Response of Mung Bean Yield to Boron and Different NPK Formulas

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D.O.I: 10.56201/ijaes.v10.no2.2024.pg100.105

Summary

A factorial field experiment was conducted in the autumn season of 2018 to study the effect of different NPK formulas (control, di-ammonium phosphate NPK 18-46-0, neutral fertilizer 20-20-20, and high potash 18-46-30) and boron levels (0, 20, 40 mg L^{-1}) on mung bean yield in a randomized complete block design (RCBD) with three replications. Local variety seeds were planted on 15/8/2018 on both sides of ridges 80 cm at 15 cm between hills. The results showed that adding all NPK formulas improved yield and its components by giving high plant pods number, seeds number pod^{-1}, and yield of seeds compared to the control, and adding high potash formula was superior (26.77, 6.99 and 1300.2 kg ha^{-1}). Boron levels caused a significant increase in pods per plant, seeds number per pod, and yield of seed compared to the control treatment, and the level 40 mg l^{-1} gave 24.9 pods, 6.99 seeds, and 1207 kg ha^{-1}. The interaction between NPK fertilizer and boron caused a significant effect and high potash fertilizer with 40 mg l^{-1} boron gave the highest seed yield (1207 kg ha^{-1}.)

Keywords*: mung bean, DAP, Neutral NPK, High potash fertilizer, boron*

Introduction:

Mung bean (*Vigna radiata* L.) is a summer crop, grown in most of Iraq's parts as a short-season plant. It is used as food and feed. Fertilizer application improved poor plant production (Kakar et al., 2002). N, P, and K nutrients are the most important and our soil appears deficient in these nutrients. Foliar fertilizer improves nutrient utilization (Salim et al, 2014) and reduces the fertilizer-adding amount. Mung bean plants require nitrogen fertilizer adding although it`s fixing atmospheric nitrogen by rhizobium in root nodules (Anjum et al., 2006). Available nitrogen at all plant growth stages is important to obtain better seed yield, (Mandic et al., 2015). Ur-Rahman et al (2014) found that NPK (20-20-20) caused a significant increase in plant pod number and seed number per pod. Haq and Mallareno (2003) found that foliar fertilization leads to an increase in the yield of soybeans. Low yields of mung bean may be due to nutrient imbalance. Boron is associated with the activity of certain enzymes, cell division, carbohydrate transport, protein synthesis, and calcium and potassium uptake. Boron deficiency during the flowering phase prevents the growth of pollen tubes which causes pollen sterility, flower abortion, and a few pod

settings (Tariq and Mott, 2007). Adding boron at the vegetative and flowering stages enhanced mung bean seed yield (Patra and Bhattacharya, 2009). Praveena et al., (2018) found that spraying boron enhanced flower development, pollen grain formation, pollen tube growth, and seed development in mung bean.

Materials and methods

A factorial field experiment was carried out during autumn season of 2016 in Babylon Governorate on a private farm, to study the effect of foliar fertilizer numbers and boron levels on the yield of mung bean in loamy clay silt soil (Table 1).

Table (1) Some physical and chemical properties of field soil

characteristic	pH	Organic matter%	Available (mg kg^{-1})			texture	EC
			N	P	K		
value	7.1	0.9	49.7	9.1	128	Silt clay loam	3.0

Randomized complete block design in three replications was used. The experiment contained two factors, the first factor included three NPK formulas (di-ammonium phosphate NPK 18-46-0, neutral fertilizer 20-20-20, and high potash 18-46-30) as well as the control treatment, and the second factor included three levels of boron (0, 20 and, 40 mg L^{-1} as borax). The experimental unit contained 3 ridges (80 cm apart and 3 m long). The seeds (Local variety) were planted on 15/8/2018 (in hills 15 cm apart) on both sides of ridges (3-4 seeds in each hill and thinned to two plants per hill when it reached 15 cm long)), (Jasim and Muhsen, 2014). All the formulas of NPK were added at thinning in lines 10 cm down of planting lines at the level of 100 kg ha^{-1}. Boron spraying was done 45 days after sowing. At plant maturity, the number of pods per plant, seeds number per pod, 1000 seeds weight, and seed yield were determined. The results were analyzed according to the statistical program (Gen Stat).

Results and discussion :

Table (2) showed that NPK fertilizer caused a significant increase in pods number per plant and high potash fertilizer was superior by giving the highest pods number per plant (26.77) compared to the control (20.55). This was due to the role of N, P, and K elements in the balance of the food state and the increasing of the photosynthetic process (Jasim and Muhsen, 2014). This result was agreed with Ur Rahman et al. (2014). Boron spraying caused a significant increase of pods number per plant compared to the control, and the level of 40 mg l^{-1} gave the highest number of 24.9 pods, respectively compared to the control (22.66). This result was due to improve growth and flowering favorable effect on growth and best flower setting (Chatterjee and Bandyopadhyay, 2017, Praveena et al., 2018). This result agreed with Uddin et al (2020), Mohsen and Jasim (2020). The interaction between NPK and boron gave a significant effect and high potash + 20 or 40 mg l^{-1} gave the highest pods number (27.21 and 27.39) compared to the control treatment (19.21).

Table (2) Effect of NPK formula fertilizer and boron on pods number per plant

NPK formula (100 kg ha^{-1})	boron(mg L^{-1})			means of NPK formula
	0	20	40	
0	19.21	20.50	20.94	20.55
DAP(18-48-0)	21.43	23.85	24. 81	23.36
NPK(20-20-20)	24.30	26. 52	26.46	25.76
High K (18-48-30)	25.71	27. 21	27.39	26.77
means of boron	22.66	24.52	24.90	
LSD $_{0.05}$	Boron=0.26 interaction=0.52			0.30

Table 3 showed that the NPK formulas fertilizer achieved the highest number of seeds per pod compared to the control, and high K gave the highest number of seeds (6.99) compared to the control treatment (5.77). This result may be related to the role of NPK in increasing plant growth that is reflected in photosynthesis (Ur Rahman et al, 2014, Jasim and Muhsen, 2014). Boron increased seeds number significantly compared to the control, and the level 20 mg l^{-1} was superior (6.82 seeds) compared to the control (6.20 seeds). This result may be due to its rule in enhancing pollen tube growth and seed setting (Tariq and Mott, 2007). This result agreed with the results of Uddin et al (2020), Jasim and Obaid (2014), Kadam and Khanvilkar (2015), and Alam and Islam (2016). The interaction between NPK formula fertilizers and boron caused a significant effect, and High K fertilizer with 20 or 40 mg l^{-1} boron gave the highest number (7.11 and 7.15 seeds) compared to the control (5.42 seeds).

Table (3) Effect of foliar fertilizer number and boron on pod seeds number

NPK formula (100 kg ha^{-1})	boron(mg L^{-1})			Means of NPK formula
	0	20	40	
0	5.42	5.69	6.21	5.77
DAP(18-48-0)	6.11	6.72	6.87	6.57
NPK(20-20-20)	6.55	6.77	7.05	6.79
High K (18-48-30)	6.72	7.11	7.15	6.99
means of boron	6.20	6.57	6.82	
LSD $_{0.05}$	Boron=0.16 interaction=0.32			0.19

Table (4) showed that high K fertilizer caused a significant effect on 1000 seeds` weight (42.14 g) compared to the control treatment (41.53 g). This may be due to the increased photosynthesis process then, carbohydrates and proteins transferred to the seeds during the seed-filling phase (Nadeem et al, 2004). This result agreed with Basavarajappa et al (2013). Boron caused a significant effect on this trait, and the levels 20 and 40 mg l^{-1} gave 41.95 and 42.12 g compared to the control 41.47 g. This result was due to boron`s role in carbohydrate transport and protein synthesis (Debnath and Ghosh, 2011). This result agreed with Mohsen and Jasim (2020), Uddin et al (2020), Kadam and Khanvilkar (2015). The interactions between the factors had a significant effect and high K fertilizer with 20 or 40 mg l^{-1} achieved the highest weight compared to the control treatment.

Table (4) Effect of foliar fertilizer number and boron on 1000 seeds weight (g)

NPK formula (100 kg ha^{-1})	boron(mg L^{-1})			Means of NPK formula fertilizer
	0	20	40	
0	41.25	41.60	41.73	41.53
DAP(18-48-0)	41.22	41.90	42.15	41.76
NPK(20-20-20)	41.56	42.11	42.22	41.96
High K (18-48-30)	41.86	42.20	42.36	42.14
means of boron	41.47	41.95	42.12	
LSD $_{0.05}$	Boron=0.45 interaction=0.90			0.52

Table (5) showed that all NPK formula fertilizers caused a significant increase in seed yield (kg ha^{-1}), and high K fertilizer was superior by giving the highest seed yield of 1300.2 kg ha^{-1} compared to 801.6 kg ha^{-1} at the control treatment. This may be due to that adding NPK providing available elements to the plants, and this was agreed with Jasim and Muhsen (2014).

Boron spraying caused an increase in total seed yield compared to the control treatment and the level of 40 mg l-1 gave the highest yield of 1207 kg ha^{-1}. This result was due to that boron caused an increase in pod number per plant and seeds number per pod (tables 2 and 3). This result agreed with Islam et al (2018), Kadam and Khanvilkar (2015), and Alam and Islam (2016). The interaction between NPK formula and boron caused a significant effect, and High K + 20 or 40 ml l^{-1} boron gave the highest yield 1347.1 and 1368.8 kg.ha^{-1} respectively compared to 708.7 kg from the control plants.

Table (5) Effect of foliar fertilizer number and boron on seed yield (kg ha^{-1})

NPK formula (100 kg ha^{-1})	Boron (mg L^{-1})			Means of NPK formula
	0	20	40	
0	708.7	800.7	895.4	801.6
DAP(18-48-0)	890.5	1108.0	1264.2	1087.6
NPK(20-20-20)	1091.5	1247.5	1299.5	1212.8
High K (18-48-30)	1184.8	1347.1	1368.8	1300.2
means of boron	968.9	1125.8	1207.0	
LSD $_{0.05}$	Boron=81.3 interaction= 162.6			93.9

Conclusion

From this experiment results, it could be concluded that adding 100 kg ha^{-1} of neutral NPK or high potash fertilizer with foliar application of boron at 20 or 40 mg l^{-1} (as borax) achieved a significant increase in mung bean yield and its components.

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