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EFFECTS OF *RHIZOBIUM*, MOLYBDENUM, BORON AND LIME ON CHICKPEA (var. BARI Chola-5)

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ABSTRACT

An experiment was conducted at a farmer's field at Thakurgaon district during 2014 to observe the effect of *Rhizobium,* molybdenum, boron and lime on chickpea (var. BARI Chola-5) and to develop an application method suitable for resource-poor farmers whether Mo and *Rhizobium* could be added in the seed priming process. The treatments were T_1: control TSP: (20 kg P ha^{-1}), Borax: (1 kg B ha^{-1}) and seed priming with Sodium molybdate: (1.5 g kg^{-1} seed) and *Rhizobium* inoculum: (4 g kg^{-1} seed), T_2: control with seed priming in water, not Mo or *Rhizobium*, T_3: control with no B application and T_4: Control + 1.5 ton dolo lime ha^{-1} $CaCO_3$ + $MgCO_3$. The highest plant height (17.1 cm), number of nodules (3.67 $plant^{-1}$), number of pods (43 $plant^{-1}$) and seed yield (1.28 t ha^{-1}) were observed with the treatment containing all i.e. TSP, boron, lime, sodium molybdate and R*hizobium.* Seed priming with water only (along with TSP + borax) also showed better performances in producing plant height and number of plants per plant. This trial confirmed that this was as effective as soil application of Mo + *Rhizobium* giving significant yield response. Economic evaluation suggested that the treatment consisting lime was suitable for obtaining higher rate of return. The results further showed that liming is necessary for chickpea cultivation in the Ruhea Soil Series of Thakurgaon district.

Key Words: *Rhizobium, molybdenum, boron, lime, chick pea, acidic soil.*

INTRODUCTION

Chickpea (Cicerarietinum L.) is one of the important pulse crops grown in Bangladesh.Many biotic and abiotic constraints influence seriously yield and destabilize chickpea production.The crop which fix nitrogen in the root nodules; and this process depend on various factors, like molybdenum and iron nutrition which play a key role in symbiotic nitrogen fixation by legumes. The soils of different parts of Bangladesh are more or less deficient in boron and molybdenum, which causes poor yield of chickpea (Bhuiyan*et et al.,* 1997).The soils of Northwest part of Bangladesh are light textured, low in organic matter and strong to moderately acidic (p^H 4.5 to 5.5) in nature (BARC, 2005).The status of available P, Ca and Mg of these soils is low.Soil acidity is a major factor that affects plant growth in many countries (Godsey*et et al.,* 2007). These constraints may be ameliorated by supplying lime, molybdenum (Mo) and inoculation of legumes with the appropriate *Rhizobium*(Bambara and Ndakidemi, 2010). Liming on acid soil increases the availability of P, Ca, Mg and Mo and renders iron, and manganese insoluble and harmless, increases fertilizer effectiveness and decreases plant diseases (Sahai, 1990). Brkics*et et al.* (2004) also stated that the application of molybdenum stimulated nodulation and biological nitrogen fixation, thus increasing the legume yield. Islam (2005) observed that seed yield of chick pea (var. BARI Chola-5) increased significantly due to application of 1 to 1.5 kg B ha^{-1}. The number of nodules, nodule dry weight and grain yield of chickpea were increased when chickpea seeds inoculated with the Rhizobium MPKV strain (Mandhare*et et al.,* 2005). However, there is a great possibility to increasechickpeaproduction by cultivating HYV with balanced fertilizationespecially micro-nutrients.Although thereis considerable literature on the beneficial effects of liming, Mo and Rhizobiuminoculation on legume growth in other parts of the world (Staley and Brauer, 2006), site specific factors can resultsyield difference. Considering the adjustment of chickpea cultivation in Northwest Bangladesh, the field trial was carried out in Old Himalayan Piedmontplain soil (AEZ 1) at Nargun union under Thakurgaon Sadar Upazila to see the response of chickpea to molybdenum, *Rhizobium* and boron fertilizers and to evaluate the additional effect on the crop from the use of lime.

MATERIALS AND METHODS

An investigation was made at the Nargoon Union of the Thakurgaonsadarupazila to observe the effect of rhizobium, molybdenum, boron and lime on chickpea. The experiment was conducted in a randomized complete block design (RCBD) with 4 treatments and 6 replications. The four treatments were T_1: control TSP: (20 kg P ha^{-1}), Borax: (1 kg B ha^{-1}) and seed priming with Sodium molybdate: (1.5 g kg^{-1} seed) and *Rhizobium* inoculum: (4 g kg^{-1} seed), T_2: control with seed priming in water, not Mo or *Rhizobium*, T_3: control with no B application and T_4:

Control + 1.5 ton dolo lime ha^{-1} $CaCO_3$ + $MgCO_3$.The unit plot size was 5 m × 5 m with spacing between block-to-block and plot-to-plot 1.5m and 1m respectively. Seeds were primed overnight before sowing with molybdenum and *Rhizobium*inoculum (collected from BINA, Mymensingh) or with water only. Sodium molybdate was dissolved first and added @1.5 g $litre^{-1}$ of priming water. *Rhizobium* inoculum was added @ 4 g $litre^{-1}$ of priming water. Chemical fertilizers Triple superphosphate (TSP) and Borax was added @20 kg P and 1kg B ha^{-1} respectively. Seeds were sown @ 37.5 kg ha^{-1} by hand maintaining a distance of 30 cm from plant to plant and of 40 cm from row-to-row at the depth of 1 cm to 1.5 cm of the soil and were covered with loose soil. Hand weeding was done after 27 and 40 days after sowing. The data were collected during (number of plants m^{-2}, plant height (cm), number of pods $plant^{-1}$, number of nodules $plant^{-1}$ from 10 randomly selected plants per plot after 30-40 days of seed sowing. Seed yield was recorded from $5m^2$ area of each plot and after sun drying the value was converted to hectare basis.Data of the different parameters were analyzed statistically following one factor Randomized Complete Block Design. The means of the statistically significant parameters between the treatments were separated by using Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Plants population

The number of plants exhibited significant variation in response to different treatment (Table 1). The number of plants m^{-2} was found to be the highest (30) from T_2 treatment due to priming of seed with water only and combined use of P and B. The lowest number of plants (28) was found with T_3 treatment (P + Mo +*Rhizobium*). The result was similar to Mut and Gulumser (2001) that Zn and Mo did not affect on plant height. Zn at 0.28 ppm without Mo and bacterial inoculation had the highest seed yield (3588.7 kg ha^{-1}).

Plant height

The application of lime significantly increased the plant height of chickpea (Table 1). The plant height ranged from 14.88 cm in T_1 (control) treatment to 17.10 in T_4 treatment. The highest plant height recorded in T_4 was significantly identical to those obtained in T_2 andT_3 treatments. The lowest plant height was observed in control treatment.

Table1. Effects of *Rhizobium*, *m*olybdenum, boron and lime on the yield and yield contributing characters of chickpea (var. BARI Chola 5)

Treatments	No. of plants (m^{-2})	Plant height (cm)	No. of nodules $plant^{-1}$	No. of fruits $plant^{-1}$	Yield (kg ha^{-1})
T_1	26.00 B	14.88 B	2.133 B	28.50 BC	816.7B
T_2	30.00 A	17.03 A	2.967 AB	17.67 C	683.3 B
T_3	25.83 B	16.00 A B	2.433 B	32.17 AB	900 AB
T_4	28.67 AB	17.10 A	3.667 A	43.00 A	1283 A
LSD (0.05)	3.743	1.761	1.050	13.48	406

T_1 – Control (TSP, B and seed priming with Rhizobium +Mo), T_2 – Control with seed priming in water, not Mo or Rhizobium, T_3 – Control with no B application and T_4 – Control + dololime
Means in a column followed by the same letter(s) are not significantly different by DMRT $p \leq 0.05$

Table 2: Benefit cost ratio in relation to yield of chickpea

Treatments	Variable cost (ha^{-1}) for						Gross Return (Tk.)	Net return (Tk.)	Benefit cost ratio
	Seed (Tk.)	Land prepn. (Tk.)	Fertilizer (Tk.)	Insecticides (Tk.)	Labour (Tk.)	Total (Tk.)			
T_1	2,444	3,333	3,127	1,000	6,000	15,904	40,850	24,946	1.568
T_2	2,444	3,333	2,328	1,000	5,700	14,805	34,150	19,345	1.306
T_3	2,444	3,333	2,999	1,020	6,120	15,916	45,000	29,084	1.827
T_4	2,444	3,333	9,127	800	6,240	21,944	64,150	42,206	1.923

T_1 – Control (TSP, B and seed priming with Rhizobium +Mo), T_2 – Control with seed priming in water, not Mo or Rhizobium, T_3 – Control with no B application and T_4 – Control + dololime

Number of nodules

The number of nodules exhibited significant variation in response to different treatment levels. The number of nodules plant^{-1} was found significantly the highest (3.667) due to application of lime in the soil, which was obtained from T_4 treatment. All the treatments were significantly superior to T_1 (Table1). The lowest numbers of nodules (2.133) plant^{-1} were found from the treatment T_1. Bhuiyan *et al*. (1997) reported that seed inoculation with *Rhizobium* along with phosphorus, potash, boron and molybdenum application gave the highest nodule number. Solaiman (1999) showed that in Nabin, Rhizobium inoculation + 1 kg B ha^{-1} provided the highest total nodules plant^{-1}, effective nodules plant^{-1} and dry weight of tops plant^{-1}.

Number of pods

The highest number of pods was obtained in the treatment T_4 (43 plant^{-1}) due to adding lime in the soil, which was statistically similar to T_3 and superior to other two treatments. The lowest numbers of pods (17.67) were found from the treatment T_2.

Seed yield

The highest seed yield (1283kg/ha) was obtained from T_4 treatment and the lowest (683.3 kg ha^{-1}) was received from T_2 treatment. The treatments T_1, T_2 and T_4 were significantly superior to T_2. Higher yields in T_4 could be attributed to the production of higher nodules plant^{-1}, higher fruits plant^{-1} compared to those of other treatments. Mahler (2005) reported that lime application of 1 ton per acre for chickpea should be considered for fields with pH values of 5.3 or less. Reduced chickpea yields may occur between soil pH 5.4 to 5.5. The yield response from liming may not be expected when soil pH is above 5.3

Benefit cost ratio

From Table 2, it was found that the maximum amounts of insecticides were applied to T_3 (without boron applied) treatment and least amount consumed by T_4 (lime added) treatment during the crop period. Considering the variable costs like fertilizers, insecticides and laborers it was clear that the treatment T_4 gave the substantial amount of economic return than T_3 and other treatments.

CONCLUSION

The results of this experiment clearly pointed out that liming is necessary for chickpea cultivation in the Ruhea soil series of Thakurgaon. An application of lime increased soil pH, available P, Ca and Mg in soils, which in turn had positive impact on the yield components and finally yield of chickpea. The rate of 1.5 t lime ha^{-1} appears to be optimum for chickpea cultivation.

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