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Response of Pod Quality Of Snap Bean (*Phaseolus vulgaris* l.) To *Rhizobium* Inoculation, And Foliar Spray With Iron And Boron

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ABSTRACT

This study was conducted during the season of 2021/2022 and 2022/2023 seasons.at the experimental Farm of Horticultural Research Station, Kassasin Region, Ismailia Governorate, Agricultural Research Centre, Egypt to investigate the effect of rhizobium inoculation and Fe and B as foliar application on pod quality of snap bean cv. Poulista under sandy soil conditions,

The layout of the experiment was laid out in randomized complete block design (RCBD) with three replicates. The experiment included 10 treatments as follows: T_1 (control), T_2 foliar application with Boron (B) at 25 ppm , T_3 foliar application with Boron (B) at 50 ppm,T_4 foliar application with iron (Fe) at 50 ppm, T_5 foliar application with iron (Fe) at 100 ppm, T_6 Seed inoculation with *Rhizobium* , T_7 *Rhizobium* seed inoculation + foliar application with B at 25 ppm, T_8 *Rhizobium* seed inoculation + foliar application with B at 50 ppm, T_9 *Rhizobium* seed inoculation + foliar application with Fe at 50 ppm, and T_{10} *Rhizobium* seed inoculation + foliar application with Fe at 100 ppm.

Results indicated that Rhizobium inoculation +foliar spray with B at the rate of 50 ppm, being the most effective on pod quality, i.e. N, B, Fe, total carbohydrates, total protein contents and lowest percentage of fibers.

***Conclusively*:** it can be concluded that *Rhizobium* inoculation and foliar spray with B at the rate of 50 ppm, increased pod quality of snap bean.

Key words: *Rhizobium* inoculation – foliar spray (B + Fe)- pod quality - snap bean.

INTRODUCTION:

Snap bean (*Phaseolus vulgaris* L.) belongs to the Fabaceae Family, which is one of the largest plant families. It is considered as one of the most important

vegetable crops grown in Egypt for both local consumption and exportation. It plays important role in human nutrition as a cheap source for protein, carbohydrates, vitamins and minerals. The protein of beans contains essential amino acids and high concentrations of folic acid (Marwa *et al.,* 2002).

Bean plant is characterized by its need for large quantities of major nutrients to obtained high production, which prompts farmers to add a large quantities of chemical fertilizers that have a negative effect on the environment, increase the pollution, and their exaggeration leads to a decrease in the productivity of the crop (Veltcheva *et al.,* 2005).

Hence, the feeding with micro-organisms, like *Rhizobium* inoculation and using a lowest quantities of micro-nutrients like, Fe and B are not only a means to improve productivity, but also an important tools to reduce the amount of chemical fertilizers added and decrease the environment pollution. Rhizobium spp are nitrogen-fixing bacteria in the soil, providing nitrogen to the existing crop, increase fertility, texture and structure of the soil (Jensen and Hauggaard, 2003). Ndakidemi *et al.* (2006) illustrated that Rhizobium spp inoculation in mung bean significantly increased photosynthetic rate, plant height, leaf area and dry matter.

Iron (Fe) plays a vital role in physiological processes and limiting the yield of plant, that plays a crucial role, being a cofactor of enzymes of the reductive assimilatory pathway. Almakhlof *et al.* (2022) concluded that foliar application of Fe, significantly increased composition and yield components of bean.

Boron (B) is on essential micro-nutrient have an important role in the normal growth of plant and in absorption of nitrogen from soil, translocation of sugars, cell wall synthesis, root elongation and nucleic acid synthesis (Singh *et al.*, 2006). Uddin *et al.* (2020) confirmed that boron significantly increased growth and yield performance of bean.

Therefore, the objectives of this study were to lest the use of rhizobium inoculation, and foliar spray with micronutrients of Fe and B on pod yield of snap bean.

MATERIALS AND METHODS

Experimental sites and soil analysis:

The study was conducted during 2021/2022 and 2022/2023 seasons at the experimental Farm of Horticultural Research Station, Kassasin Region, Ismailia Governorate, Agricultural Research Centre, Egypt to investigate the effect of rhizobium inoculation and Fe and B as foliar application on pod quality of snap bean *cv*. Poulista under sandy soil conditions.

Table (1): the physical and chemical properties of the experimental soil

Physical properties			Chemical properties		
Items	**2023**	**2024**	Items	**2023**	**2024**
Sand (%)	90.5	95.6	Organic matter (%)	0.03	0.08
Silt (%)	4.7	1.6	Available K (ppm)	55	66
Clay	4.8	4.7	Available p (ppm)	5.7	6.8
Field capacity	6.8	7.2	Available N (%)	5.9	6.3
Wilting point	2.5	2.6	Calcium carbonate (%)	0.28	0.26
Available water	4.5	4.5	pH	8.1	8.1
Water holding capacity	13.9	14.6			

The physical and chemical properties of the soil are presented in Table (1). The system of irrigation was drip irrigation.

Treatments and Experimental Design:

The layout of the experiment was laid out in randomized complete block design (RCBD) with three replicates. The seeds were inoculated by okadin which contains on *Rhizobium leguminosarum* var. phaseolli bring from seeds management of Agricultural Research Center, Giza, Egypt.

The plot area was 12 m^2 (4 rows, 5 m length and 0.6 m width). Seeds were sown with 2 seeds per hole and 20 cm between one to another at 20 and 17 September 2022 and 2023, respectively.

The experiment included 10 treatments as follows:

1- T_1 (control).
2- T_2 foliar application with Boron (B) at 25 ppm.
3- T_3 foliar application with Boron (B) at 50 ppm.
4- T_4 foliar application with iron (Fe) at 50 ppm.
5- T_5 foliar application with iron (Fe) at 100 ppm.
6- T_6 Seed inoculation with *Rhizobium*
7- T_7 *Rhizobium* seed inoculation + foliar application with B at 25 ppm.
8- T_8 *Rhizobium* seed inoculation + foliar application with B at 50 ppm.
9- T_9 *Rhizobium* seed inoculation + foliar application with Fe at 50 ppm.
10- T_{10} *Rhizobium* seed inoculation + foliar application with Fe at 100 ppm.

The sources of Fe and B were $FeSO_4$. 7 H_2O and boric acid which contains 17% boron, sprayed by 3 times during the growing seasons, where the first spray was at 25 days after planting and the second spray was 15 days after the first spray, (40 days) and the third spray after 15 days (55 days) at the early morning.

Data recorded:

Pod quality (the nutritive value of pods):

Pods samples were taken from each plot, after that the pods were dried at 70°c. The pods were grinned to fine powder and 0.2 g wet digested with a mixture of sulfuric acid (H_2SO_4) and perchloric acid ($HCICO_4$) for the different analysis of N, Fe and B.

The N, (%) and Fe and B (mg / Kg) concentrations were determined in oven dry pods. Nutrients were measured in the digestive extract and their percentage were calculated on oven dry matter. Minerals estimation were performed as follows:

Nitrogen was determined by the micro-kjeldahl method as aforementioned by A.O.A.C. (2012).

Micronutrients (Fe and B) were measured by these elements in digest resting in digest resting from HNO_3 acid in the digested plant samples using an Atonic Absorption Spectrophotometer according to the methods described by Chapman and Pratt (1961) and also by A. O. A. C. (1990).

Total carbohydrates:

It was determined according to Ranganna (2001).

Protein content:

It was calculated by multiply N percentage by 6.25 according to A. O. A. C. (1990).

Fibers percentage:

It was determined according to the methods described by A. O. A. C. (1990).

Statistical analysis:

All data were statistically analysis according to SAS software program (SAS, 2004).The least significant difference (LSD) at (0.05) level of probability was used compare the means of treatments values (Snedecor and Cochran, 1980).

RESULTS AND DISCUSION

Pod quality:

Data in Tables (2 and 3) revealed that *Rhizobium* inoculation + foliar spray with B at the rate of 50 ppm, being the most effective on pod quality, i.e. N, B, Fe, total carbohydrates, total protein contents and lowest percentage of fibers.

Table (2) : Effect of Rhizobium , Boron(B) and Iron (Fe) on N, B and Fe contents of snap bean pods during 2022L2023 seasons

Treatment groups	2022-2023 season		
	N (%)	B (mg/g dw)	Fe (mg/g dw)
Control	1.843	27.533	54.993
B at 25 ppm	1.980	30.203	58.646
B at 50 ppm	2.083	31.500	59.0833
Fe at 50 ppm	2.146	33.210	59.116
Fe at 100 ppm	1.940	29.326	57.143
Rhizobium inoculation	1.940	28.103	56.716
Rhizobium +B (25 ppm)	2.246	35.123	61.376
Rhizobium +B (50ppm)	2.450	37.090	66.153
Rhizobium +Fe (50ppm)	2.410	36.840	62.763
Rhizobium +Fe (100 ppm)	2.176	33.793	60.376
LSD (0.05)	0.0525	1.589	0.0991

Table (3) : Effect of Rhizobium , Boron(B) and Iron (Fe) on total carbohydrates, protein and fibers of snap bean pod during 2022/2023 season

Treatment groups	2022/2023 season		
	Total carbohydrates (%)	Protein (%)	Fibers (%)
Control	33.716	11.520	8.15
B at 25 ppm	34.960	12.375	7.073
B at 50 ppm	35.370	13.020	6.78
Fe at 50 ppm	35.730	13.416	6.41
Fe at 100 ppm	34.206	12.125	7.346
Rhizobium inoculation	34.073	12.125	7.55
Rhizobium +B (25 ppm)	37.123	14.0417	5.946
Rhizobium +B (50ppm)	40.736	15.312	3.82
Rhizobium +Fe (50ppm)	38.350	15.0625	4.636
Rhizobium +Fe (100 ppm)	36.356	13.604	6.136
LSD (0.05)	0.0735	0.3284	0.0561

These results followed by *Rhizobium* inoculation + foliar spray with Fe at the rate of 50 ppm, *Rhizobium* inoculation + foliar spray with B at the rate of 25 ppm, respectively.

Regarding the important role of *Rhizobium* inoculation, B and Fe on pod quality of snap bean, Jenson and Hauggaard-Nielsen (2003) demonstrated that *Rhizobium* are nitrogen fixing bacteria in the soil, providing nitrogen to the

existing crop and then improved the yield quality. Moreover, Almakhlof *et al.* (2022) concluded that Iron (Fe) plays a vital role in physiological processes and limiting the yield and its quality of plant. In addition, Singh *et al.* (2006) illustrated that Boron (B) is an essential micro-nutrient have an important role in the normal growth of plant and in absorption of nitrogen from the soil, translocation of carbohydrates, cell wall synthesis, and nucleic acid synthesis and then increased pod quality.

These results are agreement with those reported by Ndakidemi *et al.* (2006), Almakhlof *et al.* (2022) and Uddin *et al*. (2020) .

***Conclusively*:** it can be concluded that that Rhizobium inoculation with foliar spray of B at the rate of 50 ppm, increased pod quality of snap bean.

REFERENCES

A. O. A. C. (1990): *Official Methods of Analysis Association*. *Official Analytical Chemists*. 15th Ed. Inc. Wash. D.C.

A.O.A.C.(2012). *Official Methods of Analysis*, 19th Edition Pub AOAC International Maryland.

Al Dulami.N.h., and M.A. Aljmeil (2017). Response green bean to spray micronutrients and addition organic Fertilizer. The Iraqi Journal of Agricultural Scinces,2 :447-455.

Almkhlof Y.H.,I.H .klwet.A.M.ElGhamry,K.f.Fouad and Mo. Asalim (2022). Effect of compost mineral fertilizer and foliar application of micronutrients Bean(*Phseouls vulgaris* L.) under alluvial soil condition. Sirte University Scientific Journal of Applied Sciences.

Chapman, H. D. and P. F. Pratt (1961). "*Methods of Analysis for Soils*, Plants and Waters". DIV. of Agric. Sci., California Univ., Berkely, USA

Jensen ES, and H Hauggaard-Nielsen.(2003). How can increased use of biological N2 fixation in agriculture benefit the environment? *Plant and Soil*, 252; 177-186

Marwa, S., A. H, Sh. M. Selim, .A.Ragab and E.A.Saleh.(2002). Inoculation as a prime Factor affecting successful nodulation of Common bean (*Phaseolus vulgaris* L.). *J. Agric. Sci, Ain Shams Univ*.,10 (2) : 521-541.

Ndakidemi PA, FD Dakora, EM Nkonya, Ringo D and H Mansoor.(2006). Yield and economic benefits of common bean (*Phaseolus vulgaris*) and soybean (*Glycine max*) inoculation in northern Tanzania. *Animal Production Science* 46; 571-577

Ranganna, S. (2001). Handbook of analysis and quality control for fruit and vegetable products. Tata McGraw-Hill publishing Co. Ltd, New Delhi

SAS Institute Inc. (2004), *Getting Started With The Adx Interface For Experiments*, Cary, NC: SAS Institute Inc.

Singh, R.N., Singh, S., and B Kumar,. (2006). Interaction effect of sulphur and boron on yield and nutrient uptake and quality characters of soybean (*Glycine max* L. Merill) grown in acidic upland soil. *Journal of the Indian Society of Soil Science*. 54(4): 516-518.

Snedecor, G.W. and W.G. Cochran (1989): *Statistical Methods*. Eight Edition, Iowa State University Press.

Uddin,F.M.J,H.H.Mira,U.K.Sarker and Md.R.I.,Akando(2020). Effect of variety and Bron fertilizer on growth and yield performance of French bean(*Phseouls vulgaris* L.) Archives of agriculture and Environmental sciences, 5(3):241-246

Veltcheva, M., D.Svetleva, Sp. Petkova and A.Perl. (2005). In vitro regeneration and genetic transformation of common bean (*Phaseolus vulgaris L.)* Problems and progress. *Horticulture,* 107(1): 2–10.

استجابة جودة قرون الفاصوليا الخضراء (*Phaseolus vulgaris* L.) للتلقيح بالريزوبيوم والرش الورقي بالحديد والبورون

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أجريت الدراسة خلال موسمي ٢٠٢١/٢٠٢٢ و٢٠٢٢/ ٢٠٢٣ في المزرعة التجريبية لمحطة بحوث البساتين، منطقة القصاصين، محافظة الإسماعيلية، مركز البحوث الزراعية، مصر لدراسة تأثير التلقيح بالريزوبيوم والرش الورقي بالحديد والبورون على جودة قرون الفاصوليا الخضراء صنف بوليستا تحت ظروف التربة الرملية, صممت التجربة بنظام القطاعات الكاملة العشوائية (RCBD) بثلاث مكررات، واشملت التجربة ١٠ معاملات على النحو التالي:

T1 معاملة الكنترول ، T2 رش ورقى بالبورون (ب) بتركيز ٢٥ جزء في المليون، T3 رش ورقى بالبورون (ب) بتركيز ٥٠ جزء في المليون، T4رش ورقى بالحديد (Fe) بتركيز ٥٠ جزء في المليون، T5 رش ورقى بالحديد (Fe) بتركيز ١٠٠

جزء في المليون، T6 تلقيح البذور بالريزوبيوم، T7 تلقيح البذور بالريزوبيوم + رش ورقى بالبورون بتركيز ٢٥ جزء في المليون ، T8 تلقيح البذور بالريزوبيوم رش ورقى بالبورون بتركيز ٥٠ جزء في المليون ، T9 تلقيح البذور بالريزوبيوم + رش ورقى بالحديد بتركيز ٥٠ جزء في المليون ،T10 تلقيح البذور بالريزوبيوم + رش ورقى بالحديد بتركيز ١٠٠ جزء في المليون.

أشارت النتائج إلى أن تلقيح البذور بالريزوبيوم +الرش الورقي بالبورون بمعدل ٥٠ جزء في المليون كان الأكثر فعالية على جودة القرون المتمثلة في محتوي القرون من النيتروجين والبورون والحديد والكربوهيدرات الكلية ومحتوى البروتين الكلي وأقل نسبة من الألياف.

التوصية: يمكن التوصية بتلقيح البذور بالريزوبيوم مع البورون كرش ورقى بمعدل ٥٠ جزء في المليون أدى إلى زيادة جودة القرون في الفاصوليا الخضراء.

الكلمات المفتاحية: التلقيح بالريزوبيوم - البورون – الحديد - جودة القرون - الفاصوليا الخضراء