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Research Article

EFFECT OF FOLIAR APPLICATION OF ETHREL AND BORON ON MORPHOLOGICAL PARAMETERS, GROWTH CHARACTERISTICS AND YIELD IN GROUNDNUT (*ARACHIS HYPOGAEA L.)*

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ABSTRACT
A field study was conducted on groundnut (*Arachis hypogaea* L.) at Agricultural College Farm, Bapatla (A.P) during *kharif* season of 2011-12 in sandy soils with ten treatments foliar spray of ethrel @ 400 ppm, borax @ 0.25% alone and in combinations at 25 and 45 days after sowing with three replications. Results showed the significant differences in all the parameters studied. The foliar spray of ethrel + borax at 25 and 45 DAS (T_9) recorded significantly higher plant height, number of branches number of leaves, leaf area, total drymatter, number of flowers and flower to pod ratio than the other treatments. Growth characteristics viz., leaf area, LAI, AGR, RGR, CGR and NAR were also influenced by the foliar application of ethrel and boron Foliar spray of ethrel and boron significantly increased the yield and yield attributes. Higher yield (36.3 %) was recorded with ethrel (400ppm) + borax (0.25%) at 25 and 45 DAS over control. Yield in this treatment is more because increased translocation of sugars from source to sink and more retention of flowers.

Keywords: *Ethrel, Boron, Growth Characteristics, Yield, Groundnut*

INTRODUCTION
Groundnut (Arachis hypogaea L.) is one of the main oil yielding crops. In India it ranks first among the oilseed crops occupying an area of 7.28 mha with 7.85mt production and 1078 kg ha^{-1} productivity. In Andhra Pradesh, groundnut is cultivated in an area of 1.90 m ha with a production of 1.20mt and 652 kg ha^{-1} productivity which is much lower than the world's average. For enhancing productivity of a crop, the essence of modern agriculture balanced plant nutrition is necessary in order to maintain the physical organization and metabolic processes. Apart from role of macro nutrients, the micronutrients also play an important role in regulating plant functions. Boron plays an important role in the physiological processes of plants, such as, cell elongation, cell maturation, meristematic tissue development and protein synthesis. It regulates flowering, fertilization, hormonal metabolism and translocation of sugars from source to sink, thus contributes to an increase in seed yield (Marschner, 1995; Cakmak and Romheld, 1997).
The use of growth regulators not only accelerate growth but also help in the augmentation of produce (Ferres, 1951; Nayler and Davis, 1950). Ethrel effects on various physiological processes at different stages of plant growth and development are well known (Khan *et al*., 2000). Foliar spray of ethrel application at low concentration recorded maximum number of secondary branches and total dry matter per plant. Ethrel at 500ppm significantly increased the chlorophyll content in leaves and yield of mustard (Grewal *et al*., 1993).
The morpho- physiological and biochemical parameters are known to affect the yield in many ways, as they are inter linked with photosynthetic process. Hence the present study was taken up to identify the influence of growth regulators and nutrients on morpho-physiological and growth characteristics, which have close relationship with fruit yield.

METERIALS AND METHODS
A field experiment was carried out at Agricultural College Farm, Bapatla (Andhra Pradesh, India) during *kharif* season of 2011-2012 in a randomized block design with three replications to study the effect of

foliar application of ethrel and boron on morphological parameters, growth characteristics and yield in groundnut. The experiment consisted of 10 treatments *vz.*, T_1: ethrel @ 400 ppm at 25 DAS, T_2: ethrel @ 400 ppm at 45 DAS, T_3: ethrel @ 400 ppm at 25 and 45 DAS, T_4: borax @ 0.25% at 25 DAS, T_5: borax @ 0.25% at 45 DAS, T_6: borax @ 0.25% at 25 and 45 DAS, T_7: ethrel @ 400 ppm + borax @ 0.25% at 25 DAS, T_8: ethrel @ 400 ppm + borax @ 0.25% at 45 DAS, T_9: ethrel @ 400 ppm + borax @ 0.25% at 25 and 45 DAS. The soil of the experimental field was sandy in texture, acidic in reaction (6.1 pH) with 0.17 % organic carbon, 83.61 kg ha^{-1}available phosphorus and 100.08 kg ha^{-1}available potash. After good tillage field was manured with well decomposed FYM @ 5 t ha^{-1}. The seeds of groundnut variety TAG 24 were sown at a spacing of 30cm x 10cm and fertilized with recommended dose of N:P:K (30:40:50 kg ha^{-1} respectively) along with gypsum @ 500 kg ha^{-1}.The cultural management and plant protection measures were undertaken as and when needed.

Treatment wise spraying was given as per the schedule. Five representative plants were selected randomly in each plot, labeled properly and observations on morphological parameters, physiological characteristics were recorded periodically and yield was recorded at harvest. The data were analyzed statistically following the analysis of varience (ANOVA) technique as suggested by Panse and Sukhathme (1978) for Randomized block design.

RESULTS AND DISCUSSION

The foliar spray of ethrel and boron significantly influenced the morphological characteristics and yield in groundnut (Table 1)

Foliar application of ethrel (400 ppm) + borax(0.25%)at 25 and 45 DAS (T9) recorded the highest plant height (59.2 cm) compared to all other treatments except ethrel (400 ppm) + borax (0.25%) at 45 DAS (T8-53.3 cm).

The lowest plant height was observed in control plants (33.1 cm). Maximum number of branches (43) recorded with ethrel(400 ppm) + borax (0.25%)at 25 and 45 DAS (T9) was on par with the effect of ethrel + borax at 45 DAS (T8), ethrel + borax at 25 DAS (T7), ethrel at 25 and 45 DAS (T3) and borax at 25 and 45 DAS (T6) and significantly superior to remaining treatments.

More number of leaves (49.9) were recorded with ethrel (400 ppm) + borax (0.25%) at 25 and 45 DAS (T_9) and it was on par with the spray of ethrel at 25 and 45 DAS (46.0), ethrel + borax at 25 DAS (45.8) and ethrel at 25 and 45 DAS (45.7).

Application of ethrel and boron alone and in combination sprays contributed to significant differences in number of flowers over control.

Among all the treatments, spray of ethrel + borax at 25 and 45 DAS (T_9) resulted in more number of flowers (36.6) which was on par with the sprays of ethrel + borax at 45 DAS (T_8 –32.4), ethrel at 25 and 45 DAS (T_3-32.2), borax at 25 and 45 DAS (T_6- 31.9), and ethrel at 45 DAS (T_2- 30.1).

Lower value was recorded with control. Increase in growth with ethrel and boron sprays might be due to its involvement of in the regulation of cell division and cell elongation, tissue and tissue differentiation, ion absorption, IAA and carbohydrate metabolism, and translocation of sugars (Marschner, 1995; Cakmak and Romheld, 1997).

Similar increase in growth was reported by Bangar *et al.,* (2010) in soybean and Rizwan *et al.,* (2011) in sunflower and Shankhe *et al.,* (2003) in groundnut. The higher yield was obtained in foliar application of ethrel @ 400 ppm + borax @ 0.25% at 25 and 45 DAS (4521.5 kg ha^{-1}) followed by of borax @0.25% at 25 and 45 DAS (4326.7 kg ha^{-1}) and borax @0.25% at 25 DAS (2260.6 kg ha^{-1}) where as in control it was only (3700.5 kg ha^{-1}).

This increased pod yield might be due to involvement of nutrient element boron, the growth regulator ethrel. Boron might have played important role in flowering, fertilization, hormonal metabolism and translocation of sugars from source to sink (Mallick and Sawhney, 1998). The results obtained are in accordance with the findings of Narasimha *et al.,* (2005). Saxena *et al*., (2007) findings support the above results that foliar spray of ethrel (250 ppm) at pre flowering and mid flowering stages of chickpea increased the yield by 11 and 14 % respectively.

Table 1: Impact of ethrel and boron on morphological characteristics and yield of groundnut

Treatments	Plant height (cm)	Number of branches	Number of leaves	Number of flowers	Flower to pod ratio	Yield (kg/ha)
T1: Etheral 400ppm at 25 DAS	44.2	32.0	41.8	25.1	1.04	2176.8
T2: Etheral 400ppm at 45 DAS	40.3	35.3	44.3	30.1	1.23	2194.0
T3: Etheral 400ppm at 25 and 45 DAS	50.1	41.9	46.0	32.2	1.28	2189.5
T4: Borax 0.25% at 25 DAS	47.9	32.3	40.7	27.7	1.10	2260.7
T5: Borax 0.25% at 45 DAS	44.9	33.5	41.7	29.4	1.17	2169.4
T6: Borax 0.25% at 25 and 45 DAS	49.6	41.0	43.3	31.9	1.22	2179.8
T7: Etheral 400ppm + Borax 0.25% at 25 DAS	50.7	40.7	45.8	28.7	1.12	2223.7
T8: Etheral 400ppm + Borax 0.25% at 45 DAS	53.3	40.3	45.7	32.4	1.25	2238.4
T9: Etheral 400ppm + Borax 0.25% at 25 and 45 DAS	59.2	43.0	49.9	36.6	**1.36**	2700.0
T10: Water spray (control)	33.1	31.2	30.3	22.6	1.00	1980.8
SEm+	2.0	1.7	1.6	2.2	-	99.5
CD	6.0	5.2	4.9	6.6	-	295.7
CV (%)	7.4	8.1	6.6	12.9	-	7.7

Table 2: Impact of Ethrel and Boron on growth and growth characteristics of groundnut

Treatments	Total dry matter (g plant^{-1})	Leaf area (cm^2)	LAI (75 DAE)	AGR Cm d^{-1} (30-45 DAE)	CGR g m^{-2} d^{-1} (30-45 DAE)	RGR Mg g^{-1} d^{-1} (30-45 DAE)	NAR Mg cm^{-2} d^{-1} (30-45 DAE)	RWC (%) (75 DAE)
T1: Ethrel 400ppm at 25 DAS	32.0	965.0	3.22	0.62	17.71	32.33	0.82	83.2
T2: Ethrel 400ppm at 45 DAS	31.1	999.7	3.33	0.53	14.89	27.25	0.64	82.5
T3: Ethrel 400ppm at 25 and 45 DAS	35.5	1166.7	3.89	0.60	16.97	28.60	0.68	83.6
T4: Borax 0.25% at 25 DAS	28.4	1127.3	3.76	0.65	15.46	33.22	0.66	81.9
T5: Borax 0.25% at 45 DAS	27.5	1146.7	3.82	0.53	17.93	38.66	0.73	83.5
T6: Borax 0.25% at 25 and 45 DAS	38.3	1293.0	4.31	0.65	18.60	32.99	0.70	85.6
T7: Ethrel 400ppm + Borax 0.25% at 25 DAS	38.3	1479.3	4.93	0.60	17.26	28.28	0.59	83.8
T8: Ethrel 400ppm + Borax 0.25% at 45 DAS	40.3	1664.3	5.55	0.73	16.60	27.34	0.55	86.4
T9: Ethrel 400ppm + Borax 0.25% at 25 and 45 DAS	43.0	1768.0	5.89	0.83	21.06	32.05	0.68	85.1
T10: Water spray (control)	24.8	911.3	3.04	0.36	13.04	29.75	0.79	78.4
SEm+	1.6	103.8	0.35	0.03	0.65	1.95	0.04	1.2
CD	4.8	308.3	1.03	0.09	1.93	5.79	0.13	3.6
CV (%)	8.2	14.4	14.36	8.52	6.64	10.87	10.78	

Significant differences in growth characteristics were found due to ethrel and boron spray at all stages of plant growth (Table 2). All foliar sprays increased the growth characteristics over control. Among the treatments combined spray of ethrel 400ppm + borax 0.25% at 25 and 45 DAS (T9) recorded maximum leaf area (1768.0 cm2), dry matter (43.0 g), LAI ((5.89) followed by the sprays of ethrel 400ppm +borax 0.25 % at 45 DAS (1664.3 cm2, 40.3 g and 5.55 respectively), ethrel + borax at 25 DAS (T7 -1479.3 cm2, 38.3g and 4.93). The minimum was recorded with control. The data on AGR, CGR, RGR and NAR indicated that there was a decrease in AGR, CGR, RGR and NAR as growth stage advanced and high AGR, CGR, RGR and NAR were noticed at 35-45 DAE. . Among the treatments combined spray of ethrel 400ppm + Borax 0.25% at 25 and 45 DAS (T9) recorded higher AGR (0.83 cm d-1), CGR (21.06 g m-2 d-1) and RGR (32.05 mg g^{-1} d^{-1}) than the remaining treatments. Spray of ethrel at 25 DAS (T_1) recorded higher NAR (0.82 mg cm-2 d-1) than control and other treatments except borax at 25 and 45 DAS (T_6 -0.70 mg cm-2 d-1) and borax at 45 DAS (T_5 -0.73 mg cm^{-2} d^{-1}). Among sprays at 75 DAE, spray of ethrel + borax at 45 DAS showed high RWC (T_8 -86.4 %) followed by the other sprays (83.2 % to 85.6 %) except T_2 and T_4 which were on par with control. The above results were in harmony with the findings of Sarkar *et al.,* (1998) who reported the increase in the growth characteristics like CGR and LAI due to increased dry matter accumulation and leaf area with the spray of borax on groundnut. Nagasubramanium *et al.,* (2007) reported that foliar application of ethrel recorded higher CGR (14.57 g m^{-2} d^{-1}) than control in corn plants.

Conclusion

From these results it can be concluded that foliar application of ethrel (400ppm) + borax (0.25%) at 25 and 45 DAS increased the morphological parameter and growth characteristics and yield in groundnut.

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