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# EFFECT OF NUTRIENT SOURCES ON PRODUCTIVITY OF SPRING MAIZE (ZEA MAYS L.) AT KHAIRAHANI, CHITWAN, NEPAL

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**ABSTRACT**

*Maize is second most important crop of Nepal grown mostly for food, feed and fodder. While many biotic and abiotic factors may lead to yield gaps in maize, soil fertility degradation and poor nutrient management are major factors in low productivity. A research study entitled "Effect of nutrient sources on productivity of spring maize at Khairahani, Chitwan, Nepal" was conducted in Agronomy farm of Rampur Campus, Khairahani Chitwan Nepal during the spring season, 2021 to identify the appropriate nutrient source for the maximum growth and yield of maize (Zea mays L), variety Arun-2. The experiment was laid out in Randomized Complete Block Design with eight different source of nutrients as treatments viz: i). Vermicompost (4.8 tonne/ha) ii). Goat manure (8 tonne/ha) iii). Bio-compost (wonder 2.4 tonne/ha) iv). Compost (24 tonne/ha) v). FYM (24 tonne/ha) vi). Poultry manure (4 tonne/ha) vii). NPK 120:60:40 Kg/ha as chemical fertilizer and viii). Control replicated thrice. The results showed that nutrient sources significantly influenced the growth and yield of maize. The highest yield (7.17 tonne/ha) and 1000 seed weight (439 g) was found in the treatment with poultry manure used at the rate of 4 tonne/ha. Significantly, higher number of leaves per plant, leaf area index, stem length, fresh weight and dry weight were found higher in FYM (24 tonne/ha). Similarly, significantly higher harvest index% (32) was recorded in the plots treated with poultry manure. Among the treatments, poultry manure seemed to be economically better for yield of spring maize among different organic manures with higher B/C ratio (2.55) in the plain subtropical areas of Chitwan.*

**Keywords**: *Manures, Vermicompost, Leaf Area Index, Yield attributing traits, Harvest Index*

## Introduction

Maize (*Zea mays* L.) is an important cereal worldwide. It is second most important crop of Nepal grown mostly for food, feed and fodder. It is also an important source of industrial corn sugar, beverages, bread, snacks and the major source of livestock feed whose stalk, leaves and immature ears are highly preferred by livestock. It has great nutritional value as it contain about 66.70% starch, 10% protein, 4.8% oil, 8.5% fiber, 3% sugar and 7% ash (Ullah et al., 2015). maize kernels provide 86 calories per

100-gram serving and are good source (10-19% of the Daily Value) of the vitamin B, thiamin, niacin, pantothenic acid and folate. It also supplies dietary fiber and the essential minerals, magnesium and phosphorus whereas other nutrients are in low amounts (Pal et al., 2017). Maize grains provide macro and micro nutrient required for human diet but it lacks adequate amount of essential amino acids, lysine and tryptophan (Toungos, 2019).

It has production of 2,999,733 metric ton in area of 979,776 ha with a productivity of 3.06 tonne/ha in Nepal (Krishi Diary, 2079). Its demand has been constantly growing by about 5% annually in the last decades (Sapkota & Pokhrel, 2013). The per capita maize consumption of maize in Nepal is 98 g/person/day (Ghimire et al., 2015). Therefore, total quantity of maize requirement for food per year is around 2.9 million mt and the production during 2014 was 2.283 million mt only, hence the deficit was 0.67 million tonne (Ghimire et al., 2015).

It has been observed that maize is an exhaustive crop and responds well to balanced use of fertilizer. Many biotic and abiotic factors may lead to huge yield gaps, soil fertility degradation and poor nutrient management are major factors in low productivity. Different management practices are adopted to increase and optimize the maize yields. Now, fast economic development has led the farmers to use mineral fertilizers as they are more economical, affordable, easy to use and quick in response. Although these chemical fertilizers are important input to get higher crop productivity, but over reliance on them is associated with decline in some soil properties and crop yields.

The application of organic manure provides higher comparative advantage over the use of inorganic fertilizer. It counteracts the ill effects of chemical fertilizers applied to the soil by way of reducing chemical toxicity to the microbes and thereby favours their growth. Organic manure is cheap, readily available at local condition, environmentally friendly, and also has a residual effect and ability to improve soil structure compared to chemical fertilizers supplying N, P, and K and other essential elements. The application of organic manure results in increased yield of maize, higher SOM content, improved soil porosity and more water holding capacity (Mahmood et al., 2017). Besides this, organic manure improves cation exchange capacity of the soil, which helps in smooth supply of nutrients to the crop plants and finally results into profitable yields (Ponmozhi et al., 2019). It not only increases the yield and water use efficiency to a higher and more stable level but also improves the soil water-nutrients situation (Wang et al., 2020). Organic manure has strong influence on soil productivity, agronomic efficiency of crop and nitrogen dynamics in soil-plant system (Tehulie & Tola, 2020). It holds nutrient pool, improves soil buffering capacity, provides nutrient and shelter to microorganisms, improves availability of macro and micro nutrients and so on (Pinjari, 2010). When

these manures are properly applied, it benefits in production of plants like maize and generally enhance size, height and number of leaf (Okoroafor et al., 2013).

Although organic farming has numerous advantages, many farmers hesitate to change their conventional farming to organic farming due to the concern that their yields may be reduced (Cen et al., 2020). The nutrients contained in manure are not readily available for plant use as it must be broken down first by soil microorganisms in order to release the nutrients in the plant utilizable form due to which it shows slow response in comparison to chemical fertilizer (Toungos, 2019).

Moreover, very little information is available on the effects of manure application on crop productivity and soil quality in maize production in Nepal. Also, with increasing popularity of organic manures, more information is needed comparing the growth and yield of maize crops produced organically or using inorganic fertilizer. Therefore, keeping the above points in view, this study was undertaken to determine the influence of organic and inorganic fertilizers on yield and yield components of maize and to determine the economically optimum rate of organic and inorganic fertilizer rate for maize crop in Chitwan, Nepal.

This research was conducted with the following objectives:

Broad objective

- To enhance the productivity of spring maize in central terai of Nepal.

Specific objectives

- To study the response of different nutrient sources on growth and yield of maize.
- To determine the economic feasibility of different nutrient sources on maize production.

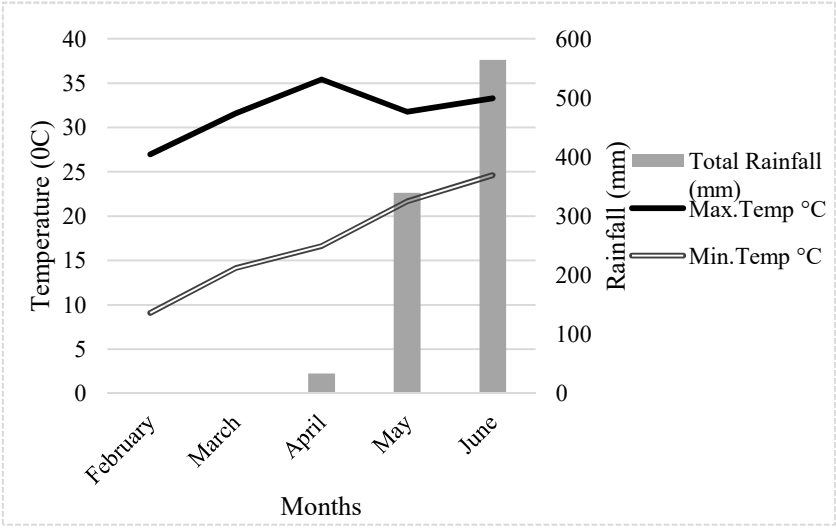
**Materials and Method**

The experiment was conducted in the agronomy farm of Institute of Agriculture and Animal Science, Rampur campus, Chitwan during spring season. The experimental site is located at $27^0$ 62' N latitude and $84^0$ 57' E longitude in Central Nepal at an altitude of 168 masl with sub-tropical climate. Soil type is clay loam. The experiment was conducted in agronomy field of IAAS, Rampur campus, Chitwan from February 20 to June 1 of 2021. The variety of maize used for experiment was Arun-2. The experimental design was Randomized Complete Block Design (RCBD) with three replication and eight treatments. The size of each plot was 12.6 $m^2$ (4.2 m × 3 m) with spacing of 60 cm ×25 cm. The climatic pattern of Chitwan during experimental period is shown in the Figure 1. The physiochemical properties of soil of experimental site is shown in the Table 1. The treatment details were as follows:

**Table 1**

| S.N | Treatments | Notation |
|---|---|---|
| 1. | Vermicompost 4.8 tonne/ha | $T_1$ |
| 2. | Goat manure 8 tonne/ha | $T_2$ |
| 3. | Bio-compost (Wonder) 2.4 tonne/ha | $T_3$ |
| 4. | Compost 24 tonne/ha | $T_4$ |
| 5. | FYM 24 tonne/ha | $T_5$ |
| 6. | Poultry manure 4 tonne/ha | $T_6$ |
| 7. | NPK 120:60:40 kg/ha (fertilizers) | $T_7$ |
| 8. | Control (No manure/fertilizer application) | $T_8$ |

Figure 1. Meteorological data during experimental period in Chitwan, 2021




Source: NMRP, 2021

Different biometric characters like plant height, number of leaves per plant, leaf area index, fresh weight and dry weight of plant were observed at 15 days interval at 35 DAS, 50 DAS and 65 DAS and yield and yield attributing characters like number of grains per cob, grain yield, 1000 seed weight and harvest index were also recorded. Then the data analysis was done by using computer software MSTATC. Treatment means were separated by Duncan's Multiple Range Test (DMRT) at 5% level of significance.

**Table 2**

**Physiochemical properties of soil of experimental site**

| **1. Physical properties of soil** | Content (%) | Rating |
|---|---|---|
| Sand content | 38.2 | |
| Silt content | 27.2 | |
| Clay content | 34.6 | |
| Soil texture | | Clay loam |
| **2. Chemical properties** | | Remarks |
| Soil pH | 5.1 | 1:2 soil water suspension |
| Total organic matter (%) | 1.46 | Walkley-Black method |
| Total nitrogen (%) | 0.07 | Kjeldahl method |
| Available phosphorus (kg/ha) | 185.2 | Olsen method |
| Available potassium (kg/ha) | 135.6 | Ammonium acetate |

Source: Khairaheni Municipality, Khairaheni, Chitwan

## Results and Discussion

### Effect of nutrient sources on biometric characters of spring maize

At 65 DAS, there was significant variation in plant height among the treatments and the average plant height was found maximum (217.2 cm) in FYM 24 tonne/ha followed by compost 24 tonne/ha (208.1 cm) and the least average plant height (173 cm) was recorded in control as shown in Table 3. Similarly, at 65 DAS, maximum number of leaves (12) per plant was recorded in FYM 24 tonne/ha followed by NPK 120:60:40 kg/ha (11.33) while least was found in control (8.78) and maximum leaf area index (3.64) was recorded in FYM 24 tonne/ha followed by compost 24 tonne/ha (3.4) while least was found in control (2.25). Similarly, highest dry weight (118.9 g) was recorded in FYM 24 tonne/ha which was significantly at par with other treatments while least was found in control (59.56 g) as shown in Table 3.

**Table 3**

**Effect of nutrient sources on plant height (cm) of maize in 2021**

| Treatments | Plant height 65 DAS (cm) | Number of leaves at 65 DAS | LAI at 65 DAS | Dry weight per plant (g) at 65 DAS |
|---|---|---|---|---|
| 1. Vermicompost 4.8 tonne/ha | $202.8\pm4.13^{b}$ | $10.67\pm0.51^{c}$ | $2.82\pm0.05^{c}$ | $102.6\pm2.75^{bc}$ |
| 2. Goat manure 8 tonne/ha | $200.1\pm4.99^{bc}$ | $10.33\pm0.19^{c}$ | $2.66\pm0.15^{c}$ | $92.86\pm6.29^{cd}$ |
| 3. Bio-compost (Wonder) 2.4 tonne/ha | $192.9\pm1.42^{c}$ | $10.33\pm0.19^{c}$ | $2.62\pm0.06^{c}$ | $86.84\pm1.61^{d}$ |
| 4. Compost 24 tonne/ha | $208.1\pm3.82^{b}$ | $10.89\pm0.11^{bc}$ | $3.40\pm0.11^{ab}$ | $95.72\pm1.8^{cd}$ |
| 5. FYM 24 tonne/ha | $217.2\pm4.58^{a}$ | $12.00\pm0.39^{a}$ | $3.64\pm0.1^{a}$ | $118.9\pm6.97^{a}$ |
| 6. Poultry manure 4 tonne/ha | $200.0\pm b2.86^{c}$ | $10.78\pm0.29^{bc}$ | $2.85\pm0.07^{c}$ | $95.55\pm0.78^{cd}$ |
| 7. NPK 120:60:40 kg/ha (fertilizers) | $206.2\pm5.43^{b}$ | $11.33\pm0.19^{b}$ | $3.25\pm0.1^{b}$ | $113.0\pm6.92^{ab}$ |
| 8. Control | $173.0\pm2.06^{d}$ | $8.78\pm0.29^{d}$ | $2.25\pm0.12^{d}$ | $59.56\pm2.46^{e}$ |
| F-test | *** | *** | *** | *** |
| LSD (at 5%) | 8.027 | 0.60 | 0.3083 | 13.24 |
| CV % | 2.29 | 3.23 | 6.02 | 7.89 |
| Grand mean | 200.026 | 10.639 | 2.937 | 95.873 |

Note: Treatment means in the same column followed by same letters are not significantly different at 5% level of significance by DMRT. ** and *** indicates significant at 1% and 0.1% level of significance respectively.

### Effect of nutrient sources on yield and yield attributing characters

Maximum number of grain per cob (255.9) was recorded in vermicompost 4.8 tonne/ha followed by FYM 24 tonne/ha (250.5) while minimum was found in control (173.3) as shown in Table 4. Similarly, maximum 1000 seed weight (439) was recorded in poultry manure 4 tonne/ha followed by NPK 120:60:40 kg/ha (420) while minimum was found in control (278.3).

**Table 4**
**Effect of nutrient sources on yield (tonne/ha) and harvest index of maize in 2021**

| Treatment | Grains per cob (no.) | 1000 seed wt (g) | Grain yield (tonne/ha) | Harvest Index (%) |
|---|---|---|---|---|
| 1. Vermicompost 4.8 tonne/ha | 255.9±2.57$^{a}$ | 350.3±3.71$^{c}$ | 6.01±0.05$^{b}$ | 29.17±0.4$^{bc}$ |
| 2. Goat manure 8 tonne/ha | 228.9±4.78$^{b}$ | 355.0±2.52$^{c}$ | 5.44±0.08$^{c}$ | 27.52±0.54$^{d}$ |
| 3. Bio-compost (Wonder) 2.4 tonne/ha | 249.6±3.29$^{a}$ | 362.7±2.67$^{c}$ | 6.06±0.06$^{b}$ | 30.64±0.38$^{ab}$ |
| 4. Compost 24 tonne/ha | 248.7±7.57$^{a}$ | 374.0±9.07$^{bc}$ | 6.23±0.19$^{b}$ | 27.82±0.36$^{cd}$ |
| 5. FYM 24 tonne/ha | 250.5±8.32$^{a}$ | 377.3±6.44$^{bc}$ | 6.33±0.16$^{b}$ | 27.25±0.56$^{d}$ |
| 6. Poultry manure 4 tonne/ha | 244.2±7.28$^{a}$ | 439.0±18.53$^{a}$ | 7.17±0.18$^{a}$ | 32.00±0.83$^{a}$ |
| 7. NPK 120:60:40 kg/ha (fertilizers) | 243.0±4.1$^{ab}$ | 420.0±5.03$^{ab}$ | 6.84±0.13$^{a}$ | 29.86±0.03$^{b}$ |
| 8. Control | 173.3±5.05$^{c}$ | 278.3±4.37$^{d}$ | 3.23±0.05$^{d}$ | 24.84±0.8$^{e}$ |
| F-test | *** | *** | *** | *** |
| LSD (at 5%) | 14.46 | 55.38 | 0.36 | 1.50 |
| CV % | 3.49 | 3.49 | 3.44 | 2.29 |
| Grand Mean | 236.77 | 370 | 5.91 | 28.64 |

Note: Treatment means in the same column followed by same letters are not significantly different at 5% level of significance by DMRT. ** and *** indicates significant at 1% and 0.1% level of significance respectively.

Grain yield was found highest in poultry manure 4 tonne/ha (7.17 tonne/ha) which was significantly on par with other treatments while minimum was recorded in control (3.23 tonne/ha). Similarly, maximum harvest index (32%) was recorded in poultry manure 4 tonne/ha followed by bio-compost (Wonder) 2.4 tonne/ha (30.64%) while minimum was found in control (24.84%).

### Economic analysis of effect of nutrient sources on spring maize

Maximum net benefit (NRs 283630) was found in plots applied with NPK 120:60:40 Kg/ha while minimum was found in plots treated with no fertilizer and manure (NRs 85315). Highest B/C ratio (3.24) was found in plots applied with NPK 120:60:40 Kg/ha followed by poultry manure 4 tonne/ha (2.55) while minimum B/C ratio was found in goat manure 8 tonne/ha (1.43) as shown in Table 5.

**Table 5**

**Economic analysis of the treatments used in the experiment during 2021**

| Treatments | Variable cost | General cost (NRs) | Total cost (NRs) | Gross return (NRs) | Net benefit (NRs) | B/C ratio |
|---|---|---|---|---|---|---|
| 1. Vermicompost 4.8 tonne/ha | 144000 | 108425 | 252425 | 360360$^{b}$ | 107935$^{e}$ | 1.43$^{e}$ |
| 2. Goat manure 8 tonne/ha | 120000 | 108425 | 228425 | 326640$^{c}$ | 98215$^{ef}$ | 1.43$^{e}$ |
| 3. Bio-compost (Wonder) 2.4 tonne/ha | 84000 | 108425 | 192425 | 363840$^{b}$ | 171415$^{c}$ | 1.89$^{c}$ |
| 4. Compost 24 tonne/ha | 120000 | 108425 | 228425 | 373740$^{b}$ | 145315$^{d}$ | 1.64$^{d}$ |
| 5. FYM 24 tonne/ha | 96000 | 108425 | 204425 | 379740$^{b}$ | 175315$^{c}$ | 1.86$^{c}$ |
| 6. Poultry manure 4 tonne/ha | 60000 | 108425 | 168425 | 430020$^{a}$ | 261595$^{b}$ | 2.55$^{b}$ |
| 7. NPK 120:60:40 kg/ha (fertilizers) | 18165 | 108425 | 126590 | 410220$^{a}$ | 283630$^{a}$ | 3.24$^{a}$ |
| 8. Control | 0 | 108425 | 108425 | 193740$^{d}$ | 85315$^{f}$ | 1.79$^{c}$ |
| F-test | | | | *** | *** | *** |
| LSD (at 5%) | | | | 21390 | 21390 | 0.124 |
| CV (%) | | | | 3.44 | 7.35 | 3.65 |
| Grand Mean | | | | 354789.7 | 166094.1 | 1.978 |

Note: Treatment means in the same column followed by same letters are not significantly different at 5% level of significance by DMRT. ** and *** indicates significant at 1% and 0.1% level of significance respectively.

Amos et al. (2015) reported that application of 15 t/ha of FYM gave the tallest plant height (140.4 cm) which was an increase of about 24% compared with the no treatment plots. Similarly, as reported by Amin (2010) who found that application of 6.46 tonne/ha cattle manure resulted higher number of leaf (14.39) compared to sole application of nitrogen of 87.6 kg/ha i.e.11.5 and control (10). It may be due to amount of nitrogen present in manure applied which improved microbial activity that led to enhanced production and mineralization of organic matter from natural source in soil (Af et al., 2020).

It was found that cattle manure has significant influence on leaf area at different application levels; maximum leaf area index (403.04) was recorded at 20 tonne/ha which may be due to increase in the amount of nitrogen present in manure applied which improved microbial activity that led to enhanced production and mineralization of organic matter from natural source in soil (Af et al., 2020). Amin (2010) reported that application of 6.46 tonne/ha cattle manure resulted higher plant dry matter (12.2 tonne/ha) compared to sole application of nitrogen of 87.6 kg/ha i.e.10.6 tonne/ha and control (8.2 tonne/ha). Increased dry matter accumulation in FYM 24 tonne/ha treated plots might be attributed due to the continuous steady release of nutrients which might have enabled the leaf area duration to extend, thus favoring the plants to increase the photosynthetic rate

which in turn, could have led to higher accumulation of dry matter (Ponmozhi et al., 2019). The higher number of grain per cob might be as of application of vermicompost provided more plant regulator to promote plant absorbing more nutrients which further promoted the dry matter transferring to maize grain (Guo et al., 2015). The higher 1000 seed weight in poultry manure treated plot may be because of poultry manure being a good source of phosphorus and helped in the seed set in maize crop and has higher test weight (Soro et al., 2015). The determining factor in higher yield of plots treated with poultry manure may be as of rate of N mineralization from poultry manure is faster than from other manures because it contains high amount of uric acid and urea substances which readily release $NH_4$-N (Tehulie & Tola, 2020). The improvement in grain yield under treatments involving organic fertilizer vermicompost and FYM might be due to the improvement in soil physico-chemical properties (viz., pH, bulk density, infiltration rate and microbial biomass carbon) and optimum availability of nutrients and organic carbon which acted as the growth and biomass enhancing characters of maize crop (Ponmozhi et al., 2019).

## Conclusion and Recommendation

The application of different nutrient sources had significant variation in growth and yield of maize crop. Based on overall performance of the treatments, poultry manure 4 tonne/ha was found to be appropriate for higher maize yield (7.17 tonne/ha) with maximum 1000 seed weight (439 g) in maize. This treatment combination gives highest B/C ratio (2.55) among the organic manures. Poultry manure is best organic nutrient source in context of Nepal and especially in case of hilly region inaccessible to chemical fertilizer. These organic fertilizers not only provide nutrients to plants but also are great factors in restoring soil fertility and improving soil physical, chemical and biological properties leading to healthy soil environment. However, further research needs to be conducted in other varieties and in different agro-climatic location for validation.

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## APPENDICES

Appendix 1: Climatic data during experimental period at Khairahani, Chitwan, 2021

| Month/Year | Max.Temp °C | Min.Temp °C | Total Rainfall (mm) | Humidity (%) |
|---|---|---|---|---|
| February, 2021 | 26.95 | 9.08 | | 59 |
| March, 2021 | 31.59 | 14.12 | | 59 |
| April, 2021 | 35.42 | 16.62 | 33.8 | 50 |
| May, 2021 | 31.76 | 21.67 | 339.5 | 77 |
| June, 2021 | 33.29 | 24.60 | 564.2 | 83 |

Appendix 2: Mean Square from ANOVA for plant height (cm) at 65 DAS as influenced by different nutrient source in maize.

| K value | Source | Degree of freedom | Sum of squares | Mean square | F value | Probability |
|---|---|---|---|---|---|---|
| **1** | Replication | 2 | 434.589 | 217.295 | 10.3412 | 0.0017 |
| **2** | Factor A | 7 | 3566.412 | 509.487 | 24.2469 | 0.0000 |
| **3** | Error | 14 | 294.174 | 21.012 | | |
| | Total | 23 | 4295.176 | | | |

Appendix 3: Mean Square from ANOVA for number of leaves at 65 DAS as influenced by different nutrient source in maize.

| K value | Source | Degree of freedom | Sum of squares | Mean square | F value | Probability |
|---|---|---|---|---|---|---|
| **1** | Replication | 2 | 1.231 | 0.616 | 5.2011 | 0.0205 |
| **2** | Factor A | 7 | 18.240 | 2.601 | 21.9665 | 0.0000 |
| **3** | Error | 14 | 1.657 | 0.118 | | |
| | Total | 23 | 21.093 | | | |

Appendix 4: Mean Square from ANOVA for LAI at 65 DAS as influenced by different nutrient source in maize.

| K value | Source | Degree of freedom | Sum of squares | Mean square | F value | Probability |
|---|---|---|---|---|---|---|
| **1** | Replication | 2 | 0.041 | 0.020 | 0.6480 | |
| **2** | Factor A | 7 | 4.419 | 0.631 | 20.1899 | 0.0000 |
| **3** | Error | 14 | 0.438 | 0.031 | | |
| | Total | 23 | 4.897 | | | |

Appendix 5: Mean Square from ANOVA for dry weight at 65 DAS as influenced by different nutrient source in maize.

| K value | Source | Degree of freedom | Sum of squares | Mean square | F value | Probability |
|---|---|---|---|---|---|---|
| **1** | Replication | 2 | 135.870 | 67.935 | 1.1877 | 0.3339 |
| **2** | Factor A | 7 | 6835.954 | 976.565 | 17.0730 | 0.0000 |
| **3** | Error | 14 | 800.792 | 57.199 | | |
| | Total | 23 | 7772.616 | | | |

Appendix 6: Mean Square from ANOVA for number of grain per cob as influenced by different nutrient source in maize.

| K value | Source | Degree of freedom | Sum of squares | Mean square | F value | Probability |
|---|---|---|---|---|---|---|
| **1** | Replication | 2 | 617.893 | 308.946 | 4.5289 | 0.0304 |
| **2** | Factor A | 7 | 15135.214 | 2162.173 | 31.6959 | 0.0000 |
| **3** | Error | 14 | 955.026 | 68.216 | | |
| | Total | 23 | 16708.132 | | | |

Appendix 7: Mean Square from ANOVA for 1000 seed weight (g) as influenced by different nutrient source in maize.

| K value | Source | Degree of freedom | Sum of squares | Mean square | F value | Probability |
|---|---|---|---|---|---|---|
| **1** | Replication | 2 | 904.333 | 452.167 | 2.7212 | 0.1004 |
| **2** | Factor A | 7 | 49193.167 | 7027.595 | 42.2924 | 0.0000 |
| **3** | Error | 14 | 2326.333 | 166.167 | | |
| | Total | 23 | 52423.833 | | | |

Appendix 8: Mean Square from ANOVA for grain yield (tonne/ha) as influenced by different nutrient source in maize.

| K value | Source | Degree of freedom | Sum of squares | Mean square | F value | Probability |
|---|---|---|---|---|---|---|
| **1** | Replication | 2 | 0.176 | 0.088 | 2.1206 | 0.1569 |
| **2** | Factor A | 7 | 30.465 | 4.352 | 105.0228 | 0.0000 |
| **3** | Error | 14 | 0.580 | 0.041 | | |
| | Total | 23 | 31.221 | | | |

Appendix 9: Mean Square from ANOVA for harvest index as influenced by different nutrient source in maize.

| K value | Source | Degree of freedom | Sum of squares | Mean square | F value | Probability |
|---|---|---|---|---|---|---|
| **1** | Replication | 2 | 3.968 | 1.984 | 2.7 | 0.1019 |
| **2** | Factor A | 7 | 106.055 | 15.151 | 10.6203 | 0.0000 |
| **3** | Error | 14 | 10.286 | 0.735 | | |
| | Total | 23 | 120.309 | | | |

Appendix 10: General cost of maize production per ha at IAAS, Khairaheni, Chitwan, 2021

| S.N | Particulars | Unit | Quantity | Rate | Total cost |
|---|---|---|---|---|---|
| **1.** | Seed | Kg | 25 | 125 | 3125 |
| **2.** | Land preparation (tractor) | Hour | 4 | 1600 | 6400 |
| **3.** | Field preparation | Man days | 15 | 800 | 12000 |
| **4.** | Sowing and manure application | Man days | 4 | 800 | 3200 |
| **5.** | Irrigation | Hours | 100 | 45 | 4500 |
| **6.** | Herbicide | Kg | 4 | 600 | 2400 |
| **7.** | Plant protection (King killer) | ml | 2000 | 130 per 100ml | 2600 |
| **8.** | Plant protection labour | Man days | 4 | 800 | 3200 |
| **9.** | Weeding and earthing up | Man days | 22 | 800 | 17600 |
| **10** | Harvesting | Man days | 7 | 800 | 5600 |
| **11.** | Shelling | Hour | 14 | 200 | 2800 |
| **12.** | Land rent | Year | 1/3 | 105000 | 35000 |
| **13.** | Farm tools (bucket, pipe, sutari, spade, sickle) | | | | 10000 |
| | Total | | | | 108425 |