Identification of water stress tolerant amaranthus genotypes (*Amaranthus tricolor* L.) with high yield and quality

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Introduction

Amaranthus (*Amaranthus tricolor* L.) is the major leafy vegetable in Kerala. It is highly nutritious in terms of minerals and vitamins. Water availability greatly influences the yield and quality of amaranthus, which is more sensitive to water stress compared to other crops. Production of water stress tolerant crops becomes more important to sustain the food security in the world.

Objective

- To identify high yielding genotypes of amaranthus with good quality and tolerance to water stress
- To know the characters which are related to water stress tolerance in amaranthus and its adaptation under field condition.

Materials and methods

The study was conducted in Kerala Agriculture University, College of Agriculture, Vellayani, Department of Plant Breeding and Genetics, during 2017-18. Ten amaranthus genotypes collected from different parts of Kerala were evaluated under water stress by scheduling irrigation at a depth of 20mm at 20 CPE (Cumulative Pan Evaporation). The observations on the biometrical, physiological and quality characters were recorded during 40 days after transplanting. The variances, correlation and path analysis was done to identify yield contributing characters under water stress condition.

Field view of the experiment

Results and discussion

- Amaranthus genotype Madhur local from Kasargod district of Kerala recorded the highest yield as well as quality under water stressed condition (Fig. 1)

Fig. 1 Yield and Quality characters of different amaranthus genotypes under water stress

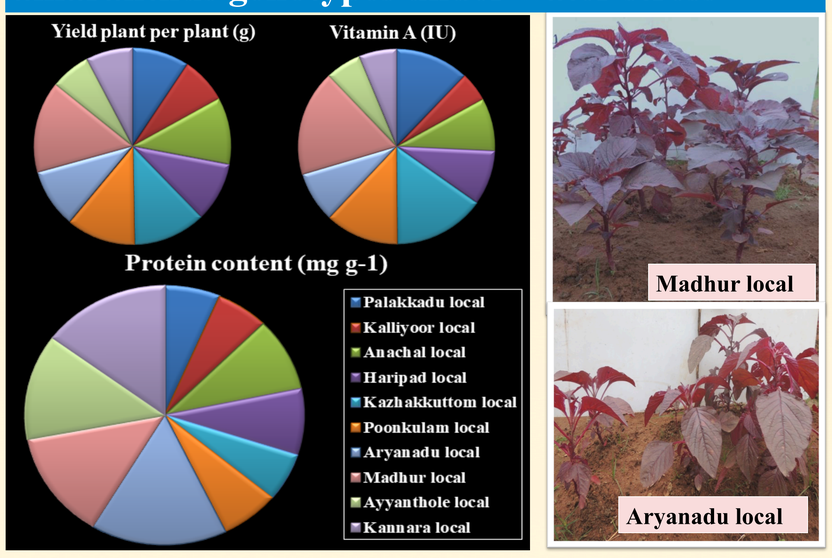

Table. 1 Genetic parameters of characters of amaranthus under water stress

Characters	Variances			GCV	PCV	H^2	GA (as % of mean)
	V_g	V_p	V_e				
Stem girth	0.09	1.39	0.04	14.07	16.99	68.54	24.00
Length of leaf lamina	0.82	0.91	0.092	11.73	12.37	89.94	22.919
Petiole length	0.20	0.25	0.05	14.95	16.75	79.72	27.51
Leaf width	0.60	0.66	0.05	17.53	18.34	91.35	34.52
Internodal length	0.26	0.29	0.03	21.46	22.92	87.69	41.41
Number of branches	3.26	3.29	0.03	37.88	38.06	99.03	77.66
Yield per plant	77.65	83.84	6.19	24.47	25.43	92.60	48.52
Leaf to stem ratio	0.02	0.03	0.01	20.69	24.40	71.89	36.14
Days to 50% bolting	6.88	8.03	1.14	4.71	5.08	85.75	8.98
Plant height	18.70	23.13	4.42	12.25	13.62	80.86	22.69
Relative water content	7.027	9.31	2.28	2.98	3.43	75.43	18.78
Proline content of leaves	116.13	120.3	2.40	4.15	4.23	96.50	8.41
Protein content	0.68	0.69	0.01	38.76	39.23	97.64	38.23
Fiber content	4.22	4.49	0.27	19.15	19.76	93.88	84.84
Vitamin A	783728	785028	1300	41.22	41.25	99.83	28.18
Oxalate content	0.13	0.23	0.09	17.85	23.29	58.73	181.73
Nitrate content	0.12	0.20	0.08	6.66	8.65	76.99	13.73

- The character Vitamin A content registered the highest GCV (41.22%) and PCV (41.25%).
- High heritability coupled with high genetic advance was observed for leaf width, number of branches, yield plant^{-1}, protein content, fibre content and vitamin A (Table. 1).

Table. 2 Genotypic correlation coefficient of among selected characters of amaranthus under waters stress condition

Characters	Petiole length	Leaf width	Number of branches	Yield plot^{-1}	Percentage leachate	Membrane integrity	Proline content of leaves	Vit. A
Petiole length	1.000							
Leaf width	-0.184*	1.000						
Number of branches	-0.574**	0.790**	1.000					
Yield plot^{-1}	-0.464**	0.673**	0.921**	1.000				
Percentage leachate	0.403**	-0.761**	-0.955**	-0.938**	1.000			
Membrane integrity	-0.407**	0.761**	0.956**	0.938**	-1.000**	1.000		
Proline content of leaves	-0.526**	0.809**	0.942**	0.913**	-0.947**	0.948**	1.000	
Vit. A	-0.413**	0.700**	0.907**	0.856**	-0.891**	0.891**	0.829**	1.00

** Significant @ 1% * Significant @ 5%

- The yield plant^{-1} was found to be significantly and positively correlated with yield plot^{-1}, membrane integrity, proline content of leaves and vitamin A both at genotypic and phenotypic levels. Petiole length and percentage leachate were found to be negatively correlated with yield plant^{-1} (Table.2).
- Proline content in leaves could be considered as a mechanism for water stress tolerance in plants (Slabbert and Kruger, 2014).

Table. 3 Direct and indirect effects of highly correlated characters of amaranthus on yield plant^{-1}

characters	Petiole length	Leaf width	Number of branches	Yield plot^{-1}	Percentage leachate	Membrane integrity	Proline content of leaves	Vit. A	Genotypic correlation
Petiole length	0.30	0.08	-0.38	-0.25	0.07	0.15	-0.34	-0.09	-0.462
Leaf width	-0.06	-0.41	0.52	0.36	-0.12	-0.28	0.53	0.16	0.677
Number of branches	-0.17	-0.33	0.66	0.49	-0.16	-0.36	0.61	0.21	0.947
Yield plot^{-1}	-0.14	-0.28	0.60	0.53	-0.15	-0.35	0.59	0.19	0.999
Percentage leachate	0.12	0.32	-0.63	-0.50	0.16	0.37	-0.62	-0.20	-0.966
Membrane integrity	-0.12	-0.32	0.63	0.50	-0.16	-0.37	0.62	0.20	0.966
Proline content of leaves	-0.16	-0.33	0.62	0.49	-0.16	-0.35	0.65	0.19	0.935
Vitamin A	-0.12	-0.29	0.59	0.46	-0.15	-0.33	0.54	0.23	0.921

- Path analysis revealed that number of branches, yield plot^{-1}and proline content of leaves had the maximum positive direct effect on yield plant^{-1} (Table 3 & Fig. 2).

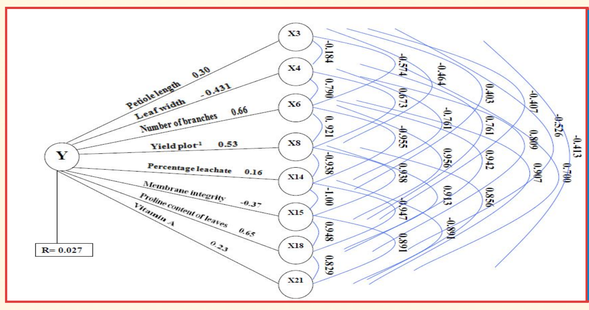

Fig. 2 Path diagram showing direct and indirect effect of different characters of amaranthus on yield

Conclusion

The study revealed that high yield with good quality under water stress condition was contributed by the combined expression of high proline content in leaves, high membrane integrity, low percentage leachate along with high vitamin A in amaranthus.

Reference

1. Slabbert, M.M. and Kruger, G.H.J. 2014. Antioxidant enzyme activity, proline accumulation, leaf area and cell membrane stability in water stressed amaranthus leaves. *S. Afr. J. Bot.* 95: 123–128.