Madras Agric. J. 91 (7-12) : 394-398 July-December 2004
https://doi.org/10.29321/MAJ.10.A00121

Residual effect of Sources and Levels of Boron application on Greengram (*Vigna radiata* L) in Sunflower – Greengram cropping sequence

A. RENUKADEVI, P. SAVITHRI AND K. ANDI
Dept. of Soil Science and Agrl. Chemisry, Tamil Nadu Agrl Univ., Coimbatore – 641 003, Tamil Nadu.

Abstract: Field experiments were conducted at Agricultural Research Station, Bhavanisagar, Tamil Nadu in Inceptisols (Typic Ustropepts) to evaluate boron fertilizers, (Borax, Boric acid and Agribor) and to assess the right mode, level of boron application on the B content and yield of the residual crop greengram. The experimental field was deficient in available B (0.35 mg kg^{-1}). Sunflower was raised as a main crop. Different B levels 0.5, 1.0, 1.5 and 2.0 kg B ha^{-1} as soil application and two levels of foliar spray 0.2% and 0.3% were compared with control. The treatments were super imposed with recommended dose of NPK. After harvesting the main crop, green gram was raised as a residual crop on the same field without any alternation. The grain haulm yields of green gram were significantly increased by the residual effect of boron applied to the previous crop. Application of B at the rate of 2.0 kg ha^{-1} recorded highest grain and haulm yields of 958 and 2663 kg ha^{-1}, respectively. The residual effect was not observed at the lower level of B (0.5 kg ha^{-1}) application. The interaction between two source showed that the performances of borax and Agribor were equal at lower levels, while at higher levels Agribor was found superior to borax. Significant correlations existed between B availability and B concentration in grain and haulm and B uptake with yield indicated the residual effect of B on the yield of green gram .

Key Words: Boron nutrition, B concentration and uptake, Residual effect of B, Green gram

Introduction

In the recent years, the yield potential of many crops could not be realized owning to the widespread micronutrient deficiency. Among the micronutrients, boron is an essential element required for the growth and development of plants. Boron is important for root and shoot growth, flower fertility, sugar translocation, chlorophyll synthesis, N utilization, protein synthesis etc. Boron deficient plants generally manifest restricted growth of terminal bud, short internodes and lateral branching. Under severe stress, B deficient plants develop chlorosis, drop their flower buds and fail to develop seed (Golakiya, 1987). B deficiency in plants is mostly widespread and in last 50 year there have been hundreds of reports dealing with essentially of B for a large number of agricultural and horticulture crops in countries from every continent of the world (Gupta, 1979).

A lot of work done so far support the enhanced nutrients uptake, increased yield attributes and yield of sunflower due to B application. But little attention is paid on the residual effect of B on the subsequent crop. An effort is made here to study the residual effect of sources and levels of B on greengram in sunflower – greengram cropping sequence.

Materials and Methods

Experiments were conducted at Agricultural Research Station, Tamil Nadu Agricultural University, Bhavanisagar during 1998-99 in an Inceptisol (Typic Ustropepts) to evaluate the efficacy of Agribor (S_2) which is a boron fertilizer ($Na_2B_{10}O_{16}.10\,H_2O$; pH 6.5 – 7.5 at 3% solution; 100% water soluable; specific gravity 0.4 g cc^{-1}) and to find out the residual effect on the yield of greengram in comparison with borax (soil) and boric acid (foliar) (S_1)

Table 1. Effect of sources, concentrations and methods of B application on the post harvest soils of sunflower and greengram : Available B (mg kg^{-1})

Treatment	Sunflower			Greengram		
	S_1	S_2	Mean	S_1	S_2	Mean
T_1	0.316	0.275	0.296	0.243	0.263	0.260
T_2	0.316	0.341	0.329	0.253	0.267	0.260
T_3	0.358	0.383	0.371	0.260	0.283	0.272
T_4	0.408	0.516	0.463	0.308	0.333	0.321
T_5	0.516	0.566	0.542	0.350	0.375	0.363
T_6	0.300	0.283	0.283	0.243	0.233	0.238
T_7	0.325	0.325	0.317	0.245	0.257	0.251
Mean	0.362	0.380	0.370	0.274	0.287	0.281
CD (P=0.05)	T=0.030	S=0.0106	TxS=0.042	T=0.017	S=0.009	TxS=NS

NS : Non significant

Table 2. Residual effect of sources and levels of B application on greengram : Grain and haulm yields (kg ha^{-1})

Treatment	Grain			Haulm		
	S_1	S_2	Mean	S_1	S_2	Mean
T_1	830	828	829	2293	2287	2290
T_2	810	833	822	2307	2310	2308
T_3	863	868	866	2433	2443	2438
T_4	922	953	938	2547	2597	2572
T_5	933	983	958	2627	2700	2663
T_6	835	838	837	2190	2250	2220
T_7	830	818	824	2133	2263	2198
Mean	860	875	868	2361	2407	2384
CD (P=0.05)	T=10.96	S=5.86	TxS=15.5	T=48.2	S=25.7	TxS=NS

NS : Non significant

Initial Soil Characteristics

The texture of the soil in which the field experiment conducted was sandyloam classified as Typic Ustropepts under Irugur series. The soil was deficient in hot water soluable B (0.35 mg kg^{-1}). The pH of the soil was neutral (7.2) and electrical conductivity non saline (0.34 dSm^{-1}). The experimental soil was low in available N (270 kg ha^{-1}) and medium in available P (20.5 kg ha^{-1}) and available K (220 kg ha^{-1}). The organic carbon content of the soil was medium (0.60%) and cation exchange capacity of the soil was 21.8 cmol (p+) kg^{-1}.

Table 3. Residual effect of sources and levels of B application on greengram : B concentration (mg kg^{-1}) and uptake (g ha^{-1}) in grain and haulm.

Treatment	B content						B uptake					
	Grain			Haulm			Grain			Haulm		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
T_1	20.0	19.8	19.9	21.3	20.5	20.9	16.6	16.4	16.5	48.9	46.9	19.9
T_2	22.2	21.8	22.0	28.0	28.5	28.3	19.3	18.2	18.8	64.5	66.1	65.3
T_3	26.0	25.0	25.5	32.0	33.3	32.7	22.4	21.7	22.1	77.9	81.4	79.7
T_4	32.0	32.8	32.4	33.2	35.5	34.3	29.5	31.5	30.5	84.5	92.2	88.3
T_5	32.5	33.7	33.1	34.3	36.8	35.6	30.4	31.6	31.0	90.0	99.4	94.7
T_6	20.3	19.8	20.1	22.7	21.8	22.3	17.1	16.7	16.9	49.6	49.2	49.4
T_7	20.3	19.7	20.0	21.7	20.7	21.2	16.9	16.1	16.5	45.9	46.8	46.4
Mean	27.0	26.0	26.5	27.6	28.2	27.9	21.7	21.7	21.7	65.9	68.9	67.4
CD (P=0.05)	T=1.29	S=NS	TxS=NS	T=1.06	S=0.57	TxS=1.51	T=1.89	S=NS	TxS=NS	T=2.44	S=1.31	TxS=3.46

NS : Non significant

Treatment details

Treatments comprised of four levels of boron (T_2-T_5) aplied basally to the soil (0.5,1.0,1.5 and 2.0 kg B ha^{-1}) and two levels of foliar spray (0.2 and 0.3 %) T_6 and T_7) besides control (T_1). Soil application of B fertilizers was done as basal by placement along the furrows and the treatments were imposed before sowing. The experiment was laid out in a factorial randomised block design (FRBD) with each treatment replicated thrice.

The detailed treatment structures are as follows

- T_1 NPK alone
- T_2 NPK + B 0.5 kg ha^{-1}
- T_3 NPK + B 1.0 kg ha^{-1}
- T_4 NPK + B 1.5 kg ha^{-1}
- T_5 NPK + B 2.0 kg ha^{-1}
- T_6 NPK + Foliar spray 0.2% Agribor*
- T_7 NPK + Foliar spray 0.3% Agribor*

* Spray solution was prepared on B equivalent to that of 0.2% and 0.3% boric acid.

After the harvest of sunflower, greengram was sown in the residual soil moisture without disturbing the original layout. At harvest, grain and haulm yields of greengram were recorded and the plant samples were analysed for B concentration (Banualoes *et al.* 1992).

Results and Discussion

Available boron status in the post harvest soil of sunflower and the extent of depletion by the end of greengram crop are given in Table 1. The data showed significant increase in hot water soluble B with the increasing levels of B added to the soil as compared to control in post harvest soil samples of green gram. Application of B at the rate of 2.0 kg ha^{-1} recorded a significantly higher available B (0.363 mg kg^{-1}) followed by soil application of B @ 1.5 kg ha^{-1} which recorded a hot water soluble boron content of 0.32 mg kg^{-1}. The treatment which received soil application of B at the rate of 2.0 kg ha^{-1} showed higher available B content indicating the significant residual effect on green gram even after satisfying the requirement of the first crop. Between the two sources, Agribor showed higher value of 0.287 mg kg^{-1} than borax (0.274 kg^{-1}).

Though B was added at equal level, the neutral pH nature of Agribor helped to maintain higher B content in soil solution as compared to borax, which has pH on the alkaline side. The effect of B application on its availability was also highlighted by Asokan and Raj (1974) in groundnut and Prabha (1995) in tomato.

Grain and haulm yields.

The grain and haulm yields of residual crop greengram were significantly influenced by the residual effect of boron applied to the previous crop. Application of B at the rate of 2.0 kg ha^{-1} (T_5) resulted in highest grain and haulm yields of 958 and 2663 kg ha^{-1}, respectively and this was followed by treatments with 1.5 and 1.0 kg B ha^{-1}. The greengram grain yield enhanced by a tune of 4.2 per cent to 13.5 per cent at 1.0 (T_3) and 2.0 kg B ha^{-1} (T_5) levels of its application to the main crop. The residual effect was not observed at the lower level of B application (0.5 kg ha^{-1}) (Table 2). The post harvest soil of sunflower crop which decides the B availability to the residual crop, was in the sufficiency status only at 2.0 kg level of B ha^{-1}, while in the remaining treatments, the contents were below the critical level. Inspite of this the grain yield greengram obtained for 1.5 kg B ha^{-1} was significantly higher than control. The response to B on yields of grain and haulm of greengram was also reflected by the significant r values obtained for yields of yields grain and stover with B content (r = 0.841*, r = 0.926*) and B uptake (r = 0.898*, r = 0.964**). Residual effect of B on yield was reported by Dongle and Zende (1977) in wheat. The effect of B in enhancing the yield promoting attributes for increasing the crop yield was also reported by Sutaria and Golakiya (1990).

B concentration in haulm and grain

A concomitant increase in the residual boron content was observed with an increase in the application of boron. Boron content of haulm ranged from 20.9 mg kg^{-1} in the NPK control (T_1) to 35.6 mg kg^{-1} in the plots which received soil application of boron at the rate of 2.0 kg ha^{-1} (T_5). The highest B content was recorded for the B application at the rate of 2.0 kg ha^{-1} (33.8 mg kg^{-1}) (Table 3). The enhanced availability of B in the B treatments resulted in increased concentration of B in haulm and grain of green gram. There also existed a positive and significant correlation between B availability and B concentration in grain and haulm with values of r=0.833** and r=0.945**, respectively.

B uptake in haulm and grain.

Boron in haulm (94.7 g ha^{-1}) was observed in the treatment which received 2.0 kg ha^{-1} (T_5). The uptake of B in other treatments followed the same orders as those noted in the content : T_5>T_4>T_3>T_2>. In grain, the uptake of boron was highest for T_5 (31.0 g ha^{-1}). The trend followed similar to concentration in the order of T_5=T_4>T_3>T_2. The effect was significant on soil application of boron at higher rates *viz.* 1.5 and 2.0 kg ha^{-1}. Between the two sources tried, Agribor registered higher value for total B uptake (90.6 g ha^{-1}) when compared with borax (87.6 g ha^{-1}). The interaction between the treatment and sources showed that performance of borax and Agribor were similar in their uptake at lower level of application (Table 3). While at higher levels, Agribor proved superior to borax by showing an uptake of 68.9 g ha^{-1} against 65.9 g ha^{-1} with borax. Boron fertilization in the form of Agribor apart from influencing its nutrition in green gram, increased the uptake of other nutrients and thus, was helpful to increase the yield of the crop.

References

Asokan, S. and Raj. D. (1974). Effect of forms and levels of boron application on groundnut. *Madras Agric. J.* **61**: 467-469.

Banuelos, G.S., Cardon, G., Pflaum, T. and Akohove, A.K. (1992). Comparison of dry ashing and wet acid digestion on the determination of boron in plant tissue. *Common Soil Sci. Plant Annual*. **23**: 2387-2389.

Dongale, J.H. and Zende, G.K. (1997). Residual effect of micronutrient application to groundnut crop on the grain yield of succeeding wheat crop. *Indian J. Agron.* **22**: 110-112.

Golakiya, B.A. (1987). Boron – A Micronutrient of major importance. *Farmers and Parliment*, **22**: 6-8.

Gupta, U.C. (1979). Boron nutrition of corps. *Adv. Agron.* **31**: 282-287.

Prabha, K. (1995). Studies on the boron nutrition of tomato *(Lycopersicon esculentum)* M.Sc. (Ag.) Thesis, TNAU. Coimbatore.

Sutaria, G.S. and Golakiya, B.A. (1990). Mechanism of yield control in groundnut by boron. *Adv. Pl. Sci.* **3**: 53-60.

(Received: November 2003; Revised: December 2004)