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STIMULATED EFFECT OF ORGANIC AND INORGANICALLY ORIGINATED TRANSITORY NITROGEN SOURCES ON THE NUTRIENT CONCENTRATION, UPTAKE AND PRODUCTION OF HYBRID MAIZE

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ABSTRACT. Soil productivity one of the essential factors which enhanced either through adding the chemical fertilizer or by incorporation of organic sources of nutrients to the soil. Regardless by the used of imbalanced fertilizer without the application of organic manure and without seeking knowledge of crops and fertility classification of soil causes to much hazards such as deterioration of soil structure, soil and water pollution etc. Two years field experiment was carried out to check the impact of transitory nitrogen sources on the nutrient concentration, uptake and production of hybrid maize at the Agronomic Research Area, University of Agriculture Faisalabad, Pakistan, during the year 2008-2009. Treatments included two hybrids: H_1 (Pioneer-30Y87) and H_2 (Pioneer-31R88) with six nitrogen sources each, which included at the rate of S_0: control (0) kg N ha^{-1}, S_1: chemical source (urea) 250 kg N ha^{-1}, S_2: poultry manure (PM) 9.6 t ha^{-1}, S_3: farm yard manure (FYM) 17.8 t ha^{-1}, S_4: pressmud of sugarcane (PMS) 8.5 t ha^{-1} and S_5: compost (C) 10.0 t ha^{-1}. Finding concluded that changing effect of nitrogen sources on both maize hybrid was found to be non significant during 2008-2009 while grain yield was significant during both years. Maximum nutrient concentration, uptake and yield were observed with nitrogen source S_1: chemical source (urea) 250 kg N ha^{-1} during 2008-2009 as compared to other nitrogen sources and minimum was found in control (0) kg N ha^{-1}, respectively. Interaction among hybrid and nitrogen sources was found to be non significant.

Key words: Chemical; Natural; Nitrogen sources; Hybrids; Economic yield.

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INTRODUCTION

In world, maize is third most important cereal crops after wheat and rice. In Pakistan it is cultivated on an area of one million hectares with the total production of 4.2 million tons (Govt. of Pakistan, 2011). It is highly nutritive and its seed contains; starch (78%), protein (10%), oil (4.8%), fibre (8.5%), sugar (3.1%) and ash (1.7%) (Chaudry, 1983).

Nitrogen plays a dominant role in different growth process of plants, because it is an integral part of chlorophyll and enzyme (Power and Schepers, 1989). Application of municipal solid waste to maize containing nitrogen at rates of 0, 168, 336, 504 and 672 kg ha^{-1} increased total dry matter and total plant nitrogen (Erikson *et al.,* 1999). More taller plant and ear height is produced at low planting density in maize with increasing rate of nitrogen and split application of nitrogen , maize with high density and 50% higher nitrogen rates can increased leaf area and plant height compared to recommended N application and planting density (Amanulah *et al*., 2009).

Ayeni *et al.* (2010) found that poultry manure at 5 and 10 t ha^{-1} enhanced maize productions by 39-43% and on residual basis, increased yield 73 and 93%. The combination of cocca pod ash at 5 t ha^{-1} and poultry manure at 10 t ha^{-1} gave the highest grain yield of 6.5 and 5.58 t ha^{-1}.

Pressmud from sugarcane is also a useful source of fertilizer; its impact is based on nutrient contents of mud and spent wash (Partha and Sivasubramanian, 2006). Nitrogen is essential for sustainable crop production and healthy food for the ever increasing world population. Increasing crop production is largely depends on the fertilizer which was used to supply essential nutrients for plants. The judicious management of fertilization must attempt to ensure both an enhanced crop yield and protect the environment from fertilizer pollution (Jen, 2008).

Inappropriate crop nutrition management and poor soil fertility are the most important factors responsible for the low yield. Soil fertility can be enhanced through the application of mineral fertilizers together with addition of organic matter to the soil. Nevertheless, imbalanced use of fertilizer without the application of organic manure and without knowing the requirements of crops and fertility status of soil causes the problem such as deterioration of soil structure, environmental and ground water pollution etc. Similarly continuous use of chemical fertilizer caused the depletion of soil fertility. Objective of the study is to check the impact of transitory nitrogen sources on the nutrient concentration, uptake and production of hybrid maize

MATERIALS AND METHODS

Two years field experiments was conducted to evaluate the impact of transitory nitrogen sources on the nutrient concentration, uptake and production of hybrid maize at the Agronomic Research

Area, University of Agriculture, Faisalabad, during the year 2008 and 2009. Experiments were laid out in a randomized complete block design (RCBD) with factorial arrangement comprising three replicates with a net plot size of 3 m x 5 m. Treatment consisting two hybrids: i.e.; H_1 (Pioneer-30Y87) and H_2 (Pioneer-31R88) with six nitrogen sources which included S_0: control (0) kg N ha^{-1}, S_1: chemical source (urea) 250 kg N ha^{-1}, S_2: poultry manure (PM) 9.6 t ha^{-1}, S_3: farm yard manure (FYM) 17.8 t ha^{-1}, S_4: pressmud of sugarcane (PMS) 8.5 t ha^{-1} and S_5: compost (C) 10.0 t ha^{-1}. A recommended dose of fertilizer containing 250 kg N ha^{-1} was applied. Organic nitrogen sources were applied on the basis of chemical analysis of soil before four weeks of the sowing which contains: nitrogen (0.040%), phosphorus (7.2 mg kg^{-1}) and potassium (145 mg kg^{-1}). Inorganic nitrogen source was applied in split doses (half at sowing and half in two equal splits-half at knee height and remaining half at tasseling). All the organic sources i.e. farm yard manure, pressmud of sugarcane, compost and poultry manure were applied at the time of sowing. Recommended amount of 100 kg P ha^{-1} and 100 kg K ha^{-1} was applied at sowing. Some amount of P and K were applied to soil from organic sources (poultry manure, farm yard manure, pressmud of sugarcane and compost) on the analysis basis of manure and remaining from inorganic sources: i.e. Single Superphosphate (SSP) and Sulphate of Potash (SOP). All other cultural practices including (sowing method, irrigation, plant protection measures etc.) were kept normal and uniform for all the treatments. Harvesting occurred on 25 November 2008 and 10 November 2009.

The following attributes like grain yield, nitrogen, phosphorus, potassium concentration in maize and nitrogen, phosphorus, potassium uptake in maize were recorded. Data regarding all the traits were collected using standard procedures and analyzed by using Fisher's analysis of variance technique. LSD test at 5% probability was used to compare the differences among treatments means (Steel *et al.,* 1997).

RESULTS AND DISCUSSION

Grain yield is the cumulative outcome of yield contributing parameters such as number of cobs per plant; number of grain rows per plant and 1000-grain weight. Hybrid maize and nitrogen sources significantly affected the grain yield during 2008 but not in 2009 (*Table 1*). H_1 produced significantly more (6.01 t ha^{-1}) grain yield as compared to H_2 (5.97 t ha^{-1}) during 2008. Grain yield differences of both hybrids were non-significant in 2009. The effect of nitrogen sources on grain yield was also significant in both seasons. S_1 produced maximum (7.43 t ha^{-1}) grain yield and minimum grain yield resulted from S_0 (3.70 t ha^{-1}). A similar effect of N sources was observed during 2009. Pressmud of sugarcane significantly increased grain yield over all other inorganic sources of N in both years. Minimum grain yield came from compost in both seasons (*Table 1*). Decrease in grain yield by N sources in 2009 was due to less availability of nitrogen to plants at the apropriate time and in proper proportion. These results are in line with those reported by Waseem *et al.* (2007), Khaliq *et al.* (2004) and Ahmad *et al.* (2006).

Table 1 - Effect of hybrid maize varieties and incorporated nitrogen sources on grain yield (t ha^{-1})

Treatments	2008	2009
A-Hybrids		
H_1 : Pioneer-30Y87	6.01 a	5.93
H_2 : Pioneer-31R88	5.97 b	5.90
LSD = 0.05	0.02*	NS
B-Nitrogen sources		
S_0 : Control 0 kg N ha^{-1}	3.70 f	3.49f
S_1 : Chemical source (urea) @ 250 kg N ha^{-1}	7.43 a	7.16a
S_2 : Poultry manure (PM) @ 9.6 t ha^{-1}	6.24 c	6.21c
S_3 : Farm yard manure (FYM) @ 17.8 t ha^{-1}	6.07 d	6.08d
S_4 : Pressmud of sugarcane (PS) @ 8.5t ha^{-1}	6.53 b	6.54b
S_5 : Compost (C) @ 10 t ha^{-1}	5.96 e	6.00e
LSD = 0.05	0.03*	0.06*
C-Interaction (H x NS)		
H_1S_0	3.59 j	3.45 g
H_1S_1	7.65 a	7.16 a
H_1S_2	5.90 i	6.52 c
H_1S_3	6.18 f	5.98 f
H_1S_4	6.70 c	6.36 d
H_1S_5	5.89 i	6.10 e
H_2S_0	3.71 j	3.54 g
H_2S_1	7.21 b	7.16 a
H_2S_2	6.57 d	5.90 e
H_2S_3	5.96 h	6.18 e
H_2S_4	6.34 e	6.71 b
H_2S_5	6.03 g	5.90 f
LSD = 0.05	0.04*	0.08*
Contrasts		
S_0 VS S_1,S_2,S_3,S_4,S_5	*	*
S_1 VS S_2,S_3,S_4,S_5	**	**

Means in a row with different letter are significantly different ($p \leq 0.05$).
* = significant at ($p \leq 0.05$); ** = significant at ($p \leq 0.05$); NS = non significant

A significant interaction of maize hybrids and nitrogen sources was observed for both years. In 2008, maximum grain yield was recorded in the H_1S_1 (7.65 t ha^{-1}) treatment combination while the minimum was found in the H_1S_0 (3.70 t ha^{-1}) combination. In 2009, maximum grain yield was recorded for H_1S_1 (7.16 t ha^{-1}) while the minimum was found in interaction of H_1S_0 (3.60 t ha^{-1}). These results are corroborating the findings of Waseem *et al.* (2007) and Sudhu and Kapoor (1999).

In 2008, comparisons between two hybrids (H_1 vs H_2) and inorganic (S_1) vs (S_2, S_3, S_4, S_5) organic nitrogen sources were highly significant for grain yield. Comparisons between S_0 (control) vs S_1, S_2, S_3, S_4, S_5 (nitrogen sources) were non significant for grain yield. In 2009, comparisons of

two hybrids (H_1 vs H_2) and S_0 (control) vs S_1, S_2, S_3, S_4, S_5 (nitrogen sources) on grain yield were significant, while coomparisons for chemical (S_1) vs (S_2, S_3, S_4, S_5) organic nitrogen sources were highly significant for grain yield.

A significant difference was found between S_0 (control) vs S_1, S_2, S_3, S_4, S_5 (nitrogen sources) during 2008 and 2009 for grain yield. A contrast comparison between chemical source (S_1) vs (S_2, S_3, S_4, S_5) organic nitrogen sources was observed to be highly significant during both year for grain yield in 2008 and 2009.

Nitrogen concentration between hybrid maize was non-significant for 2008 and 2009 as shown in *Table 2*. The effect of nitrogen sources on nitrogen content of the maize plant was however significant in both seasons. Nitrogen source S_1 gave maximum (1.45%) nitrogen content and minimum nitrogen content was noted in S_0 (0.22%). Similar results were noted for 2009. Increase in nitrogen content of maize was due to availability of nitrogen to plants at an appropriate time and in proper proportions. Similar results were reported by Akbar *et al.* (2002).

Table 2 - Effect of hybrid maize varieties and incorporated nitrogen sources on nitrogen content (%)

Treatments	2008	2009
A-Hybrids		
H_1 : Pioneer-30Y87	1.17	1.09
H_2 : Pioneer-31R88	1.17	1.08
LSD = 0.05	NS	NS
B-Nitrogen sources		
S_0 : Control 0 kg N ha^{-1}	0.22 e	0.24 e
S_1 : Chemical source (urea) @ 250 kg N ha^{-1}	1.45 a	1.45 a
S_2 : Poultry manure (PM) @ 9.6 t ha^{-1}	1.40 b	1.24 b
S_3 : Farm yard manure (FYM) @ 17.8 t ha^{-1}	1.29 d	1.22 bc
S_4 : Pressmud of sugarcane (PS) @8.5 t ha^{-1}	1.35 c	1.19 cd
S_5 : Compost (C) @ 10 t ha^{-1}	1.33 cd	1.17 d
LSD = 0.05	0.045*	0.037*
C-Interaction (H x NS)		
H_1S_0	0.22 f	0.24
H_1S_1	1.46 a	1.46
H_1S_2	1.43 ab	1.23
H_1S_3	1.17 e	1.22
H_1S_4	1.35 c	1.20
H_1S_5	1.42 ab	1.17
H_2S_0	0.22 f	0.25
H_2S_1	1.45 a	1.44
H_2S_2	1.37 bc	1.24
H_2S_3	1.41 abc	1.21
H_2S_4	1.35 c	1.18

Treatments	2008	2009
H_2S_5	1.23 d	1.17
LSD = 0.05	0.06*	NS
Contrasts		
S_0 VS S_1,S_2,S_3,S_4,S_5	**	**
S_1 VS S_2,S_3,S_4,S_5	*	*

Means in a row with different letter are significantly different ($p \leq 0.05$).
* = significant at ($p \leq 0.05$); ** = significant at ($p \leq 0.05$); NS = non significant

Table 3 - Effect of hybrid maize varieties and incorporated nitrogen sources on phosphorous content (%)

Treatments	2008	2009
A-Hybrids		
H_1 : Pioneer-30Y87	0.14	0.14
H_2 : Pioneer-31R88	0.14	0.14
LSD = 0.05	NS	NS
B-Nitrogen sources		
S_0 : Control 0 kg N ha^{-1}	0.06 d	0.07 d
S_1 : Chemical source (urea) @ 250 kg N ha^{-1}	0.21 a	0.22 a
S_2 : Poultry manure (PM) @ 9.6 t ha^{-1}	0.16 b	0.16 b
S_3 : Farm yard manure (FYM) @ 17.8 t ha^{-1}	0.13 c	0.13 c
S_4 : Pressmud of sugarcane (PS) @ 8.5 t ha^{-1}	0.13 c	0.14 c
S_5 : Compost (C) @ 10 t ha^{-1}	0.13 c	0.13 c
LSD = 0.05	0.01*	0.01*
C-Interaction (H x NS)		
H_1S_0	0.06	0.06
H_1S_1	0.21	0.22
H_1S_2	0.16	0.16
H_1S_3	0.13	0.13
H_1S_4	013	0.13
H_1S_5	0.13	0.14
H_2S_0	0.06	0.06
H_2S_1	0.21	0.23
H_2S_2	0.16	0.16
H_2S_3	0.14	0.14
H_2S_4	0.13	0.13
H_2S_5	0.13	0.12
LSD = 0.05	NS	NS
Contrasts		
S_0 VS S_1,S_2,S_3,S_4,S_5	**	**
S_1 VS S_2,S_3,S_4,S_5	*	*

Means in a row with different letter are significantly different ($p \leq 0.05$).
* = significant at ($p \leq 0.05$); ** = significant at ($p \leq 0.05$); NS = non significant

Significant interactions of maize hybrids and nitrogen sources were observed for 2008 but non significant for 2009. Maximum nitrogen content of maize was recorded in the H_1S_1 (1.46%) treatment combination while the minimum was found for H_1S_0 (0.22%). These results recount the findings of Akbar *et al.* (2002).

In 2008 and 2009 a highly significant differences was observed for nitrogen content in maize between S_0 (control) vs S_1, S_2, S_3, S_4, S_5 (nitrogen sources). A difference between chemical (S_1) vs (S_2, S_3, S_4, S_5) organic nitrogen sources was observed to be significant for nitrogen content of maize.

Table 3 presents the effects of treatments on the phosphorus content (%). In both years, hybrid effect and N content were non significant. The effect of phosphorus content (%) was found to be significant in both seasons. Nitrogen source S_1 produced a maximum (0.21%) of phosphorus content and minimum phosphorous content was noted for S_0 (0.06%). The same was true for 2009. Increase in phosphorous content (%) was due to availability of nitrogen to plants at an appropriate time and in proper proportions. These results are close to the findings of Amit (1990) and Tariq *et al.* (1994). A non significant interaction of maize hybrids and nitrogen sources was observed during both years.

During 2008 and 2009 differences between the two hybrids H_1 (Pioneer-30Y87) and H_2 (Pioneer-31R88) was observed to be non-significant for phosphorus content of maize.

During 2008 and 2009 contrast comparison between S_0 (control) vs S_1, S_2, S_3, S_4, S_5 (nitrogen sources) was found to be highly significant while a significant difference was observed between chemical (S_1) vs (S_2, S_3, S_4, S_5) organic nitrogen sources was for phosphorus content of maize during both years.

The hybrid maize varieties did not differ significantly in potash concentration for 2008 and 2009 (*Table 4*). The effect of nitrogen sources on potash concentration (%) was significant for both seasons. Nitrogen sources S_1 produced a maximum (1.14%) potash content of maize and the minimum potash content of maize was noted in S_0 (0.88%). A similar trend regarding potash content was also noted in year 2009. Improvement of potash content was due to availability of nitrogen to plants at an appropriate time and in proper proportion. Similar effects of N sources on potash content were discovered by Nielsen and Frish-Nielsen (1976).

Interactions of maize hybrids and nitrogen sources were found to be non significant for 2008 but significant for 2009. Maximum potash content of maize was observed in H_1S_1 (1.13%) treatment combinations and minimum in H_2S (0.835) treatment combinations. Nielsen and Frish-Nielsen (1976) also noted similar effects on potash content of maize.

In both 2008 and 2009 contrast comparison between S_0 (control) vs

S_1, S_2, S_3, S_4, S_5 (nitrogen sources) was found to be highly significant for potash content of maize while a significant difference was observed between chemical (S_1) vs (S_2, S_3, S_4, S_5) organic nitrogen sources was for potash content of maize during both years.

Table 4 - Effect of hybrid maize varieties and incorporated nitrogen sources on potash content (%)

Treatments	2008	2009
A-Hybrids		
H_1 : Pioneer-30Y87	1.03	1.01
H_2 : Pioneer-31R88	1.02	1.02
LSD = 0.05	NS	NS
B-Nitrogen Sources		
S_0 : Control 0 kg N ha^{-1}	0.88 c	0.84 c
S_1 : Chemical source (urea) @ 250 kg N ha^{-1}	1.14 a	1.12 a
S_2 : Poultry manure (PM) @ 9.6 t ha^{-1}	1.02 b	1.04 b
S_3 : Farm yard manure (FYM) @ 17.8 t ha^{-1}	1.04 b	1.03 b
S_4 : Pressmud of sugarcane (PS) @ 8.5t ha^{-1}	1.03 b	1.02 b
S_5 : Compost (C) @ 10 t ha^{-1}	1.03 b	1.03 b
LSD = 0.05	0.03*	0.02*
C-Interaction (H x NS)		
H_1S_0	0.89	0.86 e
H_1S_1	1.16	1.13 a
H_1S_2	1.03	1.03 bcd
H_1S_3	1.02	1.05 b
H_1S_4	1.04	1.01 d
H_1S_5	1.05	1.02 cd
H_2S_0	0.86	0.83 e
H_2S_1	1.12	1.11 a
H_2S_2	1.02	1.05 b
H_2S_3	1.05	1.02 cd
H_2S_4	1.03	1.04 bc
H_2S_5	1.02	1.05 b
LSD = 0.05	NS	0.03*
Contrasts		
S_0 VS S_1,S_2,S_3,S_4,S_5	**	**
S_1 VS S_2,S_3,S_4,S_5	*	*

Means in a row with different letter are significantly different ($p \leq 0.05$).
* = significant at ($p \leq 0.05$); ** = significant at ($p \leq 0.05$); NS = non significant

The hybrid maize showed no significant effects on N uptake during 2008 and 2009 (*Table 5*). The effect of nitrogen sources was significant in both seasons. Nitrogen sources S_1 gave a maximum (247.86 kg ha^{-1}) nitrogen uptake and the minimum was noted for S_0 (24.71 kg ha^{-1}). A similar nitrogen uptake trend was for 2009. Improvement of nitrogen uptake was due to the availability of nitrogen to plants at an apropriate time and in proper proportions. These results are similar to the findings of Akbar *et al.*

(2002). A significant interaction between maize hybrids and nitrogen sources was observed for 2008 but was not significant for 2009. Maximum nitrogen uptake was recorded for H_2S_1 (253.36 kg ha^{-1}), while minimum was found for H_1S_0 (24.35 kg ha^{-1}). Similar results were discovered by Akbar *et al.* (2002).

Table 5 - Effect of hybrid maize varieties and incorporated nitrogen sources on nitrogen uptake (kg ha^{-1})

Treatments	2008	2009
A-Hybrids		
H_1 : Pioneer-30Y87	183.68	172.33
H_2 : Pioneer-31R88	186.89	169.84
LSD = 0.05	NS	NS
B-Nitrogen sources		
S_0 : Control 0 kg N ha^{-1}	24.71 d	27.26 d
S_1 : Chemical source (urea) @ 250 kg N ha^{-1}	247.86 a	245.50 a
S_2 : Poultry manure (PM) @ 9.6 t ha^{-1}	220.43 b	194.50 b
S_3 : Farm yard manure (FYM) @ 17.8 t ha^{-1}	201.34 c	190.31 b
S_4 : Pressmud of sugarcane (PS) @8.5t ha^{-1}	214.25 b	189.04 b
S_5 : Compost (C) @ 10 t ha^{-1}	203.12 c	179.91 c
LSD = 0.05	6.94*	6.32*
C-Interaction (H x NS)		
H_1S_0	24.35 g	26.43
H_1S_1	242.36 b	242.36
H_1S_2	226.43 c	194.84
H_1S_3	182.59 f	190.71
H_1S_4	214.80 d	190.53
H_1S_5	211.55 d	174.17
H_2S_0	25.07 g	28.09
H_2S_1	253.36 a	248.64
H_2S_2	214.43 d	194.16
H_2S_3	220.10 cd	189.91
H_2S_4	213.71 d	187.55
H_2S_5	194.70 e	185.64
LSD = 0.05	9.82*	NS
Contrasts		
S_0 VS S_1,S_2,S_3,S_4,S_5	**	**
S_1 VS S_2,S_3,S_4,S_5	**	**

Means in a row with different letter are significantly different ($p \leq 0.05$).
* = significant at ($p \leq 0.05$); ** = significant at ($p \leq 0.05$); NS = Non significant

In 2008, differences between the two hybrids H_1 (Pioneer-30Y87) and H_2 (Pioneer-31R88) was non significant, While contrast comparison between S_0 (control) vs S_1, S_2, S_3, S_4, S_5 (nitrogen sources) and chemical (S_1) vs (S_2, S_3, S_4, S_5) organic nitrogen sources were significant for nitrogen uptake. A highly significant difference was

found in S_0 (control) vs S_1, S_2, S_3, S_4, S_5 (nitrogen sources) and chemical (S_1) vs (S_2, S_3, S_4, S_5) organic nitrogen sources for nitrogen uptakes.

No significant effects of hybrid maize varieties on P uptake were noted for 2008 and 2009 (*Table 6*). The effects of nitrogen sources on P uptake were significant for both seasons. Nitrogen sources S_1 gave maximum (36.86 kg ha^{-1}) phosphorus uptake and minimum phosphorus uptake was noted for S_0 (7.15 kg ha^{-1}). This was similar for 2009. Improvement in phosphorus uptake was due to the availability of nitrogen to plants at an appropriate time and in proper proportions. These results corroborate the findings of Amit (1990) and Tariq *et al.* (1994).

Table 6 - Effect of hybrid maize varieties and incorporated nitrogen sources on phosphorus uptake (kg ha^{-1})

Treatments	2008	2009
A-Hybrids		
H_1 : Pioneer-30Y87	22.61	22.23
H_2 : Pioneer-31R88	21.79	22.71
LSD = 0.05	NS	NS
B-Nitrogen sources		
S_0 : Control 0 kg N ha^{-1}	7.15 d	7.26 d
S_1 : Chemical source (urea) @ 250 kg N ha^{-1}	36.86 a	38.34 a
S_2 : Poultry manure (PM) @ 9.6 t ha^{-1}	25.86 b	26.14 b
S_3 : Farm yard manure (FYM) @ 17.8 t ha^{-1}	21.05 c	21.05 c
S_4 : Pressmud of sugarcane (PS) @8.5t ha^{-1}	21.36 c	21.15 c
S_5 : Compost (C) @ 10 t ha^{-1}	20.90 c	20.87 c
LSD = 0.05	1.60*	1.68*
C-Interaction (H x NS)		
H_1S_0	7.37	7.36
H_1S_1	35.96	37.07
H_1S_2	25.80	26.31
H_1S_3	20.26	20.26
H_1S_4	21.11	20.5/8
H_1S_5	20.24	21.78
H_2S_0	6.92	7.15
H_2S_1	37.77	39.61
H_2S_2	25.96	25.96
H_2S_3	21.84	21.84
H_2S_4	21.62	21.72
H_2S_5	21.56	19.96
LSD = 0.05	NS	NS
Contrasts		
S_0 VS S_1,S_2,S_3,S_4,S_5	**	**
S_1 VS S_2,S_3,S_4,S_5	*	**

Means in a row with different letter are significantly different ($p \leq 0.05$).
* = significant at ($p \leq 0.05$); ** = significant at ($p \leq 0.05$); NS = non significant

The interaction between maize hybrids and nitrogen sources affecting P uptake was found to be significant for both 2008 and 2009.

In both years, a non significant differences was observed between the two hybrids H_1 (Pioneer-30Y87) and H_2 (Pioneer-31R88). Contrast comparison between S_0 (control) vs S_1, S_2, S_3, S_4, S_5 (nitrogen sources) was found to be highly significant for phosphorus uptake. A significant difference perceived for uptake of phosphorus between chemical (S_1) vs (S_2, S_3, S_4, S_5) organic nitrogen sources.

During 2008 and 2009, contrast comparisons between S_0 (control) vs S_1, S_2, S_3, S_4, S_5 (nitrogen sources) was apprehend to be highly significant for phosphorus uptake. A significant difference between chemical (S_1) vs (S_2, S_3, S_4, S_5) organic nitrogen sources were observed for phosphorus uptake during both years.

The hybrid maize varieties showed no significant potash uptake differences for 2008 but significant differences for 2009 (*Table 7*). Maximum uptake of potash was found in H_2 (156.89 kg ha^{-1}) and minimum uptake of potash was observed in H_1 (1536.03 kg ha^{-1}). These results are in line with those of Nielsen and Frish-Nielsen (1976).

Table 7 - Effect of hybrid maize varieties and incorporated nitrogen sources on potash uptak (kg ha^{-1})

Treatments	2008	2009
A-Hybrids		
H_1 : Pioneer-30Y87	157.02	153.03 b
H_2 : Pioneer-31R88	156.05	156.89 a
LSD = 0.05	NS	3.47*
B-Nitrogen sources		
S_0 : Control 0 kg Nha^{-1}	98.10 c	93.12 c
S_1 : Chemical source (urea) @ 250 kg N ha^{-1}	194.75 a	189.99 a
S_2 : Poultry manure (PM) @ 9.6 t ha^{-1}	161.31 b	163.15 b
S_3 : Farm yard manure (FYM) @ 17.8 t ha^{-1}	162.30 b	161.51 b
S_4 : Pressmud of sugarcane (PS) @8.5t ha^{-1}	163.84 b	162.89 b
S_5 : Compost (C) @ 10 t ha^{-1}	158.9 b	159.10 b
LSD = 0.05	6.32*	6.01*
C-Interaction (H x NS)		
H_1S_0	99.94	92.26 d
H_1S_1	193.11	188.13 a
H_1S_2	163.22	162.74 b
H_1S_3	160.12	163.80 b
H_1S_4	164.67	159.92 b
H_1S_5	155.87	151.30 b
H_2S_0	96.97	93.97 d

Treatments	2008	2009
H_2S_1	196.39	191.85 a
H_2S_2	159.40	163.56 b
H_2S_3	164.42	159.21 bc
H_2S_4	163.0	165.87 b
H_2S_5	161.95	166.90 b
LSD =0.05	NS	8.49*
Contrasts		
S_0 VS S_1,S_2,S_3,S_4,S_5	**	**
S_1 VS S_2,S_3,S_4,S_5	**	**

Means in a row with different letter are significantly different ($p \leq 0.05$).
* = significant at ($p \leq 0.05$); **= significant at ($p \leq 0.05$); NS = non significant

The effect of nitrogen sources on potash uptake was also significant for both seasons. For nitrogen sources S_1 had maximum (194.75 kg ha^{-1}) potash uptake and the minimum was noted for S_0 (98.10 kg ha^{-1}). A similar potash uptake trend was noted for 2009. An increase in nitrogen uptake was due to the availability of nitrogen to plants at an appropriate time and in proper proportions as noted by Krishada (1998), working on maize hybrids as well.

A non significant interaction of maize hybrids and nitrogen sources was observed for 2008, but significant differences for 2009. Maximum nitrogen uptake was recorded for H_2S_1 (191.85 kg ha^{-1}), while the minimum was found with H_1S_0 (92.26 kg ha^{-1}). These results were similar to those of Krishada (1998).

Impact of differences between S_0 (control) vs S_1, S_2, S_3, S_4, S_5 (nitrogen sources) and chemical (S_1) vs (S_2, S_3, S_4, S_5) organic nitrogen sources differences were highly significant for potash uptake in 2008 and 2009.

CONCLUSION

On the basis of finding it was concluded that hybrid maize (H_1: 30Y87) produced significantly more (6.01 t ha^{-1}) grain yield as compared to (H_1: 31R88) 5.97 t ha^{-1} during both years. Nitrogen source S_1 : chemical source (urea) @ 250 kg N ha^{-1} produced maximum (7.43 t ha^{-1}) grain yield and minimum grain yield resulted from S_0 (3.70 t ha^{-1}). Combined effect of nutrient concentration and its uptakes was noted in hybrid maize 30Y87.

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