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IMPACT OF BIO-ENZYMES ON PLANT GROWTH AND MATURATION IN VEGETABLE CROPS

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Abstract:

In the fast-multiplying population there is a need for alternative modes of agriculture in that organic farming is a major concentrating research area in synthesizing nutrient-rich agricultural products. Bio-fertilizers, bio-composites, and bio-enzymes are the major components of organic farming. In this study, we are going to examine the potential of bio enzymes on plant growth and development. Eco-enzymes are the solutions (natural compounds) produced during the fermentation of fruit peel and vegetable peel waste. The present investigation was carried out in PSG College of Arts & Science, Coimbatore district. In this present investigation, bio-enzymes were collected from mixed fruits and citrus peels for the propagation of vegetable crops and the process involves optimizing the composition of Bio enzymes prepared using orange peel and Mixed fruit peel (includes banana, apple, papaya, etc.), jaggery, sugar, and water. The aim was to create an easy and affordable method for producing bio-fertilizers from waste products.

***Keywords*: Organic farming, Bio-enzymes, Fruit wastes, Bio-fertilizers, Plant growth.**

Introduction:

India's main sector is agriculture. Agriculture is a key source of employment and Gross Domestic Product (GDP) in India, hence it is critical to the country's economic prosperity. As a result, it is vital for a country like India to guarantee that agriculture stays profitable.**[1]** Vegetable crops account for only 2.8% of total farmed land in India, Despite an 11.0% increase in vegetable area. The country's vegetable production has expanded substantially over the previous decade, land area, yield, and efficiency increased by up to 60% and 44.7%, respectively. According to FAO statistics 1998, the entire global vegetable production from an area of 40 million hectares is 606 million tonnes. The production, preservation, processing, and retailing of vegetables are known as olericulture. Vegetables are rich in vitamins and minerals such as B-carotene,

vitamin B, folic acid, vitamin C, vitamin E, dietary fibers, carbohydrates, protein, and energy and have a low calorific value**.[2]**

However, in recent years, numerous geographical areas have frequently suffered production issues due to changes in the climate, a lack of downpours, and nutrient-depleted soil. Farmers frequently use chemical fertilizers, herbicides, and insecticides in the hopes of achieving a better output. Although these chemicals initially produce beneficial outcomes, in the long run, they deplete soil nutrients by harming beneficial microbes and making the soil even more barren. Furthermore, hazardous herbicides and insecticides infiltrate groundwater during irrigation. Making cost-effective and environmentally friendly products with desirable qualities and long life is a big concern. Using natural fertilizers such as bio-enzymes and bio-composites to improve soil quality is an easy and convenient solution to avoid all of these issues. Soil treated with bio-enzymes becomes more fertile, promotes healthy plant growth, and can help keep insect diseases at bay.**[1]**

A bio-composite is composed of a natural fiber matrix (resin) for reinforcing, as well as inorganic and non-polymeric components that guard against environmental deterioration and improve mechanical strength. Bio-composites are low-cost materials that have the potential to improve soil texture, prevent pathogen growth, improve soil nutrient quality, and increase plant production. Because they are natural fertilizers, bio-composites protect the environment from contaminants. Enzymes extracted from agro-waste are exploited as bio-catalysts to improve compost decomposition, micronutrient release, cell metabolism, cell division, and crop growth. Thus, the ingestion of bio-enzymes assists in the appropriate division of nutrients present in fiber or biomass, resulting in rapid development.**[3]**

Bioenzyme:

Eco-enzyme is an organic substance that can be derived from citrus fruit peels or garbage, besides different sources. It is a complicated solution developed from fresh kitchen trash such as vegetable and fruit peels. It is a vinegar developed by fermenting food waste with sugar to produce alcohol. The extraction and production of eco-enzymes not only reduces the accumulation of organic waste but also serves as a replacement for synthetic chemicals that are hazardous to both human health and the environment.

Eco enzymes are enzymes generated naturally from plants, fungi, and bacteria. These enzymes are used in several sectors, such as the processing of food, treatment of wastewater, and biological remediation. Because of their inherent characteristics, eco enzymes have the potential to be more successful than synthetic enzymes in some applications **(4).** Bio enzymes are entirely organic and assist in waste reduction because their main ingredients are fruit and vegetable peels, which are considered trash and discarded. They are entirely organic, non-hazardous, non-corrosive, and non-toxic liquids **(5).**

Materials and method:

Preparation of Raw Materials:

Selection of soil:

Good quality red soil is chosen to create a favorable environment for the plant and to form a good composite. Soil is chosen based on its nutrient value, porosity, and water absorption capacity, among other factors. It is sieved effectively to remove undesirable particles before usage **(3).**

Coconut husk fibers:

The coconut is transformed into dry jute. It is also known as coir. It possesses a large pore space, a high moisture retention capacity, a moderate biodegradation rate, a low bulk density, and is renewable. It is low in weight and high in nutrients. It is powdered after it has been ground. This is done so that it easily mixes with other components and the resulting composite has good resistance. This compound will also aid in water retention, ensuring optimum hydration of the plant root **(6).**

Plants selected for study :

Tomato, Brinjal, Okra, Chilli, Green gram, Coriander and fenugreek

Potting mixture :

The potting mixture is prepared with 30% cocopeat, 30% sand, 40% red soil, and 5ml of bio-enzyme. Along with the potting mixture, two different seeds were mixed separately for the propagation of flowering crops. We can also use charcoal, cow dung, and vermiculite in the mixture. We used plastic cups for the growth of seedlings and holes were made for aeration and removal of excess water. Sprayers are used for sprinkling water to avoid the overuse of water (**6**). Seed germination was calculated on the fifth and seventh days.

Root & shoot length was measured in centimeters. Seed Germination percentage was calculated using the formula (**7**).

$$\text{Seed Germination \%} = \frac{\text{Number of seeds germinated}}{\text{Total number of seeds sown}} \times 100$$

Statistical analysis :

Data analysis and graphical representation were done by using GraphPad Prism version 10.1 software.

Preparation of Bio-Enzymes :

The peels of fruits ingested were collected for analysis. Ripe fruits can be used to develop eco-enzymes from fruit sources. To optimize the surface area of the reaction and speed up decomposition, the peels were shredded into smaller pieces. To develop bio-enzyme, 10 liters of water and 900 g of fruit remnants are used **(3).** Jaggery (10g), peels (30g), and water were combined in an airtight plastic container in the ratio of 1:3:10

for 100 ml. A bit of yeast was then added. This fermentation process will generate gases. As a result, we selected plastic containers because they can expand, whereas glass bottles might explode. The containers were then left untouched in a dark and cool place for at least a month to allow the fermentation process to complete. Gases must be released from the containers at varied time intervals by opening the lid of the plastic containers for a few seconds and closing the lid again **(5).** Bubbles forming on the bottle's walls indicate that the reaction is proceeding properly **(6).** After a few days, the gases will begin to dissipate, and after a month, a colored liquid will be generated, along with small particles and some solid residue. The raw bio-enzymes are in the liquid portion, which must be separated by filtration. After 1.5 months, the raw liquid sample was filtered, and the bio-enzyme solution, after being filtered, was carefully stored in its dedicated bottle. **(5).** The developed eco-enzyme is capable of being used as a natural fertilizer for plants and to disinfect surfaces **(4).**

Result and Discussion :

The obtained results show that the application of bio-enzymes enhances plant growth and development. In the three treatments, the germination and plant growth were significantly higher in the treatment with bioenzyme than in the control. This enhancement of growth in bio-enzymes may be due to the presence of soluble sugars, carbohydrates, proteins, organic acids, vitamins, etc. To support the study (**8)** examined the effect of bio enzymes on chlorophyll content and photosynthetic activity which can be affected due to the decrease in nitrogen level in the soil, which ultimately affects plant growth. The study results show there is a significant increase in the chlorophyll content on treated with bioenzymes. The research aimed to investigate the impact of bio enzymes on various parameters. The finding indicates that the application of bio enzymes restores fertility to barren land by many physiological conversions like converting ammonia to nitrate is one among them. The application of bio enzymes improves soil quality and fertility due to the increase of beneficial microbes in the soil. These bio enzymes were even exploited as weedicide, fungicide, and insecticide, and the response was also recorded as positive in the study, they can also act as plant growth regulators **(1).**

(9) conducted a field investigation to assess the impact of bio-enzymes on chili growth, yield, and quality. The study findings indicated enhanced growth and development in all stages when various combinations of bio-enzymes were applied. Moreover, utilizing minimal amounts of fertilizers in combination with bio-enzymes not only led to improved plant performance but also resulted in cost reduction and decreased reliance on chemical fertilizers in production**. (8)** In their study, they aimed to evaluate the efficacy of an environmentally friendly bio-enzyme, on biochemical and oxidative stress parameters of mung (Vigna radiate). The research results have a positive impact and a significant enhancement in photosynthetic pigments across all treatments. Additionally, in the leaves of mung, the biochemical content(protein and carbohydrate) also increased**. (10)** conducted research during the rabi season. The outcomes of the result demonstrated that foliar spray of bio-enzymes improved brinjal yield, growth parameters, and morphology of fruit. Nowadays new formulations of bio-enzymes from the seaweed are isolated, studied, and exploited as plant growth regulators. **(11)**experimented with the seaweed extract bio enzyme on mungbean and the result

demonstrated that even a small amount of seaweed extract increases the germination, growth (root and shoot length), and the biochemical composition of mung bean. The study was conducted on experimenting with the potential of seaweed extract as a bio-enzyme in different stages of pepper and observed that the plant responded positively to the extract in all aspects like fruit set prior to the actual time, yield, fruit morphology, and also in biochemical composition **(12).** The study on the impact of bio-enzymes as a foliar spray on the agricultural productivity of tomatoes and the outcomes of the result shows there is a significant increase in the biochemical composition and the yield of the fruit. The yield can further be enhanced when applied in large amounts **(13).**

Figure 1 GERMINATION OF PLANTS ON TREATMENT WITH BIO-ENZYMES

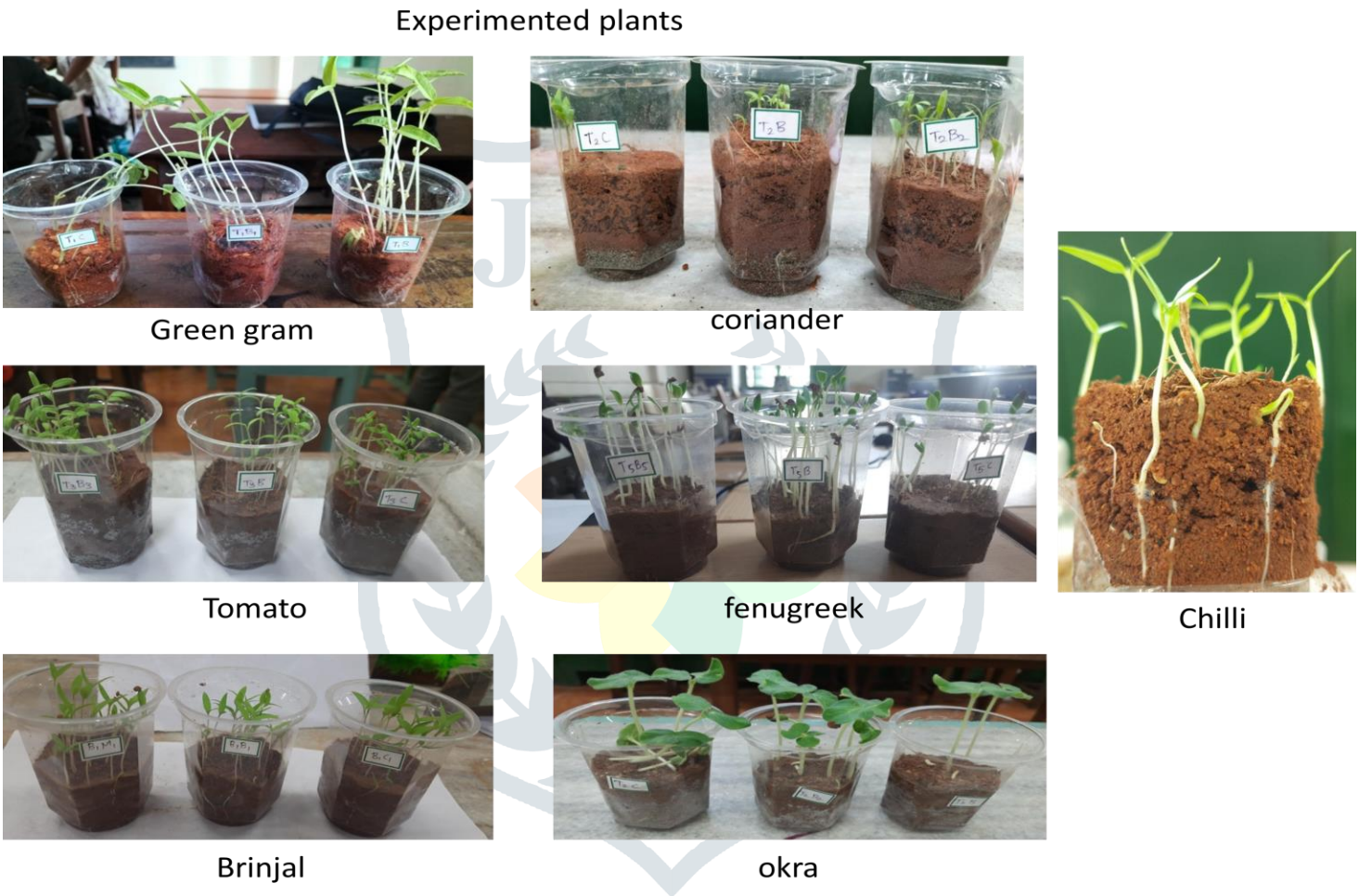


Figure 2 EXAMINATION OF ROOT AND SHOOT LENGTH

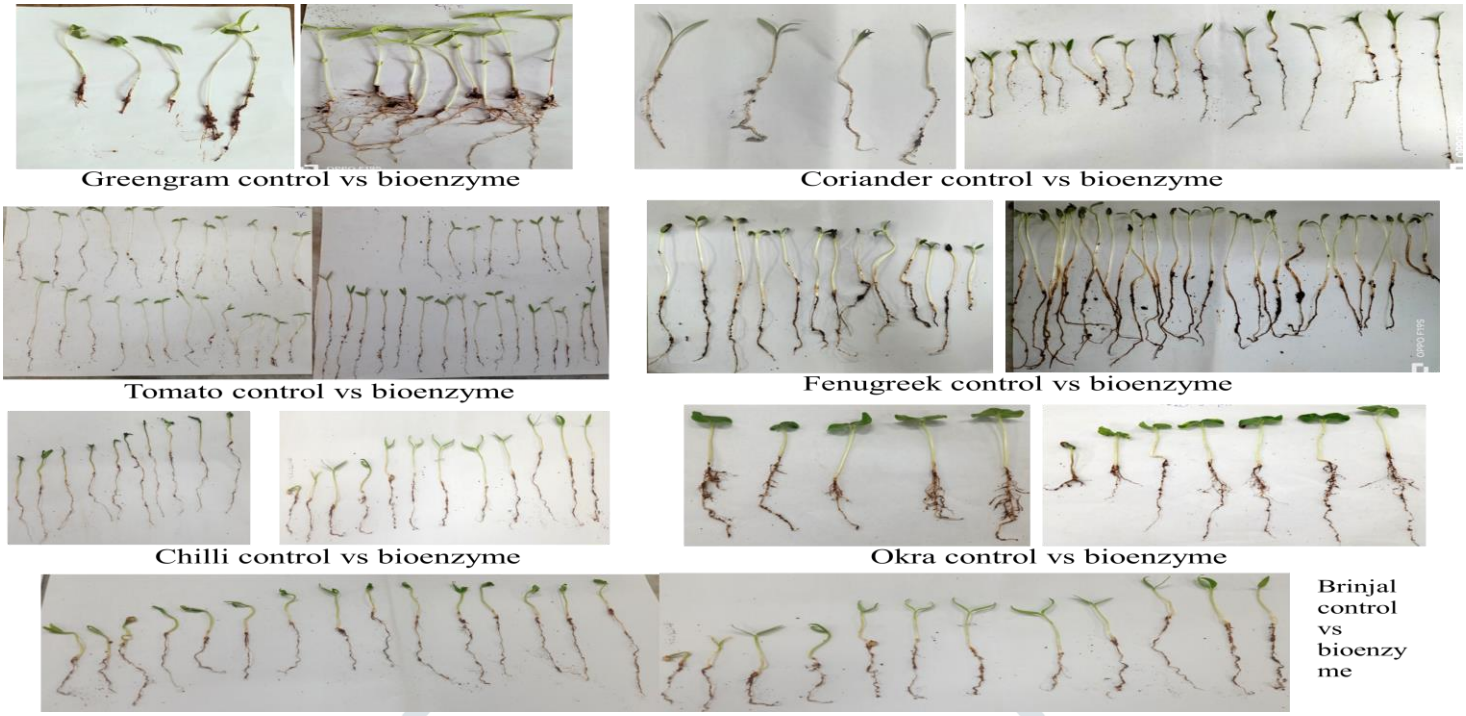
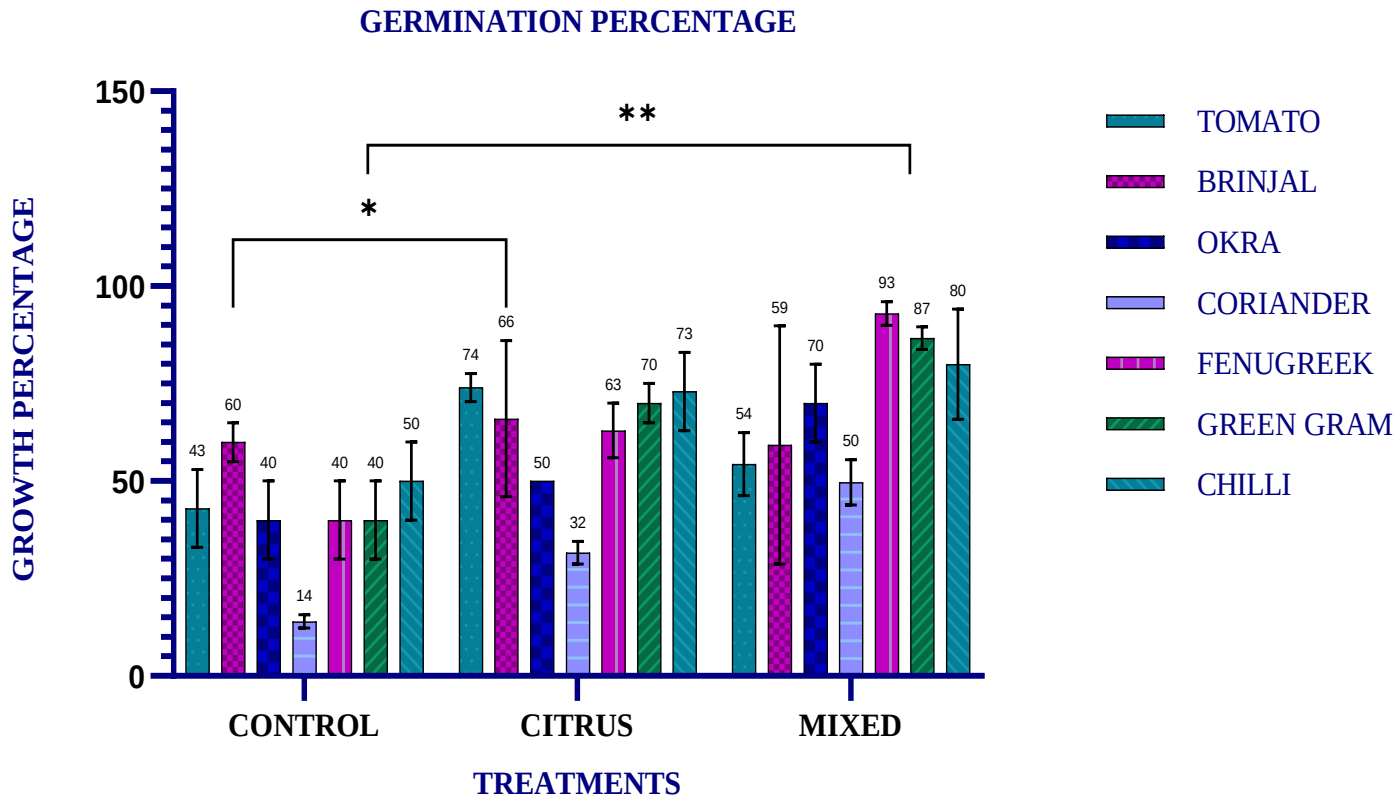


Figure 3 GRAPHICAL REPRESENTATION OF GERMINATION PERCENTAGE, ROOT AND SHOOT LENGTH



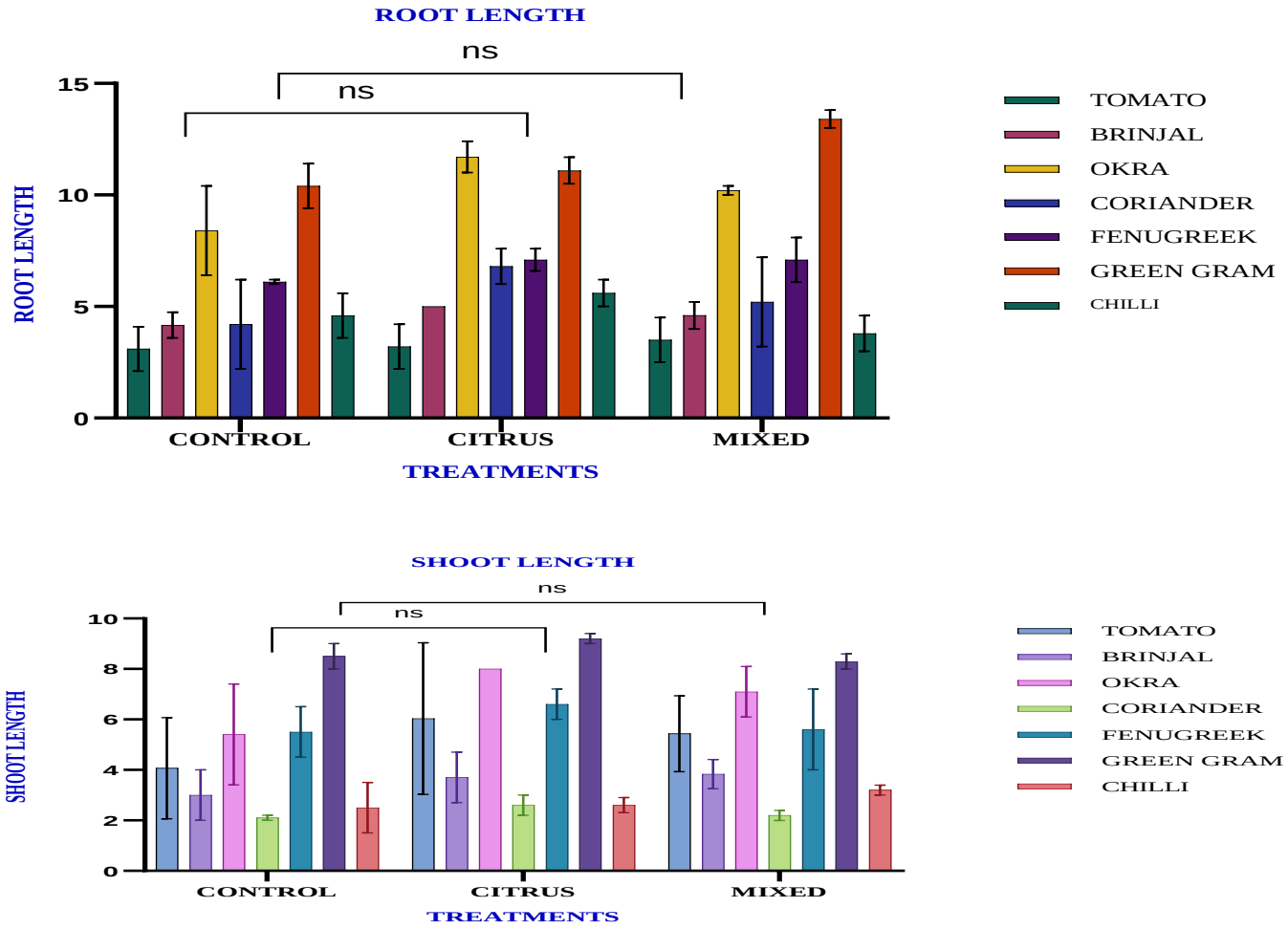


Figure 3 Represents the validation of bio-enzymes on the germination and growth of root and shoot ***p** < 0.05 and ****p** < 0.01 and the * represents a significant difference, and **ns** represents non-significant, between control, citrus bio-enzymes and mixed bio-enzymes.

Conclusion:

The study findings demonstrate that the implementation of bio-enzymes especially by the mixed fruit bio-enzymes, enhanced the germination and both the bio-enzymes improved the shoot and root length of the plants than the control in which green gram showed better growth and development than the other examined plants. In the future, the work will proceed by identifying the active compounds responsible for the enhancement and other physiological development, and other beneficial activities of the isolated compound. After examination of the compounds mass production of bioenzymes is initiated and examined under a field environment and then used as biofertilizer.

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