

Evaluation of drought stress indices in chitti bean genotypes

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Received 1 March 2021; Accepted 26 April 2021

Extended abstract

Introduction

Drought stress due to water deficit is a serious problem in agriculture, and it is one of the most important factors contributing to crop yield loss such as bean. The diversity of the genetic traits material is the basis of any breeding program and the existence of maximum variation is the greatest chance for success in the selection. Drought stress is known as an effective factor in reducing production in crops, that, in this regard, one of the ways to overcome unfavorable environmental conditions is identifying and spreading cultivars compatible with stress. Regarding the importance of bean genetic resources for use in breeding programs of this crop, this experiment was conducted to investigate yield of some of bean genotypes in normal and stress condition.

Materials and methods

In order to evaluation of genotypes of chitti bean based on tolerance and susceptibility indices, experiments were conducted in two environments without stress and drought stress in 2017 at research farm of Bean Research and education, Khomein. 24 genotypes of chitti beans along with Ghaffar cultivar as control (25 genotypes in total) were compared in Latis design with two replications. Genotypes seeds were sown on four lines with 3 m long. Irrigation was carried out under optimal and stress conditions after 50-60 and 100-110 mm evaporation from the surface of Class A evaporation pan, respectively. Evaluated traits included days number to flowering, days number to maturity, number of pods per plant, number of seeds per pod, 100-seed weight and grain yield. Some tolerance indices were calculated to evaluate the sensitive and tolerance of genotypes. Data variance analysis and statistical calculations were done by SAS statistical software.

Results and discussion

Drought stress reduced evaluated properties, significantly. Among the genotypes of chitti beans in optimal irrigation and drought stress conditions, KS21578 genotype had the highest grain yield with 2668.1 and 1581.5 kg ha⁻¹, respectively. The lowest grain yield were achieved at KS21585 genotype and KS21591 genotype in optimal irrigation and drought stress conditions, respectively. Due to drought stress, grain yield of chitti bean genotypes decreased by 49.1%. Between stress tolerance indices the highest mean productivity index, geometric mean productivity index and stress tolerance index belonged to KS21578 genotype. The highest tolerance index was observed in Ghaffar cultivar (control). Also, the lowest stress susceptibility index was obtained in KS21585 genotype. The lowest mean

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productivity index belonged to KS21584 and the lowest geometric mean productivity index, tolerance index and stress tolerance index belonged to KS21591 genotype.

Conclusion

According to the results of this study, KS21578 genotype had the highest grain yield under normal irrigation and drought stress conditions and the highest mean productivity index, geometric mean productivity index and stress tolerance index. Also, the lowest stress susceptibility index was obtained in KS21585 genotype. Based on chitti bean grain yield under normal irrigation and drought stress conditions and evaluation of stress tolerance indices as well as two-way diagram of geometric mean production indices and stress susceptibility index and considering maturity period, plant form and grain marketing 8 chitti bean genotypes were selected for testing.

Keywords: Grain yield, Legumes, Stress susceptibility

Table 1. Evaluation indices of evaluated chitti bean genotypes

Index	Equation	Reference
Stress Tolerance	$STI = [Y_P * Y_S] / [\bar{Y}_P * \bar{Y}_S]$	(Fernandez, 1992)
Geometric Mean Productivity	$GMP = \sqrt{[Y_P * Y_S]}$	
Tolerance	$TOL = [Y_P - Y_S]$	(Rosielle and Hamblin, 1981)
Mean Productivity	$MP = [Y_P + Y_S] / 2$	
Stress Susceptibility	$SSI = [(1 - (Y_S / Y_P)) / (1 - (\bar{Y}_S / \bar{Y}_P))]$	(Fischer and Maurer, 1978)

In above equations Y_S , Y_P , \bar{Y}_S and \bar{Y}_P yield in stress and non-stress condition for each genotype and yield mean in stress and non-stress condition for all of the genotypes, respectively.

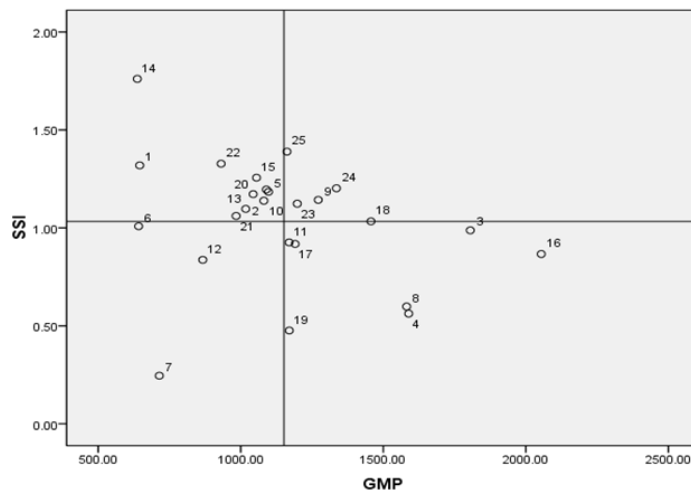


Fig. 1. Two-way diagram of geometric mean productivity and stress susceptibility index in chitti bean genotypes

Table 2. Mean of some stress tolerance indices of bean genotypes in normal irrigation and drought stress stress condition.

Genotype	Normal irrigation grain yield	Stress condition grain yield	Mean productivity index	Geometric mean productivity index	Tolerance index	Stress tolerance index	Stress susceptibility index
	-----kg ha ⁻¹ -----						
KS21581	1047	397.9	722.4	645.4	649.1	0.06	1.3
KS21582	1585.2	736.9	1161	1080.8	848.3	0.17	1.1
KS21576	2466.4	1321.4	1893.9	1805.3	1145	0.45	1
KS21577	1852.7	1362.9	1607.8	1589	489.8	0.38	0.6
KS21583	1647.9	730.8	1189.3	1097.4	917.1	0.18	1.2
KS21584	884.7	456.4	675.1	641.7	419.3	0.06	1
KS21585	759.3	671.7	715.5	714.2	787.6	0.06	0.2
KS21580	1865.9	1341.1	1603.5	1581.9	524.8	0.34	0.6
KS21586	1869.6	865.2	1367.4	1271.8	1004.4	0.24	1.1
KS21587	1646.5	721.1	1183.8	1089.6	925.4	0.18	1.2
KS21588	1556.4	879.1	1217.7	1169.7	677.3	0.20	0.9
KS21589	1112.8	675.1	893.9	866.7	437.7	0.12	0.8
KS21590	1461.8	708.2	1085	1017.5	753.6	0.15	1.1
KS21591	1534	264.6	899.3	637.1	126.4	0.06	1.8
KS21596	1648.8	675.3	1162.1	1055.2	973.5	0.17	1.3
KS21578	2668.1	1581.5	2124.8	2054.2	1086.6	0.63	0.9
KS21592	1579.2	897.9	1238.5	1190.8	681.3	0.21	0.9
KS21579	2031.3	1044.7	1538	1456.7	986.6	0.32	1
KS21593	1328.3	1031	1179.6	1170.2	297.3	0.21	0.5
KS21594	1557.5	699.3	1128.4	1043.6	858.2	0.16	1.2
KS21595	1389.5	696.5	1043	983.8	693	0.14	1.1
KS21488	1518.4	570.9	1044.6	931.1	347.5	0.13	1.3
KS21489	1744.2	823.2	1283.7	1198.3	921	0.21	1.1
KS21492	2025.5	880.9	1453.1	1335.8	1144.3	0.27	1.2
Ghaffar	1973.1	684.5	1328.8	1162.1	1288.6	0.20	1.4