Journal of Cereals and Oil seeds Vol. 3(4), pp. 56-58, December, 2012
Available online at http://www.academicjournals.org/JCO
DOI: 10.5897/JCO12.016
ISSN 2141-6591 ©2012 Academic Journals

Short Communication

Response to water stress in castor (*Ricinus communis* L.) genotypes under *in vitro* conditions

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Accepted 19 December, 2012

A laboratory experiment was conducted to study the response of 45 castor genotypes to drought stress. Five water stress levels were used. The experiment was laid out by complete randomized design with two replications. Ten seeds of each accession were sown in sterilized sand medium and the Poly Ethylene Glycol solution was given to medium. On the tenth day, the observations were recorded. Seedling length, root length and germination percentage were observed. The highest tolerance for germination was shown by RG 2474. The values of shoot length were higher in RG 2474. The maximum root length was seen in RG 2326 and RG 3013.

Key words: Castor, genotypes, water stress, *in vitro* conditions.

INTRODUCTION

Castor is an important non edible oil seed crop grown throughout the world. Due to erratic rainfall distribution, generally crop experiences prolonged dry spells during the growth stages. Growing of drought tolerant cultivars will contribute more to stable castor production and the screening of the response of castor cultivars or breeding lines to drought stress can play a crucial role in breeding programmes. Adequate water and nutrient supply are important factors affecting optimal plant growth and successful crop production. Seed germination is first critical and the most sensitive stage in the life cycle of plants (Ashraf and Mehmood, 1990), and the seeds exposed to unfavorable environmental conditions like water stress may have to compromise the seedlings establishment (Albuquerque and Carvalho, 2003).This present study was therefore conducted with the objective to determining the response of castor genotypes to drought stress at germination and seedling stages under controlled conditions and to evaluate germination and screening criteria for drought tolerance in castor.

MATERIALS AND METHODS

Experiment was carried out at Crop Physiology laboratory, Department of Seed Science and Technology, Agricultural College and Research Institute, Madurai. Forty five castor genotypes collected from the germplasm maintained at Directorate of Oilseeds Research, Hyderabad were tested against drought stress at germination and seedling stages under laboratory conditions. Poly Ethylene Glycol can be used to modify the osmotic potential of nutrient solution culture and thus induce plant water deficit in a relatively controlled manner, appropriate to experimental protocols. Poly Ethylene Glycol with a molecular weight of 6000 (PEG 6000) was used as a drought stimulator and five stress levels of zero (control), -0.2, -0.3, -0.4, and -0.5 MPa were developed by dissolving 11.9, 15.1, 17.8 and 20.2 g of PEG per 100 ml distilled water (Michel, 1983). Seeds were surface sterilized with 10% sodium hypochlorite solution for five minutes and then washed three times with distilled water. Ten seeds of each castor germplasm accessions were sown in germination tray containing sterilized sand medium. The experiment was laid out in a completely randomized design with two replicates for each experimental unit. On the tenth day the observations were recorded. Seedling length, root length and germination percentage were used to evaluate the genotypic response to PEG induced water stress.

RESULTS AND DISCUSSION

Stress tolerance ability of crop plants vary with growth stages. Seed germination and seedling stages are very vulnerable. Adequate seed germination in moisture stress field condition leads to a good crop stand. There was no consistency between germination rate in the presence of osmoticum and field emergence and subsequently yield.

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Table 1. Seedling germination percentage, shoot length and root length of 45 castor genotypes under water stress (-5.0 bars) condiction.

S/N	Genotypes	Germination percentage (%)		Shoot length (cm)		Root length (cm)	
		Control	Stress	Control	Stress	Control	Stress
1	RG152	96.32	44.61	8.52	4.55	4.12	2.17
2	RG157	88.21	43.67	8.13	4.55	4.30	1.61
3	RG551	93.00	46.29	11.96	4.75	4.10	3.42
4	RG814	99.00	43.30	12.70	4.55	3.90	4.13
5	RG969	98.20	54.15	21.00	9.42	4.23	4.86
6	RG3233	94.72	62.26*	19.20	7.81	5.30	3.89
7	RG3224	96.37	60.56*	18.86	6.25	5.10	2.71
8	RG3195	95.50	59.43*	19.60	11.80*	5.21	2.47
9	RG3120	89.37	54.16	15.40	8.78	4.30	2.71
10	RG3116	92.36	50.46	18.50	10.65	4.72	2.15
11	RG3102	94.00	62.00*	16.20	7.80	4.98	3.05
12	RG3093	99.00	56.50*	11.74	5.60	5.10	4.48
13	RG3088	89.00	61.50*	20.50	9.95	6.21	4.03
14	RG3063	96.34	68.20*	19.70	15.15*	5.72	4.96*
15	RG3013	96.51	61.50*	21.00	14.96*	6.20	6.25*
16	RG2980	94.22	59.48*	20.23	15.25*	6.50	5.50*
17	RG2958	93.72	62.12*	11.90	6.10	6.42	4.97
18	RG2944	96.58	58.24*	20.00	10.85*	6.32	6.10*
19	RG2902	96.00	59.18*	19.50	11.19*	4.32	3.02
10	RG2582	97.60	61.56*	18.00	8.83	6.12	4.58
21	RG2498	89.00	57.84*	17.25	9.81	5.72	4.42
22	RG2487	87.00	56.18*	19.32	11.15*	5.69	4.71
23	RG2481	94.43	56.25*	21.00	14.55*	6.40	5.51*
24	RG2474	98.81	68.83*	21.55	16.40*	6.42	5.79*
25	RG2473	93.36	58.42*	21.53	13.75*	5.90	4.96*
26	RG2465	90.84	50.00	13.45	12.90*	5.42	3.50
27	RG2457	96.81	52.00	16.70	7.45	5.70	3.85
28	RG2454	96.38	61.10*	14.20	8.85	5.12	4.31
29	RG2451	93.65	58.30*	13.10	10.82*	4.46	3.45
30	RG2377	99.00	50.66	14.00	10.66	5.72	4.15
31	RG2375	96.68	53.00	18.90	11.60*	4.31	3.17
32	RG2368	89.97	56.50*	16.00	15.80*	5.49	5.60*
33	RG2326	94.58	51.63	14.10	10.17	5.19	6.25*
34	RG2320	94.46	43.14	18.20	12.22*	4.80	5.13*
35	RG2266	93.68	45.18	10.10	9.60	4.20	2.06
36	RG2269	92.55	48.87	17.60	7.71	4.81	2.29
37	RG2195	96.00	49.63	18.20	5.78	7.42	4.76
38	RG2184	94.33	43.62	18.30	6.86	4.31	2.09
39	RG2035	93.28	47.27	12.25	8.56	3.73	1.71
40	RG2033	89.00	52.09	8.76	4.53	4.16	3.87
41	RG2024	93.64	56.50*	10.70	4.80	5.12	4.77*
42	RG2022	93.22	44.12	16.10	5.40	6.22	5.38*
43	RG2014	96.12	50.00	15.40	5.59	5.17	4.35
44	RG1999	96.29	58.00*	17.70	4.85	4.13	3.35
45	TMV5	97.18	55.27*	18.80	4.77	4.25	3.35
Grand mean			54.17	Grand mean	9.18	Grand mean	3.99
SE(d)			0.44	SE(d)	0.78	SE(d)	0.47
CD(5%)			0.89	CD(5%)	1.58	CD(5%)	0.95

*Significant at 5% level.

Laboratory germination studies, in general, overestimate the field germination and emergence. There were no significant differences in -2.0, -3.0 and -4.0 bar (Table 1). At -6.0bar, there was no germination. It was worth noticing that increase concentration of PEG indicates precise nature of the *in vitro* screening (Kulkarni and Deshpande, 2007).

The -5.0 bar was fixed as optimum concentration to find out the performance of the genotypes. The water stress level significantly decreased all the above characters. Total of 24 genotypes were significantly higher than the grand mean for germination percentage. Similarly, 22

genotypes for seedling shoot length and 22 genotypes for root length significantly had higher values than the grand mean. The highest tolerance for germination was shown by RG2474 (68.83%). The mean seedling shoot length was maximum in RG2474 (16.40 cm) and the mean seedling root length was high in the genotype RG 3013 and RG 2326 (6.25 cm). Eleven genotypes *viz*., RG 3088, RG3063, RG 3013, RG 2980, RG 2944, RG 2498, RG 2487, RG 2481, RG 2474, RG 2473 and RG 2368 exhibited superior mean for all the above three characters (Table 1). Shamim et al. (2009) used germination stress tolerance index (GSI), and root length stress index (RLSI) to evaluate the genotypic response to PEG-induced water stress. Hence these eleven genotypes were found to be drought tolerant under laboratory testing using PEG.

Conclusion

Genotypes showed significant variation in all the characters studied under laboratory condition. The highest tolerance for germination was shown by RG 2474 (68.83%) followed by RG 3063 (68.20%), RG 3233 (62.26%). The values of shoot length were higher in the genotype RG 2474 (16.40 cm) followed by RG 2368 (15.80 cm), RG 2980 (15.25 cm). The maximum root length was occurred in RG 2326 and RG 3013 followed by RG 2944 (6.10 cm), RG 2474 (5.79 cm) and it was minimum in RG 157 (1.61 cm) followed by RG 2035 (1.71 cm), RG 2266 (2.06 cm). Hence, these genotypes can be performed well under drought condition.

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