International Journal of Environmental Sciences & Natural Resources
ISSN: 2572-1119

Juniper Publishers
key to the Researchers

Research Article
Volume 5 Issue 5 - October 2017
DIO : 10.19080/IJESNR.2017.05.555672

Int J Environ Sci Nat Res

Seed Yield Performance of Different Maize (*Zea mays l.*) Genotypes under Agro Climatic Conditions of Haripur

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Submission: September 28, 2017; **Published:** October 12, 2017

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Abstract

An experiment was conducted to evaluate the "Seed yield performance of different maize (Zea mays L.) genotypesunder agro climatic conditions of Haripur". The experiment was sown on 17th May, 2015, at Research Farm of the University of Haripur. Four different varieties of maize (PS-1, PS-2, PS-3 and Iqbal check) were tested in the experiment. The experiment was laid out in randomized complete block design with three replications. The data recorded on various parameters were analyzed using computer software Statistics 8.1. For mean separation LSD test was used. The analyzed data revealed significant differences for various parameters studied. Mean values of the data indicated that PS^{-1} and PS-2 produced tallest plants (212.1 and 201.7 cm), higher number of rows ear-1 (15.6 and 14.8), Maximum number of grains ear^{-1} (531.3 and 518.7) and greater thousand grains weight (330 and 327 g), respectively.

While genotype PS^{-1} had maximum ear height (88.7 cm) and higher moisture contents (31.7%) in the grain. Genotypes PS^{-1} and PS-2 produced higher but at par grain yield of 5495 and 5261 kg ha^{-1}, biological yield (12679 and 12189 kg ha^{-1}) and higher harvest index of 43.3 and 43.2%, respectively. From the data obtained in this study, it can be concluded that genotypes PS^{-1} and PS-2 performed better as compared to genotypes PS-3 and Iqbal (check). Therefore, the above experiment may be recommended for further evaluation/testing across the Haripur distract to be released as commercial genotypes/varieties for Hazara region in general and Haripur in particular.

Keywords: Maize genotypes; Seed yield; University of Haripur; Pakistan

Introduction

Maize (*Zea mays L.*) is the second most important crop after wheat in Khyber Pakhtunkhwa (KP) of Pakistan but yield per unit area is very low [1]. Maize (*Zea mays L*) is a multipurpose crop that provides food for human, feed for animals especially poultry and livestock. It is a rich source of raw material for the industries where it is being extensively used for the preparation of cornstarch, dextrose, corn syrup and corn flakes [2]. Botanically, maize belongs to the grass family (poaceae/gramineae) genus *Zea*. Maize is tall, annual plant with an extensive fibrous root system. It is cross pollinating species, with the female (ear) and male (tassel) flower in separate places on the plant. The grains develop in ears or cobs, often on each silk; each ear has about 300 to 1,000 kernels, weighing between 190 and 300 g per 1,000 kernels, in a variable number of rows (12 to 18). Maize is a diploid species with a chromosome number of 2n= 2x= 20, and it has a moderate genome size of about 2400 Mb [3].

Maize is a tropical grass, well adapted to many climates and hence has wide-ranging maturities from 70 days to 210 days. Maize (*Zea mays L.*) is considered most important cereal crop after wheat and rice in the world. Maize grain yield in Pakistan (3427 kg ha^{-1}) is very low as compared to advanced countries of the world like Italy (9478 kg ha^{-1}), USA (7974 kg ha^{-1}) and China (4481 kg ha^{-1}) [4]. Maize is grown extensively in temperate, sub-tropical and tropical regions of the world for both grain and fodder. In Pakistan, average yield of maize is very low due to inadequate use of fertilizers, inadequate water, sub-optimal plant density, weeds infestation, insect pest attack and poor selection of suitable varieties for a given ecology [5]. The yield obtained from maize in Pakistan is very low as compared to other countries due to many constraints. These include poor quality seed, in discriminate application of fertilizers without soil test, poor tillage methods and lack of modern technology.

It is one of the valuable crops of Khyber Pakhtunkhwa where more than 50 percent maize of country is grown. It is a short duration, quick growing crop and has the potential to produce high quantity grains per unit area [6]. It is grown for dual-purpose, grain as well as fodder in tropical, sub-tropical and temperate regions of the world. Maize is used for multiple purposes like bread making, corn flakes, corn syrup, corn starch, textile, paper making and in food industries. Corn oil is suitable for human consumption due to the presence of unsaturated fatty acids. Maize is the leading cereal crop, which covers 4.8% area and 3.5% of the value of agricultural output. Maize is an important source of edible oil. Starch is the main product of maize from which dextrin, liquid glucose, solid glucose, powder glucose and crystalline dextrose are prepared [7,8]. Punjab and Khyber Pakhtunkhwa are the main maize growing provinces of Pakistan. Peshawar, Malakand, Hazara and Dera Ismail Khan are the major maize growing districts in KP. Maize is annually grown on an area of 1139.40 thousand hectares with total production of 4997.10 thousand tones and average yield of 4268 kg ha-1 in Pakistan [9]. A serious problem always remained between varieties and environment for successful crop stand while recommending a variety for particular location [10].

Maize being the highest yielding cereal crop in the world is of significant importance for countries like Pakistan, where rapidly increasing population has already out stripped the available food supplies. It is planted on an estimated area of 0.9 million hectare with an annual production of 1.3 million tons. The bulk (97%) of the total production come from two major provinces, Khyber Pakhtunkhwa, accounting for 57% of the total area and 68% of total production. Punjab contributes 38% acreage with 30% of total maize grain production. Very little maize 2-3% is produced in the province of Sindh and Baluchistan [11]. The optimum temperature for maize growth and development is 18 to 32°C, with temperatures of 35°C and above considered inhibitory. The optimum soil temperatures for germination and early seedling growth are 12°C or greater, and at tasseling 21 to 30°C is ideal. Genetic variability and environmental interaction play an important role in successful maize production [12]. Therefore, it is important to have the knowledge about the yield testing locations for successful stand of crop in different production environments [13]. Various synthetic or local maize varieties are in practice since many years. The introduction of hybrid proved for high production but the planting pattern and inputs application is a question to be resolved on agro-ecological basis in the country as well as provincial levels. The yield of maize however, varies from variety to variety, location to location and also depends on the availability of essential factors such as soil nutrient status, application rates and timing, and combinations [14].

The seed of improved variety and fertilizer are the main factors in enhancing the output of maize [15]. A good variety having a high yield potential is a key towards improving maize yield [16]. Yield is the primary objective in breeding maize hybrids. Hybrids generally have higher yield potential than open pollinated varieties. Hybrids maize has long ears, more grain rows per ear and greater grain yield than the open pollinated cultivars [17]. In Pakistan, maize is the staple food for a large population especially in hilly area. This crop is capable of producing the largest quantity of grain per unit area [6] and can be grown twice in a year i.e., during spring and summer seasons. Maize yield is gradually increasing from last decade in Pakistan and particularly in the Punjab province. The increase in per hectors yield of maize is mainly due to adoption of hybrid seed by progressive growers during spring season as a whole and some shift in autumn season by small farmer also. The availability of quality seed is yet not more than 50% of the total area planted in the province, while it availability on Pakistan basis is around 34%. The hybrid seed so far available is mostly imported and marketed by some multinational companies. The price of commercial hybrids is not affordable by the farming community. Maize production is not optimal in most parts of the country on account of cultivating low yielding open pollinated varieties (OPVs), high weed infestation.

Objectives

Keeping this in view, the present study was conducted with an objective to investigate "Seed yield performance of maize genotypes under the agro climatic conditions of Haripur;

a) To finding out high seed yielding maize genotype (s).

b) To finding out most suitable/adopted maize genotype (s).

Materials and Methods

A field experiment entitled "Seed yield Performance of maize genotypes under the agro climatic conditions of Haripur" was conducted at Research Farm of the University of Haripur during summer, 2015. The experiment crop was sown on 17th May, 2015. Four different genotypes of maize namely; PS-1, PS-2, PS-3 and Iqbal (check) were tested in the experiment. The experiment was laid out in randomized complete block design with three replications. The plot size was 3m x 3m with 4 rows of maize 3m long and 75 cm apart. The plant to plant distance was maintained 25cm, which was ensured by thinning. A basal dose of N and P was applied at the rate of 150 kg and 90 kg ha-1, respectively. All the phosphorus was applied at the time of seed bed preparation, whereas nitrogen was applied in two equal splits i.e., one each at sowing and second at V8 (8 leaf) stage. All other agronomic practices like irrigation, hoeing, weeding, inter culturing etc. were carried out similar for all plots to exploit full potential of the tested genotypes.

Details of the factor.

Maize Genotypes

a. Check (Iqbal)

b. PS-3

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c. PS-2

d. PS-1

Following parameters were studied in the experiment

a) Plant height (cm)

b) Ear plant^{-1}

c) Grain rows ear^{-1}

d) Grains ear^{-1}

e) Ear height (cm)

f) Thousand grains weight (g)

g) Biological yield (kg ha^{-1})

h) Moisture content at harvest (%)

i) Grain yield (kg ha^{-1})

j) Harvest index (%)

Procedure for data collection

a) Plant height (cm): Plant height for all the treatments in each replication was measured with the help of a measuring tape from the base to tassel tip of the ten randomly selected plants in two central rows and then average plant height was calculated.

b) Ear plant^{-1}: Data on number of ear plant^{-1} was recorded by counting the number of ears in five randomly selected plants and were averaged.

c) Grain rows ear^{-1}: The ear harvested for grain yield was used for the determination of number of grains ear-1 by selecting five ears randomly from each plot and counting the number of rows and were averaged.

d) Grains ear^{-1}: The ear harvested for grain yield was used for the determination of number of grains ear^{-1} by selecting five ears randomly from each plot, dried and shelled for counting the grains ear^{-1}.

e) Ear height (cm): Ear height was measured with the help of a measuring tape from the base to the point where ear is attached by randomly selecting 5 plant and then average plant height was calculated.

f) Thousand grains weight (g): Data regarding 1000 grains weight was recorded by counting actual number of 1000 grains from each plot at random and then was weighed with electronic balance.

g) Biological yield (kg ha^{-1}): Biological yield was recorded by plants harvested and dried from two central rows of each plot and then weight converted into kg ha^{-1}.

$$\frac{\text{Biological yield (kg) X 1000}}{\text{R-R x R L x No. of Rows}}$$

h) Moisture content at harvest (%): The moisture content of the grains at harvest was measured by taking seeds from the seed lot of each plot and were tested for moisture with the use of moisture probe.

i) Grain yield (kg ha^{-1}): Grains yield was recorded after shelling of ears of two central rows from each plot and then dried and weight was converted into kg ha^{-1}.

$$\frac{\text{Grain yield (kg) X 100}}{\text{R-R x R L x No.of Rows}}$$

j) Harvest index (%): Harvest index was calculated using following formula.

$$\frac{\text{Economic Yield (kg ha}^{-1}\text{) X 100}}{\text{Biological yield (kg ha}^{-1}\text{)}}$$

Results and Discussion

Table 1: Plant height, Ear plant^{-1}, Grain rows ear^{-1}, Grains ear^{-1}, Thousand grains weight, Performance of Different Maize (Zea mays L.) genotypes at Research farm University of Haripur.

Varieties	Grain yield (kg ha^{-1})	Moisture content at harvest (%)	Ear height (cm)	Biological yield (kg ha^{-1})	Harvest index (%)
Iqbal(Check)	196.3 c	1.0	13.6 b	424.3 b	269.7 b
PS-3	197.3 c	1.2	13.9 b	439.0 b	265.3 b
PS-2	201.7 b	1.2	14.8 a	518.7 a	330.0 a
PS-1	212.1 a	1.2	15.6 a	531.3 a	327.0 a
LSD(0.05)	7.8	NS	1.2	61.8	40.6

A. Plant height at maturity (cm): Among tested maize varieties, PS^{-1} produced tallest plants of 212.1 cm, which was followed by PS-2 (201.7 cm) (Table 1). Plant height was lower in both Iqbal (check) (196.3 cm) and PS-3 (197.3 cm). All maize varieties used in this study had diverse genetic background; therefore, these varieties produced varying plant height ranging from 196 to 212 cm. Plant height of PS^{-1} was higher due to the vigorous growth and genetic makeup of the hybrid [18]. Similar results have been reported earlier by [19]. Who reported variation in plant height of different maize varieties.

B. Ear plant^{-1}: Statistical analysis of the data revealed insignificant differences in ear plant^{-1} among different maize varieties (Table 1). Mean values of the data showed that number of ear plant^{-1} was statistically similar in PS^{-1}, PS-2 and PS-3 (1.20), however comparatively lower number of ear plant^{-1} (1.0) was observed in Iqbal (check). The ear

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plant-1 is a genetically controlled character and yield of less ear plant^{-1} is higher due to lower competition for nutrients. These results are in contrast with [20].

C. Grains rows ear^{-1}: Perusal of the data indicated that numbers of grain rows ear^{-1} were significantly affected by different maize varieties (Table 1). Mean values of the data indicated that higher number of rows ear^{-1} (15.6) were recorded with PS^{-1}, which was statistically similar with grains rows ear-1 of PS-2 (14.8) and lower number of grain rows ear^{-1} (13.9 and 13.6) were observed in PS-3 and Iqbal(check) respectively. These results were in line with [21] who reported that hybrid cultivar produced more number of grain rows ear^{-1}.

D. Grains ear-1: Data regarding grains ear^{-1} is presented in (Table 1) Statistical analysis of the data indicated significant effect of all the varieties on number of grains ear^{-1}. Mean values of the data showed that Maximum number of grains ear^{-1} (531.3) was found in PS^{-1} which was statistically at par with grains ear^{-1} (518.7) of PS-2, however significantly lower number of grains ear-1 (424.3 and 439.0) were produced by Iqbal (check) and PS-3 respectively [20] reported similar results that hybrid produced more grains ear^{-1} as compared to synthetic varieties due to difference in genetic makeup.

E. Thousand grains weight: Data in (Table 1) indicated thousand grains weight of maize varieties. Statistical analysis of the data indicated highly significant variation in thousand grains weight of different maize varieties. Mean values of the data indicated that greater thousand grains weight (330 g) was recorded with PS-2, which was statistically similar with thousand grains weight (327 g) of the PS^{-1}. Lower thousand grains weight (265 and 270 g) was recorded in PS-3 and Iqbal (check) respectively. Thousand grains weight is an important factor directly contributing to final grain yield of crop. Greater thousand grain weight of hybrid might be due to the fact that thousand grains weight is a genetically controlled factor so thousand grains weight of different varieties was different. The same results were also reported by [20,22].

Table 2: Grain yield (kg ha^{-1}), Moisture content at harvest (%), Ear height (cm), Biological yield (kg ha^{-1}), Harvest index (%), performance of Different Maize (*Zea mays* L.) genotypes at Research farm University of Haripur.

Varieties	Grain yield (kg ha^{-1})	Moisture content at harvest (%)	Ear height (cm)	Biological yield (kg ha^{-1})	Harvest index (%)
Iqbal(check)	4128.0	26.3	74.0	10649.3	38.9
PS-3	4202.0	29.0	77.0	10793.0	39.0
PS-2	5260.7	30.3	83.7	12188.7	43.2
PS-1	5495.0	31.7	88.7	12678.7	43.3
LSD (0.05)	272.2	3.4	11.4	1011.2	3.6

F. Ear height (cm): The data given in (Table 2) showed that maize variety PS^{-1} had maximum ear height of 88.7 cm. It was statistically similar with ear height of PS-2 (83.7 cm) whereas lower ear height was observed with Iqbal(check) and PS-3 The difference in ear height might be attributed to genetic diversity of tested maize varieties [18,23,24].

G. Moisture contents (%) at harvest: Moisture contents in the grain at harvest indicated significant differences among maize varieties (Table 2). Among varieties, PS^{-1} had higher moisture contents (31.7%) in the grain, statistically similar moisture content at harvest (30.3%) were recorded with PS-2. Lower moisture contents (26.3%) were noted in Iqbal (check). It was also noted that early maturing varieties had lower moisture contents in the grain and vice-versa [25].

H. Grain yield (kg ha^{-1}): The data given in (Table 2) revealed significant variations in grain yield. Varieties PS^{-1} and PS-2 produced similar grain yield 5495 and 5261 kg ha^{-1} respectively; however the yield was higher as compared to Iqbal (check) (4128 kg ha^{-1}) and PS-3 (4202 kg ha^{-1}). Grain yield variation might be due to the diverse genetic background of these varieties and their response to agro-ecology of the experimental area. Earlier it has been reported that genotypic variations effect grain yield of maize considerably [26-28].

I. Biological yield (kg ha^{-1}): The data given in (Table 2) showed that maize varieties differed significantly for biological yield. Highest biological yield (12679 kg ha^{-1}) was produced by PS^{-1}, at par biological yield (12189 kg ha^{-1}) was produced by PS-2, while biological yield was lower (10649 kg ha^{-1}) with Iqbal (check). In the present study, maximum biological yield was recorded in maize hybrid because it produced taller plants and more stem diameter as compare to rest of the varieties. Taller plants produce more number of leaves, larger leaf area and more light interception, which result in more photosynthesis and higher biological yield [29-45].

J. Harvest index (%): Significant variation was observed in maize varieties for harvest index (Table 2). Leading maize genotype with highest percentage of harvest index was PS^{-1} and PS-2 with harvest index of 43.3 and 43.2%, respectively [45-64]. The lowest harvest index (38.9 and 39.0%) were calculated for Iqbal (check) and PS-3 respectively. Difference in harvest index was probably due to the change in genetic makeup of the tested varieties [23,26].

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DOI: 10.19080/IJESNR.2017.05.555672

How to cite this article: Muneeb k, Kamran k, Sami U A, Nawab A, Muhammad M A, et al. Seed Yield Performance of Different Maize (Zea mays l.) Genotypes under Agro Climatic Conditions of Haripur. Int J Environ Sci Nat Res. 2017;5(5): 555672. DOI: 10.19080/IJESNR.2017.05.555672.