Indian J. Hort. 68(1), March 2011: 131-135

Short communication

Evaluation of vegetable amaranthus (*Amaranthus dubius* Mart. ex Thell.) in the humid tropics of Kerala

V.A. Celine*, L. Sindhu and L. Rajamony
Department of Olericulture, College of Agriculture, Vellayani, Thiruvananthapuram 695 522, Kerala.

Amaranthus, belonging to the family Amaranthaceae is one of the most nutritious leafy vegetable widely cultivated throughout India. The genus *Amaranthus* consists of about 60 species of which *Amaranthus tricolor* L., *A. dubius* Mart. ex Thell. and *A. tristis* L. are the major ones cultivated as vegetable. The grain amaranthus species, *viz.*, A. *hypochondriacus* L., *A. caudatus* L. and *A. cruentus* L. are used as vegetable in the tender stage to some extent. However, in Kerala, the red leaved *A. tricolor*, a native of India remains the best choice**.** The widespread occurrence of leaf blight caused by *Rhizoctonia solani* characterized by dull white spots on the leaves which later coalesce together reducing its marketability is the major constraint in its production especially during the two monsoons. Earlier studies using a wide germplasm of 65 genotypes including *Amaranthus tricolor*, *A. tristis, A. dubius* and weedy species indicated that the species *A. dubius* the only polyploid species (2n = 64) was resistant to the leaf blight disease (Priya, 6). Based on these results, a wide germplasm of the resistant species, *A. dubius* was collected and evaluated under field conditions to locate a high yielding and disease resistant line suitable for cultivation under the hot humid tropical conditions of Kerala.

The experiments were conducted at the College of Agriculture, Vellayani, Thiruvananthapuram, Kerala for two years. The site was located at 8°5' N latitude and 77°1' E longitude at an altitude of 29 m above mean sea level. Predominant soil type of the experimental site was red loam belonging to Vellayani series, texturally classified as sandy clay loam. The experimental material consisted of 32 accessions of *A. dubius* including 31 diverse genotypes supplied by the North Central Regional Plant Introduction Station, Iowa State University, USA (Table 1). The experiments were laid out in randomized block design with two replications. The popular variety Arun belonging to *A. tricolor* was grown as a susceptible check. The crop was raised as a transplanted crop. Seedlings were transplanted 25 days after sowing at a spacing of 30 cm × 20 cm.

*Corresponding author's E-mail: vaceline 2001@yahoo.com

Table 1. List of *Amaranthus dubius* Mart. ex Thell. accessions used for the study.

Sl. No	Accession No.	Identity No.	Source country
1	AD 1	AMES 10842	Seychelles
2	AD 2	AMES 19996	Yemen
3	AD 3	AMES 15201	Nigeria
4	AD 4	AMES 2020	Puerto Rico
5	AD 5	AMES 2014	Surinam
6	AD 6	AMES 2018	Puerto Rico
7	AD 7	AMES 2068	Nepal
8	AD 8	AMES 1967	Tamil Nadu, India
9	AD 9	AMES 2009	Ghana
10	AD 10	AMES 1987	Unknown
11	AD 11	AMES 2005	Tanzania
12	AD 12	AMES 1994	Taiwan
13	AD 13	AMES 1997	Ghana
14	AD 14	AMES 5312	Jamaica
15	AD 15	AMES 5164	Puerto Rico
16	AD 16	AMES 10340	Czechoslovakia
17	AD 18	AMES 5107	Virgin Island
18	AD 19	AMES 5105	Seychelles
19	AD 20	AMES 5114	Taiwan
20	AD 21	AMES 5104	Seychelles
21	AD 22	AMES 2136	Tamil Nadu, India
22	AD 23	AMES 2098	India
23	AD 24	PI 612850	United States
24	AD 25	PI 576483	Nigeria
25	AD 26	PI 605352	Jamaica
26	AD 28	PI 536444	Maldives
27	AD 29	PI 536441	Maldives
28	AD 30	PI 536438	Maldives
29	AD 31	PI 490348	Burkina Faso
30	AD 32	PI 532151	Oman
31	AD 33	PI 482047	Zimbabwe
32	AD 34	CO 1	Vellayani, India

Twenty plants were maintained in each plot. The crop received timely management practices

as recommended by the Kerala Agricultural University (Anon., 1).

Observations on biometrical characters like plant height, number of branches, stem girth, leaf length, leaf width, days to bolting and yield were recorded from five plants selected at random. The accessions were also scored for incidence of leaf blight caused by *Rhizoctonia solani* on a 0 to 4 scale (0 – No incidence; 1 – upto 25 per cent leaf area infected; 2 – upto 50 per cent leaf area infected; 3 – upto 75 per cent leaf area infected; 4 – upto 100 per cent leaf area infected).

Remarkable variability for biometric characters was reported by many workers in vegetable amaranthus (Vijayakumar, 12; Varalakshmi, 11; Shukla *et al*., 9; Shukla *et al*., 10) and in grain amaranth (Rana *et al*., 7). In the present experiment, the analysis of variance showed significant variation in all the characters studied in the first year (Table 2) and second year (Table 3). During the first year, the accession AD 30 had the maximum height and girth whereas, it was maximum for AD 22 in the second year trial. Leaf length was highest for AD 31 and the broadest leaves were that of AD 3 in the first

Table 2. Mean performance of *A. dubius* accessions during first year.

Accession No.	Plant height (cm)	Stem girth (cm)	Leaf length (cm)	Leaf width (cm)	Branches / plant	Days to bolting	Yield / plant (g)
AD 1	39.35	4.24	23.79	12.17	5.26	68.87	288.8
AD 2	32.00	4.17	26.33	13.66	3.15	73.55	255.5
AD 3	34.75	5.06	22.33	15.12	3.90	69.17	328.0
AD 4	51.70	3.75	19.73	8.32	7.52	52.26	193.0
AD 5	47.31	4.92	18.00	8.75	4.40	58.97	318.5
AD 6	42.80	3.25	18.25	8.25	5.09	50.94	132.5
AD 7	41.08	5.00	19.60	7.95	6.1	55.79	304.0
AD 8	49.43	3.45	19.10	11.05	6.90	59.22	261.5
AD 9	35.84	3.95	18.00	10.20	4.27	56.98	245.0
AD 10	41.12	4.49	15.48	9.97	4.09	61.45	260.0
AD 11	38.21	4.30	17.75	12.15	4.00	60.88	316.0
AD 12	25.13	4.35	15.38	10.61	5.05	60.68	222.0
AD 13	50.55	5.36	20.40	10.69	4.66	61.15	369.5
AD 14	54.85	4.36	17.30	7.18	6.03	54.14	245.5
AD 15	47.20	4.33	19.84	9.26	4.03	55.19	176.0
AD 16	36.63	2.57	20.08	7.30	7.20	43.51	195.0
AD 18	54.25	5.95	24.87	13.35	5.76	64.76	363.0
AD 19	48.50	3.5	15.10	8.75	4.15	55.80	205.0
AD 20	35.10	3.65	16.82	13.70	3.16	69.09	184.0
AD 21	51.75	4.80	18.10	10.66	4.18	59.03	246.0
AD 22	52.70	5.42	19.02	11.44	4.45	58.84	226.5
AD23	50.40	4.70	21.87	11.25	5.09	55.30	382.0
AD 24	51.47	3.83	18.20	7.98	7.42	51.67	248.0
AD 25	40.12	4.85	19.71	12.16	4.75	59.41	260.0
AD 26	52.91	3.94	22.80	9.75	4.67	55.65	266.0
AD 28	21.86	3.05	18.18	9.05	2.84	63.41	136.5
AD 29	40.56	3.82	17.06	8.70	1.00	70.79	347.5
AD 30	60.69	7.10	26.65	12.95	5.25	72.82	329.5
AD 31	47.43	6.75	28.60	14.10	7.10	73.01	278.0
AD 32	29.91	4.50	24.08	14.89	4.38	73.92	351.5
AD 33	51.17	6.32	10.80	10.65	6.07	54.15	271.5
AD 34	45.75	4.16	15.21	7.61	6.11	76.61	340.6
CD (p = .05)	12.39	1.05	3.44	1.57	1.94	2.87	49.09

Table 3. Mean performance of *A. dubius* accessions for II year.

Accession No.	Plant height (cm)	Stem girth (cm)	Leaf length (cm)	Leaf width (cm)	Branches /plant	Days to bolting	Yield / plant (g)
AD 1	36.12	4.43	21.02	9.42	6.30	51.53	164.50
AD 2	38.09	4.36	17.92	9.52	6.92	58.30	352.12
AD 3	32.93	3.47	19.90	9.74	5.93	47.80	182.76
AD 4	35.73	3.68	18.67	8.11	7.94	48.07	201.00
AD 5	32.99	4.22	19.84	11.41	5.99	61.67	277.00
AD 6	36.12	3.41	13.41	6.39	6.92	49.40	192.30
AD 7	40.68	4.33	23.25	10.09	7.27	54.20	320.00
AD 8	53.39	5.28	21.00	9.59	7.70	59.30	401.00
AD 9	35.98	4.31	18.70	8.00	6.63	60.00	256.50
AD 10	39.11	4.45	18.64	9.58	6.76	65.63	165.60
AD 11	54.14	3.05	18.68	6.49	8.59	54.53	415.00
AD 12	38.22	4.45	20.26	8.07	6.10	71.13	237.00
AD 13	41.88	5.02	21.81	9.31	7.17	61.00	234.40
AD 14	51.00	4.22	19.08	7.21	8.43	50.33	352.30
AD 15	46.22	4.41	21.76	9.11	7.03	48.80	169.12
AD 16	41.57	5.29	18.00	6.40	6.63	61.60	240.80
AD 18	46.45	5.45	20.14	9.08	5.13	54.13	386.13
AD 19	41.03	5.73	21.96	8.69	4.00	52.67	211.61
AD 20	36.84	2.77	19.66	5.75	6.97	52.13	183.39
AD 21	49.08	5.27	27.91	12.47	4.24	59.00	401.33
AD 22	58.20	5.91	25.99	13.02	7.60	66.00	407.18
AD 23	55.68	5.70	19.75	9.28	6.23	73.00	445.00
AD 24	34.39	4.21	17.21	6.52	5.07	60.93	188.00
AD 25	43.57	3.27	20.47	10.17	4.83	53.67	382.00
AD 26	36.92	4.46	19.14	8.64	6.50	72.47	405.30
AD 28	57.19	5.28	20.3	7.43	5.57	61.61	274.24
AD 29	52.36	2.97	21.53	10.20	6.33	60.00	366.23
AD 30	48.77	4.61	23.12	11.07	5.80	62.13	464.80
AD 31	44.92	3.13	18.02	8.53	5.11	51.73	276.90
AD 32	37.49	2.49	21.77	10.69	4.70	64.00	165.40
AD 33	44.52	4.70	14.90	6.80	7.07	58.40	238.00
AD 34	44.67	4.04	22.25	10.17	4.64	75.13	155.90
CD (p = 0.05)	1.989	0.358	0.168	0.246	0.602	1.253	18.372

experiment but in the second year, the best were AD 21 and AD 22, respectively. The total number of branches is another factor contributing to yield. In this experiment, AD 4 and AD 11 had the highest number in the first and second year respectively. But they were comparatively poor yielders. In multi-cut types, late bolters are preferred as it gives more number of harvests and thereby higher yield. The accession AD 34 took maximum days to flowering in both the years. A range of 36.38 to 74.5 (Priya, 6) and 51.5 to 112 days (Hossain and Rahman, 5) for flowering reported earlier is in line with the present results indicating scope for breeding of late bolting types of amaranthus.

The highest yield (382.0 g/plant) was recorded by AD 23 (AMES 2098) which is closely followed by AD 13 and AD 18 in the first year. In the second year, the accession AD 30 (PI 536438) recorded the highest

Table 4. Pooled mean of vegetative growth and yield characters in *A. dubius* accessions.

Accession No.	Plant height (cm)	Stem girth (cm)	Leaf length (cm)	Leaf width (cm)	Branches /plant	Days to bolting	Yield / plant (g)
AD 1	37.73	4.33	22.40	10.79	5.78	60.20	226.65
AD 2	35.04	4.26	22.12	11.59	5.03	65.92	303.81
AD 3	33.84	4.26	21.11	12.43	4.91	58.48	255.38
AD 4	43.71	3.71	19.2	8.21	7.73	50.16	197.00
AD 5	40.15	4.57	18.92	10.08	5.19	60.32	297.75
AD 6	39.46	3.33	15.83	7.32	6.00	50.17	162.40
AD 7	40.88	4.66	21.42	9.02	6.68	54.99	312.00
AD 8	51.41	4.36	20.05	10.32	7.30	59.26	331.25
AD 9	35.91	4.13	18.35	9.10	5.45	58.49	250.75
AD 10	40.11	4.47	17.06	9.77	5.42	63.54	212.80
AD 11	46.17	3.67	18.21	9.32	6.29	57.70	365.50
AD 12	31.67	4.40	17.82	9.34	5.57	65.90	229.50
AD 13	46.21	5.19	21.10	10.00	5.91	61.07	301.95
AD 14	52.92	4.29	18.19	7.19	7.23	52.23	298.90
AD 15	46.71	4.37	20.80	9.18	5.53	51.99	172.56
AD 16	39.10	3.93	19.04	6.85	6.91	52.55	217.90
AD 18	50.35	5.70	22.50	11.21	5.44	59.44	374.56
AD 19	44.76	4.61	18.53	8.72	4.07	54.23	208.30
AD 20	35.97	3.21	18.24	9.72	5.06	60.61	183.69
AD 21	50.41	5.03	23.00	11.56	4.21	59.01	323.66
AD 22	55.45	5.66	22.50	12.23	6.02	62.42	316.84
AD23	53.04	5.20	20.81	10.26	5.66	64.15	413.50
AD 24	42.93	4.02	17.70	7.25	6.24	56.30	218.00
AD 25	41.84	4.06	20.09	11.16	4.79	56.54	321.00
AD 26	44.91	4.20	20.97	9.19	5.58	64.06	335.65
AD 28	39.52	4.16	19.24	8.24	4.20	62.51	205.37
AD 29	46.46	3.39	19.29	9.45	3.66	65.39	356.86
AD 30	54.73	5.85	24.88	12.01	5.52	67.47	397.15
AD 31	46.17	4.94	23.31	11.31	6.10	62.37	277.45
AD 32	33.70	3.49	22.92	12.79	4.54	68.96	258.45
AD 33	47.84	5.51	12.85	8.72	6.57	56.27	254.75
AD 34	45.21	4.10	18.73	8.89	5.37	75.87	248.25

yield (464.8 g/plant) followed by AD 23 and AD 11. The results are in agreement with the findings of Campbell and Abbott (2), and Celine *et al.* (3) who reported the superior performance of *A. dubius* accessions compared to the other amaranthus species. In *A. tricolor*, Shukla and Singh (8) reported a foliage yield of 285.24 g/plant. The vigorous growth and high yield of *A. dubius* may be attributed to its polyploid nature.

The results of field screening for incidence of leaf blight revealed that all the *A. dubius* accessions were free from the incidence of leaf blight recording a score of zero whereas the susceptible check, *A. tricolor* cv. Arun recorded a PDI of 53.8 and 68.1 for the first and second year respectively which is indicative of high inoculum potential in the field. This confirms the observations of Gokulapalan *et al.* (4), and Priya (6).

The pooled means for the two experiments (Table 3) revealed the superiority of the best accessions in the first and second year trials. The performance of the accessions AD 30, AD 23 and AD 22 were superior for most of the characters like plant height, girth, leaf

size and yield. They were late bolters and field resistant to leaf blight. Among these, the top yielder AD 30 can be recommended for cultivation in endemic areas as an *ad hoc* measure. As the preference of Keralites is for red varieties of amaranthus, as a next step, the green *A. dubius* can be utilized in further breeding programme to incorporate the resistance to the popular *A. tricolor* varieties.

ACKNOWLEDGEMENTS

The authors are grateful to the North Central Regional Plant Introduction Station, Iowa State University, USA and NBPGR, Delhi for supplying the germplasm.

REFERENCES

1. Anonymous. 1996. *Package of Practices Recommendations 'Crops'*. Eleventh Edn. Directorate of Extension, Kerala Agricultural University, Thrissur, 267 p.

2. Campbell, T.A. and Abbott, J.A 1982. Field evaluation of vegetable amaranth (*Amaranthus* spp.). *HortSci.* **17**: 407-9.

3. Celine, V.A., Shankaran, S.S., Seema, S., Deepa, S.N., Sreelathakumary, I., and Vahab, M.A. 2007. Characterization and evaluation of vegetable amaranthus (*Amaranthus tricolor* L.) for high yield, quality and resistance to *Rhizoctonia solani*. *Acta Hort.* **752**: 447-51.

4. Gokulapalan, C., Reghunath, P., Celine, V.A. and Nair, R.S. 1997. Menace to amaranthus. *Kisan Wld*. **24**: 44.

5. Hossain, S.I. and Rahman, M.M. 1999. Response of amaranth genotypes (*A. tricolor* L.) to stem production. *Ann. Bangladesh Agric.* **9**: 105-12.

6. Priya, V.P. 1998. Screening amaranth genotypes (*Amaranthus* spp.) for yield, quality and resistance to biotic stress. M.Sc. (Hort.) thesis, Kerala Agricultural University, Thrissur, 103 p.

7. Rana, J.C., Yadav, S.K., Mandal, S., Sangeeta, Y. 2005. Genetic divergence and interrelationship analysis in grain amaranth (*Amaranthus hypochondriacus*) germplasm. *Indian J. Genet*. **65**: 99-102.

8. Shukla, S. and Singh, S.P. 2002. Varietal performance and foliage yield in vegetable amaranth. *Indian J. Pl. Genet. Resour.* **13**: 147-50.

9. Shukla, S., Bhargava, A., Chatterjee, A., Srivastava, A. and Singh, S.P. 2006. Genotypic variability in vegetable amaranth (*Amaranthus tricolor* L.) for foliage yield and its contributing traits over successive cuttings and years. *Euphytica,* **151**: 103-10.

10. Shukla, S., Bhargava, A., Chatterjee, A., Pandey, A.C. andcMishra, B.K. 2010. Diversity in phenotypic and nutritional traits in vegetable amaranth (*Amaranthus tricolor*), a nutritionally underutilised crop. *J. Sci. Food Agric.* **90**: 139-44.

11. Varalakshmi, B. 2004. Characterization and preliminary evaluation of vegetable amaranth (*Amaranthus* spp.) germplasm. *Pl. Genet. Resour. Newslett.* **137**: 55-57.

12. Vijayakumar, M. 1980. Studies on growth and development of certain types of amaranthus (*Amaranthus* sp.). M.Sc. (Ag.) thesis, Tamil Nadu Agricultural University, Coimbatore, 115 p.

Received: November, 2009; Revised: November, 2010; Accepted : December, 2010