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Genotypic variation of phenological and physiological traits in sweet sorghum (*Sorghum bicolor* L. Moench)

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Abstract
A field experiment was conducted at ICR farm of Assam Agricultural University, Jorhat during *rabi* season of 2019-2020 with 12 (twelve) diverse genotypes of sweet sorghum with the aim to study their performance in terms of phenological, physiological traits and yield. The experiment was laid out in randomized block design with three replications and the crop was raised following the recommended package of practices. The phenological, physiological parameters, yield attributes and yield were recorded following the standard methodologies.
A significant variation of all the above traits were recorded among different genotypes of sweet sorghum. Among the genotypes, ICSV 15006 required minimum duration with respect to all the phenological parameters, *viz.*, days to seedling emergence, tiller initiation, maximum tillering, 50% flowering and physiological maturity, while, ICSV 13012 required maximum duration with respect to above traits. The genotype ICSV 15006 possessed the highest leaf dry weight, stalk dry weight, panicle dry weight and total dry weight at harvest, while, the genotypeICSV13012 possessed the lowest values. Significantly higher number of stomata, epidermal cells and stomatal index in both abaxial and adaxial leaf surfaces were recorded in the genotype ICSV 15006, while, the lowest values were found in ICSV 13012.
The highest grain yield (1.06 t ha^{-1}) was obtained from the genotype ICSV 15006 followed by ICSV 25274(1.03 t ha^{-1}). Among the genotypes, ICSV-15006 and ICSV-25274 were identified as the superior genotypes based on the physiological traits and yield.

Keywords: Bio-fuel, dry weight, genotypes, physiological, phenological, sweet sorghum, yield

1. Introduction
Sweet sorghum is a C_4 crop with more growth, vigour, physiological efficiency, drought tolerance ability along with higher yield and can grow well in diverse climate and soil. The crop can be used as food and feed and in recent days receives more importance as a bio-fuel crop. The improved genotypes of sweet sorghum possess higher rate of photosynthesis, more biomass and yield. (Shinde *et al*, 2013) [11]. India ranks fifth in sweet sorghum production in the world, covering a total area of 4.39 m ha with a total production of 4.78 m tonnes with average yield of 1.08 tonnes per hectare (Anon., 2021) [2].
The area of cultivation of sweet sorghum in Assam is very negligible. There is no systematic study on varietal evaluation of sweet sorghum in Assam on the basis of physiological performance. In this context, the present research work is undertaken to study the physiological characters and yield of some genotypes of sweet sorghum during *rabi* season under Assam situation with the aim to evaluate sweet sorghum genotypes.

2. Materials and Methods
2.1 Experimental site, climate and soil
A field experiment was carried out in ICR Farm of Assam Agricultural University, Jorhat under Upper Brahmaputra Valley Agro Climatic Zone of Assam in *rabi* season in the year 2019-2020. The experimental farm was situated at 26º47 ′ N latitude and 94º12′ E longitude at an elevation of 86.6 meters above mean sea level and characterized by a sub-tropical environment with hot-humid summer and relatively dry and cold winter.
The soil of the experimental plot is sandy loam with acidic P^H and contains medium levels of nitrogen, phosphorus and potash. The experiment was laid out in Randomised Block Design (RBD) with three replications and comprising of 12 genotypes (treatments), *viz*., Madhura^{-1}, Madhura^{-2}, Madhura^{-3}, ICSV 12015, ICSV 13012, ICSV 15006, ICSV 25274, ICSV 25302,

ICSV 25306, ICSV 25307, ICSV 25308 and ICSV 93046. The crop was raised following recommended package of practices and a fertilizer dose of 80:60:40 N:P2O5:K2O was applied and the spacing was 45 cm between rows and 15 cm between plants with a sowing depth of 5 to 7 cm.

2.2 Pheno-physiological parameters

Five (5) plants were selected randomly in each plot avoiding the boarder rows, tagged properly and were used to record all the morpho-physiological parameters, yield attributes and yield. The number of days required from seed sowing to emergence of seedlings in the field, initiation of tillers, attainment of 50% flowering and physiological maturity were recorded as per the standard methodology. The crop was harvested at physiological maturity.

Five (5) randomly selected plants were uprooted at physiological maturity from each plot and separated into roots, shoots, leaves and panicles, kept in perforated brown paper bag and dried in an oven at 78°C temperature up to constant dryness and recorded the dry weight of each part with the help of an electronic balance and expressed as g per plant.

For recording stomatal frequency, green, actively growing fresh healthy leaves were selected from each plot, brought to the laboratory and on the both sides of the leaves, nail polish was smeared by gentle pressing and put a cello tape on it. After certain time, it was taken out with the leaf epidermis, placed under low power objective in a microscope and counted the number of stomata and epidermal cells and stomatal index was calculated by using the formula of Meidner and Mansfield (1968) [8]:

$$SI = (SD / [ED+SD] \times 100)$$

Where, SI= Stomatal index
SD=Number of stomata per unit leaf area
ED=Number of epidermal cell per unit leaf area

At physiological maturity, 5 tagged plants were cut from each plot and number of panicles per plant, length of the panicle, grains per panicle, 1000- grain weight, stover yield and weight of seeds per plant was taken after proper drying. Harvest Index (HI) was calculated as per the following formula and expressed as percentage.

HI=Economic yield/Biological yield x 100

Statistical analysis was carried out as per the method of Panse and Sukhatme (1967) [10].

3. Results and Discussion

3.1 Phenological parameters

The data presented in Table 1 indicated a significant difference with respect to days to seedling emergence, tiller initiation, maximum tillering, 50% flowering and physiological maturity. Seedling emergence among the different sweet sorghum genotypes was recorded from 3.26 to 6.73 days with a mean of 4.83 days. The lowest number of days for emergence of seedlings was observed in the genotype ICV 15006 (3.26 days) followed by ICSV 25274 (3.57 days) while, the genotype ICSV 13012 required the longest days of 6.73 for emergence.

The days for initiation of tillers varied from 44.13 to 55.36 days with a mean of 49.28 days. Early tillering was observed in the genotype ICSV 15006 compared to other genotypes with mean value of 43.80 days followed by ICSV 25274 (44.13 days) in which tillering was initiated in 44.13days. In the genotype ICSV13012, tillering took the longest duration (55.36days). Days required for maximum tillering ranged from 58.50 to 83.39 days with a mean of 70.36 days. The genotype ICSV15006 recorded the lowest number of days required for maximum tillering which was 58.50 days followed by ICSV25274 (60.84days) while, ICSV 13012 took maximum days for maximum tillering (91.39days).

The days required for 50% flowering ranged from122.20 to137.23 days with a mean of 129.64 days. The genotype ICSV 15006 took the lowest days (122.20days) to attain 50% flowering followed by ICSV 25274 (124.62 days) while, the genotype ICSV 13012 required significantly higher number of days with 137.23 days for 50%flowering. The days required by the genotypes to reach physiological maturity ranged from143.65 to157.57days with a mean of 150.84 days. Among the genotypes, ICSV 15006 took the lowest (143.65 days) number of days to reach physiological maturity while, the genotype ICSV 13012 took the highest number (157.57 days) of days to reach physiological maturity.

Reported that seedling emergence in sweet sorghum genotypes took place within 8-15 days and found that 80% of seeds of sweet sorghum germinated within 10 to 12 days. Studied the tillering habit in sweet sorghum and observed that the maximum tillering in sweet sorghum genotypes ST-63 and SX-17 took place between 70 to 80 days. Similar results regarding the number of days to 50% flowering was also observed by many researchers (Wadikar *et al.* (2018) [12], Gopichand (2018) [7].

Gopichand (2018) [7] also found a significant variation with respect to days to physiological maturity in different sweet sorghum genotypes. Shinde *et al.* (2013) [11] reported that the total number of days required for physiological maturity in *rabi* sweet sorghum (SSV 84, SSV 74 and CSV 19 SS along with one hybrid, CSH 22 SS) was 115.7days. Gopichand (2018) [7] studied with checked variety (*Surtilatur*) and four proposed varietiesPVRSG-101, PVRSG-102, PVRSG-8-4 and *Phulemadhur* of sweet sorghum and found that the number of days for these varieties required to physiological maturity was 124, 120, 123, 117 and 127 days, respectively.

In the present study, the genotypes ICSV 15006 and ICSV 25274 required minimum days for seedling emergence, tiller initiation, maximum tillering, 50% flowering and physiological maturity clearly indicating their production efficiency per day basis.

3.2 Accumulation and partitioning of photosynthates

Among the 12 sweet sorghum genotypes, significant variation was observed in the dry weight of the leaf, stalk, panicle and the total dry weight at harvest which is presented in table 2.

The average dry weight of leaves ranged from 1.32 to 5.01 with a mean of 3.49 g plant^{-1}. The genotype ICSV15006 showed the highest leaf dry weight(5.01 g plant^{-1}) followed by ICSV 25274 (4.92 g plant^{-1}), while, the lowest leaf dry weight of 1.32 g plant^{-1} was observed in ICSV 13012. The average stalk dry weight ranged from14.44 to17.04 g plant^{-1} with a mean of 15.93g plant^{-1}. The genotype ICSV 15006 recorded the highest stalk dry weight (17.04 g plant^{-1}) followed by ICSV 25274 (16.43 g plant^{-1}) while, the Lowes tstalk dry weight was observed in ICSV 13012(14.44gplant^{-1}).

The dry weight of panicle ranged from 4.05 to 7.04 g plant^{-1} with a mean of 5.68g plant^{-1}. The genotype ICSV 15006 showed the highest panicle dry weight (7.04 g plant^{-1}) followed by ICSV 25274 (6.73 g plant^{-1}), while, the lowest panicle dry weight was observed in ICSV13012 (4.05g plant^{-1}). The total dry weight ranged from 19.81 to 29.09 g plant^{-1} among the genotypes with a mean of 25.28g plant^{-1}. The highest total dry weight (29.09g plant^{-1}) was observed in the genotype ICSV 15006 followed by ICSV 25274 (28.08 g plant^{-1}), while, the lowest total dry weight was observed in ICSV13012 (19.81g plant^{-1}).

The results were similar with Pancholee *et al.* (2013) [9], Ghosh *et al*. (2015) [6] and Ekefre *et al.* (2017) [4] who reported significantly higher total dry weight, stem weight and panicle weight in sweet sorghum. Channappagoudar *et al.* (2009) [3] also reported a wide variation of total dry weight in different genotypes of sweet sorghum. Pancholee *et al.* (2013) [9] observed that at the boot leaf stage, the genotype SSV 74 registered significantly higher stem weight (857.5 g plant^{-1}), which was followed by CSH 22SS (805 g plant^{-1}) and Urya (540 g plant^{-1}). The genotypes Keller and SPV 1616 recorded lesser total stem weight with 190 g plant^{-1} and 250 g plant^{-1} respectively. SSV 74 and CSH 22SS maintained superiority in terms of total stem weight over the other genotypes at all stages of the crop growth. Lesser total stem weight at milky stage as compared to other genotypes was registered by SPV1616 (265g plant^{-1}), CSV15 (313g plant^{-1}) and Wray (340g plant^{-1}).

3.3 Stomatal frequency and stomatal index

The number of stomata, epidermal cells and stomatal index of leaves of both abaxial and adaxial surfaces of sweet sorghum at 50% flowering stage exhibited significant variation on both in the abaxial and adaxial leaf surfaces as presented in Table 3.

The number of stomata on the lower surface of the leaves i.e., the abaxial surface ranged from 89.46 to 109.38 mm^{-2} among the genotypes with a mean of 99.06 mm^2. The genotype ICSV 15006 recorded the highest number of stomata (109.38 mm^{-2} of leaf area) followed by ICSV 25274 (108.48 mm^{-2} of leaf area) while, the genotype ICSV 13013 recorded the lowest with (89.46 mm^{-2} of leaf area). Similarly, the number of epidermal cells were found to be highest in ICSV 15006 (282.57 mm^{-2} of leaf area) while, ICSV 13012 showed the lowest with 262.86 number of epidermal cells mm^{-2} of leaf area. The stomatal index ranged from 34.03% to 39.11%. The highest stomatal index was observed in the genotype ICSV 25274 (39.11%) followed by ICSV 15006 (38.71%), while, the lowest (34.03%) was observed in ICSV 13012.

On the other hand, the number of stomata on the upper leaf surface i.e. the adaxial surface ranged from 47.53 to 55.07 mm^{-2} of leaf area with a mean of 50.34mm^{-2}. The genotype ICSV 15006 recorded the highest number of stomata (55.07 mm^{-2} of leaf area) followed by ICSV 25274 (54.56 mm^{-2} of leaf area) while, the genotype ICSV 13012 recorded the lowest with (47.53 mm^{-2} of leaf area). The number of epidermal cells were found to be highest (247.67 mm^{-2} of leaf area) in ICSV 15006 while, ICSV 13012 showed the lowest with 224.64 number of epidermal cells mm^{-2} of leaf area. The stomatal index ranged from 19.29% to 22.24%. The highest stomatal index was observed in the genotype ICSV 15006 (22.24%) while, the lowest (19.29%) was observed in ICSV 12015.

The results related to stomatal number, number of epidermal cells and stomatal index finds co linearity with the results of Andhale (2014) [1] and Shinde *et al.* (2013) [11]. Andhale (2014) [1] reported that the stomatal frequency of sorghum genotype M 35-1 recorded highest mean stomatal frequency of 160.0 stomata/mm^2 and the genotype *Phuleanuradha* recorded the lowest stomatal frequency of 150 stomata/mm^2. Shinde *et al.* (2013) [11] opined that the mean adaxial and abaxial stomatal frequency of sweet sorghum were 145.7 mm^2 and 161.5 mm^2 respectively. They reported higher stomatal frequency on the abaxial leaf surface than the adaxial surface which is in conformity with the results of present investigation.

3.4 Yield attributes and yield

Significant genotypic variations of yield attributes and yield among sweet sorghum genotypes were observed from the data presented in table 4 (a)and 4 (b). Yield attributes *viz*., number of grains per panicle, panicle length, panicle weight, 1000 grain weight (test weight), filled grain percentage, grain yield, stover yield and harvest index differed significantly among the genotypes. All the above were found significantly higher in the genotype ICSV 15006, while, the lowest values of all were recorded in ICSV 13012.

Plant population ranged from 16.67 plants m^{-2} to 18.33 plants m^{-2}with a mean of 17.16 plants m^{-2}. The highest plant population (18.33 plants m^{-2}) was observed in the genotype ICSV 15006 followed by ICSV 25274(17.33 plants m^{-2}) while, the lowest (16.67 plants m^{-2}) was observed in ICSV 13012. Sweet sorghum bears a single panicle. The number of grains per panicle ranged from 169.00 to 249.00 with a mean of 224.33 number of grains. The highest number of grains per panicle (249.00) was observed the genotype ICSV15006 followed by ICSV 25274 (245.33 grains) while, the lowest was observed in ICSV 13012. Panicle length ranged from 13.68 cm to 25.83 cm with a mean of 20.43cm. The highest panicle length was observed in the genotype ICSV 15006 (25.83 cm) followed by ICSV 25274 (25.28 cm).Weight of panicle ranged from 4.05 g to 7.04 g with a mean of 5.67 g. The highest test weight was observed in the genotype ICSV15006 (25.71g) followed by ICSV 25274 (24.45 g) while, the lowest was observed in ICSV 13012 (19.26g). Total filled grains ranged from73.53% to 93.76% with a mean of 85.68%. The highest filled grains was observed in the genotype ICSV15006.

Among the genotypes, significantly higher stover yield, harvest index and grain yield were found in the genotype ICSV 15006 followed by ICSV 25274, while, the lowest values of all the above were recorded in the genotype ICSV 13012. Stover yield ranged from 7.08 g plant^{-1} (1.03 ton ha^{-1}) to 13.35 g plant^{-1}(2.21ton ha^{-1}) with a mean of 10.20 g plant^{-1}(1.75t ha^{-1}). The highest stover yield was observed in the genotype ICSV 15006 (2.21 ton ha^{-1}) followed by ICSV 25274(2.04ton ha^{-1}) while, the lowest was observed in ICSV 13012 (1.03tonha^{-1}). Among the genotypes, significantly higher harvest index (21.58%) was found in ICSV 15006 while, the lowest harvest index (16.86%) was observed in the genotype ICSV 13012. Grain yield ranged from 3.34 g plant^{-1}(0.56 t ha^{-1}) to 6.28 g plant^{-1} (1.06 t ha^{-1}) with a mean of 5.01gplant^{-1} (0.79tonha^{-1}). The highest grain yield was observed in the genotype ICSV 15006 (1.06 ton ha^{-1}) followed by ICSV 25274 (0.94ton ha^{-1}), while, the lowest grain yield was observed in ICSV13012 with 0.56 t ha^{-1}.

Ghosh *et al.* (2015) [6] observed that the highest grain yield (3.58 t ha^{-1}) in BD 725. However, the lowest grain yield (2.42 t ha^{-1}) was observed in BD 728. Also the highest stover yield (16.05 t ha^{-1}) was observed in BD 725. Gopichand (2018) [7] reported that the average grain yield of sweet sorghum varieties were 36.2 g plant^{-1}, 31.7 g plant^{-1}, 29.8 g plant^{-1}, 32.1 g plant^{-1}and32.3 g plant^{-1}, respectively. Wadikar *et al.* (2018) [12] also found a significant genetic variation in yield of sweet sorghum.

On the basis of morpho-physiological superiority, desired phenology and higher productivity, the genotypes ICSV-15006 and ICSV-25274 were identified as the superior genotypes which can be used in the further breeding programme for yield improvement in sweet sorghum. However, detailed morpho-physiological and molecular studies in a set of diverse sweet sorghum genotypes under different locations of the state would help in generating more relevant and reliable information in this regard.

Table 1: Days to seedling emergence, tiller initiation, maximum tillering, 50% flowering and physiological maturity in sweet sorghum

Variety	Seedling emergence (Days)	Tiller initiation (Days)	Maximum tillering (Days)	50% Flowering (Days)	Physiological maturity (Days)
Madhura1	4.77	50.33	61.48	130.10	150.09
Madhura2	4.47	49.29	65.95	131.11	149.45
Madhura3	4.25	46.40	62.30	130.48	147.67
ICSV12015	4.83	46.63	70.98	129.23	148.87
ICSV13012	6.73	55.36	83.39	137.23	157.57
ICSV15006	3.26	43.80	58.50	122.20	143.65
ICSV25274	3.57	44.13	60.84	122.79	145.36
ICSV25302	6.32	50.22	74.35	124.62	152.57
ICSV25306	5.33	53.46	82.59	134.89	156.56
ICSV25307	4.36	52.07	82.75	126.87	155.35
ICSV25308	5.03	48.33	81.64	131.31	149.45
ICSV93046	5.08	51.14	66.80	134.86	153.46
Mean	4.83	49.28	70.96	129.64	150.84
SEd. (±)	0.04	1.53	1.67	2.09	2.12
CD(0.05)	0.09	3.05	3.33	4.19	4.24

Table 2: Dry weight of Leaf, Stalk, Panicle and total dry weight at harvest in sweet sorghum

Variety	Leaf dry weight (g plant^{-1})	Stalk dry weight (g plant^{-1})	Panicle dry weight (g plant^{-1})	Total dry weight (g plant^{-1})
Madhura1	3.57	15.52	5.94	25.03
Madhura2	4.88	15.03	5.38	25.29
Madhura3	3.46	16.78	5.99	26.23
ICSV12015	2.54	14.99	5.45	22.98
ICSV13012	1.32	14.44	4.05	19.81
ICSV15006	5.01	17.04	7.04	29.09
ICSV25274	4.92	16.43	6.73	28.08
ICSV25302	3.73	15.67	5.22	26.78
ICSV25306	1.65	15.37	4.16	21.18
ICSV25307	2.15	16.64	6.08	24.87
ICSV25308	4.58	16.31	5.90	26.79
ICSV93046	4.11	16.93	6.19	27.23
Mean	3.49	15.93	5.68	25.28
S.Ed(±)	0.01	0.12	0.04	0.72
CD(0.05)	0.02	0.23	0.09	1.42

Table 3: Number of stomata, epidermal cells and Stomatal Index of abaxial and adaxial leaf surfaces at 50% flowering in sweet sorghum

Variety	Abaxial leaf surface			Adaxial leaf surface		
	Stomata (No. mm-2of leaf area)	Epidermal cells (No.mm-2of leaf area)	Stomatal index (%)	Stomata (No. mm-2 of leaf area)	Epidermal cells (No.mm-2of leaf area)	Stomatal Index (%)
Madhura1	93.45	268.04	34.86	45.25	225.65	20.05
Madhura2	105.48	276.06	38.21	50.35	246.07	20.46
Madhura3	91.56	266.55	34.35	47.75	234.85	20.33
ICSV12015	92.36	267.25	34.56	45.43	235.45	19.29
ICSV13012	89.46	262.86	34.03	47.53	224.64	21.16
ICSV15006	109.38	282.57	38.71	55.07	247.67	22.24
ICSV25274	108.48	277.34	39.11	54.56	246.34	22.15
ICSV25302	104.57	275.47	37.96	52.96	243.76	21.73
ICSV25306	90.58	263.33	34.40	48.63	235.57	20.64
ICSV25307	107.57	277.05	38.83	53.78	245.45	21.91
ICSV25308	99.47	273.78	36.33	51.34	246.53	20.83
ICSV93046	96.36	273.73	35.20	51.47	244.88	21.02
Mean	99.06	272.07	36.41	50.34	239.74	21.00
S.Ed(±)	1.94	3.45	0.56	2.33	2.93	0.09
CD(0.05)	3.89	6.91	1.12	4.68	5.85	0.19

Table 4a: Yield attributes in different genotypes of sweet sorghum

Variety	Plant Population (No.m^{-2})	No. of panicles plant^{-1}	No. of grains panicle^{-1}	Panicle Length (cm)	Panicle weight (g)	1000 grain weight (g)	Filled Grain (%)
Madhura1	17.00	1	223.05	19.54	5.94	24.13	86.55
Madhura2	17.33	1	237.33	22.63	5.38	20.97	82.41
Madhura3	17.33	1	238.01	16.47	5.99	24.06	87.65
ICSV12015	17.00	1	218.67	17.42	5.45	22.14	89.86
ICSV13012	16.67	1	169.00	13.68	4.05	19.26	73.53
ICSV15006	18.33	1	249.02	25.83	7.04	25.71	93.76
ICSV25274	17.33	1	245.33	25.28	6.73	24.45	92.62
ICSV25302	16.67	1	227.33	22.35	5.22	20.90	84.54
ICSV25306	17.00	1	179.33	14.55	4.16	20.68	77.45
ICSV25307	17.33	1	236.33	24.34	6.08	21.75	84.57
ICSV25308	17.33	1	227.67	21.75	5.90	21.83	85.65
ICSV93046	17.00	1	241.01	21.37	6.19	22.81	89.52
Mean	17.19	1	224.33	20.43	5.67	22.39	85.68
S.Ed(±)	-	-	1.85	0.11	0.03	0.12	0.42
CD(0.05)	NS	NS	3.75	0.22	0.06	0.24	0.85

Table 4b: Stover Yield, Harvest Index and Grain yield of different sweet sorghum genotypes

Genotypes	Stover yield (g plant^{-1})	Stover Yield (t ha^{-1})	Harvest Index (%)	Grain yield (g plant^{-1})	Grain Yield (g plot^{-1})	Grain yield (t ha^{-1})
Madhura1	10.14	1.76	20.93	5.24	341.12	0.84
Madhura2	9.69	1.68	19.65	4.97	322.99	0.85
Madhura3	10.00	1.74	21.92	5.75	374.97	0.88
ICSV12015	10.36	1.76	21.28	4.89	311.74	0.79
ICSV13012	7.08	1.03	16.86	3.34	183.74	0.56
ICSV15006	13.35	2.21	21.58	6.28	463.23	1.06
ICSV25274	11.42	2.04	20.69	5.81	421.15	1.03
ICSV25302	11.27	1.86	17.7	4.74	290.27	0.68
ICSV25306	10.36	1.55	17.69	3.69	207.56	0.59
ICSV25307	8.143	1.43	20.27	5.04	333.96	0.82
ICSV25308	10.07	1.74	18.33	4.91	319.09	0.77
ICSV93046	10.56	2.27	19.87	5.41	344.89	0.81
Mean	10.20	1.75	19.73	5.01	326.23	0.79
S.Ed(±)	0.52	0.54	0.44	0.09	1.03	0.04
CD(0.05)	1.04	1.10	0.82	0.19	2.06	0.09

4. Reference

1. Andhale LV. Drought tolerance studies in Rabi sorghum genotypes under rainout shelter. M.Sc. (Agri.) Thesis, MPKV, Rahuri, India; c2014.
2. Anon. Angrau Sorghum Outlook Report; c2021. p. 1-6.
3. Channappagoudar BB, Koti RV, Biradar NR. Physiological basis of evaluation of sweet sorghum genotypes for fodder purpose. Karnataka Journal of Agricultural Sciences. 2009;20(2):294-296.
4. Ekefre DE, Mahapatra AK, Latimore Jr M, Bellmer DD, Jena U, Whitehead GJ, *et al*. Evaluation of three cultivars of sweet sorghum as feed stocks for ethanol production in Southeast United States. Heliyon. 3:00490. Irrig. Sci. 2017;2:213-224.
5. Ghatode RS, Kalmegh VB, Sagare BN, Pavitrakar NR. Effect on Environment on Quality of Sorghuman ditsjuice in Relation to phenological stages. Ann. Plant Physiology. 1991;5(1):52-57.
6. Ghosh SC, Akram S, Ahsan SM, Al-Asif A, Shahriyar S. Morphological and yield performance of grains sorghum genotypes. Asian J Med. Biol. Res. 2015;1(2):271-284.
7. Gopichand SA. Development of technology for post-harvest management and processing technology for ender sweet sorghum. Vasantrao Naik Marathwada Krishi Vidyapeeth, Prabhani; c2018. p. 431-402.
8. Meidner H, Mansfield TA. Physiology of Stomata. London: McGraw-Hill; c1968. p. 177-179.
9. Pancholee V, Sankar S. Studies on biomass production stem composition and sugar profile in sweet sorghum genotypes. Biomass and Bioenergy. 2013;64:348-355.
10. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers, 2nd Edition, Indian Council of Agricultural Research, New Delhi; c1967.
11. Shinde MS, Repe SS, Gaikwad AR, Dalvi US, Gadakh SR. Physio-biochemical assessment of sweet sorghum genotypes during post rainy season. J Acad. Indus. Res. 2013;1(8):501-507.
12. Wadikar PB, Ubale DL, Magar MR, Thorat GS. Genetic Variability Studies in Sweet Sorghum [*Sorghum bicolor* (L.) Moench]. Int. J Curr. Microbiol. App. Sci. 2018;6:920-923.