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RESPONSE OF *KHARIF* PEARL MILLET CULTIVARS TO GROWTH ATTRIBUTE UNDER DIFFERENT SOWING WINDOWS

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Abstract: *The present invitation entitled "Response of kharif pearl millet (Pennisetum glaucum L.) cultivars on growth attributes under different sowing windows" was carried out during kharif , 2015 at Zonal Agricultural Research Station, Solapur, Maharashtra State (India). The experiment was conducted in split plot design with three replications. Nine treatment combinations were formed considering different cultivars viz., V_1 Shanti (RHRBH-9808), V_2 Mahyco Hybrid (MRB-204) and V_3Dhanashakti (ICTP-8203) and sowing windows viz., (S_1) 26th MW (26th June – 01st July), (S_2)- 30th MW (23rd July – 29th July) S_3 – 34th MW (20th Aug – 26th Aug). Among the three pearl millet cultivars, Shanti recorded significantly higherplant height(158.6cm), number of effective tillers plant^{-1}(4.1),number of functional leaves plant-1 (9.6), leaf area plant^{-1}(2.6 dm^2) and dry matter accumulation plant-1 (52.1 g).*

Keywords: *Kharif pearl millet, Cultivars, Growth attributes, Sowing windows.*

Introduction

In India, pearl millet is primary source of energy (360 K cal/kg) for rural population also a rich source of protein, calcium, phosphorous and iron. Pearl millet grain contains fairly high 'amount of thiamine, riboflavin and niacin.Pearl millet grain are also used as a food for poultry and green fodder or dry kadbi for cattle. Pearl millet grain contains about 12.4% moisture, 11.6% protein, 5% fat, 67% carbohydrates and about 2.7% minerals. Pearl millet is also used as poultry feed and green fodder for cattle. It is often referred as "The poor man's food". Today millet is a staple food for more than 500 million people. Area under pearl millet is estimated as 15 Mha annually in Africa and 14 Mha in Asia. Global production exceeds 10 MT a year. Pearl millet ranks third after wheat and rice in area in India. Pearl millet, which accounts for about two-thirds of India's millet production, is grown in the drier areas of the country, mainly in the states of Rajasthan, Maharashtra, Gujarat, Uttar Pradesh and Haryana (FAO, 1996).

Sowing time is the most important non-monetary input affecting yields of crop. Time of sowing varies with the variety, agro climatic conditions and crop growing season. In fact, proper planting date is important for maximizing cereal grain yields (Witt, 1996) because optimum sowing dates establish healthy and vigorous plants. A significant reduction in grain yield is associated with delayed seeding for a wide range of climatic conditions (Knapp and Knapp, 1978, Dahlke *et al.* 1993). Planting time recommendations for pearl millet and grain sorghum are commonly made based on calendar day (day of the year) and/or soil temperature (Mick 1997 and Andrews *et. al.* 1998). It was reported that the drastic reduction in yield under delayed sowing (Ramshe *et al.*1986).

In order to bring out country as a whole to a level on which other countries as standing as far as agricultural production is concerned, it is very essential to emphasize on such aspects. Some of the basic principle of factor contributing towards the increase in per hectare yield of pearl millet crops as suitable cultivars with required heritable potentiality, proper sowing times and prevalence of congenial weather conditions.

Material and Methods

The present invitation entitled "Response of *kharif* pearl millet (*Pennisetum glaucum* L.) cultivars on

growth attributes under different sowing windows" was carried out during kharif , 2015 at Zonal Agricultural Research Station, Solapur, Maharashtra State (India). The experiment was conducted in split plot design with three replications. Nine treatment combinations were formed considering different cultivars viz., V_1 Shanti (RHRBH-9808), V_2 Mahyco Hybrid (MRB-204) and V_3 Dhanashakti (ICTP-8203) and sowing windows viz., (S_1) 26thMW (26th June-01stJuly), (S_2)- 30thMW (23rd July-29th July) (S_3)-34thMW (20th Aug-26thAug).

The soil comes under the vertisol (medium black) medium black and clayey loam in texture and slightly alkaline (pH-7.4) in nature and having the uniform depth up to 90 cm. The altitude is about 483.6 M above mean sea level. The highest temperature ever recorded was 46^{0}C in May during 1988. The monsoon lasts from June to the end of September, with moderate rainfall. It has an average rainfall of about of 545 mm per year. The annual maximum and minimum temperature ranged between 25.0 to 43.2^{0}C and 7.3 to 27.1^0 C, respectively. During the *kharif* season, the maximum temperature ranged between 29.0 to 40.8^{0}C with an average of 34.7^{0}C, whereas, the minimum temperature ranged between 18.0 to 26.2^{0}C. The pan evaporation ranged between 1.8 to 12.8 mm with an average of 7.4 mm. The wind speed ranged between 2.1 to 18.3 kmph with an average of 9.7 kmph. In case of BSS which was ranged between 0.0 to 12.1 hrs with an average of 5.2 hrs. The morning RH ranged between 67 to 98per cent with an average of 80 per cent and the afternoon RH ranged between 24 to 95 per cent during the crop growing period.

The basal dose of fertilizer i.e. 50 kg N+25 kg P_2O_5 ha^{-1} was applied through urea and single super phosphate. However, 25 kg N and 25 kg P_2O_5 ha^{-1} was applied as a basal dose and remaining 25 kg N ha^{-1} was applied at 30 DAS.

The gross and net plot sizes were15.0 x 6.3 m^2 and10.0 x 4.5 m^2, respectively. All the cultivars are were dibbled as per different sowing windows at a spacing of45cm x20cm, during *Kharif,* 2015. The soil was clayey loam in texture and acidic inreaction (pH7.4)

Results and discussion

Plant height

The data in respect of plant height as influenced by sowing windows and cultivars are presented in Table 1. The initial mean plant height was 21 cm during growing season. It was increased with advancement in crop age and reached maximum up to 154 cm at harvest.

Effect of sowing windows

Sowing of pearl millet in 23rdMW significantly produced more plant height than crop sown in 26th and 34th MW at all the days of observation during the period of experimentation Table 1. Plant height was significantly the lowest when crop was sown late (26th MW) than 34th MW and 30th MW at all the growth stages during period of experimentation.

Effect of cultivars

The plants of Shanti (RHRBH-9808) were significantly taller than Mahyco hybrid (MRB-204) and Dhanashakti (ICTP-8203) under adequate soil moisture condition. This was attributed to the adequate soil moisture availability at critical growth stages Table 1.

Effect of interaction

The plant height was not significantly influenced due to interaction effects between sowing windows and cultivars at all the days of observations during period of experimentation Table 1.

Number of effective tillers plant-1

The numbers of effective / functional tillers are very important in pearl millet as it decides the productivity of crop. The relevant data on number of effective tillers plant^{-1} as influenced periodically by different treatment are presented in Table 2. The mean numbers of effective tillers plant^{-1} were 2.1 at initial stage on 28 DAS. They were increased with advancement in crop age and reached maximum up to 7.2.at 56 DAS i.e. at initiation of flowering. Thereafter, they were declined to 3.2 at harvest owing to crop senescence.

Sowing windows

A crop sown in second sowing window 30th MW significantly produced more number of tillers plant^{-1} than delayed sowing in 26thand 34th MW at all the growth stages during crop growing season. The numbers of effective tillers plant^{-1} were significantly the lowest when crop was sown late in 26th and 34th MW during crop growing season (Table.2). These results are inconformity with the findings of Kaushik and Gautam (1984), Gautam and Kaushik (1984), Jadhav et al. (1994) and Andhale (2001).

Cultivars

The number of effective tillers plant^{-1} were significantly more in Shanti (RHRBH-9808) cultivar and significantly lower in Mahyco hybrid (MRB-204) and Dhanshakti (ICTP 8203) cultivar at all the growth stages during crop growing period (Table.2). The increase in effective tillers plant^{-1} in Shanti (RHRBH-9808) cultivar was attributed to the adequate microclimatic condition at critical growth stages (Table.2).

Interaction

The interaction effects between sowing window and cultivar were non-significant at all the days of observations during crop growing season.

Number of functional leaves plant^{-1}

The relevant data on number of functional leaves plant^{-1} as influenced periodically by different treatments are presented in Table 3. The mean numbers of functional leaves plant^{-1} were 9.9 at initial stage on 28 DAS. They were increased with advancement of crop age and reached maximum to 22.2 at 56 DAS i.e. at initiation of flowering. Thereafter, they were declined to 12.3 at harvest during the experimental period, owing to crop senescence.

Effect of sowing windows

The numbers of functional leaves plant^{-1} were significantly decreased with each delay in sowing on 28, 42, and 56 DAS during the season except on 70 DAS where differences between 26th and 34th MW sowing windows were at par. The numbers of functional leaves plant-1 were significantly increased when crop was sown in 30thMW and significantly decreased when it was sown in 34thand 26thMW from 56 DAS onwards during the season. The increase in number of functional leaves plant-1 with sowing in 30th MW was attributed to favorable microclimatic conditions. These results are conformity with the findings of Andhale (2001).

Effect of cultivars

The numbers of functional leaves plant^{-1} were significantly increased with Shanti (23.6) and significantly decreased in Mahyco hybrid (21.9) and Dhanashakti (21.1) at 56 DAS and the numbers of functional leaves plant^{-1} were also significantly increased with Shanti (9.6) and significantly decreased in Mahyco hybrid (7.6) and Dhanashakti (5.9) at harvest.

Effect of interaction

The interaction effects between sowing windows and cultivars were found to be non-significant at all the days of observations.

Mean leaf area plant^{-1}

The periodical leaf area plant^{-1} as influenced by different treatments and cultivars are presented in (Table 4). The mean leaf area plant^{-1} was 1 dm^{2}at initial stage of 28 DAS during the crop growing season. It was increased with advancement of crop age and reached maximum 20.34dm^{2}at 70 DAS. It was declined thereafter and minimum leaf area of 1.83 dm^{2}was noticed at harvest.

Effect of sowing windows

The leaf area plant^{-1} is a reliable index of photosynthetic efficiency which was decreased with each delay in sowing during both the years on initial stage of 28 DAS (Table 4). The leaf area plant^{-1} was significantly increased when crop was sown in 30th MW and significantly decreased when it was sown delayed in 34th MW and 26th MW from 70 DAS onwards during the period of experimentation. These results are similar to those reported by Andhale (2001) and Waghmode (2012).

Effect of cultivar

The leaf area plant-1 was recorded significantly the highest in Shanti cultivar (2.6) than Mahyco hybrid (1.7) and Dhanashakti (1.2).

Effect of interaction

The interaction effects between sowing windows and cultivars were found to be non-significant at all the growth stages.

Dry matter accumulation plant^{-1}

The mean periodical dry matter accumulation plant^{-1} as influenced by different sowing windows and cultivars are presented in Table 5. The plant had accumulated hardly 1.85 g dry matter plant^{-1} on initial stage of 28 DAS during the period of experimentation. The dry matter accumulation increased rapidly thereafter, and reached maximum of 46.44 g plant^{-1} at harvest.

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Effect of sowing windows

The dry matter accumulation plant^{-1} indicates productive efficiency of crop. The Kharif pearl millet sown in 30th MW accumulated significantly more dry matter plant^{-1} followed by sowing of crop in 34th, and 26th MW at all the days of observations. The favorable climatic conditions when crop was sown in 30th MW, resulting in increased number of tillers and leaf area plant^{-1} and finally accumulated more dry matter.Similar results were reported by Andhale (2001).

Effect of cultivar

The dry matter accumulation plant^{-1} was significantly highest in Shanti (52.1 g plant^{-1}) cultivar than Mahyco hybrid (45.9 g plant^{-1}) and Dhanashakti (41.3 g plant^{-1}) respectively, at harvest.

Interaction

The interaction effects between sowing windows and cultivars were found to be non-significant at all the growth stages.

Table 1: Mean plant height as influenced periodically by different treatments

Treatments	Mean plant height (cm)					
	Days after sowing					
	28	42	56	70	84	At harvest
Sowing Window						
S_1 26 MW (26th June – 01st July)	19.2	35.0	94.2	117.3	144.1	150.4
S_2 30 MW (23rd July – 29th July)	22.1	38.8	102	122.8	149.9	157.2
S_3 34 MW (20th Aug – 26th Aug)	19.6	37.9	95.3	117.3	148.2	154.7
S.Em±	0.3	0.8	1.2	0.3	0.6	1.2
C.D. at 5%	1.1	1.8	4.9	1.2	2.6	4.8
Cultivars						
V_1 Shanti (RHRBH-9808)	22.8	39.6	101.0	121.7	151.1	158.6
V_2 Mahyco hybrid (MRB-204)	20.7	37.3	96.0	118.8	147.5	152.5
V_3 Dhanashakti (ICTP-8203)	18.9	34.7	94.1	116.1	143.4	150.4
S.Em±	0.3	0.4	1.0	0.5	0.9	0.8
C.D. at 5%	0.8	1.1	3.2	1.7	2.7	2.4
Interaction						
S.Em±	0.5	0.6	1.8	0.9	1.5	1.4
C.D. at 5%	NS	NS	NS	NS	NS	NS
General mean	21	37	97	119	147	154

Table 2: Mean number of effective tillers plant^{-1} as influenced periodically by different treatments

Treatments	Mean number of effective tillers plant^{-1}					
	Days after sowing					
	28	42	56	70	84	At harvest
Sowing Window						
S_1 26 MW (26th June – 01st July)	2.1	4.4	6.0	4.5	3.1	3.0
S_2 30 MW (23rd July – 29th July)	2.9	4.5	7.5	5.4	3.9	3.9
S_3 34 MW (20th Aug – 26th Aug)	2.4	4.8	6.7	5.0	3.4	3.4
S.Em±	0.1	0.1	0.1	0.1	0.1	0.1
C.D. at 5%	0.3	0.2	0.4	0.4	0.2	0.3
Cultivars						
V_1 Shanti (RHRBH-9808)	2.9	4.9	7.9	5.6	4.1	4.1
V_2 Mahyco hybrid (MRB-204)	2.4	4.5	6.7	4.9	3.3	3.3
V_3 Dhanashakti (ICTP-8203)	2.1	4.2	5.9	4.3	2.9	2.9
S.Em±	0.1	0.04	0.1	0.1	0.1	0.1
C.D. at 5%	0.2	0.1	0.3	0.2	0.2	0.2
Interaction						
S.Em±	0.1	0.1	0.2	0.1	3	0.1
C.D. at 5%	NS	NS	NS	NS	NS	NS
General mean	2.5	4.5	6.7	4.9	3.5	3.4

Table 3: Mean number of functional leaves plant^{-1} as influenced periodically by different treatment

Treatments	Mean number of effective tillers plant^{-1}					
	Days after sowing					
	28	42	56	70	84	At harvest
Sowing Window						
S_1 26 MW (26th June – 01st July)	8.9	16.1	24.0	16.6	10.7	6.1
S_2 30 MW (23rd July – 29th July)	10.8	18.8	21.9	19.5	13.8	9.1
S_3 34 MW (20th Aug – 26th Aug)	9.8	17.0	20.7	17.5	12.1	7.5
S.Em±	0.3	0.2	0.3	0.7	0.1	0.2
C.D. at 5%	1.1	0.6	1.0	2.8	0.5	0.7
Cultivars						
V_1 Shanti (RHRBH-9808)	10.2	18.6	23.6	20.3	14.0	9.6
V_2 Mahyco hybrid (MRB-204)	9.8	17.3	21.9	16.9	12.0	7.2
V_3 Dhanashakti (ICTP-8203)	9.5	16.1	21.1	14.6	10.7	5.9
S.Em±	0.2	0.1	0.2	1.2	0.2	0.2
C.D. at 5%	0.6	0.4	0.6	3.6	0.5	0.5
Interaction						
S.Em±	0.3	0.2	0.3	2.0	0.3	0.3
C.D. at 5%	NS	NS	NS	NS	NS	NS
General mean	9.9	17.3	22.2	17.9	12.2	7.6

Table 4: Mean leaf area plant-1 (dm^2) as influenced periodically by different treatments

Treatments	Mean leaf area plant^{-1} (dm^2)					
	Days after sowing					
	28	42	56	70	84	At harvest
Sowing Window						
S_1 26 MW (26th June – 01st July)	0.8	6.1	12.7	18.8	5.9	1.7
S_2 30 MW (23rd July – 29th July)	1.1	10.6	16.4	22.2	9.3	2.0
S_3 34 MW (20th Aug – 26th Aug)	0.9	7.7	15.2	19.9	7.5	1.8
S.Em±	0.03	0.06	0.33	0.4	0.3	0.0
C.D. at 5%	0.1	0.2	1.3	1.4	1.2	0.1

Cultivars						
V_1 Shanti (RHRBH-9808)	1.0	8.6	16.9	24.0	9.2	2.6
V_2 Mahyco hybrid (MRB-204)	1.0	8.2	14.4	20.3	7.9	1.7
V_3 Dhanashakti (ICTP-8203)	0.9	7.7	13.2	16.8	5.8	1.2
S.Em±	0.01	0.11	0.29	0.2	0.2	0.04
C.D. at 5%	0.04	0.33	0.90	0.11	0.5	0.12
Interaction						
S.Em±	0.02	0.18	0.51	0.43	0.35	0.07
C.D. at 5%	NS	NS	NS	NS	NS	NS
General mean	0.96	8.22	14.81	20.34	7.61	1.83

Table 5: Mean total dry matter accumulation plant^{-1}(g) as influenced periodically by different treatments

Treatments	Mean dry matter plant^{-1} (g)					
	Days after sowing					
	28	**42**	**56**	**70**	**84**	**At harvest**
Sowing Window						
S_1 26 MW (26th June – 01st July)	1.4	6.9	20.4	34.5	43.4	46.1
S_2 30 MW (23rd July – 29th July)	2.2	8.6	26.2	42.0	47.7	51.1
S_3 34 MW (20th Aug – 26th Aug)	1.8	5.9	23.2	39.2	39.11	42.0
S.Em±	0.1	0.1	0.2	0.2	0.4	0.3
C.D. at 5%	0.5	0.4	0.9	0.8	1.7	1.2
Cultivars						
V_1 Shanti (RHRBH-9808)	2.0	7.7	28.5	42.7	48.5	52.1
V_2 Mahyco hybrid (MRB-204)	1.8	7.2	23.5	38.2	43.0	45.9
V_3 Dhanashakti (ICTP-8203)	1.8	6.7	17.9	34.9	38.8	41.3
S.Em±	0.05	0.07	0.28	0.14	0.29	0.35
C.D. at 5%	0.14	0.22	0.86	0.43	0.88	1.09
Interaction						
S.Em±	0.1	0.1	0.5	0.2	0.5	0.6
C.D. at 5%	NS	NS	NS	NS	NS	NS
General mean	1.85	7.18	23.31	38.61	43.45	46.44

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