Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(6): 1416-1419
Received: 14-08-2020
Accepted: 02-10-2020

Harikrishna Balla
Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology Sciences, Prayagraj, Uttar Pradesh, India

Vikram Singh
Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology Sciences, Prayagraj, Uttar Pradesh, India

Dhananjay Tiwari
Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology Sciences, Prayagraj, Uttar Pradesh, India

Mahaboob Ali Shaik
Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology Sciences, Prayagraj, Uttar Pradesh, India

Lakshman jonnagorla
Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology Sciences, Prayagraj, Uttar Pradesh, India

Corresponding Author:
Harikrishna Balla
Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology Sciences, Prayagraj, Uttar Pradesh, India

Effect of boron and molybdenum on growth rate and yield of groundnut (*Arachis hypogea* L.)

Harikrishna Balla, Vikram Singh, Dhananjay Tiwari, Mahaboob Ali Shaik and Lakshman jonnagorla

DOI: https://doi.org/10.22271/phyto.2020.v9.i6u.13144

Abstract
A field experiment was conducted during *kharif* season of 2019 at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (U.P.) to study the effect of boron and molybdenum on groundnut (*Arachis hypogea* L.) with 9 different treatment combinations, which laid out in Randomized Block Design (RBD) & replicated thrice. The experiment finding revealed that the treatment (T_9) boron at 1.5%/ha + Molybdenum 1.5 Kg/ha performed significantly higher than other treatment i.e. plant dry weight (41.66 g), No. of pods /plant (21.16), No. of kernal yield/pod (2), Seed Index (45.66 g), pod yield (3.73 t/ha) and halum yield (10.37 t/ha). Highest CGR (52.50 g/m^2/day) and RGR (25 g/g/day) values are recorded under treatment (T_7) application of Boron at 1.5% /ha + 0.5 Kg/ha Molybdenum.

Keywords: Boron, molybdenum, groundnut, yield

Introduction
Groundnut (*Arachis hypogaea* L.), is a leguminous crop plant which is widely cultivated in the tropics and subtropics between 40°N and 40°S latitudes. It is valued for its high-oil edible seeds and as such it is the fourth most important source of edible oil and third most important source of vegetable protein in the world. Groundnut is not only an important oilseed crop of India but also an important agricultural export commodity. Groundnut is an important food legume and oilseed crop on which the country vegetable oil economy depends very much. In India, groundnut is grown in 11 states, accounts for 29 percent of total production of oilseed. Oilseed occupies an important position in Indian economy by contributing about 4% Gross National Product (GNP). At the present level area and production, it occupies about 75.72 lakh tones and productivity is about 1210 kg /ha in India. Though the share of groundnut in the total oil seed production in India has been falling since 1950, when it was 70% to the present level of 33%, groundnut is still a major oilseed crop in India. Its production decides not only the price of groundnut oil in any year, but also the price of most of other edible oils. *Kharif* groundnut is grown under rainfed situations and the summer groundnut is grown under assured irrigated conditions. Hence summer groundnut is much less likely to suffer moister deficient and consequently the average productivity (about 1500 kg/ha) is higher to *kharif* groundnut (about 1000 kg/ha). As the *kharif* groundnut continuous to be risk prone due to vagaries of monsoon, opportunities of realizing further incremental growth in average national. Groundnut is annually grown on about 24 M ha of land in about 120 countries under different agro-climatic zones between 400S and 400(Anon., 2013) [1]. In India, it is cultivated on an area of 5.53 M ha with production of 9.67 M tonnes and productivity of 1750 kg/ha during 2013-2014 (Anon., 2015).As per APEDA data, India's groundnut kernel shipment declined and is at 3.57 lakh tonnes during April-December 2018 amounting total Rs. 2,394 crore. The country exported total 5.04 lakh tonnes of groundnut kernel in 2017-18 (April-March) valued Rs. 3,386.30 crore. Around 50 per cent of our peanut exports are to Indonesia, Vietnam, Philippines and Malaysia, with the remaining being exported to China, Russia Ukraine and United Kingdom.

Materials and Methods
The experiment was carried out during *kharif* season of 2019 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Allahabad (U.P.) which is located at 250 24' 42" N latitude, 810 50' 56" E longitude and 98 m altitude above the meansea level.

This area is situated on the right side of the river Yamuna by the side of Allahabad Rewa Road about 5 km away from Allahabad city. The region receives an average annual rainfall is 981 mm. The total rainfall of 195.2mm was received during crop period in *kharif* 2019. The maximum temperature ranged in crop seasons was 29ºC to 37.8ºC and minimum temperatures during the same seasons was 21.3ºC to 28.7ºC.The soil of the experiment at site was sandy loam with a pH (7.2), EC 0.38 (ds/m^2), carbon (0.48%), available N (108.0 kg/ha) P_2O_5 (22.5 kg/ha) and K_2O (280.0 kg/ha). The experiment was laid down in randomized block design (RBD) with 9 treatments and 3 replications, each treatment replicated thrice, to study the effect of different doses of boron and molybdenum on groundnut. Kadiri-6 variety Seeds are sown in lines directly in the main field at a spacing of 30 x 10 cm at Seed rate 120 kg/ha. The crop recommended dose was 20-50-40 kg N-P-K/ha and molybdenum applied along with fertilizers as based on treatment combination as basal dose at the time of sowing respectively. Irrigation was scheduled at 6-8 days interval; however other normal cultural practices were followed timely as; spraying of boron at 35 DAS, weeding at 25 DAS & 35 DAS. In the experiment biometric observation were recorded at 20 days interval up to 100 DAS. Dry weight taken from five random plants per each treatment. Moreover, pods from harvest area(1.0 m^2) were dried in sun, cleaned and weighed separately from each plot for calculating the pods per plant, kernals per pod, pod yield in tones/ha. Halum from harvest area (1.0 m^2) was dried in sun, bundled, tagged and weighed separately from each plot for calculating the halum yield in tones/ha. Seed index was taken by 100 seeds of groundnut with physical balance. The data was analyzed by the method of analysis of variance as described by Gomez and Gomez (1984). The level of significance used in "F" test was given at 5%. During the years of experimentation, the crop was sown on 02th August 2019 and harvested on 10th December 2019.

Result and Discussion

Growth attributes

Dry weight (g/plant)

At 20 DAS, maximum plant dry weight (0.022 g/plant) was recorded under treatment (T_4) with application of at 1%/ha Boron + 0.5 Kg/ha Molybdenum and minimum dry weight (0.011 g/plant) was recorded under treatment (T_1) with at 0.5%/ha Boron + 0.5 Kg/ha Molybdenum. There was no significant difference among all treatment combinations. At 40 DAS, highest dry weight (2.09 g/plant) was recorded under treatment (T_9) with application of at 1.5%/ha Boron + 1.5 Kg/ha Molybdenum, which superior over rest of all the treatments except treatment (T_8)with application of at 1.5 %/ha Boron + 1 Kg/ha Molybdenum (1.88 g/plant), treatment (T_7)at 1.5 %/ha Boron + 0.5 Kg/ha Molybdenum (1.86 g/plant) and treatment (T_6) at 1 %/ha Boron + 1.5 Kg/ha Molybdenum (1.82 g/plant). At 60 DAS, highest plant dry weight (33.33 g/plant) was recorded under treatment (T_9) with application of at 1.5%/ha Boron + 1.5 Kg/ha Molybdenum, which was significantly superior over rest of the all treatments except treatment (T_8) with application of at 1.5% /ha Boron + 1 Kg/ha Molybdenum (31.66 g/plant) and treatment (T_7) at 1.5%/ha Boron + 0.5 Kg/ha Molybdenum (30.11 g/plant). At 80 DAS, highest plant dry weight (40 g/plant) was recorded under treatment (T_9) with application of at 1.5%/ha Boron + 1.5 Kg/ha Molybdenum, which was significantly superior over rest of the all treatments except treatment (T_8) with application of at 1.5% /ha Boron + 1 Kg/ha Molybdenum (39.77 g/plant) and treatment (T_7) at 1.5%/ha Boron + 0.5 Kg/ha Molybdenum (39.44 g/plant).

At harvest, highest plant dry weight (41.66 g/plant) was recorded under treatment (T_9) with application of at 1.5%/ha Boron + 1.5 Kg/ha Molybdenum, which was significantly superior over rest of the all treatments except treatment (T_8) with application of at 1.5% /ha Boron + 1 Kg/ha Molybdenum (41.35 g/plant) and treatment (T_7) at 1.5%/ha Boron + 0.5 Kg/ha Molybdenum (40.77 g/plant). Increasing Boron and Molybdenum rates increased dry weight/plant. These findings were also confirmed the results obtained by Srinivasan *et al.* (2008) [7]. The increase in dry matter production with Boron and Molybdenum might be due to better nodulation of crop owing to better availability of B. The improvement in nodulation might have resulted in higher amount of nitrogen fixation and there by better vegetative growth and dry matter production. These results were similar with findings of DV Hipara *et al.* (2016).

CGR (g/m2/day)

At 20-40 DAS, maximum crop growth rate (3.46 g/m^2/day) was recorded under treatment (T_8) with application of at 1.5 %/ha Boron + 1 kg/ha Molybdenum which was superior over rest of the treatments except treatment (T_9) with application of at 1.5% /ha Boron + 1.5 kg/ha Molybdenum (3.10 g/m^2/day), treatment (T_7) at 1.5 %/ha Boron + 0.5 kg/ha Molybdenum (3.02 g/m^2/day), treatment (T_6) at 1 %/ha Boron + 1.5 kg/ha Molybdenum (3.08. g/m^2/day) and treatment (T_4) at 0.5 %/ha Boron + 1.5 Kg/ha Molybdenum (2..98 (g/m^2/day). At 40-60 DAS, maximum crop growth rate (52.50 g/m^2/day) was recorded under treatment (T_9) with application of at 1.5 %/ha Boron + 1.5 kg/ha Molybdenum which was superior over rest of the treatments except treatment (T_8) with application of at 1.5%/ha + 1 Kg/ha Molybdenum (49.64 g/m^2/day) and treatment (T_7) at Boron 1.5% /ha + 0.5 Kg Molybdenum (46.69 g/m^2/day). At 60-80 DAS, maximum crop growth rate (17.77 g/m^2/day) was recorded in treatment (T_2) with application of at 0.5 %/ha Boron + 1 kg/ha Molybdenum and minimum was in treatment (T_3) with application of at 0.5 %/ha Boron + 1.5 Kg/ha Molybdenum (7.40 g/m^2/day). There was no significant difference among all treatment combinations. At 80 DAS-At harvest, maximum crop growth rate (7.84 g/m^2/day) was recorded under treatment (T_4) with application of at 1 %/ha Boron + 0.5 kg/ha Molybdenum and minimum was treatment (T_3) with application of at 0.5 %/ha Boron + 1.5 Kg/ha Molybdenum (2.36 g/m^2/day). There was no significant difference among all treatment combinations.

RGR (g/g/day)

At 20-40 DAS, maximum relative growth rate (0.25 g/g/day) was recorded under treatment (T_3) with application of at 0.5% /ha Boron + 1.5 Kg/ha molybdenum and minimum was with treatment (T_1) application of at 0.5 %/ha Boron + 0.5 kg/ha Molybdenum (0.22 g/g/day). There was no significant difference among all treatment combinations. At 40-60 DAS, maximum relative growth rate (0.145 g/g/day) was recorded under treatment (T_7) with application of at 1.5% /ha Boron + 0.5 Kg/ha molybdenum and minimum was in treatment (T_4) with application of at 1 %/ha Boron + 0.5 kg/ha Molybdenum (0.126 g/g/day). There was no significant difference among all treatment combinations. At 60-80 DAS, maximum relative growth rate (0.021 g/g/day) was recorded under treatment (T_2) with application of at 0.5% /ha Boron + 1 Kg/ha molybdenum and minimum was in treatment (T_7) with application of at 1.5 %/ha Boron + 0.5 kg/ha Molybdenum (0.007 g/g/day). There was no significant difference among all treatment combinations. At 80- at harvest, maximum relative growth rate (0.008 g/g/day) was recorded under treatment (T_4) with application of at 1 % /ha Boron + 0.5 Kg/ha molybdenum and minimum was with treatment (T_9) application of at 1.5 %/ha Boron + 1.5 kg/ha Molybdenum (0.0021 g/g/day). There was no significant difference among all treatment combinations.

Yield and yield attributes

Pods/plant (No.)

Number of pods/plant maximum was obtained with treatment (T_9) application of at 1.5% /ha Boron + 1.5 kg/ha Molybdenum (21.16), which was significantly superior over all the treatments except treatment (T_8) application of at 1.5% /ha Boron + 1 kg/ha Molybdenum (20.33), treatment (T_7) at 1.5% /ha Boron + 0.5 Kg/ha Molybdenum (20.33), treatment (T_6)at 1% /ha Boron + 1.5 Kg/ha Molybdenum (19.56) and treatment (T_3)at 0.5% /ha Boron + 1.5 Kg/ha Molybdenum. Boron and Molybdenum levels plays a key role in root and shoots growth, flower fertility, Boron is important nutrient for nodule forming bacteria therefore, increased nodule count results in more nitrogen fixation which increased the pegs (pods) /plant. Similar findings were recorded by Srinivasan *et al.* (2008) [7].

Kernals/pod (No.)

Number of kernels/pod, maximum was obtained under treatment (T_9) with application of at 1.5 %/ha Boron + 1.5 kg/ha Molybdenum (2) which was significantly superior over treatment (T_2)at 0.5 %/ha Boron + 1 Kg/ha Molybdenum (1.66) and at treatment (T_1)0.5% /ha Boron + 0.5 Kg/ha Molybdenum (1.77) and other treatments were at par with each other. (Table 4) revealed that increasing Boron and Molybdenum levels shows clear effect on mature pods and filled pods Crak *et al.* (2006) [5].

Seed index (g)

Seed index maximum was obtained under treatment (T_9) with application of at 1.5 %/ha Boron + 1 kg/ha Molybdenum (46.33 g) which was significantly superior over rest of the treatments except treatment (T_8) application of at 1.5 % Boron + 1.5 Kg/ha Molybdenum (45.66), treatment (T_7) at 1.5% /ha Boron + 0.5 Kg/ha Molybdenum (45.44), treatment (T_6) at 1 % Boron + 1.5 Kg/ha Molybdenum (43.66) and treatment (T_3) at 0.5% /ha Boron + 1.5 Kg/ha Molybdenum (44). Boron and Molybdenum increased more nodulation and nitrogen fixation and general metabolism which increased seed Index (46.33) Togay *et al.* (2008) [9].

Pod yield (t/ha)

Pod yield (t/ha) was recorded under treatment (T_9) highest with application of at 1.5% /ha Boron + 1.5 kg/ha Molybdenum (3.73 t/ha), which was significantly superior rest all treatments are at par with 1.5% /ha Boron + 1.5 kg/ha Molybdenum. Pod yield significantly affected by Boron and Molybdenum, increasing levels of boron and molybdenum responsible for nodule tissue and increase in N_2 fixation. Similar result was concluded by Mohamed *et al.* (2011), Togay *et al.* (2008) [9].

Haulm yield (t/ha)

Haulm yield (t/ha) was obtained under treatment (T_9) maximum with application of at 1.5 % /ha Boron + 1.5 kg/ha Molybdenum (10.73 t/ha) which was significantly superior over rest of all the treatments except treatment (T_8) with application of at 1.5% /ha Boron + 1 kg/ha Molybdenum (10.16 t/ha). Boron and Molybdenum increased nitrogen fixation which effects plant growth rate and metabolism which results in higher halum yields. Bhagya *et al*. (2005).

Table 1: Effect of Boron and Molybdenum on Dry weight of Groundnut.

Treatments	Treatment Combinations	Dry weight (g/plant)				
		20 DAS	40 DAS	60 DAS	80 DAS	At harvest
1	Boron 0.5% + Molybdenum 0.5kg/ ha	0.022	1.46	19.33	25.44	27.79
2	Boron 0.5% + Molybdenum 1kg/ ha	0.010	1.36	19.89	30.51	32.28
3	Boron 0.5%+ Molybdenum 1.5kg /ha	0.010	1.80	22.77	26.55	28.64
4	Boron 1%+ Molybdenum 0.5kg/ ha	0.010	1.69	21.11	26.55	31.03
5	Boron 1% + Molybdenum 1kg/ ha	0.013	1.59	24.11	30.14	34.21
6	Boron 1% + Molybdenum 1.5kg/ ha	0.012	1.86	26.44	34.58	37.39
7	Boron 1.5% + Molybdenum 0.5kg/ ha	0.012	1.82	30.11	39.44	40.77
8	Boron 1.5% + Molybdenum 1kg/ ha	0.015	1.88	31.67	39.77	41.35
9	Boron 1.5% + Molybdenum 1.5kg/ ha	0.015	2.09	33.33	40	41.66
F-Test		NS	S	S	S	S
SEm (±)		0.004	0.11	1.49	0.80	0.88
CD (5%)		0.01	0.33	4.07	2.41	2.65

Table 2: Effect of Boron and Molybdenum on Crop growth rate of Groundnut

Treatment No	Treatment Combinations	Crop growth rate (g/m^2/day)			
		20-40 DAS	40-60 DAS	60-80 DAS	80-100 DAS
1	Boron 0.5% + Molybdenum 0.5kg/ ha	2.41	29.77	7.96	6.14
2	Boron 0.5% + Molybdenum 1kg/ ha	2.26	30.86	17.77	2.87
3	Boron 0.5%+ Molybdenum 1.5kg /ha	2.98	35.51	7.40	2.36
4	Boron 1%+ Molybdenum 0.5kg/ ha	2.79	33.47	8.70	7.82
5	Boron 1% + Molybdenum 1kg/ ha	2.64	37.51	10.30	6.52
6	Boron 1% + Molybdenum 1.5kg/ ha	3.08	40.96	13.74	4.51
7	Boron 1.5% + Molybdenum 0.5kg/ ha	3.02	52.50	8.70	3.69
8	Boron 1.5% + Molybdenum 1kg/ ha	3.46	46.69	15.55	3.18
9	Boron 1.5% + Molybdenum 1.5kg/ ha	3.10	49.62	13.70	2.95
F-Test		S	S	NS	NS
SEm (±)		0.18	2.54	2.41	1.78
CD (5%)		0.56	7.61	7.24	5.35

Table 3: Effect of Boron and Molybdenum on Relative crop rate of Groundnut

Treatment No	Treatment Combinations	Relative growth rate (g/g/day)			
		20-40 DAS	40-60 DAS	60-80 DAS	80-100
1	Boron 0.5% + Molybdenum 0.5kg/ ha	0.22	0.12	0.011	0.0070
2	Boron 0.5% + Molybdenum 1kg/ ha	0.24	0.13	0.021	0.0027
3	Boron 0.5%+ Molybdenum 1.5kg /ha	0.25	0.12	0.009	0.0025
4	Boron 1%+ Molybdenum 0.5kg/ ha	0.25	0.12	0.011	0.0082
5	Boron 1% + Molybdenum 1kg/ ha	0.23	0.13	0.011	0.0059
6	Boron 1% + Molybdenum 1.5kg/ ha	0.25	0.13	0.013	0.0037
7	Boron 1.5% + Molybdenum 0.5kg/ ha	0.25	0.14	0.007	0.0028
8	Boron 1.5% + Molybdenum 1kg/ ha	0.24	0.13	0.013	0.0023
9	Boron 1.5% + Molybdenum 1.5kg/ ha	0.24	0.14	0.011	0.0021
F-Test		NS	NS	NS	NS
SEm (±)		0.01	0.005	0.003	0.0016
CD (5%)		0.03	3.4	0.009	0.0048

Table 4: Effect of Boron and Molybdenum on yield attributes and yield of Groundnut

Treatment No.	Treatment Combinations	No of pods/ plant	No. of kernels/ pod	Seed Index (g)	Pod yield (t / ha)	Biological yield (t /ha)
1	Boron 0.5% + Molybdenum 0.5kg/ ha	17.93	1.66	38.33	3.17	12.07
2	Boron 0.5% + Molybdenum 1kg/ ha	16.33	1.77	41.33	3.16	12.55
3	Boron 0.5%+ Molybdenum 1.5kg /ha	18.36	1.88	44	3.11	12.47
4	Boron 1%+ Molybdenum 0.5kg/ ha	16.13	2	42.33	3.10	12.57
5	Boron 1% + Molybdenum 1kg/ ha	15	2	42.66	3.25	12.85
6	Boron 1% + Molybdenum 1.5kg/ ha	19.56	2	43.66	3.21	13.16
7	Boron 1.5% + Molybdenum 0.5kg/ ha	20.33	2	45.44	3.50	13.14
8	Boron 1.5% + Molybdenum 1kg/ ha	20.33	2	46.33	3.51	13.89
9	Boron 1.5% + Molybdenum 1.5kg/ ha	21.16	2	45.66	3.73	14.05
F-test		S	S	S	S	S
SEm (±)		0.94	0.05	1.17	0.28	22.37
CD (5%)		3.12	0.16	3.5	0.85	67.08

Acknowledgements
The author acknowledges the department of Agronomy, Allahabad School of Agricultural, Sam Higginbottom Institute of Agriculture Technology & Sciences, Allahabad (Uttar Pradesh) for providing financial support to carry out the research work

Conclusion
It may be concluded that treatment (T_9) with application of Boron 1.5% + Molybdenum 1.5kg/ha was found to be the best for obtaining higher growth attributes and yield. Since the finding is based on the research done in one season further trials are needed to confirm the results.

References
1. Anonymous Pocket. Book of Agricultural Statistics. Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India 2014.
2. Anonymous. Annual Report of AICRP on Groundnut Kharif, Directorate of Groundnut Research, Junagadh 2012.
3. Anonymous. Groundnut area, production and productivity, USDA Foreign Agriculture Service 2015.
4. Bhagiya SR, Polara KB, Polara JV. Effect of B and Mo on yield, quality and nutrient absorption by groundnut. Advances in Plant Sciences 2005;18(2):803-806.
5. Crak C, Odabas Kevseroglu MS, Karaca K, Gulumser EA. Response of soyabean (*Glycine max*) to soil and foliar applied boron at different rates. Indian J of Agric. Sci 2006;76(10):603-606.
6. Noor S, Hannan MA, Islam MS. Effect of molybdenum and boron on the growth and yield of groundnut. Indian Journal Agricultural Research 1997;31(1):51-58.
7. Srinivasan S, Tike T, Angayarkanni A. Groundnut yield, dry matter production and nodule number as influenced by different levels of phosphorus and boron. Mysore Journal of Agricultural Sciences 2008;42(1):129-131.
8. Sutaria GS, Golakiya BA. Mechanism of yield control in groundnut by boron. Adv. Pl. Set 1990;3:53-60.
9. Togay Y, Togay N, Dogan Y. Research on the effect of phosphorus and molybdenum applications on the yield and yield parameters in lentil Lens culinaris Medic. African Journal of. Biotechnology 2008;7(9):1256-1260.
10. Hirpara DV, Sakarvadia HL, Savaliya CM, Ranpariya VS, Modhavadiya VL. Effect of different levels of boron and molybdenum on growth and yield of summer groundnut (*Arachis hypogaea* L.) under medium black calcareous soils of south Saurashtra region of Gujarat. International Journal of Chemical Studies 2017;5(5):1290-1293.