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Effect of cycocel (CCC) on growth and yield of soybean (*Glycine max* L. Merrill). cv. MAUS-162

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Abstract
Plant growth regulators are specific chemicals that regulate plant growth and development. Growth regulators are known to increase photosynthetic capacity and other physiological efficiencies. They can also improve how well accumulations in field crops are partitioned between sources and sinks. The present study was conceptualized and executed with the prime objective of study the effect of chlormequat chloride, Mepiquat chloride on morphological, physiological and biochemical parameters of soybean. The field trial was conducted following randomized block design with seven treatments replicated thrice. Soybean CV MAUS-162 served as the primary source material for this inquiry and different concentrations of growth retarding substance called chlormequat chloride. The Morphophysiological parameters, namely, Plant height, number of branches, number of leaves (trifoliates) per plant, dry matter accumulation in leaf and stem and AGR, RGR, NAR, LAI and CGR and was observed to increase significantly decreased with the application of chlormequat chloride and mepiquat chloride. The Biochemical parameters, namely, chlorophyll content was observed to increase significantly with application chlormequat chloride 50%SL at different concentrations compared to control. A significant increase in the seed protein content and Oil content was also noticed with the application of chlormequat chloride at different concentrations, compared to control. In conclusion, the study revealed the superiority of CCC (500 ppm) treatment for majority of the morphological, physiological and biochemical parameters at different growth stages, compared to other concentrations of growth retardant and control treatments studied in the present investigation for rabi soybean.

Keywords: Growth regulators, randomized block design, soybean cv. MAUS-162, morphophysiological parameters, biochemical parameters, CCC, chlormequat chloride, and mepiquat chloride

Introduction
Glycine max. L. Merril, frequently referred to as soybean, is a rainy season, dual-purpose, monocarpic legume crop that is rich in energy and nutrients. It includes edible oil (20%), biologically beneficial proteins (43%), vitamins, minerals, and salts and essential amino acids. Because of its versatility, soybean is popularly known as "Miracle Bean" and is being exploited in many agro-based industries with innumerable ways. India occupies an area of 108.83 lakh ha with a production of 104.36 lakh tons. The evaluation of morpho-physiological and biochemical traits of crops namely, Plant height, number of branches, number of leaves per plant, dry matter accumulation in leaf, stem and AGR, RGR, NAR, LAI and CGR, chlorophyll content, germination indicates crop growth patterns which are reflected in final yield and thus, influences crop productivity. According to reports, plant growth retardants, also known as regulators, can effectively boost crop yields because of their significant impact on a variety of physiological and biochemical processes in plants that result in quick, leading to rapid change in phenotype of the plant within the season to achieve desirable results. The use of growth retardants has been gaining more importance in the recent years for improvement of crop yield potential and quality of produce. In this context, there is an urgent need to identify suitable growth retardants for improving yield potential by changing the various above-mentioned parameters in soybean, cv. MAUS-162.

Materials and Methods
The investigation was conducted on *'cv.* MAUS-162 soybean genotype during 2043-14 season with seven treatments replicated thrice involving exogenous application of PGRs CCC (500 ppm) chlormequat chloride at different concentrations and a control *i.e.,* no spray in a randomized block design. Each plot measured 2.70 x 5 m. A spacing of 45 x 5 cm was maintained between and within the rows. Between the replications, one meter space was left for irrigation in the College Farm, College of Agriculture.

VNMKV, Parbhani. Foliar application of CCC was made at flower initiation stage. Plant based observations *viz*., namely, Plant height, number of branches, number of leaves (trifoliates) per plant, dry matter accumulation in leaf and stem (45, 60 and 75 days up to harvest), AGR, RGR, NAR, LAI and CGR were recorded on five randomly selected and tagged plants at 15 days intervals. The leaf area (cm^2) was measured using formula Leaf Area= LxBxKxN. Absolute Growth Rate (AGR) (g/day), Relative Growth Rate (RGR) (G/g/day), leaf area index (LAI), Crop growth rate (g dm^2/day) were estimated. Afterwards, these leaf samples were subsequently dried hot-air oven at 60^0-70 °C. The dried samples were then weighed to record data on dry matter production. The values were expressed as g/plant.

Results and Discussion

Morphological traits

The data on plant height at different growth stages (Table 1) indicated that plant height decreased by the application of CCC. The growth retardants studied in the present investigation, namely, chlormequat chloride and mepiquat chloride recorded a decrease in plant height, compared to control. A similar reduction in the plant height of soybean crop with the application of chlormequat chloride (500 ppm) at 35 DAS. The mechanism of reduction in plant height appears to be due to reduction in cell division and its expansion.

In soybeans, the number of branches per plant is a significant morphological trait that is closely associated with yield. In the present investigation, number of branches per plant increased gradually up to 75 days (table 1) by the application of CCC (chlormequat chloride) 50% SL. Application of mepiquat chloride 5%AS had also recorded significantly higher number of branches per plant, compared to control in the present study. Similar results were reported earlier in black gram and green gram. Generally speaking, leaves are regarded as a vital component of plants that help to generate yield. The number of trifoliate leaves increased gradually from 15 DAS to 60 DAS, and thereafter declined (table 1) due to senescence. Significant influence of the growth regulator treatments was noticed at 30, 45, 60, 75 DAS and harvest. All treatments of chlormequat chloride 50% SL at 45, 60 and 75DAS, increased the number of leaves (trifoliates) significantly, compared to control. The positive influence of chlormequat chloride and mepiquat chloride on number of trifoliates per plant were also reported earlier. The dry matter production in leaves increased up to 75 DAS and declined (table 2) thereafter till harvest. Among the treatments, the leaf dry weight was significantly higher with the application of CCC (chlormequat chloride 50% SL) (500 ppm), compared to control due to the beneficial effect of this growth retardant on leaf development. Among different concentration of growth retardant treatments CCC (500ppm) exhibited maximum stem dry matter over control and other treatments studied. Dry matter production, particularly in reproductive parts is an important yield contributing character. There was a gradual increase in dry matter production of pods (table 2) from 60 DAS to harvest stage, and the highest dry matter was observed at harvest stage. The data presented in table no.5 revealed that the results of all the growth parameters resulted into the maximum Grain yield and biological yield (24.72% and 51.05% respectively) by the application of CCC. In this the treatment T_4 (500 ppm) was found to be superior than other treatments.

Physiological traits

Leaf area index is considered to be one of the photosynthetic determinants in crop plants and in the present study, it increased gradually (table 3) from 30 to 75 DAS and then dropped as a result of leaf ageing and senescence. The application of growth retardants, namely, mepiquat chloride 5% AS (5%) and chlormequat chloride 50% SL at different concentrations had also resulted in higher LAI, compared to control, in the present investigation. The positive influence of chlormequat chloride and mepiquat chloride has also been reported earlier. CGR, or the average daily increment in biomass output, is a crucial and practical method for measuring production efficiency that allows for treatment comparison. The observations recorded (table 3) on CGR in the present study revealed that most of the CGR values were maximum at 45-60 DAS. There was a gradual increase in CGR values from 15-30 DAS to 45-60 DAS, and thereafter it declined, Mepiquat chloride 5% AS and chlormequat chloride 50% SL applied at 30-45 DAS recorded high RGR, compared to control.

Biochemical parameters

Apart from morphological and physiological characters, growth retardant also known to influence different biochemical parameters. The influence growth retarding substances, in rabi soybean, in comparison to control on various biochemical parameters, namely, chlorophyll content, protein content, oil content: The application of mepiquat chloride 5% AS and chlormequat chloride 50% SL at different concentrations had all resulted in significantly higher chlorophyll content, compared to control (table 4) Application of mepiquat chloride to groundnut crop resulted in high chlorophyll content due to delayed chlorophyll degradation. In soybean, increased chlorophyll content with the application of chlormequat chloride was reported earlier. mepiquat chloride 5% AS (5%) and chlormequat chloride at different concentrations, compared to control indicating that, the applied growth retardant had marked effect on Biosynthetic pathways related to protein synthesis. Similar enhancement in seed protein content with the application of mepiquat chloride and chlormequat chloride were also reported earlier.

Table 1: Effect of different growth retardant on plant height (cm), no. of branches/plant and no. of trifoliates/plant in soybean cv. MAUS-162.

Treatment		Plant height (cm)					No. of branches/plant					No. of leaves (trifoliates/plant)				
		Days after sowing					Days after sowing					Days after sowing				
T_1	Control	30	45	60	75	90	30	45	60	75	90	30	45	60	75	90
T_2	CCC-400 ppm	28.53	38.27	44.23	46.17	28.53	1.67	5.28	5.40	5.45	5.42	5.58	14.58	26.22	36.63	32.52
T_3	CCC-450 ppm	23.83	31.38	36.92	40.10	23.83	2.00	6.23	6.50	6.90	6.87	9.40	16.30	28.63	40.33	36.05
T_4	CCC-500 ppm	24.30	32.16	38.10	42.73	24.30	1.66	5.99	6.30	6.53	6.50	7.87	14.80	26.10	36.98	32.12
T_5	CCC-550 ppm	22.54	30.63	36.51	39.93	22.54	2.00	6.40	7.10	7.50	7.48	9.41	16.66	28.90	40.66	36.33
T_6	CCC-600 ppm	24.42	32.90	40.03	43.66	24.42	1.33	5.82	5.80	6.14	6.12	8.16	15.09	27.45	37.11	33.00
T_7	CCC-650 ppm	24.87	33.93	40.86	44.62	24.87	1.66	6.02	6.47	6.64	6.61	8.20	15.20	27.53	37.37	34.57
SE ±		26.87	36.26	41.78	44.98	26.87	1.67	6.14	6.28	6.50	6.47	8.58	15.34	27.79	38.86	36.02
CD at 5%		0.79	1.03	1.27	1.30	0.79	0.18	0.17	0.30	0.32	0.28	0.52	0.40	0.55	0.89	0.78

Table 2: Effect of CCC (growth retardant) on leaf dry weight (g/plant) and stem with pod dry weight (g/plant) in soybean cv. MAUS-162.

Treatment		Leaf dry weight (g/plant) Days after sowing					Stem with pod dry weight (g/plant) Days after sowing				
		30	45	60	75	90	30	45	60	75	90
T_1	Control	1.08	1.87	4.17	6.13	4.65	2.04	4.28	5.80	7.50	9.80
T_2	CCC-400 ppm	1.07	2.74	5.07	6.87	5.18	2.34	5.85	6.78	8.70	10.74
T_3	CCC-450 ppm	1.17	2.45	4.82	6.45	4.88	2.16	5.16	6.40	8.62	10.48
T_4	CCC-500 ppm	1.13	2.82	5.10	6.92	5.35	2.33	5.95	6.92	8.98	10.82
T_5	CCC-550 ppm	1.15	2.33	4.72	6.37	4.88	2.18	5.04	6.32	8.34	10.40
T_6	CCC-600 ppm	1.08	2.62	4.95	6.18	5.15	2.42	5.87	6.88	8.80	10.80
T_7	CCC-650 ppm	1.05	2.14	4.46	6.72	4.80	2.10	4.52	5.94	7.64	10.00
SE ±		0.063	0.18	0.16	0.14	0.11	0.13	0.27	0.21	0.31	0.21
CD at 5%		NS	0.56	0.51	0.44	0.34	NS	0.83	0.66	0.95	0.65

Table 3: Effect of different concentrations of CCC (growth retardant) on RGR, NAR, LAI (leaf area index)and Crop crop growth rate (CGR) g/dm^2.

Treatments		RGR				NAR				LAI					CGR			
		31-45	46-60	61-75	76-90	31-45	46-60	61-75	76-90	30	45	60	75	90	31-45	46-60	61-75	31-45
T_1	Control	0.0196	0.0139	0.0091	0.0017	0.080	0.024	0.060	0.0051	1.05	2.94	4.12	5.16	4.16	0.089	0.112	0.107	0.0241
T_2	CCC-400 ppm	0.0268	0.0927	0.0080	0.0006	0.091	0.018	0.048	0.0038	1.55	3.40	5.12	6.30	4.94	0.151	0.951	0.110	0.0107
T_3	CCC-450 ppm	0.0238	0.0123	0.0085	0.0006	0.087	0.020	0.075	0.0065	1.32	3.18	4.51	6.10	4.71	0.125	0.106	0.113	0.0083
T_4	CCC-500 ppm	0.0269	0.0917	0.0081	0.0005	0.11	0.012	0.052	0.0042	1.54	4.35	5.21	6.47	5.35	0.156	0.095	0.114	0.0078
T_5	CCC-550 ppm	0.0229	0.0117	0.0083	0.0011	0.090	0.021	0.061	0.0051	1.14	3.01	4.23	5.53	4.26	0.118	0.108	0.108	0.017
T_6	CCC-600 ppm	0.0257	0.0950	0.0081	0.0009	0.093	0.015	0.068	0.0058	1.37	3.30	4.59	6.10	4.73	0.147	0.098	0.110	0.015
T_7	CCC-650 ppm	0.0215	0.0130	0.0093	0.0009	0.086	0.021	0.070	0.0060	1.22	3.19	4.38	5.84	4.38	0.103	0.110	0.116	0.013
SE ±		0.0016	0.0021	0.0011	0.0004	0.011	0.0033	0.016	0.0016	0.013	0.014	0.23	0.20	0.17	0.011	0.019	0.014	0.0055
CD at 5%		0.0049	NS	NS	NS	NS	NS	NS	NS	NS	0.042	0.72	0.62	0.52	0.033	NS	NS	NS

Table 4: Effect of different Concentrations of CCC (growth retardant) on chlorophyll content of soybean cv. MAUS-162.

Treatments	Chlorophyll contains		
	Chlorophyll 'a'	Chlorophyll 'b'	Total Chlorophyll
T_1 (control)	0.50	0.35	1.10
T_2 (400 ppm)	0.55	0.39	1.28
T_3 (450 ppm)	0.63	0.45	1.19
T_4 (500 ppm)	0.70	0.54	1.39
T_5 (550 ppm)	0.53	0.38	1.26
T_6 (600 ppm)	0.67	0.49	1.32
T_7 (650 ppm)	0.59	0.41	1.14
SE ±	0.017	0.019	0.030
CD at 5%	0.053	0.059	0.092

Conclusion

The present study on Effect of Plant Growth retardant on Morphological, Physiological and Biochemical parameters of Soybean (*Glycine max* L. Merrill) cv. MAUS-162, revealed the superiority of CCC (500 ppm) for majority of the morphological, physiological, biochemical, parameters for soybean, compared to control.

References

1. AOAC. Official methods of analysis. 12th ed. William Star Wet Glad, editor. AOAC. Washington; c1980.
2. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. New Delhi: I.CAR; 1989, 108.
3. Lakshmamma P, Rao IVS. Influence of shading and naphthalene acetic acid (NAA) on yield and yield components in blackgram (*Vigna mungo* L.). Annals of Agricultural Research. 1996;17:320-321.
4. Shukla KC, Singh OP, Samaiya RK. Effect of foliar spray of plant growth regulator and nutrient complex on productivity of soybean. Crop Research. 1997;13:213-215.
5. Govindan K, Thirumurugan, Aruchelvan S. Response of soybean to growth regulators. Research on Crops. 2000;1(3):323-325.
6. Deotale RD, Katekhaye DS, Sorte NV, Raut JS, Golliwar VJ. Effect of TIBA and B-Nine on morpho-physical characters of soybean. Journal of Soils and Crops. 1995;5:172-176.
7. Aurovinda Das, Rajendra Prasad. Effect of plant growth regulators on greengram (*Phaseolus radiatus*). Indian Journal of Agricultural Sciences. 2004;74(5):271-272.
8. Rajesh K. Influence of growth promoting and retarding compounds on growth, dry matter production and yield in greengram during rabi; c2010.
9. Girisha. A comparative study on the growth promoting and retarding compounds on dry matter production and yield in black gram during rabi. MSc(Ag) thesis submitted; c2010.
10. Merlo D, Soldati A, Keller ER. Influence of growth regulators on abscission of lower and young pods of soybeans. Eurosaya. 1987;5:31-38.
11. Chandrasekar CN, Bangarusamy U. Maximizing the yield of mung bean by foliar application of growth regulating chemicals and nutrients. Madras Agricultural Journal. 2003;90(1-3):142-145.
12. Pankaj Kumar, Hiremath, Chetti. Influence of growth regulators on dry matter production and distribution and shelling percentage in determinate and semi-determinate soybean genotypes. Legume Research. 2006;29(3):191-195.
13. Kothule VG, Bhalerao RK, Rathod TH. Effect of growth regulators on yield attributes, yield and correlation coefficients in soybean. Annals of Plant Physiology. 2003;17(2):140-142.
14. Kumbhare, Khawale, Rajput, Datey, Dapugeanti. Effect of nitrogen levels and chlormoquat on mustard (*Brassica juncea* L.). Journal of Soils and Crops. 2007;17(2):394-397.
15. Buttar GS, Aggarwal N. Growth retardants in cotton–A review. Journal of Cotton Research and Development. 2004;18(1):61-69.

16. Feng DD, Rui LY, Geng JL. Effects of brassinosteroids on photosynthetic characteristics in soybean under Aluminum stress. Acta Agronomica Sinica. 2008;34(9):1673-1678.
17. Shalaby. Influence of cycocel (2-chloroethyl ammonium chloride) on the vegetative growth, photosynthetic pigments, flowering, abscission and yield of faba bean (*Vicia faba*, L.). Annals of Agricultural Science, Moshtohor. 2000;38(3):1485-1502.
18. Garai AK, Datta JK. Effect of phosphorus sources and cycocel spray on green gram (*Vigna radiata* (L)). Legume Research. 2003;26(1):15-19.
19. Jeyakumar P, Thangaraj M. Effect of mepiquat chloride on certain physiological and yield characteristics of groundnut (*Arachis hypogaea* L.). Journal of Agronomy and Crop Science. 1996;176(3):154-164.
20. Jeyakumar P, Thangaraj M. Physiological and biochemical effects of mepiquat chloride on groundnut (*Arachis hypogea*). Madras Agricultural Journal. 1998;85(1):23-26.
21. Devi KN. Effect of Bioregulators on Growth, Yield and Chemical Constituents of Soybean (*Glycine max*). Journal of Agricultural Science, 2011, 3(4).
22. Pathan ST. Influence of CYCOCEL on yield attributing characteristics of soybean (*Glycine max* (L.) Merrill). MSc. (Agri.) Thesis, of Agricultural University, VNMKV, Parbhani; c2013.
23. Shinde RV. Influence of plant growth regulators on growth physiology, yield and [*Glycine max* (L.) Merrill]. University Library, UAS, Dharwad; c2009.
24. Reddy P, Ninganur BT, Chetti MB, Hiremath SM. Effect of growth retardants and nipping on chlorophyll content, nitrate reductase activity, seed protein content and yield in cowpea (*Vigna unguiculata* L.). Karnataka Journal of Agricultural Sciences. 2009;22(2):289-292.