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Effect of Hydrophilic Polymer Application on Soil Moisture and Yield of Soybean Crop (Glycine Max)

Pooran pragnya[2], Sandeep Payal[1*] and Tapre Praveen[3]

[1]*Assistant Professor, College of Agricultural Engineering and Technology, India*

[2]*Department of Soil and Water Conservation Engineering, College of Agricultural Engineering and Technology, India*

[3]*Vasantrao Naik Marthwada Krishi Vidyapeeth, India*

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***Corresponding author:** Sandeep Payal, Assistant Professor, College of Agricultural Engineering and Technology, Parbhani, India, Email: poornapragnya.joshi4@gmail.com

Abstract

The present research work on application of polyacrylamide hydrophilic polymer for dry land agriculture with five treatments was conducted during kharif -2015. The treatments were replicated four times with randomized block design. The performance in all four treatments comparatively evaluated and the treatment with application of hydrophilic polymer 50kg/ha (T4) was recorded highest average per cent improvement in the soil moisture retention as 59.58 on the furrow and 50.85 between the furrows as compared to control treatment. The yield and growth attributing parameters were also recorded highest with the same treatment. The yield reduced drastically due to prolonged dry spell (35 days) especially during peak reproductive stage of Soybean crop. In case of long dry spell (more than 18 days) the combination of irrigation facility along with the application of hydrophilic polymer at least during the peak crop growth will produce better result.

Keywords: Polymer; Soil Moisture; Yield; Dry Spell; Irrigation

Introduction

Aqua orb 3005K is a hydrophilic polymer (copolymer of acryl amide and potassium acryl ate) that, when incorporated into a soil, improve water conservation through increasing of water retention capacity, reducing of infiltration rate and cumulative evaporation. This anionic polyacrylamide polymer works in absorption –release water cycles and has the property of absorbing up to 500 times their weight in distilled water Eugen Ulea [1]. Soybean (Glycine max) is the 'golden bean' or 'miracle bean'. Soybean is a major source of vegetable oil, protein and animal feed. It contains about 40% of good quality protein, 20% fat, 23% carbohydrates, 5% minerals, 8% moisture, 4% fiber and reasonable amounts of vitamins. It is one of the most economical protein sources in the world Ali [2]. Water deficiency is first limitation of soybean production in semiarid region, so more yield can be obtained by choosing strong and compatible cultivar for arid and semiarid region.

Application of hydrogels can result in significant reduction in the required irrigation frequenvy particularly for coarse-textured soil. This is an important issue in arid and semi arid regions of the world for enhancing yhe water management of coarse textured soil. The crysral colloid is destined to play an important role in the furture of Indian agriculture as farners have to produce more with the dwindling supplies of water Soliman- Mona [3].

Material and Methods

The study was carried at All India Co-ordinate Research Project (AICRP), for Dry Land Agricultural farm, for Soybean crop during Kharif-2015. Te soil type ranges from medium to deep black with pH of 8.2. As per rainfall data, the total rainfall received during the year 20415 was 574.8mm. The topography of the experimental plot was fairly leveled. The field capacity and wilting point of the soil was 32-35 and 8-10% respectively. The soil was medium black in texture having depth up to 60 cm; the bulk density was 1.27gm/cc. Aqua orb 3005K was a hydrophilic polymer used for this study. These colloids can absorb 400-500 times of water of its own weight in a short time. MAUS-81 (Shakti) is a soybean variety having good grain variety and free from soil bacterial infection was selected for the present study. It matures in 93-97 days. It grows well in the temperature range of 23-320C. This variety is tolerant to common diseases and pests. Since it is a drought resistance variety, it is extensively cultivated in semi arid regions of the country. Five treatments Viz., application of hydrophilic polymer at the rate 12.5 kg/ha (T1), 25 kg/ha (T2), 37.5 kg/ha (T3), 50 kg/ha (T4) and control (T5) were replicated four times. The experiment was carried out in Randomized block design. The moisture content was recorded regularly with an interval of seven days. The soil moisture content was determined using screw auger following standard

Gravimetric method at 0-15 and 15-30 cm depth with an interval of seven days [4-7].

The plant parameters such as height of plant, number of branches per plant and number of pods per plant were recorded from five plants randomly selected from each treatment from each replication. Besides these, seed yield and economics of treatments (gross monetary returns, net monetary return and B: C ratio) were also calculated for kharif season 2015. The results obtained were subjected to statistical analysis. The standard error and critical difference at 5% probability were also calculated using RBD software.

Result and Discussion

The treatment wise observations for on furrow and between furrow condition with seasonal rainfall readings exploited to 0-15 and 15-30 cm depth conditions are mentioned below in the result tables for its diagnostic calculations. Total rainfall received during the monsoon season was only recorded 408.1mm as against 892mm. The total rainfall received in June, July, August, September and October month was 125.6 mm, 13.6mm, 83.2mm, 183.9mm and 1.8mm respectively. There were two dry spells one in July (15 days) and another one in September-October (35 days). Soybean was sown during second week of July and was harvested in last week of November.

Table 1 reveals the overall seasonal trend of soil moisture with respect to all the treatments. The total rainfall recorded during the season was 230.20mm. It was noted that the application of hydrogel @ 50 kg/ha i.e. treatment T4 in soil recorded significantly higher soil moisture content than rest of the treatments. The treatment T4 was followed by the treatment T3. The highest soil moisture (average of whole season) recorded by the treatment T4 on the furrow at 0-15cm depth was 9.65 per-cents and at 15-30 cm depth as 10.85 per-cents and between the furrow at 0-15 cm depth as 8.96 percent and at 15-30 cm depth as 9.77 percent. The overall average improvement of soil moisture retention of the soil in season was noticed in treatment T4. It was 42.33 and 32.88 percent on the furrow and between the furrows respectively when compared with the farmer's local practice (control) (Figure 1).

Table 1: Seasonal Avaerage Soil Moisture (66 DAS).

Treatment	On the Furrow		Between the Furrow		Seasonal Rainfall (mm)
	At 0-15 cm Depth (%)	At 15-30 cm Depth (%)	At 0-15 cm Depth (%)	At 15-30 cm Depth (%)	
T1	10.23	11.62	9.54	10.68	230.20
T2	11.12	12.64	10.27	11.63	230.20
T3	11.87	13.67	11.14	12.34	230.20
T4	13.41	15.08	12.45	13.58	230.20
T5	9.81	10.55	9.31	10.28	230.20
Mean	11.27	12.71	10.55	11.70	---
SE	0.029	0.022	0.030	0.039	---
CD @ 5% Level	0.091	0.067	0.092	0.119	----

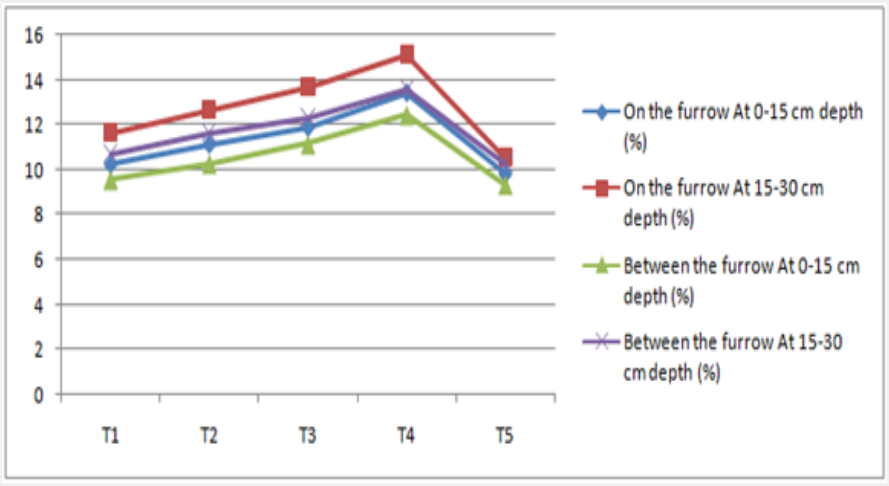

Figure 1: Graphical representation of Seasonal Avaerge Soil Moisture (66 DAS).

Table 2 shows that the treatment T4 recorded significantly higher soil moisture compared to all other treatments. It recorded highest soil moisture content on 38 DAS as 16.26 Percent while the control recorded least soil moisture content as 8.35 per cent with same amount of rainfall i.e 82.60mm. The soil moisture improvement in the plot treated with hydrophilic polymer at the rate 50 kg per hectare was 60.83 percent more than the control on the furrow at 0-15 cm depth. The Table 3

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shows that the treatment T4 recorded significantly higher soil moisture compared to all other treatmnents. It recorded highest soil moistrure on 38 DAS as 17.59 percent while the control recorded the least soil moisture content as 11.11 percent with the same amount of rainfall i.e 82.60mm. The soil moisture improvement in the plot treated with hydrophilic polymer at the rate 50 kg per hectare was 58.32 percent more than the control on th furrow at 15-30 cm depth.

Table 2: Seasonal Trend of Soil Moistrure Percent on the Furrow at 0-15 cm Depth.

Treatment	Moisture Content (%) on								
	10 DAS	17 DAS	24 DAS	31 DAS	38 DAS	45 DAS	52 DAS	59 DAS	66 DAS
T1	8.29	8.18	6.83	12.64	16.36	12.25	10.13	9.60	7.77
T2	8.85	9.03	7.92	14.08	18.33	13.12	11.23	10.93	8.00
T3	10.07	9.10	7.71	15.74	20.09	14.98	13.78	10.61	8.25
T4	11.53	10.22	8.61	15.87	22.60	17.56	13.58	10.86	9.41
T5	7.92	7.32	9.00	11.60	14.05	11.42	9.52	9.17	7.51
Rainfall (mm)	32.70	13.60	0.00	38.10	82.60	63.20	0.00	0.00	0.00

Table 3: Seasonal Trend of Soil Moistrure Percent on the Furrow at 15-30 cm Depth.

Treatment	Moisture content (%) on								
	10 DAS	17 DAS	24 DAS	31 DAS	38 DAS	45 DAS	52 DAS	59 DAS	66 DAS
T1	10.24	9.75	8.65	14.08	18.22	13.52	11.05	10.34	8.45
T2	11.06	10.70	9.16	16.08	22.18	14.66	12.28	11.24	8.64
T3	11.73	10.70	9.74	18.18	21.92	16.70	13.52	11.60	9.07
T4	13.31	11.70	10.70	19.23	24.45	19.46	15.26	12.21	9.38
T5	9.36	8.37	8.11	12.48	15.44	13.07	13.79	9.73	8.15
Rainfall (mm)	32.70	13.60	0.00	38.10	82.60	63.20	0.00	0.00	0.00

Table 4: Effect of Hydrophilic Polymer application on Yield and yield attributing parameters.

Treatment	Height of Plant (cm)	No. of Branches	No. of Pods	Yield (kg/ha)
T1	29.65	5.50	7.00	44.16
T2	29.93	6.50	7.50	49.38
T3	32.75	6.75	8.50	57.56
T4	33.25	7.50	9.75	68.34
T5	28.20	5.00	6.00	39.80
Mean	30.76	6.25	7.75	51.85
SE ±	0.828	0.665	0.710	3.221
CD @ 5 % Level	2.546	2.045	2.185	9.909

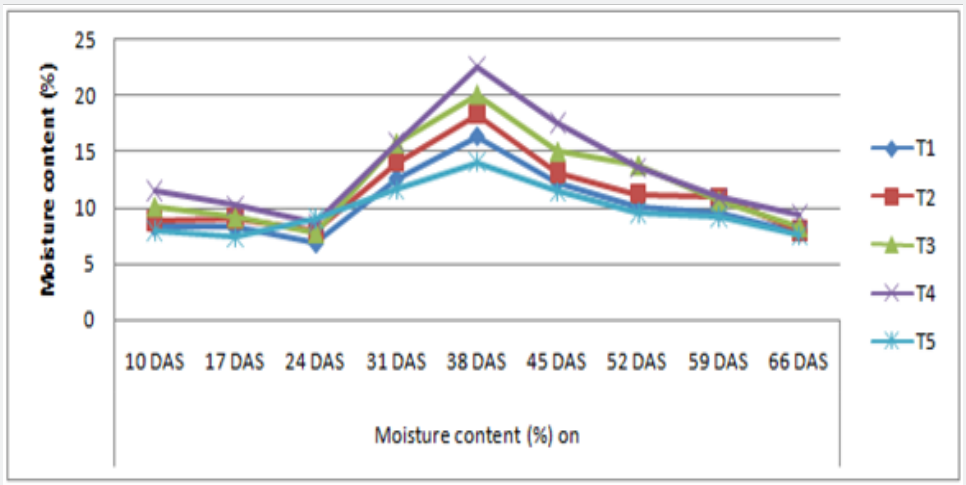

Figure 2: Graphical representation of Seasonal Trend of Soil Moistrure Percent on the Furrow at 0-15 Cm Depth.

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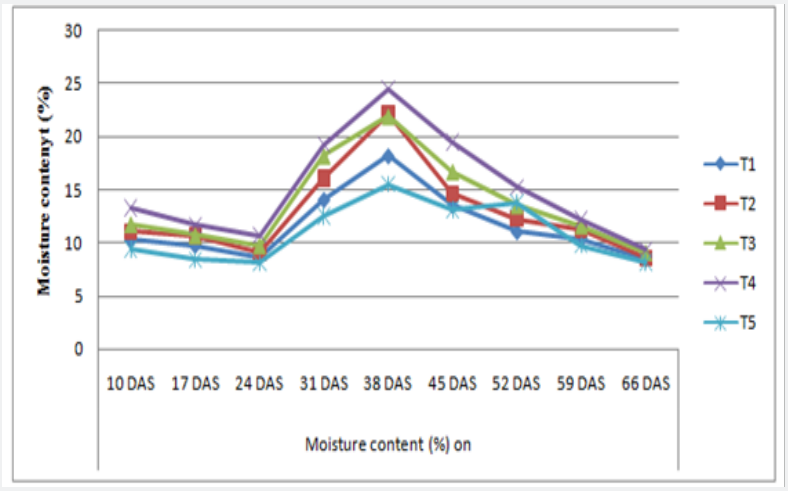

Figure 3: Graphical represenation of Seasonal Trend of Soil Moistrure Percent on the Furrow at 15-30 Cm Depth.

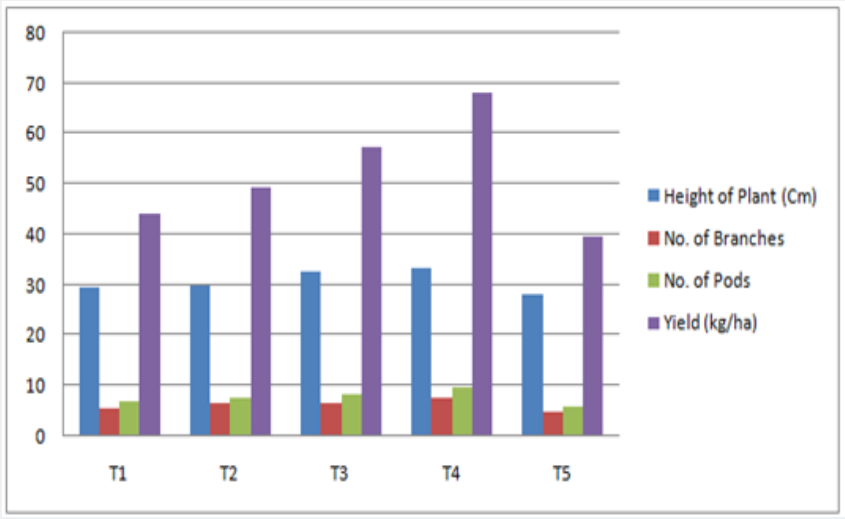

Figure 4: Graphical representation of effect of hydrophilic polymer application on yield and yield attributing parameters.

From Table 4 and Figure 2 it can be concluded that the application of hydrophilioc polymer application at the rate 50 kg per hectare (T4) recorded the better yield and yield attributing parameters viz.,plant height (cm), number of branches and number of pods compared to all other treatments. The average height of plant in treatment T4 was 33.25cm and Number of branches and number of pods were 7.50 and 9.75 respectively. The yield was also significant in treatment T4 with 68.34 kg/ha. Though the treatment T4 recorded better readings than other treatment it was lower than the normal production. Prolonged dry spell for more than 35 days was the main reason for the decline of yield in soybean. The treatment T4 recorded better soil moisture till 18 days of dry spell later its recordings were similar with the other treatments (Figures 3 & 4).

Conclusion

Application of hydrophilic polymer at the rate 50 kg/ha i.e treatment T4 recorded highest soil moisture content among all the treatments at different depth of soil. The treatment T4 recorded highest avaerge percent improvement in the soil moisture retention with same amount of rainfall. The highest yield and yield attributing paramters were also recorded with same tratment. The prolonged dry spell led to dfecrease in the yield of soybean so it is advisable that combination of irrigation facility along with the application of hydrophilc polymer in case of long dry spells (more than 18 days) at least during the peak crop growth stages will yield better result.

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