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EVALUATION OF AMARANTH (*Amaranthus* sp. L.) GENOTYPES FOR YIELD AND YIELD-CONTRIBUTING TRAITS UNDER KARAİKAL CONDITIONS

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ABSTRACT

A field investigation was carried out at the Eastern Farm of the Department of Horticulture, PAJANCOA & RI, Karaikal, Union Territory of Puducherry, to evaluate the performance of twenty-five genetically diverse amaranth [*Amaranthus* sp. (L.)] genotypes assembled from different agro-ecological regions of India. The genotypes were evaluated in a Randomized Block Design with two replications over two seasons and twenty-one growth, yield, physiological and biochemical quality traits were pooled for analysis after confirming homogeneity of error variance and a non-significant genotype $\times$ season interaction. Analysis of variance revealed highly significant ($P \leq 0.01$) differences among genotypes for all the traits studied, confirming the presence of exploitable genetic variability in the assembled germplasm. The genotype CO 2 recorded the highest total yield plot⁻¹ (4.47 kg, equivalent to an estimated yield of 14.89 t ha⁻¹), the highest fresh leaf weight plant⁻¹ (10.34 g), chlorophyll content (45.00 SPAD units), photosynthetic rate (26.27 $\mu\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$) and iron content (74.36 mg 100 g⁻¹), coupled with the lowest oxalate content (0.21 per cent), while recording an early germination of 3.00 days. Chawli Bhaji, Renu Sree and Red Amaranthus were identified as the next best genotypes for foliage yield and Amaranthus Red recorded the highest protein content (4.27 per cent). Wide genotypic variation was recorded for number of nodes plant⁻¹ (1.00 - 12.00) and days to germination (2.00 - 8.00 days), indicating scope for genotype specific agronomic recommendations. The study identifies CO 2, Chawli Bhaji, Renu Sree, Red Amaranthus and Amaranthus Red as promising donors for yield and quality improvement studies aimed at developing high-yielding, nutrient-dense amaranth cultivars suited to coastal saline tracts.

Key words : Amaranthus, Mean performance, Genotypic evaluation, Yield attributes, Nutraceutical quality, Coastal saline soils.

Introduction

Leafy vegetables occupy a pivotal position in human nutrition owing to their short growth duration, low input requirement and dense concentration of vitamins, minerals and antioxidant phytochemicals. Amaranth [*Amaranthus* sp. (L.)], often described as the “poor man’s spinach” (Negi, 2023), is cultivated widely across India, Africa, South America and South-East Asia both as a leafy vegetable and as a grain crop. It is valued for its rapid growth, adaptability to diverse agro-climatic niches and rich content of lysine, betalains, flavonoids and polyphenols that impart anti-inflammatory and antioxidant properties (Yadav and Yadav, 2024). India ranks as the world’s

second-largest vegetable producer and amaranth contributes substantially to leafy vegetable output in Tamil Nadu, Kerala, Andhra Pradesh, Odisha and West Bengal, which together account for over 60 per cent of the area under the crop.

The coastal agro-ecosystem of Karaikal, on the eastern seaboard of the Union Territory of Puducherry in the Cauvery deltaic tract, is characterised by saline, low-fertility soils and seasonal waterlogging that constrain crop performance relative to inland tracts. Realising the genetic potential of amaranth under such marginal environments is contingent on the availability of high-yielding, nutritionally superior genotypes, yet the

germplasm currently under cultivation in this belt is largely composed of unimproved local landraces that vary widely in yield, leaf pigmentation, texture and stress tolerance. Systematic evaluation of diverse genotypes for their mean performance is therefore the logical first step in any crop improvement programme, since it identifies superior genetic stocks for direct farmer use as well as donor parents for hybridisation (Chattopadhyay *et al.*, 2013; Jahan *et al.*, 2023). The present investigation was undertaken to assess the mean performance of twenty-five diverse amaranth genotypes for growth, yield, physiological and biochemical quality attributes at Karaikal, with a view to identifying superior genotypes suited to coastal saline region.

Materials and Methods

The present investigation was carried out at the Eastern Farm of the Department of Horticulture, Pandit Jawaharlal Nehru College of Agriculture and Research Institute (PAJANCOA & RI), Karaikal, Union Territory of Puducherry (10° 49' –11° 0' N latitude, 79° 52' E longitude, 4 m above mean sea level). The soil of the experimental site was sandy loam with medium fertility (pH 7.46; EC 1.12 dS m⁻¹). The site experiences a tropical climate with a mean maximum temperature of 34°C, mean minimum temperature of 18.1°C and average annual rainfall of 1437 mm spread over 56 rainy days.

Twenty-five diverse amaranth genotypes, procured from national research institutes, state agricultural universities and local seed sources across five states (Tamil Nadu, Karnataka, Kerala, Uttar Pradesh, Maharashtra, Andhra Pradesh and New Delhi), were evaluated in a Randomized Block Design (RBD) with two replications on raised beds (2.0 m × 1.5 m) over two seasons. Line sowing was adopted at 15 cm × 10 cm spacing and the crop was raised under uniform, recommended package of cultural practices including basal farmyard manure (2 t), neem cake (5 kg), urea (5 kg basal + 5 kg top dressing) and single super phosphate (10 kg).

Observations were recorded on twenty-one biometrical, yield, physiological and quality characters, viz., days to germination, plant height, leaf length, leaf width, petiole length, stem girth, number of leaves plant⁻¹, number of nodes plant⁻¹, fresh leaf weight plant⁻¹, dry leaf weight plant⁻¹, leaf stem ratio, total yield plot⁻¹, estimated yield ha⁻¹, harvest index, chlorophyll content (SPAD), photosynthetic rate, leaf area, iron content, protein content, crude fibre content and oxalate content, following standard procedures. Chlorophyll content and net photosynthetic rate were recorded using a Chlorophyll

Content Meter (CCM-200 Plus, Opti-Sciences) and a Portable Photosynthesis Meter (LCi-T, ADC BioScientific), respectively; leaf area was measured with a leaf area meter (Systronics 211); iron, protein, crude fibre and oxalate contents were estimated following Jackson (1958), Lowry *et al.* (1951), Maynard (1970) and Naik *et al.* (2014), respectively.

Since the error variances of the two seasons were found homogeneous by Bartlett's test and the genotype × season interaction was non-significant, pooled analysis of variance was performed by following Sundararaj *et al.* (1972) and the pooled mean values were used to describe the *per se* performance of the genotypes. Standard error and critical difference (CD) at P = 0.05 and P = 0.01 were computed as per Panse and Sukhatme (1954) to test the significance of genotypic differences over the general mean.

Results and Discussion

Pooled analysis of variance revealed highly significant (P ≤ 0.01) differences among the twenty-five amaranth genotypes for all twenty-one characters studied (Table 1), confirming the presence of substantial genetic variability in the germplasm assembled and validating the reliability of comparing genotypes on the basis of their pooled mean performance.

Growth attributes

Days to germination ranged widely from 2.00 to 8.00 days with a general mean of 3.24 days; eleven genotypes germinated in the shortest span of 2.00 days, whereas Kashi Suhaavani was the slowest to germinate (8.00 days) (Table 2). Rapid and uniform germination is agronomically desirable as it improves crop stand establishment, a trait similarly emphasised by Jamalluddin *et al.* (2021), while screening amaranth germplasm for early vigour.

Plant height varied from 16.62 cm (Arka Varna) to 32.47 cm (Arun), with nine genotypes exceeding the grand mean of 21.84 cm. Leaf length was maximum in CO 5 (9.69 cm) and minimum in Kadapa Local (Green) (5.08 cm), while the widest leaves were recorded in Vaika (7.55 cm) against a general mean of 4.97 cm. CO 2 recorded the longest petiole (5.75 cm), a trait associated with ease of harvest and bunching in leafy amaranth. These wide ranges corroborate the findings of Shellikeri (2022), who also reported considerable genotypic variation for vegetative descriptors in *Amaranthus tricolor*, reflecting the diverse genetic base sampled in the present study.

Stem girth was thickest in Arun (0.75 cm) and thinnest in Pal Cheera (0.35 cm), against a mean of 0.59 cm (Table 2). Number of leaves plant⁻¹ was highest in CO 5

Table 1 : Pooled analysis of variance (mean sum of squares) for twenty-one characters in twenty-five amaranth genotypes.

S. no.	Character	Replication mean sum of squares	Treatment mean sum of squares	Error mean sum of squares
1	Days to germination (days)	0.3200	4.3783**	0.2783
2	Plant height (cm)	0.0150	31.7300**	0.7040
3	Leaf length (cm)	0.0808	2.4068**	0.1241
4	Leaf width (cm)	0.0104	1.8003**	0.0468
5	Petiole length (cm)	0.0792	1.3883**	0.0588
6	Stem girth (cm)	0.0020	0.0258**	0.0009
7	Number of leaves plant ⁻¹	0.0381	5.3262**	0.3781
8	Number of nodes plant ⁻¹	0.0000	9.8750**	0.6250
9	Fresh leaf weight plant ⁻¹ (g)	0.0841	7.4116**	0.1667
10	Dry leaf weight plant ⁻¹ (g)	0.1764	0.7064**	0.0949
11	Leaf stem ratio	0.0019	0.2798**	0.0048
12	Total yield plot ⁻¹ (kg)	0.0007	0.6716**	0.0523
13	Estimated yield (t ha ⁻¹)	0.0079	7.4644**	0.5811
14	Harvest index (per cent)	0.0012	0.0063**	0.0006
15	Chlorophyll content (SPAD)	0.0260	179.8650**	1.6940
16	Photosynthetic rate ($\mu\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$)	8.3968	14.1100**	1.8030
17	Leaf area (cm ²)	0.2610	86.0780**	0.9990
18	Iron content (mg 100g ⁻¹)	6.6250	197.4280**	5.8524
19	Protein content (per cent)	0.0001	0.4649**	0.0253
20	Crude fibre content (per cent)	0.1502	1.3753**	0.1928
21	Oxalate content (per cent)	0.0000	0.0076**	0.0000

**Significant at 1% probability level.

(12.38), followed by Kadapa Local (Green) (11.28) and Arun (10.76), while number of nodes plant⁻¹ showed the widest relative spread among all traits studied (1.00 in CO 6 and Arun to 12.00 in CO 5), reflected in the high CV of 26.35 per cent. A higher node number in CO 5 indicates greater branching potential and repeated harvest capacity, consistent with the multiple-cut habit reported for high-yielding vegetable amaranth types by Kanthaswamy (2006).

Foliage yield and yield-contributing attributes

Fresh leaf weight plant⁻¹ was maximal in CO 2 (10.34 g), followed distantly by Indam Lal (8.57 g) and CO 5 (7.85 g), against a general mean of 5.29 g, while dry leaf weight followed a broadly similar trend, being highest in CO 2 (4.46 g) (Table 2). The leaf stem ratio, an index of the proportion of economically useful foliage relative to fibrous stem tissue, was likewise greatest in CO 5 (1.80) and CO 2 (1.69), both of which also recorded high leaf number and node number, suggesting that these genotypes

channel a disproportionately larger share of biomass into marketable leaf tissue, a trait similarly emphasised by Shellikeri (2022).

Total yield plot⁻¹ and the corresponding estimated yield ha⁻¹ followed an identical ranking, being highest in CO 2 (4.47 kg plot⁻¹; 14.89 t ha⁻¹), followed by Chawli Bhaji (3.48 kg; 11.60 t ha⁻¹), Renu Sree (3.10 kg; 10.34 t ha⁻¹) and Red Amaranthus (3.01 kg; 10.02 t ha⁻¹), while Arka Arunima recorded the lowest yield (1.80 kg plot⁻¹; 5.98 t ha⁻¹) (Table 2). Ten of the twenty-five genotypes exceeded the grand mean yield of 2.59 kg plot⁻¹ (8.64 t ha⁻¹). Harvest index, reflecting the efficiency of partitioning biomass into economic (leaf) yield, was highest in CO 2 and Ananthapuram Local (Red) (0.45 each) and lowest in Kashi Suhaavani (0.26), broadly paralleling the yield superiority of CO 2 reported here and consistent with the strong linkage between foliage yield and harvest index documented by Raja *et al.* (2012) in vegetable amaranth.

Table 2 : Combined mean performance of twenty-five amaranth genotypes for growth and yield characters.

Genotype	Name of the genotypes	Days to germination (days)	Plant height (cm)	Leaf length (cm)	Leaf width (cm)	Petiole length (cm)	Stem girth (cm)	No. of leaves plant ⁻¹	No. of nodes plant ⁻¹	Fresh leaf weight plant ⁻¹ (g)	Dry leaf weight plant ⁻¹ (g)	Leaf stem ratio	Total yield plot ⁻¹ (kg)	Estimated yield (t ha ⁻¹)	Harvest index (per cent)
T ₁	CO 2	3.00	21.23	8.35**	5.90**	5.75**	0.62	10.21**	2.00	10.34**	4.46**	1.69**	4.47**	14.89**	0.45**
T ₂	CO 6	2.00*	20.18	7.33	4.55	3.96	0.58	6.99*	1.00*	4.12**	2.65	0.88*	2.50	8.34	0.29*
T ₃	PLR 1	2.00	19.11**	5.76**	4.54	5.04**	0.53	7.77	6.00**	3.71**	2.46	0.76**	2.32	7.72	0.30
T ₄	Arka Arunima	4.00	25.56**	6.86	3.88**	3.16**	0.65	8.11	2.00	2.97**	1.86*	0.95	1.80**	5.98**	0.39
T ₅	Arka Suguna	3.00	23.81*	7.34	5.87**	3.81	0.49**	6.86*	3.00	6.69**	2.98	1.61**	2.86	9.52	0.34
T ₆	Arka Varna	4.00	16.62**	5.79**	4.64	4.07	0.65	7.94	3.00	4.42*	2.40	0.81**	2.32	7.72	0.31
T ₇	Arka Samraksha	4.00	24.80**	6.39	4.74	4.00	0.66*	7.00*	3.00	4.61	2.35	0.83**	2.37	7.88	0.34
T ₈	Arun	2.00*	32.47**	6.86	5.69**	3.73	0.75**	10.76**	1.00*	7.71**	2.88	1.73**	2.75	9.15	0.40*
T ₉	Renu Sree	4.00*	28.60**	7.93**	5.52*	4.89**	0.74**	7.95	2.00	6.10	3.15	1.17	3.10*	10.34*	0.35
T ₁₀	Vaika	4.00	19.50*	6.62	7.55**	4.30	0.47**	6.03**	2.00	3.85**	2.63	0.70**	2.54	8.45	0.27**
T ₁₁	Pusa Kiran	2.00*	24.89**	5.96*	3.70**	3.54	0.61	8.71	2.00	2.57**	1.79*	0.73**	1.93**	6.44**	0.41*
T ₁₂	Pusa Lal Chaulai	2.00*	24.62**	6.04*	4.22**	4.61*	0.46**	7.17	4.00	3.00**	2.17	0.76**	2.17	7.23	0.28**
T ₁₃	Kashi Suhaavani	8.00**	18.91**	7.75*	4.81	4.28	0.51*	7.51	2.00	3.62**	2.09	0.81**	2.12*	7.05*	0.26**
T ₁₄	Amaranthus Red	4.00	28.51**	8.22**	6.33**	4.83**	0.67*	10.40**	2.00	5.88	2.58	1.65**	2.48	8.25	0.40*
T ₁₅	Indam Lal	2.00*	21.57	6.69	5.25	4.21	0.47**	9.88*	2.00	8.57**	3.00	1.20*	2.99	9.97	0.41*
T ₁₆	Chawli Bhaji	6.00**	21.02	5.63**	5.43*	3.33**	0.69**	8.63	6.00**	5.75	3.50**	0.73**	3.48**	11.60**	0.39
T ₁₇	Red Amaranthus	4.00	18.00**	5.37**	4.21**	2.83**	0.56	7.42	2.00	6.93**	3.27*	1.06	3.01	10.02	0.40*
T ₁₈	Pal Cheera	3.00	18.41**	7.46	5.79**	5.20**	0.35**	7.75	6.00**	5.71	2.25	1.31**	2.52	8.38	0.29*
T ₁₉	CO 5	5.00**	20.31	9.69**	5.78**	4.57*	0.61	12.38**	12.00**	7.85**	2.77	1.80**	2.93	9.77	0.37
T ₂₀	Tiruvannamalai Local	2.00*	18.87**	5.78**	4.97	3.12**	0.74**	7.32	3.00	4.00**	2.31	0.98	2.09*	6.97*	0.28**
T ₂₁	Gobichettipalayam Local	2.00	17.27**	6.47	3.96**	4.12	0.67*	6.48**	2.00	5.13	2.46	0.89*	2.58	8.60	0.32
T ₂₂	Ananthapuram Local (Green)	2.00	18.76**	7.11	4.54	3.71	0.47**	6.81*	2.00	3.44**	1.73**	0.64**	1.85**	6.17**	0.38
T ₂₃	Ananthapuram Local (Red)	2.00	23.53	7.67*	4.69	4.17	0.70**	9.25	2.00	5.45	2.86	0.76**	2.99	9.97	0.45**
T ₂₄	Kadapa Local (Green)	2.00*	20.71	5.08**	4.38*	3.89	0.38**	11.28**	2.00	5.58	2.13	0.90	2.06*	6.85*	0.36
T ₂₅	Kadapa Local (Red)	3.00	18.79**	5.83*	3.27**	1.78**	0.69**	8.48	2.00	4.21*	2.67	0.70**	2.66	8.87	0.31
	Grand mean	3.24	21.84	6.79	4.97	4.04	0.59	8.36	3.00	5.29	2.62	1.04	2.59	8.64	0.35
	S.E.m ±	0.37	0.59	0.24	0.15	0.17	0.02	0.43	0.55	0.28	0.21	0.04	0.16	0.53	0.01
	CD (P = 0.05)	1.08	1.73	0.72	0.44	0.50	0.06	1.26	1.63	0.84	0.63	0.14	0.47	1.57	0.05
	CV (%)	16.08	3.84	5.18	4.35	6.01	5.06	7.35	26.35	7.72	11.77	6.62	8.82	8.82	6.96

* Significant at 5 per cent level; ** Significant at 1 per cent level.

Table 3 : Combined mean performance of twenty-five amaranth genotypes for physiological and quality characters.

Genotype	Name of the genotypes	Chlorophyll content (SPAD)	Photosynthetic rate ($\mu\text{mol CO}_2 \text{ m}^{-2}\text{s}^{-1}$)	Leaf area (cm^2)	Iron content ($\text{mg } 100\text{g}^{-1}$)	Protein content (per cent)	Crude fibre content (per cent)	Oxalate content (per cent)
T ₁	CO 2	45.00**	26.27**	32.35**	74.36**	3.47*	4.54**	0.21**
T ₂	CO 6	40.52**	21.24	20.84	45.80**	2.74	6.30	0.31
T ₃	PLR 1	22.59**	16.88*	16.07**	46.17**	2.63*	7.65**	0.33**
T ₄	Arka Arunima	39.23*	19.31	16.36**	40.02**	2.71*	7.13	0.40**
T ₅	Arka Suguna	41.20**	20.73	25.76**	53.78	2.68*	6.41	0.26**
T ₆	Arka Varna	22.71**	17.08*	20.23	44.33**	3.09	6.96	0.34**
T ₇	Arka Samraksha	40.95**	20.25	20.93	47.50*	2.67*	6.50	0.33**
T ₈	Arun	44.48**	22.50	25.96**	70.92**	3.87**	4.62**	0.26**
T ₉	Renu Sree	43.48**	23.13*	30.52**	56.42	3.46*	5.53	0.22**
T ₁₀	Vaika	40.91**	17.89	29.80**	52.48	2.73*	7.20*	0.29
T ₁₁	Pusa Kiran	40.91**	17.68	15.09**	54.17	2.81	6.56	0.39**
T ₁₂	Pusa Lal Chaulai	20.91**	18.62	14.75**	51.01	3.26	5.79	0.35**
T ₁₃	Kashi Suhaavani	21.63**	15.32**	21.19	46.75**	2.41**	6.53	0.36**
T ₁₄	Amaranthus Red	42.16**	24.16**	31.37**	70.89**	4.27**	5.25*	0.32**
T ₁₅	Indam Lal	40.48**	22.73	21.92	65.46**	3.30	5.31*	0.23**
T ₁₆	Chawli Bhaji	41.50**	23.24*	18.99**	63.66**	3.56**	5.67	0.21**
T ₁₇	Red Amaranthus	42.61**	18.54	14.26**	61.69**	2.90	6.70	0.23**
T ₁₈	Pal Cheera	22.82**	17.24*	31.40**	46.21**	2.92	6.26	0.31
T ₁₉	CO 5	43.98**	20.83	34.77**	55.55	3.84**	5.79	0.25**
T ₂₀	Tiruvannamalai Local	40.65**	21.29	19.67*	40.87**	2.78	6.59	0.37**
T ₂₁	Gobichettipalayam Local	42.19**	17.79	18.38**	53.50	2.77	7.17*	0.28**
T ₂₂	Ananthapuram Local (Green)	21.38**	18.17	19.34*	36.03**	2.30**	7.67**	0.39**
T ₂₃	Ananthapuram Local (Red)	44.16**	20.08	23.72	56.96	3.33	5.83	0.24**
T ₂₄	Kadapa Local (Green)	24.59**	22.05	14.40**	55.78	2.92	6.15	0.38**
T ₂₅	Kadapa Local (Red)	22.20**	20.36	12.28**	52.92	3.03	6.21	0.28**
	Grand mean	35.73	20.14	22.01	53.73	3.06	6.25	0.30
	S.Em $\pm$	0.92	0.94	0.70	1.71	0.11	0.31	0.01
	CD (P = 0.05)	2.68	2.77	2.06	4.99	0.32	0.90	0.01
	CV (%)	3.64	6.67	4.54	4.50	5.21	7.02	0.01

* Significant at 5 per cent level; ** Significant at 1 per cent level.

Physiological attributes

Chlorophyll content, photosynthetic rate and leaf area are physiological determinants of the photosynthetic source strength underlying foliage yield. CO 2 recorded the highest values for all three traits (45.00 SPAD units,

26.27 $\mu\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$ and 32.35 cm^2 , respectively), while Pusa Lal Chaulai recorded the lowest chlorophyll content (20.91 SPAD units) and Kashi Suhaavani recorded the lowest photosynthetic rate (15.32 $\mu\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$) (Table 3). CO 5 recorded the largest leaf area

(34.77 cm²). Seventeen of the twenty-five genotypes exceeded the mean chlorophyll content of 35.73 SPAD units, indicating that pigment concentration was generally high across the germplasm, though genotypic differentiation remained sharp (CV = 3.64 per cent). The concurrent superiority of CO 2 for chlorophyll content, photosynthetic rate and foliage yield lends physiological support to the yield advantage of this genotype and aligns with the positive source-sink relationship reported for leafy amaranth by Jahan *et al.* (2023).

Biochemical quality attributes

Iron content, an important nutraceutical trait in leafy amaranth, ranged from 36.03 mg 100 g⁻¹ in Ananthapuram Local (Green) to 74.36 mg 100 g⁻¹ in CO 2, with Arun (70.92 mg 100 g⁻¹) and Amaranthus Red (70.89 mg 100 g⁻¹) also recording high values (Table 3). Protein content was highest in Amaranthus Red (4.27 per cent), followed by Arun (3.87 per cent) and CO 5 (3.84 per cent), while Ananthapuram Local (Green) recorded the lowest value (2.30 per cent). Crude fibre content, a trait desirable at low levels for palatability, was minimum in CO 2 (4.54 per cent) and Arun (4.62 per cent) and maximum in Ananthapuram Local (Green) (7.67 per cent). Oxalate content, an antinutritional factor that reduces mineral bio-availability, was lowest in CO 2 and Chawli Bhaji (0.21 per cent each) and highest in Arka Arunima (0.40 per cent), with twelve genotypes recording below-mean oxalate levels. The combination of high iron and protein content with low oxalate and crude fibre observed in CO 2 and Arun is nutritionally desirable and is in agreement with the inverse relationship between oxalate and mineral availability reported by Raja *et al.* (2012), Shukla *et al.* (2006) and Shellikeri (2022) in vegetable amaranth.

Taken together, the results identify CO 2 as the most consistently superior genotype, combining early germination, high foliage yield, favourable physiological attributes and superior nutraceutical quality with low anti-nutrient content, followed by Chawli Bhaji, Renu Sree, Red Amaranthus and Arun as promising genotypes for specific traits. The considerable range of variation recorded for nearly every character, together with the highly significant genotypic differences revealed by analysis of variance, indicates that the germplasm assembled in this study offers a sound genetic base for further development of high-yielding, nutrient-dense amaranth cultivars for coastal saline environments.

Conclusion

The present study demonstrated wide and statistically significant genotypic variation among twenty-five

amaranth genotypes for growth, yield, physiological and biochemical quality traits evaluated under the coastal saline conditions of Karaikal. The genotype CO 2 emerged as the outstanding performer for foliage yield, physiological efficiency and nutraceutical quality, while Chawli Bhaji, Renu Sree, Red Amaranthus, Arun and Amaranthus Red were identified as additional promising genotypes for specific yield and quality attributes. These genotypes merit further evaluation across locations and seasons and constitute valuable base material for hybridisation programmes and multi-trait selection aimed at developing high-yielding, nutrient-rich amaranth cultivars suited to coastal saline tracts.

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