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The Response of Water Stress on the Membrane Stability Index and Seed Yield of Fenugreek (*Trigonella Foenum-Graecum L.*) Genotypes

Sonam Meena[1], Ajit Kumar Meena[2], Deshraj Meena[3], Savita Meena[4]

[1]Department of Biochemistry, SKN College of Agriculture (SKNAU), Jobner, Jaipur, Rajasthan- 303329, India, meenasonam99@gmail.com

[2]ICAR-National Bureau of Soil Survey & Land Use Planning, Nagpur, Maharashtra-440033.India

[3]Department of Soil Sc. & Agri. Chemistry, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajsthan-313001, India

[4]Department of Genetics & Plant Breeding, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan-313001, India

Abstract: A field experiment was carried out using five genotypes at Agronomyfarm, S.K.N. Collage of Agriculture, Jobner during Rabi season 2014-2015 to investigate "The response of water stress at two stages viz. 40 DAS and 65 DAS on the physiological indices and seed yield of Fenugreek (Trigonella foenum graecum L.) genotypes". The proposed investigation was conducted in randomised block design with four replication of five genotypes in three sets.The seeds of five genotypes (UM-100,UM-112,UM-124,UM-134,UM-140) were procured from Incharge, AICRP on spices, Department of Plant Breeding & Genetics, SKN College of agriculture,Jobner. The present investigation resulted that an overall reduction in membrane stability index values was observed at both stages in all the genotypes. However, UM-100 at 40 DAS exhibit bettermembrane stability under water stress condition.The genotype UM-112 was found high yielder under control (Non stressed) condition but it was highly susceptible to water stress followed by genotype UM-140.

Keywords: Fenugreek, Water stress, Physiological indices, Membrane stability index, Yield.

Introduction

In India, moisture stress is a major factor for limiting productivity. Majority of the cultivation is still dependent on rainfall and conserved moisture. Water is a limiting factor for productivity. This shows that water plays an important role in physiological and biochemical process in plants. Semi-arid and tropical areas tend to be the most sensitive to moisture deficit condition because of high evapotranspiration. Water stress severely reduces yields of field crops grown under rainfed conditions (Jangpromma *et al*. 2010a). Drought is the major cause of yield reduction in crop plants, since it is a major limiting factor for plant growth and development particularly in arid and semiarid regions. However,the response of agricultural crops to drought stress has not yet been extensively studied. It is well known that drought stress brings aboutnumerous physiological changes in plants like growth, yield (Ashraf and Iram, 2005; Benjamin and Nielsen, 2006), membrane stability (Bai *et al*., 2006).

Fenugreek (*Trigonella* foenum-*graecum* L.) 2n = 16 (Frayer, 1930) popularly known by its vernacular name 'methi' is an important condiment crop, largely grown in Northern during Rabi season. Fenugreek occupies a prime position among various seed spices grown in India. It is an annual herb belonging to sub-family papilionaceae of the family leguminaceae. India had 93090 ha

area with production of 112845 mt (Anonymous, 2013-14a). In Rajasthan, it occupies a prime position among the seed spices. More than 80% of area and production of fenugreek in the country is contributed by Rajasthan alone as it is fairly salinity tolerant which makes it suitable for cultivation in major part of the state. Rajasthan had 55,375 ha area and 64,101 mt production with productivity of 1158 kg/ha (Anonymous, 2013-14b).

Materials and method

The present investigation was carried out on fenugreek (*Trigonella foenum graecum*L.). The seeds of five genotypes (UM-100,UM-112,UM-124,UM-134,UM-140) were procured from Incharge , AICRP on spices, Department of Plant Breeding & Genetics, SKN College of agriculture, Jobner. A field experiment was carried out using 5 genotypes at Agronomy farm, S.K.N. Collage of Agriculture, Jobner during *Rabi* season 2014-2015 to investigate "The response of water stress at two stages viz. 40 DAS and 65 DAS on the physiological indices and seed yield of Fenugreek (*Trigonella foenum graecum* L.) genotypes". The proposed investigation was conducted in randomised block design.Fenugreek genotypes were raised/sown in 3m x 3m plot, keeping row to row distance (30cm x 30cm) and plant to plant (10cm x 10 cm) distance. Sowing was done on 7 December 2014 using dibbler. The Thirum treated seeds were placed at a depth of 3-5 cm. For seed yield, five plants were selected randomly of each genotypes and yield was calculated in seed yield per plant (g).The procedure described by Premchandra *et al.* (1990) modified by Sairam (1994) was used for membrane stability index. Leaf sample (0.5 g) was placed in distilled water (50 ml). One set was kept at 40^{o}C for 30 minutes and its conductivity (C1, for electrolytic leakage) was recorded using conductivity meter. The second set was kept in boiling water bath(100 ^{o}C) for 10 minutes and its conductivity (C_2) was recorded after cooling at room temperature. The MSI was calculated according to the formulae:

$MSI\% = (1-C_1/C_2) \times 100$

Results and Discussion

Membrane Stability Index: The values for stability of cellular membrane in the fenugreek genotypes revealed that there was decline in MSI percent of stressed plant in all genotypes at both stages. The minimum decrease due to water stress was observed in genotype UM-100 (1.32%) at 40 DAS as well as 65 DAS (2.31%). The decrease was more at 65 DAS than at 40 DAS in all the genotypes except UM-134.Maximum reduction in MSI values was observed in genotype UM-140 and UM-112 at both stages, indicating their high susceptibility to water stress. Membrane stability index may be used as parameter to estimate the cellular injury caused to membrane due to peroxidation of fatty acids of the membrane and the levels of membrane lipid peroxidation can be measured by Thiobarbituric acid substance called Malondialdehyde content. In present study, the increased levels of MDA in stress condition indicate the membrane sensitivity/ membrane damage to water stress. Lower rate of increase of MDA in genotypes indicate better membrane strength. The results are supported by the earlier findings of Pant *et al*., 2014, Mittal *et al*., 2006, Mittal, 2010, Karmakar*et al*., 2014.

Table1: Effect of water stress on membrane stability index(MSI) in fenugreek no type sat two stages

Genotypes	Membrane Stability Index(%FW)					
	40DAS			65DAS		
	Control	Stressed	Percent Decrease	Control	Stressed	Percent Decrease
UM-100	67.38	66.49	1.32	79.85	78.01	2.31
UM-112	61.90	54.73	11.58	70.79	57.84	18.28
UM-124	65.33	64.15	1.81	68.30	66.30	2.94
UM-134	66.04	63.01	4.58	67.71	65.76	2.87
UM-140	73.16	63.50	13.20	72.21	66.06	8.51
SEm±	1.49		0.75			
CD(p=0.05)	4.30		2.15			
CV	4.62		2.15			

Yield: The genotypic variation in seed yield varied from 13.09 to 25.56 g per plant under control, while under stress it varied from 11.08 to 18.13 g per plant at 40 DAS. Likewise at 65 DAS, seed yield varied 8.55 to 14.70 g per plant in water stress. Thus, study showed significant reduction in seed yield due to water stress at both the stages, but reduction was higher at 65 DAS as compared to 40 DAS. It indicated that the stage 65 at DAS was more sensitive to water stress. At 40 DAS, genotype UM-134 had least reduction in yieldunder water stress condition (9.65%) whereas at 65 DAS the least reduction was 18.38% followed by the genotype UM-124 (11.14% at 40 DAS & 27.95% at 65 DAS). Maximum reduction was found in genotype UM-112 (51.78% at 40 DAS & 66.16% at 65 DAS) at both the stages indicating that this genotype is most susceptible to water stress.

Table 2: Effect of water stress on seed yield in fenugreek no type sat two stages

Genotypes	Seed Yield per plant (g)				
	40 DAS			65 DAS	
	Control	Stressed	Percent Decrease	Stressed	Percent Decrease
UM-100	13.09	11.08	15.36	10.36	20.83
UM-112	25.56	12.33	51.78	8.65	66.16
UM-124	20.40	18.13	11.14	14.70	27.95
UM-134	15.29	13.81	9.65	12.48	18.38
UM-140	16.68	11.84	29.02	8.55	48.74
SEm±	0.806		0.856		
CD(p=0.05)	2.327		2.473		
CV	10.19		11.75		

Conclusion

The results of present investigation on fenugreek showed that The lowest reduction in MSI values occurred in genotypes UM-100 at both stages which shows its high tolerance whereas the higher reduction in genotypes UM-112 at 65 DAS and UM-140 at 40 DAS reveal their high susceptibility to water stress. The genotype UM-112 was found high yielder under control (Non stressed) condition but it was highly susceptible to water stress followed by genotype UM-140.

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