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ASSESSMENT OF EARLY AND MEDIUM DURATION ADVANCED ENTRIES OF PEARL MILLET (*PENNISETUM GLAUCUM* L.) FOR YIELD AND FODDER TRAITS UNDER SOUTH-WEST HARYANA CONDITIONS

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SUMMARY

The present investigation was conducted to assess the different early and late season advance lines of pearl millet for yield and its attributing traits. The grain yield varied between 0.57 kg (MPMH-17) to 2.03 Kg (MH2474), while dry fodder yield ranged between 1.18 kg (GHB 905) to 4.92 Kg (MH2474). The days to 50 % flowering was observed lowest in HHB-67-I (44 days) and highest in MH-2566 (55 days), whereas lowest number of days to maturity taken by MH-2557 & MH-2555(69 days) and highest by MH-2570 (79 days). The 1000-seed weight was found minimum in MH-2553 (5.67 g) and maximum in PB-1705 (12.60 g). The genotypes MH 2474, MH 2559, MH 2562, MH 2560 and PB 1705 were found superior for grain yield and dry fodder yield. The correlation analysis revealed that GYNP was highly significant and positively correlated DFY and PHNP, whereas DM, PH & 1000-SW showed positive and significant correlation. DFY showed highly significant and positive correlation with DF, DM PH and PHNP while PD and 1000-SW had significantly positive correlation with DFY. Moreover, cluster analysis categorized twenty seven lines into three clusters indicating that these lines share common ancestry with similar objective. Cluster III consisted of twelve lines, cluster II had eight and remaining seven lines were grouped into cluster I. The highest inter-cluster distance was found between cluster I and cluster III (85.45) while highest intra-cluster distance was observed in cluster I (55.97). Henceforth, the advanced lines yielded higher must be validated under different agro-climatic regions and further quality improvement should be strengthened.

Key words: Pearl millet, fodder traits, genotypes, cluster analysis and grain yield

Pearl millet (*Pennisetum glaucum* L.) is climate resilient crop plant having high photosynthetic efficiency capable of producing nutritious feed and fodder, ranks sixth in the world after *Oryza sativa, Triticum aestivum, Zea mays, Hordeum vulgare* and *Sorghum bicolor* whereas in India, pearl millet is the fourth most widely cultivated food crop after rice, wheat and maize. This crop can play an important role in decreasing malnutrition to ensure global food and nutritional security (Satyavathi *et al*., 2021). In India, pearl millet is designated as nutri-cereal and Govt. of India has declared Year 2018 as the "Year of Millets" to include millets into the mainstream and exploit its nutritionally superior qualities and promote its cultivation.

It is a staple food of 90 million poor people and extensively grown on 30-million-ha area in the arid and semi-arid tropical regions of Asia and Africa. It is also used for feed and fodder and accounts for almost half of the global millet production (Srivastava *et al.*, 2020). It is mainly cultivated on marginal lands under rainfed conditions and can sustain and produce a significant amount of grain even in drought-prone areas that receive an average annual precipitation of <250 mm (Nambiar *et al.,* 2011). The changing climate is leading to an increase in global average temperature affecting agricultural production worldwide. Further, it directly influences biophysical factors such as plant and animal growth along with the different areas associated with food processing and distribution.

Pearl millet is particularly helpful as the global population is growing rapidly so to meet out food demands through this nutrient-dense, climate change-ready crop with significant potential to produce higher economic returns in marginal lands in contrast to other grains, even in the event of climate change under severe weather conditions. Additionally, it has more maximum temperatures for grain production, and it's a crop that's not used much having enormous nutritional potential

that must be effectively utilized (Krishnan and Meera, 2018). It can withstand more severe meteorological occurrences like drought and water scarcity and can an essential part of guaranteeing food and nutritional security in evolving climatic scenarios, which are getting worse and worse.

Pearl millet genetic enhancement requires the use of both early and medium maturity varieties in order to preserve, assess, and record the genetic resources. Because of its extreme drought resistance, it can be cultivated in both heavily and sparingly rainy environments. In order to plan future pearl millet hybrids and varieties, the current study was carried out to evaluate the yield of various early and late season advance lines of pearl millet and its corresponding features for growing different agro-ecologies. Therefore, the assessment of early and medium duration advanced entries of Pearl millet for yield and fodder traits under rainfed conditions was conducted with the objective of improving or developing of new cultivars under changing climatic conditions.

MATERIALS AND METHODS

Seed Material and Experimental site

The experimental material comprised of twenty seven advanced lines of pearl millet evaluated at research area of CCS HAU, Regional Research Station, Bawal, Rewari (Haryana) India. Geographically, Bawal is situated in South-west Haryana and located at 28°10′ N latitude and 75°50′ E longitude with an altitude of 266 meters above the mean sea level. The soil fertility status indicated low level of nitrogen whereas phosphorous and potassium had medium level.

Meteorological data

Each entry of pearl millet was sown in six rows of 4 m length with row-to-row distance 45 cm and plant to plant spacing 15 cm. The recommended cultural and agronomic practices were followed to raise crop. During experimentation weather weekly mean of minimum and maximum temperature exhibited a wide range (15.8 to 38.1°C) and relative humidity (17.0-94.0%) (Fig. 1).

Recording of Experimental Data.

The randomized block design was used to conduct the experiment and data were recorded for

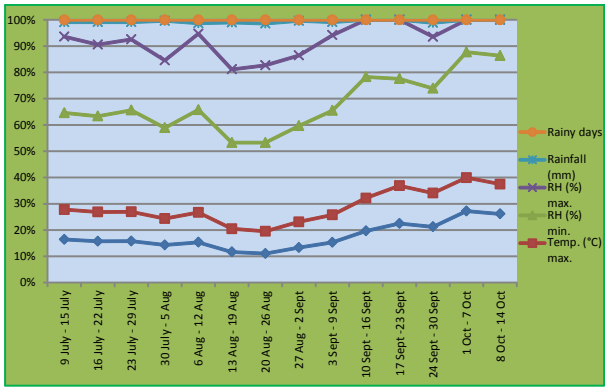

Fig. 1. Agro-meteorological data during experimentation from July 2020 to October 2020.

dry fodder yield, grain yield and its attributing traits. The grain yield and dry fodder yield were recorded from a net lot size of 10.8 m^2 area, whereas other yield attributing traits were observed at particular stage on five randomly selected competitive plants of each genotype at specified stage of crop growth. Also, the plant population at harvest recorded on the basis of net plot basis.

The following abbreviations are used in the present manuscript:

GYNP (kg)- Grain Yield (kg/ net plot); DFY (Kg)- Dry Fodder Yield (kg/net plot); DF- days to 50 % flowering; DM- days to maturity; PH (cm)- plant height; PTP- number of productive tillers per plant; Pl (cm)- Panicle length; PD- Panicle diameter; 1000-SW (g)- 1000 seed weight and PHNP- Population at harvest per plot.

Statistical Analysis

The MS-EXCEL was used for descriptive statistics on average data of three replications. Correlation and cluster analysis was performed using R-studio software.

RESULTS AND DISCUSSION

The studied lined showed significant amount of variability for each trait (Table 1). The grain yield varied between 0.57 kg (MPMH-17) to 2.03 Kg (MH2474), while dry fodder yield ranged between 1.18 Kg (GHB 905) to 4.92 kg (MH2474). The days to 50 % flowering was observed lowest in HHB-67-I (44 days) and highest in MH-2566 (55 days), whereas lowest number of days to maturity taken by MH-2557 & MH-2555(69 days) and highest by MH-2570 (79 days).

The genotype MH 2554 & GHB 905 had

TABLE 1
List of early and medium duration advanced entries of Pearl millet

Entry Name	Entry Type	GYNP (Kg)	DFY (kg)	DF	DM	PH (cm)	PTP	PL (cm)	PD (cm)	1000-SW (g)	PHNP
MH 2559	MD	1.75	4.67	53	77	228	1.78	24.00	3.61	9.20	81
MH 2560	MD	1.57	3.42	53	78	205	2.11	25.78	3.29	12.33	73
MH 2561	MD	1.20	2.80	50	77	197	1.56	22.56	3.29	12.27	72
MPMH 17	MD	0.57	1.63	51	75	199	2.89	25.33	3.24	7.13	46
MH 2562	MD	1.64	3.80	52	77	227	2.00	26.22	3.95	12.27	76
MH 2563	MD	0.84	2.53	50	76	202	1.56	30.33	4.21	12.33	54
PB 1705	MD	1.51	3.13	52	77	238	2.67	22.61	3.50	12.60	82
MH 2564	MD	1.07	2.47	49	76	213	1.89	22.06	3.82	12.00	72
MH 2565	MD	1.47	3.15	51	76	217	1.78	20.17	3.73	9.23	80
MH 2566	MD	1.03	3.43	55	78	227	2.11	23.44	4.03	8.63	73
GHB 905	MD	0.60	1.18	50	74	186	1.78	21.72	2.62	5.83	42
MH 2567	MD	0.97	3.10	51	76	225	1.44	20.89	3.51	9.20	69
MH 2568	MD	0.70	2.35	48	77	231	1.56	21.56	3.64	11.20	73
MH 2569	MD	0.92	2.63	50	77	238	1.78	23.11	2.97	7.00	74
MH 2570	MD	1.02	3.60	54	79	246	2.11	27.22	3.59	8.53	81
Average (MD)	1.12	2.93	51	77	219	1.93	23.80	3.53	9.98	70	
MH 2556	ED	0.77	1.89	50	73	212	1.33	28.33	3.66	8.73	52
HHB 67 -I	ED	1.07	2.43	44	73	187	1.78	23.28	3.18	7.57	71
MH 2558	ED	0.83	1.86	52	70	187	2.00	21.33	2.78	10.80	65
MPMH 21	ED	1.08	1.68	46	70	197	1.78	22.50	2.89	7.17	69
MH 2555	ED	1.30	2.65	49	69	213	0.89	24.28	3.04	9.27	63
MH 2553	ED	0.85	1.79	48	71	193	2.00	23.20	3.18	5.67	72
MH 2557	ED	0.65	1.67	51	69	195	1.00	21.78	2.95	8.53	66
RHB 177	ED	0.71	1.57	47	72	215	2.00	20.56	2.62	7.40	59
MH 2554	ED	0.82	1.37	47	71	186	2.00	24.89	2.87	10.53	53
MH 2552	ED	0.94	2.37	48	70	205	0.67	22.00	2.88	8.60	64
HHB 272	ED	0.72	1.83	48	73	215	2.22	24.11	3.03	7.20	58
MH 2474	ED	2.03	4.92	50	75	210	1.67	25.33	2.79	10.50	123
Average (ED)	0.98	2.17	48	71	201	1.61	23.47	2.99	8.50	68	

lowest height (186 cm) while MH 2570 had the highest height (246 cm). The numbers of productive tillers were found highest in MPMH 17(2.89) and lowest in MH 2552 (0.67).

The longest panicle was observed in MH 2563 (30.33 cm) & shortest was in MH 2556 (20.17 cm), whereas panicle diameter was maximum for MH 2563 (4.21) and minimum for GHB 905 & RHB 177 (2.62 cm). The 1000-seed weight was found minimum in MH-2553 (5.67 g) and maximum in PB-1705 (12.60 g). The plant population at harvest was lowest in GHB 905 and highest in MH 2474.

Early and Medium advanced entries performance

Pearl millet is a short duration crop best suited under rain-fed conditions, which requires developing short duration crop varieties with early and medium maturity type. The present study included fifteen medium and twelve early duration entries evaluated for fodder and grain yield traits (Table 1). The medium duration entries showed better performance as these entries yielded higher grain and fodder content. Additionally, average plant height and 1000-seed weight was reported higher in the medium duration entries. In contrast days to 50 % flowering and days to maturity were earlier in early maturity entries.

The average grain yield was 1.12 kg in medium duration compared to 0.98 kg in early duration entries. The amount of grain fodder obtained higher in medium maturity (2.93 kg) varieties than early maturity (2.17 kg). The days to 50 % flowering and days to maturity was 48 and 71 days respectively in early duration entries, while 51 days to 50 % flowering and 77 days to maturity was recorded in medium duration entries. The 1000-seed weight was 9.98 g in MD than 8.50 g in ED, whereas plant height was higher in MD (219 cm) than ED (201 cm).

Correlation and Cluster Analysis

The knowledge of association between different yield and fodder related traits studied were estimated and presented in Fig. 2. The correlation

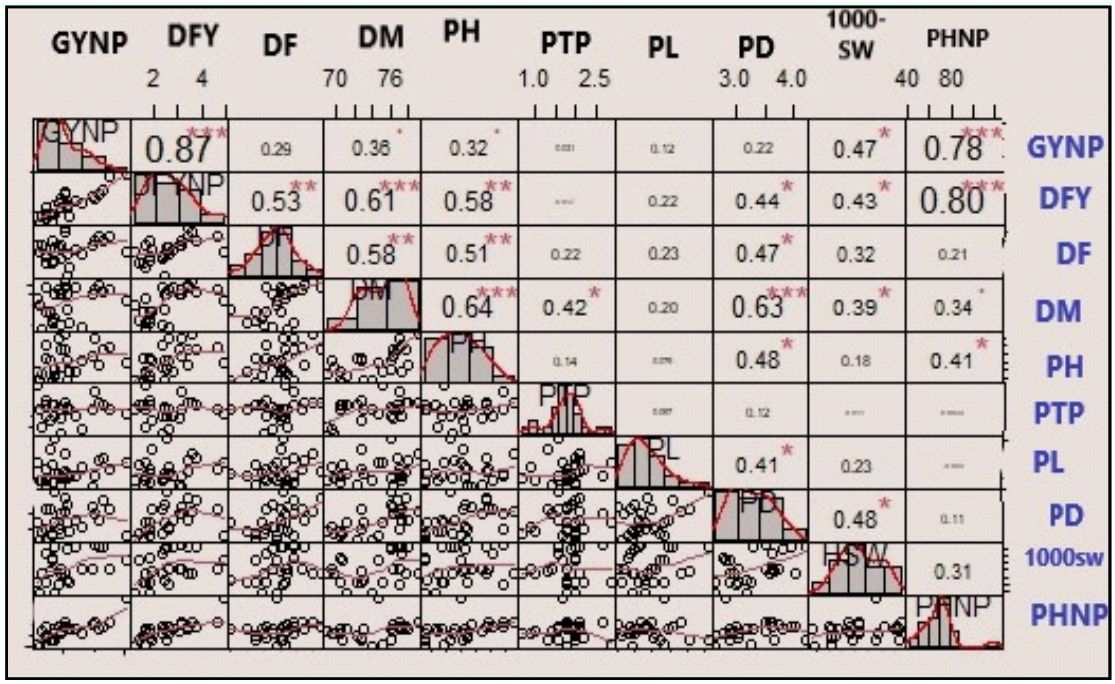

Fig. 2. Correlation coefficient analysis of early and medium duration entries of Pearl millet.

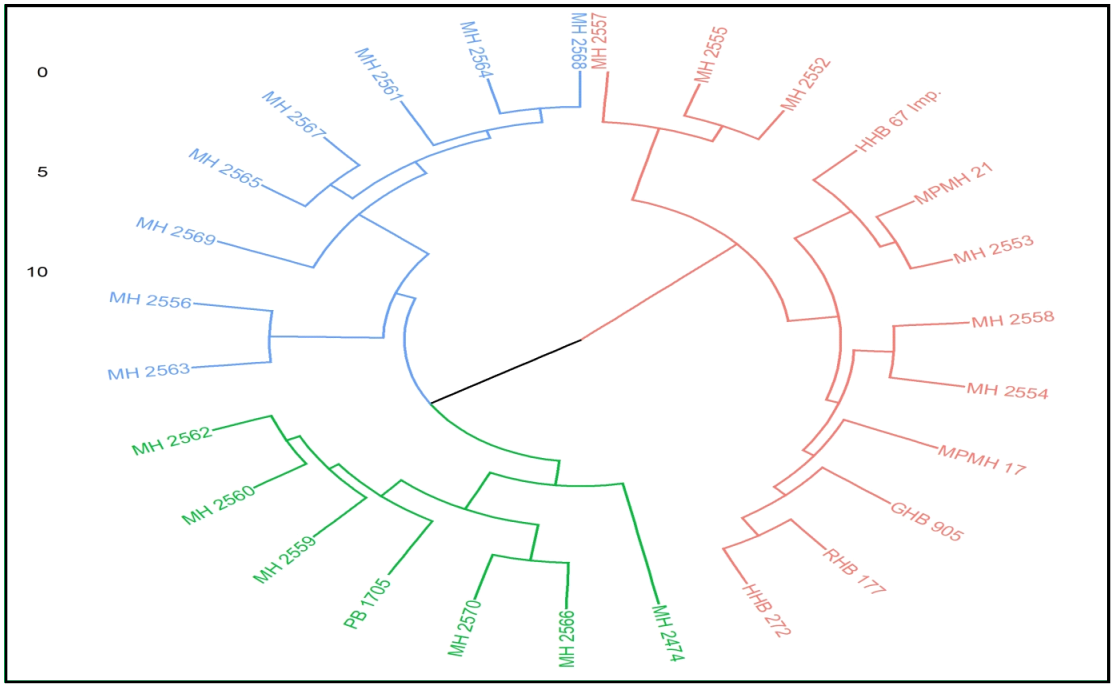

Fig. 3. Clustering pattern of early and medium duration entries of Pearl millet.

TABLE 2
Average intra (diagonal) and inter (above diagonal) cluster D2 of early and medium duration entries of Pearl millet

Clusters	Cluster I	Cluster II	Cluster III
Cluster I	55.97264	71.87369	85.445954
Cluster II		41.80494	61.249722
Cluster III			34.876951

analysis revealed that GYNP was highly significant and positively correlated DFY and PHNP, whereas DM, PH & 1000-SW showed positive & significant correlation. DFY showed highly significant and positive correlation with DF, DM PH and PHNP while PD & 1000-SW had significantly positive correlation with DFY. The DF had positive & highly significant correlation DM& PH, while significantly positive

correlation recorded with PD. The highly significant & positive correlation of DM was observed between PH & PD. Positively significant correlation also observed between PD & PL. The present findings were similar with previous reports in pearl millet (Anuradha *et al.,* 2018 and Mahendrakar *et al.,* 2019).

One useful method for classifying the data that makes it easier to divide the genetic material into different homogenous categories is cluster analysis. It makes it easier to categorize genotypes according to morpho-genetic characteristics, which makes it easier to choose different lines for crossing. Through the use of cluster analysis, it is possible to combine various gene combinations and produce ideal segregants through crossing between the chosen, diverse lines. The cluster analysis categorized twenty seven lines into three clusters indicating that these lines share common ancestry with similar objective (Table 2 & Fig. 3).

Cluster III consisted of twelve lines, cluster II had eight and remaining seven lines were grouped into cluster I. The highest inter-cluster distance was found between cluster I & cluster III (85.45) while highest intra-cluster distance was observed in cluster I (55.97). The earlier findings of Kumari *et al.,* (2016) and Mithlesh *et al*., (2020) also reported the similar results. Henceforth, the advanced lines yielded higher must be validated under different agro-climatic regions and further quality improvement should be strengthened. All the early duration entries grouped into cluster I, except MH 2556 (cluster III) and MH-2474 (cluster II). The medium maturity entries categorized in cluster II and cluster III. The clustering pattern revealed that the entries grouped into cluster I may evolved from the similar parents. Jain and Diwan (2021) also reported the similar results and categorized the studied entries based on the agro-ecological zones.

CONCLUSION

The efficient hybridization programs in pearl millet pre-requisite the suitable diverse parents based on genetic divergence analysis and it would be more rewarding coupled with the information of geographical distances. In the present study, MH 2474, MH 2559, MH 2562, MH 2560 and PB 1705 were found superior for grain yield and dry fodder yield. The positively correlated traits can be considered in the breeding programs for indirect selection and heterosis can be achieved by utilizing the entries of clusters showed maximum highest inter-cluster and intra-cluster distances.

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