CORPUS PUBLISHERS

Environmental Sciences and Ecology: Current Research (ESECR)

Volume 3 Issue 4, 2022

Article Information

Received date : May 29, 2022

Published date: June 07, 2022

*Corresponding author

Mohammedein B Alhessein, Agricultural Research Corporation, Wad Medani, Sudan

Keywords

Zea maize; Genotypes; Cariability; Heritability; Yield, Potential; Central of the Sudan

Research Article

Performance, Heritability and Correlation Studies on Maize (Zea Mays L) Genotypes Under Irrigated Condition in Central Sudan

Mohammedein B Alhessein*[1] and Suleiman H Suliman[2]

[1]*Agricultural Research Corporation, Wad Medani, Sudan*

[2]*Faculty of Agricultural Sciences, University of Gezira. Wad Medani, Sudan*

Abstract

These experiments were conducted in two different sites to study the genetic variability and the mean performance of the elite different origin maize genotypes under irrigated condition in central of the Sudan on rainy season 2014. The experiments were arranged in randomize complete block design in three replicates, the data were collected on days to 50% tasseling and silking, plant and ear height, ear length and diameter and grain yield. The analysis of variance for each site and a cross sites showed a significant variability among tested genotypes for grain yield, days to 50% tasseling and silking, plant and ear height, ear length and diameter. Also, significant different were observed for genotypes, site and a cross site for most of studied traits such as for grain yield, days to 50% tasseling and silking, plant and ear height, ear length and diameter. The combined results for genotypic coefficients of variability and broad sense heritability estimates grain yield, ear length and ear diameter varied significantly among the tested genotypes.

Introduction

Maize (Zea mays L) is considered as the third world most important cereal crop after wheat and rice, it is grown in various agro-Eco logical zones, the genus Zea belongs to the tribe Andropogneae, at sub family Panicoideae and family Poaceae. There are five species including the genus Zea. They have been examined largely and have a chromosome number (2n=20) [1]. Maize is versatile crop grown over a range of agro climatic zones, in fact the suitability of maize to diverse environments is unmatched by any other crop. It is grown from 580N to 400S, from below sea level to altitudes higher than 300 mm, and in areas with 250 mm to more than 500 mm of rainfall per year, its staple food for many people [2]. The worldwide production of maize was more than 960 million MT in 2013, in global production was grown at 3.4% from 967 million MT. Cultivated area 2.2% from 177 million hector, USA is the largest production at 37%, China 22%, Brazil7%, and other countries 17% [3]. The maize grain can be prepared for food in many different ways (fried, grilled, in a salad or soup). Processing maize can also produce a wide range of products, such as corn flour and cornmeal. Maize is also used in livestock feed (Poultry, Pigs, Cattle) in the form of grains feed milling or fodder. In addition is also used a raw material in a range of industries (Agric-Food, Textile, Pharmaceutical). To create biodegradable plastics, biofuel, and even alcohol [4]. In Sudan maize is the fourth cereal crop after Sorghum, Millet and wheat. There has been an increasing interest in developing Maize cultivates. It is introduced in the diversification policy as a new food crop in the irrigated schemes. Local varieties are adapted to the unfavorable growing conditions. They constitute a good source of genes for breeding program [5]. Maize is of recent introduction and occupies 36960 hectares with 70000 tones production and yielded 1894 Kg/hectare. Maize cultivated under irrigation in central, eastern and northern States [6]. Maize is among substitute crops to replace the wheat in agricultural schemes especially in the Gezira scheme, it can occupy an important position in the economy of the country due to the possibility of blending it with wheat for making bread [7]. Maize is a genetically highly studied plant species, consequently, the inheritance of several characteristics and its genome are well known and there are several alternatives for incorporating useful characteristics into adapted materials. The methodology depends on the heritability, gene action, number of genes involved, heterosis, and genotype x environment interactions [8]. Therefore, objective of this study to identify the genetic variability on maize genotypes under irrigation condition to asses yield potential of superior germplasm and compare grain yield of released varieties with the introduced germplasm.

Materials and Methods

Plant materials

The plant materials consist of fifteen genotype with two local checks Hudiba-2 and MO_3 GOLDEN-1, there were developed in the maize research program and tested to verify their yield potential and important agronomic traits in different irrigated locations.

Experimental sites and conditions

All the experiments were conducted in tow locations Gezira and Rahad research stations farms. The experiments were arranged in randomized complete block design with three replicates. The plot size were kept in 2 rows with 5 m long with the inter and intra row spacing of 80 x 20 cm, the seed were sown in rate of three seeds per hill then thinned to one plant per hill. Fertilization was done using urea in split-applied dose by broadcasting after two weeks from sowing and at flowering stage at a rate of 86 kg ha^{-1} of N. Irrigation was carried out at 10-14 days intervals to avoid any water stress. Weeding was done manually at least twice to keep the crop free from weeds. Overall, the trials were conducted under standard cultural practices recommended by ARC for maize production.

Data collection

The agronomic parameters were recorded for yield, and it is components such as days to 50% tasseling, days to 50% silking, plant height, ear height, ear length and diameter, and grain yield.

Statistical analysis

The statistical analysis was conducted for each location and then combined to test significant differences among the genotypes. The analysis of variance was done according to Statistical Analysis for System [9] for each season separately and then combined. Genotypic and phenotypic coefficients of variations were computed according as follows:

Genotypic coefficient of variation (GCV) Was

$$\text{Calculated as (GCV)} = \frac{\sqrt{\sigma^2 g}}{\bar{x}} \times 100$$

Phenotypic coefficient of variation (PCV) Was

$$\text{Calculated as (PCV)} = \frac{\sqrt{\sigma^2 g}}{\bar{x}} \times 100$$

genetic variance to phenotypic variance.

$$h2b = \sigma^2 g / \sigma^2 p.$$

Where: h2b = broad sense heritability

σ^2 g =genotypic variance

σ^2 p= phenotypic variance

Broad sense heritability (h2b) estimates for yield and its related characters were computed as the ratio of genetic variance to phenotypic variance.

Result and Discussion

Across analysis of variances raveled a wide range of variation significant differences among the tested genotypes for grain yield. Days to 50% tasseling and silking, plant and ear height, ear length and diameter and grain yield were presented in (Table 1,2). The combined analysis of variances a cross two locations were shown a significant difference for site, site across replication, genotype and genotype across site for most traits, this was attribute to genetic and environmental effects, as well as their interaction. Substantial variation among these different genotypes also with different genetic sources they constitute a good source of genes pool for breeding program [5]. The estimates of genotypic and phenotypic coefficient of variation and heritability in broad sense, which were presented in (Table 3), there were shown a higher values of genotypic coefficient of variation which was obtained by grain yield in Rahad Research Farm (RRF) and across two locations, also the ear length obtained a higher value in Gezira Research Farm (GRF) and across two sites. The higher value of phenotypic coefficient of variation was obtained by grain yield and ear length in two locations and their combined, but also ear placement having higher value in Rahad Research Farm (RRF) and across two locations, generally, most of studied traits having a value ranged between 4.46 to 6.60. These results indicates the genetic variability a among the tested genotypes indifferent locations due to environmental condition and G x E interaction effects. Broad sense heritability was important selection index for best genotypes with higher heritable values, therefore, a higher value was recorded by flowering time days to 50% tasseling and silking, plant height and ear length in all sites and across them, nether less, a low heritable values obtained by ear length and grain yield, generally , grain yield having a higher values for genotypic and phenotypic coefficient of variation and a moderate heritable values in Gezira Research Farm (GRF) and across locations but it was a higher in Rahad Research Farm (RRF) (Table 3,4). Genetic variability studies provide basic information regarding the genetic properties of the population based on which breeding methods are formulated for further improvement of the maize crop. They are useful and help in understanding the nature and extent of variability that can be attributed to different causes, sensitive nature of the maize crop to environmental factors. Generally, progress in any crop improvement venture depends mainly on the variability existing in the metric traits of the base population. Hence, to have a thorough comprehensive idea, it is necessary to have an analytical assessment of yield components [10].

Table 1: Name and origin of fifteen maize genotypes evaluated in irrigated condition Gezira and Rahad Research Stations Farms.

Genotype Number	Genotype Name	Origen
1	HSD-5158.	Sudan
2	PR-89B 5655.	CIMMYT
3	S 99TLQHG" AB-#-#.	CIMMYT
4	S 99TLWQ-1.	CIMMYT
5	Pool 15QPM-IR-#-#.	CIMMYT
6	EDEN.	INDIA
7	JKH 56.	INDIA
8	MAC.	INDIA
9	PAC 740	INDIA
10	PAC 745.	INDIA
11	CROSS (1) P-3.	Sudan
12	CROSS (3) P-4.	Sudan
13	CROSS (7) P-5.	Sudan
14	MO_3 GOLDEN (Local check-1)	Sudan
15	HUDIBA-2 (Local check-2)	Sudan

Table 2: Genotypic, Phenotypic variances and heritability estimates of fifteen maize genotypes tested at Gezira and Rahad season.

Source of Variation	DF	Days to 50% Tesseling	Days to 50% Silking	Plant Height	Ear Height	Ear Length	Ear Diameter	Grain Yield
Site	1	59.2***	57.6***	11673.6***	11200.2**	4.444*	1.6**	
Rep x site	4	1.06*	2.8	340.1*	210.9***	1.03	0.11*	3146927.9***
Genotypes	14	16.4**	17.1***	449.4***	127.05873***	11.9***	0.12***	1705549.7*
Genotypes x site	14	4.4	4.7	52.6	37.77302	1.5	0.03	2044152.9
Error	56	3.3	3.3	57.6	74.1	1.4	0.05	1307645.1
Mean		48	51	170.6	79.3	18.5	3.8	3762.02
CV		3.7	3.5	4.4	10.8	6.4	5.8	30.3

*, **, *** Significant at 0.05, 0.01 and 0.001 probability levels, respective.

Table 3: The mean performance of maize genotypes traits in two sites combined.

Genotypes	DT	DS	PH	EH	EL	ED	GY
HSD-5158	48def	51def	172.8bcd	75.6abc	17.9bc	3.71bcd	3977.0abc
PR-89B 5655	46.1f	49.1f	172.1bcd	82.5ab	17.8bc	3.81abcd	3975.3abc
S 99TLQHG" AB-#-#	47ef	50.1ef	168.5cde	74.5abc	17.4bc	3.85abcd	2924.4c
S 99TLWQ-1	48.1cdef	51.3def	169.6cd	80.3abc	18.3b	3.70cd	4208.3abc
Pool 15QPM-IR-#-#	48def	51def	174.5bcd	83.3ab	17.5bc	3.78abcd	3451.7abc
EDEN	52a	55.3a	189a	85a	18.9b	4.01ab	4752.5a
JKH 56	50abcd	53bcd	150.5f	72.1bc	20.5a	4.05a	2993.7bc
MAC	51ab	54ab	170.5bcd	80.6abc	18.5b	3.93abc	3175.8abc
PAC 740	50abc	53.6abc	175bc	84.1a	21.3a	3.73bcd	4030.5abc
PAC 745	48.8bcde	52cde	180.1b	85.5a	21.2a	3.91abc	3681.2abc
CROSS (1) P-3	48.5cdef	51.3cdef	170.8bcd	80abc	17.4bc	3.76abcd	4035.0abc
CROSS (3) P-4	47.1ef	50.3ef	171.5bcd	79.6abc	17.6bc	3.75abcd	3402.0abc
CROSS (7) P-5	47ef	50ef	170.3bcd	78.6abc	17.7bc	3.58d	3551.2abc
MO_3 GOLDEN	47.5ef	50.6def	159.3e	70.3c	17.2c	4.05a	4556.5ab
HUDIBA-2	48.3cdef	51.3cde	164.3ds	77.6abc	17.8bc	3.68cd	3706.2abc
Mean	48.5	51.6	170.6	79.3	18.5	3.8	3762
CV%	3.7	3.5	4.4	10.4	6.4	5.8	30.3

F value	4.96**	5.19**	7.80**	1.72*	8.48**	2.42**	1.30*

*, **, *** Significant at 0.05, 0.01 and 0.001 probability levels, respective

DT=Days to 50% Tasseling, DS=Days to 50% Silking, PH= Plant Height, EH= Ear Height, EL=Ear Length,

ED= Ear Diameter, and GY= Grain Yield.

Table 4: Genotypic, Phenotypic variances and heritability estimates of fifteen maize genotypes tested at Gezira and Rahad.

	Genotypic Coefficient of Variation			Phenotypic Coefficient of Variation			Broad Sense Heritability (h2B)		
Traits	GRF	RRF	Across	GRF	RRF	Across	GRF	RRF	Across
DT	3.8	2.37	4.29	6.06	3.56	5.77	39.4	44.3	55.4
DS	3.56	2.51	4.15	5.49	3.74	5.44	41.9	47.7	58.2
PH	5.3	4.5	0.75	6.6	6.59	4.5	63.7	47.4	2.82
EH	3.92	2.96	2.29	7.7	15.1	12.1	25.9	3.81	19.24
EL	7.82	1.83	10.12	10.09	8.8	11.9	60.9	50.9	71.3
ED	3.72	1.83	4.63	7.57	4.46	7.11	24.1	16.9	32
GY	4.01	14.25	9.68	36.3	29.03	31.9	1.23	24.1	9.2

*, **, *** Significant at 0.05, 0.01 and 0.001 probability levels, respective.

Conclusion

From this result concluded that the genetic variability among the tested genotypes for the most studied traits, therefore, a significant different were detected for genotypes, site and a cross site for grain yield, days to 50% tasseling and silking, plant and ear height, ear length and diameter. The combined results for genotypic coefficients of variability and broad sense heritability estimates grain yield, ear length and ear diameter varied significantly among the tested genotypes.

References

1. Nafziger ED (2008) Growth and Production of maize : Mechanized Cultivation. Soils, Plant Growth and Production. Crop Sciences, University of Illions, Goodwin, Urbana IL 61801, USA. Vol (1).
2. Saad MA (2009) Determent of the optimum dose rate of gamma irradiation for mutation induction in maize (Zea mays. L). Sudan Academy of sciences, Sudan.
3. Singh AD (2014) India Maize (SUMMIT) 2014 KPMG India Pvt National Commodity and Derivatives Limited, Ackruti Corporate Park 1st floor, Near GE Garden Kanjurmarg, Mumbai-78.
4. Ngosamnick EL(2012) Maize production and processing, CTA and ISF 2012. ISSBN, (CTA): 978-92-908.
5. Ali OA, Yousif MT, Bakheet GA (2010) A note on chemical constituents of some local maize (Zea mays L.). published by Sudan Journal of agricultural Research. ISSN:1561-770X.Wad Medani, Sudan.
6. Mohammed AA, Ali ES, Hamada AA, Siraj OM (2008) Optimum sowing time for maize (Zea Mays) in northern Sudan. J Agric Res 12: 1-10.
7. Mohammed AA, Ali ES (2006) Response of maize to different Nitrogen fertilizer under under different moisture regimes. Annual Report, Maize Program Breeding. Ministry of science and technology, Sudan.
8. Nass LL, Paterniani L (2000) Pre-breeding: A link Between Genetic Resources and Mize Breeding. Embrapa Recursos Genéticos Biotecnologia, SAIN Parquet Rural, CEP:70770-900-Brasília, DF 2 Depto de Genética, USP/ESALQ, Scientia Agricola 57(3): 581-587.
9. SAS Institute (1997) SAS/STAT user's guide Version 6, fourth ed. SAS Inst, Cary, NC.
10. Johnson HW, Robinson HF, Comstock R H (1955) Estimation of genetic variability and environmental variability in soybean Agron J 47: 314-318.