest grain yield as well as straw yield. Yield and yield contributing characters of *Boro* rice cv. BRRI dhan29 were significantly influenced by foliar application of urea. The highest grain yield was obtained from five times foliar urea spray @ 100 kg ha⁻¹. This highest grain yield was the resultant effect of highest number of effective tillers hill⁻¹ and grains panicle⁻¹ in this treatment. The interaction of weeding and foliar application of urea also influenced grain yield of *Boro* rice cv. BRRI dhan29. The highest grain yield was obtained from the five times foliar spray of urea @ 100 kg ha⁻¹ with three weeding regime.

Key words: Boro rice • Weeding • Foliar urea spray • Yield components • Yield

INTRODUCTION

Rice (*Oryza sativa* L.) belongs to cereal group of crops under Gramineae family. It is the staple food of a vast majority of people around the world. In 2006-2007, 10.58 million hectares of land was under rice cultivation which produced 27.31 million tons of rice [1]. Although Bangladesh ranks 4th in terms of both acreage and production in the world, the average yield of rice is low in Bangladesh, only 3.90 t ha⁻¹ [2]. Rice is cultivated in different agro-ecological conditions and thus the weeds growing in association with the rice crops and their effect on crop yield vary considerably. Competition between rice and weeds is generally influenced by the season at which the crop is sown, the weed species present and their habit and the growth rate and density of both crops and weeds [3]. Therefore, a detailed ecological

study on crop weed interaction is fundamental to enhance the success of weed control methods [4]. Mamun [5] also reported that weed growth may reduce the grain yield by 68-100% for direct seeded *Aus* rice, 16-48% for transplanted *Aus* rice, 60.29% for deep water *Aman* rice, 45% for transplant *Aman* rice and 22.36% for modern *Boro* rice.

On the other hand, judicious application of nitrogen is essential to obtain higher yield [6]. The report says that application of urea through foliar spray can reduce the requirement of urea fertilizer by 80% of soil application [7]. Spray of urea is not a common practice for field crop production. However, during nursery production foliar urea application can correct nitrogen deficiencies; decrease the amount of total nitrogen requirement [8]. Foliar application of fertilizers has increased recently because of the development of concentrated and highly

soluble fertilizers and the increasing use of machinery for spraying [9]. Spraying of fertilizers solutions is most desirable when plant nutrients are absorbed with great difficulty from the soil through roots and when nutrients are required in the smallest possible quantities.

Moreover, when ground application of fertilizers is no longer possible as a result of tall growth of some plants, spray application may serve the most practical and useful means to supply nutrients to the plant [6]. Spraying of urea fertilizer in rice is not a common practice but recently it has attracted the attention of researchers due to some propaganda made by one Television channel (channel I). With this end in view, the present investigation was, therefore, undertaken to study the effect of weeding and urea spray on yield and yield components of *Boro* rice cv. BRRI dhan29 and to find out appropriate combination of weeding and urea spray for higher yield of *Boro* rice cv. BRRI dhan 29.

MATERIALS AND METHODS

The experiment was conducted at the Agronomy Field Laboratory of the Bangladesh Agricultural University, Mymensingh during *Boro* season starting from November 2009 to May 2010. The land was medium high and the soil was silty-loam and well drained and its general fertility level was low. The soil of the experimental field was more or less neutral in nature (pH 6.82) and low in organic matter content (1.19%). There was two factors treatment namely four weeding and four foliar urea application dose. Four different weeding are W_0 (no weeding), W_1 (one weeding at 30 days after transplanting), W_2 (two weeding at 30 DAT and 60 DAT), W_3 (three weeding at 30 DAT, 60 DAT and 90 DAT) and four different foliar urea applications are F_0 (0 kg urea ha^{-1}) control, F_1 (100 kg urea ha^{-1}) applied as 5 times spray, F_2 (120 kg urea ha^{-1}) applied as 4 times spray, F_3 (150 kg urea ha^{-1}) applied as 3 times spray and F_4 (200 kg urea ha^{-1}) applied as soil application in the form of prilled urea. The experiment was laid out in a split plot design with three replications each. Weeding was allocated in the main plots and urea application was assigned in sub-plots. Individual plot size was 4m \times 2.5m. There were 60 plots in the experiment. Seedling nurseries were prepared by puddling the soil and sprouted seeds were sown in nursery. Fourty days age seedling were transplanted on the well puddled plots on 24 December 2009 maintaining three seedlings $hill^{-1}$ with 25 cm spacing between lines and 15 cm spacing between hills. Fertilizers were applied in the plots @ 120, 70 kg ha^{-1} of P_2O_5 and

K_2O through triple super phosphate (TSP) and muriate of potash (MOP), respectively. Gypsum and Zinc sulphate were also applied @ 60 and 10 kg ha^{-1} , respectively. Gap filling, irrigation, drainage and plant protection measures were done as and when necessary.

Methods of urea application are as follows: in case of 3 times spray, one-third portion of total urea was dissolved in 5L of water and then sprayed on the foliage using hand sprayer at 20 DAT. The remaining portion of urea was also sprayed in the same way in two equal splits at 40 DAT and 60 DAT. In case of 4 times spray one-fourth of total urea was dissolved in 5L of water and then sprayed on the foliage using hand sprayer at 15 DAT and the remaining portion was sprayed at 30 DAT, 45 DAT and 60 DAT. In case of 5 times spray one-fifth portion of total urea was dissolved in 5L of water and then sprayed on the foliage using hand sprayer at 12 DAT and the remaining portion was sprayed at 24 DAT, 36 DAT, 48 DAT and 60 DAT. In case of soil application, one-fifth of total urea was applied at 12 DAT and the remaining portion was applied at 24 DAT, 48 DAT and 60 DAT. Irrigation, drainage, gap filling and plant protection measures were done as and when necessary. Prior to harvest five hills $plot^{-1}$ were selected randomly (excluding border hills). They were uprooted carefully, cleaned and tagged properly. Data on Plant height, total tillers $hill^{-1}$, effective tillers $hill^{-1}$, panicle length, grains $panicle^{-1}$, 1000-grain weight, grain yield, straw yield, biological yield and harvest index were recorded from the five hills $plot^{-1}$ and yields were taken from plot-wise harvest and eventually converted to $t\ ha^{-1}$. The collected data of all the parameters were analyzed statistically and the mean differences were adjusted by Duncan's Multiple Range Test (DMRT) [10] using MSTAT computer program.

RESULTS AND DISCUSSION

Effect of Weeding: Weeding practices did not influence plant height significantly in *Boro* rice cv. BRRI dhan29 (Table 1). However, numerically the tallest plants (82.44 cm) were found from three weeding done at 30 DAT, 60 DAT and 90 DAT. Weeding practices exhibited significant difference in producing number of total tillers $hill^{-1}$ in *Boro* rice cv. BRRI dhan29. The highest number of total tillers $hill^{-1}$ was obtained from three weeding, which was significantly superior to that of any other weeding treatment. Competition between rice plants and weeds for essential nutrients and water was lower in case of three weeding compared to no weeding. This might have

favored rice plants to produce more tillers. The highest number of effective tillers hill⁻¹ was obtained from three weeding which was significantly superior to any other weeding treatment. Low competition between rice plants and weeds in case of three weeding might have resulted the highest number of effective tiller hill⁻¹. This result is supported by Singh *et al.* [11]. Weeding practices did not exhibit any significant difference in panicle length in *Boro* rice cv. BRRI dhan29.

The highest number of grains panicle⁻¹ was found from three weeding and it was at par with two weeding while the lowest one from no weeding. Less competition among rice plants and weeds might have encouraged distribution of assimilates towards grains resulting highest number of grains panicle⁻¹ in this treatment. Studies also showed that panicle number per square meter is the most important factor in increasing grain yield of rice and 89% of yield changes are due to the effect of this factor [12, 13]. Effect of weeding on 1000 grain weight of *Boro* rice cv. BRRI dhan29 was not found significant. The highest grain yield in three weeding might be the result of highest number of total tillers hill⁻¹, effective tillers hill⁻¹ and grains panicle⁻¹. This indicates that weed is a great problem for crop production and the yield increased with the increased number of weeding. The highest straw, biological yield and harvest index were obtained from three weeding, which was significantly superior to that of any other weeding.

The no weeded plots resulted lowest yield. These might be the limitation of less number of total tillers hill⁻¹ [14]. Pasha *et al.* [15] also reported that weeded rice plots produced higher yield compare to control plot.

Effect of Foliar Urea Spray: Rate of urea application (spray) exhibited significant difference in plant height of *Boro* rice cv. BRRI dhan29 (Table 2). The longest plant was obtained from 4 times spray of urea @ 120kg ha⁻¹ (F₂) and it was at par with F₃ (Three times urea spray @120 kg ha⁻¹). Spray of urea exhibited significant difference in producing number of total tillers hill⁻¹ in *Boro* rice cv. BRRI dhan29. The highest number of tillers hill⁻¹ and effective tillers hill⁻¹ obtained from F₁ (5 times urea spray @ 100 kg ha⁻¹) which was significantly superior to that of any other foliar spray. Panicle length of *Boro* rice cv. BRRI dhan29 did not differ significantly due to urea spray. However, numerically the highest number of panicle length and grains panicle⁻¹ was obtained from F₁ (5 times urea spray @ 100 kg ha⁻¹) and lowest number from F₁ (Soil application of urea) @ 200 kg ha⁻¹. This might be due to longer panicle bear more number of filled grains. 1000 grain weight did not vary significantly due to the urea application (spray). Similar trend of higher number of grains and longer panicle also reported by Beecher *et al.* [16]. Grain yield of *Boro* rice cv. BRRI dhan29 was influenced significantly by foliar application of urea. The highest grain yield was found

Table 1: Effect of weeding on yield and yield components of *Boro* rice cv. BRRI dhan29.

Treatments	Plant height (cm)	No. of total tillers hill ⁻¹	No. of effective tillers hill ⁻¹	Panicle length (cm)	No. of grains Panicle ⁻¹	1000grain wt. (g)	Grain Yield (t ha ⁻¹)	Straw Yield (t ha ⁻¹)	Biological yield (t ha ⁻¹)	Harvest index (%)
W0	80.82	6.32d	4.65d	22.78	126.13c	20.92	3.38d	5.05d	8.43d	39.18d
W1	81.57	7.337c	5.97c	22.94	140.84b	20.88	4.02c	5.6c	9.62c	41.36c
W2	81.96	8.39b	6.98b	23.25	155.89a	20.92	5.01b	6.5b	11.5b	43.06b
W3	82.44	8.87a	8.19a	23.22	162.46a	20.96	5.29a	6.68a	11.97a	44.17a
CV (%)	2.82	4.44	3.72	1.27	20.81	2.64	2.63	2.11	2.11	1.93
Level of Sig.	NS	**	**	NS	**	NS	**	**	**	**

In a column, figures with same letters or without letters do not differ significantly whereas figures with dissimilar letter differ significantly as per DMRT. NS = Not significant and ** = Significant at 1% level of probability.

Weedings: W₀ = No weeding, W₁ = One weeding, W₂ = Two weedings, W₃ = Three weedings and Urea dose: F₀ = Urea spray @ 0 kg ha⁻¹, F₁ = Five times urea spray @ 100 kg ha⁻¹, F₂ = Four times urea spray @ 120 kg ha⁻¹, F₃ = Three times urea spray @ 150 kg ha⁻¹, F₄ = Soil application of urea @ 200 kg ha⁻¹.

Table 2: Effect of foliar urea spray on yield and yield components of *Boro* rice cv. BRRI dhan29.

Treatments	Plant height (cm)	No. of total tillers hill ⁻¹	No. of effective tillers hill ⁻¹	Panicle length (cm)	No. of grains Panicle ⁻¹	1000-grain wt. (g)	Grain Yield (t ha ⁻¹)	Straw Yield (t ha ⁻¹)	Biological yield (t ha ⁻¹)	Harvest index (%)
F ₀	76.64c	6.01e	4.81e	23.13	119.00d	20.88	3.02d	4.86d	7.88e	37.88c
F ₁	82.35b	7.14d	5.75d	22.72	135.39c	20.96	3.88c	6.13b	10.01d	37.77c
F ₂	83.10ab	8.10c	6.88c	22.77	153.58b	21.10	5.01b	5.95c	10.96c	45.6a
F ₃	84.61a	8.55b	7.12b	23.15	160.24ab	20.76	5.06ab	6.47a	11.63a	44.25b
F ₄	81.79b	8.90a	7.68a	23.22	163.45a	20.88	5.15a	6.37a	11.43b	44.22b
CV (%)	2.82	4.44	3.72	1.27	5.55	3.44	2.64	2.63	2.11	1.93
Level of Sig.	**	**	**	**	**	**	**	**	**	**

In a column, figures with same letters or without letters do not differ significantly whereas figures with dissimilar letter differ significantly as per DMRT. NS = Not significant and ** = Significant at 1% level of probability.

Weedings: W₀ = No weeding, W₁ = One weeding, W₂ = Two weedings, W₃ = Three weedings and Urea dose: F₀ = Urea spray @ 0 kg ha⁻¹, F₁ = Five times urea spray @ 100 kg ha⁻¹, F₂ = Four times urea spray @ 120 kg ha⁻¹, F₃ = Three times urea spray @ 150 kg ha⁻¹, F₄ = Soil application of urea @ 200 kg ha⁻¹.

Table 3: Interaction effect of weeding and urea spray on the yield and yield components of *Boro* rice cv. BRRI dhan29.

Treatments	Plant height (cm)	No. of total tillers hill ⁻¹	No. of effective tillers hill ⁻¹	Panicle length (cm)	No. of grains Panicle ⁻¹	1000 grain wt.(g)	Grain Yield (t ha ⁻¹)	Straw Yield (t ha ⁻¹)	Biological yield (t ha ⁻¹)	Harvest index (%)
W ₀ F ₀	77.91	5.20j	5.14ij	23.20	90.77i	20.56	3.03g	3.24fg	6.27l	43.49e-h
W ₀ F ₁	79.71	7.16fg	6.62de	22.90	153.20bc	21.54	3.18f	5.12a	12.30b	42.13hi
W ₀ F ₂	83.50	7.90de	6.92d	22.85	171.92a	21.16	4.66d	6.76b	12.42b	45.56bc
W ₀ F ₃	83.13	8.50d	7.33ca	23.67	171.49a	20.69	4.68cd	7.04a	12.84a	45.20bcd
W ₀ F ₄	83.59	9.27c	8.71b	23.50	170.74a	20.63	3.63f	7.18a	12.91a	44.50b-e
W ₀ F ₅	75.54	6.23hi	3.20l	23.90	108.30h	20.82	2.16h	4.11i	9.37gh	34.40k
W ₁ F ₀	82.80	6.64ghi	4.10k	22.75	117.29gh	20.64	2.16h	5.05gh	7.21k	29.94l
W ₁ F ₁	82.74	6.35hi	5.11j	22.90	125.60fg	21.58	4.12e	5.07gh	9.19h	44.81b-e
W ₁ F ₂	83.79	6.64ghi	5.42ij	23.35	137.24def	20.76	4.25e	5.64de	9.89f	42.98fgh
W ₁ F ₃	79.24	8.26d	5.41ij	23.33	142.23cde	20.99	4.20e	5.40ef	9.60fg	43.75d-g
W ₁ F ₄	75.97	6.03i	5.33ij	23.01	143.96cde	20.63	2.86g	4.85h	7.71j	37.07j
W ₁ F ₅	83.52	7.12fg	5.89gh	22.67	131.92ef	20.80	3.15f	5.22fg	8.37i	37.66j
W ₂ F ₀	82.97	7.53ef	5.89gh	22.30	151.66bcd	21.09	4.62d	5.70d	10.33e	44.77b-e
W ₂ F ₁	84.00	9.96b	6.10fg	22.62	160.98ab	21.04	4.85c	6.04c	10.88d	44.53b-e
W ₂ F ₂	83.35	10.01ab	6.63de	23.10	168.89a	20.81	4.61d	6.18c	10.79d	42.76gh
W ₂ F ₃	77.13	6.57ghi	5.58hi	22.41	132.96ef	21.31	2.98fg	5.18fg	8.16i	36.55j
W ₂ F ₄	83.37	7.63ef	6.38ef	22.55	139.14c-f	20.87	5.02bc	7.12a	12.14bc	41.34i
W ₂ F ₅	83.20	10.37ab	9.61a	23.05	165.15ab	20.56	4.76b	6.28c	11.91c	45.87b
W ₃ F ₀	87.52	9.27c	9.63a	22.94	170.25a	20.75	5.06bc	6.71b	12.94a	44.30c-f
W ₃ F ₁	80.97	10.59a	9.95a	22.95	172.93a	21.10	5.80a	7.19a	12.39b	47.26a
CV (%)	2.82	4.44	3.72	1.27	5.55	3.44	2.64	2.63	2.11	1.93
Level of Significance	NS	**	**	NS	**	NS	**	**	**	**

In a column, figures with same letters or without letters do not differ significantly whereas figures with dissimilar letter differ significantly as per DMRT.

NS = non-significance and ** = significant at 1% level of probability

Urea: F₀= Urea spray @ 0 kg ha⁻¹, F₁= Soil application of urea @ 200 kg ha⁻¹, F₂= Three times urea spray @ 150 kg ha⁻¹, F₃= Four times urea spray @ 120 kg ha⁻¹, F₄= Five times urea spray @ 100 kg ha⁻¹ and Weeding: W₀= No weeding, W₁= One weeding, W₂=Two weeding, W₃= Three weeding.

from F₁ (5 times spray @ 100 kg ha⁻¹). Uddin *et al.* [17] found that nitrogen fertilizer has significant role in yield increment of aus rice. The highest grain yield in F₁ treatment (5 times spray @ 100 kg ha⁻¹) might be due to higher number of effective tillers hill⁻¹ and highest number of grains panicle⁻¹ [18]. Eskandari *et al.* [19] also reported positive correlation (0.62) for filled grain number per panicle with yield. The highest straw yield was produced by F₂ (4 times spray at the rate of 120 kg ha⁻¹) and it was statistically identical to F₁. The highest biological yield (11.63 t ha⁻¹) was obtained from F₂ (4 times spray @ 120 kg ha⁻¹) and it was statistically followed by F₁, F₃, F₄ and F₀. The lowest biological yield was recorded from control treatment (F₀). The harvest index of *Boro* rice cv. BRRI dhan29 was found significant due to one urea spray. The highest harvest index was (45.6) found from F₃. Lowest harvest index was observed in F₄ and it was as per with that of F₀ treatment. The results of the present study are also in agreement with the findings obtained by Bhuiya *et al.* [20].

Interaction Effect of Weeding and Foliar Urea Spray:

Plant height of *Boro* rice cv. BRRI dhan29 was not significantly influenced by the interaction of weeding and foliar application of urea (Table 3). The highest number of total tillers hill⁻¹ was found from the interaction of W₃F₁

(three weedings and five times urea spray @ 100 kg ha⁻¹). The highest number of effective tillers hill⁻¹ (9.95) was obtained from the interaction of W₃F₁ (three weedings and urea spray @ 100 kg ha⁻¹), which was significantly similar to that of interaction of W₃×F₂, W₃×F₃. The lowest number of effective tillers hill⁻¹ was observed in the interaction of W₁×F₀. Panicle length of *Boro* rice cv. BRRI dhan29 did not vary significantly due to interaction effect of weeding and urea spray. Numerically the highest panicle length (23.90 cm) was resulted from W₁F₄ while the lowest from W₂×F₃ and it was identically followed by W₃×F₂, W₀×F₃, W₀×F₂ and W₀×F₁.

Interaction of weeding and urea application exhibited significant influence on number of grains *Boro* rice cv. BRRI dhan29. The highest number of grains panicle⁻¹ was recorded due to the combination of W₃×F₁ (three weedings and five times urea spray @ 100 kg ha⁻¹).

The lowest number of grains panicle⁻¹ was observed from the combination of W₀×F₀ (no weeding and no application of urea). The interaction effect of weeding and urea application did not show any significant influence on 1000 grain weight.

Interaction of weeding and urea application had significant influence on grain yield of *Boro* rice cv. BRRI dhan29. The combination of three weeding with five times urea spray @ 100 kg ha⁻¹ produced in the highest grain yield. The lowest grain yield was obtained

from the interaction of $W_0 \times F_0$. The highest straw yield, biological yield and harvest index were found from the interaction of three weedings and urea spray @ 100 kg ha⁻¹ while the lowest straw yield was found from $W_1 \times F_0$ one weeding and no application of urea. Similar results are also reported by BRRI [21].

CONCLUSIONS

From the above results and discussion it is revealed that weeding and urea spray had significant influence on yield and yield components of Boro rice cv. BRRI dhan29 either alone or in combination. Individually three weedings and urea spray @ 100 kg ha⁻¹ performed the best in terms of grain yield. However, when both the factors were combined urea spray @ 100 kg ha⁻¹ in combination of three weedings gave the highest grain yields comparable to that of three weedings and urea spray @ 120 kg ha⁻¹. Therefore, it can be concluded that foliar spray of fertilizer did not only increase the crop yields but also reduced the quantities of fertilizer applied to the rice field.

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