



Amelioration of sodicity stress in groundnut genotypes using growth regulating substances

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Abstract: The investigation was aimed at to alleviate the adverse effects of salt stress with plant growth regulating chemicals through foliar spray. The variety CO4 and ALR3 were imposed with foliar spray of CaCl_2 1 %, BR 0.5 ppm, BR 1 ppm, SA 50 ppm, SA 100 ppm, KNO_3 1 %, DAP 2 % and nutrient mixture at preflowering, pegging and pod formation stages. The yield parameters like flower production and peg number was improved by BR treatment. Because of high fertility coefficient, the number of pods produced per plant was also increased considerably. The role of BR in facilitating the partitioning of assimilates could also be revealed through improved seed weight and high harvest index. The overall performance of BR, therefore, reflected on pod yield of groundnut in both the varieties. The application of BR 1 ppm through foliar spray at preflowering, pegging and pod formation stages effectively enhanced the overall physiological efficiency of the crop and improved the yield in both tolerant and sensitive varieties of groundnut grown under salt stress conditions.

I. INTRODUCTION

The role of many plant growth regulating chemicals in alleviating the adverse effects of stresses and imparting adaptation has been reviewed [1]. Brassinosteroids are a novel group of plant hormones that regulate cell division, cell expansion, reproductive development, retard leaf abscission and enhance resistance to stress through stabilizing membranes and DNA [2]. Salicylic acid has been shown to be essential for the plant protection against oxidative stress generated by environmental stresses. Therefore, it is directly involved in the defense mechanisms developed by the plants under stress conditions, particularly salt and osmotic stresses [3]. Several studies have shown that calcium alleviates growth inhibition by salt of glycophytic plants [4]. Development of amelioration technology may pave the way for improving growth and yield of crop plants, particularly sensitive species, growing under the hostile environments. Based on these backgrounds, the present study was formulated with the objective to evaluate the efficacy of various growth regulating chemicals on mitigating the stress effects and to select the cost effective ameliorant for higher productivity.

II. MATERIALS AND METHODS

A field experiment was carried out to study the effect of various plant growth regulating chemicals on alleviating the adverse effects of sodicity stress in groundnut. The two varieties CO4 (M_1) and ALR3 (M_2) imposed with foliar spray of Water (S_1), CaCl_2 1 % (S_2), BR 0.5 ppm (S_3), BR 1 ppm (S_4), SA 50 ppm (S_5), SA 100 ppm (S_6), KNO_3 1 % (S_7), DAP 2 % (S_8), and Nutrient mixture (S_9): DAP (1 %) + KNO_3 (0.5 %) + FeSO_4 (0.5 %) + Borax (0.2 %) + NAA (20 ppm) + SA (50 ppm) + BR (1 ppm). These treatments were imposed as foliar sprays on 25th, 55th, and 85th DAS coinciding with preflowering, pegging and pod formation stages. The soil Exchangeable Sodium Percentage Was 16 %. yield components such as number of flowers per plant, number of pegs per plant, number of pods per plant, fertility coefficient, shelling percentage, 100 seed weight and harvest index were recorded at the time of harvest, besides pod yield.

III. RESULT & DISCUSSION

Number of flowers per plant differed significantly among main plot and sub plot treatments. Comparing the two main plots, M_1 recorded more number of flowers (64) than M_2 (56). The sub plot treatment S_4 registered a maximum number of 63 flowers per plant followed by S_3 (62) and S_5 (61), which were significantly higher than control. The effect of other treatments on flower production was also significantly higher than control. The highly positive correlation between the number of flowers produced during the early reproductive phase and productivity was reported in groundnut and plant growth regulators were found to induce more number of flowers in lesser number of days leading to increased pod weight and yield [5].

The two main plot treatments differed significantly with respect to number of pegs per plant. M_1 produced more number of pegs (33) than M_2 (32). All the subplot treatments showed their significant effects on number of pegs per plant over control. S_4 was the most effective one with the peg number of 36.6 followed by S_3 (34.9). Under unsprayed control the number of pegs produced per plant was 29.6.

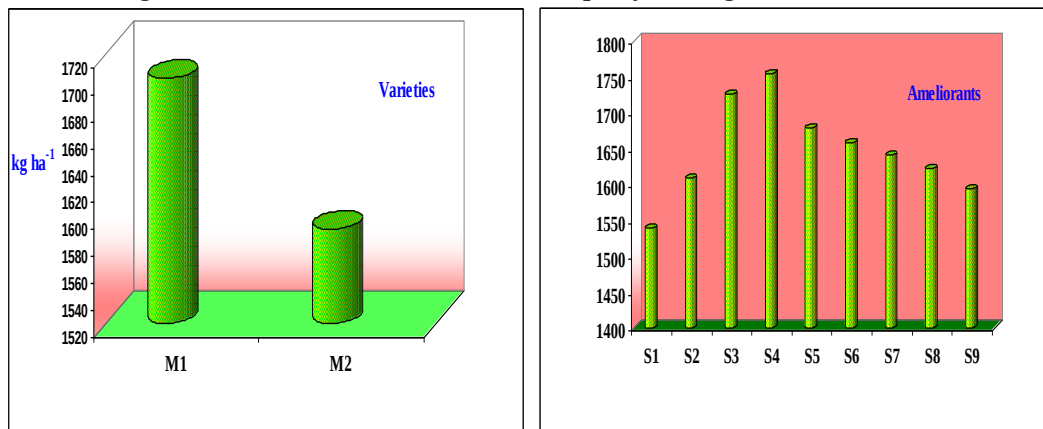
Number of pods per plant varied significantly between the two main plot treatments. M_1 recorded 26 numbers of pods per plant, whereas M_2 recorded around 22 pods per plant. All the subplot treatments were effective in improving the pod number significantly over control. Among them S_4 recorded the highest value of 26.8 followed by S_3 (25.5) and S_5 (25.1). All these treatments were significantly differed from each other. As the number of pods per plant is one of the important yield determining factors in groundnut, the reduction in pod number would have a direct reflection on total pod yield [6].

The fertility coefficient differed significantly between the two main plot treatments and M_2 recorded significantly higher value of 40.1 per cent, which was significantly higher than M_1 . All the sub plot treatments were significantly more effective than control in improving the fertility coefficient. Among them, S_4 recorded the highest fertility coefficient of 42.5 per cent. All the other treatments, except S_8 and S_9 were on par with each, but showed significantly higher value than control. The study conducted by [7] also indicated that *Arabidopsis* mutant that accumulated reduced amount of endogenous BR grown as dwarfs and their fertility was greatly impaired.

Two main plot treatments significantly differed with respect to 100 seed weight. M_1 being the best main plot treatment, registered a considerably higher 100 seed weight of 51, whereas M_2 had a weight of 42. All the subplot treatments except S_9 influenced the 100 seed weight in both the main plots. S_4 , being an effective treatment, registered the highest value of 49 with an 11 per cent increase over control. This treatment was followed by S_3 (48.38), S_5 (47.9) and S_6 (47.2), which influenced the 100 seed weight with 9, 8 and 6 per cent increase over control.

Pod yield varied significantly among main plot and sub plot treatments. M_1 recorded significantly higher mean pod yield of $1702.4 \text{ kg ha}^{-1}$, whereas M_2 recorded a mean yield of $1590.1 \text{ kg ha}^{-1}$. All the subplot treatments significantly influenced the pod yield of the two varieties. Among them, S_4 registered the highest mean yield of $1754.2 \text{ kg ha}^{-1}$, followed by S_3 with the mean yield of $1725.2 \text{ kg ha}^{-1}$. These two elite treatments were followed by S_5 (1678.9), S_6 (1657.6), S_7 (1640.3), S_8 (1621.6) and S_2 (1608.3). The influence of S_9 (1592.6) was found to be less, though significantly higher than S_1 , which recorded the lowest yield of $1537.7 \text{ kg ha}^{-1}$. Reference [8] shows revealed a pod yield reduction of 18, 51, 60 and 70 per cent at EC 3.75, 5.0, 6.25 and 7.5 dSm^{-1} respectively. As reported by [9] 50% reduction in grain yield of groundnut took place at an ESP of about 20, which indicates that groundnut is relatively a sensitive crop for sodic soils. This reduction in yield was attributed to the marked decrease in all the yield components resulting from higher ESP level [10].

Fig 1. Effect of ameliorative chemicals on pod yield of groundnut varieties



Treatments	No. of flowers per plant	No. of pegs per plant	No. of pods per plant	100 Seed Weight(g)	Fertility coefficient (%)	Pod Yield (kg ha ⁻¹)
Main plot (M_1)	64.3	33.2	25.6	51.0	39.7	1702
M_2	55.5	31.9	22.3	41.9	40.1	1590
SEd	0.01	0.01	0.01	0.01	0.01	0.1
CD(P= 0.05)	0.04	0.01	0.02	0.04	0.01	0.7
Sub plot(S_1)	56.9	29.6	19.4	44.4	34.2	1538
S_2	58.9	31.5	23.9	45.5	40.8	1608
S_3	62.5	34.9	25.5	48.4	40.7	1725
S_4	63.2	36.6	26.8	49.3	42.5	1754
S_5	61.5	33.8	25.1	48.0	40.9	1679
S_6	60.7	33.2	24.5	47.2	40.5	1658
S_7	59.2	32.2	24.0	45.9	40.7	1640
S_8	58.2	30.8	23.3	45.2	40.0	1621
S_9	58.2	30.7	22.8	44.4	39.2	1593
SEd	0.36	0.21	0.15	0.28	0.24	9.9
CD(P=0.05)	0.73	0.40	0.29	0.57	0.49	20.1

Table 1. Effect of ameliorative chemicals on yield and yield components of groundnut varieties.

IV. CONCLUSION

From the studies, it is concluded that the groundnut variety CO4 was identified as the most tolerant variety to salt stress and ALR3, the most sensitive one. Maintenance of optimum leaf area with high proline, soluble protein and chlorophyll contents and high TDMP were the physiological basis for tolerance to both salinity and sodicity stresses. Brassinolide 1 ppm sprayed at preflowering, pegging and pod formation stages was highly effective in overcoming the adverse effects of salt stress through enhancing the overall physiological efficiency of the crop and in improving the pod yield even in the varieties sensitive to salt stress.

REFERENCES

- [1] J. Larkindale and B. Huang. Thermotolerance and antioxidants systems in *Agrotis stolonifera*: Involvement of salicylic acid, abscisic acid, calcium, hydrogen peroxide and ethylene. *J. Plant Physiol.*, 161, 2004, pp: 405-413.
- [2] A. Sheela and H.S. Gehlot. An update on Brassinosteroids. *Adv. Plant Physiol.*, 3, 2000, pp :149-178.
- [3] M. Mikolajczyk., O.S.Awotunde, G. Muszynska, D.F. Klessig and G. Dobrowolska. Osmotic stress induces rapid activation of a salicylic acid induced protein kinase and a homolog of protein kinase ASK1 in tobacco cells. *Plant Cell*, 12: 2000. pp.165-178.
- [4] T.B. Kinraide. Three mechanisms of calcium alleviation of mineral toxicities. *Plant Physiol.*, 118, 1998 pp: 513-520.
- [5] C.P. Malik, R.C. Setia and N. Setia. Role of plant growth regulators in increasing crop productivity and the Indian scenario. In: *Hormonal regulation of plant growth and development*, vol. VI. Ed. S.S. Purohit, Agrobotanical Publishers. 1993. pp. 161-197.
- [6] J.D.S.Panwar, D.S. Shukla and G.S. Sirohi. Growth and development aspects in relation to yield of mung bean (*Vigna radiata* L. Wikzek). *Indian J. Plant Physiol.*, 29, 1986 pp: 312-316.
- [7] U. Klahre, T. Noguchi, S.Fujioka, S. Takatsuta, T.Yokota, T. Nomura, S.Yoshida and N.H. Chua. The *Arabidopsis* DIMINOTO / DWARF 1 gene encodes a protein involved in steroid synthesis. *Plant Cell*, 10, 1998, pp. 1677-1690.
- [8] D.C. Sharma, S.S. Puntamaker, K.C. Mehta and S.P. Seth. Note on the effect of different common salt of sodium and calcium on the germination of green gram (*Phaseolus aureus* Roxb.) varieties. *Indian J. Agric. Sci.*, 41: 1971, pp: 636-638.
- [9] Singh, S.B. and I.P. Abrol. Effect of soil sodicity on the growth, yield and chemical composition of groundnut (*Arachis hypogaea* Linn.). *Plant and Soil*, 84: 1985, pp. 123-127.
- [10] Parihar, S.K.S. and N.R. Singh. Impact of sodium and potassium uptake on sodicity tolerance of wheat (*Triticum aestivum* L.) genotypes. *Farm Sci. J.*, 3(2): 1988, pp: 136-140.