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Growth and Yield of Sesame (*Sesamum Indicum* L.) as Influenced by Combinations of Varying Levels of Nitrogen and Foliar Fertilizers

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ABSTRACT

Purpose: Various foliar fertilizers are used alone or in combination with soil-applied inorganic fertilizers in Nigeria to increase crop growth and yield. Information on the mixture of foliar fertilizers and soil-applied nitrogen on sesame is scanty. This study investigated the growth parameters of sesame under the various combination of foliar fertilizer with nitrogen.

Materials and methods: Five levels (0, 20, 40, 60, and 80 kg N/ha) of nitrogen were combined with three foliar fertilizers (Maxiforce, Supergrow, and Plantzyme) using a 3 x 5 factorial in a complete randomized block design and replicated three times.

Results: The nitrogen levels significantly influenced the number of leaves produced, leaf area, number of pods per plant, and seed yield. There were no significant effects among the foliar fertilizers on the growth and yield of sesame. Application of super grow in combination with 60kgN was appeared promising. The results of the study showed that mixing foliar fertilizer with nitrogen was found to improve the growth and yield of sesame.

Keywords: nitrogen, max force, plantzyme, supergrow, seed yield**.**

1.0 INTRODUCTION

Sesame is a flowering plant in the genus sesamum, family Pedaliaceae. It is cultivated for its seed which contained approximately 50% oil and 25% protein. Sesame is renowned as a source of medicinal and nutritional qualities with excellent oil. The oil has excellent stability due to the presence of natural antioxidants such as sesamolin and sesamin (Bedigian, 1985) which protect the oil from oxidative rancidity. This quality makes sesame an important oil crop in pharmaceutical industries. Nigeria was ranked 6th producer in the world sesame production, 2nd largest producer in Africa, and the largest supplier to the Japanese market (Chemonics

International, 2002). There has been a notable increase in the production of sesame in recent times with 80,000 metric tons valued S19,000,000 foreign exchange earning to about 158,000,000 metric tons of S139,000,000 foreign exchange respectively, in 2003 and 2010 (FAO,2013).

Nitrogen is the major nutrients affecting plant growth and yield. It is an important component of the plant cell with many structural, genetic, and metabolic compounds, such as protein and nucleic acid. It also involves energy-transfer compounds such as ATP (CFF, 2010). Increases in N supply to the plants within the limits are associated with an increase in leaf area, carboxylases, and chlorophyll content, all of which determine the photosynthetic activities of leaf and ultimately dry matter production and allocation to the various organs of a plant (Babajide and Oyeleke (2014); Maqsood *et al*. (2016). N contributes up to 50% of all the nutrient inputs, and therefore considered as the determinant of farmers' crop yield. Applications of nitrogen have been reported to increase the acidity of the soil, leaching which consequently lead to environmental and health hazards (Kuepper and Gegner, 2004). Nitrogen is taken by the plant in the form of ammonium (NH4+) and nitrate ions (N03-) (CFF, 2010). Given the importance of nitrogen as an essential plant nutrient, the demand for synthetic nitrogen fertilizer in the developing countries has increased more than three-fold in the last three decades as against declining demand in the developed countries (IFA, 2013).

The application of plant nutrients through the foliage to enhance plant growth and yield has been used on various crops (Afe and Oluleye, 2016). The technique apart from being environmentally friendly, it also acts as a catalyst in the uptake and use of macronutrients. Maxiforce, Supergrow, and Plantzyme are popular foliar fertilizers that are available in Nigeria markets and frequently used to boost crop growth. Maxiforce is a liquid fertilizer with equal concentrations of nitrogen, phosphorous, and potassium (20:20:20) along with some trace elements (Fe, Cu, Mn, and Zn). Super grow is a revolutionary liquid fertilizer made up of a high concentration of NPK plus trace elements combined with aminophenol and citric acid to allow fast absorption by plants. It also enhances good water holding capacity, aid photosynthesis, strengthen and improve root development. Planzyme is a product produced from a mixture of plant and animal wastes through bio-fermentation using a catalyst. It contains the twenty-two naturally occurring microbes that help to break down pesticides and herbicides residues. It minimizes fluctuation in soil temperature and assists in building up the organic matter contents of the soil.

The nutrient requirement for sesame has remained controversial and inconsistent. Studies have shown the possibilities of increased seed yield through the application of nitrogen. Nitrogen application in sesame was reported to increase plant height, the number of capsule /plant, seed index, and seed yield (Shehu *et al*. 2010: Blal *et al*. 2013). For instance, Ogundare, *et al*. (2015) maximized seed yield (1,333.3 kg/ha) with the application of 46 kg N/ha. In another study, Babajide and Oyeleke (2014) observed a steady increase in seed yield with the application rate of N from 20 to 80 kg N/ha. El-Sherif (2016) in his study concluded that the application of 142 kg/ha N was economical in Egypt. But in Sudan, sesame seed yield was optimized when 44 kg N/ha was applied (El Mahdi, 2008). Bahar *et al*. (2015) reported that the application of 100 kg N/ha produced higher seed yield. In an earlier study, growth and seed yield of sesame was reported to increase with the application of foliar micronutrient spray (Eisa *et al*. (2010); Yandav *et al*. (2009); and Heidan *et al*., 2011). While several authors have studied the response of sesame to nitrogen levels and foliar fertilizers on various crops, there is a dearth of information on the combination of available foliar fertilizers in Nigeria with varying levels of nitrogen. This research was therefore carried out to provide information on the growth and yield of sesame as influenced by combinations of foliar fertilizers with varying levels of nitrogen.

2.0 MATERIALS AND METHODS

The experiment was carried out at the nursery of the Crop Production Department, Kwara State Univesity, Malete between January and April 2017. The study aimed to investigate the growth and yield of sesame (*Sesamum indicum* L.) to a combination of varying levels of nitrogen with foliar fertilizers. Five levels of nitrogen 0, 20, 40, 60, and 80 kg/ha were combined with three foliar fertilizers (Maxiforce, plantzyme, supergrow) in 5 x 3 factorial combinations using a complete randomized design in three replicates. 5.5 kg of soil was collected in a perforated 5 liters bucket and eight plants were planted but thinned down four plants at two weeks after planting.

Varying levels of nitrogen were applied using granular urea (46%N) at two weeks after planting (wap) by drilling. The recommended dose of each foliar fertilizer was applied to the leaves at 4wap using a hand sprayer. Watering was carried out on alternate days until ten days before harvesting. Weeds in each pot were manually removed as at when due throughout the growing period. The crops were harvested at physiological maturity when the leaves have turned yellow and brownish. The harvested plants were made to stand erect until drying to prevent shattering after which the seeds were threshed manually.

The following data were collected from three tag plants in each pot; the number of leaves and plant height at 4, 6, and 8WAP, leaf area at 8WAP, days to 50% flowering and podding, stem girth, length of fruit zone, number of pods per plant and seed yield. The data collected were subjected to analysis of variance, using the SAS statistical package and the treatment means, where significant, were separated using Duncan's Multiple Range Test at 5% probability level.

3.0 RESULTS AND DISCUSSION

3.1 Results: As expected, the number of leaves produced and plant heights increased with the age of the plant but were not significantly different among the fertilizer levels except the control where a significantly lower number of leaves and shorter plants were recorded (Figures 1&2.). A similar number of leaves and plant height were observed among the foliar fertilizers. Although applications of super grow appeared to increase the number of leaves and height of the plant, it was not statistically manifested. The interactive effect of foliar fertilizers and nitrogen levels was not significant on growth parameters.

Application of varying levels of nitrogen significantly influenced the length of fruit zone, leaf area, number of pods produced per plant, stem girth, and seed yield of sesame (Figures 3-8). The control where no fertilizer was applied took longer days to flower and pod, it was not significantly different from other treatments. The length of fruit zone, leaf area, and seed yield increased as nitrogen level increased, the differences were not significant between the application of nitrogen from 20kg-80 kg N/ha. The responses of sesame on the number of pods per plant and stem girth were not consistent. All these parameters were superior to the treatment where no fertilizer was applied. The application of nitrogen at 60 kg N/ha significantly out-yielded other treatments. There were no significant differences in the seed yield with the application of nitrogen between 20-80 kg/ha. There were no significant differences among the foliar fertilizers on leaf area, number of pods per plant, stem girth, and seed yield.

3.2 Discussion: Generally, a combination of foliar fertilizers with soil-applied nitrogen improved the growth and seed yield of sesame. The growth progressively increased with increased nitrogen levels. The optimum seed yield at 60 kg N/ha as recorded in this study is within the limit (46-100 kg N/ha) as reported by Gebregergia and Amare (2019). According to the report, nitrogen at this limit was beneficial to enhance uptakes of other nutrients, particularly P and K, and some micronutrients. The non-significant difference in the days to 50% flowering is consistent with the work of Ogundare *et al.* (2015) on the application of urea on the growth and yield of sesame in Nigeria. The observed increased yield could be due to the availability of plant nutrients

especially nitrogen. Application of N within the limits of plant requirement was reported to increase leaf area, carboxylases, and chlorophyll content, of the plant which consequently determine the photosynthetic activities of leaf and ultimately dry matter production, partitioning, and allocation to the various organs of the plant (Babajide and Oyeleke, 2014; Maqsood *et al*, 2016). The observed increased growth and seed yield agreed with the earlier reported work of Shehu *et al*. (2010); Blal *et al.* (2013) Babajide and Oyeleke (2014). In the present study, the highest seed yield was obtained with the application of 60 kg N/ha as against 44kg N/ha and 46 kg N/ ha as reported by El -Mahdi, (2008) and Ogundare *et al.* (2015) in Sudan and Nigeria respectively. The observed differences could be due to environmental factors and varietal differences among sesame cultivars. In an earlier study, El-Sherif (2016) maximized sesame seed yield at142 kg N/ha while Bahar et al. (2015) obtained the highest seed yield at 100 kg N/ha. These nitrogen levels were slightly higher than the one obtained in this study. The discrepancy could be attributed to foliar fertilizers that were combined with the soil-applied nitrogen. Improved growth and yield of crops with the application of foliar fertilizers have been reported (Abasi *et al*. (2010); Afe and Oluleye (2017); Heidan *et al.* (2011). Foliar fertilizers when applied not only to boost the nutrient density of the plant but also act a catalyst in the uptake and use of certain macronutrients (Phlip, 2004; Fagera *et al*., 2009). The non-significant difference among the three foliar fertilizers suggests their suitability as a foliar spray on the growth and yield of crops, particularly sesame.

4.0 CONCLUSION

Based on the results of this study, the combination of foliar fertilizer with nitrogen was found to improve the growth and seed yield of sesame. The three foliar fertilizers in combination with soil-applied nitrogen are suitable for sesame growth and yield.

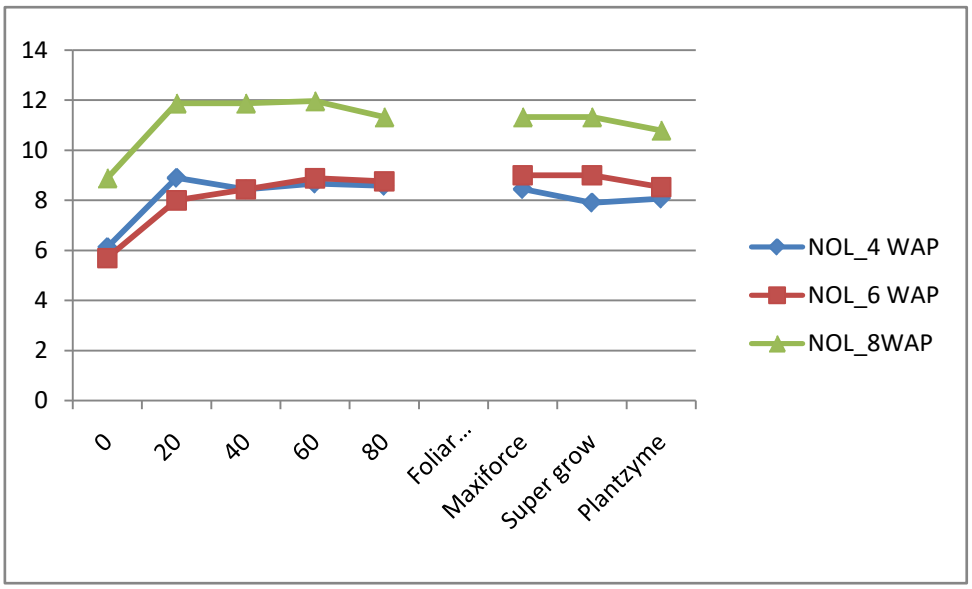

Figure1. Effect of foliar fertilizers and nitrogen levels on number of leaves at 4, 6, and 8 weeks after planting.

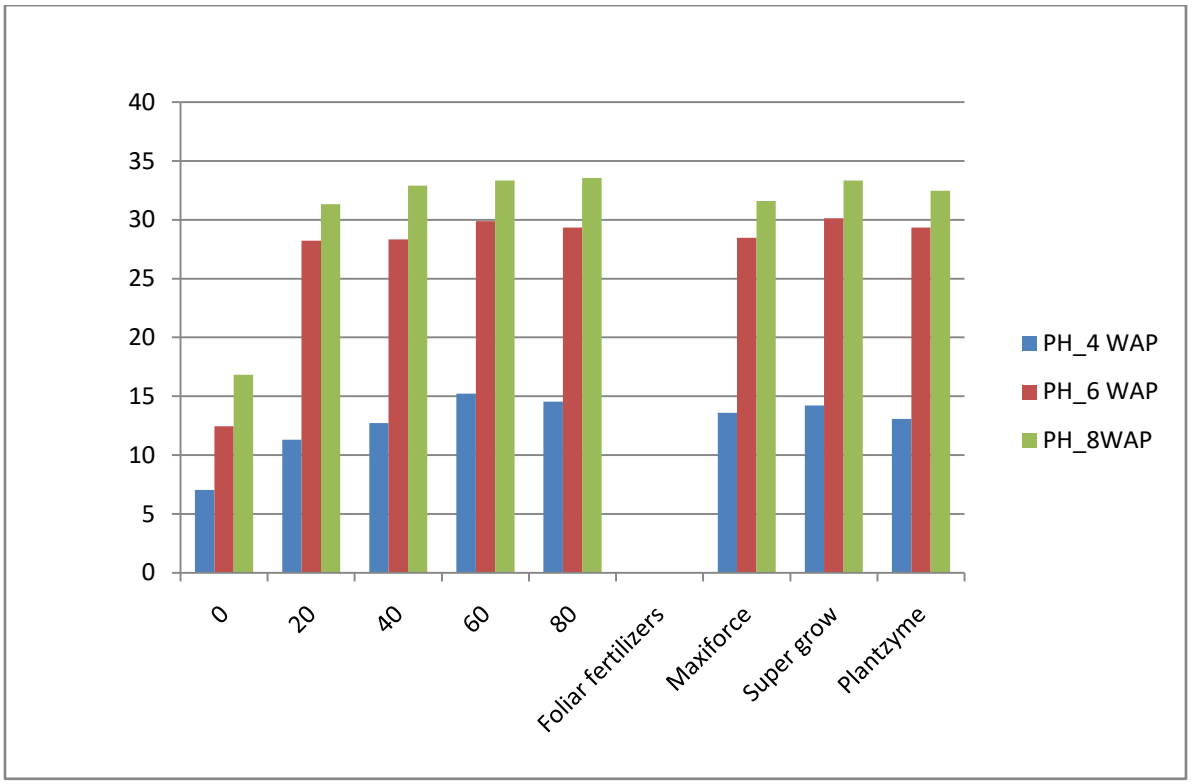

Figure 2: Effects of foliar fertilizers and nitrogen levels on plant height at 4, 6, and 8 weeks after planting.

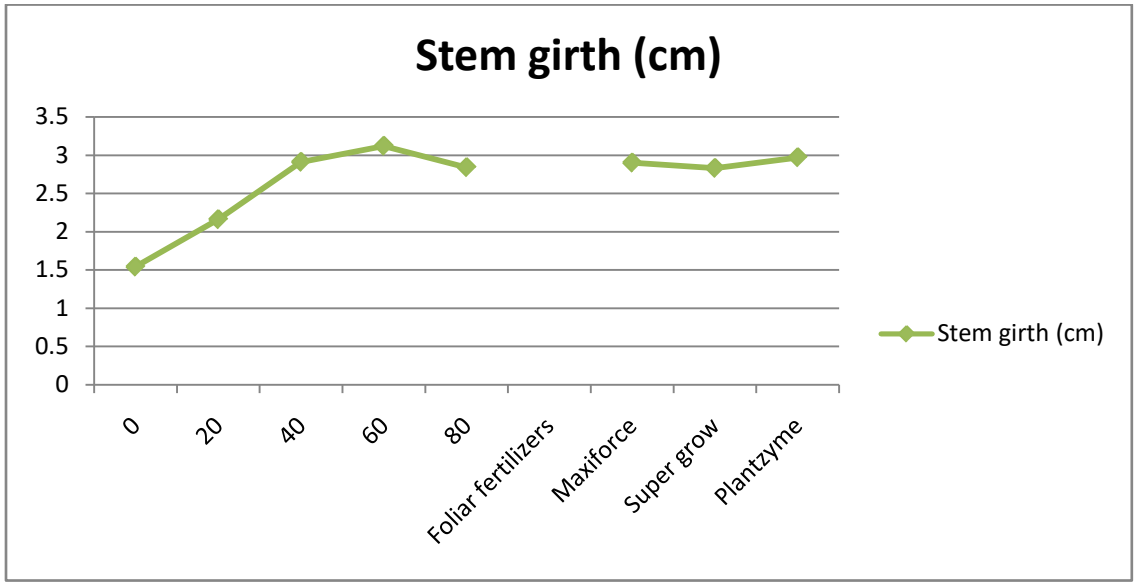

Figure 3: Effects of foliar fertilizers and nitrogen levels on stem girth at 8 weeks after planting

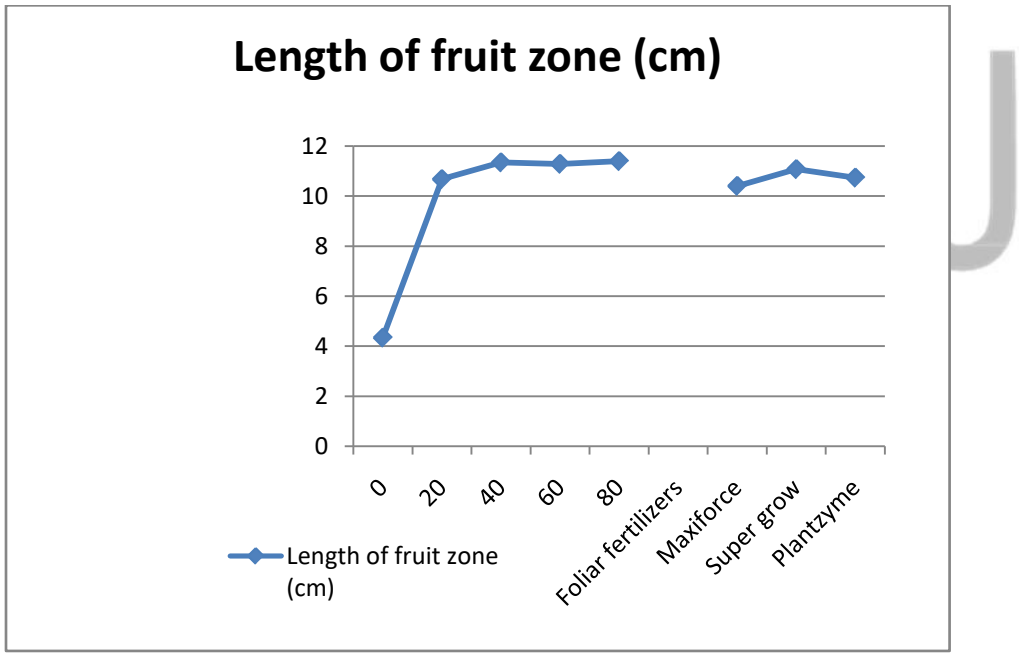

Figure 4: Effects of foliar fertilizers and nitrogen levels on length of fruit zone

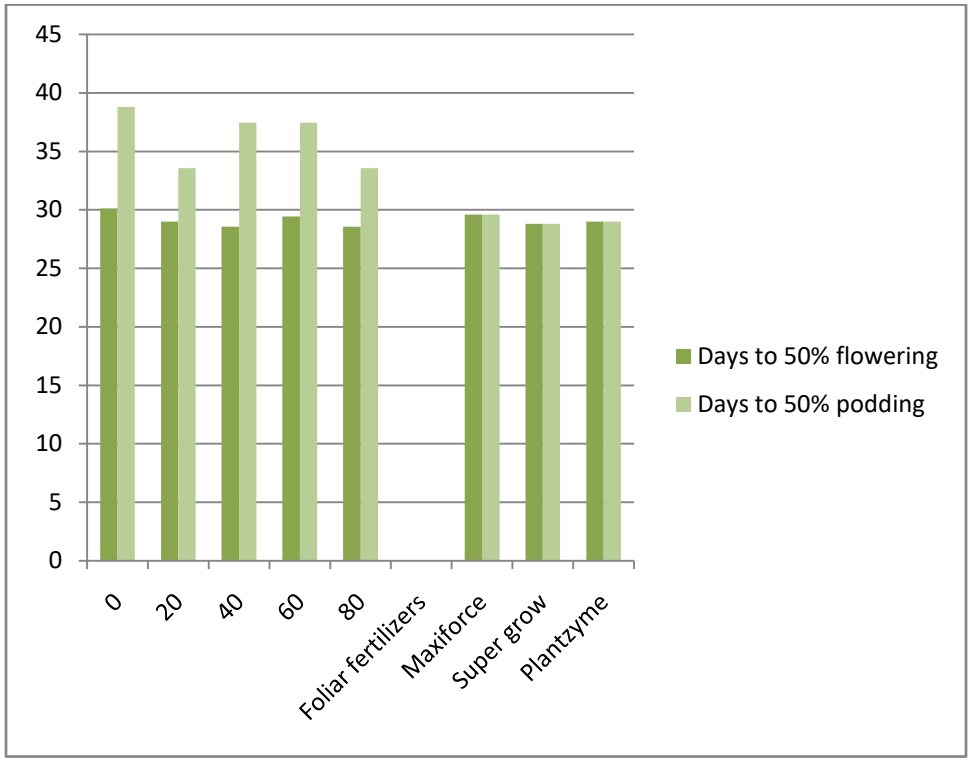

Figure 5: Effects of foliar fertilizers and nitrogen levels on length of fruit zone

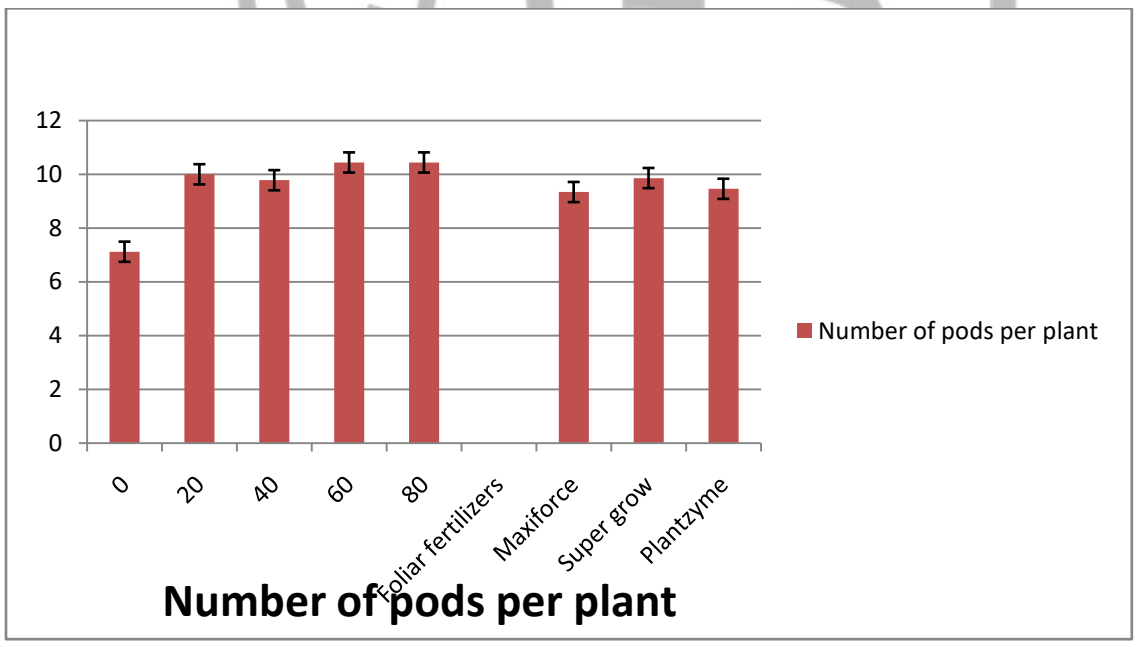

Figure 6: Effect of foliar fertilizers and nitrogen levels on number of pods per plant

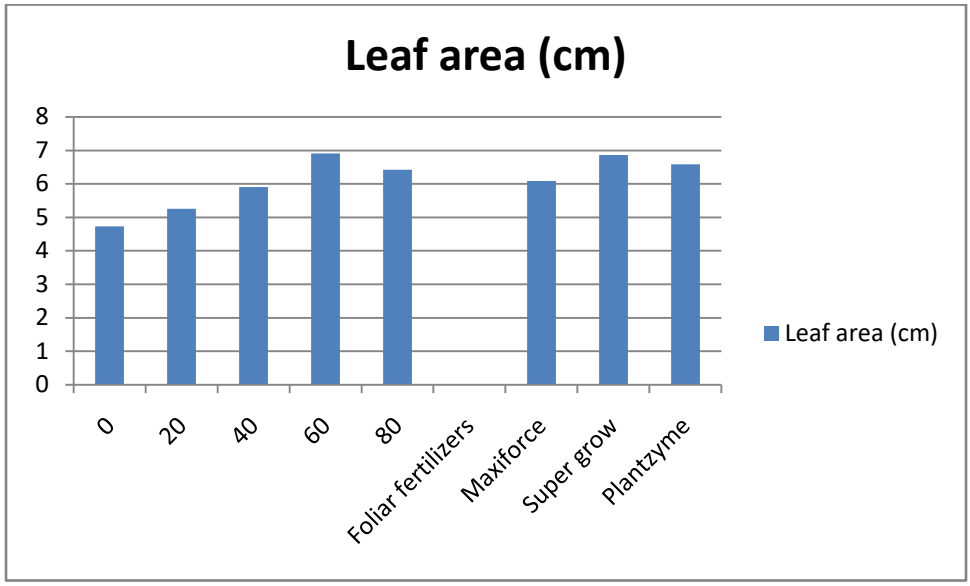

Figure 7: Effects of nitrogen rates and foliar fertilizers on leaf area

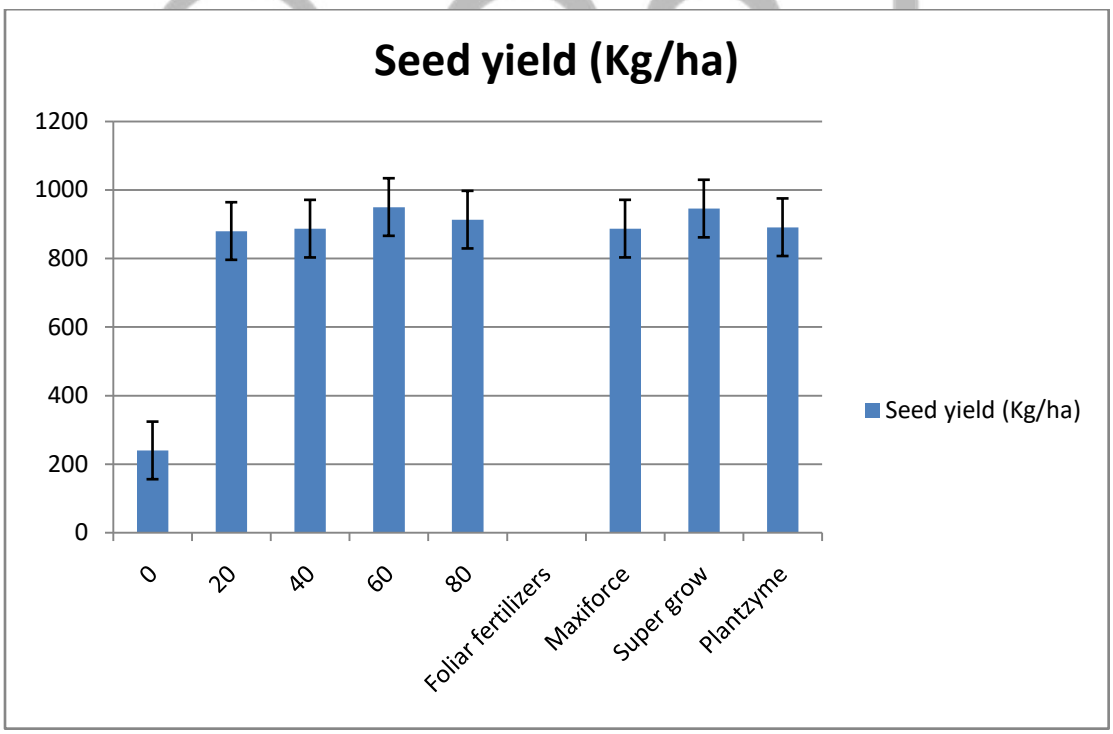

Figure 8. Effect of foliar fertilizers and nitrogen levels on seed yield.

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