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Effect of Hydrophilic Polymer and Farmyard Manure on Yield Attributes and Yields of Rainfed Chickpea

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A B S T R A C T

A field experiment was conducted during *rabi* season of 2016-2017 to find out effect of hydrophilic polymer and farmyard manure on yield attributes and yield of rainfed chickpea at Agricultural Research Station, Darsi, Andhra Pradesh, India. Results revealed that treatments influenced significantly on plant height, no of branches per plant and pods per plant. Seed yield was significant different among the treatments. Highest seed yield of 1883 kg ha^{-1} was recorded in T_7 treatment which is statistically superior followed by T_4 treatment. Highest stover yield was recorded in T_7 treatment with 3108 kg ha^{-1} followed by T_6 treatment with 2415 kg ha^{-1}. High input cost and non-availability of higher quantities of farm year manure compare to hydrophilic polymer application of 15 kg ha^{-1} hydrophilic polymer may be a climate resilient agronomic option to stabilize the crop yields.

Introduction

Chickpea is conventionally grown on residual soil moisture conditions on deep black soils. Therefore, the crop faces high temperature and water stress towards maturity which results in low and variable yields. The crop duration window is constrained by sowing at the termination of rains (later October) and the increasing heat of summer (early March), resulting in a narrow crop growth window. Within this transition period (winter to summer) especially from late February month onwards, temperatures are highly crucial for attaining optimal yields in peninsular India. Variability of occurrence of rainfall before sowing is one of the crucial factors determining the sowing window in the region. The productivity of chickpea is low in peninsular India because, it is mainly grown under receding moisture conditions with very limited or no irrigation sources.

Moisture stress is one of the main reasons for the timing of the onset of senescence in chickpea. Grain yield is significantly sensitive to water stress during the pod setting to grain development periods irrespective of soil texture (Jalota *et al.,* 2006).

Crop production potential in dryland regions was un-exploited mainly because of low surface and ground water resources. The limited availability of water therefore, necessitates the use of water management aids that can retain water for longer duration (Singh *et al.*, 2006).

Polyacrylamide is a water-absorbing polymer that absorbs soil water and retains it for a longer duration as compared to soil particles during surplus periods and releases water slowly. The water absorption rate in these polymers varies up to 400 times according to their formulation, water impurities, and salt content [Monnig, 2005]. Application hydrophilic polymers reduce the frequency of irrigation (López *et al.*, 2016), irrigation requirement by 15-50 % (Dabh *et al.*, 2013), increase in pod number and 100 seed weight in chickpea (Allahyari *et al.*, 2013), increases seed yield of sunflower (Ghatol *et al.*, 2018), soybean (Yazdani *et al.*, 2007), chickpea (Siamak *et al.,* 2014) and decreasing the effects of drought stress (Koohestani *et al.*, 2009 & Zheng *et al.*, 2009). Polymers use can maintain soil moisture and some of the nutrients for up to five years after their application at the farms [Martin *et al.*, 1993]. In view of the above, use of hydrophilic polymer is providing a new technology for dry land conditions and it is important to find out the effect of hydrophilic polymer on chickpea yield attributes and yield behavior. Keeping above point in view, the present investigation was undertaken.

Materials and Methods

The experiment was conducted during *Rabi* 2016-17 at Agricultural Research Station, ANGRAU, Darsi, Andhra Pradesh, India. The experimental site falls under semi-arid climatic conditions as per Thornthwaite's method of climate classification and Tropical savanna with dry summer as per Koppen's methods of climate classification. The annual rainfall is 313 mm and the majority of the rainfall is received from June to October (South West Monsoon period). During the crop growth period, an amount of 12.5 mm of rainfall was received against the 27.3 mm (Normal rainfall).

The experiment was laid out in randomized block design with three replications along with seven treatment viz., T_1- Control (No hydrophilic polymer), T_2 - Soil application of Hydrophilic polymer @ 5 kg ha^{-1}, T_3 - Soil application of Hydrophilic polymer @ 10 kg ha^{-1}, T_4 - Soil application of hydrophilic polymer @ 5kg ha^{-1} + FYM @ 5 t ha^{-1}, T_5 - Soil application of FYM @ 5 t ha^{-1}, T_6 - Soil application of hydrophilic polymer @ 10 kg ha^{-1} + FYM @ 6 t ha^{-1} and T_7 - Soil application of hydrophilic polymer @ 15 kg ha^{-1} + FYM @ 7 t ha^{-1}. Recommended package and practices were followed for crop management. Observations on yield attributes, seed yield and stover yield were recorded.

Results and Discussion

Perusal of data (Table-1) indicated that the treatments influenced significantly on plant height, no of branches per plant and pods per plant. The highest plant height of 49.1 cm was recorded in T_7 treatment followed by 47.5 cm in T_4 treatment. Increase water availability by the application of hydrophilic polymers increase plant height compare to control and the increase was higher in application of hydrophilic polymer along with farmyard manure. Number of branches plant^{-1} and pods plant$^{\mathbf{-1}}$ was statistically significant among the treatments and highest was recorded in T_7 treatment followed by T_4 treatment. Increase in plant^{-1} and pods plant$^{\mathbf{-1}}$ recorded due to the presence of dry and cool weather besides water and nutrient availability. Optimum conditions of temperature and soil moisture favored increase in pod setting. Dingre *et al.*, 2017 reported that application of hydrophilic polymer of 15 kg ha^{-1} recorded highest number of pods compare to the control, lower and higher doses of polymer. Test weight was statistically non-significant among the treatments.

Seed yield was significant different among the treatments. Highest seed yield of 1883 kg ha^{-1} was recorded in T_7 treatment which is statistically superior (Table-2). Similar results were reported by Anupama *et al.*, 2005. However T_4 (1715 kg ha^{-1}), T_6 (1654 kg ha^{-1}) found to be superior to control. In T_7 the addition of farm yard manure along with hydrophilic polymer may increase the availability of more micronutrients besides its water holding nature and moderation of soil temperatures to create favorable conditions for plant root. Increase in application of hydrophilic polymer in T_3 and T_4 as compare to T_2 significantly increased the seed yield. Increase in application hydrophilic polymer from 5 kg ha^{-1} (T_2 treatment) to 10 kg ha^{-1} (T_3 treatment) increased seed yield of 2.4 times higher whereas the application of 15 kg ha^{-1} increased the seed yields of 1.6 times when compare to T3 but 31 % higher than control (T_1 treatment). In similar the application of hydrophilic polymer of 15 kg ha^{-1} along with farmyard manure of 15 t ha^{-1} increased seed yields of 44% when compare to control.

Table.1 Effect of hydrophilic polymer and farmyard manure on yield attributes of rainfed chickpea

Particulars	Plant height (cm)	No. of branches plant^{-1}	Pods plant^{-1}	Test weight (gm)
T1	33.5	6.4	20.7	21.4
T2	36.9	7.1	21.3	21.4
T3	40.2	7.5	23.5	21.5
T4	47.5	8.3	25.1	21.7
T5	38.4	7.3	22.4	21.4
T6	42.9	8.1	26.3	22.0
T7	49.1	9.0	27.6	22.1
SE m ±	3.1	0.4	2.1	0.8
CD (0.05)	9.7	1.4	6.7	NS
CV (%)	13.2	10.2	12.5	6.5

Table.2 Effect of hydrophilic polymer and farmyard manure on seed yield, stover yield and harvest index of rainfed chickpea

Particulars	Seed Yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Harvest Index (%)
T1	1306	1593	45.0
T2	1418	1801	44.1
T3	1555	2053	43.1
T4	1715	2384	41.5
T5	1477	1921	43.5
T6	1654	2415	40.7
T7	1883	3108	37.7
SE m ±	92.5	129.7	1.9
CD (0.05)	288.3	405.5	NS
CV (%)	10.2	10.3	8.1

Application of farmyard manure had additional advantage over the hydrophilic polymer of 15 kg ha^{-1} but the availability and its cost had negative effects for successful implementation over a large scale. To overcome the terminal moisture stress in rainfed chickpea, application of 15 kg ha^{-1} may be a climate resilient agronomic option to stabilizes the crop yields.

Significant difference among the different treatments in stover yields was recorded. Highest stover yield was recorded in T_7 treatment with 3108 kg ha^{-1} followed by T_6 treatment with 2415 kg ha^{-1}. Increase in stover yield was attributed due to increase in plant height and branches. Harvest index was non-significant among the treatments. The T_1 treatment recorded highest harvest index of 45.0 % followed by T_2 treatment with 44.1 %. This was attributed due to the lower plant height and branches.

Gross returns obtained were higher in T7 followed by T4 treatment (Table-2). Irrigation levels influenced higher net returns with treatment T7 (Rs. 42, 166/-) followed by T4 (Rs. 38, 680/-). Treatment T7 registered higher cost benefit ratio and was superior to other treatments and control.

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