**EVALUATION OF GERMPLASM LINES FOR SEED QUALITY PARAMETERS IN FINGER MILLET (*Eleusine coracana* L. *G*aertn)**

**ABSTRACT**

The aim of this study was to evaluate the germplasm lines of finger millet for their seed quality traits. Thirty germplasm lines of finger millet including two checks *viz.,* Indravathi, Tirumala. Observations were recorded for seed quality parameters and data was statistically analyzed. The Analysis of variance (ANOVA) showed significant variation among tested germplasm. A wide range of variation was recorded among the germplasm lines for various traits studied and can be used for trait specific isolation for further crop improvement. From the present study, PPR-1397 showed outstanding performance in laboratory analysis of seed quality parameters such as root length, seedling length, seedling fresh weight, seedling dry weight, root dry weight, seedling vigour index-I and lowest in electrical conductivity. PGCF-16, PR-1643 and GE-4600 recorded high nitrogen and protein content. The promising lines are GPU-67, PR-1643, PPR-1397, IE-5870 and PPR-1304.

**Key words:** Finger millet, germplasm, seed quality traits, trait specific ioslation.

**INTRODUCTION:**

Finger millet is an important small millet popularly known as Ragi, Bird’s foot millet, Coracana millet or African millet is extensively grown in Africa, South Asia and India demonstrates its adaptability to a wide range of agro-climatic conditions. *Eleusine indica* (AA) and *Eleusine floccifolia* (or) *E. tristachya* (BB) which serve as the genome donors hybridized to produce an allopolyploid with chromosomal number 2n = 4x = 36. It belongs to the family poaceae and the genus ‘*Eleusine*’ derived from ‘*Eleusis’* who is the Greek deity presiding over agriculture. The term ‘*coracana’* is derived from *kurukkan,* the singhali name of the grain. Ragi is mentioned in ancient sanskrit literature as *Rajika* meaning red.

Finger millet is ranked as the fourth most important millet globally, next to sorghum, pearl millet and foxtail millet (Upadhyaya *et al.,* 2007). In today’s world, about 12% of the total millet area is under finger millet cultivation, which mainly covers more than 25 countries of Asia and Africa (Amisha *et al.,* 2020). In India, finger millet is mostly grown or produced in southern parts of Karnataka, Andhra Pradesh, Tamil Nadu and hilly areas of northern regions mostly in Uttarakhand (Vijayakumari *et al.,* 2003). Finger millet accounts for around 30 million tons or 10% of the total millet production worldwide. In India it is cultivated in an area of 10.37 lakh ha with a total production of 13.86 lakh tonnes and productivity of 1336 kg/ha and in A.P. in an area of 0.27 lakh ha with a production of 0.33 lakh tonnes and productivity of 1222 kg/ha. ([*https://www.apeda.gov.in*](https://www.apeda.gov.in)2023-24).

The grains of finger millet are nutritionally rich and superior to many cereals and hence designated as “*Nutri cereal”.* The nutritional composition of ragi contains protein (8.0 %), carbohydrates (76.32 %), fats (1.29 %) and iron (3.90 mg/100g) as reported by Pandey and Kumar, 2005. More remarkably, finger millet grain contains higher calcium than other cereals (Kumar *et al*., 2016). It is an excellent source of calcium (310-370mg/100g) among cereals that is three times higher than brown rice, wheat or maize and milk.

Seeds are the most important input in all crop-based agriculture and a pre-requisite for the majority of the world’s food production. Research has shown that healthy seed is one of the important factors in improving agricultural production (Gupta, 1999). The need for a good viable seed for prosperity of human race is mentioned in *Rigved* of ancient India as *“Subeejam Sukshetre Jayate Sampadyate”* which means “A good seed in a good field will win and prosper” (Poonia, 2013). Germplasm is an essential reservoir of favourable alleles for agronomic and quality traits. The germplasm identification and characterization are an important link between the conservation and utilization of plant genetic resources. The crop improvement depends mainly on basic information of the existence of genetic variability, diversity in population and the relationship between different traits. Presence of high variability offers much scope for its improvement (Poehlman, 1987).

Therefore, the evaluation of available germplasm will be helpful to serve in the near-future crop breeding programme. In view of the importance of finger millet crop in present climate change era, the present investigation on “Evaluation of germplasm lines for seed quality parameters in finger millet (*Eleusine* *coracana* L. *Gaertn*)” is being undertaken to study the seed quality traits.

**MATERIALS AND METHODS:**

The present investigation entitled “Evaluation of finger millet (*Eleusine coracana* L. *G*aertn) germplasm lines for seed quality traits” which comprised of 30 diverse germplasm lines including two checks *viz.,* Indravathi and Tirumala was carried at wetland Farm, S. V. Agricultural College, Tirupati, Andhra Pradesh. The seed material used in the study was obtained from ARS, Perumallapalle.

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| **S.No.** | **Name of the**  **Germplasm line** | **S.No.** | **Name of the**  **Germplasm line** |
| 1. | GE-113 | 16. | PPR-1363 |
| 2. | GE-4595 | 17. | PPR-1397 |
| 3. | GE-4600 | 18. | PR-1639 |
| 4. | GODAVARI | 19. | PR-1643 |
| 5. | GOWTHAMI | 20. | SRI CHAITANYA |
| 6. | GPU-48 | 21. | TNEC-1256 |
| 7. | GPU-67 | 22. | VAKULA |
| 8. | IE-3045 | 23. | VEGAVATHI |
| 9. | IE-5537 | 24. | VL-376 |
| 10. | IE-5691 | 25. | VL-394 |
| 11. | IE-5870 | 26. | VR-708 |
| 12. | KOPN-942 | 27. | VR-900 |
| 13. | PGCF-16 | 28. | WR-24 |
| 14. | PPR-1303 | 29. | INDRAVATHI© |
| 15. | PPR-1304 | 30. | TIRUMALA© |

**Table 1. Details of germplasm lines used in the study**

**Experimental Design and Layout**

The experiment was laid out in Randomized Block Design (RBD) in the field. 23-day old seedlings were transplanted in the main field with a spacing of 30 cm between the rows and 10 cm between the plants in five rows for each germplasm line with a net plot size of 4 ×1.5 meters. After harvesting and threshing, the seeds were further utilized under laboratory experiments for seed quality assessment using Completely Randomized Design (CRD). The data collected on different qualitative traits were analyzed by Panse and Sukhatme (1967).

**Sampling procedure and observations recorded:**

The observations were recorded to predict the quality of the seeds for determination of 14 qualitative traits such as speed of germination, germination (%), shoot length (cm), root length (cm), seedling length (cm), seedling fresh weight (mg), shoot dry weight (mg), root dry weight (mg), seedling dry weight (mg), seedling vigour index-I, seedling vigour index-II, EC of seed leachates, nitrogen content and protein content (%) using the harvested seeds by randomly selecting ten seedlings in each of four replications (CRD) and the average of the readings was calculated for the computation of the data. The observations were recorded for the following parameters.

**Speed of germination**

Speed of germination was calculated as per ISTA (International Seed Testing Association) rules (ISTA, 1993). In this test, four replications of 100 seeds were taken from each germplasm line, placed in the petri dish and then kept at 25±1˚c in the incubator. After the seed begin to germinate, they were checked daily until the final count (8th day). Speed of germination was calculated using the formula suggested by Maguire (1962).

Speed of emergence

Where, n is the number of emerged seedlings, d is the number of days.

**Germination percentage (%)**

The germination test was conducted as per the (ISTA, 1993) procedure using between paper method. The rolled paper towels were placed at slanting position in a BOD incubator at constant temperature of 25±1˚c and 95±1˚c per cent relative humidity. On final count (8th day) normal seedlings were recorded and percent germination was computed and expressed in percentage as per the formula mentioned below:



**Shoot length, root length and seedling length (cm)**

At the time of germination count, ten healthy seedlings were randomly selected for the assessment of root length, shoot length and seedling length. The measurement of root length was taken from the point of attachment of seed to the tip of primary root, while the shoot length was measured from the point of attachment of seed to the tip of the leaf. The resultant mean values were expressed in centimetres. The sum of root and shoot length of ten seedlings was computed and their mean was expressed as seedling length in centimetres.

**Seedling fresh weight (mg)**

Seedling fresh weight was recorded at the final count of germination test (8th day) by taking ten normal seedlings randomly from each replication. The fresh weight of seedlings was weighed with the help of an electronic balance and the average of ten seedlings was recorded as the fresh weight of that genotype. Seedling fresh weight is expressed in milli grams.

**Shoot dry weight, root dry weight and seedling dry weight (mg)**

The ten representative seedlings used for estimation of seedling fresh weight were placed in brown paper bags and subjected to a hot air oven at 70± 20C for 24 hr. Following the cooling period, the roots and shoots were meticulously separated from seedlings and their dry weights were measured using an electronic weighing balance. The sum of root dry weight and shoot dry weight of ten seedlings was calculated and their mean was expressed as seedling dry weight. The average weight was calculated and was expressed in grams per seedling.

**Seedling vigour Index-I**

Seedling vigour index-I was computed by adopting the following formula as suggested by Abdul-Baki and Anderson (1973) and expressed in whole number.

Seedling vigour index = Germination (%) x Mean seedling length (cm)

**Seedling vigour Index-II**

Seedling vigour index II was computed by adopting the following formula as suggested by Adbul-Baki and Anderson (1973) and expressed in whole number.

Seedling vigour index-II = Germination (%) x Mean seedling dry weight (g)

**EC of leachates (µS/cm)**

Five grams from all thirty germplasm lines in each replication were soaked in 50 ml of deionized water for 24 h at room temperature. The seed steep water was decanted and referred to as seed leachate. The electrical conductivity of the seed leachate was measured with a digital conductivity meter (Model: Conductivity TDS meter-307) with a cell constant of one and expressed as µS/cm.

**Nitrogen content**

Nitrogen content in ragi seeds was analysed by Micro-Kjeldahl method. 0.5 g of powdered sample of each germplasm line in each replication was taken into a well cleaned and dried digestion flask and 10 ml of sulphuric acid along with potassium sulphate and copper sulphate in 5:1 ratio (2.5 g K2SO4 and 0.5 g CuSO4) was added into the digestion flask. Then digestion unit was started and the flasks were heated till the solution turns to light green colour. The solution was allowed to cool to room temperature and 25 ml of distilled water was added to stop the reaction. The obtained solution was kept for distillation. Before starting the distillation unit, 10 ml of 4 per cent boric acid along with 2 to 3 drops of mixed indicator was taken in a volumetric flask and kept at the end of the condenser to collect the distillate. The distillate obtained from the above process was then titrated against 0.01 NH2SO4, until the colour changes from bluish green to pink. Titre value was noted down and substituted in the below formula to obtain the percentage of nitrogen present in the sample.



**Protein content (%)**

Nitrogen content was multiplied with the factor 6.25 to obtain the protein content in the given sample as given by Doubetz and Wells (1968).

**Protein content (%) = Nitrogen content (%) × 6.25 (factor)**

**RESULTS AND DISCUSSION:**

All the 30 germplasm lines of finger millet were evaluated on the basis of 14 seed quality parameters and analysed as per Completely Randomized Design (CRD) with four replications. Observations for all the seed quality parameters were recorded on a sample of 10 randomly selected plants and were statistically analyzed and discussed below under following sub heads.

**Speed of germination**

Statistically significant difference was found in speed of germination among the 30 germplasm lines and the range varied from 16.85 to 23.41 with an overall mean value of 20.41. Maximum speed of germination was found in PPR-1363 (23.41) and minimum value was reported in VL-394 (16.85). Similar variation for speed of germination was reported by Laxmi rawat *et al.* (2022) 12.68-22.21 and Rawat *et al.* (2023) 30.80-37.42.

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| --- | --- | --- |
| **Characters** | **Mean sum of squares (MSS)** | |
| **Treatment** | **Error** |
| **Degrees of freedom** | 29 | 90 |
| **Speed of germination** | 10.6591\*\* | 0.27985 |
| **Germination (%)** | 253.77\*\* | 2.438 |
| **Shoot length (cm)** | 1.2792\*\* | 0.0456 |
| **Root length (cm)** | 0.86545\*\* | 0.03171 |
| **Seedling length (cm)** | 3.6928\*\* | 0.0973 |
| **Seedling fresh weight (mg)** | 96.7545\*\* | 7.10367 |
| **Shoot dry weight (mg)** | 403.15\*\* | 0.707 |
| **Root dry weight (mg)** | 44.0216\*\* | 0.18749 |
| **Seedling dry weight (mg)** | 629.46\*\* | 1.3421 |
| **Seedling Vigour Index-I** | 86155\*\* | 1059.3 |
| **Seedling Vigour Index- II** | 5.5999\*\* | 0.0127 |
| **E.C of seed leachates (µS/cm)** | 47.1378\*\* | 1.039992 |
| **Nitrogen content** | 0.0725\*\* | 0.0029 |
| **Protein content (%)** | 2.8308\*\* | 0.1131 |

**Table 2. Analysis of variance (ANOVA) for seed quality traits in finger millet germplasm**



**Fig. 1. Seeds placed for estimation of speed of germination**

**Fig. 2. Estimation of shoot, root and seedling length (cm)**

**Germination (%)**

Significant difference in germination (%) was observed among the germplasm lines studied and the range varied from 68.23% to 95.25% with a mean value of 85.09 %. Where the germplasm line, Gowthami (95.25%) recorded the highest germination per cent while, the minimum germination percentage was reported in the germplasm line IE-3045 (68.23). Germination test is used for the estimation of planting value of seed lots. The difference might be due to the genetic makeup of each germplasm, presence of degree of seed dormancy and seed coat. Wide range of variability in germination percentage was also noticed by Krishnappa *et al.* (2001) from 23.00 to 86.00, Tzortzakis (2009) 73.00 to 91.00, Negi *et al.* (2019) 70.00 to 96.66, Kumar *et al.* (2015) 44.25 to 93.75, Laxmi rawat *et al.* (2022) 60.00 to 96.00 and Rawat *et al.* (2023) 80.50 to 96.25.

**Shoot length, root length and seedling length (cm)**

The result of shoot length for diverse germplasm lines of finger millet was found significant and the range varied from 5.89 to 8.76 cm with a mean value of 7.87 cm. The root length varied from 5.22 to 7.09 cm with a mean value of 6.22 cm and seedling length varied from 11.11 to 15.82 cm with a mean value of 14.10 cm across the finger millet germplasm. The highest shoot length was recorded in the germplasm line GPU-67 (8.76) while, the shortest was reported in the germplasm line VR-900 (5.89). Shoot length is an index of seedling vigour which may contribute towards better growth and development of seedling while root length contributes toward better establishment of seedling under abiotic stress conditions. Similar findings for shoot length were reported by Krishnappa *et al.* (2001) 3.55 to 7.50, Khan *et al.* (2010) 12.95 to 29.00, Negi *et al.* (2019) 2.20 to 5.00, Laxmi rawat *et al.* (2022) 3.49 to 7.64 and Rawat *et al.* (2023) 4.71 to 4.80 cm.

The longest root length (cm) was recorded in the germplasm line PPR-1397 (7.09) while, the shortest was reported in the germplasm line VR-900. The results are in similariton with Krishnappa *et al* (2001) for root length ranging from 5.50 to 6.40 cm, Negi *et al.* (2019) 4.10 to 7.89 cm, Laxmi rawat *et al.* (2022) 4.64 to 8.82 cm and Rawat *et al.* (2023) from 7.06 to 7.95 cm in finger millet and Khan *et al*. (2010) 13.60 to 20.90 cm in wheat. The longest seedling length (cm) was reported in the germplasm line PPR-1397 (15.82) while, the shortest was reported in the germplasm line VR-900 (11.11).Similar variation in seedling length was reported by Patil *et al.* (1999) and Krishnappa *et al.* (2001) Shailaja and Thirumeni (2007) in finger millet, Radhounane (2011) in pearl millet, Kumar *et al.* (2015) in grain amaranth, Negi *et al.* (2019) 6.97 to 12.89 in finger millet, Laxmi rawat *et al.* (2022) 8.96 to 16.45 in finger millet and Rawat *et al.* (2023) 11.77 to 12.74 in finger millet.

**Seedling fresh weight (mg)**

Seedling fresh weight (mg) varied significantly from 175.87 to 203.56 with a mean value of 189.78. The maximum value (203.56) was recorded in the germplasm line PPR-1397 which was significantly highest among all the germplasm lines followed by PR- 1643 (201.20) and IE-5870 (195.33) while, the minimum value (175.87) was observed in germplasm line PPR-1363 followed by Gowthami (182.46).

**Shoot dry weight, root dry weight and seedling dry weight (mg)**

Shoot dry weight varied significantly from 32.11 to 61.05 with a mean value of 45.50. The maximum value for shoot dry weight was recorded in IE-5870 (61.05 mg) while, the minimum was observed in germplasm line PPR-1363 (32.11).Root dry weight varied significantly from 10.30 to 19.65 with a mean value of 14.99 mg. The maximum value was recorded in the germplasm line PPR-1397 (19.65) while, the minimum value was observed in germplasm line PPR-1363 (10.30). The range of seedling dry weight varied from 42.41 to 80.54 mg for different germplasm lines of finger millet. The highest value was recorded in germplasm line PPR-1397 (80.54) while, the lowest value was recorded in the germplasm line PPR-1363 (42.41 mg). The results are in confirmation with that of Krishnappa *et al.* (2010) in finger millet, Khan *et al.* (2010) in wheat and Kumar *et al.* (2015) in grain amaranth.

**Seedling Vigour Index- I**

The analysis of results revealed significant variations among germplasm lines for Vigour Index- I from 916.30 to 1438.59 with a mean value of 1200.75. The highest value was observed in PPR-1397 (1438.59) while the lowest value for this trait was recorded in IE-3045 (916.30). Seedling vigour index-I is influenced by two factors they are germination per cent and seedling length and similar variation was reported by Krishnappa *et al.* (2001) 30.00 to 168.00, Negi *et al.* (2019) 493.06 to 1177.85, Laxmi rawat *et al.* (2022) 701.33 to 1530.57 and Rawat *et al.* (2023) 946.32 to 1226.72.

**Seedling Vigour Index-II**

The seedling vigour index-II showed range of variability for different germplasm lines of finger millet are found to be significant. The range varied from 3.15 to 7.34 with a mean value of 5.15. The highest value was observed in PR-1643 (7.34). However, the lowest value was recorded in WR-24 (3.15). Seedling vigour index- II is helpful in monitoring and ensuring the survival and growth rate of seedling after germination. Germination % and seedling dry weight are major factors for deciding the seedling vigour index-II. Similar findings were also reported by Patil *et al.* (1999) and Krishnappa *et al.* (2001) in finger millet, Katna *et al.* (2002) in maize and Kumar *et al.* (2015) in grain amaranth, Negi *et al.* (2019), Laxmi rawat *et al.* (2022), Rawat *et al.* (2023) in finger millet.

**EC of seed leachates (µS/cm)**

Significant differences in electrical conductivity were observed among the germplasm lines studied and the range varied from 35.39 to 53.63 with a mean value of 45.98. The electrical conductivity was reported maximum for germplasm line IE-3045 (53.63) followed by VR-900 (52.93) and VR-708 (49.32). Whereas the minimum electrical conductivity was reported in the germplasm line PPR-1397 (35.39) followed by Tirumala© (36.89), PPR-1304 and VL-376 (43.81). Electrical conductivity of seed leachates showed a similar variation in germplasm lines tested. Several factors may affect the results of the electrical conductivity test, such as: time and temperature of imbibition, seed size, initial seed water percentage, number of seeds in the

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S.No.** | **Germplasm line** | **SPG** | **G (%)** | **SL (cm)** | **RL (cm)** | **SDL (cm)** | **SLFW (mg)** | **SDW (mg)** | **RDW (mg)** | **SDLW (mg)** | **SVI-I** | **SVI-II** | **E.C.**  **(µS/cm)** | **N**  **(mg)** | **P (%)** |
| 1. | GE-113 | 18.71 | 85.88 (67.93) | 8.05 | 6.69 | 14.74 | 187.02 | 33.58 | 10.93 | 44.51 | 1266 | 3.82 | 45.51 | 1.07 | 6.67 |
| 2. | GE-4595 | 22.01 | 85.23 (67.40) | 6.67 | 5.42 | 12.09 | 188.34 | 50.89 | 17.11 | 68 | 1030.05 | 5.8 | 47.52 | 1.15 | 7.2 |
| 3. | GE-4600 | 22.15 | 92.87 (74.51) | 7.34 | 5.61 | 12.95 | 191.62 | 39.26 | 12.61 | 51.86 | 1201.69 | 4.82 | 46.01 | 1.31 | 8.2 |
| 4. | GODAVARI | 21.05 | 74.38 (59.59) | 8.24 | 6.51 | 14.75 | 188.18 | 42.1 | 13.52 | 55.62 | 1096.73 | 4.14 | 47.02 | 1.12 | 7.03 |
| 5. | GOWTHAMI | 19.31 | 95.25 (77.41) | 8.02 | 5.36 | 13.38 | 182.46 | 39.58 | 10.54 | 70.7 | 1274.16 | 6.73 | 45.41 | 1.17 | 7.3 |
| 6. | GPU-48 | 21.22 | 87.49 (69.29) | 7.79 | 5.88 | 13.67 | 188.99 | 41.95 | 13.63 | 55.58 | 1195.6 | 4.86 | 46.52 | 1.15 | 7.16 |
| 7. | GPU-67 | 22.17 | 80.77 (63.99) | 8.76 | 6.29 | 15.04 | 191.47 | 34.16 | 10.92 | 45.07 | 1214.96 | 3.64 | 45.81 | 1.13 | 7.07 |
| 8. | IE-3045 | 19.8 | 68.23 (55.69) | 7.4 | 6.03 | 13.43 | 194.06 | 56.82 | 18.69 | 75.51 | 916.3 | 5.15 | 53.63 | 1.14 | 7.13 |
| 9. | IE-5537 | 19.93 | 70.18 (56.90) | 7.91 | 6.21 | 14.12 | 190.6 | 56.83 | 18.11 | 74.94 | 990.65 | 5.65 | 48.82 | 1.1 | 6.9 |
| 10. | IE-5691 | 17.91 | 91.06 (72.60) | 7.61 | 6.27 | 13.88 | 184.13 | 44.79 | 14.78 | 59.57 | 1264.05 | 5.42 | 45.51 | 1.28 | 7.98 |
| 11. | IE-5870 | 21.09 | 91.95 (73.52) | 7.68 | 6.58 | 14.96 | 195.33 | 61.05 | 19.49 | 77.38 | 1375.69 | 6.89 | 45.31 | 1.04 | 6.53 |
| 12. | KOPN-942 | 20.63 | 77.49 (61.68) | 8.18 | 6.71 | 14.89 | 188.27 | 32.71 | 10.64 | 43.35 | 1154.01 | 3.36 | 46.82 | 1.02 | 6.35 |
| 13. | PGCF-16 | 20.1 | 87.09 (69.64) | 8.3 | 6.14 | 14.44 | 188.38 | 32.17 | 12.77 | 51.82 | 1269.3 | 4.55 | 45.61 | 1.4 | 8.78 |
| 14. | PPR-1303 | 18.7 | 90.95 (72.49) | 8.11 | 6.49 | 14.61 | 189.45 | 39.87 | 13.62 | 53.49 | 1328.58 | 4.87 | 45.31 | 1.16 | 7.22 |
| 15. | PPR-1304 | 21.23 | 94.06 (75.89) | 8.38 | 6.51 | 14.89 | 192.44 | 46.54 | 19.06 | 52.35 | 1400.23 | 7.28 | 43.81 | 1.18 | 7.35 |
| 16. | PPR-1363 | 23.41 | 94.06 (75.89) | 7.91 | 6.25 | 14.16 | 175.87 | 32.11 | 10.3 | 42.41 | 1247.11 | 4.92 | 45.61 | 1.24 | 7.78 |
| 17. | PPR-1397 | 22.26 | 90.52 (72.07) | 8.73 | 7.09 | 15.82 | 203.56 | 58.83 | 19.65 | 80.54 | 1438.59 | 4.74 | 35.39 | 1.25 | 7.8 |
| 18. | PR-1639 | 20.89 | 90.49 (72.04) | 7.78 | 6.2 | 13.98 | 185.97 | 40.06 | 18.68 | 58.75 | 1265.45 | 5.32 | 45.91 | 1.13 | 7.08 |
| 19. | PR-1643 | 19.58 | 88.01 (69.82) | 8.38 | 5.96 | 13.64 | 201.2 | 60.17 | 19.01 | 77.84 | 1286.08 | 7.34 | 45.31 | 1.34 | 8.38 |
| 20. | SRI CHAITANYA | 21.72 | 82.96 (65.62) | 7.84 | 6.49 | 14.33 | 190.54 | 52.45 | 16.89 | 69.34 | 1189.03 | 5.75 | 45.31 | 1.29 | 8.05 |
| 21. | TNEC-1256 | 17.65 | 83.21 (65.81) | 8.24 | 6.78 | 15.02 | 189.66 | 50.6 | 16.49 | 67.1 | 1249.75 | 5.58 | 45.61 | 1.17 | 7.3 |
| 22. | VAKULA | 20.1 | 82.61 (65.35) | 7.87 | 6.53 | 14.4 | 189.03 | 32.11 | 13.57 | 55.9 | 1189.08 | 3.5 | 46.72 | 0.91 | 5.68 |
| 23. | VEGAVATHI | 22.88 | 93.46 (75.18) | 7.67 | 6.25 | 13.92 | 190.73 | 57.29 | 19.12 | 76.41 | 1250.4 | 6.86 | 45.51 | 0.84 | 5.24 |
| 24. | VL-376 | 19.77 | 85.73 (67.81) | 8.24 | 6.3 | 14.54 | 189.66 | 47.97 | 15.66 | 63.63 | 1246.94 | 5.45 | 43.81 | 0.81 | 5.08 |
| 25. | VL-394 | 16.85 | 74.45 (59.64) | 7.82 | 5.63 | 13.44 | 189.71 | 58.16 | 18.57 | 76.72 | 1000.72 | 5.71 | 47.92 | 1.21 | 7.56 |
| 26. | VR-708 | 20.7 | 73.47 (59.00) | 7.44 | 5.66 | 13.09 | 187.71 | 35.37 | 11.75 | 47.12 | 962.02 | 3.46 | 49.32 | 1.16 | 7.25 |
| 27. | VR-900 | 17.68 | 83.53 (66.06) | 5.89 | 5.22 | 11.11 | 189.92 | 53.64 | 17.26 | 70.91 | 927.82 | 5.92 | 52.93 | 1.26 | 7.88 |
| 28. | WR-24 | 20.34 | 72.01 (58.12) | 7.83 | 6.37 | 14.2 | 189.36 | 33.01 | 10.65 | 43.65 | 1023.42 | 3.15 | 47.72 | 1.14 | 7.13 |
| 29. | INDRAVATHI © | 22.08 | 89.83 (71.40) | 7.89 | 6.4 | 14.29 | 189.34 | 32.4 | 10.55 | 42.95 | 1334.66 | 4.01 | 45.21 | 1.1 | 6.9 |
| 30. | TIRUMALA© | 20.66 | 94.46 (76.39) | 8.32 | 6.91 | 15.23 | 190.46 | 58.31 | 15.38 | 61.91 | 1432.66 | 5.85 | 36.89 | 1.28 | 7.98 |
|  | Mean | 20.41 | 85.09 | 7.87 | 6.22 | 14.10 | 189.78 | 45.50 | 14.99 | 60.49 | 1200.75 | 5.15 | 45.98 | 1.15 | 7.19 |
| SE (m)± | 0.26 | 0.78 | 0.10 | 0.08 | 0.43 | 1.33 | 0.42 | 0.21 | 0.57 | 16.27 | 0.05 | 0.50 | 0.02 | 0.16 |
| CD (5%) | 0.74 | 2.19 | 0.29 | 0.25 | 0.43 | 3.74 | 1.18 | 0.60 | 1.62 | 45.72 | 0.15 | 1.43 | 0.07 | 0.47 |
| CV (%) | 2.59 | 1.83 | 2.71 | 2.86 | 0.15 | 1.40 | 1.84 | 2.88 | 1.91 | 2.71 | 2.18 | 2.21 | 4.67 | 4.67 |

\*Values in the parenthesis indicate arc- sine transformed values

**Table 3. Mean performances of germplasm lines for 14 qualitative traits**. **SPG**- Speed of germination, **G (%)**- Germination percentage, **SL**-Shoot length (cm), **RL**- Root length (cm), **SDL**- Seedling length (cm), **SLFW**- Seedling fresh weight (mg), **SDW**- Shoot dry weight (mg), **RDW**- Root dry weight (mg), **SDLW**- Seedling dry weight, **SVI-I**- Seedling vigour index-I, **SVI-II** – Seedling vigour index-II, **EC**- Electrical conductivity of seed leachates (µS/ cm), **N**- Nitrogen content (mg), **P-** Protein content (%)

sample, and the genotype (Martins *et al*., 2002; Gaspar & Nakagawa, 2002; Dutra & Vieira, 2006). The higher seed leachate conductivity could also be an indicator of reduced seed coat membrane integrity this results from increased plasma membrane permeability which induces higher solute leakage and there by affects germination. (Sankar and mani *et al.* 2015). The results are in accordance with the above findings.

**Nitrogen content**

Significant differences in nitrogen content were observed among the germplasm lines studied and the range varied from 0.81 to 1.40 with a mean value of 1.15. Nitrogen content was found maximum for germplasm line PGCF-16 (1.40) followed by PR-1643(1.34) and GE 4600 (1.31). Whereas the minimum nitrogen content was reported in the germplasm line VL-376 (0.81) followed by Vegavathi (0.84) and Vakula (0.91).

**Protein content (%)**

Significant differences in protein content were observed among the germplasm lines studied and the range varied from 5.08 to 8.78 with a mean value of 7.19. maximum for germplasm line PGCF-16 (8.78) followed by PR-1643 (8.38) and GE 4600 (8.20). Whereas minimum protein content was reported in the germplasm line VL-376 (5.08) followed by Vegavathi (5.24) and Vakula (5.68). Similar variation in seed protein content were reported by Maloo *et al.* (1998) 6.37 to 13.00, Sankara *et al.* (1998) 6.7 to 12.4, Anusha *et al.* (2020) 2.6 to 9.2 and Upadhyaya *et al.* (2011). The variation in seed protein content among germplasm lines might be due to genetic diversity in the germplasm and seed composition.

High quality seed is essential and desirable to ensure good crop establishment. Establishment of seedling is extremely important in determining the yield of crop in short period of time (Misra 1990 and Misra *et al.,* 2002). The rate and degree of seedling establishment are extremely important factors in determining both yield and time of maturity (Briggs & Aylenfishu, 1979). Thus, seed quality testing has a great importance for the evaluation of varietal superiority in the given environment (Kumar *et al.,* 2015). Laboratory seed tests aim to provide accurate and reproducible guidance, rather than absolute answers or predictions.

**CONCLUSION:**

Based on the results obtained from present investigation, it may be concluded that the information, it may be concluded that the information generated in the present investigation on seed quality assessment can be used for isolating trait specific germplasm.

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