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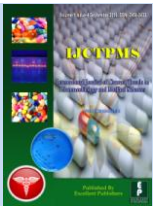

Original Research Article

Selection of Exotic Spring Maize Varieties Based on Field Evaluation Emphases on Yield Traits

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Abstract

During Spring 2014 in the experimental field area of Maize, Sorghum, Millet and Fodder Program at the National Agriculture Research Centre with Randomize Complete Block Design (RCBD). The trial was consisted of 30 different entries developed at National Agriculture Research Centre. Maximum plant populations were observed in entry number 25 (SC403) which was 42, entry number 21 (07SADVE2) was took maximum days for silking and were followed by entry number 24 (ZM521) and 30 (Local check) respectively, entry number 26 (SC513) produce the highest plant height of 212 cm, highest ear height were found in entry number 26 (SC513) which was 104 cm, entry number 21 (07SADVE2) produce the largest leaf area which was 853 cm^2 , maximum chlorophyll contents were recorded in entry number 12 (CZP132005) which was 70%., highest grains were observed in entry number 8 (CZP132001) which was 1499, entry number 26 (SC513) contained the maximum number of grain weight, which was 0.035(g) and entry number 28 (PAN413) contain the highest number of grains per hectare, which was (8772.kg ha^{-1}). Hence it is concluded that highest grain yield can be obtained by the variety of (PAN413).

Article Info

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Keywords

Maize varieties
Yielding components
Zea mays L.

Introduction

Maize (*Zea mays* L.) Known in many English speaking countries as corn, in Pakistan, it is also called maize locally known as makkai. Its local name seems to suggest that maize has come through Arab African sources. Maize originated in Central America and Cobs have been found in archaeological material dated 5000 B.C. The discovery of America by Columbus in 1492 provides enough evidence to postulate that maize was cultivated in a number of parts of the American continent. It was specially found in Mexico, Central and South America. Maize has different kernel types with their specific characteristics: dent, flint, floury, pop etc. Grain colors are white, yellow, purple, orange yellow, red, sun red, mottled and brown. Maize is one of the world's 3rd most important cereals after wheat and rice. Maize is currently produced on nearly 100 million hectares in 125 developing countries and is among the three most widely grown crops in 75 of those countries (FAO, 2000). The major maize producing countries are the United States of America, China, South and central

Africa, Argentina, Brazil and Mexico. It is most widely grown crop in the America with 332 million metric tons grown annually in the United States alone. Maize spread to the rest of world due to its popularity and ability to grow in diverse climates. Global maize production is estimated to be over 800 million tons per year (FAO, 2000) and is expected to increase in years ahead.

Agriculture is the backbone of Pakistan's economy. About 70 % of people are directly or indirectly related to agriculture. Maize has significant importance for countries like Pakistan, where rapidly increasing population has already out stripped the available food supplies. In Pakistan maize is cultivated as a multipurpose food and forage crop, generally by resource poor farmers using marginal land, few purchased inputs, with significant portions of harvest distant for home/farm consumption. The future role of maize in overall economy of the country must be critically analyzed by the policy markers, not as an isolated problem but in its inter-relationship with other commodities.

In Pakistan maize is third important and edible cereal crop after wheat and rice. Maize accounts for 4.8% of the total cropped area and 3.5% of the value of agricultural output. It is planted on an estimated area of 1.118 million hectare with an annual production of 4.036 million tones. The bulk (99%) of the total production comes from two major provinces, Khyber Pakhtunkhwa (KPK) and Punjab. KPK accounting for 48.4% of the total area and 29.5% of total production and Punjab contributes 50.6% acreage with 69.5% of total maize grain production. Very little maize is produced in the province of Sindh and Balochistan (GOP, 2008). In Pakistan the potential of crop is not being exploited satisfactorily due to a number of problems. Soaring outlay of crop husbandry, diminishing soil fertility, appalling environment and public health are important reasons for use of organic manures, bio-fertilizers.

Maize is the major kharif crop in AJK. Maize is an integral part of farming system in AJK. It is a staple food in rural setup of Northern parts. It is grown on 0.267 million acres of agricultural land with a total production of 0.185 million tones. The average yield of AJK is 0.62 tonnes per acre which is far behind the potential yield. Farmers are interested to get fodder (green & dry) and grains from the same crop. Therefore, they use a high seed rate of 4-6 kg/kanal. High seed rate may increase quantity of fodder but the grain yield is reduced. The local varieties are low yielding and tall growing and susceptible to stalk lodging whenever winds blow. That deteriorates the quantity and quality of fodder and grains (Govt. of AJK).

In Pakistan population pressure is increasing very rapidly. The rate of food consumption is very high from production. Therefore it is the cry of the day to modernize the form sector and to produce high yielding varieties. The non-availability of improved maize varieties has been rated a problem number one and has had enormous social costs in terms of limiting productivity. Thus there is high need to increase the grains yield by developing high yielding varieties and only solution to increased domestic cereal production to fulfill the population requirements.

There are several factors which contribute to low yield of maize produce in Pakistan and different strategies have been proposed to improve maize productivity (CIMMYT, 1989; De Leon and Paroda, 1993; Rajaram et al., 1998; Chughtai et al., 2002; Hussain et al.., 2003). The commercial hybrids from the multinational enterprises are mostly exotic and adopted to spring season area of Punjab. The seed cost of these hybrids is the highest in the word and hence beyond the approach of resources poor formers. Spring maize in Punjab is very high yielding sector which covers about 0.06 million hectares with an average yield 7 tons per ha. The development and adoption of maize hybrids, both in spring and kharif seasons in Pakistan can lead to a breakthrough for maize production and productivity on sustainable basis. Keeping this facts in mind, a number of hybrid have been developed locally in National Agriculture Research Center, which are largely based on indigenous maize sources. These hybrids are intended for spring as well as kharif seasons for long and short duration environments especially for rainfed and highland areas which are not attended by the private seed sector. Because these indigenous hybrids are expected to be produced locally, These are going to be much cheaper than the exotic commercial hybrids. However, the indigenous hybrids have lower yield than the commercial exotics. They are not generally preferred by the formers. Thus there is a great need to develop, popularize and locally produce the superior indigenous hybrids to ensure lower prices and wider adoption. This study indicates the data on the evaluation and suitability of selected indigenous hybrids during spring season in comparison exotic imported hybrids currently leading the market.

To gain the goal, research work has been initiated in public sector for the development of high yielding varieties based largely on utilization of indigenous maize sources. As in northern areas of Pakistan, where maize is used as primary resource of food and maize varieties rather hybrids are traditionally grown by farmer. The reason that hybrid seed is very expensive, every year need to purchase new seed, also hybrid seed need to high input and un even land create problem for required special cultural practices for better yield. Farmers have also limited resources of land, water and cost etc. which multi-crop practice (inter cropping) for their basic needs which is not possible and compatible with maize hybrids. Therefore development of high yielding maize for upland of Pakistan on priority, and present research is also an effort to compete the needs and this experiment will be help full in developing a better performing maize variety.

On the other hand it is also very important to know the inter relationship of different traits of crop and their contribution towards yield so this study was done to know these parameters which will be helpful in future.

Materials and methods

The experiment was conducted during Spring 2014 in the experimental field area of Maize, Sorghum, Millet and Fodder Program at the National Agriculture Research Centre with Randomize Complete Block Design (RCBD). The trial consisted of 30 different entries developed at National Agriculture Research Centre. Two seeds in each hill were placed and within hill 20cm distance was followed while, within rows 75cm were maintained. Rows direction was north to south. Recommended cultural practices such as thinning and weeding were followed. At physiological maturity data was recorded for days to 50% tasseling, days to 50% silking, plant height (cm), ear height (cm), leaf area (cm^2), number of grains/row, number of rows/cob, 100 grains weight and moisture content etc. The data was recorded from five randomly selected plants of each replication.

Fertilizer application: NPK is the rate of 180:90:90 kg/ha were applied.

Herbicide and insecticide application: Pre emergence herbicide primextra gold @ 400ml/acre (1 litre/ha) was applied just after planting. Insecticide Furadan was applied @ 8kg/acre (20kg/ha) at the time of sowing in the hills and 2^{nd} dose after thinning. Another insecticide Karate at 130ml/acre was also applied 3 weeks after thinning.

Thinning: Thinning was done at 5, 6 leaf stage. All other recommended cultural practices were followed for all the lines.

Statistical analysis

Statistically the data for various characters were analyzed. The analysis of variance (ANOVA) were performed among various economic characters like days to 50% tasseling, days to 50% silking, plant height (cm), ear height (cm), leaf area (cm^2), grains/row, rows/cob, 100 grain weight and grain yield /ha according to the method followed by Singh and Chaudhary (1979).

Results and discussion

Results for different parameters statistically obtained with analysis of variance by using the data collected from field experiment of 30 entries. Parameters such as, Days to 50% tasseling, Days to 50% silking, Plant height (cm), Ear height (cm), Leaf area (cm^2), Chlorophyll contents, Total grain/cob, 100 grains weight and grain yield /ha were recorded and statistically analyzed.

Plant population

Mean of plant population revealed that all the entries (30) were highly significant to each other. Maximum plant populations were observed in entry number 25 (SC403) which was 42, and the lowest plant populations were found in entry number 01 (TP1223) which was 12 (Table 1). Coefficient of variation was 10.57%, which showed the experiment validity, and the least significant value (LSD) was 1.880, if the value is less than 20% it will be acceptable. This value is used in comparison for difference among entries.

Days to 50% tasseling

Highly significant differences among the entries were observed for days to tasseling, and it was found that entry number 21 (07SADVE2) was took maximum days to tasseling, which was 85 and were followed by entry number 24 (ZM521), 30 (Local check) respectively, and minimum days to tasseling were found in entry number 19 (CZP132012) which was 71.67 (Table 1). Coefficient Variation was 2.67% and the least significant value was 1.05 (Fig. 1).

Table 1. Means of maize varieties (30 entries) planted during Spring 2014 at Maize, Sorghum Millet and Fodder Program, NARC, Islamabad.

S. No.	Varieties	Plant POP	DT	DSL	PH (cm)	EH (cm)	L.A (cm^2)	CH. CON	SPC	100 GW (kg)	GY/Ha
01	TP 1223	12	78	81	146.0	61.7	582	63	1363	0.028	2612
02	TP 122	21	77	80	170.3	70.7	693	62	1281	0.032	4773
03	TP 1222	26	76	79	169.7	76.7	729	58	1343	0.029	5962
04	TP 1220	38	76	79	179.3	81.3	655	62	1250	0.034	7022
05	TP 1219	38	77	79	176.0	82.0	694	64	1319	0.031	7250
06	TP 1217	40	78	81	184.3	83.0	700	62	1162	0.030	8494
07	VP0720	20	77	81	173.3	75.3	707	62	1309	0.029	4522
08	CZP132001	39	74	77	184.0	83.3	692	61	**1499**	0.030	8072
09	CZP132002	38	79	81	198.0	95.7	702	59	1321	0.032	7223
10	CZP132003	39	73	76	169.7	75.3	630	67	1306	0.031	5814
11	CZP132004	38	72	75	146.7	66.3	543	62	1300	0.031	6252
12	CZP132005	40	72	75	157.0	70.0	589	**70**	1262	0.029	7283
13	CZP132006	41	75	78	179.0	81.3	733	61	1359	0.029	7461
14	CZP132007	40	74	77	161.0	69.0	667	57	1151	0.029	5731
15	CZP132008	41	73	76	166.0	77.3	659	59	1319	0.029	6958
16	CZP132009	39	72	75	167.7	76.3	602	58	1287	0.031	6545
17	CZP132010	38	73	76	165.3	73.0	685	65	1190	0.031	5792
18	CZP132011	41	74	77	171.0	76.7	652	58	1196	0.030	6722
19	CZP132012	40	72	75	161.7	68.0	597	58	1233	o.031	6144
20	13SADVE1	35	78	82	200.3	87.0	774	61	1490	0.032	6333
21	07SADVE2	19	**85**	**88**	176.0	91.7	**853**	62	1207	0.030	3789
22	ZM309	35	76	78	186.3	76.3	733	59	1367	0.032	6985
23	ZM401	40	76	79	165.7	70.0	666	62	1269	0.033	6711
24	ZM521	23	82	86	190.7	91.3	707	65	1233	0.031	5092
25	SC403	**42**	75	79	192.7	83.3	744	59	1358	0.029	6366
26	SC513	35	79	83	**212.3**	**104.0**	733	60	1463	**0.035**	7654
27	SC301	29	75	78	205.7	86.7	761	61	1206	0.029	5680
28	PAN413	40	79	83	179.7	85.3	735	58	1330	0.029	**8772**
29	PAN3M01	38	74	76	161.3	70.3	658	63	1435	0.030	6216
30	Local check	27	80	83	165.0	83.7	814	59	1450	0.029	5146
C.V %		10.57	2.67	2.92	5.99	9.12	8.85	9.43	10.21	9.90	14.22
LSD		1.880	1.05	1.195	5.430	3.725	31.531	2.988	69.050	0.002	463.918
Range		12-42	72-85	74-88	146-212	61-104	543-853	57-70	1150-1499	0.028-0.035	2612-8772

DT= days to tasseling, DSIL= days to silking, PH= plant height (cm), EH= ear height (cm), LA= leaf area (cm^2), CO.CONT = Chlorophyll Contents, SPC = Seed per cob, 100 GW = 100 grain weight, GY/ha= Grain yield per hectare.C.V = Coefficient of variance, LSD = Least significant value.

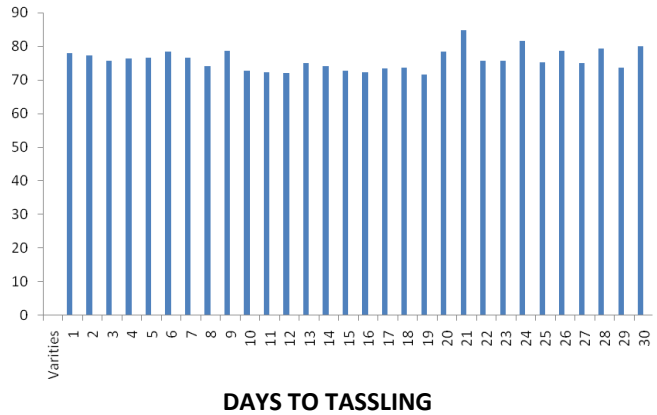

Fig. 1: Days to 50% tasseling of maize varieties.

Days to 50% silking

Highly significant difference among all the entries (30) were observed for days to silking and found that entry number 21 (07SADVE2) was took maximum days for silking and were followed by entry number 24 (ZM521) and 30 (Local check) respectively. And entry number 12 (CPZ132005) take minimum days to silking (Table 1). Coefficient of variation was 2.92% and the least significant value was 1.195, which shows the difference among the entries. Analysis of variance (statistical data) for plant height showed that all the entries were significantly different from each other (Fig. 2).

Fig. 2: Days to 50% silking of maize varieties.

Plant height (cm)

Highly significant differences among all entries (30) were observed for plant height (cm), whereas the entry number 26 (SC513) produce the highest plant height of 212 cm and followed by entry number 20 (13SADVE1) 09. (CZP132002) respectively and the lowest plant height was found in entry number 01 (TP1223) which showed in (Table 1). Ranged were produce from 146-212. Coefficient of variation was 5.99% and least significant value was 5.430. Analysis of variance (ANOVA) showed that all the entries were significantly different from each other (Fig. 3).

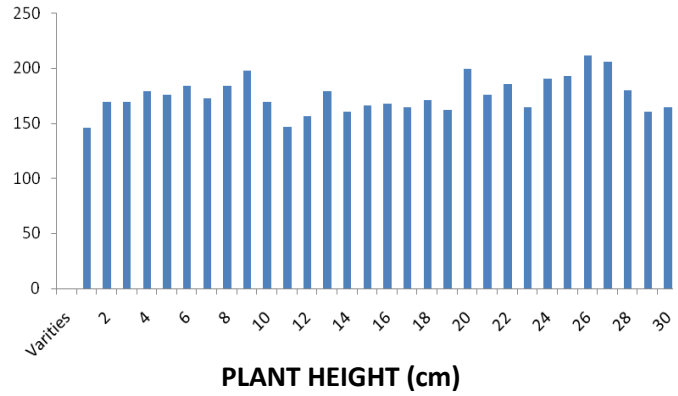

Fig. 3: Plant height (cm) of maize varieties.

Similarly to plant height, highly significant differences among the entries were observed for Ear height (cm), and the highest ear height were found in entry number 26 (SC513) which was 104 cm, and were followed by entry number 09 (CZP132002) which was 95.7 and entry number 21 (07SADVE2) which was 91.6 respectively. The lowest ear height was found in entry number 01 (TP1223) which was 61.67 cm. Coefficient of variation was 9.12%. The least significant value was 3.725. Statistical data revealed that all the entries were significantly different from each other.

Leaf area (cm^2)

Leaf area is key factor in selection parameters in any breeding program, and here highly significant differences were observed for leaf area cm^2. It was found that entry number 21 (07SADVE2) produce the largest leaf area which was 853 cm^2.and followed by entry number 30 (Local check) which was 813 cm^2. And the smallest Leaf area were produce in entry number 11 (CZP132004) which was 543 cm^2. Coefficient of variation was 8.85% and least significant value was 31.531 (Table 1). This value shows comparison for difference among the entries. By observing correlation of leaf area with other characters suggested that leaf area can be used as key selection parameters for better fodder yield and tolerance against stress like drought. And it also has strong contribution towards grain yield (Fig. 4).

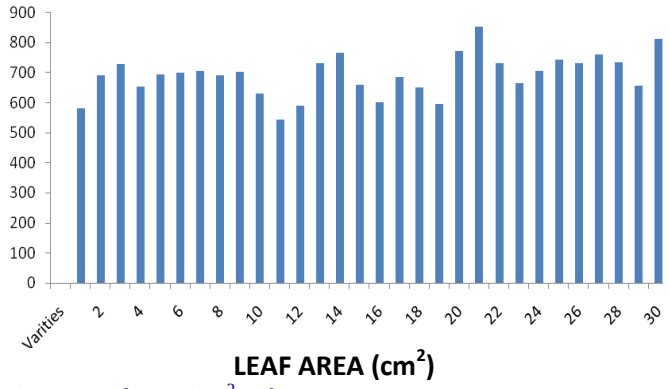

Fig. 4: Leaf area (cm^2) of maize varieties.

Chlorophyll contents

Statistical data for chlorophyll content showed non-significant differences among each other. The maximum chlorophyll contents were recorded in entry number 12 (CZP132005) which was 70%, followed by entry number 10 (CZP132006) which was recorded as 67 and entry number 17 (CZP132010) which recorded as 65 respectively (Table 1) its coefficient value was 9.43%. The least significant value was 2.988 and it might be showed that the chlorophyll contents best of all (30) entries.

Total grain / cob

Mean of grains per cob was statistically showed non-significant differences among each other. The highest

grains were observed in entry number 8 (CZP132001) which was 1499 and followed by entry number 20 (13SADVE1) which was 1490 and entry number 26 (SC513) which was 1462 respectively (Table 1). Its coefficient of variance (C.V) was 10.21% and it might be presented as selected best cobs of each entry (Fig. 5).

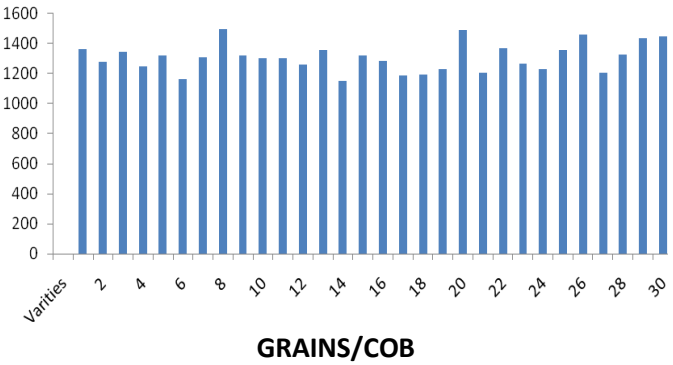

Fig. 5: Number of grains produced per cob of maize varieties.

100 grain weight (kg)

Similar as other character results, this character result was also highly significant difference among all the entries and it was found that the entry number 26 (SC513) contained the maximum number of grain weight, which was 0.035 and were followed entry 04 (TP1220) which was 0.034 and entry number 23 (ZM401) which was recorded as 0.033 (Table 1)

Coefficient of variation was 9.90% and the least significant value at 0.05 alpha level was 0.002. This value showed the comparison differences among the entries.

Grain yield/ha

Like other parameters, highly significant differences were observed for all the (30) entries. It was observed that entry number 28 (PAN413) contain the highest yield of grains per hectare, which was 8772 kg ha^{-1} and followed by entry number 06 (TP1217) which was 8494 kg ha^{-1} and entry number 08 (CZP132001) which was recorded 8072 (Table 1) and the lowest grains yield per hectare was found in entry number one which were 2612 kg ha^{-1} yield.

Coefficient of variance was 14.22% and least significant value was 463.918. Statistical data showed that the all (30) entries were different in grain yield/ha from each other (Fig. 6).

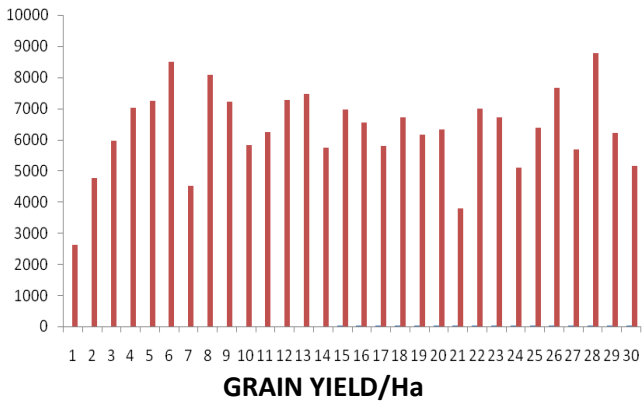

Fig. 6: Yield of grains (kg/ha^{-1}) produced by maize varieties.

Conclusion and recommendations

Maximum plant populations were observed in entry number 25 (SC403) which was 42, entry number 21 (07SADVE2) was took maximum days for silking and were followed by entry number 24 (ZM521) and 30 (Local check) respectively, entry number 26 (SC513) produce the highest plant height of 212 cm, highest ear height were found in entry number 26 (SC513) which was 104 cm, entry number 21 (07SADVE2) produce the largest leaf area which was 853 cm^2, maximum chlorophyll contents were recorded in entry number 12 (CZP132005) which was 70%., highest grains were observed in entry number 8 (CZP132001) which was 1499, entry number 26 (SC513) contained the maximum number of grain weight, which was 0.035(g) and entry number 28 (PAN413) contain the highest number of grains per hectare, which was (8772.kg ha^{-1}) Hence it is recommended that highest grain yield can be obtained by the variety of (PAN413).

Conflict of interest statement

Authors declare that they have no conflict of interest.

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