J. Egypt. Acad. Soc. Environ. Develop., 25 (1):97-111 (2024) **(D-Environmental Studies)**
E. mail: easedjournal_egypt@yahoo.com **ISSN 1110-8770**
www.jades.journals.ekb.eg **eISSN 2314-5471 (online)**

Impact of NPK and compost tea on quality of maize

Ibrahim F.M. Ahmed
Faculty of Agriculture, Bani Walid - University of Bani Walid, Libya

Received: November 10, 2024
Accepted: December 15, 2024

ABSTRACT

This field experiment was conducted in Sof Al-Jin Farm in Bani Walid, Libya, during the agricultural winter season 2023 to study the effect of NPK and compost tea on vegetative growth, yield and chemical composition of maize cv." Giza 3084". This experiment consisted of six treatments arranged in a Randomized Complete Block Design (RCBD) design with three replicates for each treatment. These treatments were (control (untreated), NPK (20-20-20) at 150 kg/ha, compost tea (CT) at 200 l/ ha, CT at 300 l/ ha, CT at 400 l/ ha, NPK + CT at 400 l/ ha. Vegetative growth traits, yield component and some chemical properties of maize were studied. The results indicated significant increase by increasing compost tea rates in all vegetative growth traits of maize under study (plant height, No. of leaves/plant, stem diameter, leaf area index, total chlorophyll), yield and yield components (ear length, ear diameter, ear weight, number of grains/ ear, 100-grain weight, grain yield, biological yield, harvest index) and chemical composition (nitrogen, phosphorus, potassium and protein percentages) showed. However, mixed of NPK + CT at 400 l/ ha recorded the highest values of all vegetative growth, yield and yield component and chemical composition were studied, followed by compost tea (CT) at 400 l/ ha, as compared to control treatment which recorded the lowest values of all vegetative growth, yield and yield component and chemical composition of maize. Therefore, the need to adapt more resilient agricultural production systems allows for the consideration of compost tea as an alternative to mitigate environmental problems and soil degradation.

Keywords: Maize (*Zea mays* L.), Compost tea, NPK, vegetative growth, yield and yield components, chemical compositions.

INTRODUCTION

Maize, also referred to as corn, is a crop that is grown in vast amounts all over the world (Suleiman *et al.,* 2013). The grass family includes maize (*Zea mays* L.), according to Badu-Apraku and Fakorede (2017). Maize is a key grain crop grown in a variety of soil types and climates in both temperate and tropical places worldwide (Khaeim *et al.,* 2022). The three most important cereal crops grown worldwide are maize, wheat (*Triticum aestivum*), and rice (*Oryza sativa*). However, maize is consumed more often due to its low cost, ease of digestion and processing, and high yields (Awopegba *et al.,* 2017).

Araújo *et al.* (2023) claimed that maize is a highly nutritious crop that is frequently eaten by both people and animals. It is also used as a raw material in the production of biofuels. However, because maize consumes a lot of nutrients, it requires careful fertility management to get the optimum yields. Gul *et al.* (2015) state that the three main nutrients that maize need are potassium, phosphorus, and nitrogen. However, extremely modest levels of numerous micronutrients, such as calcium, magnesium, and sulfur, are required. Continuous use of inorganic fertilizers alone has been found to regularly reduce soil fertility over time, ultimately leading to poor crop development. The ongoing use of inorganic fertilizers to boost agricultural productivity has made it riskier for people, animals, and the environment because they leave behind heavy metal residues, some of which are lethal (Awopegba and Awodun, 2023). Large-scale food production requires both organic and inorganic fertilizers, but it has been shown that organic fertilizers are environmentally safe because they protect the delicate ecosystem (Fayose, 2022).

Fertilization is frequently used to boost soil fertility and productivity, with corresponding changes in soil characteristics and microbial communities. It has been demonstrated to be a beneficial agronomic practice globally (Hu *et al.,* 2018; Liu *et al.,* 2020). In order to meet the growing population's demand for food, synthetic fertilizers, such as those containing nitrogen (N), phosphorus (P), and potassium (K), have been applied more frequently. However, excessive and prolonged use of synthetic fertilizers can lead to agro-ecosystem hazards such groundwater contamination, crop productivity and biodiversity declines, and soil acidification (Holub *et al.,* 2020).

Although synthetic nitrogen (N) fertilizer has greatly increased soil fertility and productivity, overuse of this fertilizer can endanger agroecosystems by reducing biodiversity, acidifying the soil, and contaminating groundwater. In the meantime, organic substitution has drawn more attention due to its advantages for production and the environment. Furthermore, NPK fertilizers which are made up of nitrogen, phosphorous, and potassium offer nutrients in a form that plants can absorb straight. The primary ingredient of NPK fertilizers, nitrogen, is necessary for plants to grow vegetative, phosphorus aids in the formation of the root system, and potassium boosts photosynthetic. Granulated solid organic fertilizer and NPK fertilizer are predicted to work in concert to maximize the yield of sweet corn cultivated in Inceptisol soil, boost plant uptake of nitrogen, and raise the soil's N-total content (Singh *et al.,* 2017). Granulated solid organic fertilizer has been shown to enhance soil quality overall, particularly by raising soil microbiological activity and organic matter content. Decomposed organic materials, like compost or manure, is converted into granules to create granule solid organic fertilizers. In addition to supplying macro and micronutrients, these fertilizers help enhance soil structure, boost water retention, and improve plant nutrient absorption efficiency **(**Reganold and Wachter, 2016).

Granule solid organic fertilizer and NPK can work in concert to sustainably supply the nutrients that plants need, boosting nitrogen uptake, raising the soil's N-total content, and maximizing the yield of sweet corn (Sohi *et al.,* 2019). Fertilization is frequently used to boost soil fertility and productivity, with corresponding changes in soil properties and microbial communities. It has been demonstrated to be an effective agronomic practice globally (Hu *et al.,* 2018; Liu *et al.,* 2020). In order to meet the growing population's demand for food, synthetic fertilizers, such as those containing nitrogen (N), phosphorus (P), and potassium (K), have been applied more frequently. However, excessive and prolonged use of synthetic fertilizers can lead to agroeco-system hazards like groundwater contamination, crop yield and biodiversity declines, and soil acidification (Holub *et al.,* 2020). Through microbial action, composting is a technique for treating organic waste that turns degradable organic matter into stable compost. Because of its high organic carbon content and active functional groups, compost helps crops grow, improves their resistance to biotic or abiotic factors, absorbs and immobilizes pesticides, and lowers heavy metal contamination (Yao *et al.,* 2023). In the 1990s, producers and researchers became interested in water-based compost preparations, leading to a variety of terms and preparation techniques (Scheuerell and Mahaffee, 2002). Compost tea, aerated compost tea, organic tea, compost extract, aqueous fermented compost extract, amended extracts, steeping, and sludges are some of the terms used to refer to compost preparations. It is important to note that some of these terms are interchangeable or can be mistaken for other ideas (Litterick *et al.,* 2004). Compost tea, then, is a fermented liquid organic preparation of composted materials along with tap water in a ratio of 1:5 or 1:10 (v/v), either with or without aeration, and optionally with nutrient additives. The beneficial microorganisms (bacteria, actinomycetes, filamentous fungi, oomycetes, and yeasts) and soluble nutrients found in compost teas work in concert to fight phytopathogens, preserve soil fertility, and boost agricultural yields (Wang *et al.,* 2022). In comparison to synthetic fertilizers, ruminant compost, and municipal solid waste compost, Hargreaves *et al.* (2009) found that giving strawberry plants compost tea foliarly produced comparable levels of most macronutrients and micronutrients. A nutrient-rich solution known as compost tea is made by fermenting compost in water to extract nutrients, soluble organic matter, and helpful microorganisms (Affendy-Lee, 2022). It has been proposed as a possible substitute for synthetic fertilizers in order to enhance soil health and encourage plant growth (Abou-ElHassan and El-Batran, 2020). After straining, the liquid is finally obtained as compost tea, which can be applied straight to the plants. Compost tea can be applied to the soil in the direction of plant roots (soil drench) or sprayed on leaves (foliar spray). It improves the soil's overall fertility by introducing nutrients and beneficial organisms when applied as a soil drench (Ralph, 2023). When applied as a foliar spray, it gives the plant nutrients directly and can aid in the management of foliar diseases (Rick, 2020). Organic amendments, which are recyclable bioenergy sources, supply enough carbon (C) and a portion of the N and P needed to support the growth of plants and the proliferation of microorganisms (Hu *et al.,* 2018; Geng *et al.,* 2019). The combined application of organic and inorganic fertilizers can increase crop yield by promoting nutrient uptake and dry matter accumulation, according to numerous researchers who have examined the effects of partial manure substitution on crop yields over the past 20 years (Iqbal *et al.,* 2020). Applying inorganic and organic fertilizers together has recently emerged as a notable technique for boosting soil fertility and productivity and aiding in fertilization strategy optimization (Akhtar *et al.,* 2019). On the other hand, organic amendments produce a more stable bacterial community, whereas prolonged overuse of inorganic N fertilizers adversely impacts bacterial richness and diversity, leading to a decrease in the stability of bacterial community structure (Kavamura *et al.,* 2018).

Compost teas are extracts of oxygenated compost water made by a suitable liquid-phase blowing method. One way to make compost tea is to ferment compost in water for a while. This process extracts nutrients, soluble organic matter, and beneficial microorganisms from the watery solution (Zaccardelli *et al.,* 2018). Though there aren't many field studies comparing the brewing techniques, research on compost tea technology started in the USA in the 1980s. In order to extract anaerobic microbes and nutrients that are used and applied to promote plant health and vitality, a bag of compost was suspended in a container of water for 14 days in the past to create a homemade compost tea extract known as "passive" or non-aerated compost tea (NCT) (Kim *et al.,* 2015). In order to increase the biological activity of the compost tea, which contains aerobic microbes and nutrients, aerated compost tea has recently been brewed in large-scale mechanized equipment for shorter periods of time. It is frequently supplemented with oxygen, nutrients, and microbial starter cultures (Sujesh *et al.,* 2017). In addition to improving the physical and chemical characteristics of soil and suppressing certain plant pathogens, compost tea is a rich source of nutrients, organic compounds, and beneficial microbes that have a positive impact on the plant rhizosphere. It is regarded as a soil amendment and has positive effects on plant growth (Abou-El-Hassan and El-Batran, 2020).

Therefore, the main objective of this research was to evaluate the effect of NPK and compost tea on vegetative growth, yield and chemical composition of maize cv."Giza 3084"

MATERIALS AND METHODS

This study was carried out during 2023 season on maize cv. "Giza 132" cultivar were grown in Private farm in Bani Walid, Libya, to evaluate the effect of NPK and compost tea on vegetative growth, yield and chemical composition of maize cv."Giza3084". This experiment consisted of six treatments arranged in a Randomized complete Block Design (RCBD) design with three replicates for each treatment.

The treatments of this experiment could be summarized as follows:

1. Control (Untreated)
2. NPK (20-20-20) 150 kg/ha
3. Compost tea (CT) at 200 l/ ha
4. Compost tea (CT) at 300 l/ ha
5. Compost tea (CT) at 400 l/ ha
6. NPK (20-20-20) 150 kg/ha + (CT) at 400 l/ ha

Preparation of compost Tea:

Concentrated solution of compost tea was prepared by soaking 10 kg compost in 50L of water without chlorine (at rate 1:5) for three days with air pumping continuously during the period of soaking by an air pump then was filtrated by plastic net. The same procedures were followed to prepare concentrated solutions of different types of enriched compost tea with adding 100 ml of algae, azolla or yeast extracts at the beginning of compost soaking. Spirulina algae extract produced by the Soil, Water and Environmental Research Institute was used. Azolla extract was prepared by grinding fresh azolla in a blender. Yeast extract was prepared by adding 20 g of dry yeast with 20 ml of molasses and adding water to a volume of 100 ml; these ingredients were transported to a non-sealed liter container and left for 12 hours. All concentrated compost tea types were diluted by water without chlorine at rate 1:10 according to Abou-El-Hassan (2010).

The mineral fertilizers of N, P and K were applied as follow: calcium super phosphate was added as one dose during soil preparation, whereas ammonium sulphate and potassium sulphate were added at three equal portions, after 2, 4 and 6 weeks from planting. All compost tea types were applied to the soil surface weekly at a rate of 1l/ m^2. Compost tea treatments started after one week from sowing seeds and continued for two months.

Experimental design

Each treatment was replicated three times which was set up using a randomized complete block design (RCBD). The experiment was conducted in 2023

, from December 5. Treatments were the control (untreated), NPK (20-20-20) fertilizer at 150 kg/ha, compost tea at three concentrations (200. 300, 400 l/ ha), and NPK (20-20-20) fertilizer at 150 kg/ ha plus compost tea at 400 l /ha.

Data recorded

A) Vegetative growth

- **Plant height:** Plant height is measured by taking a measurement from the base of the stem to the plant's highest growth point.
- **Number of leaves:** Counting the number of leaves is done by counting the leaves that have opened completely
- **Stem diameter:** Measurements were carried out on the second segment from the bottom of the soil using a caliper
- **Leaf area (cm^2):** Leaf area was measured using the ALA method (Average Leaf Area) which can be done nondestructively (Widaryanto *et al.,* 2019).

- **Chlorophyll content:**
- The chlorophyll content of the plant leaves and the total chlorophyll values were determined using the SPA-502 chlorophyll meter (SPAD-502, Konica Minolta Sensing, Inc., Japan).

B) Yield and yield components

The maize plants were harvested at full maturity (i.e. after 16 weeks), ten plants were randomly taken from each plot to record the average of the following traits:

- Ear length (cm)
- Ear diameter (cm)
- Ear weight (g)
- Number of grains/ear
- **100-grain weight (g):** adjusted to 15.5% moisture content.
- **Grain yield (t/ha):** Average grain yield/ (1met. length of 5 central rows) were estimated for each plot and the yield of grains /ha was calculated.
- **Biological yield (t/fad):** was determined using the following formula:
  Biological yield = (Grain yield + Straw yield)
- **Harvest Index (%)** =Economic yield (Grain weight) Biological yield (Total dry weight) × 100 It was expressed in percentage.

C) Chemical composition

- **Nitrogen (%):**
  Micro-Kjeldhal method was used to determine N content of maize grain (Anonymous, 1990).
- **Phosphorus (%):**
  Phosphorus was determined by the Vanadomolyate yellow method as given by Jackson (1973) and the intensity of color developed was read in spectrophotometer at 405 nm at the three growth stages.
- **Potassium (%):**
  Potassium was determined according to the method described by Jackson (1973) using Beckman Flame photometer at the three growth stages.
- **Protein (%):**
  Crude protein (%): was calculated by using the following formula: Crude protein % = Nitrogen × 5.75

Statistical analysis:

Results of the measured parameters were subjected to computerized statistical analysis using MSTAT package for analysis of variance (ANOVA) and means of treatments were compared using LSD at 0.05 according to Snedecor and Cochran (1990).

RESULTS AND DISCUSSION

A) Vegetative growth

It was obvious from results in Table (1) and Figure (1) that the treatment of mixed NPK + CT at 400 l/ha recorded the highest value of plant height (298.25 cm), number of leaves/plant (15.85/ plant), stem diameter (3.87 cm), leaf area index (6.58 cm^2), total chlorophyll (58.85 SPAD), followed by treatment of CT at 400 l/ha which recorded plant height (289.55 cm), number of leaves/plant (15.29/ plant), stem diameter (3.53 cm), leaf area index (6.25 cm^2), total chlorophyll (55.66 SPAD), as compared to the control treatment which recorded the lowest values of plant height (175.08 cm), number of leaves/plant (12.17/ plant), stem diameter (1.94 cm), leaf area index (3.40 cm^2) and total chlorophyll (44.25 SPAD). This is presumably because the application of compost tea through the leaves is more quickly absorbed by plants than that given through the soil. The compost tea given to the leaves has a more significant effect on the growth and dry weight of corn plants compared to that given to the soil. There is a correlation between plant height and P uptake, meaning that as plants absorb more P during the vegetative period, their height increases (Rifai, 2006). P is crucial for both cell division and the growth of meristem tissue (Syarief, 1986). Therefore, P can promote the growth of roots and young plants, hasten the flowering and ripening of fruit, seeds, or grain, and is also a component of protein and fat. During the vegetative phase, N plays a crucial role in helping to form photosynthetic energy, which is subsequently utilized to form new cells, elongate existing cells, and thicken tissue (Sugito *et al.,* 2002). Furthermore, Winarso (2005) noted that raising the amount of N fertilizer in the soil can directly raise the amount of protein and yield of corn plants. N availability likely contributed to the increased leaf area in soil amended with organic fertilizer by promoting leaf area during vegetative development and maintaining functional leaf area during the growth period (Mojeremane *et al.,* 2015). The leaf area index is a crucial aspect of plant growth because photosynthesis depends on a large and deficient assimilating area, enough supply of solar and CO_2, and favorable environmental conditions (Jain and Misra, 1966).

The highest LAI on the combined rates of compost and inorganic fertilizers was also reported by Masresha (2014). These results concur with those found by Gidago and Laekemariam (2012). The observed increase in stem diameter following nutrient application may have been caused by manures' activation of soil microbial biomass, which has been claimed to improve soil fertility by promoting corps development (Eleduma *et al.,* 2020). Particularly during fruiting, stem diameter has a positive impact on lodging; the thicker the stem, the less likely the plant is to lodge due to fruit carriage or other lodge-inducing factors like wind (Kashiwagi *et al.,* 2008). The fact that maize plants grew taller after applying chicken droppings indicates that the kind of manure used influences the availability of nutrients for plant uptake, which in turn encourages vigorous plant growth through effective photosynthesis (Sadur *et al.,* 2010).The increased yield characteristics that came from applying poultry manure were consistent with researches conducted by Ogar and Asiegbu (2005), Aujla *et al.* (2007) and Zainub *et al.* (2021). The stimulating effect of poultry manure, which provides the plant with nutrients needed for improved yield, may be the cause of this effect (Abdelrazzag, 2002). Udounang *et al.* (2023) claimed that applying chicken droppings boosts the growth and yield of cocoyam interpolated with melon and maize. Poultry manure application boosted maize growth, which may have been brought on by the plants' balanced nutrient availability, which created a favorable soil environment. These favorable circumstances improved the soil's ability to retain water and nutrients, which led to improved growth and yield (Rashid *et al.,* 2013). According to Gonzalez *et al.* (2001), the best results for the measured variables, such as stem width and plant height, were obtained when organic manure and chemical fertilizer were provided as necessary nutrition during the early establishment stage of growth. The stem's thickness increased when organic and inorganic fertilizers were combined (Oad *et al.,* 2004).

Table (1): Effect of NPK and compost tea on some vegetative growth of maize cv. "Giza 3084" in 2023 season.

Treatments	Plant height (cm)	No. of leaves/ plant	Stem diameter (cm)	Leaf area index (cm^2)	Total chlorophyll (SPAD)
Control (Untreated)	175.08	12.17	1.94	3.40	44.25
NPK 150 kg/ha	188.52	13.50	2.30	4.70	48.67
CT at 200 l/ ha	194.41	14.47	2.65	5.34	50.87
CT at 300 l/ ha	238.80	14.72	2.94	5.66	52.35
CT at 400 l/ ha	289.55	15.29	3.53	6.25	55.66
NPK + CT at 400 l/ ha	298.25	15.85	3.87	6.58	58.85
$LSD_{(0.05)}$	**10.55**	**0.52**	**0.06**	**0.32**	**6.28**

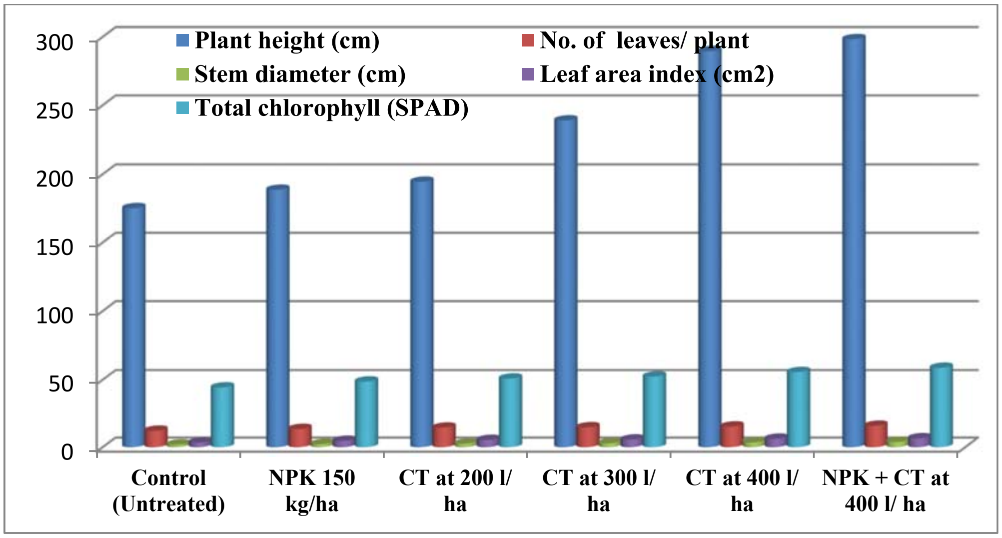

Fig. (1): Effect of NPK and compost tea on some vegetative growth of maize cv. "Giza 3084" in 2023 season.

B) Yield and yield components

Results in Table (2) and Figures (2 & 3) showed that the treatment of mixed NPK + CT at 400 l/ ha recorded the highest value of ear length (23.83 cm), ear diameter (17.88 cm), ear weight (225.31 g), number of grain/ ear (549.97), 100-grains weight (46.56 g), grain yield (8.43 t/ha), biological yield (14.70 t/ha), harvest index (57.35 %), followed by compost tea (CT) at 400 l/ ha, ear length (21.79 cm), ear diameter (16.92 cm), ear weight (211.26 g), number of grain/ ear (505.76), 100-grains weight (42.44 g), grain yield (8.20 t/ha), biological yield (14.50 t/ha), harvest index (56.55 %), as compared to the control treatment which recorded the lowest values of ear length (17.99 cm), ear diameter (11.84 cm), ear weight (140.25 g), number of grain/ ear (287.33), 100-grains weight (31.81g), grain yield (4.02 t/ha), biological yield (8.51 t/ha), harvest index (47.24 %). Because inorganic fertilizers leave behind heavy metal residues, some of which are fatal, their continued use to increase agricultural productivity has increased the risks to humans, animals, and the environment **(**Awopegba and Awodun, 2023). Both organic and inorganic fertilizers are necessary for large-scale food production; however, it has been demonstrated that organic fertilizers are safe for the environment because they preserve the fragile ecosystem (Fayose, 2022). This outcome could be explained by the plant's increased photosynthetic activity due to an adequate supply of nitrogen, which is necessary for ear growth (Fanuel and Gifole 2013). More photosynthetic activity and additional nutrients from organic or inorganic sources for plant development up to ear formation may be the cause of the increase in the number of grains per row. These results are consistent with those of Magda *et al.* (2015) and Bakry *et al.* (2009). Crop management, agronomic techniques, environmental variables, plant genetic traits, soil fertility, and water availability all affect the increase in 100-grain weight. The increased use of N, water, and other related soil-improving benefits of organic sources may have contributed to the yield improvement under this treatment by increasing plant photosynthetic efficiency. The present findings are comparable to those of Shah *et al.* (2009). According to Achieng *et al.* (2010), Afe *et al.* (2015), and Baloch *et al.* (2015), the balanced supply of nitrogen in conjunction with P and K, as well as the maximum N use efficiency from both inorganic and organic sources during the grain filling development and growth stages, were the primary causes of the increase in 100-grain weight. Incorporating organic manures may have increased the efficiency of nitrogen use, micro and macronutrient recovery, P solubilization and plant uptake, and K availability, all of which contributed to improved maize growth and yield. The application of organic manures resulted in an increase in organic matter, which enhanced soil properties and crop performance (Li *et al.,* 2010). Consequently, it is thought that applying both organic and inorganic fertilizers together is a good way to improve nutrient recovery, plant growth, and final yield; if not, higher N and P application rates are needed to increase maize yield (Mubeen *et al.,* 2013). These findings also support those of Negassa *et al.* (2001), who discovered that applying both organic and inorganic nutrients together increased corn yield by 35%. Similar outcomes with enhanced growth and yield-related traits in maize were also reported by Shisanya *et al.* (2009). Better crop growth and yield were the outcome of applying both organic and inorganic nutrient sources together, which enhanced the synchronization and synergy between nutrient release and plant recovery (Huang *et al.,* 2010). Furthermore, compared to other organic nutrient sources such as pig manure, sheep manure, cattle slurry, and ammonium sulphate, plants receiving poultry manure had higher nitrogen use efficiency (Rees and Castle, 2002). On the other hand, there was no statistically significant difference in rice yield across all plots treated with organic, inorganic, or a combination of both manures (Javier and Tabien, 2003). According to Khan *et al.* (2016), the highest biological yield of maize was obtained by combining the use of organic and inorganic nutrient sources.

Table (2): Effect of NPK and compost tea on yield and yield components of maize cv. "Giza 3084" in 2023 season.

Treatments	Ear length (cm)	Ear diameter (cm)	Ear weight (g)	No. of grain/ ear	100-grains weight (g)	Grain yield (t/ha)	Biol-ogical yield (t/ha)	Harvest index (%)
Control (Untreated)	17.99	11.84	140.25	287.33	31.81	4.02	8.51	47.24
NPK 150 kg/ha	19.88	13.30	157.76	377.76	33.26	6.84	12.15	56.30
CT at 200 l/ ha	20.20	14.67	169.54	436.30	35.21	7.50	13.74	54.59
CT at 300 l/ ha	20.85	15.81	187.83	479.68	37.83	8.00	14.30	55.94
CT at 400 l/ ha	21.79	16.92	211.26	505.76	42.44	8.20	14.50	56.55
NPK + CT at 400 l/ ha	23.83	17.88	225.31	549.97	46.56	8.43	14.70	57.35
$LSD_{(0.05)}$	**1.21**	**1.12**	**13.25**	**10.45**	**0.24**	**0.28**	**0.52**	**53.85**

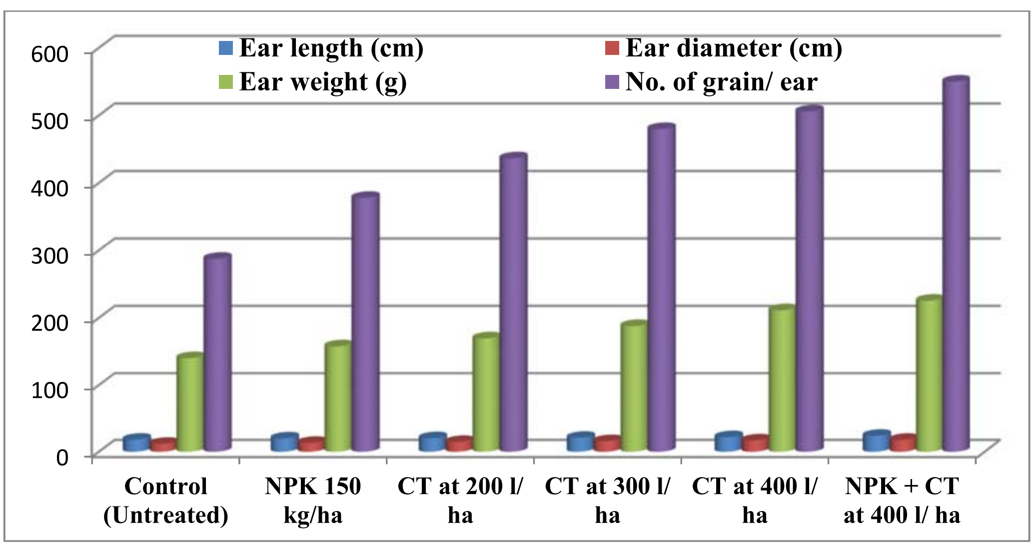

Fig. (2): Effect of NPK and compost tea on yield and yield components of maize cv. "Giza 3084" in 2023 season.

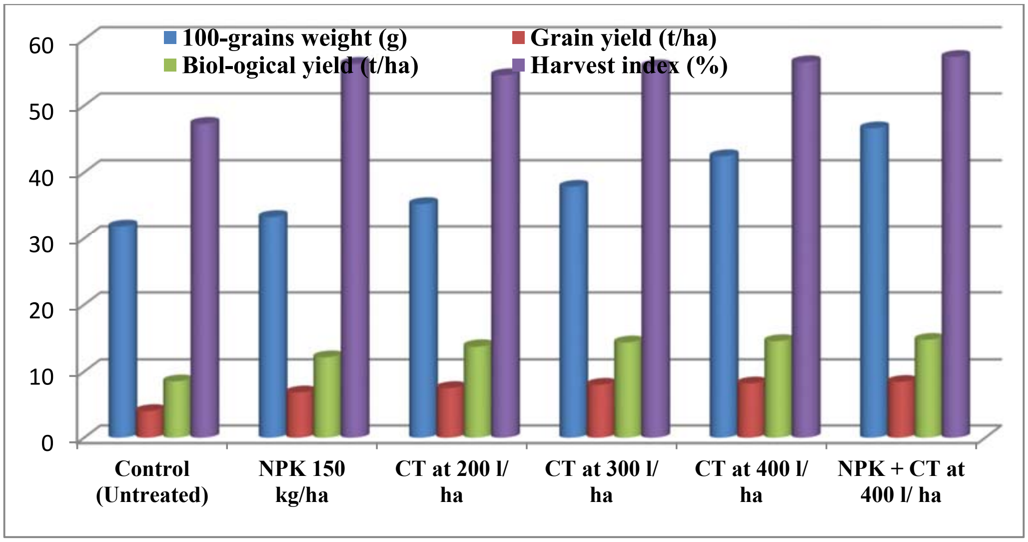

Fig. (3): Effect of NPK and compost tea on yield and yield components of maize cv. "Giza 3084" in 2023 season.

B) Chemical composition:

It was clear from results in Table (3) and Figure (3) that the treatment of mixed NPK + CT at 400 l/ ha recorded the highest value of N (2.13 %), P (0.47 %), K (3.12 %), protein (13.31%), followed by compost tea (CT) at 400 l/ ha, (1.97%, 0.21%, 2.13%, 9.75%), as compared to control treatment which recorded the lowest values of nitrogen, phosphorus, potassium and protein percentages (1.56%, 0.21%, 2.13%, 9.75%), respectively. Because chemical fertilizer is added along with organic manures and is retained in the soil, the C: N ratios in soils treated with both organic and inorganic manures may be lower. This is consistent with lower rates of N losses compared to C losses during the degradation of organic manure (Chen *et al.,* 2010). Because organic amendments greatly increased SOC, they had a significant impact on soil microbes, nutrient availability, and uptake, which may have changed the C: N ratio. The priming effect is a phenomenon whereby the addition of external organic matter with a high C: N ratio may also cause the existing organic matter to mineralize more quickly, releasing the nitrogen that has been trapped in it (Shahzad *et al.,* 2015).

In terms of the soil's nutrient status, all three organic manures combined with inorganic fertilizers increased plant growth and yield. Additionally, the soil's NPK contents significantly improved, confirming that the presence of organic manures increased the soil's nutrient use efficiency. Compared to the application of chemical fertilizer alone and/or unfertilized control, the use of organic amendments in conjunction with a lower dosage of chemical fertilizers may have increased microbial activity and nutrient availability. When combined with inorganic fertilizers, the addition of organic amendments increased the concentrations of N, P, and K in the soil (Hao *et al.,* 2008). According to Birkhofer *et al.* (2008), organic manures improve nutrient release and plant availability by having a greater positive impact on soil quality than inorganic fertilizers. The impact of adding organic materials may have increased the percentage of nutrients in leaves and stems by increasing metabolic activity within plants and encouraging metabolite migration through roots and stems toward leaves (Sikander, 2001). The addition of nitrogen from either organic or inorganic sources may be the primary cause of the rise in the protein content of maize grains. Magda *et al.* (2015) and Abdelzaher *et al.* (2017) achieved comparable outcomes.

Table (3): Effect of NPK and compost tea on chemical compositions of maize cv. "Giza 3084" in 2023 season.

Treatments	N (%)	P (%)	K (%)	Protein (%)
Control (Untreated)	1.56	0.21	2.13	9.75
NPK 150 kg/ha	1.65	0.27	2.23	10.31
CT at 200 l/ ha	1.79	0.30	2.57	11.19
CT at 300 l/ ha	1.89	0.34	2.83	11.81
CT at 400 l/ ha	1.97	0.38	2.95	12.31
NPK + CT at 400 l/ ha	2.13	0.47	3.21	13.31
$LSD_{(0.05)}$	**0.03**	**0.02**	**0.02**	**0.19**

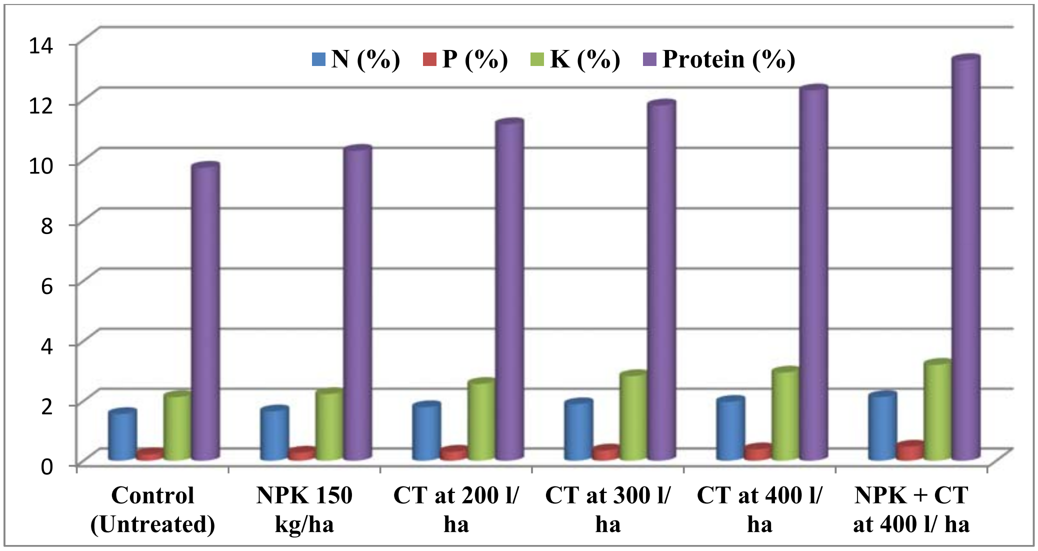

Fig. (3): Effect of NPK and compost tea on chemical compositions of maize cv. "Giza 3084" in 2023 season.

Conclusion

The combined applications of compost tea and chemical fertilizer have proved superior and have noticeably contributed to the soil properties and the performance of maize. In subtropical conditions, integrated manures and fertilizers can enhance soil fertility status and increase maize productivity during winter conditions.

EFERENCES

Abdelzaher, M.A.; Ibrahim, Z.I.; Khalil, F.A. and Mohamed, W.S. (2017). Use of some organic and Bio fertilizers as a partial substitution of the mineral nitrogen fertilization for corn, 1- The effect on corn yield and N, P and K uptake. Assiut J. Agric. Sci., 48(1-1): 229-250.

Abou-El-Hassan, S. (2010). Studies on using different compost teas as nutrient solutions for cantaloupe production with nutrient film technique. Ph.D. Thesis Fac. Agric. Ain Shams Univ., Egypt.

Abou-El-Hassan, S. and El-Batran, H. S. (2020). Integration of some bio compounds with compost tea to produce sweet corn without mineral fertilizers. Mid. East J. Agric. Res., 9(3): 645-652.

Achieng, J.O., Ouma, G., Odhiambo, G. and Muyekho, F. (2010). Effect of farmyared manure and inorganic fertilizers on maize production on Alfisols and Ultisols in Karamega, Western Kenya. Agric. Biol. J. N. Am., 1(4): 430-439.

Afe, A.L.; Atanda, S.; Aduloju, M.O.; Ogundare, S.K. and Talabi, A.A. (2015). Response of maize (*Zea mays* L.) to combined application of organic and inorganic (soil and foliar applied) fertilizers. Afr. J. Biotech., 14(44): 3006-3010.

Affendy, L.N.A. (2022). From poop to prep-Using rabbit poop as an organic fertilizer for your garden. eLingua. https://ir.uitm.edu.my/id/eprint/58487

Akhtar, K.; Wang, W.Y.; Khan, A.; Ren, G.X.; Afridi, M.Z.; Feng, Y.Z. and Yang, G.H. (2019). Wheat straw mulching offset soil moisture deficient for improving physiological and growth performance of summer sown soybean. Agric. Water Manag., 211: 16–25.

Araújo, F.; Gadelha, I.; Tsukahara, R.; Pita, L.; Costa, F.; Vaz, I. and Fôlego, G. (2023). Hinting pipeline and multivariate regression CNN for Maize Kernel counting on the Ear. arXiv preprint arXiv:2306.06553.

Aujla, M.S.; Thind, H.S. and Buttar, G.S. (2007). Fruit yield and water use efficiency of eggplant (*Solanumm elongena* L.) as influenced by different quantities of nitrogen and water applied through drip and furrow irrigation. Scientia Horti., 112(2):142-148.

Awopegba, M.; Oladele, S. and Awodun, M. (2017). Effect of mulch types on nutrient composition, maize (*Zea mays* L.) yield and soil properties of a tropical Alfisol in Southwestern Nigeria. Eurasian J. Soil Sci., 6(2):121-133.

Awopegba, T.M. and Awodun, M. A. (2023). Effect of jatropha mulch types and inorganic fertilizers on amaranth (*Amaranthus hybridus*) growth in Akure Southwestern Nigeria. Sci. Res. J. Agric. Fore. Sci., 11(2):33-38.

Badu-Apraku, B. and Fakorede, M.A.B. (2017). Morphology and physiology of maize. Advances in genetic enhancement of early and extra-early maize for sub-Saharan Africa, 33-53.

Bakry, M.A.A;, Sliman, R.A. and Sama, A.M.M. (2009). Importance of micro nutrients, organic manure and bio fertilizer for improving maize yield and its components growth in desert sandy soil. Res. J. Agric. Biol. Sci., 5(1):16-23.

Baloch, P.A.; Abro, B.A.; Chandio, A.S.; Depar, N. and Anssari, M.A. (2015). Growth and yield response of maize to integrated use of *Gliricidia sepium*, farm manure and NPK fertilizers. Pakistan J. Agric., Agril. Engg., vet. Sa'., 31(1): 14-23.

Birkhofer, K.; Bezemer, T.M.; Bloem, J.; Bonkowski, M.; Christensen, S.; Dubois, D., Ekelund, F. ; Fließach, A. ; Gunst, L. ; Hedlund, K. ; Ma¨der, P., Mikola, J. ; Robin, C., Seta¨la, H. ; Tatin-Froux, F.; Van Der Putten, W.H. and Scheu, S. (2008). Long-term organic farming fosters below and aboveground biota: implications for soil quality, biological control and productivity. Soil Biol. Biochem. 40: 2297–2308.

Chen, Y., Zhang, X.D., He, H.B., Xie, H.T., Yan, Y., Zhu, P., Ren, J. and Wang, L.C. (2010). Carbon and nitrogen pools in different aggregates of a Chinese Mollisol as influenced by long-term fertilization. J. Soil Sediment 10: 1018-1026.

Eleduma, A.F.; Aderibigbe, A.T.B. and Obabire, S.O. (2020). Effect of cattle manure on the performances of maize (*Zea mays* L) grown in forest-savannah transition zone Southwest Nigeria. Int. J. Agric. Sci. Food Tech., 6(1):110-114.

Fanuel, L. and Gifole, G. (2013). Growth and yield response of maize (*Zea mays* L.) to variable rates of compost and inorganic fertilizer integration in Wolaita, southern Ethiopia. Am. J. Plant Nutr. Fert. Technol., 3(2):43-52.

Fayose, C.A. (2022). Efficient management of environmental resources through sustainable crop production intensification. In Sustainable Management of Natural Resources. IntechOpen.

Geng, Y.; Cao, G.; Wang, L. and Wang, S. (2019). Effects of equal chemical fertilizer substitutions with organic manure on yield, dry matter, and nitrogen uptake of spring maize and soil nitrogen distribution. PLoS ONE, 14, e0219512

Gonzalez, D.; Alvarez, R. and Matheus, J. (2001). Comparison of three organic fertilizers for the production of sweet corn (*Zea mays* saccharata). Proceed. Int. American Soc. Trop. Horti., 45: 106-109.

Gul, S.; Khan, M.H.; Khanday, B.A. and Nabi, S. (2015). Effect of sowing methods and NPK levels on growth and yield of rainfed maize (*Zea mays* L.). Scientifica, 2015. https://doi.org/10.1155/2015/198575

Hao, X.; Liu, S.; Wu, J.; Hu, R.; Tong, C. and Su, Y. (2008). Effect of long-term application of inorganic fertilizer and organic amendments on soil organic matter and microbial biomass in three subtropical paddy soils. Nutr. Cycl. Agroecosys, 81: 17–24.

Hargreaves, J.C.; Adl, M.S. and Warman, P.R. (2009). Are compost teas an effective nutrient amendment in the cultivation of strawberries? Soil and plant tissue effects. J. Sci. Food Agric., 89: 390–397.

Holub, P.; Klem, K.; Tuma, I.; Vavrikova, J.; Sura, K.; Vesela, B.; Urban, O. and Zahora, J. (2020). Application of organic carbon affects mineral nitrogen uptake by winter wheat and leaching in subsoil: Proximal sensing as a tool for agronomic practice. Sci. Total Environ., 717: 137058.

Hu, X. J., Liu, J. J., Zhu, P., Wei, D., Jin, J., Liu, X. B. and Wang, G. H. (2018). Long-term manure addition reduces diversity and changes community structure of diazotrophs in a neutral black soil of northeast China. J. Soils Sed., 18: 2053–2062.

Huang, S., Weijian, Z.W., Yu, X. and Huang, Q. (2010). Effects of long-term fertilization on corn productivity and its sustainability in an Ultisol of southern China. Agri. Ecosyst. Environ., 138: 44–50.

Iqbal, A., He, L., Ali, I., Ullah, S., Khan, A., Khan, A., Akhtar, K., Wei, S., Zhao, Q., Zhang, J. and Jiang, L. (2020). Manure combined with chemical fertilizer increases rice productivity by improving soil health, post-anthesis biomass yield, and nitrogen metabolism. PLoS ONE, 15, e0238934.

Jain, T.C. and Misra, D.K. (1966). Leaf area estimation by linear measurements in Ricinus communis. Nature, 212: 741 – 742.

Javier, E.F. and Tabien, R.E. (2003). Nitrogen dynamics in soils amended with different organic fertilizers. Philipp. J. Crop Sci. 28(3): 49-60.

Kashiwagi, T., Togawa, E., Hirotsu, N. and Ishimaru, K. (2008). Improvement of lodging resistance with QTLs for stem diameter in rice (*Oryza sativa* L.). Theore. Appli. Gene., 117: 749 –757.

Kavamura, V.N.; Hayat, R.; Clark, I.M., Rossmann, M., Mendes, R.; Hirsch, P.R. and Mauchline, T.H. (2018). Inorganic nitrogen application affects both taxonomical and predicted functional structure of wheat rhizosphere bacterial communities. Fronti. Microb., 9:1074.

Khaeim, H.; Kende, Z.; Jolánkai, M.; Kovács, G.P.; Gyuricza, C. and Tarnawa, Á. (2022). Impact of temperature and water on seed germination and seedling growth of maize (*Zea mays* L.). Agron., 12(2):397.

Khan, S.; Mohammad, T.J.; Bilal, A.; Tariq, S. and Wisal, A. (2016). Yield and yield components of maize as affected by integrated management of sheep manure and urea fertilizer. Mid. East J. Agric. Res., 5(4):522-533.

Kim, M.J.; Shim, C.K.; Kim, Y.K.; Hong, S.J.; Park, J.H.; Han, E.J.; Kim, J.H. and Kim, S.C. (2015). Effect of aerated compost tea on the growth promotion of lettuce, soybean, and sweet corn in organic cultivation. The Plant Patho. J., 31(3):259-268.

Laekemariam, F. and Gidago, G. (2012). Response of maize (*Zea mays* L.) to integrated fertilizer application in Wolaita, South Ethiopia. Adv. Life Sci. Tech., 5: 21-30.

Li, Z.P.; Han, C.W. and Han, F.X. (2010). Organic C and N mineralization as affected by dissolived organic matter in paddy soils off subtropical China. Geoderma, 157:206-213

Litterick, A.M.; Harrier, L.; Wallace, P.; Watson, C.A. and Wood, M. (2004). The role of un-composted materials, composts, manures, and compost extracts in reducing pest and disease incidence and severity in sustainable temperate agricultural and horticultural crop production A review. Crit. Rev. Plant Sci., 23: 453–479.

Liu, X.; Li, Y.J.; Ren, X.J.; Chen, B.H.; Zhang, Y.; Shen, C.W.; Wang, F. and Wu, D.F. (2020). Long-term greenhouse cucumber production alters soil bacterial community structure. J. Soil Sci. Plant Nutri., 20: 306–321.

Magda, A.E.; Sabar, M.Z. and Mohamed, A.A. (2015). Effect of mineral fertilizer integration with organic manure on growth, yield and quality of maize (*Zea mays* L.). J. Soil Sci. and Agric. Eng., Mansoura Univ., 6(2):165-179.

Masresha, M. (2014). Response of maize (*Zea mays* L.) to application to mineral nitrogen fertilizer and compost in Godere District, Gambella Region Southwestern Ethiopia. M.Sc. Thesis, Haramaya University.

Mojeremane, W.; Motladi, M.; Mathowa, T. and Legwaila, G. M. (2015). Effect of different application rates of organic fertilizer on growth, development and yield of rape (*Brassic anapus* L.). Int. J. Inno. Res. Sci, Eng. Tech., 4 (12): 11680 – 11688.

Mubeen, K.; Iqbal, A.; Hussain, M.; Zahoor, F.; Siddiqui, M.H.; Mohsin, A.U.; Bakht, H.F.S.G. and Hanif, M. (2013). Impact of nitrogen and phosphorus on the growth, yield and quality of maize (*Zea mays* L.) Fodder in Pak. Philipp. J. Crop Sci. 38(2): 43-46.

Negassa, W.; Negisho, K.; Frison, D.K.; Ransom, J. and Yadessa, A. 2001. Determination of optimum FYM and NP fertilizers for maize on farmers' field. Soil. Sci. Soc. Am. J. 56: 476-484.

Oad, F.C.; Buriro, U.I. and Agha, S.K. (2004). Effect of organic and inorganic fertilizer application on maize fodder production. Asian J. Plant Sci., 3(3): 375-377.

Ogar, E.A. and Asiegbu, J.E. (2005). Effects of fertilizer rates and cutting frequency on the marketable vegetable and pod yields in fluted pumpkin in southeastern Nigeria. Agro-Sci., 4(1): 66-69.

Ralph, M. (2023). The Truth about Compost Tea: Making it, using it, and What to Expect from it. The Garden Shed Newsletter, 5(3). At: https://gardenbasics. substack. com/p/thetruth-about-compost-tea#details

Rashid, Z.; Rashid, M.; Inamullah, S.; Rasool, S. and Bahar, F. A. (2013). Effect of different levels of farmyard manure and nitrogen on the yield and nitrogen uptake by stevia (*Stevia rebaudiana* Bertoni). Afri. J. Agric. Res., 8(29): 3941– 3945.

Rees, R. and Castle, K. (2002). Nitrogen recovery in soils amended with organic manures combined with inorganic fertilizers. Agronomie, 22: 739–746.

Rick, C. (2020). Compost Tea: A How-To Guide. Rodale Institute. At: https://rodaleinstitute.org/blog/compost-tea-a-howto-guide/

Rifai, M. (2006). Pengaruh Pemberian Kompos Padat dan Teh Kompos Terhadap Ketersediaan P Tanah dan Serapan P serta Pertumbuhan Tanaman Jagung (*Zea mays*.L) pada Andisol. Skripsi. Program Studi Ilmu Tanah. Universitas Brawijaya. Malang.

Sadur, R.; Khalil, S.K.; Fida, M.; Abdur, R.; Khan, A.Z.; Saljoki, A.R.; Muhammad, Z. and Khalil, I.H. (2010). Phenology, leaf area index and grain yield of rainfed wheat influenced by organic and inorganic fertilizer. Pakistan J. Bot., 42(5): 3671-3685.

Scheuerell, S. and Mahaffee, W. (2002). Compost tea: Principles and prospects for plant disease control. Compost Sci. Util., 10: 313–338.

Shah, S.T.H.; Zamir, M.S.I.; Waseem, M.; Ali, A.; Tahir, M. and Khalid, W.B. (2009). Growth and yield response of maize (*Zea mays* L.) to organic and inorganic sources of nitrogen. Pak. J. Life Social Sci., 7:108-111.

Shahzad, T.; Chenu, C.; Genet, P.; Barot, S.; Perveen, N.; Mougin, C. and Fontaine, S. (2015). Contribution of exudates, arbuscular mycorrhizal fungi and litter depositions to the rhizosphere priming effect induced by grassland species. Soil Biol. Biochem., 80: 146–155.

Shisanya, C.; Mucheru, M.; Mugendi, D.N. and Kungu, J.B. (2009). Effect of organic and inorganic nutrient sources on soil mineral nitrogen and maize yields in central highlands of Kenya. Soil Till. Res. 103: 239–246.

Sikander, A. (2001). Effect of organic manure and inorganic fertilizers on the dynamics of soil microorganism: biomass, composition and activity. In:" Alternate/organic fertilizers" D8 Workshop, Islamabad, Pakistan, 19-20.

Singh, Y.V.; Singh, G. and Verma, J. P. (2017). Combined effect of organic manures and chemical fertilizers on soil properties and quality of crops: A review. Agric. Natural Reso., 51(1): 16-22.

Sohi, S.P.; Krull, E.; Lopez-Capel, E. and Bol, R. (2019). A review of biochar and its use and function in soil. Adv. Agron., 105: 47-82.

Sugito, Y.; Soegianto, A. and Irdiana, I. (2002). Pengaruh Dosis Pupuk Organik Cair dan Dosis Urea Terhadap Pertumbuhan dan Hasil Tanaman Jagung. Jurnal agrivita. 24 (1): 9-16

Sujesh, S., Murali, T., Sahithya, K. and Nilanjana, D. (2017). Preparation of compost tea and its utility as a plant growth promoter. Res. J. Pharm. Techn., 10(9): 3115-3122.

Suleiman, R.A.; Rosentrater, K.A. and Bern, C. J. (2013). Effects of deterioration parameters on storage of maize. Conference paper: In 2013 Kansas City, Missouri, July 21-July 24, 2013 (p. 1). Amer. Soc. Agric. Biol. Eng. DOI: 10.13031/aim.20131593351

Syarief, S. (1986). Kesuburan dan Pemupukan Tanah Pertanian. Pustaka Buana. Bandung Udounang, P.I.; Essien, O.A.; Umoh, F.O.; Ijah, C.J. and Akpainyang, F.E. (2023). Evaluation of growth and yield of cocoyam on varying rates of organic manure in a cocoyam based intercropping system. American J. Life Sci., 11(3): 50 – 55.

Wang, K.; Yin, D.; Sun, Z.; Wang, Z. and You, S. (2022). Distribution, horizontal transfer and influencing factors of antibiotic resistance genes and antimicrobial mechanism of compost tea. J. Hazard. Mater., 438: 129395.

Winarso, S. (2005). Kesuburan Tanah: Dasar Kesehatan dan Kualitas Tanah. Gava Media. Yogyakarta.

Yao, W.; Cai, D.; Huang, F.; Mohamed, T.A.; Li, P.; Qiao, X. and Wu, J. (2023). Promoting lignin exploitability in compost: A cooperative microbial depolymerization mechanism. Process Saf. Environ. Prot., 174: 856–868.

Zaccardelli, M.; Pane, C.; Villecco, D.; Maria Palese, A. and Celano, G. (2018). Compost tea spraying increases yield performance of pepper (*Capsicum annuum* L.) grown in greenhouse under organic farming system. Italian J. Agron., 13(3): 229-234.

Zainub, B.; Ayub, G.; Siddique, S.; Zeb, S. and Jamil, E. (2021). Response of Brinjal (*Solanum melongena* L.) cultivars to nitrogen levels. Pure Appli. Biol., 5 (1): 134 – 141.

أثر NPK وشاي الكمبوست على جودة الذرة

إبراهيم فرج محمد أحمد
كلية الزراعة بني وليد - جامعة بني وليد

المستخلص

تم إجراء التجربة الحقلية في مزرعة سوف الجين في بني وليد، ليبيا، خلال الموسم الزراعي الشتوي 2023 لدراسة تأثير NPK وشاي الكمبوست على النمو الخضري والإنتاج والتركيب الكيميائي للذرة الصفراء" جيزة 3084". تم استخدام ستة معاملات مرتبة في تصميم القطاعات كاملة العشوائية (RCBD) مع ثلاث مكررات لكل معاملة. تتكون معاملات هذه الدراسة من ستة معاملات، وهي (الكنترول (بدون معاملة)، NPK (20-20-20) بمعدل 150 كجم/هكتار، شاي الكمبوست (CT) بمعدل 200 لتر/هكتار، CT بمعدل 300 لتر/هكتار، CT بمعدل 400 لتر/هكتار، NPK+ CT بمعدل 400 لتر/هكتار .تمت دراسة خصائص النمو الخضري، والمحصول ومكوناته وبعض الخصائص الكيميائية للذرة. أوضحت النتائج وجود زيادة ملحوظة مع زيادة معدلات شاي الكمبوست فى جميع صفات النمو الخضري للذرة (ارتفاع النبات، عدد الأوراق/نبات، قطر الساق، مؤشر مساحة الورقة، الكلوروفيل الكلي)، والمحصول ومكوناته (طول الكوز، قطر الكوز، وزن الكوز، عدد الحبوب/ كوز، وزن 100 حبة، محصول الحبوب، المحصول البيولوجي، دليل الحصاد) والتركيب الكيميائي (نسب النيتروجين، الفوسفور، البوتاسيوم والبروتين). سجل الخليط بين NPK+ CT بمعدل 400 لتر/هكتار القيم الأعلى لجميع صفات النمو الخضري، والمحصول ومكوناته، والمحتوي الكيميائي التي تم دراستها، تليها شاي الكمبوست (CT) بمعدل 400 لتر/هكتار، مقارنةً بمعاملة الكنترول التي سجلت أقل القيم لجميع صفات النمو الخضري، والمحصول ومكوناته، والمحتوي الكيميائي للذرة.

الكلمات المفتاحية: الذرة (*Zea mays* L.)، شاي الكمبوست، NPK، النمو الخضري ، المحصول ومكوناته، المحتوى الكيميائي.