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Impact of fertilizer management and chemical nipping on physiological traits and yield of rainfed horsegram (*Macrotyloma uniflorum*)

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Abstract

A field experiment was conducted to study the influence of fertilizer management and chemical nipping on the yield of horsegram during *rabi* 2019-20. The treatment consist of three levels of Fertilizer management [100% Recommended Dose of Fertilizer (RDF), 100% RDF + TNAU Micronutrient (MN) mixture 5 kg / ha as Enriched Farm Yard Manure (EFYM), Farmers practice] and four levels of chemical nipping [chlormequat chloride 250 ppm @ 40 DAS, chlormequat chloride 250 ppm @ 50 DAS, chlormequat chloride 250 ppm @ 40 DAS & 50 DAS, No nipping] thereby making 12 treatment combinations replicated thrice in factorial randomized block design. The physiological traits *viz.*, Proline and Relative water content were recorded. Proline and relative water content was found to be higher in 100% RDF along with TNAU MN mixture 5 kg/ha as Enriched FYM and chlormequat chloride 250 ppm @ 40 & 50 DAS which ultimately helps plant to withstand in drought and improve the yield.

Keywords: Chemical nipping, chlormequat chloride, fertilizer management, horsegram

Introduction

In India, pulses are the major source of dietary protein especially for vegetarians. Horsegram (*Macrotyloma uniflorum*) is popularly known as poor man's pulse crop and it is an important drought tolerant *rabi* pulse crop. It will grow well under poor soils and adopt wide range of geographical locations. It plays a significant part in fixing biological nitrogen from the atmosphere and enrich the soil fertility also conserve the soil. It also helps in reducing cholesterol level but it is a less preferable pulse crop because of its less taste.

In India pulses are cultivated on marginal lands under rain fed conditions. Plants are damaged directly and indirectly under rainfed condition. Increasing root-shoot ratio in plants is crucial. Under stress condition, cycocel (CCC) treatment could induce changes in the physiological traits of wheat plants under stress condition (Meera & Poonam 2010) ^[8] and may increase wheat yield and quality. Chlormequat chloride is commercially known as Cycocel and chemical name is (2-chloroethyl) trimethyl ammonium chloride. Chlormequat chloride inhibit the cell elongation by inhibit gibberellin biosynthesis pathway (Rademacher, 2000) ^[10]. It reduces the intermodal length and increases the root length.

Hence present study is undertaken to find out the effect of fertilizer management and Chlormequat Chloride on physiological traits such as Proline and Relative water content in rainfed horsegram.

Materials and Methods

The field experiment was conducted during *rabi* season of 2019 at Eastern Block farm of department of agronomy, Tamilnadu agricultural university, Coimbatore. The experiment was conducted on variety Paiyur 2, comprising of 2 factors *viz.*, Fertilizer Management and chemical nipping, thereby making 12 treatment combinations replicated thrice in factorial randomized block design.

Factor 1 (Fertilizer Management)

F₁: 100% RDF (12.5:25:12.5 kg NPK/ ha)

F₂: 100% RDF + TNAU MN mixture 5 kg / ha as Enriched FYM

F₃: Farmers practice

Factor 2 (Chemical nipping)

C₁: Chlormequat chloride 250 ppm @ 40 DASC₂: Chlormequat chloride 250 ppm @ 50 DASC₃: Chlormequat chloride 250 ppm @ 40 DAS & 50 DASC₄: No nipping

Foliar application Chlormequat chloride was done in two stages of crop period (at 40 DAS and 50 DAS) based on treatments.

The relative water content and proline were recorded at 7 days after foliar spray (DAF). Relative water content (RWC) is considered as an important criterion of plant water status. It was assessed according to Barrs and Weatherly method (1962) and expressed as per cent. It estimates plant water status in terms of cellular hydration under the effect of both leaf water potential and osmotic adjustment (Gonzalez and Gonzalez-Vila, 2001) [6]. The proline content was measured by using the method of Bates *et al.* (1973) [3] and expressed as $\mu\text{g g}^{-1}$ fresh weight and the function proline is osmotic adjustment in plants. Also it protects enzymes and membranes against oxidative stress (Agarwal & Pandey 2004) [1]. The Seed yield and physiological traits *viz.*, Proline and Relative

water content were recorded and data statistically analyzed critical differences were calculated.

Result & Discussion

Physiological parameters

Proline content

As mentioned in Table.1 proline content was significantly higher in fertilizer application and foliar spraying Chlormequat chloride. In fertilizer treatments application of 100% RDF along TNAU MN mixture 5 kg/ha as Enriched FYM(F₂) recorded higher values of proline at 47 and 57 DAS (31.33 and 34.17 mg g^{-1} respectively) and lower values were observed in farmers practices(F₃). In foliar spraying of chlormequat chloride 250 ppm @ 40 DAS & 50 DAS (C₃) registered maximum proline content at 47 and 57 DAS (35.00 and 36.89 mg g^{-1} respectively) and no nipping (C₄) was registered as minimum values.

Presence of high proline levels in plants indicate that the occurrence of osmotic adjustment. Accumulation of proline is known to function in osmotic adjustment, protection of cellular macromolecules from damage by salts, storage of nitrogen and scavenging of free radicals which is supported by Chookhampaeng *et al.* (2008) [4].

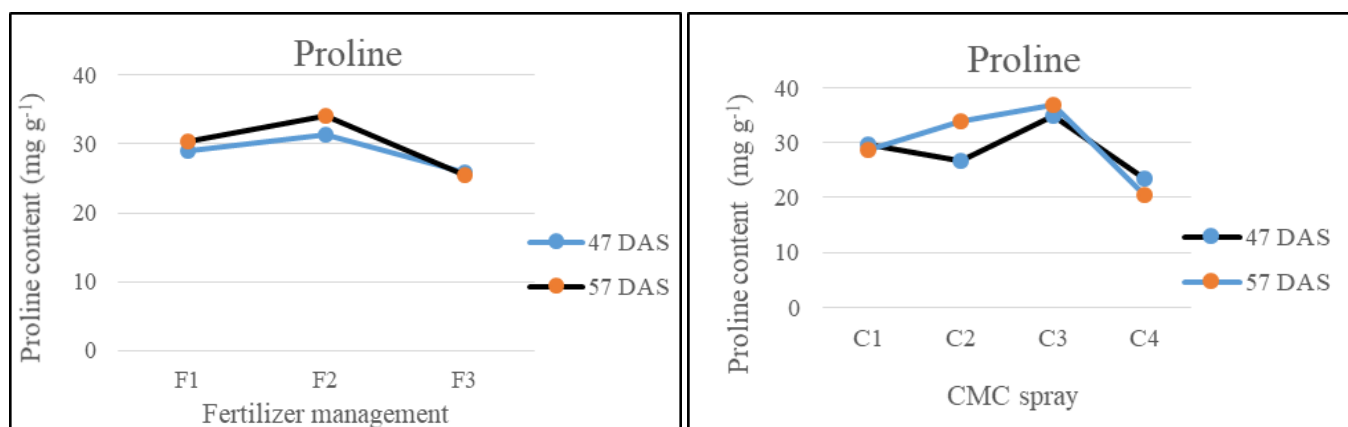


Fig 1: Fertilizer management and chemical nipping on proline (mg g^{-1}) Relative water content (RWC)

As shown in Table 1, In general RWC was significantly higher in fertilizer application and foliar spraying Chlormequat chloride. During 47 and 57 DAS, the highest RWC (47.40 and 53.35%) was observed in plants with the application of 100%

RDF along TNAU MN mixture 5 kg/ha as Enriched FYM (F₂) and the lowest (41.15 and 46.45%) was observed in farmers practices (F₃).

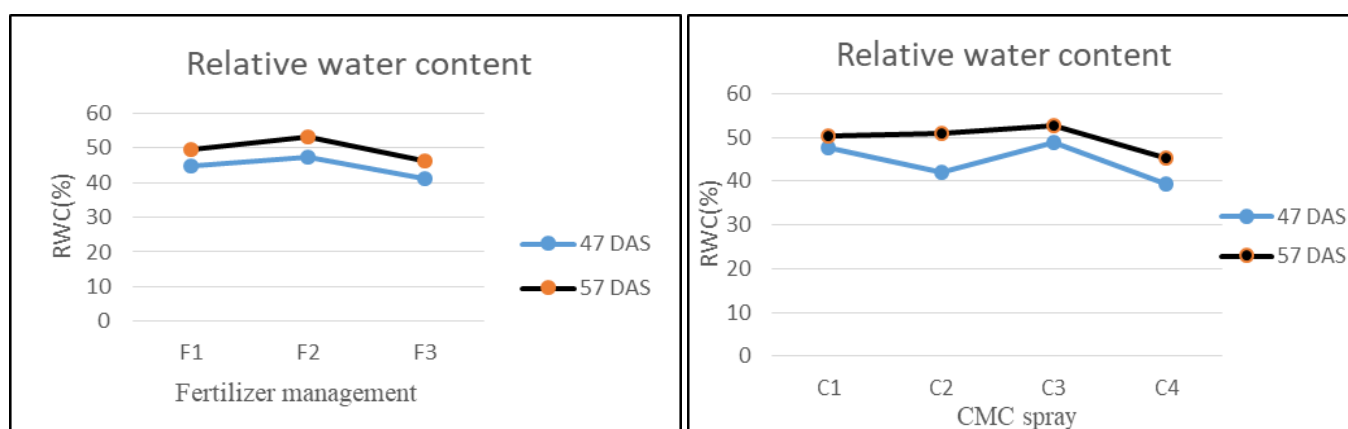


Fig 2: Fertilizer management and chemical nipping on RWC (%)

In foliar spraying of chlormequat chloride 250 ppm @ 40 & 50 DAS (C₃) registered maximum RWC at 47 and 57 DAS (48.82 and 52.81% respectively) and no nipping (C₄) was observed as minimum RWC value. Higher values in RWC

indicates that more amount of water present in the plant. Application of CCC increases relative water content and stomata resistance which are in line with Nejadsahebi *et al.* (2010) [9].

Table 1: Influence of fertilizer management and chemical nipping on proline (mg g⁻¹) and RWC (%) of horsegram at different growth stages

Treatments	Proline (mg g ⁻¹)		RWC (%)	
	47 DAS	57DAS	47 DAS	57 DAS
Fertilizer management(F)				
F ₁ - 100% RDF(12.5:25:12.5 kg NPK/ ha)	29.08	30.42	44.86	49.59
F ₂ - 100% RDF+TNAU MN mixture 5 kg/ha as EFYM	31.33	34.17	47.40	53.35
F ₃ - Farmers practice	25.83	25.50	41.15	46.45
SEd	1.39	1.18	1.68	1.75
CD(p=0.05)	2.88	2.44	3.49	3.64
Chemical nipping(C)				
C ₁ - Chlormequat chloride 250 ppm @ 40 DAS	29.67	28.67	47.76	50.24
C ₂ - Chlormequat chloride 250 ppm @ 50 DAS	26.78	34.00	41.89	50.76
C ₃ - Chlormequat chloride 250 ppm @ 40 & 50 DAS	35.00	36.89	48.82	52.81
C ₄ - No nipping	23.56	20.56	39.40	45.38
SEd	1.61	1.36	1.95	2.03
CD(p=0.05)	3.33	2.82	4.03	4.20
Interaction				
SEd	2.78	2.36	3.37	3.51
CD(p=0.05)	NS	NS	NS	NS

NS: Non-significant

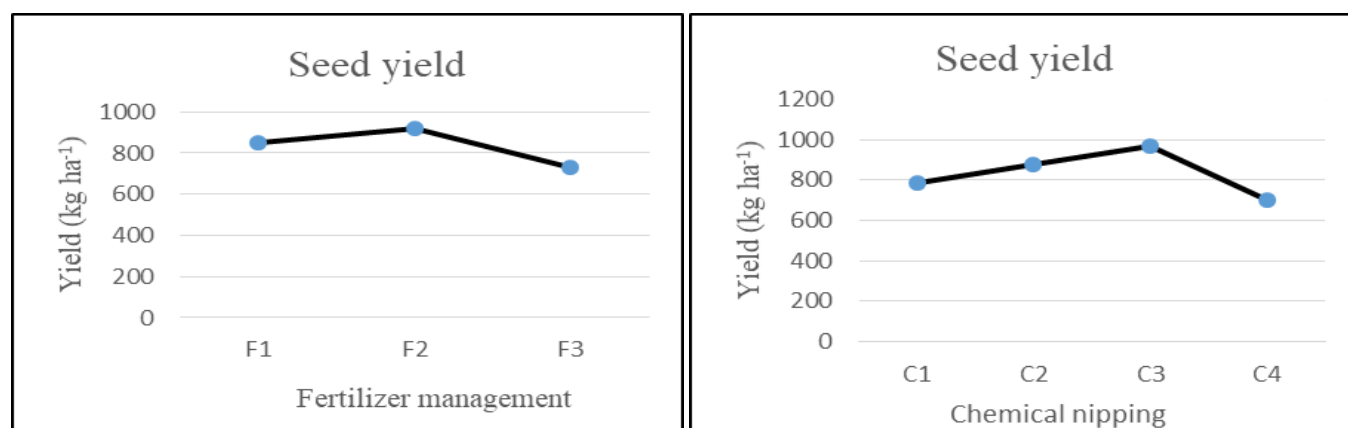
Yield

Seed yield

Data related to seed yield is shown in figure 3. In case of fertilizer management seed yield was found to be higher for the application of 100% RDF along with TNAU MN mixture 5 kg/ha as Enriched FYM (922 kg ha⁻¹) over. Soil application of MN mixture increased the yield of horsegram in rainfed condition which is due to MN mixture enhances the pod

setting and pod formation. Similar results were obtained with Kannan *et al.*, (2014) [7].

Among chemical nipping spraying of Chlormequat chloride 250 ppm @ 40 & 50 DAS (C₃) registered 27.19% increased seed yield over no nipping (C₄). Spraying of chlormequat chloride at different concentration significantly enhances the yield of horsegram in rainfed condition. Dandge *et al.*, (2016) [5] also noted that foliar spraying of chlormequat chloride increases the yield components and yield of soybean.

**Fig 3:** Fertilizer management and chemical nipping seed yield (kg ha⁻¹) of horsegram

Conclusion

In the present study, combined application of 100% RDF along with TNAU MN mixture 5 kg/ha as Enriched FYM and chlormequat chloride 250 ppm @ 40 & 50 DAS in rainfed horsegram showed a significant increase in the proline, relative water content and seed yield in comparison with other treatments. It could be concluded that the application of fertilizer and Chlormequat chloride might be recommended for profitable horsegram production under rainfed condition.

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