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Effect of Mulching and Organic Sources on Growth Parameters and Yield of Pearl Millet (*Pennisetum glaucum L.*) Crop under Rainfed Area of *Vindhyan* Region, India

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Mulching is one of the important agronomic practices in conserving the soil moisture and modifying the soil physical environment. A field experiment was conducted under rainfed conditions at Agronomy farm of Rajiv Gandhi South Campus, Brakachha (BHU) Mirzapur which is situated in *Vindhyan* region of district Mirzapur (25º 10' latitude, 82º 37' longitude and altitude of 427 meters above mean sea level) to find out the effect of organic manure and mulching on growth and yield of pearl millet crop. The experiment was laid out in a randomized complete block design with 10 different treatments. Though all the mulch treatments improved plant height, no. of tillers plant^{-1} and dry matter accumulation, yield attributes viz; ear length, ear diameter and test weight, grain yield, straw yield and harvest index at different stages (20,40,60 DAS and at harvest) of pearl millet. However, treatment Legume straw mulching + FYM + Vermicompost was found to be superior in all growth parameter and yield of pear millet followed by treatment Water hyacinth mulch + FYM +Vermicompost.

Key words: Mulching, Organic sources, Growth parameters, Pearl millet, Rainfed, yield.

In coming years, the growth in agricultural productivity vis-a-vis food security in India will increasingly depend on improved utilization of rainfed regions, which might cater for the country's 2nd Green Revolution. As water is limited, these regions must adopt suitable water conserving techniques in order to improve the water use efficiency and thereby increasing the productivity. Mulching has been proved to be beneficial in conserving moisture and increasing productivity in wheat (Verma and Acharya, 2004a,b; Li *et al*., 2005; Huang *et al*., 2005; Rahman *et al*., 2005; Chakraborty *et al*., 2008).

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Pearl millet (*Pennisetum glucum L.*) is one of the major coarse grain crops and is considered to be a poor man's food. In Asia it is an important *kharif* cereal crop of India, Pakistan, China and south eastern Asia. In India it is one of the important millet crops which flourishes well even under adverse conditions of weather and grown over an area of 8.9 million hectares with total production of 5-7 million tones. Nearly half of all food grains are grown under rainfed conditions, and hundreds of millions of poor rural people depend on rainfed agriculture as the primary source of their livelihoods. Maintaining soil moisture level during critical crop growth stages is the key to success of crop production in dry land areas. Pearl millet has relatively high resistance to drought, high production capacity in hot and dry areas and high efficiency of water use of the three-carbon,

which is considered the most suitable for the plant growing areas with limited water. This discussion suggests that the adoption of resource conserving technologies, such as zero-tillage and residue management is essential in rainfed condition to improve productivity, resource-use efficiency and sustainability of low input agriculture. Therefore, the aim in this research is to understand the Effect of mulching and organic sources on growth and yield of pearl millet (*Pennisetum glaucum L.*) crop in rainfed condition.

MATERIALS AND METHODS

Site description

The experiment was conducted in 2012-2013 at the Agronomy farm of Rajiv Gandhi South Campus, Brakachha (BHU) Mirzapur which is situated in *Vindhyan* region of district Mirzapur (25º 10' latitude, 82º 37' longitude and altitude of 427 meters above mean sea level) occupying over an area of more than 1000 ha where variety of crops like agricultural, horticultural, medicinal and aromatic plants are grown. *Vindhyan* soil comes under rainfed and invariably poor fertility status. This region comes under agro-climatic zone III A (semi-arid eastern plain zone). The climate of Barkachha is typically semi-arid, characterized by extremes of temperature both in summer and winter with low rainfall and moderate humidity. Maximum temperature in summer is as high as 45 ºC and minimum temperature in winter falls below 10 ºC. The annual rainfall of locality was 774.8 mm in 2013.

Experimental design and field management

The experiment was laid out in a randomized block design with ten treatments, namely, control without mulch cropping, Legume straw mulch (2.5 t ha^{-1}), Water hyacinth mulch (2.0 t kg ha^{-1}), Paddy straw mulch (2.5 t ha^{-1}), Legume straw mulch (2.5 t ha^{-1})+ FYM (20 t ha^{-1}), Water hyacinth mulch(2.0 t ha^{-1}) + FYM (20 t ha^{-1}), Paddy straw mulch (2.5 t ha^{-1})+ FYM (20 t ha^{-1}), Legume straw mulch (2.5 t ha^{-1}) + FYM (20 t ha^{-1}) + vermicompost (20 t ha^{-1}), Water hyacinth mulch (2.0 t ha^{-1})+FYM (20 t ha^{-1}) + vermicompost (20 t ha^{-1}) and paddy straw mulch (2.5 t ha^{-1}) + FYM (20 t ha^{-1}) + vermicompost (20 t ha^{-1}) to pearl millet plot to at the experimental field in 2012- 2013. The treatments were applied to 6.3 m^2 (3.0 m x 2.10 m) plots arranged in a randomised block design with three replications. After ridging the treatment plots, chemical fertilisers were broadcast over the soil in the form of Urea, DAP, MOP, FYM, Vermicompost. Pearl millet cv. (ICTP-8203) was sown on 7th august 2013 at a row distance of 45 cm. Relatively higher seed rate (5 kg ha^{-1}) was used for proper maintenance of plant population. A plant spacing of 10 cm within the row was maintained by thinning done about 15 days after sowing. Mulches of Hyacinth straw mulching, Paddy straw mulching and Legume straw mulching were applied @ 2 t ha^{-1}, 2.5 t ha^{-1} and 2.5 t ha^{-1} respectively after next day of sowing in between the rows, allowing plants to grow normally and also ensuring that the rainwater could enter into the soil.

RESULTS AND DISCUSSION

Plant height

The plant height of pearl millet was significantly influenced by the mulching and organic sources (Table 1).It was significantly higher in treatment Legume straw mulching + FYM + Vermicompost (39.20, 165.17, 190.93 and 194.53 cm.) followed by treatment Water hyacinth mulch + FYM +Vermicompost (36.72, 163.80, 188.87 and 193.33 cm)at 20, 40, 60 days after sowing and at harvest. The treatment Paddy straw mulch +FYM treatment was statistically at par with Water hyacinth mulch + FYM whereas treatment control was observed for minimum plant height (28.33, 142.97, 175.67 and 178.67 cm) at 20, 40, 60 day after sowing and at harvest. This could be assigned due to better nutrient supply(Singh and Agarwal, 2001; Jakhar *et al*., 2006).

Number of leaves $plant^{-1}$

The maximum number of tiller (1.70, 4.20, 3.47 and 1.27 plant-1) was observed in treatment Legume straw mulching + FYM + Vermicompost and minimum (0.80, 1.40, 1.07 and 0.47 $plant^{-1}$) in control at 20, 40, 60 DAS and at harvest (Table 1).It showed that, increase in number of tiller $plant^{-1}$ could be assigned due to application of legume straw mulch+ FYM+ vermicompost thereby increasing soil microorganism and also due to better moisture and nutrient availability (Sushila and Giri, 2000).

Dry matter accumulation (g/plant)

The dry matter accumulation (g/plant) of pearl millet was significantly influenced by the

Table 1. Effect of mulching and organic sources on plant height, no. of tillers plant^{-1} and dry matter accumulation of pearl millet crop under rainfed condition

S. No.	Treatment	Plant height (cm)				No. of Tillers				Dry matter accumulation (g plant^{-1})			
		20 DAS	40 DAS	60 DAS	At harvest	20 DAS	40 DAS	60 DAS	At harvest	20 DAS	40 DAS	60 DAS	At harvest
1	Control	28.33	142.97	175.67	178.67	0.80	1.40	1.07	0.47	4.83	11.93	44.27	87.00
2	Legume straw mulching	32.83	151.43	179.87	183.80	1.10	1.67	1.53	0.73	5.93	13.63	51.33	111.67
3	Water hyacinth mulch	31.93	149.07	176.93	181.13	1.30	1.67	1.40	0.60	5.77	13.47	50.50	102.67
4	Paddy straw mulch	28.67	146.07	177.03	179.93	0.97	1.63	1.30	0.53	5.57	12.07	48.33	97.00
5	Legume straw mulching +FYM	34.37	159.87	185.27	186.00	1.40	2.73	2.30	0.97	6.67	16.73	55.60	145.33
6	Water hyacinth mulch +FYM	32.80	154.20	182.73	183.93	1.30	1.43	2.13	0.93	6.53	15.80	54.43	136.67
7	Paddy straw mulch +FYM	33.57	153.20	182.00	183.33	0.83	2.37	1.53	0.80	6.20	15.53	53.47	131.33
8	Legume straw mulching +FYM +Vermicompost	39.20	165.17	190.93	194.53	1.70	4.20	3.47	1.27	7.33	20.20	65.50	169.67
9	Water hyacinth mulch + FYM +Vermicompost	36.72	163.80	188.87	191.33	1.37	3.60	3.33	1.13	7.27	18.63	64.63	156.33
10	Paddy straw mulch + FYM +Vermicompost	35.47	161.43	185.93	188.53	1.07	2.73	2.40	1.00	6.80	18.40	56.40	153.67
	SEm±	0.54	0.22	0.37	0.44	5.54	2.19	3.21	11.05	2.45	1.47	0.35	0.13
	CD (P=0.05)	1.61	0.64	1.11	1.30	NS	6.50	9.52	NS	7.28	4.37	1.04	0.39

Table 2. Effect of mulching and organic sources on ear length, diameter of ear, test weight, plant height, crop yield and harvest index of pearl millet crop under rainfed condition

S.No.	Treatment	Ear length (cm)	Diameter (cm)	Test weight (g)	Plant Height (cm)	Grain yield (q ha^{-1})	Stover yield (q ha^{-1})	Harvest index (%)
1	Control	16.77	6.40	6.79	178.67	16.64	34.80	32.33
2	Legume straw mulching	20.30	7.07	7.23	183.80	19.31	36.73	34.53
3	Water hyacinth mulch	18.20	6.73	7.00	181.13	18.32	35.20	34.27
4	Paddy straw mulch	18.03	6.53	6.83	179.93	17.38	35.10	33.16
5	Legume straw mulching +FYM	24.53	9.40	8.27	186.00	20.21	38.74	34.28
6	Water hyacinth mulch +FYM	23.43	8.80	7.84	183.93	20.15	38.70	34.26
7	Paddy straw mulch +FYM	21.03	8.13	7.39	183.33	19.61	37.33	34.50
8	Legume straw mulching +FYM +Vermicompost	26.07	10.10	8.75	194.53	23.20	43.56	34.78
9	Water hyacinth mulch + FYM +Vermicompost	25.00	9.53	8.47	191.33	22.69	42.52	34.42
10	Paddy straw mulch + FYM +Vermicompost	24.87	9.47	8.33	188.53	21.44	40.72	34.49
	SEm±	1.30	1.74	2.97	0.44	1.62	0.73	0.97
	CD (P=0.05)	3.88	5.16	8.81	1.30	4.83	2.16	2.87

mulch and organic sources and mulching system (Table 1). It was significantly higher at 20, 40, 60 DAS and at harvest in treatment Legume straw mulching + FYM + Vermicompost (7.33, 20.20, 65.50, and 169.57 g) followed by treatment Water hyacinth mulch + FYM + Vermicompost (7.27, 18.63, 64.63 and 156.33 g) and The lowest value of dry matter accumulation (4.83, 11.93, 44.27, and 87.0 g plant-1) was recorded in the control throughout the crop season. Results indicate that higher dry matter yields in the semi-arid region may be achieved by application of mulching and organic sources (Kler and Walia 2006).

Yield attributes

The yield attributes (ear length, ear diameter and test weight) of pear millet as influenced by mulching and organic sources under rainfed condition are presented in Table 2. Significantly highest ear length (26.07 cm) and ear diameter (10.10 cm) were found in the legume straw mulching + FYM + vermicompost however, lowest values of ear length (16.77 cm) ear diameter (6.40cm) were recorded in the treatment control. The percent difference between highest and lowest value of ear length and ear diameter of pearl millet were 55.46 and 57.81 % respectively. The maximum ear length and ear diameter in treatment legume straw mulching +FYM +vermicompost was due to proper spacing and optimum number of plant, there by nutrient uptake more, better plant growth and ultimately maximum ear diameter.

The test weight of seeds under different treatments ranged from 6.79 to 8.75 g (Table 2). The lowest test weight (6.79g) was recorded in control and maximum test weight (8.75 g) was recorded in legume straw mulching + FYM + vermicompost. Increased in nutrient availability and healthy growth contributed maximum test weight of seed. The lowest test weight was recorded in control, where low nutrient availability resulting lowest test weight of the pearl millet seed. There is direct relationship between the average seed weight and organic sources of plant nutrients, which is governed by moisture availability in soil, there by healthy growth and ultimately healthy seeds (Udom *et al*., 2007).

yield, straw yield (q ha^{-1}) and harvest index (%)

Significantly highest pearl millet yield (23.22 q ha^{-1}), straw yield (43.56 q ha^{-1}) and harvest index (34.78 %) were obtained in the treatment Legume straw mulching + FYM + Vermicompost (Table 2).The relative increase in grain and stover yield under treatment may be attributed to marked increase in yield contributing components like number of effective tillers, ear length, ear diameter, 1000-grain weight, whereas control had lower grain and stover yield attributing characters and finally a decrease in grain and stover yield were obtained(Singh A. and singh, 2006).Increase in the yield components might be connected with the release of essential nutrient elements and moisture by the organic matter (Sharma and Vyas, 2001).

CONCLUSIONS

On the basis of the findings of the present investigation, it can be concluded that mulching and organic sources of plant nutrients of Straw Mulching + FYM + Vermicompost was found most suitable method, among all the methods of mulching and organic sources under pearl millet crop in rainfed condition. The maximum dry matter accumulation 7.33, 20.20, 65.50, and 169.57 (gm) at different stages were obtained with the treatment of Legume straw mulching + FYM + Vermicompost. All growth parameters were found superior under treatment of Legume straw mulching + FYM + Vermicompost.

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