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Effect of Moisture Conservation Practices on different Growth Indices and Chlorophyll content of Pearl millet [*Pennisetum glaucum* (L.) R. Br. emend Stuntz] Hybrids

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ABSTRACT

A field experiment was conducted under loamy sand soil during two consecutive *kharif* seasons of 2018 and 2019 at Agronomy farm, Sri Karan Narendra College of Agriculture, Jobner, Jaipur to find out the best moisture conservation practices on different Phenological parameters of pearl millet [*Pennisetum glaucum* (L.) R. Br. emend Stuntz] hybrids. Hybrids *viz.,* RHB-173, RHB-177, MPMH-17 and HHB-67 in main plots and moisture conservation practices *viz.,* control, dust mulch, straw mulch, plastic mulch and seed line mulching of FYM in sub plots were tested using split plot design replicated four. RHB-173 attained significantly higher net assimilation rate, crop growth rate and relative growth rate at all stages over RHB-177, MPMH-17 and HHB-67. Hybrid HHB-67 observed higher leaf area ratio which was at par with hybrid MPMH-17 and significantly higher over RHB-173 and RHB-177 during both the years and in pooled data. Result showed that application of plastic mulch remained at par with straw mulch and significantly higher the leaf area index, leaf area duration, net assimilation rate, relative growth rate, crop growth and leaf area ratio at all stages and chlorophyll content of leaves at 40 DAS of pearl millet over control, dust mulch and seed line mulching of FYM but remained statistically at par with straw mulch during both the years and in pooled analysis.

Key words : *Pearlmillet, Hybrid, Moisture Conservation Practices, LAI, LAD, CGR, RGR, NAR, LAR and Chlorophyll content.*

Introduction

Pearlmillet [*Pennisetum glaucum* (L.) R.Br. emend Stuntz] is one of an important millet crop of India as well as Rajasthan. Pearlmillet is a short day, C_4 plant with high photosynthetic efficiency and dry matter production capacity adapted to hot climate. It is a warm weather coarse cereal crop grown in arid and semi–arid climate of tropical and subtropical regions a the country. It is staple food of poor and small land holders in these area provides source of fodder and feed for livestock in the rainfed area in Rajasthan. Pearlmillet is nutritionally better than many other cereals as 100 g of pearlmillet has the nutritional values *viz.,* energy (361 kcal), moisture (12 g), fibre (1.2 g), fat (5 g), carbohydrate (67.5 g), protein con-

tent (12.1 g), calcium (42 mg), phosphorous content (296 mg), iron (8 mg), zinc (3.1 mg), vitamin-E and B-complex and many amino acids (Anonymous, 2018).

India is the largest producer of pearlmillet globally occupying 6.93 mha area with annual production of 8.61 mt and average productivity of 1243 kg/ha (Anonymous, 2018-19). In the country, Rajasthan, UP, Maharashtra, Haryana and Gujarat account for about 90% of total area and production of the crop. Rajasthan ranks first with respect to area and production of pearlmillet. Pearlmillet crop occupies an area of 42 lac ha and annual production of 5.05 mt with a productivity of 1190 kg/ha in the state of Rajasthan (Anonymous, 2019-20). More than 80% of the area under pearlmillet falls in arid and semi-arid regions of the country. In Rajasthan, Jodhpur, Nagaur, Jaipur, Alwar, Barmer, Jalore, Churu, Sikar, Jhunjhunu and Bikaner are major pearlmillet growing districts. The soil and condition of Rajasthan provides ideal condition for growing pearlmillet.

Recently, in pearlmillet, several high yielding hybrids with good adaptation to various environments have been developed and introduced. Despite the availability of newly developed hybrids, many of the obsolete varieties and traditional land races are occupying area under cultivation and contributing to penurious productivity of pearlmillet. Hence, there is an urgent need to replace them with newly developed high potential hybrids for better production and profitability of the farmers. Pearlmillet hybrids may play an important role in boosting crop productivity and the superiority of hybrids over varieties of pearlmillet has already been proved (Sharma, 2014).

Use of mulching in crop fields increase water use efficiency, protect against solar radiation, regulates soil temperature, suppress weed growth, minimizes leaching loss of nutrients, reduces soil erosion, checks excessive evaporation, increase infiltration of rain water and improve soil moisture, production and quality of field crops (Rummana *et al.,* 2018). Mulch is also being used for its beneficial effects on crop growth and fodder yield, as it decreases soil temperature, evaporation, weed growth and conserving soil moisture content (Din *et al.,* 2013). Use of Organic mulch has also been found to increase the nutrient content of soil following decomposition and mineralization, hence, can increase the vegetative growth of plants, which ultimately results in high yield (Ahamefule and Peter, 2014).

Materials and Methods

A field experiment was conducted under loamy sand soil during two consecutive *kharif* seasons of 2018 and 2019 at Agronomy farm, S.K.N. College of Agriculture, Jobner, Jaipur Rajasthan (26° 05' N, 75° 20' E, 427 m above mean sea level). The soil of the experimental field was loamy sand with slightly alkaline in reaction pH 8.3. It was moderately fertile, being low in organic carbon (0.17 %), low in available nitrogen (130.7 kg/ha), medium in available phosphorus (14.81kg/ha) and potassium (148.63 kg/ha). The experiment was carried out in split plot design comprising four Hybrids *viz.,* RHB-173, RHB-177, MPMH-17 and HHB-67 in main plots and five moisture conservation practices *viz.,* control, dust mulch, straw mulch, plastic mulch and seed line mulching of FYM in sub plots with four replications. The recommended dose of fertilizers (RDF) for *kharif* pearlmillet in semi-arid eastern plain zone of Rajasthan is 60 kg N/ha and 30 kg P_2O_5/ha was given in the form of urea and SSP. Half of the nitrogen was applied at sowing time as basal dose along with the full quantities of phosphorus to all the plots. The remaining half dose of nitrogen was applied as top dressed in two splits through urea. The different weather parameters were recorded during crop growing period in both the years. The maximum and minimum temperature recorded during *kharif* season were in the rage of 30.0 to 42.8 °C and 19.1 to 27.6 °C in 2018 and 30.5 to 45.3 °C and 19.5 to 24.9 °C in 2019. The total rainfall received during *kharif* season was 307.2 mm in 2018 and 392 mm in 2019, respectively. The treatments wise moisture conservation practices were done in earmarked plots, *i.e.* dust mulching done after each heavy rainfall by "*kassi* upto a depth of about 4-5 cm, mustard straw mulch @ 5 t/ha (sun dried) was spread over the soil surface uniformly in between rows at 11 DAS, plastic mulch (0.05 mm thick) was placed in between the rows at 11 DAS and seed line mulching of FYM @ 2 t/ha over the soil surface uniformly in rows at 1 DAS. Chlorophyll content of Pearlmillet at 40 days after sowing was determined as per the method advocated by Arnon (1949) by taking 50 mg fresh leaf material the samples were homogenized in 80 per cent acetone and centrifuged for 10 minutes at 2000 rpm and the final volume was made to 10 ml. Absorbance of clear supernatant liquid was measured at 652 nm on Spectronic-20. The chlorophyll content was expressed in mg/g of fresh

weight of leaves.

$$\text{Total chlorophyll} = \frac{A_{(652)} \times 29 \times \text{Total volume (ml)}}{\alpha \times 1000 \times \text{weight of sample (g)}}$$

Where,

α is the path length = 1 cm

Results and Discussion

Hybrids

Pearlmillet hybrid revealed that hybrid RHB-173 attained significantly higher net assimilation rate at 30-60 DAS, crop growth rate and relative growth rate at 30-60 DAS and 60 DAS-at harvest stage over RHB-177, MPMH-17 and HHB-67 during both the years (Table 1 to 5). On the basis of pooled data, the increase in net assimilation rate was 10.4, 50.6 and 78.2 per cent at 30-60 DAS, crop growth rate was 13.2, 55.5 and 85.0 per cent at 30-60 DAS and 20.1, 36.4 and 66.0 per cent at 60 DAS-at harvest stage and relative growth rate was 8.5, 38.4 and 58.9 per cent at 30-60 DAS and 10.7, 5.7 and 13.9 per cent at 60 DAS-at harvest stage, respectively, over hybrids RHB-177, MPMH-17 and HHB-67. Hybrid HHB-67 observed higher leaf area ratio at 30-60 DAS which was at par with hybrid MPMH-17 and significantly higher over RHB-173 and RHB-177 in both the years of experimentation as well as on pooled basis. The pooled mean leaf area ratio at 30-60 DAS registered with HHB-67 was higher by 11.2 and 9.6 per cent higher over RHB-173 and RHB-177, respectively. Hybrid RHB-173 recorded significantly higher grain yield (2097 kg/ha) and stover yield (5500 kg/ha) over MPMH-17 and HHB-67'during both the years and on pooled data (Table 5 and Fig. 1). This hybrid recorded an increase of 11.7 and 27.8 % grain yield, 8.4 and 25.3 % stover yield, respectively, over MPMH-17 and HHB-67 on pooled mean basis. However, hybrid RHB-177 remained at par with RHB-173. These results are in close conformity with the finding of Singh (2006), Rana *et al.* (2009) and Yadav *et al.* (2014).

Moisture conservation practices

A perusal of data (Table 1 to 5) also revealed that the use of plastic mulch significantly increased leaf area index at 30 DAS and 60 DAS, leaf area duration, net assimilation rate, leaf area ratio at 30-60 DAS, crop growth rate, relative growth rate at 30-60 DAS and 60 DAS-at harvest stage over control, dust mulch and seed line mulching of FYM but remained statistically at par with straw mulch during both the years and in pooled analysis. Plastic mulching enhanced mean leaf area index by 16.7, 9.4 and 11.1 per cent at 30 DAS and 37.8, 21.5 and 19.9 per cent at 60 DAS, leaf area duration by 30.0, 23.9 and 10.9 per cent and net assimilation rate by 37.0, 6.6 and 18.5 per cent at 30-60 DAS, crop growth rate 75.4, 29.8, 5.8 and 31.7

Table 1. Effect of moisture conservation practices on leaf area index of pearlmillet hybrids

Treatments	Leaf area index					
	30 DAS			60 DAS		
	2018	2019	Pooled	2018	2019	Pooled
Hybrids						
RHB-173	1.36	1.31	1.33	2.50	2.49	2.48
RHB-177	1.32	1.31	1.31	2.43	2.38	2.40
MPMH-17	1.32	1.28	1.30	2.41	2.35	2.38
HHB-67	1.30	1.27	1.28	2.39	2.35	2.37
SEm±	0.03	0.02	0.02	0.04	0.04	0.03
CD (P=0.05)	NS	NS	NS	NS	NS	NS
Moisture conservation practices						
Control	1.20	1.19	1.20	2.04	1.98	2.01
Dust mulch	1.33	1.23	1.28	2.30	2.17	2.28
Straw mulch	1.40	1.38	1.39	2.68	2.67	2.68
Plastic mulch	1.41	1.40	1.40	2.78	2.75	2.77
Seed line mulching of FYM	1.27	1.25	1.26	2.34	2.37	2.31
SEm±	0.02	0.02	0.02	0.04	0.04	0.03
CD (P=0.05)	0.06	0.07	0.05	0.12	0.12	0.09
CV (%)	6.65	7.14	7.82	7.23	7.13	7.99

NS=Non significant

Table 2. Effect of moisture conservation practices on leaf area duration and net assimilation rate of pearlmillet hybrids

Treatments	Leaf area duration (days)			Net assimilation rate (g/m² leaf area/day)		
	30 - 60 DAS			30 - 60 DAS		
	2018	2019	Pooled	2018	2019	Pooled
Hybrids						
RHB-173	57.52	56.75	57.13	3.52	3.50	3.51
RHB-177	56.16	55.32	55.74	3.18	3.19	3.18
MPMH-17	55.93	54.51	55.22	2.32	2.35	2.33
HHB-67	55.34	54.24	54.79	1.98	1.96	1.97
SEm±	1.03	1.00	0.80	0.07	0.06	0.05
CD (P=0.05)	NS	NS	NS	0.22	0.18	0.15
Moisture conservation practices						
Control	48.58	47.69	48.13	2.29	2.19	2.24
Dust mulch	51.54	49.49	50.52	2.80	2.97	2.88
Straw mulch	61.24	60.71	60.97	2.97	2.96	2.97
Plastic mulch	62.78	62.36	62.57	3.11	3.03	3.07
Seed line mulching of FYM	57.03	55.77	56.40	2.58	2.60	2.59
SEm±	0.91	0.88	0.65	0.05	0.05	0.04
CD (P=0.05)	2.60	2.51	1.82	0.14	0.13	0.10
CV (%)	6.51	6.39	7.36	7.24	6.57	8.22

NS=Non significant

Table 3. Effect of moisture conservation practices on crop growth rate of pearlmillet hybrids

Treatments	Crop growth rate (g/m²/day)					
	30-60 DAS			60 DAS – At harvest		
	2018	2019	Pooled	2018	2019	Pooled
Hybrids						
RHB-173	6.58	6.47	6.53	15.3	17.0	16.1
RHB-177	5.81	5.74	5.77	13.6	13.2	13.4
MPMH-17	4.23	4.17	4.20	11.3	12.4	11.8
HHB-67	3.58	3.48	3.53	9.5	10.0	9.7
SEm±	0.09	0.09	0.07	0.22	0.24	0.18
CD (P=0.05)	0.29	0.29	0.21	0.71	0.77	0.54
Moisture conservation practices						
Control	3.64	3.43	3.53	8.6	7.5	8.0
Dust mulch	4.74	4.81	4.77	11.5	11.2	11.3
Straw mulch	5.87	5.82	5.85	15.1	16.7	15.9
Plastic mulch	6.29	6.10	6.19	15.3	17.5	16. 4
Seed line mulching of FYM	4.73	4.67	4.70	11.6	12.9	12.3
SEm±	0.08	0.08	0.06	0.20	0.21	0.15
CD (P=0.05)	0.24	0.23	0.16	0.58	0.61	0.42
CV (%)	6.60	6.46	7.40	6.59	6.50	7.43

per cent at 30-60 DAS and 105.0, 45.1, 3.1 and 33.3 per cent 60 DAS-at harvest, relative growth rate 50.5, 20.2 and 19.6 per cent at 30-60 DAS and 30.0, 14.2 and 6.9 per cent over control, dust mulch and seed line mulching of FYM but remained statistically at par with straw mulch during both the years and in pooled analysis. Application of plastic mulch recorded the chlorophyll content of leaves at 40 DAS which was significantly higher over control, dust mulch and seed line mulching of FYM in both the years but remained at par with straw mulch. The mean increase in chlorophyll content due to plastic mulch over control, dust mulch and seed line mulching of FYM was to the extent of 7.6, 4.4 and 3.7 per cent, respectively. Application of plastic mulch found maximum grain yield (2145 kg/ha) and sto-

ver yield (5620 kg/ha) of pearlmillet which was significantly higher during both the years as well as in pooled analysis over control, dust mulch and seed line mulching of FYM but remained statistically at par with straw mulch (Table 5 and Fig. 1). On pooled basis, the plastic mulch registered an increase of 40.4, 13.5 and 13.7 % grain yield and 34.1, 11.2 and 10.4 % stover yield over control, dust mulch and seed line mulching of FYM, respectively. These results are in close conformity with the finding of Kanwar *et al.,* 2017 in pearlmillet, Rummana *et al*., 2018 in wheat and Vidyashree *et al.*, 2019 in french bean.

Table 4. Effect of moisture conservation practices on relative growth rate of pearlmillet hybrids

Treatments	Relative growth rate (g/g/day)					
	30-60 DAS			60 DAS – At harvest		
	2018	2019	Pooled	2018	2019	Pooled
Hybrids						
RHB-173	7.85	7.79	7.82	8.13	7.41	7.77
RHB-177	7.21	7.22	7.21	7.49	6.55	7.02
MPMH-17	5.66	5.65	5.65	7.51	7.18	7.35
HHB-67	4.96	4.88	4.92	7.05	6.59	6.82
SEm±	0.12	0.12	0.09	0.14	0.13	0.11
CD (P=0.05)	0.37	0.38	0.28	0.45	0.42	0.32
Moisture conservation practices						
Control	5.05	4.85	4.95	6.72	5.42	6.07
Dust mulch	6.13	6.27	6.20	7.42	6.40	6.91
Straw mulch	7.18	7.15	7.17	8.16	7.75	7.96
Plastic mulch	7.50	7.41	7.45	7.93	7.85	7.89
Seed line mulching of FYM	6.23	6.24	6.23	7.51	7.26	7.38
SEm±	0.11	0.10	0.07	0.12	0.11	0.09
CD (P=0.05)	0.33	0.29	0.28	0.36	0.32	0.24
CV (%)	6.57	6.41	7.39	6.62	6.48	7.50

Table 5. Effect of moisture conservation practices on leaf area ratio (cm^2/g) and chlorophyll content of pearlmillet hybrids

Treatments	Leaf area ratio (cm^2/g)			Chlorophyll content (mg/g)		
	30 - 60 DAS			40 DAS		
	2018	2019	Pooled	2018	2019	Pooled
Hybrids						
RHB-173	60.12	59.64	59.88	2.76	2.75	2.76
RHB-177	60.86	60.72	60.79	2.73	2.72	2.73
MPMH-17	65.37	64.34	64.86	2.71	2.72	2.72
HHB-67	66.89	66.31	66.60	2.69	2.68	2.69
SEm±	1.16	1.15	0.91	0.03	0.03	0.03
CD (P=0.05)	3.70	3.67	2.70	NS	NS	NS
Moisture conservation practices						
Control	59.70	59.72	59.71	2.62	2.61	2.62
Dust mulch	59.71	57.27	58.49	2.70	2.69	2.70
Straw mulch	65.98	65.56	65.77	2.77	2.76	2.76
Plastic mulch	65.84	66.49	66.17	2.82	2.81	2.82
Seed line mulching of FYM	65.31	64.72	65.01	2.72	2.71	2.72
SEm±	1.07	1.01	0.75	0.03	0.03	0.02
CD (P=0.05)	3.04	2.88	2.10	0.09	0.09	0.06
CV (%)	6.76	6.45	7.50	4.49	4.48	5.07

NS=Non significant

Table 6. Effect of moisture conservation practices on grain and stover yield of pearlmillet hybrids

Treatments	Grain yield (kg/ha)			Stover yield (kg/ha)		
	2018	2019	Pooled	2018	2019	Pooled
Hybrids						
RHB-173	2152	2042	2097	5586	5413	5500
RHB-177	2050	1960	2005	5470	5382	5426
MPMH-17	1934	1820	1877	5189	4956	5072
HHB-67	1695	1586	1641	4505	4275	4390
SEm±	45.7	45.5	36.1	121.1	123.0	96.5
CD (P=0.05)	146.1	145.7	107.1	387.4	393.5	286.7
Moisture conservation practices						
Control	1580	1475	1528	4288	4096	4192
Dust mulch	1942	1835	1889	5181	4926	5054
Straw mulch	2132	2025	2079	5563	5494	5529
Plastic mulch	2196	2093	2145	5689	5550	5620
Seed line mulching of FYM	1939	1832	1886	5217	4965	5091
SEm±	34.5	33.1	25.6	91.5	89.6	68.4
CD (P=0.05)	98.2	94.2	71.7	260.1	254.7	191.9
CV (%)	7.1	7.2	8.5	7.1	7.2	8.5

NS=Non significant

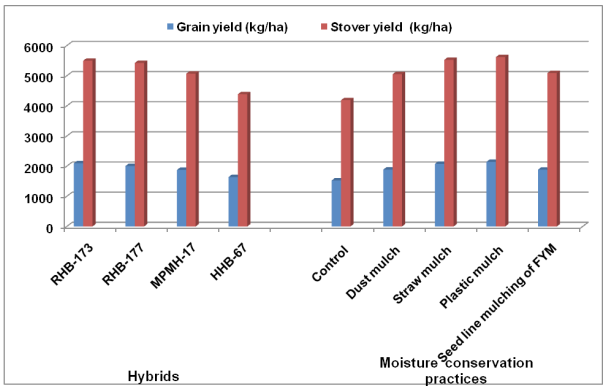

Fig. 1. Effect of moisture conservation practices on grain and stover of pearlmillet hybrids

Conclusion

Based on results of two years experimentation, it may be concluded that hybrid RHB-173 recorded significantly higher net assimilation rate, crop growth rate and relative growth rate being remained at par with RHB-177. Hybrid HHB-67 observed higher leaf area ratio which was at par with hybrid MPMH-17 and significantly higher over RHB-173 and RHB-177. Application of plastic mulch significantly increased leaf area index, leaf area duration, net assimilation rate, relative growth rate, crop growth and leaf area ratio at all stage and chlorophyll content of leaves at 40 DAS over seed line mulching of FYM, dust mulch and control and it was at par with straw mulch.

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