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Influence of different levels of boron along with application of farmyard manure on nutrient uptake and yield of sesame

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ABSTRACT

The experiment was conducted on influence of different levels of boron on yield and nutrient uptake of Kharif sesame with application of farmyard manure at college farm, College of Agriculture, Rajendranagar during Kharif season of 2014 in split-plot design with two main treatments viz M_1 (recommended dose of fertilizers (RDF), 40-60-40 kg NPK/ha) and M_2 (RDF) along with application of 25 per cent N through farmyard manure and three sub-treatments viz S_1 (2.5 kg B/ha), S_2 (5.0 kg B/ha) and S_3 (7.5 kg B/ha). Application of RDF along with 25 per cent N through FYM recorded higher nutrient uptake, seed yield, stover yield and harvest index over application of RDF alone. Among boron levels application of 7.5 kg boron/ha recorded highest nutrient uptake, seed yield, stover yield and harvest index and it was on par with application of over application of 5.0 kg/ha.

Keywords: Sesame; farmyard manure; boron; nutrient uptake; yield

INTRODUCTION

Sesame, *Sesamum indicum* L (Pedaliaceae) is one of the most important oilseed crops extensively grown in different parts of the world and it ranks fourth among oilseed crops in the world.

Sesame is drought resistant crop which can easily be grown under rainfed conditions; has been grown all over the world for thousands of years and is said to be ancient crop in India. It can play an important role to fulfill the local demand of edible oil. Since it is short duration and photo-insensitive crop with wider adaptability, it can be cultivated throughout the year.

Prolonged use of chemical fertilizers alone in intensive cropping systems leads to unfavorable soil fertility, harmful effects on soil physico-chemical and biological properties and undermine sustainable crop production. Deficit of organic matter makes the situation worst for oilseed crops. Among the micronutrient deficiencies, boron deficiency is the second most dominant problem globally (Alloway 2008). The importance of boron deficiency has been reported by Chatterji and Nautiyal (2000). Among the micronutrients boron deficiency is one of the most wide spread micronutrient deficiency in India. Boron is involved in pollen germination. Its deficiency and toxicity cause lower chlorophyll content and rate of photosynthesis and may induce cell wall synthesis influencing the activity of the plasma lemma and can disturb the maintenance of meristem in the plants. Higher level of boron reduced seed yield and oil content (Bolanos et al 2004). It has been reported that boron is required for pollen germination and pollen tube growth (Dugger 1983). Boron deficiency can affect pollen viability and abortion of stamen and pistils which contribute to low seed set as reported by Chatterjee and Nautiyal (2000).

MATERIAL and METHODS

The present experiment on sesame was conducted during Kharif 2014 at college farm, College of Agriculture, Rajendranagar, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad. The farm is geographically situated at an altitude of 542.6 m amsl on 17^{o} 19' N latitude and 78^{o} 28' E longitude. It is located in the southern Telangana agro-climatic zone of the state. Hima (JCS 9426) suitable for Kharif, Rabi and summer conditions matures in 90 days with yield potential of 750 kg/ha. It is a short duration white seeded variety with long capsules. The soil of the experimental site was sandy loam in texture with pH of 7.9 and electrical conductivity 0.41 dS/m, low in organic carbon (0.40%) and available nitrogen (175 kg/ha), medium in available phosphorus (36 kg/ha), high in available potassium (342 kg/ha) and low in available sulphur (19.7 kg/ha).

The experiment was laid out side by side in a split-plot design with 6 treatments comprising two main plot treatments viz M_1 (recommended dose of fertilizers (RDF) and M_2 (RDF along with 25% N) through farmyard manure with three sub-plot treatments in each experiment viz three boron levels viz S_1 (2.5 kg B/ha), S_2 (5.0 kg B/ha) and S_3 (7.5 kg B/ha) replicated four times. Full dose of P_2O_5 and K_2O along with half of the nitrogen in all the treatments was applied as basal. Remaining nitrogen was applied 30 DAS.

RESULTS and DISCUSSION

Nutrient uptake

The sesame crop due to application of RDF along with 25 per cent N through FYM showed significant increase in the nitrogen uptake of seed and stover (12.70 kg/ha and 8.08 kg/ha respectively) than the uptake of nitrogen in seed and stalk crop under application of RDF alone (11.19 kg/ ha and stover 7.48 kg/ha respectively).

FYM improved the physico-chemical and biological properties, availability of macro and micronutrients and microbial activity in the root zone of plant to support vegetative growth. Similar findings were also reported by Tripathy and Bastia (2012). Data pertaining to nitrogen uptake of sesame crop as influenced by main treatments are presented in Fig 1.

In the sub-plots the nitrogen uptake was significantly more in the seed (15.30 kg/ha) and stover (8.30 kg/ha) of the sesame crop fertilized with S_3 (7.5 kg B/ha) and it was on par with S_2 (5.0 kg B/ha) [(14.87 kg/ha (seed), 8.16 kg/ha (stover)] and S_1 (2.5 kg B/ha [12.13 kg/ha (seed), 7.16 kg/ha (stover)] recording significantly lower uptake compared to other treatments. Data pertaining to nitrogen uptake of sesame crop as influenced by sub-treatments are presented in Fig 2. Application of boron (7.5 kg/ha) showed significant increase in nitrogen uptake due to its role in increase in nutrient uptake. Similar findings were made by Jeena et al (2013).

Phosphorus uptake

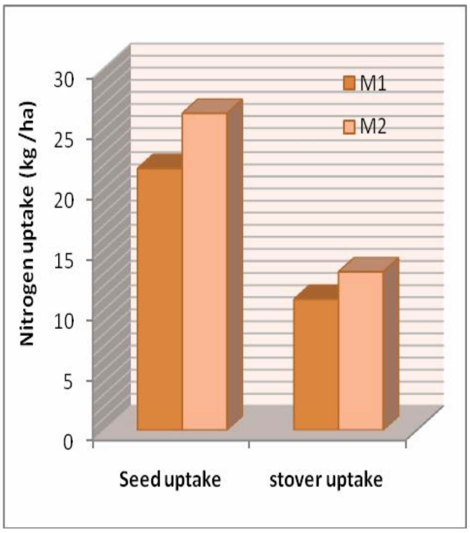
The sesame crop due to application of RDF along with 25 per cent N through FYM significantly increased the phosphorus uptake by seed (6.4 kg/ha) and stover (8.1 kg/ha) that was significantly greater than the uptake of nitrogen by seed and stover in case of RDF alone (4.5 kg/ha and 6.3 kg/ha respectively). Similar findings were reported by Tripathy and Bastia (2012). Data pertaining to phosphorus uptake as influenced by the treatments are presented in Fig 3.

In the sub-plots the phosphorus uptake was significantly more in the seed (4.6 kg/ha) and stover (6.4 kg/ha) of the sesame crop fertilized with S_3 (7.5 kg B/ha) and it was on par with application of S_2 (application of 5.0 kg B/ha [3.9 kg/ha (seed), 5.7 kg/ha (stover)] and S_1 (2.5 kg B/ha) [3.2 kg/ha (seed), 5.0 kg/ha (stover)] recording significantly lower uptake compared to other treatments. Data pertaining to phosphorus uptake as influenced by sub-treatments are presented in Fig 4. Similar views were reported by Patil et al (2006). Interaction effect of phosphorus uptake in seed and stover of sesame crop as influenced by main and sub-treatments was found non-significant.

Potassium uptake

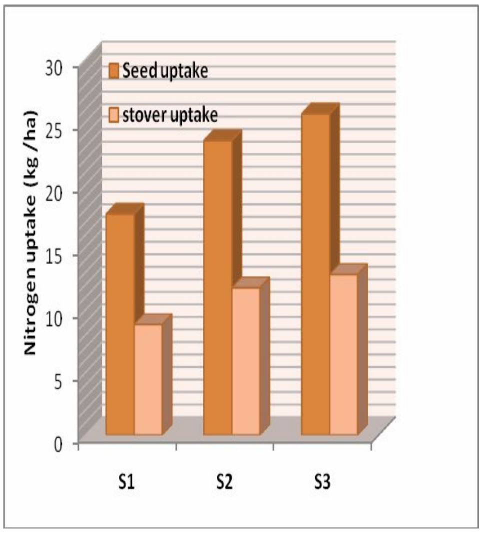
The application of RDF along with 25 per cent N through FYM significantly increased the potassium uptake by seed (14.63 kg/ha) and stover (29.72 kg/ha) that was significantly greater than the uptake of potassium by seed and stalk under RDF alone (14.63 kg/ha, 32.88 kg/ha respectively). Data pertaining to potash uptake as influenced by main treatments are presented in Fig 5.

In the sub-plots the potassium uptake was significantly more by seed



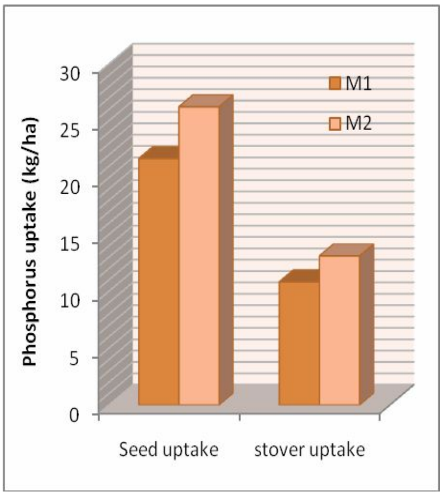
M_1: RDF, M_2: RDF along with 25% N through FYM

Fig 1. Nitrogen uptake (kg/ha) of sesame as influenced by main treatments



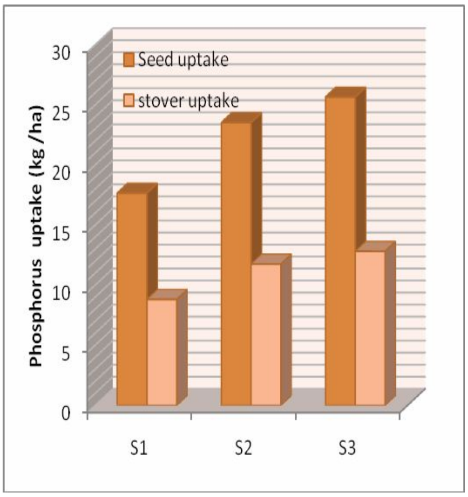
S_1: 2.5 kg S/ha, S_2: 5.0 kg S/ha, S_3: 7.5 kg S/ha

Fig 2. Nitrogen uptake (kg/ha) of sesame as influenced by sub-treatments



M_1: RDF, M_2: RDF along with 25% N through FYM

Fig 3. Phosphorus uptake (kg/ha) of sesame as influenced by main treatments



S_1: 2.5 kg S/ha, S_2: 5.0 kg S/ha, S_3: 7.5 kg S/ha

Fig 4. Phosphorus uptake (kg/ha) of sesame as influenced by sub-treatments

(16.91 kg/ha) and stover (28.18 kg/ha) with S_3 (7.5 kg B/ha) and it was on par with S_2 (5.0 kg B/ha) [16.10 kg/ha (seed), 30.98 kg/ha (stover)]. Significantly lowest uptake was recorded in S_1 (2.5 kg B/ha) [15.67 kg/ha (seed), 28.18 kg/ha (stover)] compared to other treatments. Data pertaining to phosphorus uptake as influenced by sub-treatments are presented in Fig 6.

Boron uptake

The crop due to application of RDF along with 25 per cent N through FYM significantly increased the boron uptake by seed (26.24 ppm) and stover (13.12 ppm) that was significantly greater than under application of RDF alone (21.68 ppm and 10.84 ppm respectively). Data pertaining to boron uptake as influenced by main treatments are presented in Fig 7. The higher boron uptake under application of RDF along with 25 per cent N through FYM might be due to beneficial effect of combined use of fertilizers and FYM. FYM improves the physico-chemical and biological properties, availability of macro and micronutrients and better microbial activity in the root zone of plant to support vegetative growth. Similar findings were reported by Tripathy and Bastia (2012).

Data pertaining to boron uptake as influenced by main treatments are presented in Fig 8. In the sub-plots the boron uptake was significantly more by the seed (25.67 ppm) and stover (12.83 ppm) in S_3 (7.5 kg B/ha) which was on par with S_2 (5.0 kg B/ ha) [23.54 ppm (seed), 11.77 ppm (stover)] and S_1 (2.5 kg B/ha [17.67 ppm (seed), 8.83 ppm (stover)] that recorded significantly lower uptake compared to other treatments. Application of boron (7.5 kgha) may have shown significant increase in boron uptake due to its role in increase in nutrient uptake. Similar findings were reported by Jeena et al (2013).

Yield

Data on yield viz seed yield (kg/ ha), stover yield (kg/ha) and harvest index (%) of sesame crop as influenced by application of boron with or without use of farmyard manure are presented in Table 1.

Seed yield was significantly influenced by main treatments ie application of RDF along with 25 per cent N through FYM. Seed yield was significantly higher (540 kg/ha) when the crop was fertilized with RDF along with 25 per cent N through FYM over application of RDF alone (461 kg/ha). Higher seed yield of sesame was obtained with RDF along with 25 per cent N through FYM which may be due to more availability of nutrients and their uptake. Similar findings were also reported by Saeed et al (2002) who stated that organic manure alone or in combination with synthetic fertilizers significantly increases grain and biological yield.

Within the sub-plots the seed yield was significantly higher (521 kg/ha) in S_3

(7.5 kg B/ha) and it was on par with S_2 (5.0 kg B/ha) (513 kg/ha). The seed yield with 2.5 kg B/ha was found significantly lower (350 kg/ha) compared to rest of the treatments. Application of boron 7.5 kg/ha owing to availability of more nutrients for plant growth parameters (plant height, number of branches/plant, leaf area index and dry matter/plant) and higher yield attributes (capsules/plant, seeds/capsule and test weight) proved best. These results are in line with those of Oyinlola (2007) and Patil et al (2006).

Interaction effect of seed yield of sesame crop influenced by main and sub-treatments was found to be non-significant.

Stover yield

Data on stover yield of sesame crop as influenced by application of boron with or without the use of farmyard manure are presented in Table 1.

Stover yield was significantly influenced by RDF along with 25 per cent N through FYM. Stover yield was significantly higher (1087 kg/ha) when the crop was fertilized with RDF along with 25 per cent N through FYM in comparison to sole application of RDF (938 kg/ha) at harvest. The increase in crop dry matter with organic sources might be attributed to considerable increase in plant height, number of branches and effective utilization of nutrients, moisture and light. These results tend to support the results of Barik and Fulmali (2011).

Within the sub-plots the stover yield of 1083 kg/ha was significantly higher than S_3 (7.5 kg B/ha) which was on par with S_2 (5.0 kg B/ha) (1008 kg/ha). The stover yield with 2.5 kg B/ha was found to be lower (904 kg/ha). Gitte et al (2005) reported that application of boron 7.5 kg/ha owing to availability of more nutrients for plant growth parameters like plant height, branches/plant and leaf area index and ultimately dry matter/plant increased the biological yield which might be due to role of boron in cell elongation, cell division and biomass accumulation.

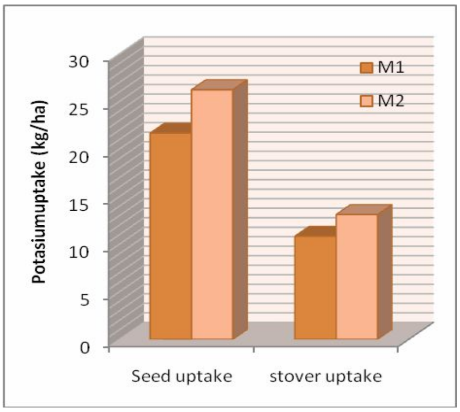
Interaction effect of stover yield influenced by main and sub-treatments was found to be non-significant.

Harvest index (%)

Data on harvest index (%) of sesame crop as influenced by application of boron with or without use of farmyard manure are presented in Table 1.

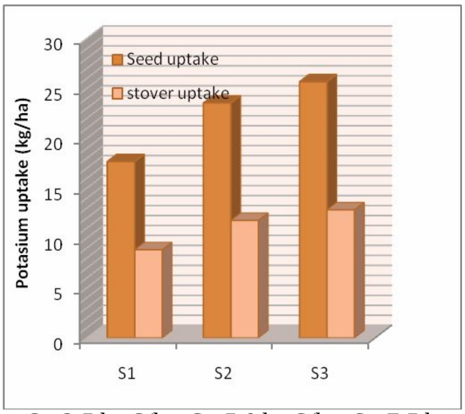
Sesame crop when applied with M_1 (RDF along with 25% N through FYM) recorded harvest index of 33.27 per cent compared to 32.30 per cent in M_1 (RDF) alone.

Within the sub-plots the harvest index of 34.43 per cent was significantly higher with S_3 (fertilized with 7.5 kg B/ha) which was on par with S_2 fertilized with 5.0 kg B/ha (34.12%). The harvest index with 2.5 kg B/ha was found to be lower



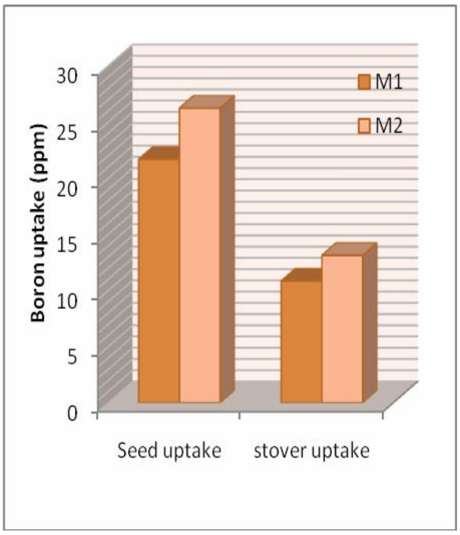
M_1: RDF, M_2: RDF along with 25% N through FYM

Fig 5. Potassium uptake (kg/ha) of sesame as influenced by main treatments



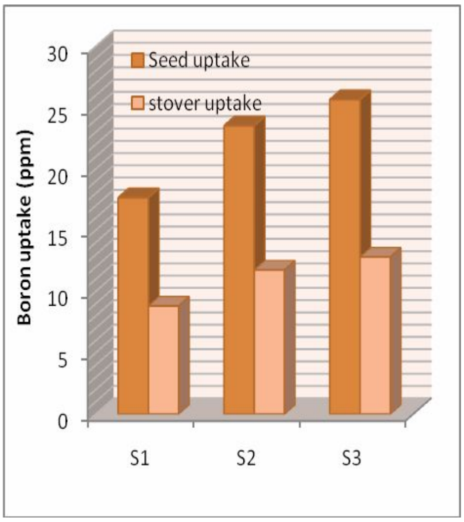
S_1: 2.5 kg S/ha, S_2: 5.0 kg S/ha, S_3: 7.5 kg S/ha

Fig 6. Potassium uptake (kg/ha) of sesame as influenced by sub-treatments



M_1: RDF, M_2: RDF along with 25% N through FYM

Fig 7. Boron uptake (ppm) of sesame as influenced by main treatments



S_1: 2.5 kg S/ha, S_2: 5.0 kg S/ha, S_3: 7.5 kg S/ha

Fig 8. Boron uptake (ppm) of sesame as influenced by sub-treatments

Table 1. Seed yield, stover yield and harvest index (%) of sesame as influenced by application of boron with or without FYM

Treatments	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest index
Main treatments			
M_1: RDF	461	938	32.95
M_2: RDF + 25% N through FYM	540	1087	33.20
SEm±	8.6	18.8	0.32
$CD_{0.05}$	27.8	60.1	NS
Sub-treatments (boron levels)			
S_1 : 2.5 kg/ha	385	904	31.42
S_2 : 5.0 kg/ha	513	1008	32.01
S_3 : 7.5 kg/ha	521	1083	32.50
SEm±	6.1	25.0	0.35
$CD_{0.05}$	19.0	77.0	NS
Interaction			
Sub-treatment at same level of main treatment			
SEm±	8.7	16.9	0.49
$CD_{0.05}$	NS	NS	NS
Main treatment at same/different level of sub-treatment			
SEm±	11.2	27.0	0.51
$CD_{0.05}$	NS	NS	NS

(31.81%) compared to rest of the treatments.

Interaction effect on harvest index of sesame crop influenced by main and sub-treatments was found to be non-significant.

Harvest index was maximum under RDF along with 25 per cent N through FYM when compared to RDF alone as RDF must have supplied nutrients for higher biomass, seed yield and partitioning of dry matter between seed and other plant parts. Increased harvest index of sesame crop may be due to its role in increase in assimilation transport from source to sink as reported by Shaker and Mohammed (2011).

CONCLUSION

From the present investigation, it can be concluded that application of RDF (40-60-40 kg NPK/ha) along with 25 per cent N through FYM for sesame crop was ideal for obtaining higher nutrient uptake, seed yield and stover yield. Among different levels of boron, application of boron (5.0 kg/ha) was found ideal for sesame in order to obtain higher nutrient uptake, seed yield and stover yield. However it was on par with application of 7.5 kg B/ha.

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