***Original Research Article***

**Maize Growth, Yield, and Economic Returns as Influenced by Phosphorus and Defoliants in a Pigeonpea-Maize Cropping System under rainfed conditions in Telangana, India**

# Abstract:

This study aims to evaluate the effects of residual phosphorus and defoliant applications on the growth, yield, and economic aspects of maize cultivation in pigeon pea-maize cropping systems under rainfed conditions in Telangana. Phosphorus plays a fundamental role in plant growth and metabolism, influencing photosynthesis, root development, energy transfer, carbon assimilation, enzyme activity, signalling, and nucleic acid synthesis. It is critical for sustaining soil fertility, particularly in intensive agricultural systems, yet remains one of the least accessible nutrients in the soil. The field experiment was conducted at College Farm, PJTAU, Hyderabad, India during 2016-17 and 2017-18. The application of 20:75:0 N: P2O5:K₂O kg ha-1 + Defoliant (T7) resulted in the highest growth, yield, and economic returns, followed by 20:50:0 N: P2O5:K₂O kg ha-1 + Defoliant (T6), with significant differences from other treatments. T7 recorded the highest plant height (197.25, 198.59, and 202.82 cm in 2016-17; 198.09, 200.64, and 204.15 cm in 2017-18 at 60, 90 DAS, and harvest) and the highest leaf area index (0.54, 4.93, 4.53, and 2.11 in 2016-17; 0.53, 5.26, 4.73, and 2.30 in 2017-18 at 30, 60, 90 DAS, and harvest). The highest grain yield (7329 and 7498 kg ha⁻¹) and stover yield (10,260 and 10,782 kg ha⁻¹) were obtained with T7 in both years. The economic analysis confirmed T7 as the most profitable, with the highest gross margins, net returns, and benefit-cost ratio, while T6 followed as the next best treatment, demonstrating significant agronomic and economic benefits in the pigeon pea-maize cropping system.

**Keywords:** Maize Growth, Residual Phosphorus, Defoliant, Cropping System, Economics

**Introduction**

Maize (Zea mays L.) is a globally vital cereal crop, serving as both a staple food and a key feed source in many developing countries. It ranks third after rice and wheat in global food consumption, contributing 9% to India’s food basket and 5% to the world’s dietary energy supply, making it integral to food security. Due to its remarkable yield potential, maize is often called the “Miracle Crop” and the “Queen of Cereals.” Its adaptability allows it to thrive in diverse cropping systems, supporting human nutrition and livestock production, particularly in the poultry industry (Nooli, 2001). Additionally, maize has extensive industrial applications, including starch, oil, baby corn, popcorn, dairy and piggery feed, pharmaceuticals, cosmetics, and biofuels, with significant export potential fueling global demand (Revanth Nathan et al. 2024). India, the world’s fifth-largest maize producer, accounts for 3% of global production, cultivating 10.74 million hectares and producing 38.09 million tons, with an average productivity of 3.55 t ha-1 (<https://upag.gov.in/>).

Phosphorus plays a fundamental role in plant growth and metabolism, influencing photosynthesis, root development, energy transfer, carbon assimilation, enzyme activity, signalling, and nucleic acid synthesis (Vance et al., 2003; Tiwari et al. 2004). It is critical for sustaining soil fertility, particularly in intensive agricultural systems, yet remains one of the least accessible nutrients in the soil (Freiling et al. 2022). Phosphorus is an essential factor for cell division because it is a constituent element of nucleoproteins which are involved in the cell reproduction processes (Ojha et al. 2023). Among the various inputs, Phosphorus is considered the costly and key input for root growth. Phosphorus is one of the most limiting nutrients in agricultural cropping systems (Ramesh et al. 2023). In India, where cereal-cereal cropping systems dominate, the indiscriminate use of fertilizers, excessive irrigation, and heavy tillage have led to soil nutrient imbalances (Yadav et al., 1998). The adoption of short-duration pigeonpea varieties has enabled multiple cropping in both irrigated and rainfed conditions. The performance of succeeding crops is significantly influenced by the preceding crops and their inputs, underscoring the importance of legume-based cropping systems for sustainable agricultural productivity. The objective of this study is to evaluate the effects of residual phosphorus and defoliant applications on the growth, yield, and economic aspects of maize cultivation in pigeon pea-maize cropping systems under rainfed conditions in Telangana.

**Materials and Methods**

A comprehensive field experiment was undertaken at the College Farm, College of Agriculture, Rajendranagar, Hyderabad, Southern Telangana, India, to assess the production potential of the pigeon pea-maize cropping system. This study, spanning the *kharif* and *rabi* seasons of 2016-17 and 2017-18, investigated the influence of applied and residual phosphorus, coupled with defoliant application, on crop performance. The experimental site comprised sandy clay loam soil with a pH of 7.6, an electrical conductivity of 0.60 dS m-1, low organic carbon content (0.53%), deficient available nitrogen (238.74 kg ha-1), moderate phosphorus availability (64.06 kg ha-1), and a high potassium content (388.6 kg ha-1).

For *Kharif* pigeonpea (2016 and 2017), a Randomized Block Design (RBD**)** was employed, encompassing seven distinct treatments incorporating varying phosphorus levels and defoliant applications:

* **T1:** Control (0 NPK)
* **T2:** Recommended Dose of Fertilizers (RDF) - 20:50:0 N:P2O5:K2O kg ha-1
* **T3:** 20:25:0 N:P2O5:K₂O kg ha-1
* **T4:** 20:75:0 N:P2O5:K₂O kg ha-1
* **T5:** 20:25:0 N:P2O5:K₂O kg ha-1 + Defoliant
* **T6:** 20:50:0 N:P2O5:K₂O kg ha-1 + Defoliant
* **T7:** 20:75:0 N:P2O5:K₂O kg ha-1 + Defoliant

In the subsequent *rabi* season, a split-plot design was implemented, wherein the residual phosphorus treatments from the preceding *kharif* pigeon pea crop constituted the main plots. Each main plot was further stratified into three sub-treatments, representing 50%, 75%, and 100% ofthe Recommended Dose of Phosphorus (RDP), with three replications allocated for maize cultivation during *rabi* 2016-17 and 2017-18.

**Data Collection and Parameters**

The study meticulously recorded various growth and yield parameters for maize, as detailed below:

* **Plant Height (cm):** The height of ten designated plants per plot was systematically recorded at 30, 60, and 90 days after sowing (DAS), as well as at harvest. Measurements were taken from the soil surface to the apex of the plant, and the average height per plant was computed.
* **Leaf Area Index (LAI):** The leaf area was assessed for two randomly selected plants per plot at 30, 60, and 90 DAS, and at harvest, utilizing a digital leaf area meter **(LI-3100)**.
* The LAI was subsequently derived using the formula proposed by Watson (1952):

LAI= Leaf Area​ / Unit Ground Area

* **Grain Yield (kg ha-1):** The grain yield from each net plot was meticulously sun-dried, weighed, and expressed in kg ha-1.
* **Straw Yield (kg ha-1):** Analogous to grain yield estimation, straw from each net plot was sun-dried, weighed, and documented accordingly.
* **Gross Monetary Returns (₹ ha-1):** The gross returns were calculated by multiplying the recorded grain and stover yields by their respective prevailing market prices, as per the methodology outlined by Perin et al. (1979).
* **Net Returns (₹ ha-1):** The net returns for each treatment were determined by deducting the total cost of cultivation from the computed gross returns.
* **Benefit-Cost Ratio (B:C Ratio):** The B: C ratio was obtained by dividing the gross returns by the corresponding cost of cultivation for each treatment.

**Statistical Analysis**

The recorded data were subjected to rigorous statistical analysis using analysis of variance (ANOVA) for both pigeonpea and maize. The treatment effects in the pigeonpea experiment were evaluated following a randomized block design, wherein the significance of variations among treatments was ascertained via the F-test. Whenever significant differences were detected, critical differences (CD) at a 5% probability level were computed, and mean comparisons were conducted accordingly.

### ****Results and Discussion****

#### ****1. Growth Parameters****

**Plant Height (cm)**

The data presented in **Table 1–4** indicate that maize plant height was significantly influenced by residual phosphorus treatments, while the direct application of phosphorus to maize also exhibited a substantial impact across all treatments during both years of study. The application of **20:75:0** N: P2O5:K2O kg ha-1 **+ Defoliant (T7)** resulted in the highest maize plant height across both **2016-17 and 2017-18**, with recorded values of **197.25 cm, 198.59 cm, and 202.82 cm** in **2016-17**, and **198.09 cm, 200.64 cm, and 204.15 cm** in **2017-18** at **60 DAS, 90 DAS, and harvest**, respectively. This treatment exhibited a statistically significant difference from other treatments, although it remained comparable to **20:50:0** N: P2O5:K2O kg ha-1 **+ Defoliant (T6),** which recorded heights of **195.03 cm, 197.85 cm, and 202.05 cm (2016-17)** and **195.26 cm, 199.86 cm, and 203.28 cm (2017-18)** at the same growth stages.

The enhanced plant height observed under these treatments may be attributed to the incorporation of **legume crop residues**, which facilitated nitrogen accumulation in maize stover. The gradual decomposition of these residues likely contributed to a sustained nitrogen release, promoting steady growth in the succeeding maize crop. Additionally, the superior performance of pigeonpea residues could be linked to increased biomass production and enhanced nitrogen uptake. These findings align with the reports of **Tesfa et al. (2001), Radhakumari and Srinivasulu Reddy (2009), and Shankar et al. (2012).**

Across both years, phosphorus fertilization levels also exhibited a significant effect on maize plant height. The **100% Recommended Dose of Phosphorus (RDP) (S3)** resulted in the tallest plants, recording **192.82 cm, 194.98 cm, and 199.21 cm (2016-17)** and **193.36 cm, 197.03 cm, and 200.50 cm (2017-18)** at **60 DAS, 90 DAS, and harvest**, respectively. This treatment significantly outperformed both **75% RDP (S2)** and **50% RDP (S1).** The improved plant height with higher phosphorus application can be attributed to the critical role of phosphorus in **cell division and elongation,** leading to an accelerated stem elongation rate and overall plant growth. These results corroborate the findings of **Patel et al. (2000).**

### ****Leaf Area Index (LAI)****

The data presented in **Table 5-8** indicate that the **Leaf Area Index (LAI)** of maize was significantly influenced by residual phosphorus treatments, while the direct phosphorus application to maize also exerted a considerable impact across treatments in both years of study. The highest LAI has recorded under **20:75:0** N:P2O5:K2O kg ha-1 **+ Defoliant (T7)**, with values of **0.54, 4.93, 4.53, and 2.11 (2016-17)** and **0.53, 5.26, 4.73, and 2.30 (2017-18)** at **30,60 90 DAS, and at harvest,** respectively. This treatment exhibited a statistically significant difference from most other treatments, although it remained comparable to **20:50:0** N:P2O5:K2O kg ha-1 **+ Defoliant (T6)**, which recorded **0.49, 4.91, 4.45, and 1.96 (2016-17)** and **0.51, 5.21, 4.57, and 2.22 (2017-18)** at the same growth intervals.

Among fertilizer treatments, the highest LAI was observed with a **100% Recommended Dose of Phosphorus (RDP) (S3)**, recording **0.47, 4.84, 4.33, and 1.92 (2016-17)** and **0.48, 5.02, 4.49, and 2.17 (2017-18)** at **30, 60, 90 DAS, and at harvest**, respectively. This was significantly superior to **75% RDP (S2)** and **50% RDP (S1).**

The enhanced LAI observed in treatments with higher phosphorus application can be attributed to **improved leaf expansion, accelerated cell division, and increased cell enlargement**, which collectively promoted vigorous vegetative growth. The superior phosphorus availability in the soil, coupled with enhanced nutrient uptake and translocation within the plant system, played a crucial role in stimulating these physiological processes. The increase in morphological parameters, such as **plant height and LAI**, facilitated the greater **interception of solar radiation,** optimizing its conversion into chemical energy (carbohydrates) and ultimately resulting in **higher biomass accumulation**. These findings align closely with the observations of **Arya and Singh (2001).**

### ****Grain Yield (kg**** ha-1****)****

The data on maize grain yield (Table 9 and Fig. 1) under various treatments indicate a **significant impact of residual phosphorus application and fertilizer levels** on yield throughout the study period (2016–17 and 2017–18). Both residual treatments and direct phosphorus application substantially enhanced grain yield. The highest grain yield was recorded with **20:75:0** N: P2O5:K2O kg ha-1 **+ Defoliant (T7)**, achieving **7329 kg** ha-1 **(2016–17) and 7498 kg** ha-1 **(2017–18)**, followed closely by **20:50:0** N: P2O5:K2O kg ha-1 **+ Defoliant (T6)**, with yields of **6956 kg** ha-1 **and 7116 kg** ha-1, respectively. These treatments exhibited **significant superiority over the other residual treatments** from the preceding pigeon pea crop.

The enhanced grain yield can be attributed to **improved nutrient solubilization and availability** resulting from residue incorporation, facilitating better nutrient uptake and enhanced yield attributes. The decomposition and mineralization of crop residues likely synchronized with the early growth stages of maize, ensuring a **steady and sustained nitrogen supply** throughout the crop’s developmental phases. These findings align with previous studies by **Bhal and Pasricha (2000) and Arif et al. (2011).**

Among fertilizer levels, the highest yield was observed with **100% Recommended Dose of Phosphorus (RDP) (S3)**, registering **6715 kg** ha-1 **(2016–17) and 6995 kg** ha-1 **(2017–18)**, which was **significantly superior** to both **75% RDP (S2) and 50% RDP (S1)**. The increase in yield attributes under higher phosphorus application appears to be **a result of improved plant height, LAI, and total biomass accumulation**, which enabled plants to maximize their genetic potential for grain production. Adequate phosphorus availability ensured optimal **metabolite synthesis and photosynthate allocation**, thereby enhancing yield formation. These results corroborate the findings of **Manimaran and Poonkodi (2009), Arya and Singh (2001), and Nair (2000)**.

### ****Interaction Effects of Residual Treatments and Fertilizer Levels****

The combination of **T7S3 (20:75:0** N: P2O5:K2O kg ha-1 **+ Defoliant with 100% RDP)** recorded the highest grain yield, reaching **8730 kg** ha-1 **(2016–17) and 8932 kg** ha-1 **(2017–18)**, which was significantly superior to other treatment combinations but statistically at par with **T6S3 (8059 kg** ha-1 **and 8244 kg** ha-1**, respectively).**

The superior maize yield under these treatments can be attributed to **improved soil physical properties, enhanced soil fertility, and effective moisture conservation** resulting from residue incorporation. The application of crop residues as mulch likely reduced **evaporation losses**, contributing to improved soil moisture retention, while also mitigating **nutrient losses—particularly nitrogen volatilization**—thereby enhancing nitrogen uptake and overall productivity. These results are in accordance with findings from **Alfred (2009), Egbe and Ali (2010), Svubure et al. (2010), Talebbeigi and Ghadiri (2012), Fabunmi and Agbonlahor (2012), and Usman et al. (2013).**

### ****Stover Yield (kg**** ha-1****)****

The data on maize **stover yield** (Table 10 and Fig. 2) across different treatments revealed a **significant impact of residual phosphorus application and fertilizer levels** throughout the study period (2016–17 and 2017–18). Both residual phosphorus and direct fertilizer application significantly enhanced stover yield, demonstrating a clear advantage over other treatments.

Among the treatments, the highest stover yield was recorded with **20:75:0** N: P2O5:K2O kg ha-1 **+ Defoliant (T7)**, producing **10,260 kg** ha-1 **(2016–17) and 10,782 kg** ha-1 **(2017–18),** followed closely by **20:50:0** N: P2O5:K2O kg ha-1 **+ Defoliant (T6)**, with yields of **10,018 kg** ha-1 **and 10,571 kg** ha-1, respectively. These treatments were **significantly superior** to other residual treatments involving the preceding pigeonpea crop. The increased stover yield is attributed to **residue incorporation**, which enhances **biomass accumulation** through **symbiotic nitrogen fixation**, ultimately leading to improved crop growth and productivity. These findings are consistent with the reports of **Suryavanshi et al. (2008), Shafi et al. (2007), and Rao (2012).** The increase in stover yield can be attributed to improvements in key growth parameters, including plant height, green leaf retention, leaf area index (LAI), and dry matter accumulation. Enhanced phosphorus and potassium uptake improved photosynthetic efficiency and facilitated the efficient translocation of photosynthate**s** from source to sink, ultimately leading to a higher harvest index. These results align with findings from Manimaran and Poonkodi (2009), Arya and Singh (2001), and Kumar and Singh (2003), who also reported increased stover yield with phosphorus application.

### ****Effect of Fertilizer Levels on Stover Yield****

Phosphorus fertilization had a **significant impact** on maize stover yield, with the highest yield recorded under **100% RDP (S3)**, achieving **9786 kg** ha-1 **(2016–17) and 10,355 kg** ha-1 **(2017–18)**, which was **significantly superior** to 75% RDP (S2) and 50% RDP (S1). This highlights the **crucial role of phosphorus** in enhancing **biomass production and nutrient translocation**. Moreover, the interaction between **residual treatments and phosphorus application** exhibited **synergistic effects**, with the highest stover yield observed in **T7S3 (20:75:0** N: P2O5:K2O kg ha-1 **+ Defoliant with 100% RDP)**, producing **11,406 kg** ha-1 **(2016–17) and 11,986 kg** ha-1 **(2017–18)**. This was statistically **on par** with **T6S3 (11,304 kg** ha-1 **and 11,494 kg** ha-1**, respectively)**, both of which significantly outperformed the other treatment combinations, reaffirming the **benefits of phosphorus supplementation** and **residue incorporation** in improving maize stover yield.

**4. Economics (Rs ha-1)**

The **economic feasibility** of maize cultivation was **significantly influenced** by residual treatments and phosphorus management strategies (Table 11-13). The application of **20:75:0 N**: P2O5:K2O kg ha-1 **+ Defoliant (T7)** yielded the **highest financial returns** during both **2016–17 and 2017–18**, with **gross returns of Rs 117,271** ha-1 **and Rs 119,973** ha-1, **net returns of Rs 83,904** ha-1 **and Rs 86,605** ha-1, and a **benefit-cost ratio (B: C) of 3.51 and 3.59**, respectively. Among the fertilizer levels, **100% RDP (S3)** was the most profitable, achieving **gross returns of Rs 107,438** ha-1 **and Rs 111,915** ha-1**, net returns of Rs 73,621** ha-1 **and Rs 78,097** ha-1, and a **B:C ratio of 3.18 and 3.31** during both years of study. The **higher net returns and B:C ratios** under T7 and S3 can be attributed to the **lower cost of cultivation** and **higher yield potential**. These findings align with previous research by **Dasaraddi (2002), Sharma and Behera (2009), and Patel et al. (2000)**, further reinforcing the economic benefits of optimized phosphorus fertilization and residue management in maize cultivation.

### ****Conclusion****

The application of **20:75:0** N:P2O5:K2O kg ha-1 **+ Defoliant (T7)** resulted in the **highest plant height and leaf area index (LAI) at 30, 60, and 90 days after sowing (DAS) and at harvest** during both **2016–17 and 2017–18**. This treatment also produced the **highest grain and stover yield**, followed by **20:50:0** N:P2O5:K2O kg ha-1 **+ Defoliant (T6)** within the **pigeon pea–maize cropping system**. Among phosphorus levels, **100% RDP (S3)** exhibited the **greatest plant height, LAI, and yield parameters**, consistently outperforming **75% RDP (S2) and 50% RDP (S1)** across both study years. A **positive interaction effect** between residual treatments and fertilizer levels was observed, with **T7S3 recording the highest grain and stover yield**, statistically on par with **T6S3**. Furthermore, the **greatest net income, gross income, and benefit-cost (B: C) ratio** were also associated with these treatments, underscoring their agronomic and economic superiority.

**Suggestions for Future Research**

Future studies should investigate the long-term effects of phosphorus application and defoliant use on soil health and subsequent crops. Additional research is needed to validate these findings across diverse agro-climatic regions and cropping systems.

**REFERENCE:**

Alfred, A. 2009. Effect of decomposing crop residues on soil properties and crop productivity in the semi-deciduous forest zone of Ghana. Ph.D Thesis. College of Agriculture and Natural Resources, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

Arif, Md., Tariqjan, Md., Jamal Khan, Md., Saeed, Md., Iqbal, M., Ziauddin, Akbar, H., Shahensha and Zafarulla Khan Md. 2011. Effect of cropping system and residue management on maize. *Pakistan Journal of Botany.* 43(2): 915-920.

Arya, K.C and Singh, S.N. 2001. Productivity of maize (*Zea mays* L.) as influenced by different levels of phosphorus, zinc and irrigation. *Indian Journal of Agricultural Sciences.* 71: 57-59.

Bhal, G.S and Pasricha, N.S. 2000. N-utilization by maize (*Zea mays* L.) as influenced by crop rotation and field pea (*Pisum sativum* L.) residue management. *Soil Use and Management*. 16: 230-231.

Dasaraddi, S.V., Hiremath, S.M and Patil, R.H. 2002. Performance of legumes as inter crops in maize. *Journal of Research*. 14(2): 241-244.

Egbe, O.M and Ali, A. 2010. Influence of soil incorporation of food legume stover on yield of maize in sandy soils of Moist savanna Woodland of Nigeria. *Agriculture and Biology Journal of North America.* 1(2): 156- 162.

Fabunmi, T.O and Abgonlahor, M.U. 2012. The economics of maize production under different cowpea-based green manure practices in the derived savanna zone of Nigeria. *Journal of Organic Systems*. 7(2): 5-13.

Kumar, M and Singh, M. 2003. Effect of nitrogen and phosphorus levels on yield and nutrient uptake in maize (*Zea mays* L.) under rainfed condition of Nagaland. *Crop Research*. 25(1): 46-49.

Manimaran, M and Poonkodi, P. 2009. Yield and yield attributes of maize as influenced by graded levels of phosphorus fertilization in salt affected soils. *Annals of Agricultural Research.* 30(1&2): 26-28.

Nair, A.K. 2000. Effect of farmyard manure and fertilizer levels on yield of maize (*Zea mays* L.) and succeeding rice bean (*Vigna umbellata*) crop in Sikkim. *Indian Journal of Agricultural Sciences.* 70: 239-240.

Nooli, S.S. 2001. Influence of in-situ green manuring of intercropped legumes on the performance of maize-safflower sequence cropping. *M. Sc. (Agri.) Thesis.* University of Agricultural Sciences, Dharwad.

Patel, G.J., Patel, G.N., Goyal, S.N and Patel, B.G. 2000. Effect of Phosphorus on the growth and yield of hybrid maize (*Zea mays* L.) *Gujarat Agri. Univ. Research Journal*. 26(1): 59-60.

Perin, R. K., Donald, L.W., Edwards, R.M and Jack, R. A. 1979. From Agronomic data farmer recommendations. In: An economic training manual, CIMMYT Information Bulletin. 27: 15-33.

Radha Kumari, C and Srinivasulu Reddy, D. 2009. Productivity of summer groundnut (*Arachis hypogea* L.) as influenced by cumulative residual effect of crop residue incorporation and nitrogen management. *Journal of Oil seeds Research.* 26(2): 114-118.

Rao, P.V. 2012. Effect of plant density and NP rates on productivity of rice-fallow maize under zero-tillage conditions. *Ph. D Thesis*, Acharya N.G. Ranga Agricultural University, India.

Shafi, Md., Jahan, B., Tariq jan Md and Shah, Z. 2007. Soil C and N dynamics and maize (*Zea mays* L) yield as affected by cropping systems and residue management in North- Western Pakistan. *Soil & Tillage Research*. 94: 520-529

Shankar, L.J., Shivay, Y.S., Parihar, C.M and Meena, H.N. 2012. Evaluation of summer legumes for their economic feasibility, nutrient accumulation and soil fertility. *Journal of Food Legumes*. 25(3): 240-243.

Sharma, A.R and Behera, U.K. 2009. Recycling of legume residues for nitrogen economy and higher productivity in maize (*Zea mays*)-wheat (*Triticum aestivum*) cropping system. *Nutrient Cycling in Agroecosystems*. 83: 197-201.

Suryavanshi, V. P., Chavan, B. N., Jadhav, V. T and Baig, M. I. A. 2008. Response of maize to nitrogen and phosphorus application in Vertisols. *International Journal of Tropical Agriculture*. 26 (3-4): 293-296.

Svubure, O., Mpepereki, S and Makonese, F. 2010. Sustainability of maize-based cropping systems in rural areas of Zimbabwe: An assessment of the residual soil fertility effects of grain legumes on maize (*Zea mays* L.) under field conditions. *International Journal of Engineering, Science and Technology*. 2(7): 141-148.

Talebbeigi, R.M and Ghadiri, H. 2012. Effects of cowpea living mulch on weed control and maize yield. *Journal of Biological and Environmental Sciences*. 6(17): 189-193.

Tesfa, B., Assenga, R.H., Mmbaga, T.E., Friesen, D.K., Kikafunda, J and Ransom, J.K. 2001. *Legume fallows for maize based systems in eastern Africa: Contribution of legumes to enhanced maize productivity and reduced nitrogen requirements*. Seventh Eastern and Southern Africa Regional Maize Conference. 11th -15th February, 324-329.

Tiwari, R.C., Sharma, P.K and Khadelwal, S.K. 2004. Effect of green manuring through *Sesbania* *cannabina* and *Sesbania rostrata* and nitrogen application through urea to maize (*Zea mays*) in maize wheat (*Triticum aestivum*) cropping system. *Indian Journal of Agronomy.*  49(1): 15-17.

Usman, A., Osunde, A.O and Bala, A. 2013. Nitrogen contribution of some selected legumes to a sorghum based cropping system in the Southern Guinea savanna of Nigeria. *African Journal of Agricultural Research*. 8(49): 6446-6456.

Vance, C.P., Uhde-Stone, C and Allan, D. 2003. Phosphorus acquisition and use: critical adaptations by plants for securing a non renewable resource. New Phytologist.157: 423–447.

Watson, D.J. 1952. The physiological basis of variation in yield. Advances in Agronomy. 4: 101-146.

Yadav, R., Yadav, D and Singh, R. 1998. Long term effects of inorganic fertilizer inputs on crop productivity in a rice-wheat cropping system. Nutrient Cycling in Agroecosystems. 51: 193–200.

Revanth Nathan, J. K., Vidya Sagar, G. E. C., Laxmi Narayana, P., Madhavi, A., & Narender Reddy, S. (2024). Influence of applied as well as residual phosphorus and defoliant on yield and nutrient uptake of maize under pigeonpea-maize cropping system. International Journal of Research in Agronomy, SP-7(7), 33-36.

Ojha, A. K., Dawson, J., & Rana , A. (2023). Effect of Phosphorus and Boron on Growth, Yield and Economics of Sweet Corn (Zea mays L.). International Journal of Plant & Soil Science, 35(9), 91–98. <https://doi.org/10.9734/ijpss/2023/v35i92909>

Ramesh, C., Ramana, M. V., & Sree, G. J. (2023). Influence of Levels of Phosphorus on Yield Components and Yield of Zero Till Maize in Rice-maize (Zea mays L.) Sequence. Int. J. Environ. Clim. Change, 13(12), 1366-1374.

Freiling, M., von Tucher, S., & Schmidhalter, U. (2022). Factors influencing phosphorus placement and effects on yield and yield parameters: A meta-analysis. Soil and Tillage Research, 216, 105257.

**Table 1. Plant height (cm) of maize at 30 DAS as influenced by residual effect and fertilizer levels**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2016-17 | | | |  | | 2017-18 | | | |
|  | **Sub plot treatments** | | | |  | | **Sub plot treatments** | | | |
|  | **Recommended dose of phosphorus** | | | |  | **Recommended dose of phosphorus** | | | | |
| Main treatments | **50 %** | **75 %** | **100 %** | **Mean** |  | | **50 %** | **75 %** | **100 %** | **Mean** |
| T1 : Control (0 NPK) | 46.66 | 47.00 | 47.70 | 47.12 |  | | 48.85 | 48.99 | 49.15 | 49.00 |
| T2 : RDF  (20: 50: 0 N: P2O5: K2O) | 50.30 | 53.97 | 54.02 | 52.76 |  | | 51.29 | 55.00 | 55.21 | 53.84 |
| T3 : 20: 25: 0 | 47.99 | 52.80 | 52.93 | 51.24 |  | | 49.18 | 52.80 | 53.54 | 51.84 |
| T4 : 20: 75: 0 | 50.55 | 54.00 | 54.06 | 52.87 |  | | 51.36 | 55.17 | 55.78 | 54.10 |
| T5 : 20: 25: 0+ Defoliant | 48.48 | 52.88 | 52.96 | 51.44 |  | | 49.23 | 53.49 | 54.29 | 52.33 |
| T6 : 20: 50: 0+ Defoliant | 50.83 | 55.04 | 55.15 | 53.67 |  | | 51.56 | 56.09 | 56.97 | 54.88 |
| T7 : 20: 75: 0+ Defoliant | 52.00 | 55.08 | 55.25 | 54.11 |  | | 53.25 | 56.71 | 57.21 | 55.72 |
| MEAN | 49.54 | 52.97 | 53.15 |  |  | | 50.67 | 54.04 | 54.59 |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | S.Em± | CD (P=0.05) | CV% |  | S.Em± | CD (P=0.05) | CV% |  |
| Main treatments(M) | 1.65 | N S | 9.54 |  | 1.77 | N S | 8.41 |  |
| Sub plot treatments(S) | 1.24 | N S | 10.98 |  | 1.31 | N S | 9.29 |  |
| M at same level of S | 3.15 | N S |  |  | 3.34 | N S |  |  |
| S at same level of M | 3.29 | N S |  |  | 3.46 | N S |  |  |

**Table 2 Plant height (cm) of maize at 60 DAS as influenced by residual effect and fertilizer levels**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2016-17 | | | | | |  | | | | 2017-18 | | | |
|  | **Sub plot treatments** | | | | | |  | | | | **Sub plot treatments** | | | |
|  | **Recommended dose of phosphorus** | | | | | |  | **Recommended dose of phosphorus** | | | | | | |
| Main treatments | **50 %** | **75 %** | **100 %** | | | **Mean** |  | | | **50 %** | | **75 %** | **100 %** | **Mean** |
| T1 : Control (0 NPK) | 160.13 | 162.03 | | 163.51 | 161.89 | |  | | 152.25 | | | 171.67 | 173.70 | 165.87 |
| T2 : RDF  (20: 50: 0 N: P2O5: K2O) | 177.03 | 187.29 | | 193.06 | 185.79 | |  | | 179.80 | | | 190.20 | 193.07 | 187.69 |
| T3 : 20: 25: 0 | 164.03 | 180.55 | | 185.29 | 176.62 | |  | | 176.97 | | | 181.73 | 188.20 | 182.30 |
| T4 : 20: 75: 0 | 178.20 | 187.79 | | 193.95 | 186.65 | |  | | 181.35 | | | 190.97 | 194.60 | 188.97 |
| T5 : 20: 25: 0+ Defoliant | 165.35 | 180.63 | | 186.68 | 177.56 | |  | | 178.67 | | | 182.73 | 184.33 | 181.91 |
| T6 : 20: 50: 0+ Defoliant | 178.58 | 194.05 | | 212.45 | 195.03 | |  | | 181.63 | | | 196.07 | 208.07 | 195.26 |
| T7 : 20: 75: 0+ Defoliant | 178.92 | 198.01 | | 214.83 | 197.25 | |  | | 181.60 | | | 201.13 | 211.53 | 198.09 |
| MEAN | 171.75 | 184.33 | | 192.82 |  | |  | | 176.04 | | | 187.79 | 193.36 |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | S.Em± | CD (P=0.05) | CV% |  | S.Em± | CD (P=0.05) | CV% |  |
| Main treatments(M) | 2.59 | 7.98 | 5.24 |  | 1.73 | 5.33 | 5.79 |  |
| Sub plot treatments(S) | 1.50 | 4.36 | 6.38 |  | 1.54 | 4.47 | 6.81 |  |
| M at same level of S | 4.15 | N S |  |  | 3.75 | N S |  |  |
| S at same level of M | 3.98 | N S |  |  | 4.08 | N S |  |  |

**Table 3 Plant height (cm) of maize at 90 DAS as influenced by residual effect and fertilizer levels**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2016-17 | | | |  | | | 2017-18 | | | |
|  | **Sub plot treatments** | | | |  | | | **Sub plot treatments** | | | |
|  | **Recommended dose of phosphorus** | | | |  | **Recommended dose of phosphorus** | | | | | |
| Main treatments | **50 %** | **75 %** | **100 %** | **Mean** |  | | **50 %** | | **75 %** | **100 %** | **Mean** |
| T1 : Control (0 NPK) | 161.36 | 166.09 | 168.49 | 165.31 |  | | 163.41 | | 168.14 | 170.54 | 167.36 |
| T2 : RDF  (20: 50: 0 N: P2O5: K2O) | 172.49 | 195.44 | 202.84 | 190.26 |  | | 174.54 | | 197.49 | 204.89 | 192.30 |
| T3 : 20: 25: 0 | 170.49 | 184.14 | 188.09 | 180.91 |  | | 172.54 | | 186.19 | 190.14 | 182.95 |
| T4 : 20: 75: 0 | 175.94 | 198.24 | 202.99 | 192.39 |  | | 177.99 | | 200.29 | 205.14 | 194.47 |
| T5 : 20: 25: 0+ Defoliant | 172.44 | 185.19 | 188.46 | 182.03 |  | | 174.49 | | 187.24 | 190.51 | 184.08 |
| T6 : 20: 50: 0+ Defoliant | 181.79 | 205.19 | 206.57 | 197.85 |  | | 183.84 | | 207.24 | 208.51 | 199.86 |
| T7 : 20: 75: 0+ Defoliant | 182.78 | 205.56 | 207.44 | 198.59 |  | | 184.83 | | 207.61 | 209.49 | 200.64 |
| MEAN | 173.90 | 191.41 | 194.98 |  |  | | 175.94 | | 193.45 | 197.03 |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | S.Em± | CD (P=0.05) | CV% |  | S.Em± | CD (P=0.05) | CV% |  |
| Main treatments(M) | 1.77 | 5.45 | 4.81 |  | 1.76 | 5.44 | 4.83 |  |
| Sub plot treatments(S) | 1.17 | 3.38 | 5.16 |  | 1.18 | 3.38 | 5.35 |  |
| M at same level of S | 3.08 | NS |  |  | 3.08 | NS |  |  |
| S at same level of M | 3.08 | NS |  |  | 3.09 | NS |  |  |

**Table 4 Plant height (cm) of maize at harvest as influenced by residual effect and fertilizer levels**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2016-17 | | | |  | | | 2017-18 | | | |
|  | **Sub plot treatments** | | | |  | | | **Sub plot treatments** | | | |
|  | **Recommended dose of phosphorus** | | | |  | **Recommended dose of phosphorus** | | | | | |
| Main treatments | **50 %** | **75 %** | **100 %** | **Mean** |  | | **50 %** | | **75 %** | **100 %** | **Mean** |
| T1 : Control (0 NPK) | 166.26 | 170.32 | 172.72 | 169.77 |  | | 166.59 | | 171.65 | 174.05 | 170.76 |
| T2 : RDF  (20: 50: 0 N: P2O5: K2O) | 176.72 | 199.67 | 207.07 | 194.49 |  | | 178.05 | | 201.00 | 208.40 | 195.82 |
| T3 : 20: 25: 0 | 174.72 | 188.37 | 192.32 | 185.14 |  | | 176.05 | | 189.70 | 193.65 | 186.47 |
| T4 : 20: 75: 0 | 180.17 | 202.47 | 207.32 | 196.65 |  | | 181.50 | | 203.80 | 208.65 | 197.98 |
| T5 : 20: 25: 0+ Defoliant | 176.67 | 189.42 | 192.69 | 186.26 |  | | 178.00 | | 190.75 | 194.02 | 187.59 |
| T6 : 20: 50: 0+ Defoliant | 186.02 | 209.42 | 210.70 | 202.05 |  | | 187.35 | | 210.75 | 211.73 | 203.28 |
| T7 : 20: 75: 0+ Defoliant | 187.01 | 209.79 | 211.67 | 202.82 |  | | 188.34 | | 211.12 | 213.00 | 204.15 |
| MEAN | 178.22 | 195.64 | 199.21 |  |  | | 179.41 | | 196.97 | 200.50 |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | S.Em± | CD (P=0.05) | CV% |  | S.Em± | CD (P=0.05) | CV% |  |
| Main treatments(M) | 1.73 | 5.32 | 3.75 |  | 1.59 | 4.90 | 4.72 |  |
| Sub plot treatments(S) | 1.21 | 3.50 | 3.92 |  | 1.19 | 3.45 | 3.36 |  |
| M at same level of S | 3.13 | NS |  |  | 3.02 | NS |  |  |
| S at same level of M | 3.20 | NS |  |  | 3.15 | NS |  |  |

**Table 5 Leaf Area Index of maize at 30 DAS as influenced by residual effect and fertilizer levels**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2016-17 | | | |  | | 2017-18 | | | |
|  | **Sub plot treatments** | | | |  | | **Sub plot treatments** | | | |
|  | **Recommended dose of phosphorus** | | | |  | **Recommended dose of phosphorus** | | | | |
| Main treatments | **50 %** | **75 %** | **100 %** | **Mean** |  | | **50 %** | **75 %** | **100 %** | **Mean** |
| T1 : Control (0 NPK) | 0.21 | 0.23 | 0.26 | 0.23 |  | | 0.21 | 0.25 | 0.27 | 0.24 |
| T2 : RDF  (20: 50: 0 N: P2O5: K2O) | 0.33 | 0.43 | 0.46 | 0.41 |  | | 0.33 | 0.44 | 0.50 | 0.42 |
| T3 : 20: 25: 0 | 0.26 | 0.38 | 0.40 | 0.34 |  | | 0.27 | 0.39 | 0.42 | 0.36 |
| T4 : 20: 75: 0 | 0.35 | 0.43 | 0.47 | 0.42 |  | | 0.34 | 0.46 | 0.54 | 0.45 |
| T5 : 20: 25: 0+ Defoliant | 0.26 | 0.38 | 0.41 | 0.35 |  | | 0.31 | 0.40 | 0.43 | 0.38 |
| T6 : 20: 50: 0+ Defoliant | 0.35 | 0.51 | 0.62 | 0.49 |  | | 0.37 | 0.57 | 0.59 | 0.51 |
| T7 : 20: 75: 0+ Defoliant | 0.36 | 0.55 | 0.70 | 0.54 |  | | 0.38 | 0.57 | 0.63 | 0.53 |
| MEAN | 0.30 | 0.42 | 0.47 |  |  | | 0.32 | 0.44 | 0.48 |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | S.Em± | CD (P=0.05) | CV% |  | S.Em± | CD (P=0.05) | CV% |  |
| Main treatments(M) | 0.02 | 0.05 | 10.89 |  | 0.01 | 0.05 | 10.70 |  |
| Sub plot treatments(S) | 0.01 | 0.04 | 9.54 |  | 0.01 | 0.03 | 8.53 |  |
| M at same level of S | 0.03 | N S |  |  | 0.02 | N S |  |  |
| S at same level of M | 0.04 | N S |  |  | 0.02 | N S |  |  |

**Table 6 Leaf Area Index of maize at 60 DAS as influenced by residual effect and fertilizer levels**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2016-17 | | | |  | | 2017-18 | | | |  |
|  | **Sub plot treatments** | | | |  | | **Sub plot treatments** | | | |  |
|  | **Recommended dose of phosphorus** | | | |  | **Recommended dose of phosphorus** | | | | |  |
| Main treatments | **50 %** | **75 %** | **100 %** | **Mean** |  | | **50 %** | **75 %** | **100 %** | **Mean** |  |
| T1 : Control (0 NPK) | 3.87 | 3.90 | 4.30 | 4.02 |  | | 4.26 | 4.29 | 4.33 | 4.29 |  |
| T2 : RDF  (20: 50: 0 N: P2O5: K2O) | 4.50 | 4.77 | 4.94 | 4.73 |  | | 4.53 | 4.80 | 4.97 | 4.77 |  |
| T3 : 20: 25: 0 | 4.37 | 4.57 | 4.72 | 4.55 |  | | 4.40 | 4.60 | 4.75 | 4.58 |  |
| T4 : 20: 75: 0 | 4.52 | 4.86 | 4.95 | 4.78 |  | | 4.55 | 4.89 | 4.98 | 4.81 |  |
| T5 : 20: 25: 0+ Defoliant | 4.42 | 4.58 | 4.73 | 4.58 |  | | 4.45 | 4.61 | 4.76 | 4.61 |  |
| T6 : 20: 50: 0+ Defoliant | 4.53 | 5.07 | 5.13 | 4.91 |  | | 4.56 | 5.44 | 5.62 | 5.21 |  |
| T7 : 20: 75: 0+ Defoliant | 4.56 | 5.10 | 5.14 | 4.93 |  | | 4.59 | 5.50 | 5.70 | 5.26 |  |
| MEAN | 4.39 | 4.69 | 4.84 |  |  | | 4.48 | 4.88 | 5.02 |  |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | S.Em± | CD (P=0.05) | CV% |  | S.Em± | CD (P=0.05) | CV% |  |
| Main treatments(M) | 0.04 | 0.12 | 5.52 |  | 0.05 | 0.15 | 4.05 |  |
| Sub plot treatments(S) | 0.05 | 0.15 | 5.21 |  | 0.05 | 0.13 | 4.26 |  |
| M at same level of S | 0.12 | N S |  |  | 0.11 | NS |  |  |
| S at same level of M | 0.14 | N S |  |  | 0.12 | NS |  |  |

**Table 7 Leaf Area Index of maize at 90 DAS as influenced by residual effect and fertilizer levels**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2016-17 | | | |  | | 2017-18 | | | |
|  | **Sub plot treatments** | | | |  | | **Sub plot treatments** | | | |
|  | **Recommended dose of phosphorus** | | | |  | **Recommended dose of phosphorus** | | | | |
| Main treatments | **50 %** | **75 %** | **100 %** | **Mean** |  | | **50 %** | **75 %** | **100 %** | **Mean** |
| T1 : Control (0 NPK) | 3.33 | 3.38 | 3.41 | 3.37 |  | | 3.48 | 3.53 | 3.56 | 3.52 |
| T2 : RDF  (20: 50: 0 N: P2O5: K2O) | 3.60 | 4.03 | 4.52 | 4.05 |  | | 3.90 | 4.12 | 4.64 | 4.22 |
| T3 : 20: 25: 0 | 3.45 | 3.81 | 3.88 | 3.71 |  | | 3.58 | 3.84 | 3.94 | 3.79 |
| T4 : 20: 75: 0 | 3.66 | 4.05 | 4.60 | 4.10 |  | | 3.71 | 4.15 | 4.71 | 4.19 |
| T5 : 20: 25: 0+ Defoliant | 3.50 | 3.85 | 3.91 | 3.75 |  | | 3.70 | 3.91 | 4.06 | 3.89 |
| T6 : 20: 50: 0+ Defoliant | 3.69 | 4.73 | 4.94 | 4.45 |  | | 3.75 | 4.83 | 5.12 | 4.57 |
| T7 : 20: 75: 0+ Defoliant | 3.71 | 4.82 | 5.07 | 4.53 |  | | 3.80 | 4.99 | 5.41 | 4.73 |
| MEAN | 3.56 | 4.10 | 4.33 |  |  | | 3.70 | 4.20 | 4.49 |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | S.Em± | CD (P=0.05) | CV% |  | S.Em± | CD (P=0.05) | CV% |  |
| Main treatments(M) | 0.07 | 0.20 | 4.89 |  | 0.09 | 0.27 | 4.93 |  |
| Sub plot treatments(S) | 0.08 | 0.22 | 8.64 |  | 0.08 | 0.24 | 6.16 |  |
| M at same level of S | 0.18 | N S |  |  | 0.20 | N S |  |  |
| S at same level of M | 0.20 | N S |  |  | 0.22 | N S |  |  |

**Table 8 Leaf Area Index of maize at harvest as influenced by residual effect and fertilizer levels**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2016-17 | | | |  | | 2017-18 | | | |  |
|  | **Sub plot treatments** | | | |  | | **Sub plot treatments** | | | |  |
|  | **Recommended dose of phosphorus** | | | |  | **Recommended dose of phosphorus** | | | | |  |
| Main treatments | **50 %** | **75 %** | **100 %** | **Mean** |  | | **50 %** | **75 %** | **100 %** | **Mean** |  |
| T1 : Control (0 NPK) | 1.00 | 1.11 | 1.11 | 1.07 |  | | 1.19 | 1.24 | 1.29 | 1.24 |  |
| T2 : RDF  (20: 50: 0 N: P2O5: K2O) | 1.33 | 1.74 | 1.86 | 1.64 |  | | 1.59 | 2.07 | 2.18 | 1.95 |  |
| T3 : 20: 25: 0 | 1.13 | 1.37 | 1.68 | 1.39 |  | | 1.39 | 1.75 | 1.92 | 1.69 |  |
| T4 : 20: 75: 0 | 1.33 | 1.74 | 1.87 | 1.65 |  | | 1.63 | 2.08 | 2.19 | 1.97 |  |
| T5 : 20: 25: 0+ Defoliant | 1.14 | 1.37 | 1.56 | 1.36 |  | | 1.41 | 1.76 | 2.01 | 1.73 |  |
| T6 : 20: 50: 0+ Defoliant | 1.33 | 1.87 | 2.67 | 1.96 |  | | 1.66 | 2.19 | 2.79 | 2.22 |  |
| T7 : 20: 75: 0+ Defoliant | 1.36 | 2.25 | 2.72 | 2.11 |  | | 1.73 | 2.35 | 2.82 | 2.30 |  |
| MEAN | 1.23 | 1.64 | 1.92 |  |  | | 1.51 | 1.92 | 2.17 |  |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | S.Em± | CD (P=0.05) | CV% |  | S.Em± | CD (P=0.05) | CV% |  |
| Main treatments(M) | 0.09 | 0.28 | 4.95 |  | 0.07 | 0.21 | 7.53 |  |
| Sub plot treatments(S) | 0.06 | 0.19 | 4.25 |  | 0.05 | 0.14 | 8.13 |  |
| M at same level of S | 0.17 | N S |  |  | 0.12 | N S |  |  |
| S at same level of M | 0.17 | N S |  |  | 0.13 | N S |  |  |

**Table 9. Grain yield (kg ha-1) of maize as influenced by residual effect and fertilizer levels**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2016-17 | | | |  | | 2017-18 | | | |  |
|  | **Sub plot treatments** | | | |  | | **Sub plot treatments** | | | |  |
|  | **Recommended dose of phosphorus** | | | |  | **Recommended dose of phosphorus** | | | | |  |
| Main treatments | **50 %** | **75 %** | **100 %** | **Mean** |  | | **50 %** | **75 %** | **100 %** | **Mean** |  |
| T1 : Control (0 NPK) | 4659 | 4736 | 5187 | 4861 |  | | 4937 | 5050 | 5306 | 5098 |  |
| T2 : RDF  (20: 50: 0 N: P2O5: K2O) | 5261 | 5877 | 6869 | 6002 |  | | 5382 | 6012 | 7361 | 6252 |  |
| T3 : 20: 25: 0 | 5218 | 5458 | 5593 | 5423 |  | | 5338 | 5585 | 5722 | 5548 |  |
| T4 : 20: 75: 0 | 5351 | 6272 | 6955 | 6193 |  | | 5474 | 6416 | 7449 | 6447 |  |
| T5 : 20: 25: 0+ Defoliant | 5240 | 5500 | 5611 | 5451 |  | | 5361 | 5661 | 5949 | 5657 |  |
| T6 : 20: 50: 0+ Defoliant | 5386 | 7422 | 8059 | 6956 |  | | 5510 | 7593 | 8244 | 7116 |  |
| T7 : 20: 75: 0+ Defoliant | 5455 | 7803 | 8730 | 7329 |  | | 5580 | 7983 | 8932 | 7498 |  |
| MEAN | 5224 | 6153 | 6715 |  |  | | 5369 | 6329 | 6995 |  |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | S.Em± | CD (P=0.05) | CV% |  | S.Em± | CD (P=0.05) | CV% |  |
| Main treatments(M) | 176.90 | 545.07 | 8.80 |  | 155.01 | 477.64 | 7.46 |  |
| Sub plot treatments(S) | 105.52 | 305.69 | 8.02 |  | 90.32 | 261.66 | 6.64 |  |
| M at same level of S | 288.54 | 855.88 |  |  | 249.20 | 739.69 |  |  |
| S at same level of M | 279.19 | 808.79 |  |  | 238.97 | 692.28 |  |  |

**Table 10 Stover yield (kg ha-1) of maize as influenced by residual effect and fertilizer levels**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2016-17 | | | |  | | 2017-18 | | | |
|  | **Sub plot treatments** | | | |  | | **Sub plot treatments** | | | |
|  | **Recommended dose of phosphorus** | | | |  | **Recommended dose of phosphorus** | | | | |
| Main treatments | **50 %** | **75 %** | **100 %** | **Mean** |  | | **50 %** | **75 %** | **100 %** | **Mean** |
| T1 : Control (0 NPK) | 7344 | 7925 | 7969 | 7746 |  | | 7717 | 8328 | 8370 | 8139 |
| T2 : RDF  (20: 50: 0 N: P2O5: K2O) | 8594 | 9304 | 9817 | 9238 |  | | 9027 | 9687 | 10760 | 9825 |
| T3 : 20: 25: 0 | 7969 | 8873 | 8906 | 8583 |  | | 8374 | 9329 | 9359 | 9021 |
| T4 : 20: 75: 0 | 8595 | 9375 | 10009 | 9326 |  | | 9030 | 9852 | 10843 | 9908 |
| T5 : 20: 25: 0+ Defoliant | 7991 | 8906 | 9089 | 8662 |  | | 8538 | 9342 | 9674 | 9185 |
| T6 : 20: 50: 0+ Defoliant | 8750 | 10000 | 11304 | 10018 |  | | 9178 | 11042 | 11494 | 10571 |
| T7 : 20: 75: 0+ Defoliant | 8750 | 10625 | 11406 | 10260 |  | | 9195 | 11165 | 11986 | 10782 |
| MEAN | 8285 | 9287 | 9786 |  |  | | 8723 | 9821 | 10355 |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | S.Em± | CD (P=0.05) | CV% |  | S.Em± | CD (P=0.05) | CV% |  |
| Main treatments(M) | 181.55 | 559.42 | 5.97 |  | 158.79 | 489.27 | 5.95 |  |
| Sub plot treatments(S) | 91.73 | 265.74 | 5.61 |  | 107.78 | 312.22 | 5.13 |  |
| M at same level of S | 268.76 | 801.19 |  |  | 281.82 | 832.90 |  |  |
| S at same level of M | 242.70 | 703.09 |  |  | 285.15 | 826.06 |  |  |

**Table 11 Gross returns (₹ ha-1) of maize as influenced by residual effect and fertilizer levels**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2016-17 | | | | 2017-18 | | | |
|  | **Sub plot treatments** | | | | **Sub plot treatments** | | | |
|  | **Recommended dose of phosphorus** | | | | **Recommended dose of phosphorus** | | | |
| Main treatments | **50 %** | **75 %** | **100 %** | **Mean** | **50 %** | **75 %** | **100 %** | **Mean** |
| T1 : Control (0 NPK) | 74539 | 75784 | 82986 | 77770 | 78987 | 80803 | 84897 | 81562 |
| T2 : RDF  (20: 50: 0 N: P2O5: K2O) | 84175 | 94025 | 109906 | 96035 | 86114 | 96191 | 117778 | 100028 |
| T3 : 20: 25: 0 | 83488 | 87330 | 89488 | 86768 | 85413 | 89355 | 91547 | 88772 |
| T4 : 20: 75: 0 | 85616 | 100348 | 111285 | 99083 | 87588 | 102661 | 119185 | 103145 |
| T5 : 20: 25: 0+ Defoliant | 83841 | 88004 | 89781 | 87209 | 85770 | 90576 | 95179 | 90508 |
| T6 : 20: 50: 0+ Defoliant | 86180 | 118749 | 128938 | 111289 | 88166 | 121485 | 131912 | 113854 |
| T7 : 20: 75: 0+ Defoliant | 87276 | 124852 | 139684 | 117271 | 89287 | 127725 | 142905 | 119973 |
| MEAN | 83588 | 98442 | 107438 |  | 85904 | 101257 | 111915 |  |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | S.Em± | CD (P=0.05) | CV% | S.Em± | | | CD (P=0.05) | CV% |  |
| Main treatments(M) | 1471 | 4533 | 5.47 | |  | 1297 | 3998 | 4.90 |  |
| Sub plot treatments(S) | 1688 | 4891 | 8.09 | |  | 1445 | 4186 | 7.64 |  |
| M at same level of S | 2932 | N S |  | |  | 2380 | NS |  |  |
| S at same level of M | 2467 | N S |  | |  | 2823 | NS |  |  |

**Table 12 Net returns (₹ ha-1) of maize as influenced by residual effect and fertilizer levels**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2016-17 | | | |  | | 2017-18 | | | |  |
|  | **Sub plot treatments** | | | |  | | **Sub plot treatments** | | | |  |
|  | **Recommended dose of phosphorus** | | | |  | **Recommended dose of phosphorus** | | | | |  |
| Main treatments | **50 %** | **75 %** | **100 %** | **Mean** |  | | **50 %** | **75 %** | **100 %** | **Mean** |  |
| T1 : Control (0 NPK) | 41621 | 42416 | 49169 | 44402 |  | | 46069 | 47436 | 51080 | 48195 |  |
| T2 : RDF  (20: 50: 0 N: P2O5: K2O) | 51258 | 60658 | 76089 | 62668 |  | | 53197 | 62824 | 83961 | 66661 |  |
| T3 : 20: 25: 0 | 50571 | 53963 | 55670 | 53401 |  | | 52496 | 55987 | 57730 | 55404 |  |
| T4 : 20: 75: 0 | 52698 | 66981 | 77468 | 65716 |  | | 54671 | 69294 | 85367 | 69777 |  |
| T5 : 20: 25: 0+ Defoliant | 50924 | 54637 | 55964 | 53842 |  | | 52853 | 57209 | 61361 | 57141 |  |
| T6 : 20: 50: 0+ Defoliant | 53263 | 85382 | 95121 | 77922 |  | | 55249 | 88118 | 98094 | 80487 |  |
| T7 : 20: 75: 0+ Defoliant | 54359 | 91485 | 105866 | 83904 |  | | 56370 | 94358 | 109088 | 86605 |  |
| MEAN | 50671 | 65075 | 73621 |  |  | | 52986 | 67889 | 78097 |  |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | S.Em± | CD (P=0.05) | CV% |  | S.Em± | CD (P=0.05) | CV% |  |
| Main treatments(M) | 1414 | 4356 | 6.72 |  | 1317 | 4059 | 5.96 |  |
| Sub plot treatments(S) | 1688 | 4891 | 12.2 |  | 1445 | 4186 | 9.96 |  |
| M at same level of S | 2467 | NS |  |  | 2388 | NS |  |  |
| S at same level of M | 2912 | NS |  |  | 2823 | NS |  |  |

**Table 13 B:C ratio of maize as influenced by residual effect and fertilizer levels**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2016-17 | | | |  | | 2017-18 | | | |  |
|  | **Sub plot treatments** | | | |  | | **Sub plot treatments** | | | |  |
|  | **Recommended dose of phosphorus** | | | |  | **Recommended dose of phosphorus** | | | | |  |
| Main treatments | **50 %** | **75 %** | **100 %** | **Mean** |  | | **50 %** | **75 %** | **100 %** | **Mean** |  |
| T1 : Control (0 NPK) | 2.26 | 2.27 | 2.45 | 2.33 |  | | 2.40 | 2.42 | 2.51 | 2.44 |  |
| T2 : RDF  (20: 50: 0 N: P2O5: K2O) | 2.56 | 2.82 | 3.25 | 2.88 |  | | 2.62 | 2.88 | 3.48 | 2.99 |  |
| T3 : 20: 25: 0 | 2.54 | 2.62 | 2.65 | 2.60 |  | | 2.59 | 2.68 | 2.71 | 2.66 |  |
| T4 : 20: 75: 0 | 2.60 | 3.01 | 2.29 | 2.97 |  | | 2.66 | 3.08 | 3.52 | 3.09 |  |
| T5 : 20: 25: 0+ Defoliant | 2.55 | 2.64 | 2.65 | 2.61 |  | | 2.61 | 2.71 | 2.81 | 2.71 |  |
| T6 : 20: 50: 0+ Defoliant | 2.62 | 3.56 | 3.81 | 3.33 |  | | 2.68 | 3.64 | 3.90 | 3.41 |  |
| T7 : 20: 75: 0+ Defoliant | 2.65 | 3.74 | 4.13 | 3.51 |  | | 2.71 | 3.83 | 4.23 | 3.59 |  |
| MEAN | 2.54 | 2.95 | 3.18 |  |  | | 2.61 | 3.03 | 3.31 |  |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | S.Em± | CD (P=0.05) | CV% |  | S.Em± | CD (P=0.05) | CV% |  |
| Main treatments(M) | 0.08 | 0.26 | 8.75 |  | 0.07 | 0.23 | 7.45 |  |
| Sub plot treatments(S) | 0.05 | 0.15 | 7.96 |  | 0.04 | 0.13 | 6.64 |  |
| M at same level of S | 0.04 | NS |  |  | 0.02 | NS |  |  |
| S at same level of M | 0.03 | NS |  |  | 0.01 | NS |  |  |

Fig. 1: Grain yield (kg ha-1) of maize as influenced by residual effect and fertilizer levels

**Fig. 2: Stover yield (kg ha-1) of maize as influenced by residual effect and fertilizer levels.**