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Effect of Sowing Windows on Growth and Yield Parameters of Small Millets and their Varieties during Late *Kharif*

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Abstract

A field trial was conducted during the *kharif* seasons of 2021 and 2022, at UAS, GKVK, Bengaluru, Karnataka. The aim of the study was to investigate the agronomic performance of two varieties each in foxtail millet, proso millet and little millet across three sowing windows *viz*., second fortnight of august (W_1), first fortnight of september (W_2) and second fortnight of september (W_3). There were 18 treatment combinations with three replications each, tested in RCBD with factorial design concept. In the study, significant variations were observed among the sowing windows and millet varieties with respect to plant height, leaf area, dry matter production, productive tillers, days to 50 per cent flowering and maturity, ear head length, ear head weight and yield. Foxtail millet consistently displayed higher values in several parameters, with genotype DHFt-109-3 showing superior performance in terms of ear head weight and ear head length. Proso millet demonstrated the early maturation, while little millet showed relatively late performance across different sowing windows. The first sowing window (W_1) consistently recorded the highest grain and straw yields across millet crops, followed by subsequent sowing windows W_2 and W_3. The findings highlight the importance of sowing small millet crops in late *kharif* to optimize agronomic practices in aberrant weather condition. Additionally, the findings emphasize the importance of selecting suitable varieties that exhibit robust performance across different sowing windows, contributing to sustainable agriculture practices in the face of climate variability.

Keywords : Aberrant weather, Small millets, Sowing windows, Varieties, Yield

Millets, often referred to as 'nutri-cereals,' are small-grain cereal crops packed with essential nutrients such as protein, dietary fibre, vitamins and minerals (Sukanya *et al*., 2023). These nutrient-rich grains play a crucial role in traditional diets, providing a staple food source in many cultures. Additionally, millets are increasingly being incorporated into modern food products, including probiotics and popped snacks, due to their health benefits and versatility (Nithyashree & Vijayalaxmi, 2022 and Yadagouda & Ravindra, 2022). Their high nutritional value makes them an excellent choice for promoting food security and improving dietary quality, especially in regions facing nutritional deficiencies.

Seven major small millets, including finger millet, foxtail millet, kodo millet, little millet, barnyard millet, proso millet and brown top millet are the most dependable food crops for resource-poor dryland farmers due to their resilience to climate change and sustainable production (Sukanya and Narayanan, 2023).

Increasing the area under cultivation, growing high yielding varieties and enhancing crop management are potential strategies for boosting small millet production. While new, improved varieties are continuously being released, there is a significant gap in information regarding the late sowing windows for these varieties in Karnataka. Prioritizing suitable agronomic techniques is essential for achieving vigorous root growth, vegetative progress and ultimately, a prominent yield (Sukanya and Narayanan, 2023). Selecting suitable cultivars and determining the optimal sowing time are not only essential for maximizing yield potential and yield-contributing factors (Honnaiah *et al*., 2021; Kumar *et al.,* 2021; Salmankhan *et al*., 2021; Jadipujari *et al*., 2023 and Pannase *et al*., 2024) but also for minimizing risk of crop failures and cost reduction (Soler *et al.,* 2008). Additionally, evaluating varietal performance under different sowing windows and adapting management practices in the context of climate change are vital. This includes adjusting sowing dates to align with predicted weather patterns and potential changes in precipitation levels. With this background, current study was undertaken with an aim to identify optimum sowing window in late *kharif* for the three small millets - foxtail millet, proso millet and little millet and their varieties for Bangalore region.

Material and Methods

The field trial was conducted during late *kharif* 2021 and 2022, between August second fortnight to November second fortnight, September first fortnight to December first fortnight and September second fortnight to December second fortnight, at the Zonal Agriculture Research Station (ZARS), University of Agricultural Sciences, GKVK, Bengaluru (13° 4' 44.688" N, 77° 34' 16.5684" E; elevation 930 m), Karnataka, India. The soil of experimental site was red sandy clay loam in texture. The soil was slightly acidic in reaction (pH 5.95), low electrical conductivity (0.22 dS/m) and low organic carbon content (0.36%). The soil was low in available nitrogen (249.7 kg/ha), high in available phosphorus (71.80 kg/ha) and medium in available potassium (180.40 kg/ha). During both experimental periods, the site received higher than normal rainfall.

The experiment consisted of 18 treatments with three sowing windows (W_1: August 2nd fortnight, W_2: September 1st fortnight and W_3: September 2nd fortnight), three crops (C_1: Foxtail millet, C_2: Proso millet and C_3: Little millet) and two varieties in each crop (V_1: GPUF 3, GPUP 28 and GPUL6; V_2: DHFt 109-3, GPUP 21 and DHLM 36-3). Seeds were sown at a spacing of 30 cm x 10 cm and plot measured 14.7 sq. m., with a net plot area of 9.3 sq.m. Normal post-sowing agronomic practices recommended for this region to raise a healthy crop were followed.

Growth and yield attributes were recorded at 30, 60 DAS and at harvest. The grain and straw yield obtained from each net plot area was converted to kg/ha. The data recorded on various parameters were subjected to Fisher's method of analysis of variance and interpretation of the data was made as given in the F-test was P = 0.05. Whenever, the F-test was significant for comparison amongst the treatments, an appropriate value of critical differences (CD) was worked out. Otherwise, against CD values abbreviation 'NS' (Non-significant) is indicated.

Results and Discussion

The data on various growth and yield attributing parameters of the three small millets evaluated in three sowing windows were collected across the *kharif* seasons of 2021 and 2022 and pooled data is presented in the Tables 1, 2, 3, 4 and 5.

Plant Height (cm)

Plant height at harvest was significantly influenced by different sowing windows, crops and their varieties. The data pooled over two years are presented in Table 1.

Data indicated that the crop sown during second fortnight of august recorded significantly higher plant

TABLE 1

Plant height (cm) and leaf area (cm^2/ hill) at harvest of small millets as influenced by sowing windows and varieties at harvest

Treatment*	Plant height (cm)			Leaf area (cm^2/hill)		
	2021	2022	Pooled	2021	2022	Pooled
Sowing Window (W)						
W_1	93.2	95.3	94.2	645.8	689.8	667.8
W_2	87.7	90.8	89.3	538.9	574.0	556.4
W_3	83.6	86.0	84.8	468.8	498.9	483.8
S.Em ±	1.97	2.17	2.07	7.13	8.61	6.14
CD at 5%	5.65	6.24	5.94	20.49	24.74	17.65
Crops (C)						
C_1	94.6	96.8	95.7	681.2	721.5	701.4
C_2	82.0	84.7	83.3	545.9	583.8	564.9
C_3	88.0	90.5	89.2	426.4	457.3	441.8
S.Em ±	1.97	2.17	2.07	7.13	8.61	6.14
CD at 5%	5.65	6.24	5.94	20.49	24.74	17.65
Varieties (V)						
V_1	87.0	89.7	88.4	530.2	569.9	550.0
V_2	89.3	91.6	90.5	572.1	605.2	588.7
S.Em ±	1.60	1.77	1.69	5.82	7.03	5.01
CD at 5%	4.61	5.09	4.85	16.73	20.20	14.41
Sowing Window (W) x Crops (C)						
W_1C_1	100.0	100.8	100.4	768.3	827.8	798.0
W_1C_2	87.4	89.6	88.5	639.6	672.9	656.3
W_1C_3	92.0	95.4	93.7	529.4	568.7	549.0
W_2C_1	94.6	97.5	96.0	692.8	719.3	706.1
W_2C_2	80.6	85.2	82.9	526.3	574.6	550.5
W_2C_3	88.1	89.8	88.9	397.5	428.0	412.8
W_3C_1	89.1	92.2	90.6	582.4	617.5	600.0
W_3C_2	77.9	79.4	78.7	471.7	504.0	487.8
W_3C_3	83.7	86.4	85.1	352.3	375.2	363.7
S.Em ±	3.40	3.76	3.58	12.35	14.91	10.63
CD at 5%	9.78	10.81	10.29	35.49	42.86	30.56
Sowing Window (W) x Varieties (V)						
W_1V_1	92.1	94.9	93.5	639.4	676.0	657.7
W_1V_2	94.3	95.7	95.0	652.2	703.5	677.9
W_2V_1	87.0	90.3	88.6	519.3	558.6	539.0
W_2V_2	88.5	91.3	89.9	558.5	589.3	573.9

Continued....

TABLE 1 Continued....

Treatment*	Plant height (cm)			Leaf area (cm^2/hill)		
	2021	2022	Pooled	2021	2022	Pooled
W_3V_1	82.1	84.0	83.0	419.1	447.5	433.3
W_3V_2	85.1	87.9	86.5	518.5	550.3	534.4
S.Em ±	2.78	3.07	2.92	10.08	12.18	8.68
CD at 5%	7.99	8.82	8.40	28.97	34.99	24.95
Sowing Window (W) x Crops (C) x Varieties (V)						
$W_1C_1V_1$	98.7	100.1	99.4	760.7	824.1	792.4
$W_1C_1V_2$	101.3	101.5	101.4	775.9	831.4	803.7
$W_1C_2V_1$	84.9	87.3	86.1	608.9	653.8	631.3
$W_1C_2V_2$	89.9	91.9	90.9	670.4	692.0	681.2
$W_1C_3V_1$	92.6	97.2	94.9	586.9	632.7	609.8
$W_1C_3V_2$	91.5	93.7	92.6	471.8	504.6	488.2
$W_2C_1V_1$	92.1	95.2	93.7	636.0	673.6	654.8
$W_2C_1V_2$	97.0	99.7	98.4	749.7	765.0	757.4
$W_2C_2V_1$	80.4	85.1	82.7	507.2	563.7	535.5
$W_2C_2V_2$	80.8	85.2	83.0	545.5	585.5	565.5
$W_2C_3V_1$	88.4	90.6	89.5	414.6	438.5	426.6
$W_2C_3V_2$	87.8	88.9	88.3	380.4	417.5	399.0
$W_3C_1V_1$	83.5	86.3	84.9	453.2	485.8	469.5
$W_3C_1V_2$	94.6	98.0	96.3	711.7	749.1	730.4
$W_3C_2V_1$	77.2	78.2	77.7	446.4	469.5	457.9
$W_3C_2V_2$	78.6	80.6	79.6	497.0	538.4	517.7
$W_3C_3V_1$	85.5	87.6	86.5	357.7	387.0	372.4
$W_3C_3V_2$	82.0	85.2	83.6	346.8	363.4	355.1
S.Em ±	4.81	5.32	5.07	17.46	21.09	15.04
CD at 5%	13.84	15.28	14.56	50.18	60.61	43.22

*Treatments : Window : W_1: August 2nd fortnight; W_2: September 1st fortnight; W_3: September 2nd fortnight; Crop: C_1: Foxtail millet; C_2: Proso millet; C_3: Little millet; Variety: V_1: GPUF 3 /GPUP 28 / GPUL6; V_2: DHFt 109-3/ GPUP 21 / DHLM 36-3

height (94.2cm) at harvest followed by the crop sown at first fortnight of September (89.3cm). Among the different small millets, higher plant height was recorded in foxtail millet (95.7cm) followed by little millet (89.2cm). Among varieties, DHFt-109-3 of foxtail millet, GPUP 21 of proso millet and GPUL 6 of little millet were significantly superior over GPUF 3 of foxtail millet, GPUP 28 of proso millet and DHLM 36-3 of little millet at harvest.

The significant interaction was found between sowing windows and crops at harvest. Sowing of foxtail millet during second fortnight of August has recorded significantly higher plant height (100.4cm) followed by sowing of foxtail millet during first fortnight of september (96cm). The interaction between sowing windows and varieties was found significant in which second fortnight of august and variety V_2 (DHFt 109-3, GPUP 21 and GPUL 6) has recorded significantly higher plant height (95 cm), which was followed by second fortnight of august and variety V_1 (GPUF 3, GPUP 28 and DHLM 36-3) significantly lower plant height was observed with second fortnight of september and variety V_1 (83cm).

The significant interaction was found between crop and variety. Among different combinations DHFt-109-3 of foxtail millet has recorded significantly higher plant height (98.7 cm) which was followed by GPUF 3 variety of foxtail millet (92.6cm). Significantly lower plant height was recorded in GPUP 28 of proso millet (82.2cm).

Overall interaction between sowing windows, crops and varieties found significant in all growth stages of crop. Sowing of foxtail millet variety DHFt 109-3 during second fortnight of august (101.4cm) has recorded significantly higher plant height which was on par with foxtail millet variety GPUF 3 sown in second fortnight of august (99.4cm).

Increased plant height in first sowing window might be due to favorable climatic conditions during the early stages of growth, such as adequate sunlight, rainfall and temperature which attribute to crop growth at different stages and resulted in maximum plant height. These results are in accordance with the findings of Pandiselvi *et al*. (2010) in finger millet and Gavit *et al*. (2017) in proso millet and crop sown during second fortnight of august had advantage in terms of having more time to establish their root systems and undergo early growth stages. The results are in conformity with Kiranmai *et al.* (2021) in small millets. The lower plant height was recorded with second fortnight of september sown crop. This might be due to unfavorable climatic conditions which limit the plant growth. The present findings corroborate with that of Girase *et al*. (2016) in summer pearl millet. Variations in plant height in different varieties was attributed to variations in their genetic inheritance. Short duration varieties typically have a shorter growth cycle, reach maturity more quickly than long-duration varieties. Combined effect of sowing of DHFt 109-3 variety of foxtail millet resulted in taller plants due to favourable weather conditions. These results corroborate with the findings of Rurinda *et al*. (2014) who reported significant increase in the yield of maize, finger millet and sorghum crops with early sowing.

Leaf Area (cm^2/hill)

Leaf area was significantly influenced by different sowing windows, crops and their varieties. The pooled data of two years are presented in Table 1. Crop sown during second fortnight of august showed significantly higher leaf area (667.8cm^2/hill) at harvest. It is followed by first fortnight of september (556.4cm^2/hill) and significantly lower leaf area was observed in crop sown on september second fortnight (483.8cm^2/hill). Among the crops, foxtail millet (701.4 cm^2/hill) has recorded higher leaf area followed by proso millet (564.9 cm^2/hill) and little millet (441.8 cm^2/ hill) at harvest. Varieties V_2 (DHFt 109-3 of foxtail millet, GPUP-21 of proso millet and GPUL 6 of little millet) (588.68 cm^2/hill) have recorded higher leaf area which was followed by V_1 (GPUF 3 of foxtail, GPUP 28 of proso millet and DHLM-36-3 of little millet) (550.02 cm^2/ hill) at harvest.

There was significant interaction between sowing window and crop with respect to leaf area at harvest in which sowing of foxtail millet during second fortnight of august has recorded significantly higher leaf area (798.03cm^2/ hill) followed by foxtail millet sown during first fortnight of september (706.08cm^2/ hill).

There was significant interaction found between sowing windows and varieties among which, the combination of V_2(DHFt 109-3 of foxtail millet, GPUP 21 of proso millet and GPUL 6 of little millet) variety sown during second fortnight of august (677.85 cm^2/hill) has recorded significantly higher leaf area which was on par with variety V_1 (GPUF 3 foxtail millet, GPUP 28 of proso millet and DHLM 36-3 of little millet) sown during second fortnight of august (657.70cm^2/hill) and significantly lower leaf area was recorded in V_1 (GPUF 3 foxtail millet, GPUP 28 of proso millet and DHLM-36-3 of little millet) variety of little millet sown during second fortnight of september (433.26cm^2/hill).

There was significant interaction among crops and their varieties, among different combinations foxtail millet variety DHFt 109-3 has recorded significantly higher leaf area (763.82cm^2/hill) which was followed by variety GPUF 3 of foxtail millet (638.89cm^2/hill) and significantly lower leaf area was recorded in little millet variety DHLM 36-3 (414.10cm^2/hill).

There was significant interaction between all three factors, the combination of DHFt 109-3 variety of foxtail millet sown during second fortnight of august (803.68 cm^2/hill) recorded significantly higher leaf area (792.39cm^2/hill) which was on par with sowing of GPUF 3 of foxtail millet sown during second fortnight of august.

The higher leaf area observed in crops sown during the second fortnight of August may be due to favorable temperatures that promote rapid tissue multiplication and increased growth substances, including auxins. These findings are consistent with those of Bashir *et al.* (2015). Early sowing resulted in a greater number of larger leaves due to optimal weather conditions. In contrast, late sowing can lead to a mismatch between the crop's photoperiod requirements and the actual photoperiod, resulting in lower leaf area in crops sown during the second fortnight of September.

Foxtail millet demonstrated wider adaptability as a C_4 crop with low water requirements. Varieties such as DHFt-109-3 of foxtail millet, GPUP 21 of proso millet and GPUL 6 of little millet exhibited vigorous growth, resulting in higher leaf area per hill. The interaction effect of sowing in the second fortnight of August and the three small millet varieties had a synergistic impact on leaf area. Combining short-duration varieties with sowing in the second fortnight of August resulted in better crop growth and higher leaf area. Himasree *et al.* (2018) in foxtail millet, Srikanya *et al.* (2020) in foxtail millet and Sukanya *et al.* (2022) in kodo millet also observed similar findings.

Dry Matter Production (g/hill)

Dry matter production at harvest was significantly influenced by different sowing windows, crops and their varieties at harvest. The pooled data of two years are presented in Table 2.

TABLE 2

Total dry matter production (g/hill) and number of productive tillers/hills of small millets as influenced by sowing windows and varieties at harvest

Treatment*	Total Dry matter (g/hill)			No. of Productive tillers/hill		
	2021	2022	Pooled	2021	2022	Pooled
Sowing Window (W)						
W_1	22.0	22.2	22.1	3.76	3.97	3.87
W_2	20.7	20.4	20.6	3.14	3.35	3.24
W_3	18.9	19.0	19.0	2.66	2.91	2.78
S.Em ±	0.42	0.38	0.38	0.05	0.05	0.05
CD at 5%	1.20	1.10	1.10	0.13	0.14	0.14
Crops (C)						
C_1	22.3	23.0	22.7	2.55	2.70	2.62
C_2	20.7	20.2	20.5	3.17	3.41	3.29
C_3	18.6	18.4	18.5	3.84	4.12	3.98
S.Em ±	0.42	0.38	0.38	0.05	0.05	0.05
CD at 5%	1.20	1.10	1.10	0.13	0.14	0.14
Varieties (V)						
V_1	20.3	20.2	20.3	3.17	3.39	3.28

Continued....

Table 2 Continued....

Treatment*	Total Dry matter (g/hill)			No. of Productive tillers/hill		
	2021	2022	Pooled	2021	2022	Pooled
V_2	20.8	21.8	21.2	3.20	3.42	3.31
S.Em ±	0.34	0.31	0.31	0.04	0.04	0.04
CD at 5%	0.98	0.90	0.90	NS	NS	NS
Sowing Window (W) x Crops (C)						
W_1C_1	24.0	25.9	25.0	3.19	3.27	3.23
W_1C_2	21.6	20.7	21.2	3.61	3.87	3.74
W_1C_3	20.3	19.9	20.1	4.50	4.76	4.63
W_2C_1	22.3	22.5	22.4	2.36	2.65	2.51
W_2C_2	20.6	20.2	20.4	3.20	3.34	3.27
W_2C_3	19.3	18.4	18.8	3.84	4.06	3.95
W_3C_1	20.6	20.7	20.6	2.11	2.17	2.14
W_3C_2	19.9	19.7	19.8	2.69	3.02	2.86
W_3C_3	16.3	16.8	16.5	3.18	3.54	3.36
S.Em ±	0.73	0.66	0.66	0.08	0.08	0.08
CD at 5%	2.08	1.90	1.91	0.23	0.24	0.24
Sowing Window (W) x Varieties (V)						
W_1V_1	22.0	22.2	22.1	3.72	3.87	3.80
W_1V_2	22.0	22.1	22.0	3.80	4.06	3.93
W_2V_1	20.4	19.8	20.1	3.14	3.30	3.22
W_2V_2	21.1	21.0	21.0	3.13	3.40	3.26
W_3V_1	18.7	18.6	18.6	2.58	2.81	2.70
W_3V_2	19.2	19.5	19.3	2.74	3.00	2.87
S.Em ±	0.59	0.54	0.54	0.06	0.07	0.07
CD at 5%	1.70	1.55	1.56	0.19	0.20	0.19
Crops (C) x Varieties (V)						
C_1V_1	21.4	21.6	21.5	2.39	2.51	2.45
C_1V_2	23.2	24.5	23.9	2.72	2.88	2.80
C_2V_1	20.5	20.1	20.3	2.99	3.32	3.16
C_2V_2	20.9	20.3	20.6	3.34	3.50	3.42
C_3V_1	19.1	19.0	19.0	4.21	4.44	4.33
C_3V_2	18.1	17.8	17.9	3.47	3.79	3.63
S.Em ±	0.59	0.54	0.54	0.06	0.07	0.07
CD at 5%	1.70	1.55	1.56	0.19	0.20	0.19
Sowing Window (W) x Crops (C) x Varieties (V)						
$W_1C_1V_1$	23.7	25.2	24.4	2.92	2.98	2.95
$W_1C_1V_2$	24.4	26.5	25.5	3.46	3.56	3.51
$W_1C_2V_1$	21.4	20.7	21.0	3.50	3.76	3.63

Continued....

TABLE 2 Continued....

Treatment*	Total Dry matter (g/hill)			No. of Productive tillers/hill		
	2021	2022	Pooled	2021	2022	Pooled
$W_1C_2V_2$	21.9	20.7	21.3	3.71	3.98	3.85
$W_1C_3V_1$	20.9	20.8	20.8	4.75	4.87	4.81
$W_1C_3V_2$	19.6	19.1	19.4	4.25	4.65	4.45
$W_2C_1V_1$	21.4	20.4	20.9	2.31	2.54	2.42
$W_2C_1V_2$	23.2	24.7	23.9	2.42	2.76	2.59
$W_2C_2V_1$	20.5	20.1	20.3	3.02	3.31	3.17
$W_2C_2V_2$	20.8	20.4	20.6	3.38	3.36	3.37
$W_2C_3V_1$	19.2	18.9	19.1	4.07	4.34	4.21
$W_2C_3V_2$	19.4	17.9	18.6	3.61	3.78	3.70
$W_3C_1V_1$	19.1	19.1	19.1	1.94	2.00	1.97
$W_3C_1V_2$	22.1	22.3	22.2	2.28	2.33	2.31
$W_3C_2V_1$	19.7	19.5	19.6	2.46	2.89	2.67
$W_3C_2V_2$	20.1	19.8	20.0	2.93	3.15	3.04
$W_3C_3V_1$	17.3	17.2	17.2	3.82	4.12	3.97
$W_3C_3V_2$	15.3	16.3	15.8	2.54	2.95	2.75
S.Em ±	1.03	0.94	0.94	0.11	0.12	0.12
CD at 5%	2.95	2.69	2.70	0.32	0.34	0.33

*Treatments : Window : W_1: August 2nd fortnight; W_2: September 1st fortnight; W_3: September 2nd fortnight, Crop : C_1: Foxtail millet; C_2: Proso millet; C_3: Little millet, Variety: V_1: GPUF 3 /GPUP 28 / GPUL6; V_2: DHFt 109-3/ GPUP 21 / DHLM 36-3

Significantly higher dry matter production was found in the second fortnight of august sowing (22.07g/hill) followed by sowing during first fortnight of september (20.56g/hill). Among different crops, foxtail millet has recorded significantly higher dry matter content (22.67g/hill) which was followed by proso millet (20.45g/hill). Whereas, in varieties, V_2 (DHFt 109-3 of foxtail millet, GPUP-21 of proso millet and GPUL 6 of little millet) has recorded significantly higher dry matter content per hill compared to V (GPUF 3 foxtail millet, GPUP 28 of proso millet and DHLM-36-3 of little millet) at all the growth stages.

There was significant interaction between sowing window and crop at harvest in which, foxtail millet sown during second fortnight of August (24.95g/hill) has recorded significantly higher dry matter production which was on par with the sowing of proso millet during second fortnight of august (21.16g/hill).

There was significant interaction found between sowing windows and varieties among which, the combination of V_2 (DHFt 109-3 of foxtail millet, GPUP-21 of proso millet and GPUL 6 of little millet) variety sown during second fortnight of august has recorded significantly higher dry matter production (22.03 g/hill) which was on par with variety V_1 (GPUF 3 of foxtail millet, GPUP 28 of proso millet and DHLM-36-3 of little millet) sown during second fortnight of august (22.10g/hill).

A significant interaction between crops and their varieties was noticed and among different combinations, foxtail millet variety DHFt 109-3 (23.86 g/hill) has recorded significantly higher values (21.48g/hill) for dry matter production which was found on par with foxtail millet GPUF 3.

There was significant interaction between all three factors at harvest. The combination of foxtail millet variety DHFt 109-3 sown during second fortnight of august has recorded significantly higher dry matter production per hill (25.47g/hill) and found on par with sowing of foxtail millet variety GPUF 3 (24.44g/hill) on second fortnight of august.

The higher dry matter production was obtained when the crops were sown during second fortnight of August. It may be attributed to the maximum length of growing period was availed for early sowings which resulted in better vegetative growth with maximum dry matter accumulation. These results are similar with the findings of Shinde *et al.* (2003) and Patel *et al.* (2017). In latter sown windows, crops may face shorter growing season and cooler as they approach maturity. Among crops, foxtail millet has recorded higher dry matter because of higher leaf surface area which resulted in increased photosynthesis which is further contributing to higher dry matter production compared to proso millet and little millet. Varieties of DHFt 109-3 of foxtail millet, GPUP 21 of proso millet and GPUL 6 of little millet produced maximum dry matter accumulation might be due to genetic potential of these varieties. These findings are in accordance with results of Dixit *et al.* (2005) and Agarwal *et al.* (2005) in fodder sorghum. The interaction effect of foxtail millet variety sown during second fortnight of August resulted in higher dry matter production due to the ability to produce more photosynthates and partitioning of dry matter from sources to sink.

Productive Tillers Per Hill

The pooled data of two years are given in Table 2. Data indicated that the crop sown during second fortnight of august recorded significantly maximum productive tillers (3.87) followed by the crop sown at first fortnight of september (3.2). Significantly lower productive tillers were recorded in second fortnight of september sown crops(2.8). Among the small millets, significantly higher number of productive tillers was recorded in little millet (3.98) followed by proso millet (3.29) and lower number of productive tillers were observed in foxtail millet (2.6).

There was a significant interaction found between sowing windows and crops. Among different combinations, the sowing of little millet during second fortnight of august recorded significantly higher number of productive tillers (4.63) followed by sowing of little millet during first fortnight of september (3.95).

The interaction effect between sowing windows and varieties was found significant in which the second fortnight of august sowing and V_2 (DHFt 109-3 of foxtail millet, GPUP 21 of proso millet and GPUL 6 of little millet) has recorded significantly higher productive tillers (3.93) whereas significantly the lowest number of productive tillers was observed with second fortnight of September sowing and V_1 (GPUF 3 of foxtail millet, GPUP 28 of proso millet and DHLM-36-3 of little millet) (2.70).

The significant interaction between crop(foxtail millet, proso millet and little millet) and variety was observed. Among different combinations, GPUL 6 variety of little millet has recorded significantly maximum productive tillers (4.33). Significantly lower productive tillers were recorded in variety GPUF 3 of foxtail millet (2.45).

Overall interaction between sowing windows, crops and varieties found significant with respect to productive tillers. The combination of sowing of little millet genotype GPUL 6 during second fortnight of august (4.81) has recorded significantly higher number of productive tillers and significantly lower productive tillers was observed with combination sowing of GPUF 3 variety of foxtail millet during second fortnight of September (1.97) which was followed by sowing of DHFt 109-3 variety of foxtail millet during second fortnight of september (2.31).

Significantly higher numbers of productive tillers were found with the second fortnight of August sowing, irrespective of the crops or varieties tested. The next highest was found with the first fortnight of September sowing. This is likely because crops sown earlier benefited from favorable micro-climatic conditions, such as temperature, during critical growth stages. This led to better overall crop growth and more productive tillers. Similar results were observed in pearl millet (Andhale *et al.*, 2003) and castor (Patel *et al.*, 2005). Late sowing has resulted in a reduced number of tillers being produced. It could be because plants have a shorter growing season and so there is less time for tiller initiation and development. As a result, the overall tiller density may be lower, leading to decrease in the potential number of heads or grains produced per unit area. These results agree with the findings of Saikishore *et al.* (2020) in browntop millet, Srikanya *et al.* (2020) in foxtail milet, Kiranmai *et al.* (2021) in proso millet, little millet and foxtail millet and Lokesh *et al.* (2023) in foxtail millet. Varieties DHF 109-3, GPUP 21 and GPUL 6 produced the highest number of productive tillers, likely due to their genetic potential under the given climatic conditions. These results are consistent with the findings of Rana *et al.* (2013) and Satpal *et al.* (2016) in forage sorghum.

Days to 50 per cent Flowering and Days to Maturity

The data on 50 per cent flowering and days to maturity was significantly influenced by sowing windows, crops and their varieties at harvest. The data pooled over two years are presented in Table 3.

TABLE 3

Days to 50% flowering and days to maturity of small millets as influenced by sowing windows and varieties

Treatment*	Days to 50% flowering			Days to maturity		
	2021	2022	Pooled	2021	2022	Pooled
Sowing Window (W)						
W_1	53.79	54.53	54.2	86.2	86.8	86.50
W_2	49.17	49.85	49.5	81.0	81.6	81.34
W_3	42.70	43.26	43.0	76.4	76.9	76.7
S.Em ±	0.83	0.84	0.83	1.41	1.41	1.41
CD at 5%	2.37	2.43	2.40	4.05	4.04	4.05
Crops (C)						
C_1	49.1	49.7	49.4	83.1	83.8	83.5
C_2	44.5	45.1	44.8	74.7	75.2	74.9
C_3	52.1	52.8	52.4	85.8	86.4	86.1
S.Em ±	0.83	0.84	0.83	1.41	1.41	1.41
CD at 5%	2.37	2.43	2.40	4.05	4.04	4.05
Varieties (V)						
V_1	48.8	49.4	49.1	82.2	82.8	82.5
V_2	48.3	49.0	48.7	80.2	80.7	80.5
S.Em ±	0.67	0.69	0.68	1.15	1.15	1.15
CD at 5%	NS	NS	NS	NS	NS	NS
Sowing Window (W) x Crops (C)						
W_1C_1	54.1	54.8	54.4	87.8	88.6	88.2
W_1C_2	50.2	50.9	50.6	80.7	81.3	81.0
W_1C_3	57.1	57.8	57.4	90.0	90.5	90.2
W_2C_1	49.4	50.1	49.7	82.5	83.2	82.8

Continued....

Table 3 Continued....

Treatment*	Days to 50% flowering			Days to maturity		
	2021	2022	Pooled	2021	2022	Pooled
W_2C_2	45.7	46.3	46.0	74.8	75.3	75.9
W_2C_3	52.4	53.1	52.8	85.8	86.4	86.1
W_3C_1	43.7	44.3	44.0	79.1	79.7	79.4
W_3C_2	37.6	38.0	37.8	68.5	68.8	68.6
W_3C_3	46.8	47.4	47.1	81.7	82.2	82.0
S.Em ±	1.43	1.46	1.45	2.44	2.44	2.44
CD at 5%	4.11	4.20	4.16	7.02	7.00	7.01
Sowing Window (W) x Varieties (V)						
W_1V_1	53.9	54.6	54.3	86.7	87.4	87.1
W_1V_2	53.7	54.4	54.0	85.7	86.2	85.9
W_2V_1	49.3	50.0	49.6	81.6	82.2	81.9
W_2V_2	49.0	49.7	49.3	80.5	81.0	80.7
W_3V_1	43.1	43.7	43.4	78.3	78.8	78.6
W_3V_2	42.3	42.8	42.6	74.5	75.0	74.8
S.Em ±	1.17	1.19	1.18	2.00	1.99	1.99
CD at 5%	3.36	3.43	3.39	5.73	5.72	5.72
Crops (C) x Varieties (V)						
C_1V_1	49.1	49.8	49.4	84.7	85.5	85.1
C_1V_2	49.0	49.7	49.4	81.6	82.2	81.9
C_2V_1	45.1	45.7	45.4	75.4	75.9	75.7
C_2V_2	43.9	44.5	44.2	73.9	74.5	74.2
C_3V_1	52.1	52.8	52.4	85.2	85.6	85.4
C_3V_2	52.1	52.8	52.5	86.5	87.2	86.8
S.Em ±	1.17	1.19	1.18	2.00	1.99	1.99
CD at 5%	3.36	3.43	3.39	5.73	5.72	5.72
Sowing Window (W) x Crops (C) x Varieties (V)						
$W_1C_1V_1$	53.9	54.6	54.2	88.8	90.0	89.4
$W_1C_1V_2$	54.2	55.0	54.6	86.8	87.3	87.0
$W_1C_2V_1$	51.0	51.7	51.3	80.6	81.0	80.8
$W_1C_2V_2$	49.5	50.2	49.9	80.9	81.7	81.3
$W_1C_3V_1$	56.9	57.6	57.3	89.3	89.7	89.5
$W_1C_3V_2$	57.2	58.1	57.6	90.6	91.4	91.0
$W_2C_1V_1$	49.2	49.9	49.5	84.9	85.7	85.3
$W_2C_1V_2$	49.6	50.3	50.0	80.0	80.7	80.3
$W_2C_2V_1$	46.6	47.2	46.9	73.3	73.9	73.6
$W_2C_2V_2$	44.8	45.4	45.1	76.4	76.8	76.6
$W_2C_3V_1$	52.2	52.9	52.6	86.5	87.2	86.8

Continued....

TABLE 3 Continued....

Treatment*	Days to 50% flowering			Days to maturity		
	2021	2022	Pooled	2021	2022	Pooled
$W_2C_3V_2$	52.6	53.4	53.0	85.2	85.6	85.4
$W_3C_1V_1$	44.2	44.8	44.5	80.3	80.8	80.6
$W_3C_1V_2$	43.3	43.9	43.6	77.9	78.5	78.2
$W_3C_2V_1$	37.9	38.3	38.1	72.4	72.7	72.6
$W_3C_2V_2$	37.3	37.8	37.5	64.5	65.0	64.8
$W_3C_3V_1$	46.3	46.9	46.6	81.1	81.5	81.3
$W_3C_3V_2$	47.2	47.9	47.5	82.3	83.0	82.6
S.Em ±	2.02	2.07	2.05	3.46	3.45	3.45
CD at 5%	5.82	5.94	5.88	9.93	9.91	9.91

*Treatments : Window: W_1: August 2nd fortnight; W_2: September 1st fortnight; W_3: September 2nd fortnight; Crop : C_1: Foxtail millet; C_2: Proso millet; C_3: Little millet; Variety: V_1: GPUF 3 /GPUP 28 / GPUL6; V_2: DHFt 109-3/ GPUP 21 / DHLM 36-3

Data indicated that the crop sown during second fortnight of August recorded significantly more number of days to reach 50 per cent flowering and maturity (54.2 and 86.5 days) followed by the crop sown at first fortnight of september (49.5 and 81.3 days). Significantly lower number of days to 50 per cent flowering and maturity was recorded in crop sown during second fortnight of september (42.9 and 76.7 days). Among the small millets, significantly more number of days to reach 50 per cent flowering and maturity was recorded in little millet (52.4 and 86.1 days) followed by foxtail millet (49.4 and 83.5 days). Significantly lower number of days to 50 per cent flowering and days to maturity was observed in proso millet (45.1 and 74.9 days). Varieties were found to be non-significant with respect to flowering and maturity.

There was a significant interaction found between sowing windows and crops. Among different combinations, the sowing of little millet during second fortnight of August has recorded significantly more days to 50 per cent flowering and maturity (57.45 and 90.25 days) followed by sowing of foxtail millet during second fortnight of August (54.43 and 88.21 days).

The interaction between sowing windows and varieties was found significant in which second fortnight of August and V_1 (GPUF 3 of foxtail millet, GPUP 28 of proso millet and DHLM 36-3 of little millet) has recorded significantly more days to 50 per cent flowering and maturity (54.27 and 87.06 days) which was on par with second fortnight of August and V_2 (DHFt 109-3 of foxtail millet, GPUP 21 of proso millet and GPUL 6 of little millet) (54.05 and 85.94 days) and significantly lesser days to 50 per cent flowering and maturity was observed with second fortnight of september and V_2 (DHFt 109-3 of foxtail millet, GPUP 21 of proso millet and GPUL 6 of little millet) (42.57 and 74.76 days).

There was significant interaction between crop and variety. Among different combinations, little millet variety DHLM 36-3 of (52.45 and 86.81days) has recorded significantly maximum number of days to reach 50 per cent flowering and maturity which was on par with variety GPUL 6 of little millet (49.43 and 85.09 days).

The combination of sowing little millet variety DHLM 36-3 during second fortnight of August has recorded significantly higher number of days to reach 50 per cent flowering and maturity (57.6 and 90.9 days) which was on par with the combination of sowing little millet variety GPUL 6 during second fortnight of august (57.3 and 89.5 days) and significantly lower number of days to 50 per cent flowering and maturity was observed with combination sowing of proso millet variety GPUP 21 during second fortnight of September (37.5 and 64.7 days).

Late sowing can significantly affect the number of days required to reach 50 per cent flowering in crops. The timing of flowering is a crucial stage in plant growth and development, as it marks the beginning of reproductive processes and subsequent grain formation. The number of days taken to 50 per cent flowering and maturity decreased significantly with each day's delay in sowing during the experiment. This reduction is likely due to the exposure of late-sown crops to lower temperatures, which forces the crop into the reproductive phase without sufficient vegetative growth. These findings are consistent with those of Kiranmai *et al.* (2021) in proso millet, foxtail millet, little millet.

Crops sown in the second fortnight of August exhibited significantly more number of days to maturity compared to those planted later. This is likely because crops sown earlier received less solar radiation and lower temperatures during growth, resulting in a prolonged vegetative phase and extended days to maturity. These observations align with the results of Patel *et al.* (2005) and Ramanjaneyulu *et al.* (2013) both in castor. Furthermore, as the sowing window progresses, crops mature early due to cold stress, which can negatively impact grain filling and maturity, leading to reduced grain yield and quality. These results are supported by Parvin *et al.* (2013) in amaranth and Kiranmai *et al.* (2021) in proso millet, little millet and foxtail millet. Differences among varieties in days to maturity were non-significant, likely due to the genetic makeup of the crops and their varieties.

Ear Head Length (cm) and Ear Head Weight (g)

The data on ear head length and ear head weight was significantly influenced by sowing windows, crops and their variety. The data pooled over two years are presented in Table 4.

TABLE 4

Ear head length, ear head weight and test weight of small millets as influenced by sowing windows and varieties

Treatment*	Ear head length (cm)			Ear head weight (g)			Test weight (g)		
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
Sowing Window (W)									
W_1	18.82	19.51	19.17	5.68	5.85	5.76	2.87	2.88	2.87
W_2	17.36	18.02	17.69	5.09	5.25	5.17	2.83	2.85	2.84
W_3	13.44	13.95	13.69	4.79	4.94	4.86	2.77	2.79	2.78
S.Em ±	0.29	0.23	0.26	0.07	0.07	0.07	0.04	0.04	0.04
CD at 5%	0.84	0.65	0.74	0.20	0.21	0.20	NS	NS	NS
Crops (C)									
C_1	19.14	19.83	19.49	8.30	8.56	8.43	3.20	3.22	3.21
C_2	17.93	18.62	18.28	5.18	5.34	5.26	2.79	2.81	2.80
C_3	12.54	13.02	12.78	2.07	2.14	2.11	2.47	2.49	2.48
S.Em ±	0.29	0.23	0.26	0.07	0.07	0.07	0.04	0.04	0.04
CD at 5%	0.84	0.65	0.74	0.20	0.21	0.20	0.12	0.13	0.12
Varieties (V)									
V_1	15.27	15.83	15.55	5.00	5.16	5.08	2.76	2.77	2.76

Continued....

Table 4 Continued....

Treatment*	Ear head length (cm)			Ear head weight (g)			Test weight (g)		
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
V_2	17.81	18.48	18.15	5.36	5.53	5.45	2.89	2.91	2.90
S.Em ±	0.24	0.18	0.21	0.06	0.06	0.06	0.03	0.04	0.04
CD at 5%	0.68	0.53	0.61	0.16	0.17	0.17	NS	NS	NS
Sowing Window (W) x Crops (C)									
W_1C_1	23.43	24.25	23.84	8.91	9.19	9.05	3.28	3.30	3.29
W_1C_2	18.94	19.66	19.30	5.91	6.10	6.01	2.84	2.82	2.83
W_1C_3	14.09	14.63	14.36	2.20	2.27	2.23	2.49	2.51	2.50
W_2C_1	21.82	22.65	22.23	8.17	8.43	8.30	3.21	3.23	3.22
W_2C_2	17.67	18.35	18.01	5.01	5.17	5.09	2.80	2.83	2.81
W_2C_3	12.58	13.06	12.82	2.08	2.14	2.11	2.47	2.49	2.48
W_3C_1	12.15	12.61	12.38	7.82	8.06	7.94	3.12	3.13	3.12
W_3C_2	17.19	17.84	17.52	4.61	4.75	4.68	2.74	2.77	2.76
W_3C_3	10.97	11.38	11.17	1.94	2.00	1.97	2.45	2.46	2.46
S.Em ±	0.50	0.39	0.45	0.12	0.12	0.12	0.07	0.08	0.07
CD at 5%	1.45	1.13	1.29	0.35	0.36	0.35	0.21	0.22	0.21
Sowing Window (W) x Varieties (V)									
W_1V_1	18.61	19.27	18.94	5.61	5.78	5.69	2.79	2.80	2.79
W_1V_2	19.03	19.75	19.39	5.74	5.92	5.83	2.94	2.95	2.95
W_2V_1	16.92	17.57	17.25	4.80	4.95	4.88	2.76	2.78	2.77
W_2V_2	17.79	18.47	18.13	5.37	5.54	5.46	2.89	2.92	2.91
W_3V_1	10.27	10.66	10.47	4.60	4.74	4.67	2.72	2.73	2.72
W_3V_2	16.60	17.23	16.92	4.98	5.13	5.06	2.82	2.85	2.83
S.Em ±	0.41	0.32	0.37	0.10	0.10	0.10	0.06	0.06	0.06
CD at 5%	1.18	0.92	1.05	0.29	0.29	0.29	0.17	0.18	0.17
Crops (C) x Varieties (V)									
C_1V_1	15.13	15.65	15.39	8.21	8.46	8.33	3.09	3.11	3.10
C_1V_2	23.14	24.02	23.58	8.39	8.65	8.52	3.31	3.33	3.32
C_2V_1	17.73	18.41	18.07	4.70	4.84	4.77	2.68	2.69	2.69
C_2V_2	18.14	18.82	18.48	5.66	5.84	5.75	2.90	2.92	2.91
C_3V_1	12.94	13.44	13.19	2.11	2.17	2.14	2.49	2.50	2.50
C_3V_2	12.14	12.61	12.38	2.04	2.10	2.07	2.45	2.47	2.46
S.Em ±	0.41	0.32	0.37	0.10	0.10	0.10	0.06	0.06	0.06
CD at 5%	1.18	0.92	1.05	0.29	0.29	0.29	0.17	0.18	0.17
Sowing Window (W) x Crops (C) x Varieties (V)									
$W_1C_1V_1$	22.71	23.43	23.07	8.82	9.09	8.96	3.15	3.16	3.16
$W_1C_1V_2$	24.15	25.07	24.61	9.00	9.28	9.14	3.41	3.43	3.42

Continued....

TABLE 4 Continued....

Treatment*	Ear head length (cm)			Ear head weight (g)			Test weight (g)		
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
$W_1C_2V_1$	18.54	19.25	18.89	5.73	5.90	5.82	2.72	2.70	2.71
$W_1C_2V_2$	19.34	20.07	19.71	6.10	6.29	6.20	2.95	2.94	2.94
$W_1C_3V_1$	14.57	15.13	14.85	2.27	2.34	2.31	2.50	2.52	2.51
$W_1C_3V_2$	13.60	14.12	13.86	2.12	2.19	2.16	2.47	2.49	2.48
$W_2C_1V_1$	20.29	21.05	20.67	8.02	8.27	8.14	3.10	3.12	3.11
$W_2C_1V_2$	23.35	24.24	23.80	8.32	8.59	8.46	3.32	3.35	3.33
$W_2C_2V_1$	17.38	18.05	17.71	4.31	4.45	4.38	2.68	2.70	2.69
$W_2C_2V_2$	17.97	18.66	18.31	5.72	5.89	5.80	2.91	2.95	2.93
$W_2C_3V_1$	13.11	13.61	13.36	2.08	2.14	2.11	2.49	2.51	2.50
$W_2C_3V_2$	12.04	12.51	12.28	2.08	2.15	2.11	2.45	2.47	2.46
$W_3C_1V_1$	18.92	19.75	19.19	7.78	8.02	7.90	3.03	3.04	3.04
$W_3C_1V_2$	21.92	22.75	22.34	7.85	8.09	7.97	3.21	3.22	3.21
$W_3C_2V_1$	17.28	17.94	17.61	4.06	4.18	4.12	2.65	2.67	2.66
$W_3C_2V_2$	17.10	17.74	17.42	5.16	5.32	5.24	2.83	2.88	2.85
$W_3C_3V_1$	11.14	11.57	11.36	1.96	2.03	1.99	2.48	2.47	2.48
$W_3C_3V_2$	10.79	11.19	10.99	1.92	1.98	1.95	2.42	2.45	2.43
S.Em ±	0.71	0.55	0.63	0.17	0.18	0.17	0.10	0.11	0.11
CD at 5%	2.05	1.59	1.82	0.49	0.51	0.50	0.29	0.31	0.30

*Treatments : Window: W_1: August 2nd fortnight; W_2: September 1st fortnight; W_3: September 2nd fortnight; Crop : C_1: Foxtail millet; C_2: Proso millet; C_3: Little millet; Variety: V_1: GPUF 3 /GPUP 28 / GPUL6; V_2: DHFt 109-3/ GPUP 21 / DHLM 36-3

Significantly higher ear head length and ear head weight was found in crop sown during second fortnight of August (19.17cm and 5.76g) followed by sowing during first fortnight of september (17.69cm and 5.17g). significantly the least ear head length was observed in september second fortnight of September (13.69 cm and 4.86g). Among different crops, foxtail millet has recorded significantly higher ear head length (19.49) and ear head weight (8.43g) which was followed by proso millet (18.28cm and 5.26g).

There was significant interaction between sowing window and crop in which sowing of foxtail millet during second fortnight of August has recorded significantly higher ear head length (23.84cm) and ear head weight (9.05g) which was followed by sowing of foxtail millet during first fortnight of september (22.23cm and 8.30g) and significantly lower ear head length and ear head weight was recorded in little millet which was sown during second fortnight of september (11.17cm and 1.97g).

There was significant interaction found between sowing windows and varieties among which combination of V_2 (DHFt 109-3 of foxtail millet, GPUP-21 of proso millet and GPUL 6 of little millet) sown during second fortnight of August has recorded significantly higher ear head length (19.39cm) and ear head weight (5.83g) which was on par with V_1 (GPUF 3 of foxtail millet, GPUP 28 of proso millet and DHLM 36-3 of little millet) sown during second fortnight of august (18.94cm and 5.69g).

There was significant interaction between crops and their varieties, among different combinations DHFt 109-3 variety of foxtail millet has recorded significantly higher ear head length (23.58cm) and weight (8.52g).

There was significant interaction between all three factors in ear head length and ear head weight. The combination of foxtail millet variety DHFt 109-3 sown during second fortnight of august has recorded significantly higher ear head length (24.61cm) and ear head weight (9.14g) which was on par with sowing of foxtail millet variety GPUF 3 during second fortnight of august (23.07cm and 8.96g).

Significant variations in ear head length and ear head weight were found, the highest in the earliest (W_1) sowing window followed by W_2 and W_3. This is likely due to increased photosynthetic surface resulting in increased production of photosynthates and thereby increased translocation of photosynthates from source to sink. These results are in conformity with Govindan *et al.* (2002) in castor, Kamara *et al.* (2009) in corn and Terefe *et al.* (2015) in castor. Foxtail millet showed better resilience as compared to proso millet and little millet due to its wider adaptability which attributes to higher ear head length and ear head weight. Similar variations in yield attributes were noticed by Chandrappa (1993) in small millets. Variations in yield attributes in different varieties may be attributed to variations in their genetic traits.

Test Weight (g)

Test weight was not significantly influenced by sowing windows and varieties. However, it was significantly influenced by crops (Table 4). Among different crops, foxtail millet has recorded significantly higher test weight (3.21g) which was followed by proso millet (2.80g) and significantly lower test weight was recorded in little millet (2.48g).

There was significant interaction found between sowing window and crop in which sowing of foxtail millet during second fortnight of August has recorded significantly higher test weight (3.29g) which was on par with sowing of foxtail millet during first fortnight of september (3.22g).

Interaction effect between sowing window and variety was found significant. Combination of V_2 (DHFt 109-3 of foxtail millet, GPUP 21 of proso millet and GPUL 6 of little millet) variety sown during second fortnight of August has recorded significantly higher test weight (2.95g) which was on par with V_2 (DHFt 109-3 of foxtail millet, GPUP-21 of proso millet and GPUL 6 of little millet) variety sown during first fortnight of september and V_2 (DHFt 109-3 of foxtail millet, GPUP-21 of proso millet and GPUL 6 of little millet) variety sown during second fortnight of September (2.91g). Lower test weight was recorded in V_1 variety sown during second fortnight of september (2.72g).

The interaction effect between crops and their varieties was significant, among different combinations variety DHFt 109-3 of foxtail millet has recorded significantly higher test weight (3.32g) which was on par with variety GPUF 3 of foxtail millet (3.10g) and significantly lower test weight was recorded in variety DHLM 36-3 of little millet (2.46g).

Overall interaction between all three factors was found significant with respect to test weight. The combination of variety DHFt 109-3 variety of foxtail millet sown during second fortnight of August has recorded significantly higher test weight (3.42g) which was on par with sowing of variety GPUF 3 of foxtail millet during second fortnight of August (3.16g). Significantly lower test weight was observed with combination of little millet variety DHLM 36-3 of sown during second fortnight of september (2.43g) which was on par with combination of variety GPUL 6 of little millet sown during second fortnight of september.

Test weight is a measure of the weight of a specified volume of grain and is often used as an indicator of grain quality. Foxtail millet has the highest test weight because of its genetics. These results are in line with Srikanya *et al*. (2020) and Lokesh *et al.* (2023) in foxtail millet. Among interactions combination of millets along with sowing in second fortnight of September (W_3) has recorded the lowest test weight. This is likely due to late sowing does which might have prevented the full growth and development cycle resulting in incomplete grain filling and reduced test weight.

Grain Yield, Straw Yield and Harvest Index

The data on grain and straw yield was significantly influenced by sowing windows, crops and their varieties. The data pooled over two years are presented in Table 5.

Data indicated that the crop sown during second fortnight of August recorded significantly higher grain yield and straw yield (1994kg/ha and 3115kg/ha, respectively) followed by the crop sown at first fortnight of september (1740 kg/ha and 2807 kg/ha, respectively). Significantly lower grain yield and straw yield was recorded in crops sown during second fortnight of september (1562kg/ha and 2538kg/ha, respectively). Among the different small millets, significantly higher grain yield and straw yield was recorded in foxtail millet (2090 kg/ha and 3327 kg/ha, respectively) followed by proso millet (1715 kg/ha and 2699kg/ha, respectively).

There was a significant interaction found between sowing windows and crops. Among different combinations, sowing of foxtail millet during second fortnight of August (2402 kg/ha and 3729 kg/ha) has recorded significantly higher grain yield and straw yield followed by sowing of foxtail millet during first fortnight of September (2050 kg/ha and 3289 kg/ha).

TABLE 5

Grain yield, Straw yield and Harvest index of small millets as influenced by sowing windows and varieties

Treatment*	Grain yield (kg/ha)			Straw yield (kg/ha)			Harvest index		
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
Sowing Window (W)									
W_1	1943	2044	1994	3052	3177	3115	0.38	0.39	0.39
W_2	1696	1784	1740	2703	2912	2807	0.38	0.38	0.38
W_3	1524	1601	1562	2432	2644	2538	0.36	0.37	0.37
S.Em ±	50.7	53.47	52.09	73.24	70.84	66.14	0.01	0.01	0.01
CD at 5%	145.73	153.68	149.70	210.49	203.60	190.08	NS	NS	NS
Crops (C)									
C_1	2037	2144	2090	3250	3404	3327	0.38	0.39	0.38
C_2	1672	1757	1715	2621	2777	2699	0.37	0.39	0.38
C_3	1455	1528	1491	2317	2552	2434	0.37	0.37	0.37
S.Em ±	50.7	53.47	52.09	73.24	70.84	66.14	0.01	0.01	0.01
CD at 5%	145.73	153.68	149.70	210.49	203.60	190.08	NS	NS	NS
Varieties (V)									
V_1	1656	1741	1698	2598	2781	2690	0.38	0.38	0.38
V_2	1786	1878	1832	2860	3041	2950	0.37	0.38	0.38
S.Em ±	41.4	43.66	42.53	59.8	57.84	54.00	0.01	0.01	0.01
CD at 5%	118.99	125.48	122.23	171.87	166.24	155.20	NS	NS	NS
Sowing Window (W) x Crops (C)									
W_1C_1	2340	2464	2402	3666	3793	3729	0.39	0.39	0.39
W_1C_2	1845	1941	1893	2769	2849	2809	0.39	0.41	0.40
W_1C_3	1644	1728	1686	2720	2891	2806	0.36	0.37	0.37

Continued....

Table 5 Continued....

Treatment*	Grain yield (kg/ha)			Straw yield (kg/ha)			Harvest index		
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
W_2C_1	1997	2103	2050	3201	3377	3289	0.38	0.38	0.38
W_2C_2	1669	1754	1711	2717	2877	2797	0.37	0.38	0.38
W_2C_3	1424	1494	1459	2191	2481	2336	0.38	0.38	0.38
W_3C_1	1772	1864	1818	2882	3041	2962	0.37	0.38	0.38
W_3C_2	1501	1577	1539	2376	2606	2491	0.36	0.37	0.36
W_3C_3	1298	1361	1330	2039	2285	2162	0.36	0.37	0.37
S.Em ±	87.82	92.61	90.22	126.86	122.70	114.55	0.02	0.02	0.02
CD at 5%	252.41	266.18	259.28	364.58	352.65	329.22	NS	NS	NS
Sowing Window (W) x Varieties (V)									
W_1V_1	1920	2021	1971	2955	3062	3009	0.39	0.40	0.39
W_1V_2	1966	2068	2017	3148	3293	3220	0.37	0.38	0.38
W_2V_1	1610	1692	1651	2587	2777	2682	0.38	0.38	0.38
W_2V_2	1783	1875	1829	2819	3047	2933	0.38	0.38	0.38
W_3V_1	1437	1509	1473	2253	2505	2379	0.36	0.37	0.37
W_3V_2	1611	1692	1651	2612	2783	2697	0.36	0.38	0.37
S.Em ±	71.71	75.62	73.66	103.58	100.19	93.53	0.01	0.01	0.01
CD at 5%	206.09	217.33	211.71	297.68	287.93	268.81	NS	NS	NS
Crops (C) x Varieties (V)									
C_1V_1	1862	1959	1911	2951	3147	3049	0.38	0.38	0.38
C_1V_2	2211	2328	2269	3549	3661	3605	0.38	0.39	0.38
C_2V_1	1603	1685	1644	2460	2593	2526	0.37	0.39	0.38
C_2V_2	1741	1830	1785	2782	2961	2872	0.37	0.38	0.38
C_3V_1	1503	1578	1540	2385	2604	2494	0.37	0.38	0.37
C_3V_2	1408	1477	1442	2248	2501	2374	0.37	0.37	0.37
S.Em ±	71.71	75.62	73.66	103.58	100.18	93.53	0.01	0.01	0.01
CD at 5%	206.09	217.33	211.71	297.68	287.93	268.81	NS	NS	NS
Sowing Window (W) x Crops (C) x Varieties (V)									
$W_1C_1V_1$	2256	2376	2316	3574	3703	3639	0.39	0.39	0.39
$W_1C_1V_2$	2424	2552	2488	3757	3882	3820	0.39	0.39	0.39
$W_1C_2V_1$	1753	1843	1798	2430	2488	2459	0.41	0.43	0.42
$W_1C_2V_2$	1938	2039	1988	3108	3210	3159	0.37	0.39	0.38
$W_1C_3V_1$	1753	1843	1798	2861	2996	2928	0.37	0.38	0.37
$W_1C_3V_2$	1535	1612	1573	2580	2786	2683	0.36	0.37	0.36
$W_2C_1V_1$	1798	1891	1844	2883	3076	2980	0.38	0.38	0.38
$W_2C_1V_2$	2197	2314	2256	3519	3679	3599	0.39	0.39	0.39
$W_2C_2V_1$	1597	1678	1638	2668	2756	2712	0.36	0.38	0.37

Continued....

Table 5 Continued....

Treatment*	Grain yield (kg/ha)			Straw yield (kg/ha)			Harvest index		
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
$W_2C_2V_2$	1740	1830	1785	2766	2999	2882	0.38	0.38	0.38
$W_2C_3V_1$	1436	1507	1471	2210	2498	2354	0.38	0.38	0.38
$W_2C_3V_2$	1412	1481	1446	2171	2464	2318	0.39	0.38	0.38
$W_3C_1V_1$	1533	1611	1572	2394	2661	2527	0.38	0.38	0.38
$W_3C_1V_2$	2011	2117	2064	3370	3422	3396	0.36	0.38	0.37
$W_3C_2V_1$	1458	1534	1496	2281	2535	2408	0.35	0.36	0.36
$W_3C_2V_2$	1544	1621	1582	2471	2676	2574	0.36	0.38	0.37
$W_3C_3V_1$	1320	1384	1352	2084	2318	2201	0.36	0.37	0.37
$W_3C_3V_2$	1277	1339	1308	1993	2251	2122	0.36	0.37	0.37
S.Em ±	124.2	130.98	127.59	179.4	173.53	162.00	0.02	0.02	0.02
CD at 5%	356.96	376.43	366.68	515.6	498.72	465.59	NS	NS	NS

*Treatments:Window: W_1: August 2nd fortnight; W_2: September 1st fortnight; W_3: September 2nd fortnight Crop: C_1: Foxtail millet; C_2: Proso millet; C_3: Little milletVariety: V_1: GPUF 3 /GPUP 28 / GPUL6; V_2: DHFt 109-3/ GPUP 21 / DHLM 36-3

The interaction between sowing windows and varieties was found significant in which, the second fortnight of August and V_2 (DHFt 109-3 of foxtail millet, GPUP-21 of proso millet and GPUL 6 of little millet) has recorded significantly higher grain yield and straw yield (2017 and 3220kg/ha, respectively) and was on par with second fortnight of august and V_1 (GPUF 3 of foxtail millet, GPUP 28 of proso millet and DHLM 36-3 of little millet) (1971 kg/ha and 3009 kg/ha, respectively).

There was significant interaction between crop and variety. Among different combinations, variety DHFt-109-3 of foxtail millet has recorded significantly higher grain yield and straw yield (2269 kg/ha and 3605 kg/ha respectively).

Overall interaction between sowing windows, crops and varieties was found significant with respect to grain and straw yield. The combination of sowing genotype DHFt 109-3 of foxtail millet during second fortnight of August has recorded significantly higher grain yield and straw yield (2488kg/ha and 3820kg/ha, respectively) and was found on par with variety GPUF 3 of foxtail millet sown during second fortnight of August (2316kg/ha and 3639kg/ha, respectively) and significantly lower grain yield and straw yield was observed with combination sowing little millet variety DHLM 36-3 during second fortnight of September (1308kg/ha and 2122kg/ha, respectively). However, harvest index was found to be non-significant with respect to sowing windows, crops and varieties.

Grain and straw yields were highest when the crop was sown in the second fortnight of August (W_1). This is attributed to the favorable microclimate, with higher absorption of photosynthetically active radiation (PAR) and improved light use efficiency (LUE), leading to increased photosynthetic rates and yield attributes. Delayed sowing resulted in lower yields due to unfavorable conditions. These findings are supported by Siddig *et al.* (2013) in Pearl millet, Kiranmai *et al.* (2021) in foxtail millet, little millet and proso millet and Sukanya *et al*., (2022) in proso millet and kodo millet who noted similar yield declines in small millets with delayed sowing. Crops sown in the second fortnight of september likely faced colder conditions and shorter growing seasons, negatively impacting yield. The limited time for crops to complete their life cycle before adverse weather further reduced yields, as noted by Maurya *et al.* (2016) in pearl millet, Nandini and Shridhara (2019) in foxtail millet, Saikishore *et al.* (2020) in brown top, Dimple *et al.* (2022) in proso millet and Lokesh *et al.* (2023) in foxtail millet. The lowest yields from the third sowing window (W_3) were possibly due to biotic and abiotic stresses such as moisture stress and higher temperatures.

Among the crops, foxtail millet recorded the highest grain and straw yields, followed by proso millet and little millet. These differences can be attributed to factors like leaf area index (LAI), panicle weight and test weight, which depend on the genetic potential and adaptability of varieties to current climatic conditions, as noted by Vikramarjun (2019). The interaction between sowing windows, millet crops and varieties was significant for yield.

The outcomes of present study showed that the growth and yield were influenced by sowing windows, crops and their varieties. The combination of varieties of all the three small millets *i.e.,* variety DHFt 109-3 of foxtail millet, variety GPUP 21 of proso millet and variety GPUL-6 of little millet sown during second fortnight of August has recorded higher growth, grain yield (2488 kg/ha, 1988kg/ha and 1798kg/ha, respectively) and yield attributing components like ear head length (24.61, 19.71 and 14.85cm, respectively) and ear head weight (9.14, 6.20 and 2.31g respectively).

References

Agarwal, S. B., Shukla, V. K., Sisodia, H. P. S., Tomar, R. and Shrivastava, A., 2005, Effect of inoculation and nitrogen levels on growth, yield and quality of fodder sorghum (*Sorghum bicolor* (L.) Moench) varieties. *Forage Res.,* **31** (2) : 106 - 108.

Andhale, R. P. Shinde, S. H. and Pawar, V. S., 2003, Effect of sowing dates on growth and yield of pearl millet during summer season. *J. Agrometerol*., **5** (2) : 102 - 105.

Bashir, M. M. H., Yagoub, S. O. and Mohammed, A. S. A., 2015, Effect of different sowing dates on growth and yield of three pearl millet (*Pennisetum glaucum* (L.) R. Br) cultivars in West Darfur Sudan. *Int. J. Plant Soil Sci.,* **5** (4) : 191 - 200.

Chandrappa, M., 1993, Studies on the comparative performance of small millets in different dates of sowing in different dates of sowing under rainfed condition. *M.Sc. (Ag.) Thesis,* University of Agricultural Sciences, Bengaluru.

Dimple, K. T., Nagamani, C., Chandrika, V., Kumar, A. R. N. and Sagar, G. K., 2022, Effect of times of sowing and nitrogen levels on yield and yield attributes of proso millet (*Panicum miliaceum* L.). *Agric. Sci. Dig.,* **10** (3) : 18805 - 5622.

Dixit, A. K., Singh, O. P., Kachroo, D. and Bali, A. S., 2005, Response of promising rainy season sorghum genotype to nitrogen and phosphorus fertilization. *Indian. J. Agron.,* **50** : 206 - 209.

Gavit, H. D., Rajemahadik, V. A., Bahure, G. K., Jadhav, M. S., Thorat, T. N. and Kasture, M. C., 2017, Effect of establishment techniques and sowing time on yield and yield attributes of proso millet (*Panicum miliaceum* L.). *Int. J. Curr. Microbiol. Appl. Sci.*, **6** (5) : 1523 - 1528.

Girase, P. P., Suryawanshi, R. T. and Patil, H. T., 2016, Productivity of hybrid summer pearl millet (*Pennisetum glaucum*) as influenced by sowing dates and fertilizer levels. *Bioinfolet*. **13** (3) : 464 - 465.

Govindan, R., Sannappa, B., Bharathi, V. P., Shankar, M. A., Singh, M. P. and Hegde D. M., 2002, Growth and yield parameters of some castor genotypes as influenced by date of sowing under rainfed condition. *Int. J. Agric. Res*., **20** (4) : 970 - 975.

Himasree, B., Chandrika, V., Sarala N. V. and Prasanthi, A., 2018, Evaluation of foxtail millet (*Setaria italica* L.) based intercropping systems under late sown conditions Andhra Pradesh. *J. Agric. Sci.,* **4** (1) : 67 - 70.

Honnaiah, P. A., Sridhara, S., Gopakkali, P., Ramesh, N., Mahmoud, E. A., Abdelmohsen, S. A. M., Alkallas, F. H., El-Ansary, D. O. and Elansary, H. O., 2021, Influence of sowing windows and genotypes on growth, radiation interception, conversion efficiency and yield of guar. *Saudi J. Biol. Sci.*, **28** : 3453 - 3460.

Jadipujari, J., Anand S. R., Nagangoudar, M. B., Rao, G. E. and Kalyana Murthy, K. N., 2023, Performance of Quinoa (*Chenopodium quinoa*) under varied sowing windows and planting patterns. *Environ. Conserv. J.,* **24** (2) : 208 - 217.

Kamara, A. Y., Ekeleme, F, Chikoye, D. and Lucky, O., 2009, Planting date and cultivar effects on grain yield in dryland corn production. *Agron. J.,* **101**(7) : 91 - 98.

Kiranmai, J., Saralamma, M. S. and Mohan, C. V., 2021, Assessing the influence of sowing windows on growth and yield of small millets. *Int. J. Curr. Microbiol. Appl. Sci.,* **10** (02) : 939 - 944.

Kumar, G. V. S., Jayaramaiah, R., Koler, P. and Bhairappanavar, S. T., 2021, Growth, yield and quality parameters of fodder oats (*Avena sativa* L.) under varied dates of sowing and nitrogen application. *Mysore J. Agric. Sci.*, **55** : 37 - 45.

Lokesh, T., Choudhary A. A. and Mairand N. R., 2023, Effect of different sowing windows and line spacings on yield and economics of foxtail millet during *rabi* season. *J. Pharm. Innov.,* **12** (2) : 1121 - 1123.

Maurya, S. K., Nath, S., Patra, S. S. and Rout, S., 2016, Effect of different sowing dates on growth and yield of pearl millet (*Pennisetum glaucum* L.) varieties under Allahabad condition. *Int. J. Sci. Nature.,* **7** (1) : 62 - 69.

Nandini, K. M. and Sridhara, S., 2019, Heat use efficiency, helio thermal use efficiency and photo thermal use efficiency of foxtail millet (*Setaria italica* L.) genotypes as influenced by sowing dates under Southern Transition Zone of Karnataka. *J. Pharmacogn. Phytochem.,* **26** (3) : 284 - 290.

Nithyashree, K. and Vijayalaxmi, K. G., 2022, Effect of popping on nutrients and anti-nutrients in proso millet. *Mysore J. Agric. Sci.*, **56** (4) : 313 - 319.

Pandiselvi, A., Narayanan, L. and Karthikeyan, R., 2010, Evaluation of optimum time of sowing of finger millet (*Eleusine coracana* G.) varieties in Karaikal region. *Int. J. Agric. Sci.,* **6** (1) : 94 - 96.

Pannase, S., Bagade, S. V., Sonawane, D. A. and Sondawale, P. A., 2024, Effect of foxtail millet cultivars on yield and yield attributes under different sowing windows. *J. Sci. Res. Rep.*, **30** : 277 - 288.

Parvin, N., Islam, M. R., Nessa, B., Zahan, A. and Akhand, M., 2013, Effect of sowing time and plant density on growth and yield of Amaranth. *Eco-Friendly Agric. J.,* **6** (10) : 215 - 219.

Patel, K. S., Patel, G. N., Patel, M. K., Pathak, H. C. and Patel, B. S., 2005, Seed yield of castor, *Ricinus communis* hybrids as influenced by different dates of sowing. *J. Oilseeds Res.,* **22** (1) : 204 - 205.

Patel, S. B., Patel, A. G., Chavda, J. N. and Patel, M. A., 2017, Effect of time of sowing and nitrogen levels on yield attributes, yield and quality parameters of *rabi* forage maize (*Zea mays* L.). *Int. J. Chem. Stud.*, **5** (3) : 868 - 871.

Ramanjaneyulu, A. V., Madhavi, A., Reddy, V. and Neelima, T. L., 2013, Influence of date of sowing and irrigation scheduling on *rabi* castor (*Ricinus communis*) in Peninsular India. *Indian J. Agron.,* **58** (1) : 100 - 104.

Rana, D. S., Singh, B., Gupta, K. and Dhaka, A. K., 2013, Performance of single cut forage sorghum genotypes to different fertility levels. *Grass Forage Sci.,* **39** (2) : 96 - 98.

Rurinda, J, A, B., Mapfumo, B. C., Van Wijka, D. F., Mtambanesngwe, B. M. C., Rufino, D. E. R., Chikowo, B. K. E. and Giller, A., 2014, Comparative assessment of maize, finger millet and sorghum for household food security in the face of increasing climatic risk. *European J. Agron.,* **9** (55) : 29 - 41.

Saikishore, A., Rekha, K. B., Hussain, S. A. and Madhavi, A., 2020, Growth and yield of browntop millet as influenced by dates of sowing and nitrogen levels. *Int. J. Chem. Stud.,* **8** (5) : 1812 - 1815.

Salmankhan, R. M., Lalitha, B. S., Kalyana Murthy, K.N., Jayadeva, H. M., Satisha and Mohan Kumar, T. L., 2021, Effect of different dates of sowing, spacing and nutrient levels on growth and yield of buckwheat (*Fagopyrum esculentum* L.). *Mysore J. Agric. Sci.*, **55** (4) : 310 - 319.

Satpal, T., Duhan, B. S., Arya, S., Kumari, P. and Devi, S., 2016, Performance of single cut forage sorghum genotypes to different fertility levels. *Grass Forage Sci.,* **42** (3) : 184 - 188.

Shinde, G. G., Aglave, B. N. and Deshmukh, A. S., 2003, Ideal sowing dates and genotypes for summer irrigated sorghum in Maharashtra, India. *Int. Sorghum & Millets Newsletter*, **44** : 83 - 86.

Siddig, A, Mohamed Ali, Kamal, I, Adam, Ali, Bahar, H. and Thabit, A. H., 2013, Effect of sowing date and variety on growth and yield of pearl millet (*Pennisetum glaucum*) grown on two soil types under rainfed condition at Zalingei area in Sudan. *J. Sci. Tech.,* **3** (4) : 340 - 344.

Soler, C. M. T., Maman, N., Zhang, X., Mason, S. C. and Hoogenboom, G., 2008, Determining optimum planting dates for pearl millet for two contrasting environments using a modelling approach. *J. Agric. Sci.,* **146** : 445 - 459.

Srikanya, B., Revathi, P., Reddy, M. M. and Chandrashaker, K., 2020, Effect of sowing dates on growth and yield of foxtail millet (*Setaria italica* L.) varieties. *Intl. J. Curr. Microbiol. App. Sci.,* **9** : 3243 - 3251.

Sukanya, T. S., Prabhakar, Krishne Gowda, K. T., Swarna, R., Hariprasanna, K. and Tonapi, V. A., 2022, Good agronomic practices for higher yield in small millets, ICAR- All India Coordinated Research Project on Small Millets, ICAR-Indian Institute of Millets Research, Hyderabad. ISBN: 978 - 93 - 94673 - 11 - 3.

Sukanya, T. S., Kumar, A., Sathya, K., Chaithra, C., Narayanan, A. L., Anand, M. R., Kishore, K., Shyam, M. and Nag, N. K., 2023, Nutri cereals role in indian agriculture, Food and Nutritional Security: A Review. *Mysore J. Agric. Sci.,* **57** (2) : 1 - 10.

Sukanya, T. S. and Narayanan, A. L., 2023, Climate resilient agriculture and small millets-an agronomic perspective In: Sensitizing the millet farming, consumption and nutritional security - challenges and opportunities, *Dept. Agrl. Econ. Agrl. Extn*., Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, Puducherry, India, pp. : 89 - 100.

Terefe, M., Ibrahim, A., Tilahun, A. and Shifa, K., 2015, The effect of different agronomic practices for optimum production of yield and yield components of castor (*Ricinus communis*). *Int. J. Agric. Res.,* **3** (9) : 17 - 22.

Vikramarjun, M., Seenappa, C., Thimmegowda, M. N. and Kalyana Murthy, K. N., 2019, Yield performance of different contingent crops under delayed sowings in changed climate in rainfed agriculture. *Indian J. Dryland Agric. Res. Dev.,* **34** (2) : 33 - 37.

Yadagouda, V. R. and Ravindra, U., 2022, Formulation and evaluation of foxtail millet composite mix for probiotication. *Mysore J. Agric. Sci.,* **56** (1) : 417 - 425.