Effect of Different Nitrogen and Phosphorus Levels on Growth and Yield of Maize during Kharif Season

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A B S T R A C T

A field experiment was conducted during two consecutive kharif seasons of 2014 and 2015 to evaluate the effect of different levels of nitrogen (200, 250 and 300 kg ha\(^{-1}\)) and phosphorus (40, 60, and 80 kg ha\(^{-1}\)) on the growth and yield of maize. The growth parameters of maize viz., plant height, leaf area index and dry matter production were considerably influenced by nitrogen and phosphorus levels at 30, 90 DAS and at harvest in the first year and only by nitrogen levels at all the stages on dry matter production and on LAI at 90 DAS in the second year. Interaction was not significant except at 90 DAS on plant height and at harvest, on dry matter production in the first year. During both the years, the highest and lowest grain and stover yields were recorded with N level of 300 kg ha\(^{-1}\) and 200 kg ha\(^{-1}\) and with P level of 60 kg ha\(^{-1}\) and 40 kg ha\(^{-1}\) respectively. The combination of 250 kg N and 60 kg P\(_2\)O\(_5\) ha\(^{-1}\) resulted in higher yield of maize during kharif season.

Keywords: Maize, Nitrogen, Phosphorus, Growth parameters

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Introduction

Wheat, rice and maize are the most important cereal crops in the world but maize is the most popular due to its high yielding, ease of processing, readily digested and costs less than other cereals (Jaliya et al., 2008). Maize as a major source of carbohydrate is used as food, in livestock diet and in alcohol production. Maize has immense potential in the tropics and yield of up to 7500 kg ha\(^{-1}\) can be obtained if the crop is properly managed. Unfortunately, yields are still generally below 5000 kg ha\(^{-1}\) (FAO, 2007) and this had caused inadequacy of maize for its numerous usages. Yield differences between temperate and tropical areas have been attributed to low nutrient status of tropical soils especially nitrogen, phosphorus and potassium resulting from the practice of slash and burn farming system with excessive leaching of the soil nutrients. The low fertility status of most tropical soils hindered maize production as maize has a strong exhausting effect on the soil. Luxuriant growth resulting from fertilizer application leads to larger dry matter production owing to better utilization of solar radiation and nutrients (Saeed et al., 2001). Conflicting results about the benefits and adverse effects of fertilizer have however been found in literature. Ayoola and Adeniyan (2006) had reported that the use of inorganic fertilizer has not been helpful under intensive agriculture because it is often associated with reduced yield, nutrient imbalance, leaching and pollution of...
groundwater. In view of inconsistency in the fertilizer and increasing cost of production associated with its usage, field trials were conducted in 2014 and 2015 to determine the appropriate N and P rate that will produce the optimum yield in maize.

**Materials and Methods**

Field trial was conducted at College Farm of Agricultural College, Mahanandi campus of Acharya N. G. Ranga Agricultural University, situated at 15.51°N latitude, 78.61°E longitude and at an altitude of 233.5 m above the mean sea level, in the Scarce Rainfall Zone of Andhra Pradesh during kharif seasons of 2014 and 2015. The soil was sandy loam in texture, neutral in reaction (pH of 7.34), low in organic carbon (0.45%) and available nitrogen (275 kg ha\(^{-1}\)), medium in available phosphorus (153 kg ha\(^{-1}\)) and high in available potassium (670 kg ha\(^{-1}\)), during beginning of experimentation.

The trials were laid down in a randomized block design with factorial concept. The treatments included three nitrogen levels (200 kg ha\(^{-1}\) (N\(_1\)), 250 kg ha\(^{-1}\) (N\(_2\)) and 300 kg ha\(^{-1}\) (N\(_3\))) and three phosphorus levels (40 kg ha\(^{-1}\) (P\(_1\)), 60 kg ha\(^{-1}\) (P\(_2\)) and 80 kg ha\(^{-1}\) (P\(_3\))). The test variety of maize was P-3396 a single cross hybrid. Recommended practices for disease and insect pest control were followed. Nitrogen was applied at graded levels as per the treatments in three splits i.e., one third at basal, one third at knee high stage and the remaining one third at tasseling stage. Entire quantity of P\(_2\)O\(_5\) as per the treatments and K\(_2\)O (60 kg K\(_2\)O ha\(^{-1}\)) was applied as a basal dose. The sources of nitrogen, phosphorus and potassium were urea, single super phosphate and muriate of potash respectively. The split dose of nitrogen fertilizer was applied by placement at 5 cm away and 5 cm below the seed rows. Five plants were randomly selected per plot for determination of growth parameters. The growth parameters assessed included plant height (cm), leaf area index (LAI) and total dry matter (kg ha\(^{-1}\)). At harvest, the cobs and stover were harvested and weighed separately. The cobs and stover were dried and re-weighed. The grain on the cobs were shelled and weighed.

The data recorded on hybrid maize for various parameters during the course of investigation were statistically analyzed following the method of analysis of variance for randomized block design with factorial concept. Wherever the treatmental differences were found significant (‘F’ test), critical difference was worked out at 0.05 % probability level and the values are furnished. Treatmental differences that were non-significant are denoted as NS.

**Results and Discussion**

**Plant height**

Among the nitrogen levels, application of nitrogen at 300 kg ha\(^{-1}\) (N\(_3\)) produced taller plants, which were on par with that of 250 kg N ha\(^{-1}\) (N\(_2\)) at all the stages of crop growth except at 30 DAS during the first year (Table. 1). Improvement in plant height with each successive increment of nitrogen might be attributed to the fact that nitrogen is an integral part of proteins, the building blocks of plant and it also helps in maintaining higher auxin level which might have resulted in better plant height. Similar findings were reported by Dawadi and Sah (2012) and Nsanzabaganwa et al., (2014).

Among the phosphorus levels, application of 60 kg P\(_2\)O\(_5\) ha\(^{-1}\) (P\(_2\)) produced taller plants in the first year and 80 kg P\(_2\)O\(_5\) ha\(^{-1}\) (P\(_3\)) in the second year. Improvement in plant height with higher phosphorus levels over and above 40 kg P\(_2\)O\(_5\) ha\(^{-1}\) (P\(_2\)) might be attributed to the fact that phosphorus is a constituent of nucleic
acids, phospholipids, coenzymes and most importantly ATP. It activates coenzymes for amino acid production used in protein synthesis which might have resulted in better plant height. Similar results were obtained by Gemechu (2011).

With regard to interaction, increase in levels of nitrogen in combination with increased phosphorus levels resulted in taller plants i.e \(N_3P_3\) (300 kg N + 80 kg P\(_2\)O\(_5\) ha\(^{-1}\)) at 30 DAS and \(N_2P_2\) (250 kg N + 60 kg P\(_2\)O\(_5\) ha\(^{-1}\)) at 90 DAS. The increase in plant height in the presence of adequate nutrients might be due to rapid cell division and cell elongation which might have stimulated the growth. Significant interaction between nitrogen and phosphorus levels with respect to plant height was in conformity with the works of Baffoe (2014).

**Leaf Area Index**

Significantly higher LAI was recorded with the application of 300 kg N ha\(^{-1}\) (\(N_3\)) followed by 250 kg N ha\(^{-1}\) (\(N_2\)), whereas the lowest LAI was obtained with 200 kg N ha\(^{-1}\) (\(N_1\)) (Table 2). Increase in LAI with application of nitrogen at higher levels might be due to adequate dose and timely application which could have facilitated luxurious uptake of nitrogen, triggering the foliage emergence. The positive effect of nitrogen on LAI in terms of more leaf elongation and less leaf senescence leading to production of larger leaves and improved photosynthetic capacity of the plants was also quoted by Nsanzabaganwa et al., (2014) and Thimmappa et al., (2014).

With regard to phosphorus, application of 60 kg ha\(^{-1}\) (\(P_2\)) resulted in higher LAI, which was comparable to 80 kg ha\(^{-1}\) (\(P_3\)) and was significantly superior to 40 kg ha\(^{-1}\) (\(P_1\)). This was due to availability of adequate phosphorus at higher levels of application which encouraged leaf expansion and growth. Similar observations were also recorded by Gemechu (2011) and Araei and Mojaddam (2014). The interaction was not significant with respect to LAI during both the years of study.

| Treatments                          | Plant height (cm) of maize at different growth stages during kharif season |
|------------------------------------|--------------------------------------------------------------------------------|
|                                    | Plant height                                                                 |
|                                    | 30 DAS | 60 DAS | 90 DAS | At Harvest |
| Nitrogen levels (kg N ha\(^{-1}\)) |         |         |         |            |
| \(N_1\)                            | 106.2  | 94.5   | 268.8  | 257.6      | 276.2 | 269.2 | 276.8 | 269.4 |
| \(N_2\)                            | 111.8  | 96.4   | 269.9  | 260.9      | 277.7 | 272.0 | 277.8 | 272.4 |
| \(N_3\)                            | 117.9  | 99.1   | 274.1  | 261.2      | 281.6 | 271.7 | 281.6 | 273.5 |
| SEm±                               | 1.10   | 1.56   | 2.16   | 2.83       | 1.69  | 3.71  | 2.34  | 4.21  |
| CD (P = 0.05)                      | 3.30   | NS     | NS     | NS         | 5.1   | NS    | NS    | NS    |
| Phosphorus levels (kg P\(_2\)O\(_5\) ha\(^{-1}\)) |         |         |         |            |
| \(P_1\)                            | 108.6  | 95.8   | 270.4  | 257.6      | 273.6 | 271.7 | 276.0 | 271.9 |
| \(P_2\)                            | 115.9  | 97.3   | 271.6  | 263.2      | 279.7 | 268.4 | 279.9 | 269.9 |
| \(P_3\)                            | 111.4  | 96.9   | 270.5  | 259.0      | 279.0 | 272.9 | 279.4 | 274.6 |
| SEm±                               | 1.10   | 1.56   | 2.16   | 2.83       | 1.69  | 3.71  | 2.34  | 4.21  |
| CD (P = 0.05)                      | 3.30   | NS     | NS     | NS         | 5.1   | NS    | NS    | NS    |
| Interaction                         |        |         |         |            |
| SEm±                               | 1.91   | 2.70   | 3.73   | 4.91       | 2.94  | 6.43  | 4.05  | 7.30  |
| CD (P = 0.05)                      | 5.72   | NS     | NS     | NS         | 8.8   | NS    | NS    | NS    |
Interaction between N and P levels on plant height of maize at 30 DAS during 2014

|       | P1  | P2  | P3  | Mean |
|-------|-----|-----|-----|------|
| N1    | 105.7 | 108.4 | 104.3 | 106.2 |
| N2    | 110.5 | 118.5 | 106.4 | 111.8 |
| N3    | 109.5 | 120.9 | 123.3 | 117.9 |
| Mean  | 108.6 | 115.9 | 111.4 |       |

Interaction between N and P levels on plant height of maize at 90 DAS during 2014

|       | P1  | P2  | P3  | Mean |
|-------|-----|-----|-----|------|
| N1    | 269.9 | 279.8 | 278.8 | 276.2 |
| N2    | 273.9 | 283.1 | 277.2 | 277.7 |
| N3    | 280.9 | 282.8 | 281.1 | 281.6 |
| Mean  | 274.9 | 281.9 | 279.0 |       |

Table.2 Leaf area index of maize at different growth stages during kharif season

| Treatments | Leaf area index |   |   |   |   |   |   |
|------------|----------------|---|---|---|---|---|---|
|            | 30 DAS         | 60 DAS | 90 DAS | At Harvest |
|            | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 | 2014 | 2015 |
| Nitrogen levels (kg N ha⁻¹) |       |       |       |       |       |       |       |
| N1         | 2.26 | 1.38 | 4.26 | 4.33 | 4.27 | 4.36 | 4.26 | 3.12 |
| N2         | 2.36 | 1.63 | 4.65 | 4.42 | 4.75 | 4.65 | 4.64 | 3.22 |
| N3         | 2.47 | 1.89 | 4.80 | 4.45 | 5.08 | 4.75 | 5.03 | 3.24 |
| SEm±       | 0.08 | 0.24 | 0.234 | 0.212 | 0.205 | 0.119 | 0.195 | 0.127 |
| CD (P = 0.05%) | NS | NS | NS | NS | 0.51 | 0.35 | 0.58 | NS |
| Phosphorus levels (kg P₂O₅ ha⁻¹) |       |       |       |       |       |       |       |
| P1         | 2.31 | 1.59 | 4.01 | 4.05 | 4.10 | 4.32 | 4.02 | 3.16 |
| P2         | 2.42 | 1.68 | 4.56 | 4.46 | 4.76 | 4.49 | 4.70 | 3.20 |
| P3         | 2.36 | 1.62 | 4.34 | 4.16 | 4.69 | 4.36 | 4.64 | 3.24 |
| SEm±       | 0.08 | 0.24 | 0.234 | 0.212 | 0.205 | 0.119 | 0.195 | 0.127 |
| CD (P = 0.05%) | NS | NS | NS | NS | 0.61 | NS | 0.58 | NS |

Interaction

| SEm± |       |       |       |       |       |       |       |       |
|------|-------|-------|-------|-------|-------|-------|-------|-------|
| CD (P = 0.05%) | NS | NS | NS | NS | NS | NS | NS | NS |
Table 3 Dry matter production (kg ha\(^{-1}\)) of maize at different growth stages during \textit{kharif} season

| Treatments | Dry matter production (kg ha\(^{-1}\)) | 30 DAS | 60 DAS | 90 DAS | At Harvest |
|------------|---------------------------------------|--------|--------|--------|------------|
|            |                                       | 2014   | 2015   | 2014   | 2015       | 2014 | 2015 |
| Nitrogen levels (kg N ha\(^{-1}\)) |            |        |        |        |            |
| N\(_1\)      | 942       | 725    | 7823   | 6507   | 13882      | 16026| 15093| 21139|
| N\(_2\)      | 1002      | 751    | 8756   | 7959   | 14793      | 16555| 16320| 21306|
| N\(_3\)      | 1164      | 902    | 9392   | 8387   | 15508      | 17361| 17521| 22330|
| SEm±         | 50.6      | 58.2   | 296.3  | 209.9  | 382.8      | 411.7| 375.7| 363.2|
| CD (P = 0.05\%) | 152      | 175    | 888    | 629    | 1148       | 1235 | 1127 | 1082 |
| Phosphorus levels (kg P\(_2\)O\(_5\) ha\(^{-1}\)) |            |        |        |        |            |
| P\(_1\)      | 1019      | 805    | 7944   | 7715   | 14762      | 16255| 15859| 21659|
| P\(_2\)      | 1105      | 889    | 8712   | 7994   | 14958      | 16445| 16958| 22701|
| P\(_3\)      | 1061      | 837    | 8438   | 7744   | 15950      | 16325| 17103| 22116|
| SEm±         | 50.6      | 58.2   | 296.3  | 209.9  | 382.8      | 411.7| 375.7| 334.3|
| CD (P = 0.05\%) | NS      | NS    | NS    | NS    | 1148       | 1235 | 1127 | NS |
| Interaction  |            |        |        |        |            |
| SEm±         | 87.7      | 102.5  | 513.3  | 363.6  | 663.1      | 713.0 | 650.7 | 1445.0 |
| CD (P = 0.05\%) | NS      | NS    | NS    | NS    | NS         | NS    | 1952 | NS |

Interaction between N and P levels on dry matter production of maize during 2014

| Treatments | P\(_1\) | P\(_2\) | P\(_3\) | Mean |
|------------|--------|--------|--------|------|
| N\(_1\)  | 13236  | 16173  | 14968  | 14793|
| N\(_2\)  | 14163  | 16172  | 17725  | 16020|
| N\(_3\)  | 17178  | 18528  | 15957  | 17221|
| Mean     | 14859  | 16958  | 16217  |      |

Table 4 Grain and stover yield of maize as influenced by nitrogen and phosphorus levels during \textit{kharif} season

| Treatments | Grain yield (kg ha\(^{-1}\)) | Stover yield (kg ha\(^{-1}\)) |
|------------|-----------------------------|-------------------------------|
|            | 2014 | 2015 | 2014 | 2015 | 2015 | 2015 |
| Nitrogen levels (kg N ha\(^{-1}\)) |            |        |        |        |        |        |
| N\(_1\)      | 6885 | 8170 | 7997 | 10951|      |      |
| N\(_2\)      | 7832 | 9116 | 8961 | 12186|      |      |
| N\(_3\)      | 8231 | 9146 | 9277 | 12517|      |      |
| SEm±         | 124.4| 125.5| 252.9| 402.3|      |      |
| CD (P = 0.05\%) | 373 | 376 | 758 | 1206|      |      |
| Phosphorus levels (kg P\(_2\)O\(_5\) ha\(^{-1}\)) |            |        |        |        |        |        |
| P\(_1\)      | 7271 | 8714 | 8491 | 12003|      |      |
| P\(_2\)      | 7983 | 8936 | 9387 | 13240|      |      |
| P\(_3\)      | 7693 | 8781 | 8357 | 11844|      |      |
| SEm±         | 124.4| 125.5| 252.9| 402.3|      |      |
| CD (P = 0.05\%) | 373 | NS | 758 | 1206|      |      |
| Interaction  |            |        |        |        |        |        |
| SEm±         | 215.4| 217.3| 438.0| 696.8|      |      |
| CD (P = 0.05\%) | NS | 651 | NS | NS |      |      |
Interaction between N and P levels on grain yield of maize during 2015

|       | P_1  | P_2  | P_3  | Mean |
|-------|------|------|------|------|
| N_1   | 8071 | 8319 | 8120 | 8170 |
| N_2   | 8986 | 9307 | 9055 | 9116 |
| N_3   | 9087 | 9183 | 9169 | 9146 |
| Mean  | 8714 | 8936 | 8781 |

**Dry matter production**

Among the nitrogen levels tried, 300 kg (N_3) and 250 kg ha\(^{-1}\) (N_2) produced significantly higher dry matter accumulation than that of 200 kg ha\(^{-1}\) (N_1) (Table. 3). This indicated the positive effect of nitrogen in boosting the crop growth. Shivay and Singh (2000) observed that application of nitrogen increased plant height by increasing leaf size resulting in more and larger photosynthetic apparatus consequently influencing dry matter production. LAI and leaf greenness determine the capture and use of solar radiation by maize plant, there by affecting the conversion rate of available radiation to dry matter accumulation. These findings are in conformity with the results of Nsanzabaganwa et al., (2014) and Om et al., (2014).

Application of phosphorus at 60 kg ha\(^{-1}\) (P_2) resulted in higher dry matter, which was comparable to 80 kg ha\(^{-1}\) (P_3) and significantly superior to 40 kg ha\(^{-1}\) (P_1). It seems the reason is increase in leaf area, photosynthesis improvement resulting in higher dry matter. Araei and Mojaddam (2014) also recorded the highest dry weight and leaf area of maize by applying 60 kg P ha\(^{-1}\) over 0 and 90 kg P\_2O\_5 ha\(^{-1}\).

Interaction existed at the harvest stage of maize crop and the dry matter accumulation increased significantly by enhancing the fertility level up to N_3P_2 (300 kg N + 60 kg P\_2O\_5 ha\(^{-1}\)), however this was significantly superior over N_3P_3 (300 kg N + 80 kg P\_2O\_5 ha\(^{-1}\)). Higher LAI paved the way for higher dry matter production. Similar observations were recorded by Gul et al., (2015) and Massey and Gaur (2016).

**Yield**

During the first year, application of 300 kg N ha\(^{-1}\) (N_3) resulted in higher grain yield, which was statistically superior to that of 250 kg (N_2) and 200 kg N ha\(^{-1}\) (N_1). The lowest grain yield was associated with 200 kg N ha\(^{-1}\) (N_1). During the second year nitrogen applied at 300 kg ha\(^{-1}\) (N_3) resulted in highest grain yield, which was statistically on par with that of 250 kg N ha\(^{-1}\) (N_2). The lowest grain yield was associated with 200 kg N ha\(^{-1}\) (N_1) (Table. 4). This might be due to favourable effect at higher nitrogen level leading to better crop growth and increase in yield attributes which was reflected in kernel yield of maize.

In physiological terms, the grain yield of maize was largely governed by source and sink relationships as it is directly related to nitrogen. These results are in accordance with the findings of Nsanzabaganwa et al., (2014), Om et al., (2014) and Thimmappa et al., (2014).

Maize supplied with 60 kg P\_2O\_5 ha\(^{-1}\) (P_2) resulted in higher grain yield, which was however statistically on par with 80 kg P\_2O\_5 ha\(^{-1}\) (P_3). Significantly lowest grain yield was obtained with 40 kg P\_2O\_5 ha\(^{-1}\) (P_1) in the first year. Similar trend was observed during the second year but all the three phosphorus levels recorded statistically on par values of grain yield.
Grain yield of maize increased significantly up to 60 kg P$_2$O$_5$ ha$^{-1}$. Further increase in P from 60 to 80 kg P$_2$O$_5$ ha$^{-1}$, failed to record statistical significance. Increase in grain yield up to certain level of phosphorus was directly related to the vegetative and reproductive growth phases of the crop and attributes to complex phenomenon of phosphorus utilization in plant metabolism. Similar results were obtained by Araei and Mojaddam (2014) and Nsanzabaganwa et al. (2014).

Highest grain yield of maize was recorded with N$_2$P$_2$ (250 kg N + 60 kg P$_2$O$_5$ ha$^{-1}$) which was statistically superior over lower levels of N and P, while on par with the higher levels. The balanced nitrogen and phosphorus levels might have helped in efficient absorption and utilization of other required plant nutrients which ultimately increased the grain yield. Similar results were obtained by Jaliya et al., (2008) and Abera et al., (2009).

Stover yield of maize increased significantly with increase in nitrogen levels from 200 to 300 kg N ha$^{-1}$. Increased stover yield with increase in nitrogen level could be attributed to adequate nutrient supply, which in turn improved growth parameters like plant height, leaf area index and dry matter production which resulted in higher stover yield. These results are agreement with the findings of Om et al., (2014).

Stover yield of maize increased significantly up to 60 kg P$_2$O$_5$ ha$^{-1}$. Further increase in P from 60 to 80 kg P$_2$O$_5$ ha$^{-1}$, decreased the stover yield. Higher straw yield at medium phosphorus level could be attributed to adequate and balanced nutrient supply over higher and lower levels. Similar results were obtained by Araei and Mojaddam (2014) and Nsanzabaganwa et al., (2014).

Combination of 250 kg N and 60 kg P$_2$O$_5$ ha$^{-1}$ was found to be advantageous in getting the higher values of growth parameters and the yield of maize during kharif season.

References

Abera, T., Feyisa, D and Friesen, D. K. 2009. Effects of Crop Rotation and N-P Fertilizer Rate on Grain Yield and Related Characteristics of Maize and Soil Fertility at Bako, Western Oromia, Ethiopia. *East African Journal of Sciences*. 3 (1): 70-79.

Araei, M and Mojaddam, M. 2014. The effect of different levels of phosphorus from triple super phosphate chemical fertilizers and biological phosphate fertilizer (fertile 2) on physiological growth parameters of corn (sc704) in Ahvaz weather conditions. *International Journal of Plant, Animal and Environmental Sciences*. 4: 625-632.

Ayoola, O. T. and Adeniyan, O. N. 2006. Influence of poultry manure on yield and yield components of crops under different cropping systems in South west Nigeria. *African Journal of Biotechnology*. 5:1386-1392.

Baffoe, M. J. N. 2014. Effect of different rates of nitrogen and phosphorus fertilizer on maize grain protein content. M.Sc. thesis submitted to the University of Ghana Legon, Accra, Ghana.

Dawadi, D. R and Sah, S. K. 2012. Growth and yield of hybrid maize (*Zea mays* L.) in relation to planting density and nitrogen levels during winter season in Nepal. *Tropical Agricultural Research*. 23 (3): 218-227.

FAO. (2007). Food and Agriculture Organisation yearbook Volume 60.

Gemechu, G. A. 2011. Influence of nitrogen and phosphorus fertilizers on seed yield and quality of maize (*Zea mays* L.) at Bedele, South-Western Ethiopia. M. Sc thesis submitted to the Department of Plant Sciences, School of Graduate
Studies, Haramaya University, Ethiopia.

Gul, S., Khan, M. H., Khanday, B. A and Sabeena Nabi. 2015. Effect of sowing methods and NPK levels on growth and yield of rainfed maize (Zea mays L.) Hindawi Publishing Corporation, Scientifica. 1-6.

Jaliya, A. M., Falaki, A. M., Mahmud, M Sani, Y. A. 2008. Effects of sowing date and NPK fertilizer rate on yield and yield components of quality protein maize (Zea mays L.). Journal of Agriculture and Biological Sciences. 2:23-29.

Massey, J. X and Gaur, B. L. 2006. Effect of plant population and fertility levels on growth and NPK uptake by sweet corn (Zea mays L.) cultivars. Annals of Agricultural Research (New series). 27 (4): 365-368.

Nsanzabaganwa, E., Das, T. K and Rana, D. S. 2014. Nitrogen and phosphorus effects on the growth, phenology, heat and nutrients accumulation and yield of winter maize (Zea mays) in Western Indo-Gangetic Plains. Indian Journal of Agricultural Sciences. 84 (5): 661-664.

Om, H., Singh, S. P., Singh, J. K., Singh, R. N., Ansari, M. A., Meena, R. L and Yadav, B. 2014. Productivity, nitrogen balance and economics of winter maize (Zea mays) as influenced by QPM cultivars and nitrogen levels. Indian Journal of Agricultural Sciences. 84 (2): 306-308.

Saeed, I. M., Abbasi, R and Kazim, M. 2001. Response of maize (Zea mays) to nitrogen and phosphorus fertilization under agro-climatic condition of Rawalokol, Jammu and Kaslim and Kashmir. Pakistan Journal of Biological Sciences. 4: 949-952.

Shivay, Y. S and Singh, R. P. 2000. Growth, yield attributes, yield and nutrient uptake of maize (Zea mays L.) as influenced by cropping systems and nitrogen levels. Annals of Agricultural Research. 21 (4): 494-498.

Sridhar, M. K. C and Adeoye, G. O. 2003. Organo-mineral fertilizer from urban wastes. The Field. 68:91-111.

Thimmappa, V., Reddy, M. S., Reddy, U. V. B and Reddy, S. T. 2014. Effect of nitrogen levels and plant densities on growth parameters, yield attributes and yield of kharif maize (Zea mays L.). Crop Research. 47 (1, 2 & 3): 29-32.

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