Int.J.Curr.Microbiol.App.Sci (2021) *10*(06): 215-222

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 10 Number 06 (2021)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2021.1006.023

Characterization of Sorghum Genotype and Varieties using Physiological and Biochemical Test

Minakshi Agney[1*], M. Elangovan[2], H. S. Talwar[2] and K. Keshavulu[1]

[1]Department of Seed Science and Technology, ANGRAU, Rajendranagar, Hyderabad, India
[2]Directorate of Sorghum Researh, Rajendranagar, Hyderabad, India

**Corresponding author*

Keywords

Sorghum, Characterization, Physiological and Biochemical tests

Article Info

Accepted:
12 May 2021
Available Online:
10 June 2021

A B S T R A C T

The present investigation was undertaken with an objective to characterize DUS and seedling traits in *Rabi* sorghum landraces of India. The present study clearly indicated that the sorghum genotypes can be distinguished and identified by physiological and biochemical test. The genotype EA 6 was observed with highest (93%) percent of seed germination whereas, EP 84 and EP 87 genotypes showed highest rate, speed and velocity of germination. The genotype SEVS 3 showed 96% of field emergence and genotype EP 97 (15.73cm) was with longest in root length while, PEC 7(15.91cm) was longest in shoot length. The genotype EC 34 showed (2711.46) high vigour index among the genotypes. Physiological observations studied in the present investigation can be helpful to identify the genuineness of the cultivar, planting value and the authenticity of the certified lot. The physiological parameters viz., root length, high vigour index are important traits in drought tolerance screening. Since, these *Rabi* landraces were collected from the drought prone area of the country, we can assume them as drought tolerant. The physiological traits seed vigour index and field emergence were very important for the evaluation of seed quality. The high vigour index was observed in genotypes EP 59, EA 10 and EA 11 while, the genotypes SEVS 96, EA 11, EP 80 and EP 95 were observed to possess high percent of field emergence. The accessions which were observed with high percentage of germination under cold stress condition were EP 9, EP 41 and SEVS 20.Biochemical observation *viz.*, protein content, starch content, fat content, ash content and electrical conductivity were also studied. The genotype CSV 25 (18.72%) showed high percent of protein while the variety M 35 1 (69.70%) showed high percent of starch content among the studied genotypes. The high protein and starch *Rabi* landraces could be used to develop trait specific varieties. The sorghum genotypes EA 10, EA 6, EC 11, EC 21, EC 12, PEC 2 and variety M 35 1 were observed to possess high percent of starch, fat, protein and ash. These genotypes with better seedling and biochemical attributes could be suggested for use in the future breeding programmes.

Introduction

Sorghum (*Sorghum bicolor* L.) is an important food and fodder crop in India and the word and considered as the king of millets or great millet. It is extensively grown in Africa, china, USA, Mexico and India. In India sorghum is the most important cereal for the poor people in semiarid zones. It is grown mainly in the states of Maharastra, Karnataka, Andhra Pradesh, Tamil Nadu, Gujrat, Madhya Pradesh and Uttar Pradesh. To sustain high production and productivity of sorghum, a large number of high yielding varieties, hybrids and germplasm are available in public domain out of which many genotypes are now in seed production chain and crop improvement programme. However, there is lack of compilation of key diagnostic characteristics of these genotypes which are essential to carry out scientific seed production, certification, endores proper quality control and to promote the seed trade beside crop improvement programme.

Further, in order to maintain genuiness and quality of seed, careful attention is needed at every stage at seed multiplication of genotype.

The proper variety identification serves as an important goal, to maintain genetic purity, mitigate legal claims and confirm intellectual property rights (IPR). Therefore, to identify sorghum genotype relative taxonomical descriptors are published by international bodies like international union for protection of new varieties (UPOV, 1998), international bureau of plant genetic resources (IBPGR,1995). These morphological descriptors have traditional significance and have been a major component of varietal identification for seed production and quality control purposes. But, identification of crop varieties, based only on morphological characters is increasingly difficult because of the large number of verities already released and are being released year after year. So in addition to these morphological characters some of the rapid biochemical and physiological tests are needed for easy reliable identification of varieties which must be quick and reproducible. Thus the laboratory methods can be done all round the year keeping the environmental fluctuation at non significant.

However, any such technique by itself may not be conclusive to correctly diagnose and identify a variety. When these characters are used in conjunction with each other almost any number of sorghum genotypes can be distinguished from each other. Further, keys for identification could be developed on the basis of these morphological and biochemical traits which could serve as a database and ready reckoner for characteristics of genotype.

Thus, the present investigation was conducted to provide information on stable diagnostic characteristics of sorghum genotype using, physiological and biochemical techniques.

Materials and Methods

Seed germination (%)

Germination test was conducted by using a germination paper towel and between paper methods as per the standard procedure prescribed by the International Seed Testing Association (1985). Four replications of hundred seeds in each were placed equidistantly on paper towel, rolled and placed in BOD incubator at 25 ± 10^0C day/night temperatures. Germination count was taken on the 10^{th} day and based on number of normal seedling produced, germination percent calculated.

$$\text{Germination (\%)} = \frac{\text{No. of normal seedling}}{\text{Total number of seeds}} \times 100$$

Vigour index (absolute value, no units)

Vigour index of the seedling obtained from the germination test was calculated using the formula suggested by Abdul-Baki and Anderson (1973).

Vigour index = Germination percentage X mean length of seedlings

Seed germination under cold stress (%)

The seed germination in cold test was computed by planting 100 seeds in four replicates in rolled paper towel and kept at 10^0C for 8 days. The results of cold test are expressed as the percentage of normal seedlings produced.

Field emergence (%)

One hundred seeds were selected randomly from each genotype and were sown in four replications in a well prepared seed bed. Seeds were sown uniformly at 4 cm depth with spacing of 60 cm between rows and 15 cm between plants.

The seedlings were considered emerged when the plumules were just visible on the soil surface. Field emergence was recorded by adding the quotient of the daily count divided by number of days taken for germination.

Field emergence

$$= \frac{N_1}{T_1} + \frac{N_2}{T_2} + \frac{N_3}{T_3} = \text{--------} \frac{Nx}{Tx}$$

Biochemical Observation

Protein content of seeds (%)

Protein content of seeds was determined by Micro-kjeldahl method Ma and Zuazaga (1942).

Starch content of seeds (%)

Skill Development Series No.11 was used to determine starch content of seeds. The starch content in sorghum seeds was evaluated as per the procedure given by Nagur *et al.,* (1992).

Fat content of seed (%)

Fat content of seed was determined by Soxhlet method. Wana *et al.,* (1998) used Soxhlet method to determine the Free Fatty Acid in cotton seed.

Ash content of seed (%)

Ash content was determined by lab analytical procedure. Laboratory Analytical Procedure (LAP) was reported by Sluiter *et al.,* (2005).

Results and Discussion

Physiological traits

Range of seed germination varied from 72% (EP 138) to 93% (EA 6) with mean of 85.8%. Majority of the genotypes (51) and four check varieties (M 35 1, CSV 14 R, CSV 23 and CSV 25) found in range of 80 to 90 % germination, twelve genotypes EP 9, EP 13, EP 14, EP 22, EP 59, EP 82, EP 93, EP 106, EP 107, PEC 7, PEC 26, EP 127 were more than 90 percent of germination and only four genotypes EP 55, EP 64, EP 87 and EP 138 showed germination between 70 to 80 percent. Seed germination under cold stress varied from 71% (EP 124) to 93 % (CSV 216 R) with mean of 82.7%. Forty five genotypes and three varieties were observed in the range of 80 to 90 percent germination of cold stress conditions. The seventeen genotypes EP 22, EC 1, EC 21, EC 33, EP 64, EP 65, EP 78, EP 80, EP 91, EP 92, EP 97, EP 102, EP 103, EP 106, PEC 7, PEC 26, EP 124 and one variety CSV 25 was in range of 70 to 80 percent whereas, five genotypes (EP 9, EP 41, SEVS

20, EA 11 and EP 127) and one variety CSV 216 R was observed in range of > 90 percent germination. Field emergence is varied from 81% (SEVS 20) to 96 % (SEVS 3) with mean of 86.6%. The fifty four genotypes and five varieties observed within the 80 to 90 percent of field emergence and thirteen genotypes EP 24, EP 45, SEVS 3, EA 11, EP 68, EP 78, EP 80, EP 81, EP 82, EP 84, EP 87, EP 91 and EP 105 were observed with more than 90 percent of field emergence. The vigor index varied between 1300.92 (CSV 25) to 2711.46 (EC 34) with mean of 1991.5. Thirty four genotypes and two varieties observed more than 2000 vigour index and thirty three genotypes and three varieties were within 1000 to 2000 vigour index.

Biochemical

The protein content ranged from 12.75% (EC 12) to18.72% (CSV 25) with the mean of 15.1%. The genotypes EA10 (16.22%), EP 9(14.36%), EA 11(13.70%), EC 12 (12.75%), EC 34 (14.37%), EC 21(13.72%), SEVS 20 (15.20%), EA 6 (16.22%), PEC 2 (16.86%) and varieties M35 1(14.37%), CSV 25(18.72%) were observed with different percent of protein content.

The starch content of genotype ranged from 67.72% (EC 34) to 69.70% (M 35 1) with mean of 68.6%.The genotypes EA10 (69.45%), EP 9(67.72%), EA 11(68.55%), EC 12(68.85%), EC 34 (67.72%), EC 21(69.35%), SEVS 20 (67.72%), EA 6 (68.77%), PEC 2 (68.80%) and varieties M35 1(69.70%), CSV25 (67.80%) were observed with different percent of starch content. Fat content of genotype ranged from 2.23% (SEVS 20) to 3.29% (CSV 25) with mean of 2.9%. The genotypes EA 10(1.81%), EP 9(1.80%), EA 11(1.71%), EC 12(1.90%), EC34 (1.75%), EC21 (1.83%), SEVS 20(1.75%), EA 6(1.81%), PEC 2 (1.84%) and varieties M35 1(1.80%), CSV 25(1.78%) were observed with different percent of fat content.

Ash content of genotypes ranged from 1.71% (EA 11) to 1.90% (EC 12) with mean of 1.8%.The genotypes EA10 (2.98%), EP 9(3.03%), EA 11(2.89%), EC 12(3.14%), EC 34(2.25%), EC21(3.12%), SEVS 20 (2.23%), EA 6 (3.28%), EA 6 (3.14%), PEC2 (3.14%) and variety M35 1(3.28%), CSV 25 (3.29%) were observed with different percent of ash content.

The genotype EA 6 (93%) showed highest percent of germination followed by EP 13(91%), EP 14(91%), EP 22(91%), EP 82(91%), PEC 7(91%), PEC 26(90%) and EP 172 (90%). Among the genotypes EP 139 (72%) showed the lowest percent of germination followed by EP 64(74%), EP 55 (78%) and EP 87(79%). Similar finding were reported by Tonapi *et al.,* (2006) and Oliveira *et al.,* (2009). The vigour index was highest in EC 34 (2711.46) followed by EP 115 (2248.50), EP 127 (2353.31), EP 124 (2245.99), CSV 23(2210.81) and CSV 216 R (2159.49). The genotype CSV 25 (1300.92) showed lowest vigour index among the genotypes followed by EP 138 (1713.16), EP 102 (1727.35), CSV 14 R (1736.68), EP 107 (1767.91), EP 120 (1794.07). Similar findings were reported by Wang *et al.,* (2003) in forage species and Verma *et al.,* (2003) in sorghum. The variety CSV 216 R (93%) showed highest percent of germination followed by SEVS 20 (92%), EA 11 (91%), EP 9 (90%) and EP 41(90%). Among the genotype EP 124 (71 %) showed lowest percent of germination followed by EP 22 (72%), EC 1(76%), EC 21(76%), EP 78(75%), EP 64(74%), EP 65(74%) and, EP 80(73%). Similar observation was recorded by Fill (1999) in maize.

Table.1 List of material used for the study and its pedigree details

S. No.	Genotype	Vernacular name/Pedigree	Origin
1	EP 1	Tamalwadi Dhagdi	Maharashtra
2	EP 9	Yermala joot	Maharashtra
3	EP 11	Yemala lakdi	Maharashtra
4	EP 12	Yermala durki	Maharashtra
5	EP 13	Shrirala dagdi	Maharashtra
6	EP 14	Shrirala gota	Maharashtra
7	EP 16	Jamgaon dagadi	Maharashtra
8	EP 17	Jamgaon joot	Maharashtra
9	EP 22	Dagdi maldandi	Maharashtra
10	EP 23	Dagdi local	Maharashtra
11	EP 24	Local maldandi	Maharashtra
12	EP 37	Dharunyak danda local	Karnataka
13	EP 41	Hurjajola	Karnataka
14	EP 42	Jevari local	Karnataka
15	EP 45	Gundu jola	Karnataka
16	EP 46	Bagadahali local	Karnataka
17	EP 52	Hale jola	Karnataka
18	SEVS 2	Pachcha jonna	Andhra Pradesh
19	SEVS 3	Nattu jonna	Andhra Pradesh
20	SEVS 20	Gompu jonna	Andhra Pradesh
21	EC 1	Tella jonna	Andhra Pradesh
22	EC 11	Mudda jonna	Andhra Pradesh
23	EC 12	Raichur jonna	Andhra Pradesh
24	EC 21	Eduakula jonna	Andhra Pradesh
25	EC 33	Palar jonna	Andhra Pradesh
26	EC 34	Mudda jonna	Andhra Pradesh
27	EA 6	Matthappu cholam	Tamil Nadu
28	EA 11	Irungu cholam	Tamil Nadu
29	EA 12	Sevappu cholam	Tamil Nadu
30	EP 54	Godorani maldandi	Maharashtra
31	EP 55	R-8	Maharashtra
32	EP 57	Beedari	Maharashtra
33	EP 59	Beed maldandi	Maharashtra
34	EP 64	Sedam maldandi gurang	Maharashtra
35	EP 65	Gurang maldandi	Maharashtra
36	EP 68	Dadar	Maharashtra
37	EP 78	Gurang	Maharashtra
38	EP 80	Gurang sabet	Maharashtra
39	EP 81	Gurang dagdi	Maharashtra
40	EP 82	Sabet ganga gopargaon	Maharashtra
41	EP 84	Valsangh Madandi local	Maharashtra
42	EP 87	Vadgaon Dagdi Madandi	Maharashtra

43	EP 91	Sultanpur maldandi	Maharashtra
44	EP 92	Harni jogdi	Maharashtra
45	EP 93	Harni jogdi	Maharashtra
46	EP 94	Chungi Maldandi	Maharashtra
47	EP 95	Musti local Maldandi	Maharashtra
48	EP 97	Bile maldandi	Karnataka
49	EP 102	Bili jola	Karnataka
50	EP 103	Kodumurugu jola	Karnataka
51	EP 104	Kanaggu jola	Karnataka
52	EP 105	Allin jola	Karnataka
53	EP 106	Bili jola	Karnataka
54	EP 107	Kanaggu jola	Karnataka
55	EP 114	Maldandi Bili	Karnataka
56	EP 115	Allur jola	Karnataka
57	EP 117	Bili maldandi	Karnataka
58	EP 120	Farm maldandi	Karnataka
59	PEC 2	Jungala local	Maharashtra
60	PEC 5	Baddi jowar	Maharashtra
61	PEC 7	Chakur maldandi	Maharashtra
62	PEC 15	Maldandi	Karnataka
63	PEC 22	Sai jona	Andhra Pradesh
64	PEC 26	Thandur local	Andhra Pradesh
65	EP 124	Khondya	Maharashtra
66	EP 127	Mukta	Maharashtra
67	EP 138	Bendri dagdi	Maharashtra
68	M 35 1	Selection form Maldandi landraces	DSR
69	CSV 14 R	(M35-1xCS2947x CS2655)xM35-1	DSR
70	CSV216R	Selection from landraces	DSR
71	CSV 23	SPV861xSU 248	DSR
72	CSV25	SB104BxSomapur local	DSR

The genotype SEVS 3 (96%) showed highest percent of field emergence followed by EP 82(93%), EP 84(93%), EP 87(93%), EP 91(93%), EP 24(92%), EP45 (92%), EA 11 (91%) and EP 81 (91%). Among the genotypes SEVS showed (81%) percent of field emergence followed by EP 1(82%), EP 11(82%), EP 107(82%), PEC 22(82%), PEC 26(82%), EP 127(82%), EP128(84%). Similar findings were reported by Vanzolini and Nakagawa (2003).

The genotype CSV 25 (18.72%) showed high percent of protein content whereas the genotype EC 12 (12.75%) showed low percent of protein content among the studied genotype. Similaraly Ma and Zuazaga reported micro-kjeldahl determination of nitrogen (1942).

The genotype M 351 (69.70%) showed high percent of starch content whereas the genotype EC 34(67.72%) low percent of starch content in among the genotype. The starch content was varied in among the studied genotypes. Starch content was observed by Shanmugavalli and Renganayaki (2006) in sorghum and Mc cleary *et al.,* (1994) in

cereal. The genotype EC 12 (1.90%) showed high percent of ash content whereas the genotype EA 10 (1.71%) showed low percent of ash content in among the studied genotypes. Similar findings were reported by Wu *et al.*, (2008). The genotype CSV 25 (3.29%) showed high percent of fat content whereas the genotype SEVS 20 (2.23%) showed low percent of fat content in studied among the studied genotypes. The variation in fat and ash content was may be due to environmental conditions or growing location. Similarly, Wu *et al.*, (2008) studied that ash content, fat content and starch content were significantly affected by growing location and environment.

Acknowledgements

The authors are thankful to the breeders from Directorate of Sorghum Research Rajendranagar Hyderabad for providing seed material used in the present study.

References

Abdul- Baki, A. A and Anderson, J. D.1973. Vigour determination in soybean seed by multiple criteria. *Crop Science.* 13: 630-633.

Agrawal, P. K. 1985. Field plot testing for assessing genetic purity in hybrid cotton. *Seed Tech News*. 15 (3): 1-5.

Anita, G. 1995. Morphological and Biochemical characters for identification of sunflower genotypes. *M. Sc. (Ag.) Thesis.* Acharya N G Ranga Agriculture University, Hyderabad, India.

Anon, (1987). Measurement of the starch content of commercial starches. 39: 414-416.

AOSA. 2009. *Seed Vigor Testing Handbook.* Contribution No. 32 to the Handbook on Seed Testing.

Aruna, C and Audilakshmi, S. 2008. A strategy to identify potential germplasm for improving yield attributes using diversity analysis in sorghum. *Plant genetic resources*: Characterization and Utilization 1-8.

Burris, J. S., Wahab, A. H and Edje, O. T. 1971. Effect of seed size on seedling performance in soyabean. *Crop Science*. 11: 492-496.

Edwards, C. J., Jr and Hartwing, E. E. 1971. Effect of seed size upon rate of germination in soybean. *Agronomy Journal*. 63: 429-430.

International seed testing association 1985. Seed germination procedure, anonymously.

Jaiswal and Agarwal, R. L.1990. Development of laboratory methods for verification of genetic purity of laboratory methods or verification of genetic purity of paddy varieties. *International Conference on Seed Science and Technology*, Indian society of Seed technology, New Delhi, February 21: 25 61.

Karkalis, J. 1985. An improved enzymic method for the determination of native and modified starch. *J. Sci. Fd. Agric*. 36: 1019-1027.

Kim, S. H., Z. R. Choe, J. H. Kang, L. O. Copeland, and S. G. Elias.1994. Multiple seed vigor indices to predict field emergence and performance of barley. *Seed Science & Technol*ogy. 22: 59-68.

Li Chao, Xiao Muji, Zhou Yufei, Xu WenJuan and Huang Rui Dong. 2009. Effect sowing dates on the starch contents in sorghum grains. *Journal of Shenyang Agricultural University*. 40 (6): 708-711.13.

Ma, T and Zuazaga, G. 1942. Micro-Kjeldahl Determination of Nitrogen. A New Indicator and an improved rapid method. *Industrial and Engineering Chemistry Analytica Edition.* 14 (3): 280-282.

How to cite this article:

Minakshi Agney, M. Elangovan, H. S. Talwar and Keshavulu, K. 2021. Characterization of Sorghum Genotype and Varieties using Physiological and Biochemical Test. *Int.J.Curr.Microbiol.App.Sci.* 10(06): 215-222. doi: https://doi.org/10.20546/ijcmas.2021.1006.023