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Effect of Moisture Conservation Practices on Growth and Yield of Pearlmillet [*Pennisetum glaucum* (L.) R. Br. emend Stuntz] Hybrids

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ABSTRACT

Background: 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 to find out the best moisture conservation practices on growth and yield of pearlmillet [*Pennisetum glaucum* (L.) R. Br. emend Stuntz] hybrids.

Methods: 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.

Result: The results further indicated that hybrid RHB-173 being at par with RHB-177 significantly higher plant height, dry matter accumulation, yield attributes, grain yield (2097 kg/ha), stover yield (5500 kg/ha) and biological yield (7597 kg/ha) over MPMH-17 and HHB-67. Result showed that application of plastic mulch recorded significantly increased the plant height, dry matter accumulation, yield attributes, grain yield (2145 kg/ha), stover yield (5620 kg/ha) and biological yield (7764 kg/ha) compared to other moisture conservation practices in both the years of experimentation as well as on pooled basis.

Key words: Growth, Hybrids, Moisture conservation practices, Pearlmillet, Yield.

INTRODUCTION

Pearlmillet [*Pennisetum glaucum* (L.) R.Br. emend Stuntz] is one of an important millet crop of India as well as Rajasthan. It is a warm weather coarse cereal crop grown in arid and semi–arid climate of tropical and subtropical regions the country. In India, pearlmillet is the third most widely cultivated food crop after rice and wheat on area basis. Pearlmillet is nutritionally better than many other cereals as 100 grams 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 content (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, 2019). In the country, Rajasthan, UP, Maharashtra, Haryana and Gujarat account for about 90% of total area and production of the crop. 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, 2020). 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.

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

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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. The crop was harvested at physiological maturity stage on 28 September, 2018 and 30 September, 2019. The soil moisture was determined, soil samples were collected from central area of each plot from seven successive layers *viz.,* 0-15 cm, 15-30 cm, 30-45 cm, 45-60 cm, 60-75 cm, 75-90 cm and 90-100 cm at sowing, before and 24 hours after each irrigation and at harvest with the help of soil auger in aluminum boxes. Data on plant height and dry matter accumulation of plant recorded from randomly selected 5 plants from each plot at 30, 60 DAS and at harvest during 2018 and 2019. Data on yield attributes and grain yield, stover yield and biological yield were recorded at harvest and the data were statistically analyzed.

RESULTS AND DISCUSSION

Growth parameters

An examination of data (Table 1 and 2) revealed that pearlmillet hybrids did not differ significantly at 30 DAS in their plant height and dry matter accumulation per plant. The hybrid RHB-173 significantly higher plant height at 60

Table 1: Effect of moisture conservation practices on plant height of pearlmillet hybrids.

Treatments	Plant height (cm)								
	30 DAS			60 DAS			At harvest		
	2018	2019	Pooled	2018	2019	Pooled	2018	2019	Pooled
Hybrids									
RHB-173	38.97	38.84	38.91	141.80	139.99	140.90	184.19	183.24	183.72
RHB-177	39.34	39.24	39.29	129.16	125.40	127.28	169.53	166.73	168.13
MPMH-17	39.68	39.55	39.61	126.32	120.27	123.30	160.56	156.68	158.62
HHB-67	40.13	40.04	40.08	121.32	116.12	118.72	153.91	145.60	149.75
SEm±	0.74	0.73	0.58	2.42	2.28	1.86	3.06	2.97	2.38
CD (P=0.05)	NS	NS	NS	7.73	7.28	5.51	9.78	9.50	7.08
Moisture conservation practices									
Control	38.78	38.70	38.74	116.56	110.98	113.77	148.39	139.28	143.84
Dust mulch	39.41	39.50	39.46	130.13	123.99	127.06	159.54	156.06	157.80
Straw mulch	39.56	39.10	39.33	135.76	135.48	135.62	178.39	176.43	177.41
Plastic mulch	40.45	40.38	40.42	141.12	139.06	140.09	183.68	181.57	182.63
Seed line mulching of FYM	39.45	39.41	39.43	124.68	117.72	121.20	165.23	161.98	163.61
SEm±	0.65	0.64	0.47	2.20	2.10	1.63	2.74	2.61	1.93
CD (P=0.05)	NS	NS	NS	6.26	5.97	4.58	7.78	7.42	5.41
CV (%)	6.60	6.47	7.46	6.79	6.69	8.08	6.55	6.40	7.38

NS- Non significant; DAS- Day after sowing.

DAS (140.90 cm) and at harvest stages (183.72 cm) and dry matter accumulation per plant at 60 DAS (28.06 g) and at harvest stages (63.34 g), over RHB-177, MPMH-17 and HHB-67 during both the years of study and in pooled analysis. The improvement in these growth parameters might have led to greater interception and absorption of radiant energy, resulting to higher photosynthesis and ultimately dry matter accumulation. These results are in close conformity with the finding of Gupta *et al.* (2016). Moisture conservation practices significantly influenced plant height and dry matter accumulation per plant of pearlmillet hybrids during both the years. The use of plastic mulch being at par with straw mulch at 60 DAS and at harvest stage significantly enhanced the plant height and dry matter accumulation over control, dust mulch and seed line mulching of FYM. On pooled mean basis, the plastic mulch recorded 23.1, 10.3 and 15.6% higher plant height at 60 DAS and 27.0, 15.7 and 11.6% at harvest and dry matter accumulation per plant by 27.0, 12.8 and 14.4% at 60 DAS and 60.7, 28.3 and 24.5% at harvest over control, dust mulch and seed line mulching of FYM, respectively. It may be due to more availability of moisture during crop growth and high water status in the root zone. It is obvious that mulching practices leads to better plant growth by changing the micro-climate by retaining more moisture through suppressed weeds, reduced evaporation loss, modifying soil temperature and thus, economizing the use of irrigation water. Furthermore, adequate and proper conservation of moisture to plants results in full cell turgidity and eventually higher meristematic activity, greater photosynthetic rate, consequently more plant growth and development. The result corroborate with the finding of Rajput and Bhadouriya, (2019), Lal *et al.* (2017), Kanwar *et al.* (2017) and Meena *et al.* (2006).

Yield attributes and yield

Hybrid RHB-173 attained significantly higher yield attributes *viz.,* effective tillers per metre row length (19.74), Ear length (24.5 cm) and number of grains per ear (1390) which was found at par with hybrid RHB-177 over MPMH-17 and HHB-67 during both the years and in pooled data. An investigation of data (Table 3 and 4) revealed that pearlmillet hybrids varied significantly in the grain, stover and biological yields during both the year of experimentation. Hybrid RHB-173 recorded significantly higher grain yield (2097 kg/ha), stover yield (5500 kg/ha) and biological yield (7597 kg/ha) over MPMH-17 and HHB-67 during both the years and on pooled data. This hybrid recorded an increase of 11.7 and 27.8% grain yield, 8.4 and 25.3% stover yield 9.3 and 25.9% biological yield and respectively, over MPMH-17 and HHB-67 on pooled mean basis. However, hybrid RHB-177 remained at par with RHB-173. Since, yield formation in any crop like pearlmillet is a complex process and governed by interaction between source and sink component. Therefore, as a consequence of marked improvement in both these regulative process as evidenced from higher accumulation of biomass and nutrients as well as yield attributes under hybrid RHB-173 led to significant higher grain yield. Further, the grain yield of pearlmillet is dependent on two most important attributes namely grains per ear and higher test weight. Thus, due to more number of grains by virtue of increased number of ear and more test weight under RHB-173, increased the grain yield over MPMH-17 and HHB-67, being remained at par with hybrid RHB-177. The marked variation in various yield attributes and yield between hybrids were observed by Sharma *et al.* (2013) and Gupta *et al.* (2016).

Moisture conservation practices enhanced all the yield attributes *viz.,* effective tillers per metre row length, ear length

Table 2: Effect of moisture conservation practices on dry matter accumulation of pearlmillet hybrids.

Treatments	Dry matter accumulation (g/plant)								
	30 DAS			60 DAS			At harvest		
	2018	2019	Pooled	2018	2019	Pooled	2018	2019	Pooled
Hybrids									
RHB-173	14.89	14.81	14.85	28.23	27.90	28.06	64.27	62.41	63.34
RHB-177	14.78	14.62	14.70	26.56	26.23	26.39	58.79	52.88	55.83
MPMH-17	14.68	14.56	14.62	23.26	23.01	23.13	49.97	48.08	49.02
HHB-67	14.63	14.52	14.58	21.89	21.57	21.73	44.29	41.88	43.08
SEm±	0.28	0.27	0.21	0.46	0.45	0.36	0.76	0.93	0.67
CD (P=0.05)	NS	NS	NS	1.46	1.43	1.06	2.44	2.98	2.00
Moisture conservation practices									
Control	14.52	14.40	14.46	21.89	21.35	21.62	42.23	36.48	39.35
Dust mulch	14.76	14.62	14.69	24.35	24.36	24.35	51.52	47.05	49.28
Straw mulch	14.88	14.85	14.87	26.77	26.64	26.70	62.54	60.38	61.46
Plastic mulch	15.01	14.85	14.93	27.75	27.20	27.47	63.85	62.61	63.23
Seed line mulching of FYM	14.57	14.40	14.48	24.15	23.86	24.00	51.49	50.06	50.77
SEm±	0.24	0.24	0.17	0.41	0.40	0.29	1.00	0.82	0.64
CD (P=0.05)	NS	NS	NS	1.16	1.12	0.81	2.85	2.34	1.79
CV (%)	6.62	6.48	7.47	6.56	6.41	7.38	7.37	6.43	7.62

NS- Non significant; DAS- Day after sowing.

and number of grains per ear and test weight of pearlmillet hybrids over control (Table 3 and 4). Significantly higher number of effective tillers per metre row length (20.15), Ear length (25.3 cm) and number of grains per ear (1407) were recorded with application of plastic mulch over rest of the mulching treatments but remained statistically at par with straw mulch during both the years as well as in pooled analysis. Application of plastic mulch found maximum grain yield (2145 kg/ha), stover yield (5620 kg/ha) and biological yield (7764 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. On pooled basis, the plastic mulch registered an increase of 40.4, 13.5 and 13.7 % grain yield, 34.1, 11.2 and 10.4 % stover yield and 35.7, 11.8 and 11.3 % biological yield over control, dust mulch and seed line mulching of FYM, respectively. The superiority of plastic mulch as well as straw mulch, seed line mulch of FYM and dust mulch over control could be assigned to their effectiveness in reducing the evaporation

Table 3: Effect of moisture conservation practices on yield attributes of pearlmillet hybrids.

Treatments	No. of effective tillers /metre row length			Ear length (cm)			No. of grains /ear			Test weight (g)		
	2018	2019	Pooled	2018	2019	Pooled	2018	2019	Pooled	2018	2019	Pooled
Hybrids												
RHB-173	19.86	19.62	19.74	24.2	24.8	24.5	1392	1387	1390	6.57	6.53	6.55
RHB-177	19.16	19.00	19.08	23.4	23.7	23.5	1340	1334	1337	6.50	6.46	6.48
MPMH-17	18.16	17.87	18.01	22.8	22.9	22.8	1202	1196	1199	6.31	6.30	6.31
HHB-67	17.81	17.49	17.65	21.6	21.3	21.5	1182	1176	1179	6.28	6.27	6.28
SEm±	0.34	0.34	0.27	0.4	0.4	0.3	23	23	18	0.12	0.12	0.09
CD (P=0.05)	1.10	1.08	0.80	1.4	1.4	1.0	74	73	54	NS	NS	NS
Moisture conservation practices												
Control	16.99	16.44	16.71	20.7	20.8	20.7	1136	1133	1134	6.29	6.27	6.28
Dust mulch	18.09	18.01	18.05	22.1	22.3	22.2	1209	1196	1202	6.50	6.34	6.42
Straw mulch	19.81	19.57	19.69	24.5	24.6	24.6	1371	1363	1367	6.42	6.45	6.44
Plastic mulch	20.30	20.00	20.15	25.2	25.3	25.3	1409	1406	1407	6.49	6.48	6.49
Seed line mulching of FYM	18.55	18.46	18.50	22.6	22.8	22.7	1272	1270	1271	6.38	6.42	6.40
SEm±	0.31	0.30	0.22	0.4	0.4	0.3	21	20	15	0.11	0.10	0.08
CD (P=0.05)	0.87	0.84	0.61	1.1	1.1	0.8	59	57	41	NS	NS	NS
CV (%)	6.55	6.41	7.39	6.6	6.4	7.4	7.1	6.4	7.0	6.61	6.44	7.44

NS- Non significant; DAS- Day after sowing.

Table 4: Effect of moisture conservation practices on grain, stover and biological yield and harvest index of pearlmillet hybrids.

Treatments	Grain yield (kg/ha)			Stover yield (kg/ha)			Biological yield (kg/ha)			Harvest index (%)		
	2018	2019	Pooled	2018	2019	Pooled	2018	2019	Pooled	2018	2019	Pooled
Hybrids												
RHB-173	2152	2042	2097	5586	5413	5500	7738	7455	7597	27.78	27.37	27.57
RHB-177	2050	1960	2005	5470	5382	5426	7521	7342	7431	27.23	26.67	26.95
MPMH-17	1934	1820	1877	5189	4956	5072	7123	6776	6949	27.12	26.83	26.98
HHB-67	1695	1586	1641	4505	4275	4390	6200	5861	6031	27.31	27.03	27.17
SEm±	45.7	45.5	36.1	121.1	123.0	96.5	166.6	168.5	132.5	0.47	0.47	0.37
CD (P=0.05)	146.1	145.7	107.1	387.4	393.5	286.7	533.0	539.1	393.6	NS	NS	NS
Moisture conservation practices												
Control	1580	1475	1528	4288	4096	4192	5868	5571	5720	26.92	26.47	26.70
Dust mulch	1942	1835	1889	5181	4926	5054	7123	6761	6942	27.25	27.14	27.20
Straw mulch	2132	2025	2079	5563	5494	5529	7695	7519	7607	27.70	26.93	27.31
Plastic mulch	2196	2093	2145	5689	5550	5620	7885	7643	7764	27.84	27.38	27.61
Seed line mulching of FYM	1939	1832	1886	5217	4965	5091	7156	6797	6977	27.09	26.95	27.02
SEm±	34.5	33.1	25.6	91.5	89.6	68.4	126.0	122.7	93.9	0.45	0.45	0.32
CD (P=0.05)	98.2	94.2	71.7	260.1	254.7	191.9	358.3	348.8	263.6	NS	NS	NS
CV (%)	7.1	7.2	8.5	7.1	7.2	8.5	7.1	7.2	8.5	6.63	6.62	7.43

NS- Non significant; DAS- Day after sowing.

losses by creating obstacle in external evaporation process and energy supply to evaporating site by deflecting part of solar radiation falling on the soil surface. Reduced fluctuation of soil temperature under different mulch materials may have attributed better plant development. Thus, the improvement in yield attributes and yield of pearlmillet hybrids under mulching practices could be ascribed to increase in the soil moisture and modified temperature led to addition of nutrients to the soil and reduced number of days taken to meet the required heat units for proper vegetative growth and development of plants and ultimately improved the yield attributes and yield under light textured soils of semi arid region. The greater effectiveness of plastic mulch is due to its higher efficiency in reducing evaporation loss, modifying temperature and less weed problem than organic mulches. A significant improvement in yield attributing characters was found by Kanwar *et al*. (2017) and Kumar *et al.* (2018).

CONCLUSION

Based on results of two years experimentation, it may be concluded that hybrid RHB-173 recorded significantly higher growth parameter, yield attributes and yield being remained at par with RHB-177. Use of plastic mulch proved to be the most suitable moisture conservation practices as it provided significantly increased growth parameter, yield attributes and yield, remained at par with straw mulch.

Conflict of interest: None.

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