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Effect of Boron, Brasssinosteroids and Salicylic Acidon Growth, Dry Matter Production and Yield of Chick Pea

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ABSTRACT

The present investigation entitled "Physiological effects of Boron, Brasssinosteroid and Salicylic acidon growth, dry matter production and yield of chickpea (*Cicer arietinum* L.)" was undertaken at the Agricultural College Farm, Bapatla during *rabi* 2013-14.The experiment was laid out in randomized block design with eight treatments *viz.,* Brassinosteroid @ 1ppm at 25DAS (T_1), Salicylic acid@ 20ppm at 35DAS (T_2), Borax @ 0.25% at 45DAS (T_3), Brassinosteroid @ 1ppm at 25DAS + Salicylic acid @ 20ppm at 35DAS (T_4), Brassinosteroid @ 1ppm at 25DAS + Borax @ 0.25% at 45DAS (T_5), Salicylic acid @ 20ppm at 35DAS + Borax @ 0.25% at 45DAS (T_6), Brassinosteroid @ 1ppm at 25DAS + Salicylic acid @ 20ppm at 35DAS + Borax @ 0.25% at 45DAS (T_7) and Control (T_8) in three replications. Application of Brassinosteroid at 25DAS, Salicylic acidat 35DAS and Borax at 45DAS (T_7) exhibited higher performance by increasing plant height by 13.9 per cent. Brassinosteroid at 25DAS, Salicylic acidat 35DAS and Borax at 45DAS (T_7), produced high amount of total dry matter, which was 27.14 per cent higher than the control and 9.0 to 27.14 per cent higher than remaining treatments. The same treatment resulted in an increase of 23.29 per cent in pod yield ha^{-1} and 23.12 per cent in harvest index compared to control.

Key words: *Brassinosteroids (BR), Growth, Salicylic acid, Boron, Total Dry matter, Yield.*

Chickpea (*Cicer arietinum* L.) is an important pulse crop grown all over the country during *rabi* season. In India it is grown on an area about 8.32 million hectares with an annual production of 7.58 million tones with an average yield of 912 kg ha^{-1}. Chickpea occupies 40% of total pulse growing area and 47% of the total pulse production in the country.

Chickpea is self pollinated annual herbaceous food legume originated in South Eastern Turkey and subsequently spread to India and Europe (Singh and Auckland, 1975). It is generally grown in arid or semi-arid climates where soils are generally marginal in their physico-chemical characteristics.

Nutritionally, Chickpea is relatively free from various anti-nutritional factors, has high protein digestibility than other pulses (Ramalho-Ribero and Portugal, 1988). Apart from high protein content (20-22%), chickpea is also rich in fiber and minerals (Phosphorus, Calcium, Magnesium, Iron and Zinc). It possesses the lipids containing high fraction of unsaturated fatty acid (William and Singh, 1987).

Many reports are available stating that foliar application of brassinosteroids significantly improved the growth, dry matter production and yield under moisture deficit conditions and ameliorates the adverse effects of abiotic stresses (Bajguz and Hayat, 2009).

Salicylic acid (SA) (2-hydroxybenzoic acid) is a simple natural phenolic signaling molecule, which plays an important role in regulating a number of physiological processes in plants. As its external application affects many plant physiological processes, some have recognized it as a plant growth regulator.

Boron is an important micronutrient, plays an important role in flower retention, pollen fertility and germination, pod setting and development. Thus the necessity of Boron is more for reproductive development than for vegetative growth.

The aim of present research was to study the effect of three chemicals (Brassinosteroids, Salicylic acid and Boron) on growth, dry matter production and yield in chickpea.

MATERIAL AND METHODS

The field experiment was conducted during the *rabi* season of 2013-14 at Agricultural College, farm Bapatla to investigate "Physiological effects of Boron, Brasssinosteroid and Salicylic acid on

growth, dry matter production and yield of chickpea (*Cicer arietinum*)". The experiment was laid out in randomized block design with eight treatments *viz.,* Brassinosteroid @ 1ppm at 25DAS (T_1), Salicylic acid@ 20ppm at 35DAS (T_2), Borax @ 0.25% at 45DAS (T_3), Brassinosteroid @ 1ppm at 25DAS + Salicylic acid@ 20ppm at 35DAS (T_4), Brassinosteroid @ 1ppm at 25DAS + Borax @ 0.25% at 45DAS (T_5), Salicylic acid@ 20ppm at 35DAS + Borax @ 0.25% at 45DAS (T_6), Brassinosteroid @ 1ppm at 25DAS + Salicylic acid@ 20ppm at 35DAS + Borax @ 0.25% at 45DAS (T_7) and Control (T_8) in three replications. Growth parameters and yield attributes were recorded and subjected to statistical analysis for testing variations among treatments.

RESULTS AND DISCUSSION

Growth characteristics:

In the present investigation, plant height increased continuously, however the rate of increase declined from 55 DAS to harvest. The spray of Brassinosteroid at 25DAS + Salicylic acidat 35DAS + Borax at 45DAS (T_7) exhibited higher performance by increasing plant height by 17 per cent over control and by 8 to 16 per cent compared to the remaining treatments.

It was noticed that the treatment with application of Brassinosteroid at 25DAS + Borax at 45DAS (T_5-7.00), Brassinosteroid at 25DAS + Salicylic acidat 35DAS + Borax at 45DAS (T_7-7.33), Salicylic acid at 35DAS (T_2 -7.33), Borax at 45DAS (T_3-7.67) ,Brassinosteroid at 25DAS (T_1-7.67), Brassinosteroid at 25DAS + Salicylic acid at 35DAS (T_4-7.67) and Salicylic acidat 35DAS + Borax at 45DAS (T_6-8.33) dropped low number flowers when compared to the control (T_8-10.00) and the treatments on par with each other, significantly decreases when compared to the control.

Same as the number of flowers dropped, the number of flowers aborted also showed significantly decreased. Among the treatments spraying of Brassinosteroid at 25DAS + Salicylic acidat 35DAS + Borax at 45DAS (T_7) dropped low number of flowers (6.33) followed by Borax at 45DAS (T_3-7.00), Brassinosteroid at 25DAS + Borax at 45DAS (T_5-7.33), Brassinosteroid at 25DAS + Salicylic acidat 35DAS (T_4-7.33), Salicylic acidat 35DAS + Borax at 45DAS (T_6-7.33), Brassinosteroid at 25DAS (T_1-7.67) when compared to the control (T_8-12.67).

The number of flowers developed in to pods showed significant differences by the sprays Brassinosteroid, Salicylic acidand Borax. Among all the treatments the number of flowers developed in to pods will be high by the spraying of Brassinosteroid at 25DAS + Salicylic acidat 35DAS + Borax at 45DAS (T_7-22.33) followed by Brassinosteroid at 25DAS + Borax at 45DAS (T_5-21.67), Salicylic acidat 35DAS + Borax at 45DAS (T_6-21.33), Borax at 45DAS (T_3-21.00), Brassinosteroid at 25DAS (T_1-21.00) and Salicylic acid at 35DAS (T_2 -20.00) which were on par with each other and showed significant differences with control (T_7-15.00).

Among all the treatments spraying of Brassinosteroid at 25DAS + Salicylic acidat 35DAS + Borax at 45DAS (T_7) show less number of flowers dropped, less number of flowers aborted and more number of pods developed i.e the pod setting percentage is more when compared to other treatments.

At maturity, application of Boron, Brasssinosteroid and Salicylic acidcontributed significant difference in Total dry matter over control, ranges from 10.28 g plant^{-1} to 13.07 g plant^{-1} with an average of 11.98 g plant^{-1}. Spraying of Brassinosteroid @ 1ppm at 25DAS + Salicylic acid@ 20ppm at 35DAS + Borax @ 0.25% at 45DAS (T_7-13.07 g plant^{-1}) showed higher value, which was on par with Brassinosteroid @ 1ppm at 25DAS + Borax @ 0.25% at 45DAS (T_5-13.02 g plant^{-1}). Salicylic acid@ 20ppm at 35DAS+ Borax @ 0.25% at 45DAS (T_6-12.48 g plant^{-1}), Borax @ 0.25% at 45DAS (T_3-12.47g plant^{-1}), Brassinosteroid @ 1ppm at 25DAS (T_1-12.41 g plant^{-1}) and Brassinosteroid @ 1ppm at 25DAS + Salicylic acid@ 20ppm at 35DAS (T_4-12.13 g plant^{-1}), which are significantly differed with the control.

Total dry matter accumulated in vegetative parts and its further translocation from source to sink is the major factor that governs the economic yield of the crop. A higher amount of total dry matter accumulation observed due to Boron, Brassinosteroid and Salicylic acidapplication might be due increased leaf number, leaf area, fresh weights of stem and leaf photosynthetic pigments

Table 1. Effect of Brassinosteroid, Salicylic acid and Boron Foliar Sprays on Growth Characteristics and Total Dry Matter of Chickpea at Maturity Stage.

Treatments	Plant height (cm)	Total dry matter (g plant^{-1})	No of flowers produced	No of flowers dropped	No of flowers aborted	No of pods developed
T_1	43.39	12.14	36.33	7.67	7.67	21.00
T_2	41.89	10.32	37.33	7.33	10.00	20.00
T_3	43.46	12.47	35.67	7.67	7.00	21.00
T_4	43.65	12.13	35.67	7.67	7.33	20.67
T_5	45.56	13.02	36.00	7.00	7.33	21.67
T_6	43.89	12.48	37.00	8.33	7.33	21.33
T_7	46.37	13.07	36.00	7.33	6.33	22.33
T_8	40.71	10.28	37.67	10.00	12.67	15.00
SEm±	0.64	0.421	0.827	0.415	0.3753	1.1225
CD	1.92	1.29	NS	1.256	1.135	3.394
CV (%)	6.57	6.22	NS	9.13	7.91	9.42

T_1- Brassinosteroid @ 1ppm at 25DAS T_2- Salicylic acid @ 20ppm at 35DAS T_3- Borax @ 0.25% at 45DAS T_4- Brassinosteroid @ 1ppm at 25DAS + Salicylic acid @ 20ppm at 35DAS T_5- Brassinosteroid @ 1ppm at 25DAS + Borax @ 0.25% at 45DAS T_6- Salicylic acid @ 20ppm at 35DAS + Borax @ 0.25% at 45DAS T_7- Brassinosteroid @ 1ppm at 25DAS + Salicylic acid @ 20ppm at 35DAS + Borax @ 0.25% at 45DAS T_8-control.

Table 2. Effect of Brassinosteroid, Salicylic acid and Boron on Test weight (g), Seed yield (Kg ha^{-1}) and Harvest index (%) of Bengal gram.

Treatments	Test weight (g)	Seed yield (Kg ha^{-1})	Harvest index (%)
T_1	31.74	1220.56	31.42
T_2	31.18	1218.95	31.36
T_3	31.47	1219.00	31.14
T_4	31.94	1235.51	31.90
T_5	32.69	1238.37	31.92
T_6	31.96	1230.33	31.85
T_7	33.46	1273.67	32.96
T_8	28.96	1033.00	26.77
SEm±	0.649	60.529	1.406
CD	1.962	183.61	4.267
CV (%)	3.59	8.80	8.02

T_1- Brassinosteroid @ 1ppm at 25DAS T_2- Salicylic acid @ 20ppm at 35DAS T_3- Borax @ 0.25% at 45DAS T_4- Brassinosteroid @ 1ppm at 25DAS + Salicylic acid @ 20ppm at 35DAS T_5- Brassinosteroid @ 1ppm at 25DAS + Borax @ 0.25% at 45DAS T_6- Salicylic acid @ 20ppm at 35DAS + Borax @ 0.25% at 45DAS T_7- Brassinosteroid @ 1ppm at 25DAS + Salicylic acid @ 20ppm at 35DAS + Borax @ 0.25% at 45DAS T_8-control.

in the plants. These all factors reflect towards dry matter production. Boron might have played important role in increasing leaf area, leaf area index and higher photosynthetic rate as reflected through the total dry matter. The above results were in support with the findings of Bangar *et al.* (2010) in soybean.

Yield and its components

Foliar application of Brassinosteroid @ 1ppm at 25DAS + Salicylic acid@ 20ppm at 35DAS + Borax @ 0.25% at 45DAS (T_7) significantly increased the test weight of seeds. This trait plays a vital role in crop improvement being affected by large number of physiological mechanisms including dry matter production and portioning. Higher test weight was recorded in T_7 *i.e.*33.46 g followed by T_5 *i.e.* Brassinosteroid @ 1ppm at 25DAS + Borax @ 0.25% at 45DAS (32.69g), T_6 *i.e.* Salicylic acid@ 20ppm at 35DAS + Borax @ 0.25% at 45DAS (31.96 g), Brassinosteroid @ 1ppm at 25DAS + Salicylic acid@ 20ppm at 35DAS (T_4 -31.94 g) and Brassinosteroid @ 1ppm at 25DAS (T_1-31.74 g) which were on par with T_7. All the treatments showed significant difference over the control. Lower test weight was recorded in control T_8 (28.96 g).

Among all the treatments, spray of Brassinosteroid @ 1ppm at 25DAS + Salicylic acid@ 20ppm at 35DAS + Borax @ 0.25% at 45DAS (T_7) recorded higher seed yield ha^{-1} (1273.67 kg ha^{-1}) followed by Brassinosteroid @ 1ppm at 25DAS + Borax @ 0.25% at 45DAS (T_5-1238.37 kg ha^{-1}), Brassinosteroid @ 1ppm at 25DAS + Salicylic acid@ 20ppm at 35DAS (T_4-1235.51 kg ha^{-1}), Salicylic acid@ 20ppm at 35DAS + Borax @ 0.25% at 45DAS (T_6-1230.33 kg ha^{-1}), Brassinosteroid @ 1ppm at 25DAS (T_1-1220.56 kg ha^{-1}), Borax @ 0.25% at 45DAS (T_3-1219.00 kg ha^{-1}) and Salicylic acid@ 20ppm at 35DAS (T_2-1218.95 kg ha^{-1}) which were on par with each other. All the other treatments significantly increased yield over control (T_8).

Spray of Brassinosteroid @ 1ppm at 25DAS + Salicylic acid@ 20ppm at 35DAS + Borax @ 0.25% at 45DAS (T_7) reported an increase of 23.30 % in pod yield over control (T_8).

It is clear from the study that, bioregulators application plays an important role in promoting growth, development, and metabolism of plants by increasing the photosynthetic activity thereby enhancing the productivity in chickpea.

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