Pakistan Journal of Life and Social Sciences

www.pjlss.edu.pk

RESEARCH ARTICLE

Effect of Seed Priming of Potash and Boron on Yield and Quality of Mungbean

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ARTICLE INFO

Received: Apr 10, 2021

Accepted: Nov 19, 2021

Keywords

Mungbean

Potash

Boron

Quality

Yield

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ABSTRACT

Mungbean helps to increase income of farmer and fertility of soil. An experiment was arranged to examine the influence of potash and boron on mungbean. Before sowing, seeds were primed with potash and boron. The NM-2011 variety of mungbean was used as test crop. Ten treatments were applied to check the effect of K and B on mungbean. The Randomized Complete Block Design with three replications was applied to conduct the research. Results revealed that seed priming of potash and boron significantly affected the yield and quality traits of mungbean. The maximum increase observed in these parameters when 0.5 g K kg^{-1} of seeds + 0.5 g B kg^{-1} of seeds were applied. By the application of treatments the level of potash and boron contents were increased.

INTRODUCTION

Pulses are source of protein (Crepon et al., 2010). Mungbean is known as an important pulse crop of summer. It is most important source of food material after cereal crops because of its nutritional value. An ancient Asian-crop, mung bean, is important for its dietary value. Low yield of pulse crops is due to deficiency of nutrients and production of mung bean can be enhanced by using better yielding varieties and proper fertilization (Yin et al., 2018). Excess of Fe and Al causes formation of complex compounds with B which ultimately results in deficiency of B (Singh, 2006). Application of B fertilizers may help to overcome further negative results of deficiency of boron on agricultural production (Jana and Nayak, 2006). Among micronutrients, deficiency of B is common in calcareous and light textured soils (Islam et al., 1997). It shows vital role in the process of formation of pods and seeds (Islam et al., 2017) Application of boron recorded maximum seed yield in pulses (Kathyayani et al., 2021). Potassium is at third level macronutrient after N and P, important for growth of plants (Abbas et al., 2011). It is important for the production of crop (Baligar et al., 2001). Its sufficient supply helps to improve photosynthesis process (Garg et al., 2005). It also helps to maintain turgor pressure which is important for stomatal movements. Its adequate supply results in activation of 60 enzymes (Bukhsh et al., 2011). Boron supply increases the synthesis of amino acids and makes immunity against pathogens attack (Arif et al., 2008). Application of boron increases the yield of mungbean (Ali et al., 2010).

MATERIALS AND METHODS

A field trial was carried out at the Agronomic Research Area, University of Agriculture Faisalabad, Pakistan (31º N latitude,73º E longitude and 135 m altitude) during 2017. At the area the soil was relatively uniform in fertility. The soil was analyzed in the laboratory. Report of soil-physico-chemical analysis showed that it contained; 44 % sand, 40 % silt, 16 % clay, 0.57 % organic matter, 0.042 % nitrogen, 6.68 ppm phosphorous, 182.9 ppm potassium and 7.7 soil pH.

The trial was set in RCBD with three replications having plot size 5 m × 1.8 m. The NM-2011 cultivar was used in this study. Sowing of seed was done on 22th of March. At 75 cm spaced rows, seeds were sown at the rate of 30 kg $ha^{-1}$by using single-row hand drill. By using urea and DAP as sources the required dosage of fertilizer was applied at the rate of 23: 58 $kgha^{-1}$ N: P. Thinning was done to achieve a distance of 10 cm between two plants. Potassium sulphate (50 % K) and Boric acid (17 %) were used as sources of potash (K) and boron (B), respectively. Before seed sowing, potash and boron were applied as per treatment. To keep crop free of diseases, recommended plant protection measures were adopted. Harvesting was done on 22-June when about 90% pods had ripened.

As a sample, from every plot, ten plants were selected. From every sample yield parameters and quality parameters were determined through standard procedures. The recorded data during experiment was statistically analyzed by using Fisher's analysis techniques and treatments means were compared by LSD at 5% probability level (Steel et al., 1997).

RESULTS

Pods plant^{-1}

Statistically, the treatment T_7 (T_7=0.5 g K kg^{-1} of seed + 0.5 g B kg^{-1} of seed) produced highest pods number (21). The minimum number of pods (13) was produced by treatment T_1 (T_1=No priming) (Table 1).

Seeds pod^{-1}

Statistically, the treatment T_7 (T_7=0.5 g K kg^{-1} of seed + 0.5 g B kg^{-1} of seed) produced maximum seeds pod^{-1} (8). The treatment T_1 (T_1=No priming) produced minimum number of seeds pod^{-1} (5.66) (Table 1).

1000-seed weight (g)

Significantly, the maximum 1000-Seed weight (51.66 g) was obtained by treatment T_7 (T_7=0.5 g K kg^{-1} of seed + 0.5 g B kg^{-1} of seed) statistically, the treatment T_1 (T_1=No priming) produced lowest 1000-Seed weight (45 g) (Table 1).

Seed yield (kg ha^{-1})

Significantly, the treatment T_7 (T_7=0.5 g K kg^{-1} of seed + 0.5 g B kg^{-1} of seed) produced highest seed yield (1373 kg ha^{-1}). Statistically, the treatment T_1 (T_1=No priming) produced minimum seed yield (492 kg ha^{-1}). Increase in yield was might be due the regulatory effect of boron (Table 1).

Biological yield (kg ha^{-1})

Statistically, highest biological yield (4887 kg ha^{-1}) was produced by the treatment T_7 (T_7=0.5 g K kg^{-1} of seed + 0.5 g B kg^{-1} of seed) the treatment T_1 (T_1=No priming) produced lowest biological yield (3428 kg ha^{-1}) (Table 1).

Harvest index (%)

Statistically, the treatment T_7 (T_7=0.5 g K kg^{-1} of seed + 0.5 g B kg^{-1} of seed) produced highest harvest index (28.09 %). The lowest harvest index (14.34 %) was produced by treatment T_1 (T_1=No priming) (Table 1).

Chlorophyll "a"

The treatment T_7 (T_7=0.5 g K kg^{-1} of seed + 0.5 g B kg^{-1} of seed) significantly produced maximum chlorophyll "a" (2.21 mg/g fresh wt). The minimum chlorophyll "a" (0.60 mg/g fresh wt) was produced by the treatment T_1 (T_1=No priming) (Table 2).

Chlorophyll "b"

The treatment T_8 (T_8=0.5 g K kg^{-1} of seed + 1 g B kg^{-1} of seed) significantly produced maximum chlorophyll "b" (0.50 mg/g fresh wt). Statistically, the treatment T_1 (T_1=No priming) produced minimum chlorophyll "b" (0.10mg/g fresh wt) (Table 2).

Total Chlorophyll

Statistically, the treatment T_7 (T_7=0.5 g K kg^{-1} of seed + 0.5 g B kg^{-1} of seed) produced maximum total chlorophyll (2.40 mg/g fresh wt). The treatment T_1 (T_1=No priming) produced minimum total chlorophyll (0.80 mg/g fresh wt) (Table 2).

Malondialdehyde (MDA)

Significantly, the treatment T_7 (T_7=0.5 g K kg^{-1} of seed + 0.5 g B kg^{-1} of seed) produced maximum reduction in MDA activity (145 μmol/g) which resulted in highest crop growth. The treatment T_1 (T_1=No priming) produced minimum reduction in MDA activity (310μmol/g) and crop growth was negatively affected (Table 2).

H_2O_2 content

Statistically, the treatment T_6 (T_6=1 g B kg^{-1} of seed) produced maximum reduction in H_2O_2 contents (0.11 Units/mg protein). The treatment T_1 (T_1=No priming) produced minimum reduction in H_2O_2 contents (1.19 Units/mg protein) because there was no treatment on crop and crop was under environmental stress (Table 2).

Carotenoids

Significantly, the treatment T_7 (T_7=0.5 g K kg^{-1} of seed + 0.5 g B kg^{-1} of seed) produced maximum carotenoids (2.70 mg/g fresh wt). The treatment T_1 (T_1=No priming) produced minimum Carotenoids (0.70 mg/g fresh wt) (Table 2).

Peroxidases

Statistically, maximum peroxidases (2.50 mg/g fresh wt) was observed in treatment T_7 (T_7=0.5 g K kg^{-1} of seed + 0.5 g B kg^{-1} of seed). The treatment T_1 (T_1=No priming) produced minimum peroxidases (1.00 mg/g fresh wt) (Table 2).

Proteins

The treatment T_7 (T_7=0.5 g K kg^{-1} of seed + 0.5 g B kg^{-1} of seed) significantly produced maximum protein percentage (21.50 %). Statistically, the minimum protein percentage (18.00 %) was produced by the treatment T_1 (T_1=No priming) (Table 2).

DISCUSSION

Lower number of podsplant^{-1} was recorded when no potash was applied. It was might be due to stunted growth because of unavailability of potash. These results are similar with Samiullah (2003). Boron helped to increase seeds number which was might be due to maximum increase in chlorophyll formation that resulted an increase in photosynthesis process. These results were matched with findings of Kushwaha (1999). Maximum weight of 1000-seedswas might be due to B which resulted an increase in yield contributing parameter, 1000-seed weight, because B was involved in many physiological processes in plants. These conclusions are in accordance with findings of Verma and Mishra (1999). Boron application showed an increase in seed yield which was might be due to improvement in chlorophyll formation. These results are in line with findings of Dwivedi et al. (1990). Seed treatment with boron increased biological yield which was might be due to high germination level and balance in growth patterns. These results are in line with (Sharma, 2006). Boron application increased the harvest index which was might be due to increase in activity of nitrogenase enzyme because nitrogenase required micronutrients during the nitrogen fixation process. These results are similar with Gupta (1993).

Chlorophyll "a" contents were increased in T_7. It was might be due to boron application because it played role in chlorophyll synthesis. Similar results were presented by Parvaneh et al. (2013). When potash and boron were applied, an increase in chlorophyll "b" synthesis was observed. It was might be due to part of boron in the formation of chlorophyll. Similar findings were informed by Nandini et al., 2012. Improvement in chlorophyll contents was might be due to application of B because it helped in nitrogen fixation process and in chlorophyll formation. These findings are similar with El-Yazeid et al. (2007). MDA toxicity reduced with the application of potash and boron which was might be due to potassium role in improvement of quality of mungbean. These findings were in accordance with findings of Ali et al. (2006). Reduction in H_2O_2 toxicity was might be due to potash application because it helped to lower environmental stress and beneficially affected mungbean. These interpretations are in accordance with results reported by Fatma et al. (2001). Increase in carotenoids synthesis was might be due to seed priming with boron because it had played role in improving the quality parameters (Sarkar and Malik, 2001). Increase in activity of peroxidases was might be due to application of potash because it helped to activate different enzymes (Das, 1999). Protein percentage increased with the application of molybdenum that was might be due to increased level of nitrogen absorption. These findings are similar with Mali et al. (2000). In conclusion, seed-priming with 0.5 g K kg^{-1} of seed + 0.5 g B kg^{-1} of seed significantly

Table 1: Effect of seed priming of potash and boron on agronomic parameters (*Vigna radiata* L.).

Treatments	No. of pods plant^{-1}	No. of seeds pod^{-1}	1000-seed weight(g)	Seed yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest index(%)
T_1=No priming	13 e	5.66 b	45.00 f	492 j	3428 j	14.34 j
T_2=Hydro-priming	14 de	6.00 ab	46.00 ef	602 i	3691 i	16.31 i
T_3=0.5 g K kg^{-1} of seed	14 de	6.33 ab	47.33 def	653 h	3893 h	16.77 h
T_4=1 g K kg^{-1} of seed	15 cde	6.33 ab	47.66 cde	736 g	4081 g	18.03 f
T_5=0.5 g B kg^{-1} of seed	15 cde	6.66 ab	48.33 cde	756 f	4271 f	17.69 g
T_6=1 g B kg^{-1} of seed	16 cd	6.66 ab	48.66 bcd	856 e	4446 e	19.24 e
T_7=0.5 g K kg^{-1} of seed + 0.5 g B kg^{-1} of seed	21 a	8.00 a	51.66 a	1373 a	4887 a	28.09 a
T_8=0.5 g K kg^{-1} of seed + 1 g B kg^{-1} of seed	19 ab	7.66 ab	51.33 a	1326 b	4817 b	27.52 b
T_9=1 g K kg^{-1} of seed + 0.5 g B kg^{-1} of seed	17 bc	7.33 ab	51.00 ab	1060 c	4697 c	22.56 c
T_{10}=1 g K kg^{-1} of seed + 1 g B kg^{-1} of seed	16 cd	6.66 ab	50.00 abc	907 d	4603 d	19.70 d
LSD value	2.58	2.02	2.47	4.89	3.77	0.12

Potash (K), Boron (B)

Table 2: Effect of seed priming of potash and boron on quality parameters (*Vigna radiata* L.).

Treatments	Chl. a (mg/g fresh wt)	Chl. b (mg/g fresh wt)	Total Chl. (mg/g fresh wt)	MDA (µmol/g)	H_2O_2 (Units/mg protein)	Car. (mg/g fresh wt)	POD (units/mg protein)	Protein %
T_1=No priming	0.60 h	0.10 e	0.80 g	310.0 j	1.19 f	0.70 h	1.00 g	18.00 f
T_2=Hydro-priming	0.80 g	0.12 de	1.10 f	282.0 i	1.17 ef	0.90 g	1.10 g	18.20 f
T_3=0.5 g K kg^{-1} of seed	0.90 fg	0.15 de	1.15 f	260.0 h	0.30 ef	1.10 f	1.30 f	19.00 e
T_4=1 g K kg^{-1} of seed	1.01 f	0.16 cde	1.20 f	245.0 g	0.27 e	1.40 e	1.50 e	19.20 e
T_5=0.5 g B kg^{-1} of seed	1.17 e	0.18 cde	1.35 e	229.0 f	0.15 b	1.50 e	1.70 d	19.70 de
T_6=1 g B kg^{-1} of seed	1.30 d	0.20 cd	1.45 e	210.0 e	0.11 a	1.80 d	1.80 d	20.10 cd
T_7=0.5 g K kg^{-1} of seed + 0.5 g B kg^{-1} of seed	2.21 a	0.40 b	2.40 a	145.0 a	0.15 b	2.70 a	2.50 a	21.50 a
T_8=0.5 g K kg^{-1} of seed + 1 g B kg^{-1} of seed	1.75 b	0.50 a	2.20 b	162.0 b	0.16 bc	2.40 b	2.30 b	21.10 ab
T_9=1 g K kg^{-1} of seed + 0.5 g B kg^{-1} of seed	1.70 b	0.35 b	2.00 c	175.0 c	0.22 cd	2.10 c	2.20 b	20.70 bc
T_{10}=1 g K kg^{-1} of seed + 1 g B kg^{-1} of seed	1.53 c		1.65 d	190.0 d	0.24 d	2.00 c	2.00 c	20.40 bcd
LSD value	0.12	0.09	0.13	11.78	0.04	0.17	0.18	0.74

Potash (K), Boron (B)

affected the yield and quality traits when compared with control (no-treatment). Thus, application of potash and boron is helpful to obtain high yield and quality of mungbean.

Authors' Contribution

MT, FZ, and MI conceived, designed, and conceptualized the study. MT and FZ performed the main experiment, measured the parameters, wrote the original manuscript and did the statistical analysis. MI helped with manuscript preparation, review, editing, and data analysis.

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