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EFFECT OF DIFFERENT SOWING DATES ON GROWTH AND YIELD OF PEARL MILLET (*Pennisetum glaucum* L.) VARIETIES UNDER ALLAHABAD CONDITION

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ABSTRACT
A field experiment was conducted during the kharif season 2014 at the research farm of School of Forestry & Environment, Sam Higginbottom Institute of Agriculture Technology and Sciences, Allahabad, to find out the effect of different sowing dates on performance of Pearl millet (*Pennisetum glaucum* L.) varieties under Allahabad condition in Randomized block design (factorial) with nine treatments replicated thrice. The results revealed that treatment 23rd July + Ganga kaveri-22 was recorded highest plant height (177.21cm), plant dry weight (78.25 g), grain yield (3.579 t ha^{-1}) and stover yield (10.225 t ha^{-1}).

KEY WORDS: Pearl millet, Varieties, Agrometeorological parameters.

INTRODUCTION

In last few decades, there has been an increasing of the importance of millets in India, major cereals which are grown on soils supplied with large quantity of fertilizers, irrigation and pesticide inputs have attained yield plateau. Millets have potentiality of contributing to increased food production, both in developing and developed countries. Millets are one of the cereals asides the major wheat, rice, and maize. Millets are major food sources for millions of people, especially those who live in hot, dry areas of the world. Millets are classified with maize, sorghum, and Coix (Job'stears) in the grass sub-family Panicoideae. In contrast, millet is the major source of energy and protein for millions of people in Africa. It has been reported that millet has many nutritious and medical functions (Yang *et al*., 2001). They are grown mostly in marginal areas under agricultural conditions in which major cereals fail to give substantial yields.Pearl millet [(*Pennisetum glaucum* L.) Br. Emend stuntz.] popularly known as *Bajra*, cattle millet, bulrush millet belongs to the grass family or gramineae. In the world, it's rank sixth followed by rice, wheat, corn, barley and sorghum (Anonymous, 2010). However, in India, it is fourth most important cereal crop after rice, wheat and sorghum. It has the greatest potential among all the millets. In India, annual planting area under pearl millet is 9.4 million hectares producing nearly 10.1 million tonns of grains. The Pearl millet growing countries are India, China, Nigeria, Pakistan, Sudan, Egypt, Arabia, and Russia. India is the largest producer of Pearl millet in the world. In India major producing state are Rajasthan (46%), Maharashtra (19%), Gujarat (11%), Uttar Pradesh (8%) and Haryana (6%). Sowing time is the most important non-monetary input influencing crop yield. Sowing at optimum time improves the productivity by providing suitable environment at all the growth stages. Upadhyay *et al*. (2001) have reported higher grain yield of summer pearl millet when sown on 15 march and found reduction in grain yield with delay in sowing. Identifying suitable time of sowing for pearl millet during summer is important to have proper growth and development of plants, save the crop from early monsoon showers and timely vacate the field for succeeding kharif crop. Keeping in view of the importance the study was aimed to investigate the effect of different dates of sowing on performance of pearl millet (*Pennisetum glaucum* L.) varieties under Allahabad condition.

MATERIALS & METHODS

The study was conducted at research farm of School of Forestry & Environment, Sam Higginbottom Institute of Agriculture, Technology and Sciences (Deemed-to-be-University), Allahabad during in one year 2014-2015 in the *Kharif* season. The area is situated on the south of Allahabad on the right hand of rivers Yamuna at Rewa Road at a distance of about 6 km of Allahabad city. It is positioned at 25°57' N latitude 81°50'E longitude and at the altitude of 98 meters above the sea level. Allahabad has a sub-tropical climate prevailing in the south east part of U.P. with both the extremes in temperature the summer. In summer the temperature rises up to 46-48^{0}C during the month of May and June. The average rainfall is around 1013.4 mm achieve is mostly received during the middle of July to end of August. Both the mechanical and chemical analysis of soil were done before the start of the experiment to ascertain the initial fertility gradient of the soil fence, the soil of the experimental field was analyzed mechanically and chemically and the procedure followed are presented below.

Mechanical Analysis

The mechanical analysis was done by "Bouyoucous hydrometer method" as described by Bouyoucos (1927). The results of analysis are as follows (Table 1).

Chemical Analysis

The chemical analysis was done for pH, Organic carbon, Electrical Conductivity (EC), available nitrogen, phosphorus and potassium. pH was determined by Digital pH meter. The organic carbon was estimated by Walkley and Black method (1934). The Electrical Conductivity (EC) was estimated by electrical conductivity meter. The available nitrogen was estimated by Kjeldahl method, the available phosphorus was determined by Olsen's Spectrophotometer method and available potassium was determined by Flame photometer analysis is presented in the following table 2.

TABLE 1: Mechanical composition of soil

Composition	Percentage	Method
Sand	60	
Clay	26	Bouyoucous
Silt	14	Hydrometer method
Texture Class	Sandy loam	(1927)

TABLE 2: Chemical properties of soil before sowing

Analysis	Quantity	Method
Bulk density(g/cm^3)	1.64	Core method (Black, 1965)
Particle density (g/cm^3)	2.70	Volumetric flask method (Black, 1965)
Pore space (%)	34.3	Volumetric flask method (Black, 1965)
Water holding capacity (%)	11.37	Volumetric flask method (Muthuaval *et al.* (1992)
pH (1:2)	7.6	Digital pH meter (Jackson, 1973)
EC (dSm^{-1})	0.38	Digital EC meter
Organic carbon %	0.36	Rapid titrations method (Wilcox, 1955)
Available nitrogen (kg ha^{-1})	260	Alkaline permanganate Subbiah, and Asija, (1956).
Available Phosphorus (kg ha^{-1})	26	Colorimetric method (Olsen,1954)
Available Potassium (kg ha^{-1})	252	Flame Photometric method (Toth and Prince, 1949)

The field experimental was layout in a randomized block design 3X3 Factorial with 9 treatment combination, each treatment replicated three times. The factors were located randomly and 3 sowing dated and 3 pearl millet varieties. This design allowed irrigation and other cultural practices to be performed on each sowing time independently. Treatment combinations as follows *viz*.,

Treatment details

Treatment No.	Treatment Combination	Varieties	Dates
T_1	D_1V_1	Ganga kaveri-22	
T_2	D_1V_2	DHANYA-1	23rd July
T_3	D_1V_3	Pusa-322	
T_4	D_2V_1	Ganga kaveri-22	
T_5	D_2V_2	DHANYA-1	30 July
T_6	D_2V_3	Pusa-322	
T_7	D_3V_1	Ganga kaveri-22	
T_8	D_3V_2	DHANYA-1	6th August
T_9	D_3V_3	Pusa-322	

Seed treatment was performed with Chloropyriphos @ 4 ml kg^{-1} seed to control termite and squirrel all such. Recommended dose of fertilizer was applied through chemical fertilizers at the time of sowing. The nutrients were applied in the form of urea [$CO(NH_2)_2$] and di-ammonium phosphate [$(NH_4)_2HPO_4$]. Nitrogen was applied in three split doses with 50 percent as basal application, 25 % at 25 days after sowing and remaining 25 % at sowing after 45 DAS. Subsequently irrigation was applied to the crop as per requirement. Other plant protections measures were taken as and when required. The seeds were sown as per the treatment combination. The observations were recorded on five randomly selected competitive plants in each replication for all the characters. Pre-harvest observations- Plant height (cm) at 25, 50, 75 and 90 DAS, Dry weight plant (gm), post-harvest observations- Grain yield (t/ ha^{-1}), Stover yield (t/ ha^{-1}), Harvest Index (%).The data observed were subjected to statistical analysis as for the methods detailed by Gomez and Gomez (1984).

RESULTS & DISCUSSION

The result obtained during the present course of investigation was carried out to visualize a significant influence of different date sowing. In case of plant height it was observed that there was a steady increase in plant height from 25, 50, 75 and 90 DAS. At 50, 75 and 90 DAS interval, plant height showed significant, while 25 DAS interval showed non-significant difference. At 25 DAS, highest plant height (12.33 cm.) was observed in V_1 (Ganga kaveri-22), while lowest plant height (11.97 cm) was observed in V_2 (DHANYA-1) among varieties. At 50 DAS, highest plant height (50.99 cm) was observed in V_2 (DHANYA-1), while lowest plant height (43.73 cm) was observed in V_3 (Pusa-322) among varieties. At 75 DAS, highest plant height (156.28 cm) was observed in V_3

(Pusa-322), while lowest plant height (142.99 cm) was observed in V_2 (DHANYA-1) among varieties. At 90 DAS, highest plant height (162.06 cm) was observed in V_3 (Pusa-322), while lowest plant height (148.42 cm) was observed in V_2 (DHANYA-1) among varieties. In case of Performance under different dates of sowing at 25 DAS, highest plant height (12.70 cm.) was observed in D_2 (30 July), while lowest plant height (11.40 cm) was observed in D_3 (06 August) different dates of sowing. At 50 DAS, highest plant height (53.48 cm) was observed in D_1 (23rd July), while lowest plant height (43.32 cm) was observed in D_3 (06 August) different dates of sowing. At 75 DAS, highest plant height (156.62 cm) was observed in D_1 (23rd July), while lowest plant height (143.59 cm) was observed in D_3 (06 August) different dates of sowing. At 90 DAS, highest plant height (162.07 cm) was observed in D_1 (23rd July), while lowest plant height (149.48 cm) was observed in D_3 (06 August) different dates of sowing. The interaction effect between different dates of sowing and varieties maximum plant height (13.90 cm) at 25 DAS non-significant, while 50, 75 and 90 DAS plant height (67.42 cm, 171.76 cm and 177.21 cm) showed significant difference. Different dates of sowing and varieties are affected the plant height at all stages of growth. Interaction table 3, shows the results, treatment T_1 (23rd July + Ganga kaveri-22) was significantly maximum plant height as compared with all other varieties and dates of sowing.

TABLE 3: Effect of different dates of sowing and varieties on plant height of pearl millet

D/V	25 DAS				50 DAS			
	D_1	D_2	D_3	M	D_1	D_2	D_3	M
V_1	13.90	12.17	10.93	12.33	67.42	41.68	36.18	48.42
V_2	11.88	13.30	10.74	11.97	47.18	63.43	42.36	50.99
V_3	11.50	12.10	12.54	12.04	45.86	33.91	51.42	43.73
MEAN	12.42	12.70	11.40		53.48	46.34	43.32	
	F-test	SED (±)	CD at 5%		F-test	SED (±)		CD at 5%
Due to variety	NS	0.26			S	5.20		11.04
Due to date	NS	0.87			S	7.38		15.66
Due to interaction	NS	1.72			S	19.95		42.30

D/V	75 DAS				90 DAS			
	D_1	D_2	D_3	M	D_1	D_2	D_3	M
V_1	171.76	148.82	145.54	155.37	177.21	155.21	151.78	161.40
V_2	136.29	164.98	127.70	142.99	141.47	170.56	133.21	148.42
V_3	161.83	149.48	157.54	156.28	167.54	155.21	163.45	162.06
MEAN	156.62	154.42	143.59		162.07	160.32	149.48	
	F-test	SED (±)	CD at 5%		F-test	SED(±)	CD at 5%	
Due to variety	S	10.50	22.26		S	10.88	23.07	
Due to date	S	9.86	20.91		S	9.65	20.45	
Due to interaction	S	21.87	46.37		S	21.79	46.20	

The early sowing date resulted in significant (P≤ 0.05) number of leaves/plant (25.6) compared with late sowing date (22.2), whereas sowing date had no significant effect on other growth attributes but the early sowing date produced tall plants at the two sites (132.1, 117.9 cm) successfully. The results also indicated that the variety had a significant effect (P≤ 0.05) on plant height. The results showed significant difference (P≤ 0.05) between the two sowing dates in number of days to maturity, whereas the plants grown earlier were reached maturity stage earlier than late plants at the two sites, on the other hand results indicated that the variety had significant effect (P≤ 0.05) on most crop yield component (Ali *et al.* 1984). A major constraint faced by farmers in these areas is the changing growing conditions such as low temperature of 10–15°C, which reduces plant growth, delays maturity, and leads to a reduced biomass yield. The existence of genetic variation for this trait can effectively address this issue. The farmers' practice of adjusting sowing time largely overcomes the problem of poor seed setting at low temperature. However, genetic improvement of this trait is needed to allow flexible sowing time (Mula *et al.*, 2009). Plant dry weight there was a steady increase in plant dry weight from 25, 50, 75 and 90 DAS. At 50, 75 and 90 DAS, interval plant dry weight showed significant, while 25 DAS plant dry weight shown non-significant difference. At 25 DAS, highest plant dry weight (1.03 g) was observed in V_3 (Pusa-322), while lowest plant dry weight (0.97 g) was observed in V_1 (Ganga kaveri-22) varieties. At 50 DAS, highest plant dry weight (15.79 g) was observed in V_3 (Pusa-322), while lowest plant dry weight (14.44 g) was observed in V_1 (Ganga kaveri-1) varieties. At 75 DAS, highest plant dry weight (59.96 g) was observed in V_3 (Pusa-22), while lowest plant dry weight (56.57 g) was observed in V_2 (DHANYA-1) varieties. At 90 DAS, highest plant dry weight (73.73 g) was observed in V_3 (Pusa-22), while lowest plant dry weight (71.32g) was observed in V_2 (DHANYA-1) varieties. Performance under different dates of sowing there was a steady increase in plant dry weight from 25, 50, 75 and 90 DAS. At 75 and 90 DAS, interval plant dry weight showed significant, while 25 and 50 DAS plant dry weight shown non-significant difference. At 25 DAS, highest plant dry weight (1.05 g) was observed in D_1 (23rd July), while lowest plant dry weight (0.96 g) was observed in D_2 (30 July) dates of sowing. At 50 DAS, highest plant dry weight (15.50 g) was observed in D_1 (06 August), while lowest plant dry weight (14.82 g) was observed in

D_3 (06 August) dates of sowing. At 75 DAS, highest plant dry weight (61.50 g) was observed in D_1 (23rd July), while lowest plant dry weight (55.17 g) was observed in D_2 (30 July) dates of sowing. At 90 DAS, highest plant dry weight (75.61 g) was observed in D_1-23rd July, while lo west plant dry weight (70.17 g) was observed in D_3 (06 August) dates of sowing. The interaction effect between different dates of sowing and varieties on dry weight at 50, 75 and 90 DAS significant, while 25 DAS plant dry weight showed non-significant difference. Interaction table 4, shows the results, treatment T_1 (23rd July + Ganga kaveri-22) was significantly increased of maximum plant dry weight (78.25 gm) compared with all other varieties and dates of sowing. The effect of date of sowing on phenology and heat unit requirement of groundnut (*Arachis hypogaea* L.) genotypes during summer season.

TABLE 4: Effect of different dates of sowing and varieties on dry weight of pearl millet

D/V	25 DAYS				50 DAYS			
	D_1	D_2	D_3	M	D_1	D_2	D_3	M
V_1	1.14	0.96	0.82	0.97	16.13	13.85	13.36	14.44
V_2	0.94	1.00	1.07	1.00	14.13	15.98	16.02	15.37
V_3	1.07	0.93	1.09	1.03	16.26	16.01	15.10	15.79
MEAN	1.05	0.96	0.99		15.50	15.28	14.82	
	F-test	SED (±)		CD at 5%	F-test	SED (±)		CD at 5%
Due to variety	NS	0.04			S	0.97		2.06
Due to date	NS	0.06			NS	0.49		1.04
Due to interaction	NS	0.17			S	1.83		3.88

D/V	75 DAYS				90 DAY			
	D_1	D_2	D_3	M	D_1	D_2	D_3	M
V_1	64.36	55.07	57.95	59.12	78.25	71.29	66.12	71.88
V_2	54.50	56.66	58.56	56.57	71.50	71.27	71.21	71.32
V_3	65.64	53.80	60.45	59.96	77.09	70.93	73.18	73.73
MEAN	61.50	55.17	58.98		75.61	71.16	70.17	
	F-test	SED (±)		CD at 5%	F-test	SED(±)		CD at 5%
Due to variety	S	2.49		5.29	S	1.77		3.77
Due to date	S	4.51		9.54	S	4.09		8.69
Due to interaction	S	5.61		11.90	S	4.64		9.84

accumulated higher growing degree days, heliothermal unit and photo-thermal units at all the phenophases than the local genotypes M-522, SG-84. SG 84 attained harvest maturity 5-10 days earlier than other 4 genotypes and translocated highest dry matter towards pods at 93 and 114 days, while total dry-matter /plant was maximum in M 522 during both the years (Brar *et al.,* 1999). This was in agreement with of nine millet varieties named Cholistani Bajra, Barani Bajra, MB-87, Sargodha Bajra 2011, 18-BY, Super Bajra-1, PARC-MS-2, 86-M-52 and FB-822. The variety 86-M-52 produced maximum forage and dry matter yield because of more number of leaves (14), leaf area (3540.1 cm^2) followed by Sargodha Bajra-2011. All cultivars have statistically significant differences in respect of quality characteristics (Hassan *et al.,* 2011).The number of leaves and the total biomass are higher with early sowing because of the extended development period (Kouressy *et al.,* 1998). In case of crop growth rate it was observed that there was a steady increase in CGR from 0-25, 25-50, and 50-75 DAS, later at interval 75-90 DAS CGR decreased. Between 0-25, 25-50, 50-75 and 75-90 DAS CGR showed non-significant difference. Between 0-25 DAS, highest CGR (0.54 g m^{-2} day^{-1}) was observed in V_3 (Pusa-322), while lowest CGR (0.51 g m^{-2} day^{-1}) was observed in V_1 (Ganga kaveri-22) varieties. Between 25-50 DAS, highest CGR (7.86 g m^{-2} day^{-1}) was observed in V_3 (Pusa-322), while lowest CGR (7.18 g m^{-2} day^{-1}) was observed in V_1 (Ganga kaveri-1) varieties. Between 50-75 DAS, highest CGR (23.81 g m^{-2} day^{-1}) was observed in V_1 (Ganga kaveri-1), while lowest CGR (21.96 g m^{-2} day^{-1}) was observed in V_2 (Pusa-322) varieties. Between 75-90 DAS, highest CGR (13.10 g m^{-2} day^{-1}) was observed in V_2 (Pusa-322), while lowest CGR (11.33 g m^{-2} day^{-1}) was observed in V_1-Ganga kaveri-22 varieties. Under different dates of sowing that there was a steady increase in CGR from 0-25, 25-50 and 50-75 DAS, later at interval 75-90 DAS CGR decreased. Between 25 and 50 DAS showed non-significant, while 50-75 and 90 DAS CGR showed significant influence. Between 0-25 DAS, highest CGR (0.55 g m^{-2} day^{-1}) was observed in D_1 (23rd July), while lowest CGR (0.51 g m^{-2} day^{-1}) was observed in D_2 (30 July) dates of sowing. Between 25-50 DAS, highest CGR (7.70 g m^{-2} day^{-1}) was observed in D_1 (23rd July), while lowest CGR (7.37 g m^{-2} day^{-1}) was observed in D_3 (06 August) dates of sowing. Between 50-75 DAS, highest CGR (24.51 g m^{-2} day^{-1}) was observed in D_1 (23rd July), while lowest CGR (21.26 g m^{-2} day^{-1}) was observed in D_2 (30 July) dates of sowing. Between 75-90 DAS, highest CGR (14.20 g m^{-2} day^{-1}) was observed in D_2 (30 July), while lowest CGR (9.93 g m^{-2} day^{-1}) was observed in D_3 (06 August) dates of sowing. The interaction effect between different dates of sowing and varieties between, 0-25 was non-significant, while between 25-50, 50-75 and 75-90DAS CGR showed significant difference. Interaction table 5, shows the results, treatment T_6 (30 July + Pusa-322) was significantly of maximum plant CGR (15.22 g m^{-2} day^{-1}) compared with all other varieties and dates of sowing. The results showed that significantly higher plant stand was observed in 9th June and 4th July sowing date of the groundnut at harvest. 20th April sowing had

significantly higher dry matter accumulation, CGR of 30-60 and 60-90 DAS of HNG-10 variety. Further delays in sowing significantly reduce growth parameters. However, growth parameters *viz.* dry matter accumulation, CGR, RGR *etc.* in all the sowing dates in TG-37A was statistically at par with each other (Meena and Yadav 2014).

TABLE 5: Effect of different dates of sowing and varieties on crop growth rate (g m^{-2} day^{-1}) of pearl millet

D/V	25 DAS				50 DAS			
	D_1	D_2	D_3	M	D_1	D_2	D_3	M
V_1	0.60	0.51	0.44	0.51	7.99	6.87	6.68	7.18
V_2	0.50	0.53	0.57	0.53	7.03	7.98	7.97	7.66
V_3	0.57	0.49	0.58	0.54	8.09	8.04	7.46	7.86
MEAN	0.55	0.51	0.53		7.70	7.63	7.37	
	F-test	SED (±)	CD at 5%		F-test	SED (±)		CD at 5%
Due to variety	NS	0.02			NS	0.49		
Due to date	NS	0.03			NS	0.24		
Due to interaction	NS	0.09			S	0.91		1.93

D/V	75 DAS				90 DAS			
	D_1	D_2	D_3	M	D_1	D_2	D_3	M
V_1	25.71	21.97	23.77	23.81	12.34	14.41	7.25	11.33
V_2	21.52	21.69	22.68	21.96	15.10	12.98	11.24	13.10
V_3	26.32	20.14	24.18	23.54	10.17	15.22	11.31	12.23
MEAN	24.51	21.26	23.54		12.53	14.20	9.93	
	F-test	SED (±)	CD at 5%		F-test	SED(±)	CD at 5%	
Due to variety	NS	1.41			NS	1.25		
Due to date	S	2.35	4.99		S	3.04	6.45	
Due to interaction	S	2.31	4.91		S	3.23	6.84	

It was observed that there was a steady increase in Relative growth rate (g g^{-1} day^{-1}) from 25-50 DAS to 50-75 DAS, later at interval 75-90 DAS RGR decreased. Between 25-50, 50-75 AND 75-90 DAS interval RGR showed nonsignificant difference. Between 25-50 DAS, highest RGR (0.1079 g g^{-1} day^{-1}) was observed in V_1 (Ganga kaveri-1), while lowest RGR (0.1013 g g^{-1} day^{-1}) was observed in V_3 (Pusa-322) varieties. Between 50-75 DAS, highest RGR (0.0563 g g^{-1} day^{-1}) was observed in V_1 (Ganga kaveri-1), while lowest RGR (0.0532 g g^{-1} day^{-1}) was observed in V_3 (Pusa-322) varieties. Between 75-90 DAS, highest RGR (0.0148 g g^{-1} day^{-1}) was observed in V_3 (Pusa-22), while lowest RGR (0.0121 g g^{-1} day^{-1}) was observed in V_1 (Ganga kaveri-22) varieties. In case of performance under different dates of sowing from 25-50 DAS to 50-75 DAS, later at interval 75-90 DAS RGR decreased.

TABLE 6: Effect of different dates of sowing and varieties on relative growth rate (g g^{-1} day^{-1}) of pearl millet

D/V	25-50 DAS				50-75 DAS			
	D_1	D_2	D_3	M	D_1	D_2	D_3	M
V_1	0.1059	0.1068	0.1112	0.1079	0.0552	0.0551	0.0586	0.0563
V_2	0.1073	0.1000	0.0967	0.1013	0.0571	0.0506	0.0518	0.0531
V_3	0.1086	0.1003	0.1048	0.1045	0.0558	0.0484	0.0556	0.0532
Mean	0.1072	0.1029	0.1041		0.0560	0.0513	0.0553	
	F-test	SED (±)	CD at 5%		F-test	SED (±)		CD at 5%
Due to variety	NS	0.0046			NS	0.0028		
Due to date	NS	0.0034			NS	0.0032		
Due to interaction	NS	0.0060			NS	0.0033		

D/V	75-90 DAS			
	D_1	D_2	D_3	Mean
V_1	0.0130	0.0147	0.0088	0.0121
V_2	0.0180	0.0153	0.0110	0.0147
V_3	0.0106	0.0214	0.0126	0.0148
Mean	0.0138	0.0171	0.0108	
	F-test	SED (±)	CD at 5%	
Due to variety	NS	0.0021		
Due to date	S	0.0044	0.0094	
Due to interaction	NS	0.0049		

Between 25-50, 50-75 DAS showed non-significant, while 75-90 DAS interval RGR showed significant difference. Between 25-50 DAS, highest RGR (0.1072 g g^{-1} day^{-1}) was observed in D_1 (23rd July), while lowest RGR (0.1029 g g^{-1} day^{-1}) was observed in D_2 (30 July) dates of sowing. Between 50-75 DAS, highest RGR (0.0560 g g^{-1} day^{-1}) was observed in D_1 (23rd July), while lowest RGR (0.0513 g g^{-1} day^{-1}) was observed in D_2 (30 July) dates of sowing. Between 75-90 DAS, highest RGR (0.0171 g g^{-1} day^{-1}) was observed in D_2 (30 July), while lowest RGR (0.0108 g g^{-1} day^{-1}) was observed in D_3 (06 August) dates of sowing.

TABLE 7: Effect of different dates of sowing and varieties on grain yield (t ha^{-1}) of pearl millet

D/V	D_1	D_2	D_3	Mean
V_1	3.579	2.985	2.863	3.142
V_2	2.918	3.061	2.372	2.783
V_3	2.870	2.551	2.968	2.796
Mean	3.122	2.865	2.734	
	F-test	SED (±)		CD at 5%
Due to variety	S	0.28		0.61
Due to date	S	0.27		0.59
Due to interaction	S	0.45		0.97

TABLE 8: Effect of different dates of sowing and varieties on stover yield of pearl millet

D/V	D_1	D_2	D_3	Mean
V_1	10.225	9.105	8.771	9.367
V_2	8.313	9.484	7.367	8.388
V_3	9.522	8.383	8.857	8.920
Mean	9.353	8.990	8.331	
	F-test	SED (±)	CD at 5%	
Due to variety	S	0.69	1.46	
Due to date	S	0.73	1.55	
Due to interaction	S	1.10	2.34	

TABLE 9: Effect of different dates of sowing and varieties on Harvest index of pearl millet

D/V		D_2	D_3	M
V_1	25.88	24.72	24.71	25.10
V_2	26.00	24.41	24.47	24.96
V_3	23.34	23.34	25.10	23.92
MEAN	25.07	24.15	24.76	
	F-test	SED (±)		CD at 5%
Due to variety	NS	0.91		
Due to date	NS	0.65		
Due to interaction	NS	1.28		

The interaction effect between different dates of sowing and varieties at 25-50, 50-75 and 75-90 DAS was non-significant. Interaction table 6, shows the results, treatment T_6 (30 July + Pusa-322) was significantly increased of maximum plant RGR (0.0214 g g^{-1} day^{-1}) compared with all other varieties and dates of sowing. Further delays in sowing significantly reduce growth parameters. However, growth parameters *viz.* dry matter accumulation, CGR, RGR *etc.* in all the sowing dates in case of TG-37A was statistically at par with each other (Meena and Yadav *2014*).For grain yield (t ha^{-1}) it was observed that grain yield showed statistically significant due to variety. Highest grain yield (3.142 t ha^{-1}) was observed in V_1 (Ganga kaveri-22), while lowest grain yield (2.783 t ha^{-1}) was observed in V_2 (Pusa-22) varieties under different varieties and under different dates of sowing grain yield showed statistically significant difference. Highest grain yield (3.122 t ha^{-1}) was observed in D1 (23rd July), while lowest grain yield (2.734 t ha^{-1}) was observed in D_3 (06 August) dates of sowing (Table 7). The interaction effect between dates of sowing and varieties was observed that grain yield showed statistically significant difference. Highest grain yield (3.579 tha^{-1}) was observed in treatment D_1V_1 (23rd July + Ganga Kaveri-22), while lowest grain yield (2.372 t ha^{-1}) was observed in treatment D_3V_2 (06 August + DHANYA-1).This may be due to suitable planting date irrespective of varieties followed by 24th June. The Results obtained showed that the growth and yield attributing characters were higher under pre-monsoon sowing as in case of higher pod and haulm yields of groundnut which were recorded in first date of sowing followed by early monsoon sowing. The water requirement, Water use efficiency, Heat use efficiency and Heliothermal use efficiency were also highest in first date of sowing (Sahu *et al.,* 2010). Stover yield (t ha^{-1}) performance under different varieties showed statistically

significant. Highest stover yield (9.367 t ha^{-1}) was observed in V_1 (Ganga kaveri-22), while lowest stover yield (8.388 t ha^{-1}) was observed in V_2 (Pusa-22) varieties. . Highest stover yield (9.353 t ha^{-1}) was observed in D1 (23rd July), while lowest stover yield (8.331 t ha^{-1}) was observed in D_3 (06 August) dates of sowing. The interaction effect between dates of sowing and varieties was observed that stover yield showed statistically significant. Highest stover yield (10.225 t ha^{-1}) was observed in treatment D_1V_1 (23rd July + Ganga Kaveri-22), while lowest stover yield (7.367 t ha^{-1}) was observed in treatment D_3V_2 (06 August + DHANYA-1) (Table 8). The number of leaves and the total biomass are higher with early sowing because of the extended development period (Kouressy *et al*. 1998) and this also may be due to delayed sowing, continuous low temperature during vegetative stage adversely affected the straw yield (Agrawal and Arora, 1980). Harvest Index (%) performance under different varieties showed non-significant difference. Maximum harvest index (25.10%) was observed in V_1 (Ganga kaveri-22), while minimum harvest index (23.92%) was observed in V_3 (Pusa-322) in each varieties. Performance under different dates of sowing showed non-significant difference. Maximum harvest index (25.07%) was observed in D_1 (23rd July), while minimum harvest index (24.15%) was observed in D_2 (30 July) dates of sowing. The interaction effect between different dates of sowing and varieties was observed that harvest index showed non-significant difference. Highest harvest index (26%) was observed in treatment D_1V_2 (23rd July + DHANYA-1), while lowest harvest index (23.34%) was observed in treatment D_1V_3 (23rd July + DHANYA-1) and D_2V_3 (30 July + Pusa-322) (Table 9).

CONCLUSION

From the above study it is concluded that the pearl millet variety Ganga kaveri-22 is found to be most suitable for sowing at 23rd July. The growth and yield of pearl millet variety Ganga kaveri-22 and sowing date 23rd July provides favorable weather condition for better growth and yield under Allahabad condition. In case of late sowing condition the weather parameters were not favorable for the Ganga kaveri-22 variety, thus affecting of plant height, CGR, RGR, which ultimately reduced the yield.

REFERENCES

Agrawal, S.K. and Arora, N.R. (1980) Effect of sowing dates and seed rates on growth and yield of Barley Varieties. *Indian J. Agron.*25 (1): 65-70.

Ali, A., Gregory, S.N., Monteitb, P.J. and J.L. (1984) Effects of planting density on water use and productivity of pearl millet *(Pennisetum typhotdes)* grown on stored water. I. Growth of roots and shoots. II. Water use, light interception and dry matter production. *Experimental Agriculture*.20:203-224.

Anonymous (2010) Annual Report All India Co-ordinated Pearl millet Improvement Project. 141-142.

Black, C.A. (1965) Methods of Soil Analysis, Part 2 (ed.), *American Society* of Agronomy. Inc. Madison, Wisconsin, USA.

Bouyoucos, G. (1927) The hydrometer as a new method for the mechanical analysis of soils. *Soil Sci*. 23:343-352.

Brar, A.S., Dhingra, K.K. and Kaul, J.N. (1999) Phonological behavior and heat unit requirement of groundnut (*Arachis hypogaea* L) genotypes under two dates of sowing during *summer* season. *Indian Journal of Agricultural Sciences*.69(6):419-423.

Gomez, K.A. & Gomez, A.A. (1984) Statistical procedures for Agricultural Res. 2nd edn. John Wiley and Sons, New York. 680 pp.

Hassan, F.U., Kaleem, S. and Ahmad, M. (2011) Oil and fatty acid distribution in different circles of sunflower head. *Food Chem*. 128: 590-595.

Jackson, M.L. (1973) Soil Chemical Analysis, Prentice Hall of India Pvt Ltd., New Delhi.

Kouressy, M., Niangado, O., Vaksman, M. and Reyniers, F.N. (1998) Etude de la variability phenologique du mil du Mali et de so utilization pour l' amelioration varietal. In Reyniers F-N. et BACCI, L Eds. Le future des cereals photoperiodiques pour une production durable en Enrique tropical semi-arid. Florence : 59-75.

Meena, R.S. & Yadav, R.S. (2014) Phenological performance of groundnut varieties under sowing environments in hyper arid zone of Rajasthan, India. *Journal of Applied and Natural Science*. 6(2):344-348.

Mula, M.G., Saxena, K.B., Rathore, A. and Kumar, R.V. (2009) Response to spacing and irrigation in a medium duration CMS-line of pigeon pea. *Jour. of food legumes*. 23(3-4):186-190.

Muthuvel, P. and Udayasoorian, C. (1999) Soil, plant, water and agrochemical analysis, Tamil Nadu Agricultural University, Coimbatore, India.

Olsen, S.R., Cole, C.V., Watanabe, F.S. and La Dean (1954) Estimation of available phosphorus in soils by extraction with sodium bicarbonate. United States Department of Agriculture, Circular 939, Washington, District of Columbia, USA. 19.

Sahu, D.D., Solanki, R.M. and Chopada, M.C. (2010) Determination of sowing time for rainfed groundnut using heat concept under South Saurashtra Agro climatic Zone. *Agrometeorological Services for Farmers AAU, Anand.* 98-105.

Subbiah, B.V. and Asija, G.L. (1956) A rapid procedure for estimation of available nitrogen in soils. *Current Science.* 25: 259-260.

Toth, S.J. and Prince, A.L. (1949) Estimation of cation exchange capacity and exchangeable calcium, potassium, and sodium contents of soils by flame photometer techniques, Soil Science,Vol. 67: 439-445.

Upadhyay, PN., Dixit ,A.G., Patel, J.R. and Chavda, J.R. (2001) Response of summer pearl millet to time and

method of planting, age of seedling and phosphorus grown on loamy sand soils of Gujarat. *Indian J. Agron*. 46(1):126-130.

Walkley, A. and Black, A. (1934) An examination of Degtjareff Method of Determining Soil Organic Matter and a proposed modification of the chromic acid titration method. Soil Science. 37: 29-38.

Wilcox, L.V. (1955) Classification and use of irrigation waters. US Department of Agriculture, Arc 969, Washington DC.

Yang, J., Zhang, J., Wang, Z., Zhu, Q. and Liu, L.(2001) Water deficit-induced senescence and its relationship to the remobilization of pre-stored carbon in wheat during grain filling. *Agronomy Journal*.93: 196–206.