Genetic Evaluation for Effects of Salt and Drought Stress on Growth Traits of *Zea mays* Seedlings

M. Khalil, M.S. Rashid, Q. Ali* and A. Malik

Institute of Molecular Biology and Biotechnology, The University of Lahore, Lahore, Pakistan

Corresponding author: Q. Ali
E-mail: saim1692@gamil.com
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ABSTRACT. Maize is an important grain cash crop grown throughout the world for its grain and fodder. It is highly sensitive for abiotic stress conditions; like drought, chilling, alkalinity, heat, salt and cold conditions. Present study was carried out to find out the effects of salt or NaCl and drought stress on three selected maize genotypes *viz*., P6103, L5971 and P1429. The seeds of selected maize genotypes were sown in pots filled with pure sand. The stress treatments were carried out as 0.50 mM NaCl and 50% drought. The treatments were applied 4 times after each 7days of germination of maize seedlings. After the pots were given the treatments of salt and drought data of different parameters were collected, viz., plant weight, root length, shoot length and leaf length after each 7 days of each treatment application. The data was statistically analyzed for the analysis of variation to determine the significance of results. There was a notable increase in root length in drought and control as compared to salt (NaCl) stress, where all growth parameters performed well under NaCl stress. The combined statistical analysis showed that the L6103 genotype worked better under both NaCl and drought stress compared to P1429 and L5971. The genotype that performed less than all types was P1429. The genetic advance and heritability were also found higher for around all studied traits of L6103 under all treatments. It was suggested that the genotype L6103 may be used to increase the grain yield and fodder of *Zea mays* under drought as well as salt (NaCl) stress as compared to L5971 and P1429.

Keywords: Salt; Drought; *Zea mays*; NaCl; Root length; Shoot length; Genetic advances

INTRODUCTION

Maize (*Zea mays L.)* is one of the major cereals grown for both humans and animals in different parts of the world. Maize grains have high nutrient contents and are used for various bakery products, while green fodder is rich in protein used as feed for livestock (Dowswell et al., 1996; Donderski and Brzezinska, 2005). Maize is the third major grain in Pakistan after wheat and rice. As an important "Kharif" crop (spring crop), maize is cultivated on about one million hectares with a total production of about 3.13 million tonnes and the average yield is 3264 kg per hectare (Mazhar et al., 2020). In most lands high amount of salt are present in soil which badly affects crop plant productivity. About, 7% of the world's land area used for agriculture, from which about half of agricultural land is affected by high salt content (Szabolcs, 1994; Zubair et al., 2016). In view of FAO, 2.1% of global dry land agriculture is affected by saline (FAO, 2003). The effects of salinity are more pronounced in dry and subtropical regions, where limited rainfall, high evaporation, and high temperatures associated with poor water and soil management practices are as major factors (Munnas et al., 2006; Iqra et al., 2020ab; Masood et al., 2020). Demand of the maize has been increasing day by day throughout the world. There is need to develop such maize genotypes which can combat with all types of environmental stress condition.

MATERIALS AND METHODS

The present study was performed in greenhouse of Institute of Molecular Biology and Biotechnology, The University of Lahore to find out effects of salt and drought stress on maize seedling growth. For our study we have selected three maize varieties viz., L6103, P1429 and L5971. Seed from selected maize genotype was used to grow in 36 pots, filled with 1.5 kg washed pure sand. Seed of each variety was sown in triplicate pots with all the ingredients need. To succeed our research we have used subsequent sets for treatment. We use concentration of NaCl or salt 0.5 m Molar NaCl, control and 50% drought stress to our three varieties to test out how resistant they are in these stress conditions. The treatments were applied 4 times and the data was collected after each 7 days of all treatment. The data collected for 4 times from four weeks was pooled to carry out analysis of variance and all pairwise comparison for maize variety in different stress conditions. Data was collected on different morphological traits including the Fresh plant weight, leaf length, shoot length root length. The collected data which was statistically analyzed through used analysis variance technique (Steel et al., 1997) by using SPSS23.1 software.

RESULTS AND DISCUSSION

The purpose of our research was to determine the salt and drought effects on different maize genotypes including the genotypes P1429, L5971 and L6103, and to find out which genotype was best for the growth under the drought and salt stress conditions. A combined statistical analysis was done in which three genotypes under three stresses were separately examined. The results were significant which showed that the coefficient of variation was low which indicated that the results were consistent and reliable and we can use these varieties for developing tolerant genotypes against salt and drought stress (Asif et al., 2020; Topolska et al., 2004). However the results exposed that the genotype L6103 performed better in two types of stresses drought and salt (NaCl) stress as compared to the varieties L5971 and P1429 which showed less resistance to drought and salt (NaCl) stress conditions. It was found from results that the genetic advance for root length (17.89%, 18.03%, 15.37%), leaf length (18.24%, 19.35%, 20.44%), shoot length (17.24%, 18.19%, 19.24%) and fresh plant weight (20.26%, 14.20%, 18.43%) was recorded for L6103, L5971 and P-1429 respectively. The heritability was frond for root length (92.25%, 89.28%), leaf length (93.17%, 88.35%, 90.24%), shoot length (90.19%, 89.87%, 86.67%) and fresh plant weight (94.47%, 88.01%, 82.43%) was recorded for L6103, L5971 and P-1429 respectively. The higher genetic advance and heritability indicated that the selection of maize genotypes on the basis of root length, shoot length, leaf

length and fresh plant weight may be helpful to improve grain and fodder yield of maize genotypes (Masood et al., 2020; Mazhar et al., 2020) (Table 1).

Sources	Root Length	Leaf Length	Shoot Length	Fresh plant weight
		L6103		
Coefficient of variation	5.22	8.11	9.25	8.94
Genetic Advance (%)	17.89	18.24	17.24	20.26
Heritability (%)	92.25	93.17	90.19	94.47
		L9571		
Coefficient of variation	7.82	8.22	5.19	8.15
Genetic Advance (%)	18.03	19.35	18.14	14.20
Heritability (%)	89.28	88.35	89.87	88.01
		P1429		
Coefficient of variation	6.67	9.24	9.45	7.92
Genetic Advance (%)	15.37	20.44	19.24	18.43
Heritability (%)	88.24	90.24	86.67	82.43

Table 1. Genetic components for morphological traits of maize from analysis of pooled data.

CONCLUSION

The results concluded that the genotype L6103 performed better under salt and drought stress as compared to the varieties L5971 and P1429 which showed less resistance to drought, salt (NaCl) and salt (NaCl). The genotype L6103 may be used for the development of synthetic and hybrids of maize to improve grain and fodder yield under drought and salt stress conditions.

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