INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
1560–8530/2004/06–2–260–263
http://www.ijab.org

Effectiveness of Farmyard Manure, Poultry Manure and Nitrogen for Corn (*Zea mays* L.) Productivity

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ABSTRACT

Two corn hybrids i.e. Pioneer 3062 and Pioneer 3012 were tested with farmyard and poultry manure along with urea in a field experiment carried out on a sandy clay loam soil. The two hybrids differed significantly in number of cobs per plant, 1000-grain weight and grain yield. On the other hand, harvest index remained unaffected by treatments. Hybrid pioneer 3062 performed better with respect to all parameters, except number of grains per cob. Combined use of poultry manure and urea performed the best amongst all treatments.

Key Words: Farmyard manure; Poultry Manure; Nitrogen; Corn

INTRODUCTION

Corn is a multipurpose crop, provides food for human, feed for animals and poultry and fodder for livestock. It is a rich source of raw material for the industry where it is being extensively used for the preparation of cornstarch, corn, dextrose, corn syrup, corn flakes etc. In conventional Agriculture, farmers apply high doses of fertilizers and chemical plant protection measures to realize high crop yield. The enhanced crop yield by chemical fertilizers and pesticides is beyond doubt, however, their indiscriminate use is causing problems such as soil structure deterioration, ground water pollution, higher nitrate in vegetables and some times very high investment which makes the system unstable (FAO, 1978).

During the last decade, crop yield in Pakistan has been declining despite increased inputs of fertilizers, pesticides and due to the use of synthetic or composite varieties, which have less potential as compared to the hybrid corn (Njeru, 1983). The potential of any variety can only be fully exploited by judicious use of inputs, proper plant protection measures and sufficient irrigations at critical growth stages. So, agricultural scientists are engaged to establish an agricultural system, which can lower production cost and conserve the natural resources. Therefore, recent interest in manuring has re-emerged because of high fertilizer prices and importance of green manure, farmyard manure and other types of manures maintaining long-term soil productivity besides meeting timely requirement of nutrients. There is also a positive interaction between the combination of organic manures and urea as nitrogen source (Bocchi & Tano, 1994). Keeping this in view, the present study was undertaken to evaluate the performance of corn hybrids under the combined use of organic and inorganic fertilizers.

MATERIALS AND METHODS

A field study was conducted at Agronomic Research Area, University of Agriculture, Faisalabad, during the autumn season of 2000. The experiment was laid out according to RCBD with factorial arrangement having three replications and a net plot size as 9 x 2.8 m. The treatments included two maize hybrids Pioneer-3062, Pioneer-3012 and fertilizer levels were control, whole N (200 kg ha^{-1}) as urea, whole N (200 kg ha^{-1}) as farmyard manure (36.63 t ha^{-1}), whole N (200 kg ha^{-1}) as poultry manure (13.79 t ha^{-1}), half N (100 kg ha^{-1}) as FYM (18.32 t ha^{-1})+ 100 kg N ha^{-1} as urea, half N (100 kg ha^{-1}) as P.M. (6.90 t ha^{-1}) + 100 kg N ha^{-1} as urea.

The soil texture of the experimental site was sandy clay loam and the chemical analysis of soil is given in Table I. The crop was sown on 02 August 2000 using seed rate of 30 kg ha^{-1} in 70 cm apart rows with the help of a single row drill. A basal dose of NPK @ 200-100-100 kg ha^{-1} in the form of urea, TSP, SOP, FYM and poultry manure was applied. FYM and PM were analyzed (Table II) and dose of P and K were adjusted including quantity of P and K coming from FYM and poultry manure. Half doses of N from urea and full dose of P, K, FYM and poultry manure were applied at the time of second irrigation according to the treatments. The interplant distance was maintained at 20 cm by thinning the surplus plants at the time of four leaves stage. All other agronomic practices were kept normal and uniform in the treatments. The crop was harvested on November 07, 2000. The observations which recorded during the course of study were days taken to 50% tasseling, Number of cobs per plant, Number of grains per cob, 1000-grain weight (g), grain yield (t ha^{-1}) and Harvest index (%).

Table I. Characteristics of experimental site

Characteristics	Unit	Value
Organic matter	%	1.13
Total nitrogen	%	0.042
Available Phosphorus	Ppm	1.00
Available Potassium	Ppm	183.0
pHs	-	7.70
ECe	dS m-1	1.20
Soil textural class	-	Sandy clay loam

Table II. Chemical analysis of farmyard and poultry manure

Characteristics	Unit	Value	
		Farmyard manure	Poultry manure
Nitrogen	%	0.546	1.45
Phosphorus	%	0.225	0.81
Potassium	%	0.613	0.36
Dry matter	%	20.00	47.00
Moisture	%	80.00	53.00

Days taken to 50% tasseling were counted from the date of sowing to time when 50% plants had completed their tasseling. Total number of plants and total number of cobs per plot were counted at harvest. Then average number of cobs per plant was calculated. The number of grains was counted from randomly selected sample of ten cobs per plot and then average number of grains per cob was calculated. After threshing 1000-grains were taken from each plot and weighed. After threshing total grain weight was recorded from each plot and grain yield on hectare basis was calculated. Harvest index was calculated by using the formula.

$$\text{Harvest index (HI)} = \frac{\text{Economic yield}}{\text{Total biomass}} \times 100$$

Standard methods and procedures were followed for recording data on growth and yield parameters. The data collected were analyzed statistically by using Fisher's analysis of variance technique and treatment means were compared by using the least significant difference test at 0.05-probability level (Steel & Torrie, 1984).

RESULTS AND DISCUSSION

Days taken to 50% tasseling. Tasseling is prerequisite of cob formation and finally the maturity of the crop. The data (Table III) indicated that corn hybrids had non-significant effect on days taken to 50% tasseling, on an average this period extended from 51.50 to 51.78 days. Different proportions of organic and inorganic fertilizers applied to corn crop significantly influenced the tasseling period. The comparison of individual treatment means indicated that significantly maximum number (52.83) of days taken to tasseling was recorded when maize crop fertilized @ 100 kg N ha^{-1} as poultry manure + 100 kg N ha^{-1} as urea (F_6) as compared to F_1 (control) but statistically at par with all other treatments. These results are in line with the findings of Amanat (1998) and Farooqi (1999) who also observed that more availability of nitrogen and phosphorus delay the tasseling period.

The interactive effect of genotype and fertilizer was also non-significant and average days taken to 50% tasseling ranged from 48.33 to 53.00.

Number of cobs per plant. Number of cobs per plant has great effect on the final grain yield of corn. It is clear from the data (Table IV) that corn hybrids differed significantly in number of cobs per plant. Pioneer-3062 showed more number of cobs per plant (1.13) than Pioneer-3012 (1.10).

The data presented in Table IV reflect the effects of various proportions of organic and inorganic sources of nutrients on the number of cobs per plant. All the treated plots produced more number of cobs than untreated plot. Significantly more number (1.22) of cobs per plant was recorded from plot fertilized with proportion of 1/2 urea + 1/2 poultry manure (F_6) followed by F_2 (1.19) but the difference between them was found to be non-significant. Similarly F_5 and F_4 produced statistically similar number of cobs per plant; whereas, significantly less number (1.01) of cobs per plant was recorded from control plot. These results are in accordance with those of Tamayo *et al.* (1997), Amanat (1998), Farooqi (1999), Shah and Arif (2000) who also observed that number of cobs increased with the increase in the level of organic and inorganic fertilizers. The reason for such results may be adequate and balanced supply of plant nutrients. Due to the application of poultry manure + mineral fertilizer, plants received large amount of nutrients throughout their growth period and nourished properly which resulted in maximum number of cobs per plant. The interaction between fertilizers and hybrids was found to be non-significant.

Number of grains per cob. Corn hybrid Pioneer-3012 produced more number (463.75) of grains per cob as compared to Pioneer-3062 (Table IV). The difference in grain number per cob may be due to variable genetic potential of genotypes. These results are in line with the findings of Amanat (1998) and Farooqi (1999) who reported that more availability nutrients increase no of grains per cob. Iqbal (2000) concluded that genotype had not significant effect on number of grains per cob.

Different levels of organic and inorganic fertilizers also significantly influenced the number of grains per cob. The treatment F_6 (100 kg N ha^{-1} as urea + 100 kg N ha^{-1} as poultry manure) produced more number (484.65) of grains per cob than F_4 (200 kg N ha^{-1} as poultry manure) which produced 442.84 grains per cob but it (F_6) was not statistically different from the plot fertilized with 200 kg N ha^{-1} as FYM (F_5). While minimum number of grains per cob was recorded from the plot where no fertilizer and manure was applied, i.e. control plot. The increase in number of grains per cob in case of half urea + half poultry manure was mainly due to more cob length. These findings are

Table III. Days taken 50% tasseling and number of cobs per plant as affected by organic and inorganic fertilizers

Treatment	Days taken to 50% tasseling		Mean	Number of cobs per plant		Mean
	P-3062	P-3012		P-3062	P-3012	
F1	49.66	48.33	49.00 b	1.01	1.00	1.01 d
F2	52.00	52.33	52.17 a	1.20	1.17	1.19 a
F3	52.33	51.67	52.00 a	1.09	1.05	1.07 c
F4	51.67	52.00	51.83 a	1.11	1.08	1.10 bc
F5	52.00	52.00	52.00 a	1.15	1.12	1.14 b
F6	53.00	52.67	52.83 a	1.23	1.20	1.22 a
Mean	51.778	51.50 ns		1.13 a	1.10 b	-

ns= Non-significant; Figure sharing same letter did not differ significantly

Table IV. Number of grains per cob and 1000-grain weight (g) as affected by organic and Inorganic fertilizers

Treatment	Number of grains per cob		Mean	1000 grain weight (g)		Mean
	P-3062	P-3012		P-3062	P-3012	
F1	398.83	397.30	398.07 c	250.35	238.27	244.31 b
F2	475.66	483.49	479.58 a	268.92	263.39	275.16 a
F3	407.00	457.22	432.11 b	274.16	242.01	258.09 b
F4	422.09	463.59	442,84 b	278.87	277.30	278.09 a
F5	442.46	573.08	457.77ab	280.74	269.44	275.09 a
F6	461.49	507.80	484.65 a	297.23	284.83	291.03 a
Mean	434.59 b	463.75 a	-	278.05a	262.54b	-

Figure sharing same letter did not differ significantly

Table V. Grain yield (t/ha) and harvest index (%) as affected by organic and inorganic fertilizers

Treatment	Grain yield (t/ha)		Mean	Harvest Index (%)		Mean
	P-3062	P-3012		P-3062	P-3012	
F1	4.53	4.32	4.43 d	17.67	15.98	16.82 d
F2	6.08	5.42	5.75 ab	25.54	22.06	23.83 b
F3	5.24	5.10	5.17 c	20.54	18.96	19.75 c
F4	5.32	5.26	5.29 c	21.88	20.77	21.33 c
F5	5.72	5.52	5.62 b	24.59	23.86	24.33 b
F6	6.17	5.80	5.98 a	27.40	24.72	26.06 a
Mean	5.509 a	5.98 b	-	22.95 a	21.06 a	-

Figure sharing same letter did not differ significantly

strongly supported by the results of Sharma and Gupta (1998), Chaudhary *et al*. (1998) and Shah and Arif (2001). They reported that available N and P in soil increased with increase in organic matter.

Contradictory to individual factors the interaction between fertilizers and hybrid was statistically non-significant. The number of grains per cob varied from 507 to 397.30.

1000-grain weight (g). Grain weight is an important yield component. It is clear from Table IV that the corn hybrids, Pioneer-3062 and Pioneer-3012 differed significantly from each other. Pioneer-3062 produced more 1000-grain weight (278.05 g) than Pioneer-3012. These results are in line with the findings of Rehman (1990) and Iqbal (2000), who also observed that genetic potential had significant effect on 1000-grain weight.

Similarly data showed that 1000-grain weight was affected significantly by different levels of organic and inorganic fertilizers. Maximum 1000-grain weight (291.03 g) was observed from F_6 (100 kg N ha^{-1} as urea + 100 kg N ha^{-1} as poultry manure) that was statistically similar to F_2, F_5 and F_4 which produced 275.16, 275.09 and 278.09 g, respectively. While minimum 1000-grain weight (244.31 g) was obtained from control plot (F_1). The increase in 1000-grain weight was mainly due to the balanced supply of food nutrients from both urea and poultry manure throughout the grain filling and development period. These results are similar to the findings of Rutunga *et al.* (1998), Sevaram *et al.* (1998) and Ma *et al.* (1999). The interactive effect of hybrid and fertilizers on 1000-grain weight was found to be non-significant.

Grain yield (t ha^{-1}). Grain yield is the end result of many complexes morphological and physiological processes occurring during the growth and development of crop. Grain yield in case of corn hybrids differed significantly; Pioneer-3062 produced more grain yield (5.509 t ha^{-1}) than Pioneer-3012 (5.235 t ha^{-1}). Similar were the findings of Ma *et al.* (1999) and Iqbal (2000), who also observed that genetic potential had significant effect on 1000-grain weight and grain yield.

As regards nutrient resources, different levels of organic and inorganic sources affected grain yield

significantly. The combined application of 100 kg N ha^{-1} as urea + 100 kg N ha^{-1} as poultry manure (F_6) produced maximum corn grain yield (5.98 t ha^{-1}) which was statistically at par with F_2. F_5 also produced statistically similar yields as that of F_2. Where as, control (F_1) plot gave minimum yield (4.43 t ha^{-1}). The increase in grain yield in case of combined use of fertilizer was mainly due to more number of grains per cob as well as number of cobs per plant and better grain development. These results are in accordance with the findings of Das *et al.* (1992) and Tamayo *et al.* (1997). They observed that combined use of mineral and organic manure gave maximum yield. The interaction between fertilizer and corn hybrids was not significant.

Harvest index (%). The physiological efficiency of a crop plants in converting the photosynthates into grain yield is measured in the form of harvest index. Higher the index value, higher the efficiency of converting dry matter into economic yield.

It is clear from the Table V that the corn hybrids differed significantly from each other in their harvest index. Pioneer-3062 gave more harvest index (22.95%) than Pioneer-3012 (21.06%). These results are in line with findings of Farooqi (1999) and Iqbal (2000) who also observed that genetic potential had significant effect on grain yield and harvest index.

Similarly, different levels of organic and inorganic fertilizers had significant effect on harvest index. The comparison of treatment means showed that maximum harvest index (26.06%) was recorded from T_6 (100 kg N ha^{-1} as urea + 100 kg N ha^{-1} as poultry manure). Treatments F_2 and F_5 behaved similarly. F_3 and F_4 were also statistically at par. The lowest harvest index (16.82%) was recorded in control treatment.

Interaction between various levels of organic and inorganic fertilizers and corn hybrids remained non-significant. However, harvest index values ranged from 27.40 to 15.98%.

CONCLUSION

Both the hybrids differed significantly with respect to number of cobs per plant, number of grains per cob, 1000-grainweight, grain yield and harvest index. All these characteristics except number of grains per cob were higher in hybrid Pioneer-3062 than those of Pioneer-3012; while Pioneer-3012 produced more number of grains per cob. On the other hand, number of days taken to 50% tasseling was affected non-significantly. In case of yield parameters like number of cobs per plant, number of grains per cob, 1000-grainweight, grain yield and harvest index were significantly more from the plots fertilized @ 100 kg N ha^{-1} as urea + 100 kg N ha^{-1} as poultry manure. On the basis of these experimental findings, it seems that use of organic and inorganic fertilizers in proper combination can gave higher yields than the sole application of either of the fertilizer or manure particularly in hybrid corn.

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(Received 02 October 2003; Accepted 10 February 2004)