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INFLUENCE OF BORON AND MAGNESIUM ON GROWTH AND YIELD PARAMETERS OF GROUNDNUT (*ARACHIS HYPOGAEA* L.) IN MEDIUM BLACK SOIL

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ABSTRACT

Field experiment was conducted to study the optimization of boron and magnesium on growth and yield parameters by groundnut in medium deep black soil at Agriculture College Farm, Raichur. The results revealed that combined application of (T_{10}): RDF + MgO 20 kg ha^{-1} + Borax 5 kg ha^{-1} recorded significant higher pod and haulm yield (1723 and 3101 kg ha^{-1}) fallowed by T_9 and T_8 as compare to control (983 and 1670 kg ha^{-1}). The soil application of RDF + 20 kg MgO ha^{-1} + 5 kg borax ha^{-1}found better in increasing pod and haulm yield evidenced by increased growth, yield attributes and uptake of nutrients.

INTRODUCTION

Groundnut (*Arachis hypogeae* L.) is an annual legume native of South America, being grown in most tropical, sub-tropical and warm temperate regions of the world. Groundnut is the world's fourth most important source of edible oil and third in vegetable protein and being grown in area of 24.59 million ha with an annual production of 38.20 million tons with the productivity of 1550 kg ha^{-1} (Anon, 2011). In Karnataka, it is cultivated in an area of 1.30 m ha with production being 1.14 m t and productivity 589 kg ha^{-1}. The current average yield level of 1305 kg ha^{-1} is deplorably low as compared to 3568 kg ha^{-1} in China and 4699 kg ha^{-1} in USA (FAO, 2012). Lower productivity was attributed to several reasons including imbalanced fertilization, damage caused by pest and disease. (Ghewande, 1987).

Boron is an essential element which has received maximum attention over last 15 years. The deficiency symptoms appear especially on leaves, stems and reproductive parts. It is very useful in the production of legume seed with proper seed setting, improved seed quality, dry matter accumulation in roots, shoots, leaves and helps in the absorption of nitrogen to a certain extent. Magnesium is a structural component of chlorophyll, thus, is indispensable for photosynthesis by plants (Meena *et al*., 2007). Due to unique chemistry, magnesium is subject to various cycling processes in agricultural ecosystems. In principle there are two reasons for Mg deficiency to occur, absolute deficiency and cation competition. Absolute deficiency can be a consequence of low Mg contents in the source rocks, Mg loss from the soil through mobilization and subsequent leaching (Grzebisz, 2011) and also of long-term unbalanced crop fertilization practice neglecting Mg depletion of soils through crop removal (Van der Pol and Traore, 1993). Keeping these points in view, the present investigation was carried out to study the optimization of boron and magnesium in groundnut.

MATERIALS AND METHODS

A field experiment was carried out during *kharif* 2013, at Agriculture College Farm, Raichur, Karnataka, India to study application of boron and magnesium on growth and yield of groundnut in medium black soil. Experimental soil was clay loam in texture having pH 7.96, electrical conductivity (1:2.5) dSm^{-1} 0.36, CEC (c mol (p^+) kg^{-1}) 48.2, organic carbon (g kg^{-1}) 6.2, nitrogen (268 kg ha^{-1}), medium in phosphorus (26.50 kg ha^{-1}) and potassium (239.00 kg ha^{-1}), exchangeable calcium (26.6 c mol (p^+) kg^{-1}), exchangeable magnesium (9.6 c mol (p^+) kg^{-1}), available sulphur (19.00 kg ha^{-1}), available boron (0.38 ppm).

The experiment comprises of Ten treatments and replicated thrice *viz*., T_1: Control, T_2: RDF, T_3:RDF+15kgMgOha^{-1}, T_4:

RDF + 20 kg MgO ha^{-1}, T_5: RDF + 2.5 kg borax ha^{-1}, T_6: RDF + 5 kg borax ha^{-1}, T_7: RDF + 15 kg MgO ha^{-1} + 2.5 kg borax ha^{-1}, T_8: RDF + 15 kg MgO ha^{-1} + 5 kg borax ha^{-1}, T_9: RDF + 20 kg MgO ha^{-1} + 2.5 kg borax ha^{-1}, T_{10}: RDF + 20 kg MgO ha^{-1} + 5 kg borax ha^{-1}. Soil pH and EC (1:2.5) was measured using digital pH and EC meters (Jackson, 1973), Organic carbon content by wet oxidation method of Walkley and Black (1934), Available nitrogen by Subbaiah and Asija, 1956, available phosphorus using Olsen extractant by colorimetric method, available potassium using ammonium acetate by flame photometer, and calcium, magnesium and sulphur using calcium chloride as described by Jackson (1973) and boron using Azomithine H method as outlined by Berger and Trough, 1939.

RESULTS AND DISCUSSION

The plant height of groundnut differed significantly due to soil application of nutrients at different crop growth stages. At harvest, significantly higher plant height was recorded with soil application of T_{10}: RDF + 20 kg MgO ha^{-1} + 5 kg borax ha^{-1} (25.93 cm) and was on par with rest of the treatments except control. The lowest plant height was recorded in control treatment (20.53 cm). The number of primary branches per plant of groundnut differed significantly higher number of branches per plant was recorded with T_{10}: RDF + 20 kg MgO ha^{-1} + 5 kg borax ha^{-1} (9.17) and was on par with T_9 (9.0), T_8 (8.47) compared to lower number of branches per plant was recorded with control treatment (5.3). Higher total dry matter accumulation per plant was with T_{10} (12.20 g plant^{-1}) and was on par with T_9 (12.00 g plant^{-1}), T_8 (11.67 g plant^{-1}) and the lowest total dry matter accumulation was recorded in control (4.8 g plant^{-1}). There was a significant increase in plant height at harvest over other treatments. Soil application of magnesium and boron treatments were on par in their effects on plant height of the crop. It is a fact that boron is essential in enhancing carbohydrate metabolism, sugar transport, cell wall structure, protein metabolism, root growth and stimulating other physiological processes of plant. Boron being essential for N-fixation, which ensured better N supply to the crop and also improved plant height and dry matter accumulation in plant which resulted in better growth and yield of crop (Duyingqiong *et al.*, 2002 and Patil *et al.*, 2014). These results were in accordance with Pushpa Sharma and Virendra Sardan, 2012).

Number of pods per plant (19) was recorded in T_{10}: RDF + 20 kg MgO ha^{-1} + 5 kg borax ha^{-1} over other treatments. Significantly lower numbers of pods were recorded in control (9.00). Number of filled pods per plant (17.00) was recorded in T_{10}: RDF + 20 kg MgO ha^{-1} + 5 kg borax ha^{-1} over other treatments. The treatments T_6: RDF + 5 kg borax ha^{-1} (15.00) and T_5: RDF + 2.5 kg borax ha^{-1} (14.00) were on par with each other and significantly lower number of filled pods per plant

Table I: Growth parameters at harvest as influenced by boron and magnesium in groundnut

Treatments	Plant height(cm)	Number of branches	Total dry matter production(g plant^{-1})
T_1: Control	20.53	5.33	5.87
T_2: RDF	25.28	7.10	11.13
T_3: RDF + 15 kg MgO ha^{-1}	25.27	7.20	11.27
T_4: RDF + 20 kg MgO ha^{-1}	24.27	7.23	11.37
T_5: RDF + 2.5 kg Borax ha^{-1}	23.00	7.30	11.40
T_6: RDF + 5 kg Borax ha^{-1}	22.07	7.40	11.53
T_7: RDF +15 kg MgO ha^{-1} + 2.5 kg Borax ha^{-1}	22.93	8.20	11.57
T_8: RDF + 15 kg MgO ha^{-1} + 5 kg Borax ha^{-1}	23.60	8.47	11.67
T_9: RDF + 20 kg MgO ha^{-1} + 2.5 kg Borax ha^{-1}	22.33	9.00	12.00
T_{10}: RDF + 20 kg MgO ha^{-1} + 5 kg Borax ha^{-1}	25.93	9.17	12.20
S. Em +	0.99	0.21	0.31
C. D. (P=0.05)	2.89	0.62	0.92

Note: Recommended dose of fertilizer (RDF) 25:75:25 kg NPK ha^{-1} + 10 t FYM ha^{-1} + 500 kg gypsum ha^{-1}

Table II:Yield attributes and yield of groundnut as influenced by soil application of boron and magnesium

Treatments	Number of pods plant^{-1}	Number of filled pods plant^{-1}	Pod weight plant^{-1}	100 kernel weight	Pod yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	Shelling outturn
T_1: Control	9	7.67	8.17	23.4	983	1670	51.43
T_2: RDF	12.67	11.67	11.67	31.5	1350	2616	52.8
T_3: RDF + 15 kg MgO ha^{-1}	12.67	12	11.87	33.83	1450	2731	52.53
T_4: RDF + 20 kg MgO ha^{-1}	14.33	12.67	13.2	33.07	1490	2790	53.17
T_5: RDF + 2.5 kg Borax ha^{-1}	15.33	14	14.17	34.8	1460	2720	53.7
T_6: RDF + 5 kg Borax ha^{-1}	16.33	15	14.83	35.27	1500	2820	54.47
T_7: RDF +15 kg MgO ha^{-1} + 2.5 kg Borax ha^{-1}	17.33	16	16.07	34.17	1600	2860	56.57
T_8: RDF + 15 kg MgO ha^{-1} + 5 kg Borax ha^{-1}	17.67	16.33	16.7	37.13	1666	2810	57.63
T_9: RDF + 20 kg MgO ha^{-1} + 2.5 kg Borax ha^{-1}	18	16.67	16.77	34.03	1676	2980	55.6
T_{10}: RDF + 20 kg MgO ha^{-1} + 5 kg Borax ha^{-1}	19	17	16.9	38.5	1723	3101	57.2
S. Em ±	0.48	0.52	0.35	1.3	40.32	105.52	1.02
C. D. (P=0.05)	1.39	1.51	1.02	3.81	117.7	308.01	2.97

was recorded in control treatment (7.67). Highest pod weight per plant (16.90 g) was recorded in (T_{10}) RDF + 20 kg MgO ha^{-1} + 5 kg borax ha^{-1} followed by T_9 (16.67 g), T_8 (16.33 g) and T_7 (16.00 g) were on par with each other and significantly superior over control treatment. Significantly higher 100-kernel weight (38.50 g) was recorded in T_{10} followed by T_8 (37.13 g), T_6 (35.27 g) were on par with each other and lower 100-kernel weight was recorded in control treatment (23.40 g). The highest shelling percentage (57.63 %) was recorded in T_8: RDF + 15 kg MgO ha^{-1} + 2.5 kg borax ha^{-1} which was on par with T_{10}: RDF + 20 kg MgO ha^{-1} + 5 kg borax ha^{-1} (57.20 %) followed by T_7 (56.57 %) and T_9 (55.60 %) and the lowest shelling percentage was recorded in control (51.10 %). Higher pod and halum yield of 1723.33 and 3101 kg ha^{-1} was recorded in T_{10}: RDF + 20 kg MgO ha^{-1} + 5 kg borax ha^{-1} followed by T_9 (1666.67 kg ha^{-1} and 2980 kg ha^{-1}) and the lowest pod yield of 983.33 and 1670 kg ha^{-1} was recorded in control.

The increase in pod yield of groundnut as a result of magnesium and boron along with RDF were attributed to better crop stand, increase in plant height, number of pods per plant, pod weight per plant as a consequent of improvement in root growth and nodulation. These findings are in agreement with those reported by Bhuiyan *et al*. (1997), Singh *et al*. (1990), Prasad and Prasad (1994), Duyingqiong *et al*. (2002) and Chang and Sung (2004). Significantly higher haulm yield (3101 kg ha^{-1}) was recorded in the treatment T_{10}: RDF + 20 kg MgO ha^{-1} + 5 kg borax ha^{-1} (Table. 2) higher over control (1670 kg ha^{-1}) might be due to the deficiency of magnesium and boron which has been reported to help in seed formation, seed filling and weight. The increased growth and yield with the soil application of magnesium and boron in combination attributed to complementary effect of these nutrients on growth parameters, nutrient utilization efficiency and yield Subrahmaniyan *et al*. (2001). Boron being essential for N-fixation, which ensured better N supply to the crop and also improved plant height and dry matter accumulation in plant. This may be ascribed to the enhanced root development which improved nutrient uptake and growth as reported by (Dam *et al*., 2011 and Layek *et al*., 2014). It is concluded that soil application of RDF + 20 kg MgO ha^{-1} + 5 kg borax ha^{-1} found better in increasing pod and haulm yield. This was also evidenced by increased growth, yield attributes, quality parameters and uptake of nutrients.

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