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Effect of Magic Growth on Rice Yield

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ABSTRACT

Investigation during T. Aus 2012 through Boro 2013-14 at BRRI farm, Gazipur evaluated the effect of magic growth (MG) solution on rice. The experiment compared variable doses of N with or without MG along with N control in a randomized complete block design with three replications. Basal application of N with its top dress was also compared with only top dress of N (no basal). All the plots (except control) received a blanket application of phosphorus, potassium, sulfur and zinc. The application of MG spraying produced no yield advantage on rice grain yield in Aus, Aman and Boro seasons. Basal application of N with top dress produced higher yield over N top dressing only in Boro season at lower rate of N.

Keywords: Liquid fertilizer, N spray, N top dress, Basal N, rice

INTRODUCTION

Judicious application of fertilizer is one of the most effective means for maximizing rice yield. Modern rice plants uptake more nutrients to produce more yields. Nitrogen is one of major essential plant nutrients and plays a key input role for increasing crop yield. (De Datta and Buresh, 1989). Urea is the most frequently used N fertilizer, which can be applied in different ways. In Bangladesh crystal urea is applied mostly as top dressing. Urea can also be supplied to plants as foliar sprays. Major nutrients, such as N, P, K and S are needed by the rice plants in large quantities (Anonymous, 2010).So, supplying them adequately as spray may cause foliar burn. Because of this problem, major nutrients are applied as granular fertilizers. Application of urea super granule (USG) @ 75 kg ha^{-1} produced 22.03% more yield than granular urea application at two and three equal splits. Foliar spray of urea produced the lowest yield (Hasanuzzaman *et al.,* 2009). Aerial spray of nutrients is preferred in many cases than the soil application (Jamal *et al*., 2006).

Recently foliar application of nutrients has become an important practice in the production of crops while application of fertilizers to the soil remains as the basic method of feeding the major crop plants. Some of the companies/individuals claim that liquid fertilizer is better than granular ones. Magic growth, a liquid fertilizer has been proposed by a company that it can supplement nitrogenous fertilizer. We hypothesize that magic growth may affect rice growth and development based on its application rates and methods along with N fertilizer at variable rates. So, series of experiments were conducted at BRRI farm, Gazipur during T. Aus, T. Aman and Boro seasons.

MATERIALS AND METHODS

Series of experiments were conducted at BRRI farm, Gazipur. In all seasons, unit plot size was 4-×5-m and surrounded by 30-cm bund and 50-cm drain. Rice was transplanted at 20- × 20-cm spacing and grown on submerged soil (5-10 cm water depth). The experiments were laid out in a randomized complete block (RCB) design with three replications.

T. Aus 2012

The treatment combinations were: 56 kg N ha^{-1} + spraying magic growth (MG) five times (T_1), 56 kg N ha^{-1} (T_2), 75 kg N ha^{-1} (T_3), 75 kg N ha^{-1} + spraying MG twice (T_4), 38 kg N ha^{-1} (T_5) and no fertilizer (T_6). A basal dose of PKSZn @10-37-7-1 kg ha^{-1} was used. Twenty-seven-day-old seedlings of BRRI dhan43 was transplanted on 14 June 2012. Seedlings used in T_1 where sprayed with MG liquid fertilizer at 12, 22 days after sowing (DAS) and one day before transplanting. The concentration of MG liquid fertilizer was 2ml L^{-1} water for an area of 3- × 1.5-m seed bed. Nitrogen was applied on 10 and 25 DAT at 34 and 17 kg N ha^{-1}, respectively. Spray of MG at 96 ml 48L^{-1} water + 600g urea/33 dec) was done in the afternoon at 25 and 40 DAT. Similar amount of MG was sprayed in the main field in T_4. In other treatments, N was applied at basal, 25 and 39 DAT in equal splits. At maturity, the crop was harvested from 5 m^2 area at the centre of each plot and grain yield was adjusted to 14%

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moisture content and straw yield was recorded from 16 hills.

T. Aman 2012

The treatment combinations were: 51 kg N ha^{-1} + 4 kg N ha^{-1} from urea spraying with MG five times (T_1), 56 kg N ha^{-1} (T_2), 75 kg N ha^{-1} (T_3), 75 kg N ha^{-1} + spraying MG twice (T_4), 38 kg N ha^{-1} (T_5) and no fertilizer (T_6). A basal dose of PKSZn @10-37-7-1 kg ha^{-1} was used. Forty-eight-day-old seedlings of BR22 were transplanted on 11 September 2012. In T_1, MG was sprayed as in T. Aus. Similar amount of MG alone was sprayed in the main field in T_4. In T_1, N was applied in two splits: 1st top-dress at 15 DAT (34 kg N ha^{-1}) and 2nd top-dress at 27 DAT (17 kg N ha^{-1}). In other treatments N was applied in three equal splits (at basal, 25 DAT and 43 DAT). Data were recorded as like as T. Aus.

Boro 2012-13

Field 1. The treatment combinations were: no fertilizer (T_1), 50 kg N ha^{-1} (T_2), 50 kg N ha^{-1} + 6 kg N ha^{-1} from urea spraying with MG seven times (T_3), 100 kg N ha^{-1} (T_4), 100 kg N ha^{-1} + 6 kg N ha^{-1} from urea spraying with MG seventimes (T_5), 50 kg N ha^{-1} (T_6), 75 kg N ha^{-1} (T_7), 100 kg N ha^{-1} (T_8), 125 kg N ha^{-1} (T_9) and 150 kg N ha^{-1} (T_{10}). A basal dose of PKSZn @ 20-60-10-2.2 kg ha^{-1} was used. Fifty-three-day-old seedlings of BRRI dhan29 were transplanted on 22 January 2013. However, seedlings used in T_3 and T_5 where MG liquid fertilizer was sprayed four times at 17, 27, 38 DAS and one day before transplanting. Concentration of MG for seed bed was similar to T. Aus. In T_2 and T_3, N was applied at 15 DAT (33 kg N ha^{-1}) and 29 DAT (17 kg N ha^{-1}). First spray of MG applied at 96 ml MG 48L^{-1} water + 600g urea/33 dec in the afternoon on 29 DAT, 2nd spray at 96 ml MG 48L^{-1} water + 600g urea/33 dec + 300g MoP/33 dec on 44 DAT and 3rd spray at 96 ml MG 48L^{-1} water + 600g urea/33 dec + 300g MoP/33 dec on 58 DAT in T_3. Similar amount of MG was sprayed in the main field in T_5. In T_4 and T_5, N was applied at 15, 29 and 44 DAT in equal splits. In other treatments N was applied at basal, 25 and 43 DAT equally. Data were recorded as like as T. Aus.

Field 2. The treatment combinations were: no fertilizer (T_1), 50 kg N ha^{-1} (T_2), 50 kg N ha^{-1} + 6 kg N ha^{-1} from urea spraying with MG three times (T_3), 100 kg N ha^{-1} (T_4), 100 kg N ha^{-1} + 6 kg N ha^{-1} from urea spraying with MG three times (T_5), 50 kg N ha^{-1} (T_6), 75 kg N ha^{-1} (T_7), 100 kg N ha^{-1} (T_8), 125 kg N ha^{-1} (T_9) and 150 kg N ha^{-1} (T_{10}). A basal dose of PKSZn @ 20-60-10-2.2 kg ha^{-1} was used. Sixty-four-day-old seedlings of BRRI dhan29 were transplanted on 4 February 2013. There was no spray at seed bed. Amount and time of MG spray in the main field for T_3 and T_5 were similar to Field 1. In T_2 and T_3, N was applied at 14 DAT (33 kg N ha^{-1}) and 29 DAT (17 kg N ha^{-1}). In T_4 and T_5, N was applied at 14, 29 and 44 DAT equally. In other treatments, N was applied at basal, 26 and 48 DAT equally. Data were recorded as in T. Aus.

Boro 2013-14

Table 1 shows the treatment combinations. In T_4, T_5 and T_6, N was applied on soil in two splits. In T_4 and T_5, 20% at 7 DAT and 30% at 27 DAT while in T_6 25% at 7 DAT and 35% at 27 DAT. In T_4 and T_6, 10% N of STB but in T_5, 15% N of STB were sprayed three times with MG. In T_2 and T_{10} only MG (no N) was sprayed. In other treatments, N was applied at 7, 27 and 47 DAT

Table 1. Treatment imposed during Boro 2013-14.

$T_1 = N_0$
$T_2 = N_0$ (only MG)
$T_3 = N_{60}$ % of STB (70 kg N ha^{-1})
$T_4 = N_{50}$ % of STB + 10% with MG (58 kg + 12 kg N ha^{-1})
$T_5 = N_{50}$ % of STB + 15% with MG (58 kg + 17 kg N ha^{-1})
$T_6 = N_{60}$ % of STB + 10% with MG (70 kg + 12 kg N ha^{-1})
$T_7 = N_{70}$ % of STB (82 kg N ha^{-1})
$T_8 = N_{85}$ % of STB (99 kg N ha^{-1})
$T_9 = N_{100}$ % of STB (116 kg N ha^{-1})
$T_{10} = N_{100}$ % of STB + MG)

equally. A basal dose of PKSZn @ 17-60-20-4 kg ha^{-1} was used. The test rice variety was BRRIdhan28. Roots of the seedlings were dipped in a solution containing KCl and MG according to supplier's recommendation. Data were recorded as in T. Aus.

RESULTS AND DISCUSSION

T. Aus 2012

Nitrogen fertilizer application significantly increased straw and grain yield (t ha^{-1}) compared to without fertilizer (Table 2). Statistically similar grain yield was obtained with and without MG sprays at similar levels of N. It means that spraying of MG in rice did not show any yield advantage over similar rate of conventional N fertilizer application. These results are supported by the findings of Aziz and Miah (2008) who revealed that STB fertilizer dose gave significantly higher rice yield than flora (liquid fertilizer) treated (3ml L^{-1} water) plot. There was no significant yield difference between STB dose and STB + flora treatments. Nutrient content in MG indicated 0.67% total N along with considerable concentration of P, K and S (Table 3) and the amount of N added to rice crop through spraying of MG was very negligible and thus had no effect on rice yield. The N content did not vary even after modification of determination process (Table 4).

Table 2. Influence of magic growth fertilizer on yield of BRRI dhan43, T. Aus 2012, BRRI farm, Gazipur.

Treatment	Straw yield (t ha^{-1})	Grain yield (t ha^{-1})
$T_1 = N_{56} + MG_5$	2.59ab	3.05a
$T_2 = N_{56}$ (without MG)	2.54ab	2.92a
$T_3 = N_{75}$ (AEZ base dose)	2.83a	3.01a
$T_4 = N_{75} + MG_2$	2.75a	3.12a
$T_5 = N_{38}$ (50% of T_3)	2.29b	2.53b
T_6 = Control (no fertilizer)	1.66c	1.91c
Level of significance	**	**
CV (%)	9.5	6.0

Blank dose: PKSZn @ 10-37-7-1 kg ha^{-1}.

Table 3. Nutrient content of magic growth liquid fertilizer.

Parameter	Sample supplied for T. Aus		Sample supplied for Boro	
	Fresh aliquot	Digested aliquot	Fresh aliquot	Digested aliquot
pH	1.17	-	0.98	-
Total N (%)	0.67	5.23	0.35	7.07
Total P (%)	2.18	-	3.18	-
Total K (%)	9.6	-	7.5	-
Total S (%)	0.65	-	0.33	-
Total Fe (%)	0.02	-	0.01	-
Total Cu (%)	0.03	-	0.03	-
Total Zn (%)	0.02	-	0.02	-
Total Mn (%)	0.004	-	0.01	-

Table 4. Percent N content of magic growth liquid fertilizer.

Magic growth	Aliquot without digestion		Aliquot digestion without shaking
	Without shaking	Shaking	
Sample supplied for T. Aus	1.12	1.44	3.73
Sample supplied for Boro	1.85	1.89	5.13

Note. Table 3 shows the N contents of fresh and digested aliquot. Percent N in fresh aliquot was less than digested aliquot. Obtained N from fresh aliquot was quite perfect to uptake by plant in field condition, because this amount is the available form, but N from digested aliquot is not suitable for plant because most of the N is in unavailable form.

T. Aman 2012

Nitrogen fertilizer application significantly increased plant height, tiller numbers, straw and grain yields than control (Table 5). Nitrogen @ 56 kg ha^{-1} in three splits produced yield 3.52 t ha^{-1}, which was significantly higher than T_1 = N_{51} + 4 kg N ha^{-1} from urea spraying with MG five times. It indicated that soil application of urea-N (56 kg ha^{-1}) was superior to 51 kg N ha^{-1} soil application (2 × top dress) plus 4 kg N ha^{-1} as urea solution spray with MG. The yield obtained with this dose was also statistically at per with N 75 kg ha^{-1} with and without MG spraying treatment. In late transplanting situation, 56 kg N ha^{-1} was considered as optimum dose for satisfactory grain yield. However, rice yield at 75 kg N ha^{-1} with and without MG was statistically similar. It means MG spray also did not bring any yield advantage over without MG spray and also indicated that soil application of N fertilizer was better than foliar application of MG. This result represents the findings of Alam *et al.* (2010) who revealed that application of 1% urea solution alone (46 kg N ha^{-1}) is not enough to produce good yield, while with 94 kg urea soil application (112.24 kg N ha^{-1}) the performance was better but still the yield were lower than that obtained with soil application alone. On the other hand, 3% urea alone also showed poor performance compared to soil application of urea and even with 2% urea solution.

Table 5. Influence of magic growth liquid fertilizer on yield and yield components of BR22, T. Aman 2012, BRRI farm, Gazipur.

Treatment	Plant height (cm)	Tiller no./m^{-2}	Straw yield (t ha^{-1})	Grain yield (t ha^{-1})
T_1 = N_{51} + N_{4*} with MG_5	82a	278a	2.88bc	3.28b
T_2 = N_{56} (without MG)	84a	263ab	3.30ab	3.52a
T_3 = N_{75} (AEZ base dose)	82a	270a	3.23abc	3.64a
T_4 = N_{75} + MG_2	84a	275a	3.50a	3.59a
T_5 = N_{38}	80a	243bc	2.84c	3.31b
T_6 = Control (no fertilizer)	67b	232c	2.16d	2.00c
Level of significance	**	**	**	**
CV (%)	6	4.6	8.7	3.5

*4 kg N calculated from urea solution spray with MG liquid fertilizer.

Boro 2012-13

Field 1. There was no significant effect of MG on rice yield (Table 6). Regardless of N application method, grain yield increment was observed up to 125 kg N ha^{-1} (Fig. 1). The highest grain yield (5.05 t ha^{-1}) was obtained at 125 kg N ha^{-1} applied with basal and two top dresses (T_9), which was statistically similar to 100 kg N ha^{-1}with basal and two top dresses (T_8), 100 kg N with MGS_7 (T_5) and 150 kg ha^{-1} N (basal and two top dresses) (T_{10}). So, the best performance was observed when 100 kg N ha^{-1} was used as basal and two top dresses. Yogendra *et al.* (2013) also found better performance with basal N fertilizer application than without basal. Application of 50 kg ha^{-1} N following basal and two top dresses (T_6) produced similar grain yield with 50 kg N + MG_7 (T_3) followed by without basal N (T_2) but T_6 was superior to T_3. There was significant difference on grain yield between T_3 (N_{50+6*} with MG_7 and without basal) and T_4 (N_{100} without basal and without MG). So, these findings do not support our hypothesis. Our findings are

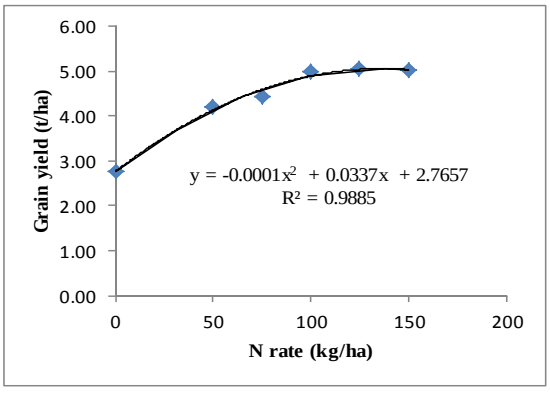

Fig. 1. Influence of N rate on yield of BRRI dhan29, Boro 2012-13, BRRI farm, Gazipur.

Table 6. Influence of magic growth fertilizer on yield of BRRI dhan29, Boro 2012-13, BRRI farm, Gazipur.

Treatment	Plant ht (cm)	Tiller no. m^{-2}	Straw yield (t ha^{-1})	Grain yield (t ha^{-1})
T_1 = Control (no fertilizer)	80e	164d	1.90d	2.76f
T_2 = N_{50} (without MG and without basal)	85cd	221bc	3.00c	3.67e
T_3 = N_{50+6*} (with MG_7 and without basal)	86bcd	205cd	2.84cd	3.87de
T_4 = N_{100} (without MG and without basal)	89abcd	234bc	3.35bc	4.47bc
T_5 = N_{100+6*} (with MG_7 and without basal)	90ab	257b	4.46a	4.93ab
T_6 = N_{50} (Basal and two top dresses)	86bcd	191cd	2.59cd	4.22cd
T_7 = N_{75} (Basal and two top dresses)	84d	205cd	2.85cd	4.43c
T_8 = N_{100} (Basal and two top dresses)	93a	234bc	4.03ab	5.00a
T_9 = N_{125} (Basal and two top dresses)	91ab	264b	4.05ab	5.05a
T_{10} = N_{150} (Basal and two top dresses)	90abc	346a	4.26ab	5.02a
Level of significance	**	**	**	**
CV (%)	2.4	7.9	11.8	4.4

*N with MG.

also supported by Karim *et al.* (2015) who reported maximum grain yield through soil fertilization compared to liquid fertilizer spray.

Field 2. Nitrogen fertilizer application significantly increased tiller number, straw and grain yields than without fertilizer addition (Table 7). The highest grain yield of 6.15 t ha^{-1} was obtained with T_8 (N_{100} with basal and two top dresses), which was statistically similar to T_5 ($N_{100 + 6*}$ with MG_3 and without basal), T_7 (N_{75}: Basal and two top dresses) and T_9 (N_{125}: Basal and two top dresses). Statistically similar grain yield was obtained from T_2 (N_{50} without MG and without basal) and T_3 (N_{50+6*} with MG_3). Similar trend was found with T_4 (N_{100} without MG) and T_5 (N_{100+6*} with MG_3). There was a significant difference on grain yield between T_3 (N_{50+6*} with MG_3 and without basal) and T_8 (N_{100} with basal and two top dresses). In spite of same N dose in the T_2 and T_6, significantly higher grain yield was obtained from T_6 (N_{50}: Basal and two top dresses). Similar trend was observed with T_4 (N_{100} without basal and three top dresses) and T_8 (N_{100} with basal and top dresses). It might be due to the variation in fertilizer application time and method. Regardless the method of N application, the highest grain yield increment was observed up to 100 kg N ha^{-1} (Fig. 2). The highest number of tiller (316) was obtained in T_{10}, which was statistically similar to T_4, T_5 and T_9. The highest straw yield of 5.87 t ha^{-1} was obtained in T_{10}, which was statistically similar to T_5 and T_9. There was no significant difference on straw yield among T_2, T_3, T_4, T_6, T_7 and T_8. Similar finding was achieved by

Table 7. Influence of magic growth fertilizer on yield of BRRI dhan29, Boro 2012-13, BRRI farm, Gazipur.

Treatment	Tiller no. m^{-2}	Straw yield (t ha^{-1})	Grain yield (t ha^{-1})
T_1 = Control (no fertilizer)	173e	2.72d	3.95e
T_2 = N_{50} (without MG and without basal)	237d	4.36bc	5.02d
T_3 = N_{50+6*} (with MG_3 and without basal)	254bcd	4.39bc	5.36cd
T_4 = N_{100} (without MG and without basal)	273abcd	4.64abc	5.56bc
T_5 = N_{100+6*} (with MG_3 and without basal)	292abc	5.16ab	5.95ab
T_6 = N_{50} (Basal and two top dresses)	249cd	3.66cd	5.61bc
T_7 = N_{75} (Basal and two top dresses)	268bcd	3.72cd	5.86abc
T_8 = N_{100} (Basal and two top dresses)	267bcd	4.30bc	6.15a
T_9 = N_{125} (Basal and two top dresses)	295ab	5.19ab	5.74abc
T_{10} = N_{150} (Basal and two top dresses)	316a	5.87a	5.61bc
Level of significance	**	**	**
CV (%)	6.3	11.4	3.8

*N with MGS.

Alam *et al.* (2010) who reported that soil application of N fertilizer was the best for obtaining higher grain yield. Yogendra *et al.* (2013) also found that basal N fertilizer application performed better than without basal.

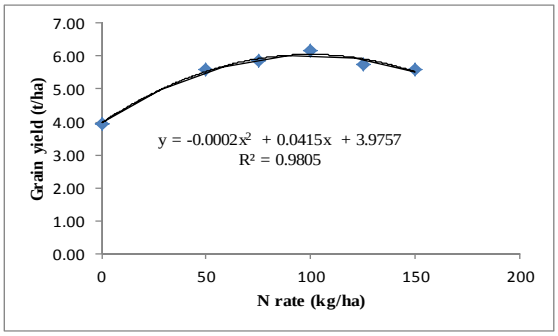

Fig. 2. Influence of N rate on grain yield of BRRI dhan29, Boro 2012-13, BRRI farm, Gazipur

Boro 2013-14

Nitrogen fertilizer application significantly increased tiller m^{-2} and straw yield of BRRI dhan28 (Table 8). But grain yield of BRRI dhan28 was not significantly increased with application of N irrespective of method (soil application or spray with MG). However, the N_0 treatment gave the lowest grain yield, which insignificantly increased with N application. The highest grain yield was obtained with T_6 where 60% N was applied in soil and 10% sprayed with MG. In comparison to T_7 where 70% N was applied as BRRI method (without MG and spray), the yield increment with T_6 (507 kg ha^{-1}) was not significant. On the other hand, if we compare T_1 with T_2 and T_9 with T_{10} MG spray slightly decreased the grain yield of BRRI dhan28 though the differences were not significant. It means MG spray did not bring any yield advantage over without MG spray and soil application of N fertilizer was better than foliar application of liquid fertilizer. Similar finding was also reported by Alam *et al.* (2010) who found that soil application of N fertilizer was the best treatment for obtaining higher grain yield.

Table 8. Influence of magic growth fertilizer on growth and yield of BRRI dhan28, Boro 2013-14, BRRI farm, Gazipur.

Treatment	Tiller m^{-2}	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
$T_1 = N_0$	307cd	5.38	3.84c
$T_2 = N_{0\ (only\ MG)}$	286d	5.28	4.01bc
$T_3 = N_{60\%\ of\ STB\ (70\ kg\ N\ ha^{-1})}$	371ab	5.78	5.35a
$T_4 = N_{50\%\ of\ STB\ +\ 10\%\ with\ MG\ (58\ kg\ +\ 12\ kg\ N\ ha^{-1})}$	337bcd	6.12	4.77abc
$T_5 = N_{50\%\ of\ STB\ +\ 15\%\ with\ MG\ (58\ kg\ +\ 17\ kg\ N\ ha^{-1})}$	327bcd	6.10	4.83abc
$T_6 = N_{60\%\ of\ STB\ +\ 10\%\ with\ MG\ (70\ kg\ +\ 12\ kg\ N\ ha^{-1})}$	346bc	6.23	4.74abc
$T_7 = N_{70\%\ of\ STB\ (82\ kg\ N\ ha^{-1})}$	352bc	5.72	4.88abc
$T_8 = N_{85\%\ of\ STB\ (99\ kg\ N\ ha^{-1})}$	349bc	5.94	4.94abc
$T_9 = N_{100\%\ of\ STB\ (116\ kg\ N\ ha^{-1})}$	412a	5.91	5.82a
$T_{10} = N_{100\%\ of\ STB\ +\ only\ MG}$	364ab	5.79	5.80a
Level of significance	**	NS	**
CV (%)	9.5	10.0	14.3

CONCLUSIONS

Similar grain yield was obtained with and without magic growth liquid fertilizer spray at similar levels of N in T. Aus season. Also, there was no added benefit of magic growth spray on grain yield during T. Aman and Boro seasons. Proposition of producer about 44% saving of N due to magic growth spraying did not match with the present results. However, the study showed a significant effect of N fertilizer application method for rice cultivation. Basal application of N with top dresses produced higher grain yield over N top dress only.

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