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Effect of Mulching and Hydrogel on The Productivity of Pearl Millet Under Rai Fed Condition

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Abstract

A field experiment was conducted at ICAR- AICRP on Pearl millet Project, College of Agriculture, Dhule in three year consecutive rainy (*Kharif*) seasons of 2017-2019 to study the effect of mulching and hydrogel on the productivity of pearl millet under rainfed conditions. The soil of the experimental field was medium black soil in available nitrogen (197 kg ha^{-1}) medium in available phosphorus (18.4 kg ha^{-1}) and high in available potash (568 kg ha^{-1}) with0.0.20 per cent organic carbon and alkaline (pH 8.15) in reaction. The experiment consisting of eight treatments was conducted in randomized block design with three replications. The study revealed that the total no.of tillers ,effective tillers $plant^{-1}$ and test weight were significantly influenced by application of hydrogel and crop residue. The grain, stover yield and WUE were significantly influenced by the hydogel application. The trial response of application of crop residue mulch @ 5.0 t ha^{-1} + hydrogel @ 7.5 kg ha^{-1} produced significantly higher grain yield (31.30 q ha^{-1}) and fodder yield (52.93 q ha^{-1}) over other treatments. But at par with crop residue mulch @ 5.0 t ha^{-1} + hydro gel @ 5.0 kg ha^{-1}, crop residue mulch @ 5.0 t ha^{-1} and application hydrogel @ 7.5 kg ha^{-1} and same treatment recorded highest WUE of 78.10 per cent.

Key words : Hydrogel, Growth, Yield attributes , WUE, pearl millet.

Pearl millet (*Pennisutum glaucum* L.) is the fourth most important crop after rice, wheat and maize in India. It is the staple food for millions of people in the semi-arid tropics. The pearlmillet crop was grown on 6.87 lakh ha. of land with 9.06 lakh metric tones of grain production with productivity of 1317 kg/ha (2020-2021). Pearl millet survives in rainfed areas because of its drought escaping mechanism but still responds well to all inputs including fertilizers. Soil moisture is the most important factor for successful crop production in dry lands. Under rainfed situation, risk of crop failure does not permit the farmers to apply recommended dose of chemical fertilizer and other inputs. Supplemental irrigations at critical growth stage with harvested rain water can increase water use efficiency (WUE) over that of rain fed crop but where rain water collection is not possible due to less runoff (combined effect of low rain intensity and high infiltration rate), the water absorbing product like hydrogel may be used as soil amendment (Singh and Naga, 2006). Keeping this in view, an experiment was conducted to study the effect of mulching and hydrogel on the productivity of pearl millet and improving water use efficiency in pearl millet.

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consisting of eight treatments (Table 1) was conducted in randomized block design with three replications. The hydrogel is applied at the time of sowing and mixed with chemical fertilizers along with crop lines before sowing. Pearl millet GHB558 was sown in 45cm row spacing and recommended dose of fertilizer and other cultivation practices were adopted. The rainfall received during the growing period (June to September) was 427.00 mm in 2017, 333.00 mm in 2018 and 564.00 mm in 2019. Seasonal consumptive use of water by the crop for the entire growing season was estimated from total soil- moisture depletion by soil moisture determination (Dastane, 1972).

Yield Attributes and Crop Yield : Crop yield attributes *viz*., Total tillers, effective tillers plant^{-1} and test weight were significantly influenced by application of hydrogel (Table 1) . The maximum increase in total number of tillers, effective tillers per plant and test weight were observed with application of crop residue mulch@ 5.0 t ha^{-1} + hydrogel @ 7.5 kg ha^{-1} to pearl millet crop. Almost same results were reported by A. K. Katiyar and *et al*. (2017).

The grain and Stover yields were also significantly influenced by hydrogel application (Table 2) The highest increasing in grain and fodder yield was found with crop residue mulch@ 5.0 t ha^{-1} + hydrogel@ 7.5 kg ha^{-1}.

Table 1. Effect of mulching and hydrogel on the yield attributing characters and WUE of pearl millet.(Pooled data 2017-2019).

Treatments	Total tillers plant^{-1}	Effective tillers plant^{-1}	Test w.t (gm)	WUE (kg ha^{-1} cm^{-1})
Control	3.26	1.88	13.99	50.27
Crop residue mulch @ 5.0 t ha^{-1}	3.78	2.13	14.14	69.41
Hydrogel @ 2.5 kg ha^{-1}	3.45	1.96	13.66	57.19
Hydrogel @ 5.0 kg ha^{-1}	3.66	1.92	14.17	60.09
Hydrogel @ 7.5 kg ha^{-1}	3.67	2.03	13.62	63.90
T_2 + Hydrogel @ 2.5 kg ha^{-1}	3.90	2.13	14.11	69.54
T_2 + Hydrogel @ 5.0 kg ha^{-1}	4.09	2.21	14.03	74.09
T_2 + Hydrogel @ 7.5 kg ha^{-1}	4.33	2.46	14.25	78.10

Table 2. Effect of mulching and hydrogel on the yield and economics of pearl millet (Pooled data 2017-2019)

Treatments	Pearl millet yield (q ha^{-1})		GMR (Rs. ha^{-1})	Cost of cultivation (Rs. ha^{-1})	NMR (Rs. ha^{-1})	B:C ratio
	Grain	Fodder				
Control	17.68	31.31	36088	21590	14498	1.67
Crop residue mulch @ 5.0 t ha^{-1}	27.67	44.58	58764	23640	35124	2.49
Hydrogel @ 2.5 kg ha^{-1}	22.79	39.18	49270	24640	24630	2.00
Hydrogel @ 5.0 kg ha^{-1}	23.93	40.55	50297	25617	24680	1.96
Hydrogel @ 7.5 kg ha^{-1}	25.49	42.23	52698	27090	25608	1.95
T_2 + Hydrogel @ 2.5 kg ha^{-1}	23.68	45.40	57721	26725	30996	2.16
T_2 + Hydrogel @ 5.0 kg ha^{-1}	29.52	48.58	61008	27885	33123	2.19
T_2 + Hydrogel @ 7.5 kg ha^{-1}	31.30	52.93	65088	29090	35998	2.24
SE(±)	2.14	1.85	-	-	-	-
CD @5%	6.39	5.50	-	-	-	-
CV (%)	10.41	7.25	-	-	-	-

The crop residue mulch@ 5.0 t ha^{-1} + hydrogel @ 7.5 kg ha^{-1} produced significantly higher grain yield (31.30 q ha^{-1}) and fodder yield (52.93 q ha^{-1}) over other treatments. But it was at par with treatment residue mulch@ 5.0 t ha^{-1} + hydrogel@ 5.0 kg ha^{-1} in respect of grain and fodder yield of pearl millet. And also at par with treatment of residue mulch@ 5.0 t ha^{-1} + hydrogel@ 7.5 kg ha^{-1} in respect of grain yield only. The increase in the crop yield parameters and crop yield might be due to the fact that hydrogel application increase the availability of water in root zone at early stage of crop. Hydrogels when hydrogel transformed themselves into water laden gel 'chunk' and these gel chunks acted as local water reservoirs which perhaps helped in initial establishment of crop and resulted in better crop growth. Kant *et. al*., (2008) also reported the improvement in crop parameters under water stress condition with the application of hydrogel substract in bean. Bana R.S. and *et al.* (2023) reported the same trend of incease in grain and stover yield of pearl millet by use of hydrogel and crop residue.

Water Use Efficiency : The maximum water use efficiency (WUE)(78.10%) was noted with application of crop residue mulch@ 5.0 t ha^{-1} + hydrogel@ 7.5 kg ha^{-1} over other treatment of untreated control. This increased value of WUE might be ascribed to higher grain yield. Harphool singh (2012) reported the same trend of increase in water use efficiency by application of hydrogel.

Economics : The treatment application of crop residue mulch@ 5.0 t ha^{-1} + hydrogel@ 7.5 kg/ha produced significantly superior gross monetary returns (Rs. 65088), net monetary returns(Rs. 35998) as compared to other treatments of hydrogel application.

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