EVALUATION OF HYBRID AND LOCAL MAIZE VARIETIES AND THEIR RESPECTIVE FERTILIZER REQUIREMENTS

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ABSTRACT: The fodder scarcity is the major constraint to achieve potential livestock production; and it is high time to introduce high yielding fodder and cereal varieties to ensure good animal health. Two maize Hybrids (Hycorn-11+, Hycron-984) were compared for their performance with local maize (Afgoy) and optimized their NPK requirement evaluating NPK levels of 75-50-50, 100-65-60, 125-80-70 kg ha^{-1}). The hybrids out-yielded local variety of maize regardless the fertility levels. Hycorn-984, Hycorn-11+, Afgoy produced cob girth of 5.8±0.09, 5.9±0.03, 5.6±0.04 cm; cob weight 82.9±0.61, 79.0±0.42, 73.4±0.85 g; grains/cob 176.4±3.73, 167.4±4.81, 157.2±2.29; grain weight/plant 171.0±2.55, 171.2±2.42, 145.0±2.14g and grain yields of 3152.7±33.11, 3140.0±28.10, 2483.3±30.00 kg ha^{-1}, respectively. The hybrids were not only out yielded conventional maize but also found to be more responsive to higher fertilizer dose and NPK @125-80-70 kg/ha resulted in highest yield (3237kg/ha); while lower NPK levels attributed to reduced growth and yield.

Keywords: Maize, varietal evaluation, hybrids and fertilizer requirement.

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INTRODUCTION

Maize (*Zea mays* L.) is an important multipurpose cereal crop used as food, fodder, fuel and in the manufacture of industrial products (Stephen *et al*., 2006 and Derby *et al*., 2005). Maize has higher yield potential and short growth duration. It is rich source of food and fodder (Ahsan and Mehdi, 2000; Sial and Alam, 1998). Vertical improvement of maize production could be achieved by maximizing per unit area yield (Sakala and Kabambe, 2004).

Maize in Pakistan contributes 2.2 percent to the value added in agriculture and 0.5 percent to GDP (GOP, 2015). Maize requires abundant of readily available plant nutrients and soil reaction between 5.5 and 8.0 pH for best production. Although soil and climatic condition of Pakistan are highly favorable and high yielding varieties are available. For raising the crop yield, fertilizer impact is one of the major factors and it contributes about 50% to yield performance (Fedotkin and Kravtsov, 2001).

Fertilization for maize depends on numerous factors including environmental conditions, management systems and genotypes (Darren *et al.* 2000). Maize fodder yield depends upon crop growth which needs balanced fertilizer nutrients. Nitrogen and phosphorus are mainly deficient in soil of Pakistan and their provision increase crop growth and yield. Nitrogen seems to exert the most pronounced effects. Phosphorus, promote the development of root system and help in seed formation. Phosphorus hastens maturity and helps in strengthening of straw as well as green fodder. Phosphorus is required for efficient uptake of nitrogen from the soil. The crop takes up nutrients from soil through their roots system (Rasheed *et.al;* 2004 and Saruhan and Sireli, 2005).

Considerable research has been conducted in the world on nutrients requirements of the maize varieties. The change from an agrarian society and a subsistence type of agriculture to modern mechanized society is accomplished by a marked increase in the use of fertilizers (El-Aziz, 2007). The present experiment was conducted to compare the performance of hybrid and local maize varieties under different fertility regimes.

MATERIAL AND METHODS

The experiment was conducted at the Malir Experimental Farm, Sindh Agriculture University Tandojam during autumn season of 2014, in the form of three replicated Randomized Complete Block Design (Factorial) keeping plot size of 3.50 x 5.0m (17.50m^2). The soil of the experimental area comprised of 15.0% sand, 44.0% silt and 41.0% clay at 0-15 cm soil depth, while at 15-30 cm depth, the soil had 15.9% sand, 42.6% silt, 41.5% clay and considered as silty clay loam in texture. The soil at 0-15 and 15-30 cm soil depth had pH level 7.59 and 7.89, EC 0.38 and 0.34 dSm^{-1}, organic matter 0.86 and 0.59%, $CaCO_3$ 15.89 and 15.15%, total N 0.056 and 0.043, AB-DTPA extractable phosphorus 2.764 and 1.725 mg kg^{-1} and AB-DTPA extractable potassium 163.76 and 156.98 mg kg^{-1}, respectively. The

land was prepared by giving two dry ploughing followed by precision land leveling. After soaking dose, when soil came in condition two crosswise ploughing with cultivator followed by planking were practiced to achieve the desired seedbed.

The N, P and K were provided in the form of urea, single super phosphate (SSP) and muriate of potash (MOP). The crop was irrigated as per the schedule. The seeds of three maize varieties were sown by means of single coulter hand drill on August 2 and 3, 2014. All P and K and half of the N were provided at the time of sowing by mixing in the soil while seedbed was prepared. The remaining half of N was divided into two splits and applied at second and third irrigations, respectively. In all five experimental units, irrigations were applied throughout the maize growing season and harvested in the third week of November. For sampling, 10 plants in each replication of all the treatments were labeled. All other cultural practices were performed in all the plots uniformly. The observation on seedling emergence was recorded in days from sowing till the seedling emergence in all the experimental units. Plant height and cob length were recorded at maturity in the field. However, cob weight and grains per cob were recorded after harvesting the cobs. The harvested cobs were stored for drying in the threshing yard for a week's time and grain weight per/plant and grain yield/ha were recorded on the basis of dried cobs. The data collected was subjected to analysis of variance and in view of the statistical outcomes the results were interpreted using the statistical software MSTATC.

RESULTS AND DISCUSSION

Seedling emergence: The seedling emergence was recorded on an average in shortest time (4.5±0.11 days) when the maize varieties were fertilized with highest NPK level of 125-80-70 kg ha^{-1}, and the emergence of the seedling delayed to 5.8±0.20 days when NPK level was reduced to 100-65-60 kg ha^{-1}, while the maximum days to seedling emergence (6.4±0.14) were noted when the maize crop were fertilized with lowest NPK level of 75-50-50 kg ha^{-1}. In case of varieties, the variety Afgoy took comparatively lower number of days (5.5±0.22) to seedling emergence, followed by hybrids Hycorn-11+ and Hycorn-983 with 5.6±0.16 and 5.6±0.21 days to seedling emergence, respectively (Table 1). These results are partially supported by those of El-Aziz (2007), who had reported early seedling emergence when soil applied MPK fertilizers as basal dose at higher rates were applied. (Rasheed *et.al;* 2004) found that seedling emergence in maize delayed in control plots where no fertilizer was applied.

Plant height (cm): The maize plant height was significantly maximum i.e. 198.77±1.999 cm when the crop was fertilized with highest NPK level of 125-80-70 kg ha^{-1}, while the plant height was gradually decreased to 190.11±3.03 cm when NPK fertilizer level was reduced to 100-65-60 kg ha^{-1}. However, the minimum plant height of 177.44±2.35 cm on average was observed when the crop was fertilized with lowest NPK level of 75-50-50 kg ha^{-1}. The varietal response to fertility levels indicated that the plants of variety Afgoy were taller than both the hybrids with mean plant height of 200.7±2.08 cm, while hybrids Hycorn-984 and Hycorn-11+ had average plant height of 198.7±2.66 and 180.5±1.99 cm, respectively (Table-1). Similar results had been reported by Abdel Monem *et al.* (2001) who applied 288 kg N ha^{-1} and achieved maximum plant remarkably greater in hybrids Hycorn-11+ and Hycorn-984 with average cob weight of 82.9±0.61 g and 79.0±0.42 g, respectively. However, the local maize variety Afgoy had significantly lower cob weight of 74.4±0.85 g than the hybrids. The cob weight was remarkably higher in maize hybrids than local variety Afgoy, which indicated that the Cob weight was variety dependent, while the character associated with the quantity of inputs used such as NPK fertilizers, because soils were 100% deficient of N, 90% P, while 20% deficiency of K had been reported. Similar results were reviewed from the study carried out by (Rasheed *et.al;* 2004) who reported heavier maize cobs under higher NPK rates under normal soil and crop management conditions. Verma *et.al*; (2003) found that cob weight was higher when NPK fertilizers were applied at higher rates than lower rates as well as control. Varied interactive effect of varieties and NPK doses on cob weight was reported.

Cob Girth (cm): The highest cob girth of 6.0±0.14 cm was recorded when the crop was fertilized with highest NPK level of 125-80-70 kg ha^{-1}, while the cob girth was slightly reduced to 5.8±0.09 cm when NPK fertilizer level was diminished to 100-65-60 kg ha^{-1}. However, the lowest cob girth of 15.60.43 cm on average was observed when the crop was fertilized with lowest NPK level of 75-50-50 kg ha^{-1}. In case of varieties, the cob girth was remarkably greater in hybrids Hycorn-11+ and Hycorn-984 with average cob girth of 5.9±0.03 cm and 5.8±0.09 cm, respectively. This indicated that cob girth was associated with the plant growth as has been reported by (Rasheed *et.al;* 2004) that girth of cob in maize would follow the growth rate of the plant. However, effect of variety on the cob girth was well recognized. (Verma *et.al;* 2003) reported that cob girth increased with increasing NPK rates; however, genetically varieties differed in cob girth, showing similar funding as have been reported by previous researchers.

Cob weight (g): The highest cob weight of 84.2±0.63 g was obtained from the maize crop fertilized with highest NPK level of 125-80-70 kg ha^{-1}, followed by average cob weight of 79.8±0.85 g recorded in the crop fertilized with

NPK level of 100-65-60 kg ha^{-1}. However, the highest cob weight of 71.3±0.21 g on average was observed when the crop was fertilized with lowest NPK level of 75-50-50 kg ha^{-1}. In case of varieties, the cob weight was remarkably greater in hybrids Hycorn-11+ and Hycorn-984 with average cob weight of 82.9±0.61 g and 79.0±0.42 g, respectively. However, the local maize variety Afgoy had significantly lower cob weight of 74.4±0.85 g than the hybrids. The cob weight was remarkably higher in maize hybrids than local variety Afgoy which indicated that the cob weight was variety dependent, while the character was associated with the quantity of inputs used such as NPK fertilizers, because soils were 100% deficient of N, 90% P, while 20% deficiency of K had been reported. Similar results were reviewed from the study carried out by Rasheed *et.al;* (2004) who reported heavier maize cobs under higher NPK rates under normal soil and crop management conditions; while Verma *et al.* (2003) found that cob weight was higher when NPK fertilizer were applied at higher rates than lower rates as well as control. They also reported varied interactive effect of varieties and NPK doses on cob weight was reported.

Number of grains cob^{-1}: The highest number of grains i.e. 182.0±3.46 cob^{-1} was achieved in maize crop given highest NPK level of 125-80-70 kg ha^{-1}, followed by reduced NPK levels of 100-65-60 kg and 75-50-50 kg ha^{-1} which resulted averagely 170.6±3.56 and 148.4±3.37 grains cob^{-1}, respectively (Table 2). In case of varieties, the maximum number of grains i.e. 176.4±3.74 cob^{-1} was obtained by hybrid Hycorn-984, followed by Hycorn-11+ with 167.4±4.81 average number of grains cob^{-1}, while the minimum number of grains of 157.2±2.29 cob^{-1} was recorded in maize variety Afgoy. Both the maize hybrids i.e. Hycorn-984 and Hycorn-11+ proved to be the most superior in attaining the number of grains cob^{-1} over local variety Afgoy. The present results were in accordance with Thakur *et.al;* (2003) who examined maize hybrids and recorded varied response to the fertilizer rates; while Saleem *et.al;* (2006) indicated that number of cobs did not vary due to application rate of NPK fertilizers, but this trait was mostly associated with the varieties.

Total grain weight (g): It was evident from the results (Table-2) that the maximum grain weight of 179.8±2.54 g $plant^{-1}$ was reported by the crop fertilized with highest NPK level of 125-80-70 kg ha^{-1}, followed by 100-65-60 kg and 75-50-50 kg ha^{-1} NPK levels produced grain weight of 164.4±2.63 and 142.8±1.95 g $plant^{-1}$, respectively. In varieties, the maximum grain weight of 171.0±2.55 g $plant^{-1}$ was acquired by hybrid Hycorn-984, followed by another hybrid Hycorn-11+ with grain weight of 171.2±2.42 g $plant^{-1}$, while the minimum grain weight of 145.0±2.14 g $plant^{-1}$ was recorded in local maize variety Afgoy. The results were further showed that both the hybrids i.e. Hycorn-984 and Hycorn-11+ equally proved to be the superior than local variety Afgoy for this parameter. The results further supported by Monem *et.al;* (2001), Pramanik *et.al;* (2002), Thakur *et.al;* (2003) and Saleem *et.al;* (2006) who associated increased grain weight of maize hybrids with the application of higher NPK rates.

Grain yield ha^{-1} (g): The maize crop when fertilized with highest NPK level of 125-80-70 kg ha^{-1}, resulted significantly high grain yield of 3237.0±35.19 kg ha^{-1}, followed by 2975.9±30.01 and 2563.1±27.03 kg ha^{-1} using 100-65-60 kg and 75-50-50 kg ha^{-1} NPK levels respectively (Table 2). In case of varieties, the highest grain yield of 3152.7±33.11 kg ha^{-1} was produced by hybrid Hycorn-984, followed by hybrid Hycorn-11+ with average grain yield of 3140.0±28.10 kg ha^{-1}, while the minimum grain yield of 2483.3±30.00 kg ha^{-1} was recorded by local maize variety Afgoy. The maximum grain yield under higher NPK levels was mainly associated with improved growth and yield components which contributed cumulatively to a higher grain yield. Similar results were reported by Monem *et.al;* (2001), Pramanik *et.al;* (2002), Thakur *et.al;* (2003) and Saleem *et.al;* (2006) who found that higher NPK rates resulted in increased grain yield in maize regardless varieties.

Table 1. Average days to seedling emergence, plant height and cob length of local and hybrid maize as affected by different fertility regimes.

Parameters	Days to seedling emergence	plant height (cm)	cob girth (cm)
NPK Levels(F)			
F1=75-50-50	6.4±0.14^{a}	177.4±2.35^{b}	5.6±0.09^{b}
F2=100-65-60	5.8±0.20^{ab}	190.1±3.03^{a}	5.8±0.03^{a}
F3=125-80-70	4.5±0.11^{b}	198.7±1.99^{a}	6.0±0.04^{a}
SE	0.19	2.68	0.05
LSD 0.05	1.55	9.32	0.32
Varieties(V)			
Afgoy	5.5±0.22	200.7±2.08^{a}	5.6±0.04^{ab}
Hycorn-11+	5.6±0.16	180.5±1.99^{b}	5.9±0.03^{a}
Hycorn-984	5.6±0.21	198.7±2.66^{a}	5.8±0.09^{a}

SE	0.19	2.68	0.05
LSD 0.05	NS	8.78	0.30
F*V			
F1×V1	6.3±0.29	187.0±1.91	5.3±0.80
F1×V2	6.3±0.22	171.6±2.82	5.7±0.09
F1×V3	6.6±0.10	173.6±3.00	5.6±0.03
F2×V1	5.6±0.84	201.0±3.11	5.6±0.32
F2×V2	6.0±0.33	181.6±2.20	5.9±0.23
F2×V3	6.0±0.35	187.6±1.93	5.8±0.04
F3×V1	4.6±0.21	214.3±3.22	5.8±0.02
F3×V2	4.6±0.18	188.3±2.83	6.1±0.19
F3×V3	4.3±0.25	193.6±2.99	6.0±0.10
SE	0.34	3.91	0.10
LSD 0.05	NS	NS	NS

Table 2. Average cob weight, grains cob^{-1}, Grain weight plant Grains cob^{-1} and grain yield ha Grains cob^{-1} of maize as affected by different fertility regimes.

Parameters	Cob weight (g)	Grains cob^{-1}	Grain weight plant^{-1} (g)	Grain yield ha^{-1} (g)
NPK Levels(F)				
F1=75-50-50	71.3±0.21^{c}	148.4±3.37b	142.8±1.95^{b}	2563.1±27.03^{c}
F2=100-65-60	79.8±0.85^{b}	170.6±3.56a	164.4±2.63^{ab}	2975.9±30.01^{b}
F3=125-80-70	84.2±0.63^{a}	182.0±3.45a	179.8±2.54^{a}	3237.0±35.19^{a}
SE	0.76	3.98	2.56	29.01
LSD 0.05	3.91	20.04	14.19	160.80
Varieties(V)				
Afgoy	74.4b±0.85	157.2±2.29^{b}	145.0±2.14^{b}	2483.3±30.00^{b}
Hycorn-11+	79.0a±0.42	167.4±4.81^{a}	171.2±2.42^{a}	3140.0±28.10^{a}
Hycorn-984	82.9a±0.61	176.4±3.73^{a}	171.0±2.55^{a}	3152.7±33.11^{a}
SE	0.76	3.92	2.56	29.01
LSD 0.05	4.21	22.10	13.37	151.50
F*V				
F1×V1	64.0±1.21	136.3±4.25	126.5±3.91	2113.0±45.02
F1×V2	72.7±1.19	153.0±5.30	153.5±3.21	2764.3±58.11
F1×V3	77.3±1.28	156.0±6.83	148.7±4.23	2812.0±46.24
F2×V1	76.3±1.12	162.0±4.76	145.0±4.12	2435.3±50.02
F2×V2	79.3±2.13	169.0±6.66	173.8±4.30	3273.7±47.22
F2×V3	83.7±0.11	181.0±4.00	174.5±4.40	3218.7±60.31
F3×V1	80.0±2.10	173.3±6.40	163.5±4.16	2901.7±52.20
F3×V2	85.0±1.22	180.3±5.34	186.2±4.56	3382.0±42.10
F3×V3	87.7±1.36	192.3±6.85	189.8±4.42	3427.3±50.24
SE	1.31	6.90	4.43	50.25
LSD 0.05	NS	NS	NS	145.80

Conclusion: The hybrids Hycorn-984 and Hycorn-11+ showed superior performance over the local variety Afgoy, while highest NPK level of 125-80-70 kg ha^{-1} remarkably improved growth and yield components which cumulated to produce higher grain yield.

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