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Induced resistance of rice plant to blast (*Pyricularia grisea*) by seed treatment using natri tetraborate ($Na_2B_4O_7$) under field condition.

Pham van Du[1], Nguyen Be Sau [1], Tran Ngoc Bich[1] and Pham van Kim[2]

ABSTRACT

Natri tetraborate is believed to enhance blast resistance as well as growth of rice plant by seed treatment and foliar spraying with very low concentrations. Seed treatment by natri tetraborate enhanced seedling vigor through an increase of root length and coleoptiles. Slightly toxic symptom in leaves was observed at concentration beyond 24 mM, however, fungitoxicity to pathogen was observed on media at concentration beyond 6 mM. Seeds treated with natri-tetraborate reduced disease incidence from 19% to 27 % in greenhouse and about 7% of neck blast incidence under field condition. In dry season, rice plants with treated seeds flowered one week earlier than untreated ones. An increase of yield components such as filled grain number / panicle, 1000-grain weight, number of panicles / m^2 was recognized and a reduce of unfilled grain percentage, discolored grain percentage was also noticed. Grain yield increased 10-12 % as compare to the control. More field experiments need to be conducted in the coming seasons to evaluate the efficacy of chemical elicitors.

Key words: natri tetraborate, chemical elicitor

INTRODUCTION

Blast is caused by *Pyricularia grisea* (Rossman et al. 1990), a very destructive fungus of rice in the Mekong Delta. In 2000-2001 dry season, almost newly released varieties became susceptible to leaf and neck blast. The blast outbreak is unpredictable, however, low temperature (about 22-25^{0}C) and long dew appearance are considered as two important factors to be recognized to induce blast epidemic. A quick matching of pathogen virulence leads to difficulty for rice farmers to use resistant varieties and they had had to apply fungicides to control it. Intensive use of fungicides will influence to water resources and also cause environmental problems. The change of intensive mono rice system into multiple cropping systems is to be planned in Mekong delta to improve farmer income because of very low rice price in world market currently. Other alternative to improve farmers' income is to lower inputs of crop practices including elimination of pesticides used during rice growth stage.

Inducing the resistance of rice plants to blast should be considered as one of component in the integrated nutrient management. It is economically important and eco-friendly strategy for rice crop in the region. Di-potassium hydrogen phosphate (DHP) had been reported to induce blast resistance by Manandar et al. (1998); Pham et al. (2000). Recently, natri-tetraborate ($Na_2B_4O_7$) a new chemical inducer was found to express localized and systemic resistance to blast (*Pyricularia grisea)* by observation cellular changes and its reaction at plant level under greenhouse condition. Study aims at investigating the chemical under field condition how to enhance rice plant growth and express the resistance to blast through seed treatment and exogenous application.

MATERIALS AND METHODS

1. Effect of natri-tetraborate ($Na_2B_4O_7$) on seed germination (%), root length (cm) and coleoptile length (cm): Effect of natri-tetraborate at different concentration levels (1-

[1] Cuu Long Delta Rice Research Institute, O Mon, Can Tho

[2] University of Can Tho, Can Tho

16mM) on seed germination (%), root length (cm) and coleoptile length (cm) was observed in case of OMCS99 variety (a susceptible genotype to blast). The experiment was laid out in CRD (Completely Randomized Design) with three replications and seventeen treatments. Different concentration levels of natri-tetraborate ranged from to 1-16 mM and one control with distilled water were set up. One hundred seeds were soaked in natri-tetraborate with the concentrations from 1-16 mM in 24h. After 48 h, seed germination (%), root length (cm) and coleoptiles (cm) were measured. Statistical analysis was done with GLM procedure in PC-SAS, version 6.11.

2. The sensitivity of rice plant to $Na_2B_4O_7$:

The sensitivity of rice plant to $Na_2B_4O_7$ was assessed by spraying $Na_2B_4O_7$ on leaves at 20, 40 days after transplanting with the concentration from 0.6 mM to 30 mM. Those experiments were conducted in RCBD with 3 replication under net house condition, using OMCS 99 and OMCS 2000 varieties. The sensitivity of rice plants was observed at 7 days after spraying $Na_2B_4O_7$ through (%) damaged leaf percentage by chemical.

3. Seed treatment of natri-tetraborate to blast severity in green house:

Rice seeds were soaked in natri-tetraborate with different concentration levels from 1-16 mM for 24h, then incubated for 24 h. The rice plants were grown in greenhouse, blast disease incidence (%) and leaf recovery (%) were measured at 30 days after sowing.

4. Seed treatment and foliar spray of natri-tetraborate under field condition:

Experiment was conducted in CRD with three replications, using OMCS 2000 (a susceptible genotype to blast) at Cuu Long Delta Rice Research Institute experimental field. Fertilizer was applied at the rate of 100 kg N , 60 kg P_2O_5, 0 kg K_2O / ha.

- T1: Seed soaking in natri - tetraborate (0.2mM)
- T2: Seed soaking in natri - tetraborate (0.35mM)
- T3: Foliar spray with DHP (19mM)
- T4: Foliar spray with natri - tetraborate (0.05mM)
- T5: Foliar spray with natri - tetraborate (0.35mM)
- T6: Foliar spray with natri - tetraborate (0.7mM)
- T7: Control (water spraying)

Chemical spraying was taken at 25 and 38 days after transplanting. And 7 days later, field plots were supported and inoculated with spore suspension of *Pyricularia grisea* (C69) at 50,000 to 60,000 spores/ml. Disease was assessed at ten days after inoculation by measuring the diseased leaf area (%) and neck blast (%). At the harvest time, yield components and grain yield (tons/ha) were also measured.

RESULTS AND DISCUSSION

Natri-tetraborate applied at the concentrations from 1 to 3mM offered the highest percentage of seed germination, root length and coleoptile length (figure 1).

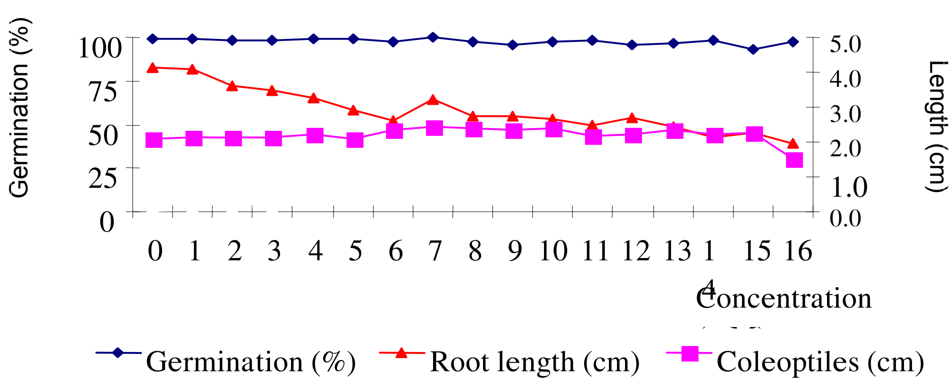

Figure 1: Effect of $Na_2B_4O_7$ concentrations on rice seed germination at 48 h after treating, OMCS 99 variety, 2000 wet season

However, when these seeds were measured after 60 hours, root length and coleoptiles would be still enhanced at the concentrations from 0.1 to 1 mM (Table 1)

Table 1: Effect of $Na_2B_4O_7$ to root length (cm), (%) germination and coleoptiles (cm).

Treatment	Root length (cm)	Coleoptile (cm)	(%) Germination
0.1 mM	13.8 a	4.3 abc	67.3 a
0.5 mM	12.8 abc	4.0 c	72.3 a
1 mM	13.1 ab	4.7 a	69.3 a
2 mM	11.2 bcd	3.8 c	65.7 a
3 mM	11.3 bcd	4.2 abc	76.0 a
4 mM	10.0 d	4.0 bc	76.0 a
5 mM	10.5 cd	4.6 ab	68.0 a
Control	12.6 abc	4.0 bc	69.3 a
CV (%)	10.4	7.8	8.2

Values in the column followed the same letters are not significantly different at P<0.05 by DMRT

Sensitivity of 20-day old rice seedlings by foliar spray of natri-tetraborate at the concentrations from 0.06 mM to 30 mM was observed, rice plant canopy was not affected. However, at 47 days after transplanting, slightly toxic symptom in leaves were observed, about 2% of leaf area were damaged at the concentrations beyond 24 mM (Figure 2)

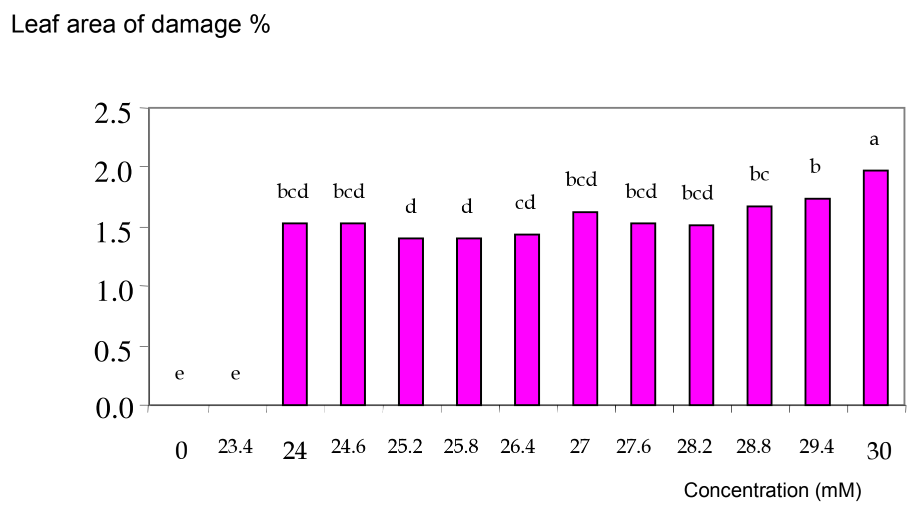

Figure 2: Effect of natri-tetraborate on rice plant canopy, OMCS99 variety, at 47 days after transplanting, 2000 wet season, OMon, Can Tho.

In green house, rice seeds treated by natri-tetraborate at the concentration from 3.0 to 4.0mM reduced disease incidence from 19 to 20 % and 27 % of diseased leaf area as compared to the control significantly (Figure 3). Seed soaking in natri tetraborate enhanced rice plant resistance to blast.

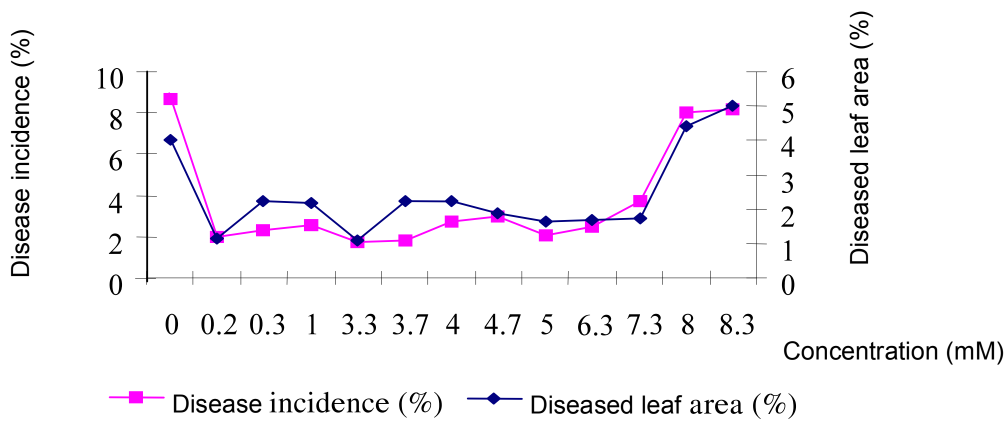

Figure 3: Effect of seeds treated with natri-tetraborate at the concentrations from 0 to 8mM to blast disease incidence (%) and diseased leaf area (%) under green house condition.

Seed treatment of natri-tetraborate to diseased leaf blast area (%) and neck blast (%) under field condition showed that soaking seeds with low concentrations reduced diseased leaf area about 2-3% and neck blast incidence about 7% as compared to the control. Interestingly, rice plants in treated plot flowered one week earlier than control (Figure 4 and 5).

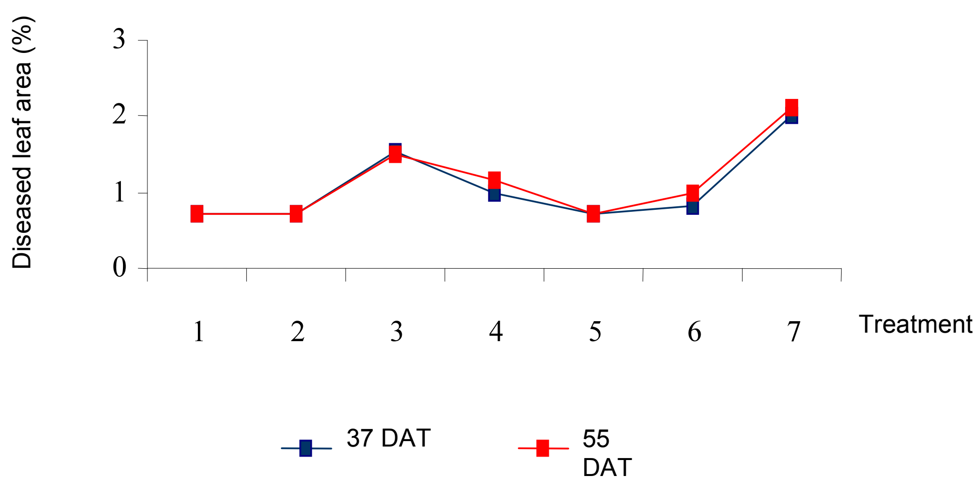

Figure 4: Effect of natri-tetraborate to diseased leaf area (%) observed at 37 and 55 days after inoculation (DAI), OMCS2000 variety, 2000-01 dry season, Omon, Can Tho

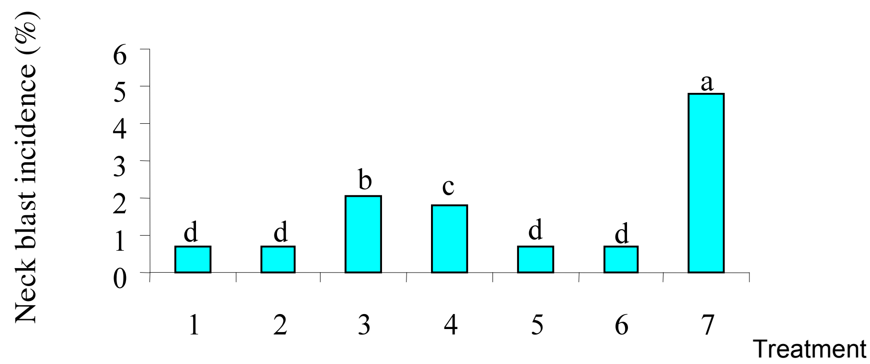

Figure 5: Effect of natri tetraborate to neck blast incidence (%),OMCS2000 variety, 2000-01 Dry season, Omon, Can Tho

At time of assessment, disease pressure in these plots was still low, but at flowering stage neck blast infection was severely extended.

Seed treatment of natri tetraborate to yield and yield components:

Table 2: Effect of natri-tetraborate to yield components of OMCS2000, 2000-2001 Dry season, Omon, Cantho.

Treatment*	No. of filled grains. panicle^{-1}	Unfilled grain (%)	1000-grain weight (g)	Discolored grain (%)	No. of panicles /m^2
T1	90.98 ab	12.06 a	26.90 a	6.88 bc	327.92 bc
T2	86.14 ab	12.8 a	25.98 ab	5.80 c	349.10 ab
T3	81.47 b	15.01 a	25.73 b	7.38 b	303.97 c
T4	94.86 a	14.55 a	26.29 ab	8.12 b	309.08 c
T5	84.83 ab	16.30 a	25.89 ab	5.84 c	364.47 a
T6	88.58 ab	14.94 a	26.04 ab	7.51 b	316.25 c
T7 (control)	84.09 b	17.07 a	25.48 b	14.56 a	301.87 c
CV (%)	5.91	17.26	2.20	10.28	3.33

Values in the columns followed by the same letters are not differ significantly according to DMRT ($P<0.05$)

Soaking seed in natri tetraborate, and spraying natri tetraborate with low concentrations increased number of filled grains/panicle, 1000-grain weight, number of panicles/m^2 and reduced unfilled grain, discolored grain (Table 2) and grain yield increased 10-12 % as compared to the control (Figure 6).

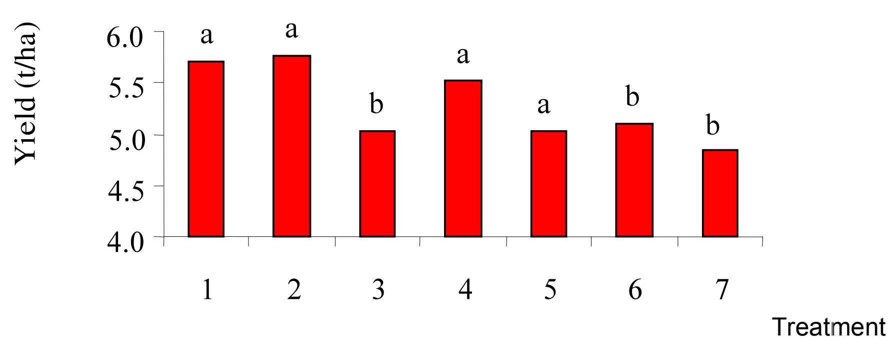

Figure 6: Effect of natri-tetraborate to seeds treated (T1, T2) as compared to spray DHP (T3), natri tetraborate (T4, T5, T6) to grain yield of OMCS2000, 2000-2001 Dry season, Omon, Cantho.

CONCLUSION

Natri tetraborate is believed to enhance blast resistance as well as growth of rice plant by seed treatment and foliar spraying with very low concentration. An increase of seedling vigor such as root length and coleoptile length at minimum concentration was observed. When applying in the rice leaves, the slightly toxic symptom in leaves was determined beyond 24 mM, however, fungitoxicity to pathogen was observed in media at the concentration of beyond 6 mM. Rice plants of treated seeds were flowered one week earlier than untreated ones. An increase of yield components such as number of filled grains/panicle, 1000-grain weight, number of panicles/m^2 and a decrease of unfilled grain prcentage, discolored grain percentage were recognized. Grain yield was found to be increased from10-12 % as compared to the control.

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SUMMARY IN VIETNAMESE

Tính kích kháng cho lúa đối với bệnh cháy lá (*Pyricularia Grisea)* bằng xử lý hạt với chất natri-tetraborate (NA_2 B_4 O_2) điều kiện đồng ruộng

Natri tetraborate có hiệu lực kích kháng chống bệnh cháy lá và kích thích sinh trưởng đối với lúa bằng phương pháp xử lý hạt và phun lên tán lá với liều lượng rất thấp, xử lý hạt, trước hết làm gia tăng cường lực mạ rễ và diệp tiêu. Khi phun lên tán lá ở liều lượng ngoài 24 mM gây ngộ độc nhẹ cho cây, đối với nấm, khuẩn ty sẽ ngừng phát triển ở liều lượng lớn hơn 6 mM. Xử lý hạt giảm tỷ lệ bệnh trên lá từ 19-27% trong điều kiện nhà lưới, đồng thời giảm 7 % tỷ lệ bệnh trên cổ gié ở thí nghiệm đồng ruộng. Ngoài ra nghiệm thức xử lý hạt trổ sớm hơn 7 ngày so với đối chứng trong vụ đông xuân. Về thành phần năng suất, như số hạt chắc/bông, trọng lượng 1000 hạt, số bông/m^2 gia tăng, và đồng thời giảm tỷ lệ hạt lép, hạt lem, năng suất tăng khoảng 10-12% so với đối chứng. Thí nghiệm đồng ruộng sẽ được tiếp tục thực hiện trong vụ tới nhằm xác định hiệu quả của phương pháp xử lý chất kích kháng.
