THE STUDY OF OPEN-POLLINATED MAIZE VARIETY UNDER NON-IRRIGATED CONDITION

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ABSTRACT

Maize is the one of the world leading crop. 90% of the maize produced in industrialized countries is grown in temperate production environments which mean that Mongolia has potential to grow maize plant. Three open-pollinated varieties (OPV) were studied in Institute of Plant and Agricultural Sciences to compare growing potential under non-irrigated condition. Mongolian corn population showed high significance than the other two on yield related traits, ear length, kernel length, fresh ear weight, tassel length and number of kernel per row. The result showed that studied OPV can yield under rain-fed condition and can be distributed to the farmers.

KEY WORDS: drought, rain-fed, non-irrigated, corn population

INTRODUCTION

More than 90% of the maize produced in industrialized countries is grown in temperate production environments. This stands in sharp contrast to the developing world where only about 25% of the maize is grown in temperate environments, most of which are China and Argentina [1]. Maize is the one of top three crops in the world due to its planting and grain yield.

Open pollinated variety or OPV is male and female flower of plant that is open pollinated. Crossing and selection of offspring of hybrid and cultivars can result in high-yielding variety that is OPV. With each new generation, there is a reshuffling of the genes, which keeps open-pollinated corn highly heterozygous and maintains its genetic variability [2]. This means heterozygous OPVs can be grown in diverse agricultural zones, give an opportunity to farmers to select their own seeds and plant 2-3 years but it yields 10-25% lower than the hybrids [3]. For this reason, it is still being planted in some African countries [4] and seed resource poor countries where lack of hybrid development and seed production markets. But in developing countries, OPV was replaced by F_1 when single cross method was developed in the USA in 1930s [5].

Mongolia has started planting annual and biennial feed crops since 1945. In 1963, feed crops were planted in 54 thousand hectares including corn in 9.8 thousand hectares [6] and feed crops in 117 thousand hectares from 1986-1990. Later, corn varieties were studied under irrigated condition in Dornogobi aimag from 1987-1988, in genebank experimental station of IPAS from 2008-2010 by Dr. Namjilsuren [7] and in Ugtaaltsaidam and MULS experimental field in Bornuur by Ts.Batttuya *et al*., in 2015 [8].

The objective of our study was to compare three OPV varieties under non-irrigated condition that have been planted for many years in Plant breeding and genebank division of IPAS. The value of OPV is first priority in Mongolia as considering difficulty of seed production of hybrid maize.

MATERIALS AND METHODS

Three different OPV maize were planted with three replications in Institute of Plant and Agricultural Sciences experimental field on 29th of May. One OPV, Fuerla was originated in Japan and planted from 2008, the other one was DKS-26/75 which originated in Canada. The third OPV, further referred to Mongolian Corn Population (MCP), was the result of breeding program started in 2004 at IPAS cooperating with International Corn Foundation. During 2015 year, the field was not irrigated and the total precipitation from May to mid of September was 258.2mm according to Darkhan-Uul weather station. Each plot size was 9 m^2, 40 cm plant to plant, 60 cm row to row, each hill with 2 seeds. Plant population per hectare was 83000. Fertilizer $N_{24}P_{18}$ was applied once prior to planting and hand weeding was done twice in June and once in July during plant growing period. Before flowering, 15 plants were randomly selected for data collection. Plant height (PH), ear height (EH), tassel length (TL) were measured on the field whereas ear length (EL), kernel length (KL), ear diameter (ED), row number and kernel number was counted when the ears were dried. Mean of survival percentage, male and female flowering in days, 1000 seed weight, ear fresh weight, ear dry weight and anthesis-silk interval (ASI) and 3 dried big ear were calculated. ASI equation was:

days to 50% silking – days to 50% anthesis

based on 50% of flowered male and female selected plants. Reduced ASI has been used successfully to increase the drought tolerance in selection [11],[12], and smaller ASI values mean a greater chance of successful seed set, increased kernel numbers and increased yield [13].

Growing degree day (GDD) from 29th May to 12th of September was calculated as following [9].

$$(\frac{Tmin+Tmax}{2}) - T_{base}$$

T_{min} and T_{max} are the temperatures below and above which the plant does not develop that is 10C and 30C for maize, respectively, and T_{base} for maize is 10C [10].

Collected ears were analyzed by SPSS 16 program.

RESULT

The plant growing days were 106 days from 29th of May to 12th of September and harvested at 48% moisture. Total growing degree day during plant growing period was 1131. Table 1 shows mean of survival, male and female flowering, weight of 1000 seed, fresh ear, dry ear, 3 selected ear and ASI. Survival among three OPV was 71% for DKS-26/75, followed by 63% for MCP and 52% for Fuerla. DKS-26/75 and Fuerla flowered 5 and 3 days earlier for male flowering and 4 and 2 days earlier for female flowering than MCP. ASI from the number of days for male and female flowering, MCP showed 1 whereas DKS-26/75 and Fuerla was 4. Mean 1000 seed weight was 167.5 in Fuerla whereas MCP was 126.7 and 125 in DKS-26/75.

Table 2 shows one-way ANOVA result comparing three different OPVs. The three showed no significance for ear diameter and dry weight traits whereas eight traits had significant difference at P=0.05.

Table 1

Mean of some traits

	Survival, %	Male flowering	Female flowering	Fresh ear weight	Dry ear weight	1000 seed weight	3 dried big ear	ASI
MCP	63	71	74	169.33	79.87	126.7	327.42	3
Fuerla	52	68	72	120.28	68.68	167.5	273.44	4
DKS-26/75	71	66	70	137.94	68.71	125.0	301.5	4

Table 2

ANOVA for yield and other traits

		Sum of Squares	df	Mean Square	F	Sig.
Plant_height	Between Groups	2700.504	2	1350.252	3.562	.031
	Within Groups	50041.822	132	379.105		
	Total	52742.326	134			
Ear_height	Between Groups	1198.770	2	599.385	4.539	.012
	Within Groups	17430.667	132	132.051		
	Total	18629.437	134			
Ear_length	Between Groups	269.497	2	134.749	14.135	.000
	Within Groups	1172.578	123	9.533		
	Total	1442.075	125			
Ear_diameter	Between Groups	.030	2	.015	.108	.898
	Within Groups	17.122	123	.139		
	Total	17.152	125			
Kernel_length	Between Groups	219.715	2	109.857	13.619	.000
	Within Groups	992.200	123	8.067		
	Total	1211.915	125			
Fresh_weight	Between Groups	55063.458	2	27531.729	10.177	.000
	Within Groups	354381.288	131	2705.201		
	Total	409444.745	133			
Tassel_length	Between Groups	812.193	2	406.096	12.372	.000
	Within Groups	4332.800	132	32.824		
	Total	5144.993	134			
Number_of_row	Between Groups	37.519	2	18.759	4.245	.016
	Within Groups	543.615	123	4.420		
	Total	581.134	125			
Dry_weight	Between Groups	3495.789	2	1747.894	2.439	.091
	Within Groups	88141.467	123	716.597		
	Total	91637.255	125			
Number_of_kernel	Between Groups	850.452	2	425.226	11.890	.000
	Within Groups	4399.040	123	35.765		
	Total	5249.492	125			

Table 3 showed homogenous group by SPSS program for 5 traits which had significant difference. MCP differed from the other two varieties in ear length, kernel length, fresh weight, tassel length and number of kernel which are yield related traits.

Table 3

Homogenous group of varieties showed high significance

	Ear length			Kernel length			Fresh weight			Tassel length			Number of kernel		
Variety	N	Subset for alpha =0.05		N	Subset for alpha =0.05		N	Subset for alpha =0.05		N	Subset for alpha =0.05		N	Subset for alpha =0.05	
		1	2		1	2		1	2		1	2		1	2
TCK	45	14.29		45	13.50		44	120.28		45	25.84		45	27.33	
Fuerla	39	14.55		39	13.52		45	137.94		45	27.15		39	28.05	
MCP	42		17.51	42		16.31	45		169.33	45		31.57	42		33.14
Sig.		.920	1.000		.999	1.000		.247	1.000		.525	1.000		.847	1.000

DISCUSSION

Studies on corn in Mongolia showed that corn plant can yield higher under irrigated condition. But due to high cost of inputs it is required to develop drought and heat resistant corn varieties to plant under non-irrigated condition. The studied varieties showed good performance under non-irrigated condition only with 258.2 mm precipitation which means that maize has a great potential to grow and develop in any area of Mongolia.

As shown in Ts.Battuya *et al*., study, farmers may loss the entire yield by planting exotic varieties and hybrids. For this reason, non-local maize hybrids or varieties can be reshuffled with local open pollinated varieties which are acceptably yielding. Therefore, exotic germplam should be studied in experimental fields to introduce, to enhance genetic diversity and background of OPVs to meet the first priority and support seed demand.

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