Seed Hardening and Moisture Conservation Practices to Mitigate Water Stress in Cowpea

Syama S. Menon
Kerala Agricultural University, India

K. E. Savithri
Kerala Agricultural University, India

The 23rd International Grassland Congress (Sustainable use of Grassland Resources for Forage Production, Biodiversity and Environmental Protection) took place in New Delhi, India from November 20 through November 24, 2015.

Proceedings Editors: M. M. Roy, D. R. Malaviya, V. K. Yadav, Tejveer Singh, R. P. Sah, D. Vijay, and A. Radhakrishna

Published by Range Management Society of India

Paper ID: 916
Theme 2. Grassland production and utilization
Sub-theme 2.7. Seed production, storage, availability and quality

Seed hardening and moisture conservation practices to mitigate water stress in cowpea

Syama S. Menon*, K. E. Savithri
Kerala Agricultural University, Thrissur, India
*Corresponding author e-mail: menonsyama105@gmail.com

Keywords: Antitranspirants, Moisture conservation, Mulches, Seed priming, Water stress

Introduction

Cowpea is an important protein catering feed/fodder for cattle. Being a non-season bound crop, it can be grown throughout the year and performs well during summer season under irrigation but water scarcity limits its area under cultivation. It necessitates the development of alternate management technologies to overcome the water stress period for the sustainable growth and yield of the crop. Seed hardening, soil moisture conservation measures like mulching and antitranspirant sprays are the techniques which helps the plant to survive under drought. So the present study was undertaken to evaluate the efficacy of various seed primers, antitranspirants and mulches for mitigating water stress in cowpea grown during summer season, to find out the best among each and also to assess the response of cowpea to these techniques under water stress conditions.

Materials and Methods

Research works are rare combining all the 3 types of moisture conservation measures together in a particular crop. So a field experiment was conducted during summer season of 2014 (January - March) in Agronomy farm, College of Horticulture, Vellanikkara of Thrissur district in Kerala (India) using the cowpea variety *Kashi Kanchan*. It is a short duration (65-70days), photo-insensitive, bush type variety with dark green, soft, fleshy pods. The soil of the experimental site was sandy clay loam having pH 5.4, organic carbon 1.2%, available phosphorus and potassium 31.9 and 378.8 kg/ha respectively. The experiment was laid out in Randomized Block Design with 11 treatments replicated thrice in mini plots of size 1.5m x1.5m. The treatments comprised of three seed primers namely 2% $CaCl_2$, 0.5% NaCl and 1% KH_2PO_4, two types of mulching namely plastic mulching (PM) and plant residue mulching (PRM) and three antitranspirants like kaolin 2%, lime water 2% (LWS), and atrazine 0.1kg/ha 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 stress imposed period. The spray fluid used was 500L/ha. Cowpea seeds were dibbled at a spacing of 30cm x 30cm. The experimental plots were irrigated daily upto 5 days after sowing (DAS) for uniform germination of seeds. Thereafter, the plots sown with primed seeds and mulched were irrigated at 10 days interval as they help in moisture conservation for a long time and plots sprayed with antitranspirants were irrigated at 5 days interval upto 15 DAS with skipping irrigation at 20, 25, 30 and 35 DAS to impose water stress. Antitranspirants were sprayed at 25 DAS.

Results and Discussion

Growth parameters showed that plant height (at 45 DAS), number of leaves (at 45 DAS) and root length were significantly influenced by treatments. Application of various treatments resulted in an increasing trend of plant height from 2 to 21 %, and number of leaves from 15 to 67 % compared to that which received no treatment during the crop period. Tallest plants with highest number of leaves were observed in plots which received irrigation on alternate days (Farmer's practice) due to non-exposure of plants to water stress. However, plant height in plots irrigated on alternate days (Farmer's practice) was found to be on par with seed hardening either with $CaCl_2$, or NaCl, or KH_2PO_4, mulching with either polythene or plant residue, spraying lime water as antitranspirant during water stress period. Root length was also significantly higher in all treatments compared to control with imposed water stress. Water shortage forced the plants to increase the root length so as to extract more water from deeper layers of soil. All these showed the positive effect of seed hardening and moisture conservation measures like mulching and antitranspirant spray on the growth of cowpea plants grown under water stress situation. All the water stress imposed treatments showed a slight delay in flowering (1 to 4 days) compared to control which received irrigation at 2 days and 5 days interval. This is due to the delay in attaining sufficient vegetative growth before flowering as a result of imposed water stress as reported by French (2012) in faba bean.

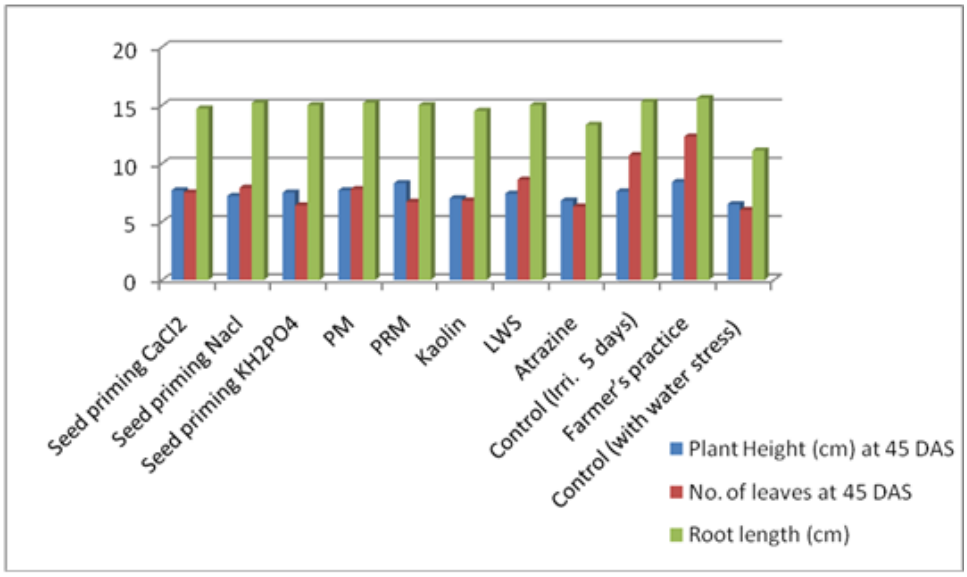

Fig. 1: Effect of treatments on growth parameters of crop

All treatments except Kaolin spray (2%) recorded significantly higher pod yield, stover yield and drymatter production compared to control which was irrigated at 5 days interval with imposed water stress, as a result of higher growth characters and yield attributes. This showed the positive effect of seed hardening and soil moisture conservation measures like mulching and antitranspirant like lime water spray on the yield of cowpea plants grown under water stress situation. Among the seed primers, NaCl 0.5% recorded the 34% higher pod yield than $CaCl_2$ and KH_2PO_4, which showed its better effect in hardening the plants to drought (Table 2). Jisha and Puthur (2014) also noticed the improved drought stress tolerance potential of *Vigna radiata* with halopriming using NaCl. Mulching resulted in a higher yield (162-182% over control) and drymatter production compared to non mulched plots due to better soil moisture conservation (Table 1). Sarolia and Bhardwaj (2012) has also reported that mulched plants grow and mature more uniformly than unmulched plants as mulching reduces evaporation, increase infiltration and there by conserve soil moisture. Among antitranspirants, lime water spray exhibited a significant influence on drymatter production of cowpea compared to kaolin spray and atrazine spray. This is due to the effect of lime water spray in reflecting sunlight/increasing albedo thereby reducing leaf temperature and transpiration which favourably influenced the relative leaf water content and total chlorophyll and resulted in better growth and yield attributes of cowpea plants grown under water stress situation.

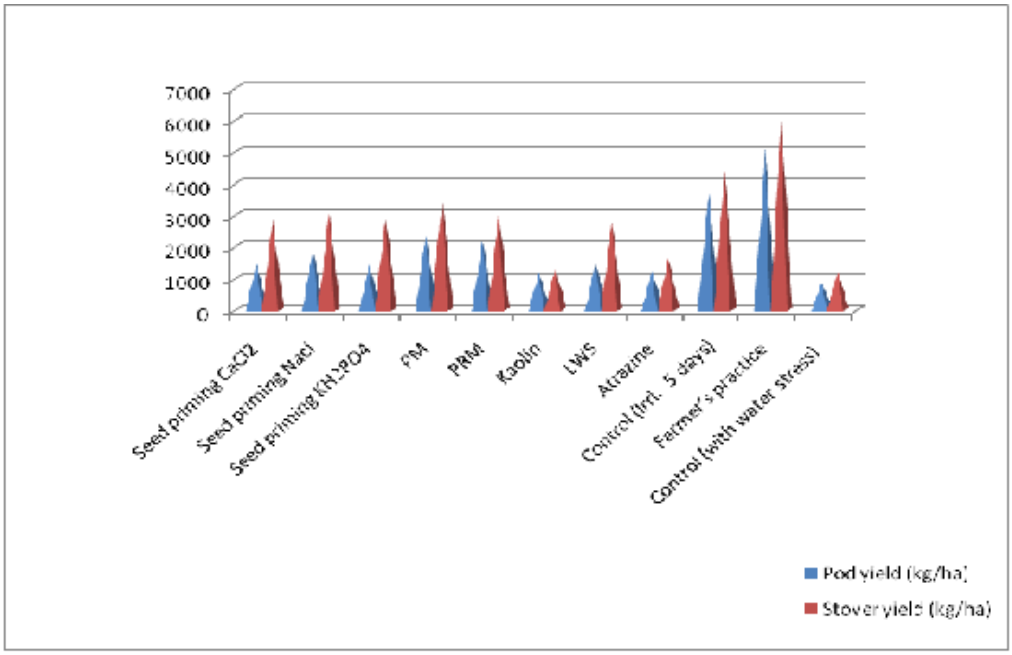

Fig. 2: Effect of treatments on yield and yield attributes of crop

Table 1: Effect of treatments on soil moisture content

Treatments	Soil moisture content (%)			
	15 DAS	30 DAS	45 DAS	60 DAS
Seed priming $CaCl_2$	8.4	9.7	8.1	8.9
Seed priming Nacl	8.9	9.3	8.0	8.4
Seedpriming KH_2PO_4	8.9	9.7	8.9	8.2
PM	11.2	10.8	9.4	9.3
PRM	10.6	11.0	9.2	9.9
Kaolin	9.7	7.7	9.4	8.3
LWS	9.6	7.5	9.2	8.2
Atrazine	9.9	7.4	9.3	8.3
Control (Irri. 5 days)	9.5	11.5	10.4	9.3
Farmer's practice (Irri. 2 days)	12.3	15.5	12.5	10.8
Control (Irri 5 days with imposed water stress)	9.3	6.3	8.9	8.5
CD(0.05)	0.537	0.463	0.545	0.523

Table 2: Effect of treatments on growth parameters and yield of crop

Treatment	Plant height (cm) 45 DAS	No. of leaves 45DAS	Root length (cm)	Pod yield (kg/ha)	Stover yield (kg/ha)
Seed priming $CaCl_2$	7.7	7.5	14.7	1444.44	2885.18
Seed priming Nacl	7.2	7.9	15.2	1951.85	3038.27
Seed priming KH_2PO_4	7.5	6.4	15.0	1451.85	2960.90
PM	7.7	7.8	15.2	2344.44	3553.08
PRM	8.3	6.7	15.0	2177.77	3124.69
Kaolin	7.0	6.8	14.5	1177.77	1311.11
LWS	7.4	8.6	15.0	1503.70	2725.92
Atrazine	6.8	6.3	13.3	1207.40	1674.07
Control(Irri. 5 days)	7.6	10.7	15.3	3662.96	4422.22
Farmer's practice (Irri. 2 days)	8.4	12.3	15.6	5111.11	6065.43
Control (Irri.5 days with imposed water stress)	6.5	6.0	11.1	833.33	1194.23
CD(0.05)	1.12	2.42	2.06	351.9	495.8

Conclusion

The present study to evaluate the efficacy of seed priming and moisture conservation practices to mitigate water stress in cowpea revealed that seed priming with 0.5% NaCl, mulching either with polythene or plant residue, 2% lime water spray during water stress period were found beneficial for mitigating water stress in cowpea grown during summer season in laterite soils of Kerala.

References

French, R. J. 2012. Effects of early water deficit on growth and development of faba bean In: *Proceedings of the 9th Australian Agronomy Conference* (July 20-23, 1998), Charles Sturt University, Wagga Wagga.

Jisha, K. C. and J. T. Puthur. 2014. Halopriming of seeds imparts tolerance to NaCl and PEG induced stress in *Vigna radiata* (L.) Wilczek varieties. *Physiol. Molecular Biol. Plants*. 20(3): 303-312.

Sarolia, D. K. and R. L. Bhardwaj. 2012. Effect of mulching on crop production under rainfed condition: A Review. *Int. J. Res. Chem. Environ*. 2(2): 8-20.