Plant Growth Regulators for Mitigating Water Stress in Cowpea

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Introduction

Water is becoming a scarce commodity for irrigation especially under the present changing climatic scenario. Water stress hampers important physiological and biochemical mechanisms leading to reduction in plant growth and yield. Studies revealed that the exogenous application of plant hormones has been found to alleviate the negative effects of various abiotic stresses. Cowpea, being a non-season bound crop, can be grown throughout the year and it performs well during summer season under irrigation, but water scarcity limits its area under cultivation. However, limited research works have been conducted to investigate the potential benefits of exogenous application of plant growth regulators (PGRs) in cowpea grown under water stress conditions. So the present study was undertaken to evaluate the efficacy of exogenous application of certain plant growth regulators to mitigate water stress in cowpea, to find out an effective plant growth regulator for drought management and to assess the response of cowpea to these plant growth regulators.

Materials and Methods

A field experiment was conducted during summer season of 2014 (January - March) in Agronomy farm, College of Horticulture, Vellanikkara of Thrissur district using the cowpea variety *Kashi Kanchan* (variety released from IIVR, Varanasi) which is a short duration (65-70 days), photo-insensitive, dwarf and bush type vegetable cowpea variety. The soil of the experimental site was sandy clay loam and the experiment was laid out in Randomized Block Design with 15 treatments and 3 replications in mini plots of size 1.5m x1.5m. The treatments comprised of foliar spray of CCC @ 10mg/L and 20 mg/L, salicylic acid (SA) and ascorbic acid (AA) @ 1% and 2%, NAA @ 20mg/L and 40 mg/L, brassinolide (Br.) @ 0.5 mg/L and 1mg/L, coconut water (CW) and water spray (WS) which were compared with farmers practice (irrigation at 2 days interval), irrigation at 5 days interval and irrigation at 5 days interval with no irrigation during water stress imposed period. The spray fluid used was 500L/ha. Cowpea seeds were sown at a spacing of 30cm x 30cm on 3rd January. The experimental plots were irrigated daily upto 5 days after sowing (DAS) for uniform germination of seeds and thereafter all treatment plots other than farmers practice and irrigation at 5 days interval were irrigated at 5 days interval upto 15 DAS with skipping irrigation at 20, 25, 30 and 35 DAS to impose water stress. Plant growth regulators, coconut water and water were sprayed at 25 DAS.

Results and Discussion

General growth of the plants was less compared to their normal growth during rainy season due to their exposure to extreme dry weather condition prevailed during the crop growth period. Growth parameters showed that the treatments could bring about significant influence on number of leaves at 45& 60 DAS and root length. The treatments which received spraying of plant growth regulators during the water stress imposed period resulted in an increasing trend of plant height from 7 to 25 %, number of leaves from 2 to 15 % and number of branches from 8 to 26 % compared to that which received no treatment during the crop period. Plant height increased progressively with age and it varied from 10.7 cm to 13.7 cm at 60 DAS. Number of leaves ranged from 7.3 to 15.3 at 45 DAS and 7.4 to 12.2 at 60 DAS. At 45 DAS, plants irrigated on alternate days (farmer's practice) recorded the highest leaf number of 15.3 followed by those irrigated at 5 days interval (12.6) which declined to 12.2 and 8.8 at 60 DAS as the leaves started falling down due to early maturity. At 30 DAS, the branch initiation was started in plants sprayed with SA 2% along with plants irrigated on alternate days (farmer's practice) and at 5 days interval. All the water stress imposed treatments showed a slight delay in flowering (1-4days) compared to those received irrigation on alternate days (farmer's practice) and at 5 days interval due to the delay in attaining sufficient vegetative growth before flowering as a result of imposed water stress. Pod yield, stover yield, total dry matter production and yield attribute like number of pods/plant and pod lengths were significantly influenced by the treatments. All treatments which received spraying of plant growth regulators could bring about 16 to 124 % increase in pod yield, 5 to 76 % increase in stover yield and 10 to 113 % increase in total dry matter production compared to no treatment during the crop period. Among the treatments, highest pod yield was recorded by farmer's practice (irrigation

on alternate days) which was on par with spraying SA 2% due to the cumulative effect of more yield attributes like number of pods per plant, weight of pod and seeds per pod. This showed the positive effect of spraying SA2% during water stress period for overcoming the severity of drought situation by cowpea through improvement in RLWC and total chlorophyll content and its favourable influence on better translocation of assimilates to the economic part as evident from highest harvest index. Bera *et al*. (2008) also reported increased pod set and yield along with more N, P, K content in green gram with SA application. Among the PGR applied plots, highest stover yield and total dry matter production were observed in plots sprayed with NAA 40 ppm due to its favourable influence on growth parameters. Parmer *et al*. (2011) also reported the maximum stover yield in green gram with foliar spray of NAA 40 ppm. Hence the present study revealed that foliar application of SA 2% or NAA 40 ppm or water spray during dry spell was beneficial for mitigating water stress in cowpea.

Table 1: Effect of treatments on growth parameters of crop

Treatments	Plant height (cm)				No. of leaves				No. of branches			Root length (cm)	Days to 50% flowering
	15 DAS	30 DAS	45 DAS	60 DAS	15 DAS	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS		
CCC 10	5.8	6.0	7.8	11.8	3.1	5.5	7.4	8.4	0	0.1	2.1	15.8	46.5
CCC 20	6.1	6.2	7.7	12.3	3.2	6.3	8.3	9.5	0	0.1	2.5	14.8	48.7
SA 1%	5.4	5.6	7.2	11.8	3.1	5.7	7.7	8.3	0	0.4	2.9	15.7	47.0
SA 2%	5.9	6.4	7.8	12.9	3.1	5.5	9.3	10.5	0.06	0.8	2.9	17.4	45.3
AA 1%	5.6	5.8	8.0	12.1	3.3	6.0	7.7	8.2	0	0.3	2.1	14.9	47.0
AA 2%	5.6	5.9	7.4	11.9	3.2	5.6	7.3	7.6	0	0.2	1.3	14.8	48.0
NAA 20	5.7	5.9	7.7	12.4	3.1	5.6	8.9	9.5	0	0.3	2.3	16.3	48.0
NAA 40	5.9	6.0	8.2	13.7	3.2	6.0	9.8	10.5	0	1.1	2.0	16.4	48.0
Br. 0.5	5.9	6.1	7.5	12.0	3.1	5.7	8.4	9.5	0	1.1	2.8	15.7	46.0
Br. 1	5.7	6.2	7.6	10.7	3.1	5.7	7.7	9.3	0	0.4	1.9	15.2	48.7
CW	5.7	5.9	7.2	11.0	3.1	5.3	6.9	7.4	0	0.5	1.5	15.8	48.7
WS	6.0	6.2	7.8	11.9	3.1	6.4	9.7	9.7	0	0.5	2.3	16.9	45.3
Control (Irri. 5 days)	5.3	5.5	8.8	13.1	3.2	7.3	12.6	8.8	0.40	2.9	3.9	16.7	44.3
Farmer's practice (Irri. 2 days)	5.6	6.0	9.1	13.6	3.1	7.6	15.3	12.2	0.30	3.0	4.7	19.9	44.3
Control (Irri. 5 days with imposed water stress)	6.1	6.4	7.3	11.0	3.0	5.4	7.4	9.1	0	0.1	2.3	11.9	48.7
CD(0.05)	NS	NS	NS	NS	NS	NS	3.12	2.09	NS	NS	NS	2.61	NS

Table 2: Effect of treatments on yield and yield attributes of crop

Trts.	Pod No./plant	Pod length (cm)	Seeds/pod	Pod yield (kg/ha)	Stover yield (kg/ha)	Total DMP* (kg/ha)	Harvest index
CCC 10	2.3	24.7	12.3	1537.03	2719.75	844.44	0.3
CCC 20	2.6	26.4	12.8	1629.62	3339.50	934.56	0.3
SA 1%	2.3	26.1	12.6	1866.66	3508.64	940.74	0.3
SA 2%	3.3	26.6	13.5	2962.96	3195.06	978.18	0.4
AA 1%	3.0	25.7	12.4	2151.85	2407.40	888.06	0.4
AA 2%	3.0	26.1	12.1	1740.74	2865.43	911.93	0.3
NAA 20	2.6	29.1	13.2	1951.85	3376.54	982.30	0.3
NAA 40	3.0	29.7	13.6	2774.07	4024.69	1375.72	0.4
Br. 0.5	2.6	27.2	12.9	2377.77	3531.68	1165.43	0.4
Br. 1	2.0	26.8	12.4	1040.74	2532.09	709.46	0.2
CW	2.6	26.6	12.4	1844.44	2508.64	896.29	0.4
WS	3.0	26.5	13.9	2755.55	3225.93	1109.05	0.4
Control (Irri. 5 days)	5.6	27.5	13.8	2777.77	4768.72	1422.22	0.3
Farmer's practice (Irri. 2 days)	8.0	27.8	14.0	3348.14	5097.53	1661.72	0.3
Control (Irri. 5 days with imposed water stress)	2.3	26.9	11.3	1322.22	2290.94	644.93	0.3
CD(0.05)	1.34	3.19	NS	560.8	455.2	201.5	

Conclusion

The present study revealed that among the stress mitigating PGRs, salicylic acid 2%, NAA 40ppm and water spray during water stress period were found beneficial for mitigating water stress in vegetable cowpea grown during summer season in laterite soils of Kerala.

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