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Effect of Water Stress on Seed Germination and Seedling Growth in Rice

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ABSTRACT

A laboratory experiment was conducted at Department of Crop Physiology,Agricultural college Bapatla during 2011-12 to study the effect of water stress on seed germination and seedling growth in rice genotypes .The results revealed that as the water stress increased from -0.3 M.Pa to -1.2 M.Pa ,the percentage of germination , root, shoot length and seedling vigor index was decreased in all the genotypes . Among the rice genotypes tested, Ramappa and WGL14 withstand the water stress even up to -1.2 M.Pa followed by Erramallelu , WGL 283 and K12

Key words : Rice ,Seed germination, Seedling vigor index, Water stress

Rice is a stable food crop in India providing 43% calories requried for more than 70% of Indian population ,which is grown in 44 million hactares with a production of about 90 millions tonnes .Seed germination and early seedling growth are considered important for crops establishment and yield of the crop (Gelmond ,1978) .Germination and seedling emergence are sensitive to water stress conditions and vary from species to species and from cultivars to cultivars (Sharma *et al* ,.2007).Among the growth stages early plant growth is important since the later development and crop productivity depend on effective germination and seedling emergence .Such phenomenon is more concerned to the successful cultivation of pulses cereals and millets .The present study was therefore conducted to know the effect of water stress on seed germination and seedling growth of rice genotypes .

MATERIAL AND METHODS

A laboratory experiment was conducted in Department of Crop Physiology ,Agricultural college Bapatla with factorial randomized block design replicated thrice during 2011-12. The treatments consists of 5 rice genotypes (Erramallelu,K12, Ramappa , WGL 14 and WGL 283) and 4 levels of water potentials (control, -.0.3 M.Pa ,-0.6 M.Pa ,-0.9M.Pa ,-1.2 M.Pa water potential).Fifty seeds of uniform size from each genotypes were placed in the petridishes containing filter paper .The seeds were treated with polyethylene glycol solutions of -.0.3 M.Pa ,-0.6 M.Pa ,-0.9M.Pa ,-1.2 M.Pa and water as control and petridishes were kept for germination under laboratory conditions .Germination counts were taken on 4th day after sowing .Twenty seedlings were randomly selected from each petridish on the 7th day after sowing for measuring root and shoot length .Seedling vigor index was calculated by multiplying seedling length with germination percentage .

RESULTS AND DISCUSSION

The rice genotypes showed a significant difference in seed germination at different water potentials (Table 1). The interaction between genotypes and water potential was also significant. Among the genotypes tested, Ramappa recorded maximum percentage of germination at all the osmotic potential compared to that with other genotypes. In all the genotypes as the water stress increased from -0.3 M.Pa to -1.2 M.Pa, the percentage of germination was decreased. This might be due to the decreasing of water potential, water imbibed by the seeds was decreased by osmotic effect hence result in decreased germination of the seeds. At -1.2 M.Pa , Ramappa recorded maximum germination percentage of 61 followed by WGL14(50%), Erramallelu (45%) , WGL283 (42%) and K12(36%).There was a differences in genotypes for drought resistance in ragi genotypes .This shows that Ramappa can withstand higher water stress showing it drought resistance nature .Decline in seed germination with the increase in moisture stress was also reported by By Rao (1997) in Korra.

There was a significant differences between the genotypes and water potentials regarding root length of rice (Table 2).As the water stress

Table 1. Seed germination and root length of rice genotypes under water deficit conditions.

Genotypes	Seed germinatin (%)						Shoot length (Cm)					
	Water potentials (M.Pa)						Water potentials (M.Pa)					
	Control	-0.3	-0.6	-0.9	-1.2	Mean	Control	-0.3	-0.6	-0.9	-1.2	Mean
Erramallelu	100 (90.00)	94.40 (76.31)	80.50 (63.79)	60.10 (50.83)	45.20 (42.25)	76.04 (60.67)	5.35	3.95	2.95	2.20	1.05	3.10
K 12	95.00 (77.00)	90.20 (71.76)	80.60 (63.87)	56.30 (48.62)	35.40 (36.45)	55.30 (48.04)	4.95	3.81	2.56	1.90	0.50	2.74
Ramappa	100 (90.00)	98.30 (82.30)	88.10 (69.73)	75.10 (60.07)	61.50 (51.65)	84.60 (66.89)	5.92	4.35	3.60	2.50	1.50	3.57
WGL 14	100.00 (90.00)	96.00 (78.46)	85.20 (67.37)	65.50 (54.03)	50.60 (45.34)	79.46 (63.08)	5.65	4.00	3.00	2.30	1.20	3.23
WGL 283	98.00 (81.87)	91.50 (73.05)	78.40 (62.30)	58.00 (49.60)	42.30 (40.57)	73.64 (59.02)	5.10	3.90	2.88	2.00	0.75	2.92
Mean	98.60 (83.20)	94.00 (75.94)	82.56 (65.27)	63.00 (52.54)	47.01 (43.20)		5.39	4.02	2.99	2.18	1.00	
C.D at 5% Genotypes(G)						3.30						0.30
Water potential(W)						4.50						0.70
GXW						7.80						0.95

Values in paranthesis indicates arcsine transformed values.

Table 2. Shoot length and seedling vigor index of ragi genotypes under water deficit conditions.

Genotypes	Root length (Cm)						Seedling vigor index					
	Water potentials (M.Pa)						Water potentials (M.Pa)					
	Control	-0.3	-0.6	-0.9	-1.2	Mean	Control	-0.3	-0.6	-0.9	-1.2	Mean
Erramallelu	5.50	4.60	3.70	2.90	1.95	3.73	1085	545.00	535	306	135	573
K 12	4.70	3.95	3.20	2.50	1.50	3.17	916	497.25	464	247	70	479
Ramappa	6.75	5.24	4.15	3.50	2.10	4.34	1267	579.20	682	450	221	712
WGL 14	6.00	4.85	3.95	3.20	2.05	4.01	1165	674.97	544	360	164	616
WGL 283	5.30	4.50	3.50	2.75	1.75	3.56	1019	758.50	500	287	105	535
Mean	5.65	4.62	3.70	2.97	1.87		1090	611.10	813	330	139	
C.D at 5%Genotypes(G)						0.33						52
Water potential(W)						0.65						185
GXW						0,98						236

Values in paranthesis indicates arcsine transformed value.

increased from -0.3 M.Pa to -1.2 M.Pa ,there was a simultaneous decreasing of root length in all rice genotypes .The decreased root length might be due to the decreasing of water potential .Among the rice genotypes ,Ramappa recorded maximum root length at all water potential treatments compared to other genotypes .At -1.2 M.Pa ,Ramappa recorded maximum 2.10 cm root length followed by WGL14 (205 cm).Similar results were reported by Gupta *et al*.,(2000) in chickpea .

There was a significant differences between genotypes and water potential treatments regarding shoot length in Rice genotypes (Table 1) .As the water stress increased from -0.3 M.Pa to -1.2M.Pa there was a decrease in shoot length in all genotypes .Among the genotypes ,Ramappa recorded maximum shoot length at all water potentials compared to other genotypes . At -1.2 M.Pa, Ramappa recorded a shoot length of 1.50 cm followed by WGL14 (1.20 cm) .This clearly indicates that Ramappa having drought resistance nature. Similar results were reported by Rao (1997) in Korra .

Seedling vigor index(SVI) is the most important parameter to judge the drought resistance of the genotype .There was a significant difference between genotypes and water stress treatments regarding SVI of rice genotypes. As the water stress increased from -0.3 to -1.2 M.Pa, there was a significant decrease in SVI of genotypes .This might be due to decreasing of germination, root length and shoot length under water stress conditions. The decreasing of seedling growth in response to increasing of moisture stress in field and laboratory conditions were also reported by Rao in Korra and Gupta *et al.,* (2000) in chickpea . Among the genotypes, Ramappa recorded maximum SVI at all water stress treatments compared to other genotypes .At -1.2 M.Pa ,Ramappa recorded SVI of 221 followed by WGL 14(164) .The present preliminary study revealed that Ramappa and WGL 14 genotypes of rice can withstand moisture stress conditions and their performance at reduced levels of moisture stress requires a detailed field study .

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