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AGRO-ECONOMIC EVALUATION OF VARIOUS MAIZE HYBRIDS UNDER DIFFERENT PLANTING PATTERNS

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ABSTRACT. An experiment was carried out at the Agronomic Research Area, University of Agriculture, Faisalabad to assess the agro-economic performance of two maize hybrids (SIPRA-4444 and TS-13) under five different sowing patterns viz. ridge sowing 60 cm apart rows, bed sowing 60 cm apart rows, 60 cm apart single row strips, 90 cm apart double row strips and 120 cm apart triple row strips. The results indicated that the hybrids and the sowing patterns had a significant influence on the grain yield of maize. SIPRA-4444 produced maximum grain yield (6.02 tha^{-1}) as compared to TS-13 (5.80 tha^{-1}). Among the planting methods, ridge sowing produced highest grain yield (7.13 t ha^{-1}). The interactive effect of hybrids and sowing methods showed that the hybrid SIPRA - 4444 produced maximum yield when it was sown on 60 cm apart ridges. From economic point of view, maximum net income of Rs. 114172 and benefit to cost ratio of (2.37) was obtained when the hybrid SIPRA-4444 was sown on 60 cm spaced ridges.

Key words: Maize; Hybrids; Sowing patterns; Grain yield.

INTRODUCTION

Maize (*Zea mays* L.) is a member of grass family *Poaceae* and is an elevated plant having a fibrous network of roots. It is a valuable grain crop which is cultivated throughout the world under varied agro ecological conditions. It is often called as the "queen of cereals". Maize is a staple food in numerous areas of the world. The utilization of maize for food as well as feed is rising day by day and it has been predicted that the world wide demand for maize will escalate further in the coming years. It has been reported that maize is involved directly or indirectly in the synthesis of approximately four thousand industrial products (Sprague *et al*., 1988).

Maize contributes a lot to the economic well being of Pakistan. Currently maize crop is being raised on an area of 1118 thousand hectares with aggregate production of 4036

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thousand tones per annum (MINFAL, 2008). In Pakistan maize can be planted in Spring season as well as in Autumn. Despite of a great potential, the average corn yield is still presenting a gloomy picture which can credited to the cultivation of varieties with less yield potential, water stress (Tabassum *et al*., 2007), inappropriate planting methods and crop varieties (Rasheed *et al*., 2004b; Abdullah *et al*., 2008). Sowing patterns and hybrids are of much value apart from other agronomic factors influencing the grain yield of maize. There is a need to abridge the gap between the existing and potential yield of maize. Selection of high yielding cultivars, crop establishment practices, date of sowing and optimum plant stand are the key factors that can guarantee maize yield potential and stability.

The conventional varieties are losing their potential gradually. The crop yield in Pakistan has declined during the last decade despite the accessibility to a wide range of inputs. The cause of yield decline is the sowing of low yielding composite varieties (Njeru, 1984). The production potential of newly evolved maize hybrids is greater as compared to conventional varieties (Russel, 1986). Studies show that there is 10-15% yield advantage in using hybrid seeds. Due to higher leaf area index and crop growth rate the modern hybrids respond to nutrients more efficiently and bear plant population stress more than local varieties. Planting pattern is an imperative factor that determines the yield potential of maize crop (Cardwell, 1982). Planting technique affects germination, water requirements of crop, growth and development of roots and exploitation of moisture from soil layers. Inputs such as water and nutrients are economically utilized if the plants are arranged in an appropriate pattern (Ali *et al.*, 1998). Radiation use efficiency is also influenced by planting methods. Planting corn in narrow rows results in an increased light interception for each plant. Hence, narrow rows boost photosynthetic activity and contribute significantly towards higher grain yield (Tollenaar and Aguilera, 1992). Planting geometry also has an influence on the water use efficiency. The losses of water through evaporation are minimum in closer row spacing because the leaf canopy is able to cover up the soil surface quickly. Taking into account the aforementioned considerations, the research was carried out to analyze the growth and yield performance of various corn hybrids under different planting patterns and to assess an economically feasible sowing method for maize crop.

MATERIALS AND METHODS

The proposed study was conducted at Agronomic Research Area, Department of Agronomy, University of Agriculture, Faisalabad, Pakistan, to determine the agro-economic behavior of various maize hybrids under different sowing patterns**.** Two maize hybrids (SIPRA-4444 and TS-13) were studied under five different

sowing patterns viz. ridge sowing 60 cm apart rows, bed sowing 60 cm apart rows, 60 cm apart single row strips, 90 cm apart double row strips and 120 cm apart triple row strips. Hybrids were allotted to main plot and sowing patterns to subplots. The experiment was laid out in randomized complete block design with split plot arrangement having three replications with a net plot size of 3.6m x 7.0 m. The crop was fertilized with NPK 150:100:100 kg ha^{-1}, respectively.

Procedure for data collection

Plant height was recorded at the time of physiological maturity from bottom to top excluding tassel (Guzman and Lamkey, 2000). Number of cobs per plant was noted by counting the total number of cobs and then averaged. Cob length of ten cobs was measured from each plot with the help of scale and then average was taken. It was expressed in centimeters. Thousand grain weights were taken on randomly selected shelled ears of each subplot and then their average weight was recorded. Grain yield data was recorded in each subplot and converted in tons per hectare. Harvest index was calculated as % age ratio of economic and biological yield.

RESULTS AND DISCUSSION

Plant height

The height of a crop plant is an index of vegetative growth attained by a crop during its life cycle. The figures presented in *Table 1* showed a highly significant impact of corn hybrids on stature of plants. The hybrid SIPRA-4444 produced maximum plant height (193.72 cm) while the mean plant height in case of TS-13 remained 187.93 cm. These results are verified by the work of Gozubenli (2010), but the results are in disagreement with the conclusions of Zamir *et al.* (2011). Planting geometry had a strong impact on the plant height. The ridge sown crop managed to gain maximum height (202.41cm), while the crop planted under 120 cm apart triple rows attained minimum height (178.75 cm). These results are supported by the findings of Gozubenli (2010) and Bakht *et al*. (2011). The results are in contradiction to the conclusion drawn by Ahmad *et al*. (2000). Hybrids x sowing pattern interaction was found to be non significant. In general, SIPRA-4444 grown on 60 cm spaced ridges produced tallest plants. These findings are in concurrence with those of Bakht *et al*. (2011).

Number of cobs per plant

The cob number per plant is a fundamental factor to judge yield of maize plant. The information presented in *Table 1* revealed that the number of cobs per plant was not influenced by hybrids to a significant level. On an average, SIPRA-4444 had 1.36 ears per plant while TS-13 had 1.34 cobs. These results are validated by the conclusions drawn by Khan (2002) but these findings are in conflict with those of Bakht *et al*. (2011). As far as the sowing patterns were concerned, no statistical differences were observed among them regarding the parameter under discussion. The observations are corroborated by the experimental results of Bakht *et al*. (2011) and

Bakht *et al*.(2006) but the findings are in direct conflict to those of Arif *et al*. (2001). The interaction between hybrids and sowing patterns was non significant as well. These results are again supported by the findings of Bakht *et al*. (2011) but contradicted by Arif *et al*. (2001).

Table 1 - Growth, yield and yield components of various maize hybrids as affected by different sowing patterns

Treatments	Plant height (cm)	Cobs per plant	Cob length (cm)	1000 grain (g)	Grain yield (t ha^{-1})	Harvest index (%)
Hybrids						
H1	193.72 a	1.36	18.37 a	273.44 a	6.02 a	34.52 a
H2	187.93 b	1.34	18.16 b	269.81 b	5.80 b	32.64 b
LSD Sowing patterns						
S1	202.41 a	1.37	20.85 a	287.12 a	7.13 a	32.35 c
S2	190.29 c	1.33	16.20 d	260.00 d	5.50 d	37.17 a
S3	184.17 d	1.33	18.23 c	276.03 c	5.74 c	34.63 b
S4	198.51 b	1.37	20.44 b	281.38 b	5.91 b	29.41 d
S5	178.75 e	1.35	15.61 e	253.30 e	5.27 e	34.34 b
LSD						
H1S1	204.67	1.40	21.15	287.70 a	7.32 a	34.01 b
H1S2	193.64	1.30	16.23	262.43 e	5.57 ef	37.00 a
H1S3	187.77	1.37	18.25	278.50 c	5.88 d	35.40 ab
H1S4	201.56	1.37	20.53	283.20 b	6.06 c	37.73 c
H1S5	180.95	1.37	15.67	255.37 f	5.26 g	34.43 b
H2S1	200.14	1.33	20.55	287.13 a	6.94 b	30.68 c
H2S2	186.95	1.37	16.17	257.57 f	5.43 fg	37.34 a
H2S3	180.56	1.30	18.21	273.57 d	5.59 ef	33.86 b
H2S4	195.46	1.37	20.35	279.57 c	5.77 de	27.08 d
H2S5	176.55	1.33	15.54	251.23 g	5.28 g	34.25 b

Cob length (cm)

Table 1 contains the data on the cob length as affected by maize hybrids and planting methods. The data revealed that both the hybrids differed significantly for cob length. SIPRA-4444 produced longest cobs (18.37 cm) while the cobs produced by TS-13 were shorter in length (18.16 cm). These results are supported by the conclusions drawn by Konuskan (2000). Zamir *et al.* (2011) also noted significant

differences among the hybrids for ear length. A highly significant difference was observed among various planting methods. Ridge sowing produced maximum cob length (20.85 cm) while 120 cm apart triple rows produced minimum length of cobs (15.61 cm). The results are not supported by Bakht *et al*. (2007). The combined effect of sowing patterns and hybrids was found to be non significant.

1000 grain weight (g)

1000 grain weight is a fundamental yield contributing factor. The genetic potential of a particular genotype can be judged by its 1000 grain weight. It became clear from *Table 1* that both the hybrids differed significantly for the concerned parameter. SIPRA-4444 produced heavier grains (273.44 g) while the weight of grains was lighter in case of TS-13 (269.81 g). Tahir *et al*. (2008) noticed a substantial impact of hybrids on the 1000 grain weight. The differences among sowing techniques regarding the parameter were also noted to be highly prominent. Ridge sown crop performed exceptionally well and produced maximum weight (287.42 g) whereas planting the crop under 120 cm apart triple rows resulted in minimum 1000 grain weight (253.30 g). The results are in similarity with the assumptions made by Ahmad *et al*. (2000) and Memon *et al.* (2007). The combined effect of hybrids and planting methods was also highly prominent. SIPRA-4444 produced maximum test weight when dibbled on 60 cm spaced ridges while the seed index was minimum when the same hybrid was sown under 120 cm apart three rows. Similarly when TS-13 was dibbled on 60 cm spaced ridges, maximum value of seed index was obtained (287.13g) while in 120 cm spaced triple rows the grains produced by TS-13 were lighter in weight (251.23 g). These assumptions are confirmed by the findings of Singh and Srivastava (1991).

Grain yield (t ha^{-1})

Grain yield is the out product of all the yield contributing factors. *Table 1* clearly suggested the statistical significance between the maize hybrids. It showed the superiority of SIPRA-4444 over TS-13 in terms of grain yield. SIPRA-4444 yielded higher (6.02 t ha^{-1}) than TS-13 (5.80 t ha^{-1}). The findings are in line with those reported by Gozubenli *et al*. (2004) and Abdulai *et al*. (2007). As far as the impact of sub plot factor was concerned, various planting methods exhibited significant differences for grain yield. Ridge planting method provided congenial environment during the life cycle of maize crop due to which the grain yield was maximum (7.13 t ha^{-1}) under 60 cm spaced ridges. On the other hand, the planting pattern of 120 cm apart triple row strips did not gave satisfactory results. The grain yield remained low (5.27 t ha^{-1}) in that case. These results are verified by the work of Shakarami and Rafiee (2009). The interaction between the planting techniques and hybrids remained

statistically significant. SIPRA-4444 produced maximum grain yield (7.32 t ha^{-1}) when planted on ridges while the yield of SIPRA-4444 was minimum (5.26 t ha^{-1}) under 120 cm spaced triple rows. TS-13 gave highest yield (6.94 t ha^{-1}) under ridge planting while its yield remained minimum (5.28 t ha^{-1}) under 120 cm apart three row strips. These results are in line with those of Ali (1995) but in contradiction to the findings of Khan (2002).

Harvest index (%)

Harvest index indicates the efficiency of a crop plant to convert photo synthates into economical yield. The ANOVA presented in *Table 1* depicted that the effect of genotypes on the harvest index was significant. SIPRA-4444 produced more harvest index (34.52 %) as compared to TS - 13 (32.64%). These results are in conformity with those of Graybill *et al.* (1991) but the results are in contradiction to those of Nasir (1997). There existed highly significant differences among planting techniques regarding the parameter. Maximum value of harvest index was recorded in crop that was planted on beds (37.17%) while minimum value (29.41 %) was noted in 90 cm apart double row strips. Graybill *et al*. (1991) endorsed these statistics in their trial. The results did not get confirmation from the findings of Bakht *et al*. (2006). The interaction between the hybrids and planting patterns regarding harvest index was found to be highly significant. SIPRA-4444 produced more harvest index (37.00%) when planted on beds which was statistically at par with the harvest index when SIPRA-4444 was sown under 60 cm spaced single row strips (35.40%). Maize hybrid TS-13 produced maximum harvest index when sown at beds (37.34%) and minimum value of above mentioned trait (27.08%) under 90 cm spaced twin row strips. These findings are validated by the observations of Khan (2002).

Economic analysis

The economic analysis of the data presented in *Table 2* depicted that the maximum net income of Rs. 118932 was noticed when the hybrid SIPRA-4444 was sown on 60 cm spaced ridges. A gross income of Rs. 202140 was worked out for this particular treatment. The maximum benefit per unit cost (2.43) was obtained from the same hybrid and ridge sowing pattern. It was followed by a net return of Rs. 109122 which was recorded under treatment H2S1 (TS-13 planted on 60 cm apart ridges). A gross income of Rs. 192330 and a benefit to cost ratio of 2.31 was computed under this treatment. The minimum return (Rs. 68332) and BCR (1.81) was obtained in case of treatment H2S2 (TS-13 planted on beds with 60 cm row to row distance).

Table 2 – Economic analysis per hectare

Treatment	Maize (t ha^{-1})	Value Rs. per hac.	Stover yield (t ha^{-1})	Value Rs. (t ha^{-1})	Gross income	Total cost	Net return	BCR
H1S1	7.32	183000	19.14	19140	202140	83208	118932	2.43
H1S2	5.57	139250	16.88	16880	156130	84098	72032	1.86
H1S3	5.88	147000	17.28	17280	164280	81838	82442	2.01
H1S4	6.06	151500	18.62	18620	170120	80508	89612	2.11
H1S5	5.26	131500	16.46	16460	147960	79428	68532	1.86
H2S1	6.94	173500	18.83	18830	192330	83208	109122	2.31
H2S2	5.43	135750	16.68	16680	152430	84098	68332	1.81
H2S3	5.59	139750	17.02	17020	156770	81838	74932	1.92
H2S4	5.77	144250	18.00	18000	162250	80508	81742	2.02
H2S5	5.28	132000	16.42	16420	148420	79428	68992	1.87

CONCLUSION

On the basis of results it can be concluded that the maize hybrid SIPRA-4444 should be planted on 60 cm spaced ridges for achieving higher grain yield under the agro ecological conditions of Faisalabad. From economic point of view, ridge sowing is the most feasible sowing method for maize crop.

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