DOI : 10.5958/0974-0112.2018.00057.9

Indian J. Hort. 75(2), June 2018: 337-340

Short Communication

Stability of yield and its components in vegetable amaranth

R.S. Pan* and A.K. Singh

ICAR Research Complex for Eastern Region Research Centre, Ranchi 834 010, Jharkhand

ABSTRACT

An experiment was conducted during summer season (February-April) of 2008, 2010 and 2011 at ICAR Research Complex for Eastern Region Research Centre, Ranchi (Jharkhand, India) to study the stability parameters viz., regression coefficient (bi) and mean square deviations (s^2di) from linear regression, along with *per-se* performance of 14 lines/varieties of vegetable amaranth (*Amaranthus tricolor* L.) for nine yield related characters. The line HAMTH-15 (19.79 t/ha) was the top yielder of greens/ha, stable and suitable for favourable environment. The line was also better performing, stable and suitable for favourable environment for length of internode (6.16 cm), length of lamina (9.23 cm) and width of lamina (6.34 cm) and for unfavourable environment for girth of stem (0.64 cm) and leaf-stem ratio (1.05). The line HAMTH-13 was also very promising, stable and suitable for unfavourable environment for yield of greens (17.43 t/ha).

Key words: *Amaranthus tricolor*, stability parameters, regression coefficient.

Amaranth is one of the most important leafy vegetables of tropical and subtropical parts of the world. The leaves and tender stems provide cheap but rich source of vitamins A and C and elements like N, P, K, Ca, Mg, Fe, Na and Zn (Peter *et al.*, 3). Being a C_4 plant, it is highly efficient in biomass production. Among the different species of amaranth, *Amaranthus tricolor* L. is the most commonly grown species in India. The crop is grown almost round the year in Eastern Plateau and Hill Region of India. There is no report of recommended stable and high yielding cultivar of vegetable amaranth for Eastern Plateau and Hill Region. In this context, a large number of germplasm of vegetable amaranth were collected from different parts of the country and evaluated at ICAR Research Complex for Eastern Region Research Centre, Ranchi, Jharkhand which is located in Eastern Plateau and Hill Region. This resulted in isolation of 12 promising genotypes. The stability parameters have been studied by Shukla and Singh (4) for foliage yield parameters in vegetable amaranth under northern Indian condition of Lucknow, Uttar Pradesh. However, there is no information on stability of yield of greens (leafy shoots) and its components in vegetable amaranth in Eastern Plateau and Hill Region of India. With this background, the promising genotypes of vegetable amaranth were evaluated to identify a few stable and high yielding genotypes to be suitable for commercial cultivation in Eastern Plateau and Hill Region of India through stability analysis.

Twelve genotypes of vegetable amaranth viz., HAMTH-5, HAMTH-9, HAMTH-13, HAMTH-15, HAMTH-16, HAMTH-21, HAMTH-24, HAMTH-29, HAMTH-33, HAMTH-42, HAMTH-43 and HAMTH-48 collected from Jharkhand, Bihar, West Bengal and NBPGR Regional Station, Vellanikkara, Thrissur, Kerala and two released varieties Pusa Lal Chaulai and Pusa Kirti collected from Indian Agricultural Research Institute were grown during summer season (February-April) of 2008, 2010 and 2011. An experiment on each environment (year) was conducted in Randomized Block Design with 3 replications. A spacing of 30 cm × 3-4 cm was maintained. Observations on a set of nine agro-morphological characters viz., days to 1st clipping, girth of stem, length of internode, length of lamina, width of lamina, leaf-stem ratio, number of clippings, duration of harvest and total yield of greens (leafy shoots)/plot (1.8 m^2) were recorded. The total yield of greens/plot was converted into t/ha. Ten randomly selected leafy shoots were used for recording data on girth of stem, length of internode, length of lamina and width of lamina. The data were analyzed statistically for stability parameters based on Eberhart and Russell (1) model.

The analysis of variance of pooled data indicated highly significant/significant differences among 14 genotypes of vegetable amaranth and the environments for all the nine characters studied. However, stability analysis of variance of mean data indicated significant/highly significant differences among the genotypes for length of internode, length of lamina and leaf-stem ratio. The environment + G × E interactions were highly significant when tested against pooled error for all the characters which satisfied the requirement of stability analysis

*Corresponding author's E-mail: rabispan@rediffmail.com

i.e., the genotypes interacted considerably with the environment in expression of the characters. Similar results were reported by Varalakshmi (7) in her study on stability analysis of five quantitative traits in 14 vegetable amaranth lines. Sharma *et al.* (5) and Varalakshmi and Pratap Reddy (8) also observed significant differences for environments and G × E interactions for yield characters in their studies in grain amaranth. Highly significant mean sum of squares due to environment (linear) for all the characters except width of lamina indicated considerable differences among the environments and their predominant effects on the characters. This was due to variation in weather conditions during different years and locations. Shukla and Singh (4) also observed highly significant mean sum of squares due to environment and environment + G × E interaction in their study on stability of foliage yield in vegetable amaranth (*Amaranthus tricolor* L.). Non-significant linear component of G × E interactions and highly significant pooled deviation for all the characters except length of internode indicated non-linear response of the genotypes due to environmental changes and role of unpredictable component of G × E interactions towards differences in stability of the genotypes. Kishore *et al.* (2) also reported significant pooled deviation for seed yield traits in stability analysis of eight diverse genotypes of grain amaranth (*Amaranthus hypochondriacus* L.). However, even for unpredictable traits, prediction can still be made on considering stability parameters of individual genotypes (Singh *et al.*, 6).

Eberhart and Russell (1) suggested an ideal genotype as one having high mean performance, regression coefficient (bi) near unity and deviation from regression (s^2di) near zero. The line HAMTH-48 took 39 days for 1st clipping which was earlier than population mean (43 days) (Table 1a). The line recorded bi value <1 and very less and non-significant s^2di value which indicated its stability and adaptation to unfavourable environment.

The lines HAMTH-29 (0.67 cm), HAMTH-42 (0.66 cm) and HAMTH-15 (0.64) performed better than population mean (0.63 cm) in respect of girth of stem. HAMTH-42 and HAMTH-15 recorded bi values <1 and zero s^2di values which indicated their stability and adaptation to unfavourable environment. HAMTH-29 recorded bi value >1 and zero s^2di value which indicated its stability and adaptation to specific favourable environment. The lines HAMTH-48 (6.37 cm), HAMTH-15 (6.16 cm), HAMTH-29 (5.68 cm) and HAMTH-42 (5.63 cm) performed better than population mean (5.10 cm) in respect of length of internode. HAMTH-48, HAMTH-15 and HAMTH-42

Table 1a: Stability parameters for yield and its contributing characters in vegetable amaranth.

Accession	Days to 1st clipping			Girth of stem (cm)			Length of internode (cm)		
	X	bi	S^2di	X	bi	S^2di	X	bi	S^2di
1. HAMTH-5	44.3	1.17	0.10	0.46	0.97*	0.00	3.59	0.86	1.12
2. HAMTH-9	44.0	1.12	-0.35	0.61	1.75*	0.01*	3.93	0.73	-0.11
3. HAMTH-13	44.1	1.14	-0.28	0.63	0.22*	-0.00	5.40	0.82	1.19
4. HAMTH-15	44.1	1.14	-0.28	0.64	-0.22*	0.00	6.16	1.27	0.45
5. HAMTH-16	44.1	1.14	-0.28	0.63	1.33*	0.00	4.91	1.32	0.11
6. HAMTH-21	41.3	0.85	11.46**	0.79	0.64*	0.06**	4.89	0.85	-0.45
7. HAMTH-24	44.3	1.17	0.10	0.70	0.70*	0.01*	4.46	1.05	-0.32
8. HAMTH-29	43.0	0.96	2.89**	0.67	1.60*	-0.00	5.68	0.87	-0.44
9. HAMTH-33	42.1	0.82	11.58**	0.61	2.37**	0.00	4.99	1.03	-0.42
10. HAMTH-42	43.2	1.00	1.57*	0.66	0.55*	-0.00	5.63	1.25	-0.25
11. HAMTH-43	43.7	1.08	-0.23	0.46	1.07*	0.00	5.08	1.26	-0.33
12. HAMTH-48	39.0	0.48	0.45	0.73	0.48*	0.02*	6.37	1.16	0.95
13. Pusa Lal Chaulai	41.3	0.85	11.46**	0.67	0.99*	0.09**	5.08	0.53	-0.09
14. Pusa Kirti	43.3	1.01	1.04*	0.62	1.50*	-0.00	5.20	0.93	-0.07
General mean	43.0			0.63			5.10		
SE (Mean)	1.26			0.10			0.52		
SE of bi		0.17			1.50			0.24	

*Significant at 0.05, **Significant at 0.01 probability level recorded bi values >1 and very low/negative and non-significant s^2di values which indicated their stability and adaptation to specific favourable environment. HAMTH-29 recorded bi value <1 and negative and non-significant s^2di value which indicated its stability and adaptation to unfavourable environment.

The lines HAMTH-16 (9.53 cm), HAMTH-15 (9.23 cm), HAMTH-24 (8.15 cm) and HAMTH-29 (7.98 cm) performed better than population mean (7.85 cm) in respect of length of lamina (Table 1b). HAMTH-16 and HAMTH-15 recorded bi values >1 and very low and non-significant s^2di values which indicated their stability and adaptation to specific favourable environment. HAMTH-24 and HAMTH-29 recorded bi value <1 and very low and non-significant s^2di value which indicated their stability and adaptation to unfavourable environment. The lines HAMTH-15 (6.34 cm), HAMTH-24 (5.65 cm), HAMTH-29 (4.97 cm) and HAMTH-48 (4.89 cm) performed better than population mean (4.79 cm) in respect of width of lamina. HAMTH-15 and HAMTH-48 recorded bi values >1 and negative/very low and non-significant s^2di values which indicated their stability and adaptation to specific favourable environment. HAMTH-24 and HAMTH-29 recorded bi value <1 and negative/very low and non-significant s^2di value which indicated their stability and adaptation to unfavourable environment. The line HAMTH-15 (1.05 cm) performed better than population mean (0.86 cm) in respect of leaf-stem ratio. The line recorded bi value <1 and zero s^2di value which indicated its stability and adaptation to unfavourable environment.

The line HAMTH-9 (3.55) performed better than population mean (3.46) in respect of number of clipping (Table 1c). The line recorded bi value <1 and almost zero and non-significant s^2di value which indicated its stability and adaptation to unfavourable environment. The lines HAMTH-48 (35.22 days) and HAMTH-21 (34.55 days) performed better than population mean (32.61 days) in respect of duration of harvest. Both the lines recorded bi value <1 and very low and non-significant s^2di values which indicated their stability and adaptation to unfavourable environment. The lines HAMTH-15 (red leaved; 19.79 t/ha) and HAMTH-13 (green leaved; 17.43 t/ha) recorded total yield of greens (leafy shoots) more than population mean (16.36 t/ha). HAMTH-15 recorded bi value >1 and negative and non-significant s^2di value which indicated its stability and adaptation to specific favourable environment whereas HAMTH-13 recorded bi value<1 and negative and non-significant s^2di value which indicated its stability and adaptation to unfavourable environment. Both the leaf amaranth lines HAMTH-15 (red leaved) and HAMTH-13 (green

Table 1b: Stability parameters for yield and its contributing characters in vegetable amaranth.

Accession	Length of lamina (cm)			Width of lamina (cm)			Leaf-stem ratio		
	X	bi	S^2di	X	bi	S^2di	X	bi	S^2di
1. HAMTH-5	6.66	1.35	0.02	4.18	3.72**	-0.06	1.30	3.07	0.01*
2. HAMTH-9	8.02	1.20	1.65*	4.82	-2.42**	0.29	1.02	2.29	0.11**
3. HAMTH-13	6.93	0.90	-0.12	4.06	-0.72**	-0.12	0.73	0.62**	-0.00
4. HAMTH-15	9.23	1.46	-0.18	6.34	13.07**	-0.09	1.05	0.09**	0.00
5. HAMTH-16	9.53	1.18	-0.22	6.11	13.00**	0.52*	1.45	0.11**	0.50**
6. HAMTH-21	8.72	0.67	5.34**	5.60	-2.34**	1.93**	0.95	0.66**	0.03**
7. HAMTH-24	8.15	0.80	0.15	5.65	-4.78**	-0.10	1.14	2.52	0.07**
8. HAMTH-29	7.98	0.65	0.11	4.97	-8.45**	0.23	0.58	0.70**	0.02**
9. HAMTH-33	7.48	0.22	0.37	4.14	-3.98**	-0.14	0.58	-0.27**	0.00
10. HAMTH-42	7.46	0.88	-0.02	3.88	-1.72**	-0.12	0.71	0.42**	0.05**
11. HAMTH-43	6.17	1.29	-0.15	3.50	4.20**	-0.14	0.75	1.47**	0.03**
12. HAMTH-48	8.12	1.29	2.20**	4.86	2.96**	0.08	0.61	1.12**	0.11**
13. Pusa Lal Chaulai	7.53	0.81	1.95**	4.51	-1.03**	1.90**	0.60	0.52**	0.01*
14. Pusa Kirti	7.86	1.24	0.27	4.48	2.49**	0.17	0.59	0.63**	-0.00
General mean	7.85			4.79			0.86		
SE (Mean)	0.74			0.47			0.19		
SE of bi		0.39			7.02			1.07	

*Significant at 0.05, **Significant at 0.01 probability level

Table 1c: Stability parameters for yield and its contributing characters in vegetable amaranth.

Accession	Number of clipping			Duration of harvest (days)			Total yield of greens (t/ha)		
	X	bi	S^2di	X	bi	S^2di	X	bi	S^2di
1. HAMTH-5	3.33	1.12	0.02	31.33	1.16	3.50	13.52	0.93	-0.89
2. HAMTH-9	3.55	0.95	0.05	32.66	0.99	-3.23	15.36	0.97	-0.46
3. HAMTH-13	3.44	1.24	0.19**	31.33	1.06	42.44**	17.43	0.75	-0.94
4. HAMTH-15	3.44	1.04	-0.02	32.55	1.00	-3.19	19.79	2.18**	-0.88
5. HAMTH-16	3.33	1.12	0.02	31.55	1.13	1.43	14.78	0.95	9.24**
6. HAMTH-21	3.55	0.55	0.34**	34.55	0.81	2.43	18.17	1.11	25.94**
7. HAMTH-24	3.44	0.84	0.15*	31.88	1.07	-3.10	12.53	1.04	4.28*
8. HAMTH-29	3.66	0.86	0.28**	32.11	1.03	-1.64	16.66	0.52	8.95**
9. HAMTH-33	3.66	0.86	0.28**	31.22	1.15	-3.01	17.12	0.63	14.48**
10. HAMTH-42	3.66	0.86	0.28**	34.33	0.78	7.42	16.96	0.60	13.87**
11. HAMTH-43	3.33	1.12	0.02	31.66	1.12	0.54	17.96	1.97	5.92**
12. HAMTH-48	3.33	1.12	0.02	35.22	0.69	3.85	17.34	-0.26**	6.23**
13. Pusa Lal Chaulai	3.44	0.84	0.15*	33.77	0.91	11.98*	15.79	1.39**	-0.52
14. Pusa Kirti	3.22	1.41	-0.02	32.33	1.03	-2.82	15.64	1.16**	-0.73
General mean	3.46			32.61			16.36		
SE (Mean)	0.28			1.90			1.87		
SE of bi		0.57			0.23			0.44	

*Significant at 0.05, **Significant at 0.01 probability level

leaved) can be recommended for cultivation as stable and high yielding genotypes.

REFERENCES

1. Eberhart, S.A. and Russell, W.A. 1966. Stability parameters for comparing varieties. *Crop Sci.* **6**: 36-40.

2. Kishore, N., Dogra, R.K., Thakur, S.R. and Chahota, R.K. 2007. Stability analysis for seed yield and component traits in amaranthus (*Amaranthus hypochondriacus* L.) in high altitude dry temperate regions. *Indian J. Genet.* **67**: 153-55.

3. Peter, K.V., Nirmaladevi, S. and Sadhan Kumar, P.G. 2009. Advances in improvement of leaf vegetables.*(In) Leafy Vegetable Research in India, a Compendium on Brainstorming Session on Leafy Vegetables* held on 12th February, 2009 at Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India, Pugalendhi *et al.* (compiled), pp 52-66.

4. Shukla, S. and Singh, S.P. 2003. Stability of foliage yield in vegetable amaranth (*Amaranthus tricolor* L.). *Indian J. Genet.* **63**: 357-58.

5. Sharma, J.K., Lata, S. and Sharma, R.P. 2001. Study for grain yield in amaranth (*Amaranthus hypochondriacus* L.). *Indian J. Agric. Sci*. **71**: 319-24.

6. Singh, J.V., Paroda, R.S., Arora, R.N. and Saini, M.L. 1991. Stability analysis for green and dry fodder yield in cluster bean. *Indian J. Genet. Pl. Br*. **51**: 345-48.

7. Varalakshmi, B. 2003. Phenotypic stability for economic traits in vegetable amaranth (*Amaranthus tricolor*). *Indian J. Agric. Sci.* **73**: 114-15.

8. Varalakshmi, B. and Pratap Reddy, V.V. 2002. Genotype × Environment interactions for some quantitative characters in grain amaranth (*Amaranthus hypochondriacus* L.). *Indian J. Agric. Res.* **36**: 216-18.

Received : February, 2017; Revised : April, 2018; Accepted : May, 2018