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EFFECT OF *Gliricidia sepium* LEAFY BIOMASS AND NPK (15:15:15) FERTILISER ON THE GROWTH AND YIELD OF TOMATO, *Solanum lycopersicum* (L.)

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ABSTRACT. The use of organic amendments and appropriate nutrient management practices is essential for sustainable agricultural production. The present study investigated the effect of *Gliricidia sepium* leafy biomass and NPK (15:15:15) on the growth and yield of tomato plants (*Solanum lycopersicum* L.). A randomised complete block design with five treatments and four replicates was employed in this experiment. The treatments included T1 (Control), T2 (100% *G. sepium* leafy biomass), T3 (25% *G. sepium* leafy biomass + 75% NPK fertiliser), T4 (50% *G. sepium* leafy biomass + 50% NPK), T5 (100% NPK), and T6 (75% *G. sepium* leafy biomass + 25% NPK). The application of *G. sepium* leafy biomass and NPK had significant effects on tomato growth and yield ($p<0.05$). The combined application of *G. sepium* leafy biomass and NPK (T4) and the sole application of *G. sepium* leafy biomass (T2) resulted in the highest plant height, stem girth, and fruit yield compared to the other treatments. Additionally, treatment with 75% *Gliricidia* leafy biomass and 25% NPK fertiliser (T6) resulted in a superior fruit weight compared to the other treatments. The application of *G. sepium* leafy biomass (T2) alone and NPK alone (T5) showed a significant improvement in plant growth parameters and fruit yield compared to the

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control (T1), although the effects were not as pronounced when combined with NPK (T4). The application of NPK fertiliser (T3) also positively influenced plant growth and yield, but the effects were lower compared to T2, T4, and T6. Further studies are warranted to optimise the application rates of *G. sepium* leafy biomass and NPK for different tomato cultivars and growing conditions.

Keywords: agroforestry tree species; crop nutrition; fertilisers; growth; tomato plant.

INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is an important horticultural crop globally, consumed both fresh and processed, providing essential nutrients and vitamins to human diets (Ciudad-Mulero *et al.*, 2022; Liu *et al.*, 2022; Seymour and Rose, 2022). Despite the potential of this crop, tomato production in Ghana has decreased from 9.5 metric tonnes/ha in 2013 to 6.9 metric tonnes/ha in 2018, due to nutrient decline in the soil (Adam and Ulas, 2023; FAO, 2020). According to Bergstrand *et al*. (2020), Magwaza *et al.* (2020), and Massimi (2021), low soil fertility and nutrient deficiencies are major limiting factors for its growth and yield. Soil fertility depletion is a major constraint on agricultural productivity in sub-Saharan Africa, leading to low yields of crops, such as tomato (Agegnehu *et al.*, 2021; Aloo *et al.*, 2021; Tumbure *et al.*, 2022).

Most smallholder farmers in the tropics have resorted to the use of chemical fertilisers to increase soil fertility and achieve higher yields in tomato cultivation (Abdulraheem *et al.*, 2022; Nkengafac *et al.*, 2021; Tsufac *et al.*, 2021). However, the high cost of chemical fertilisers and their negative impact on the environment have led to the exploration of alternative sources of plant nutrients (Elbasiouny *et al.*, 2020; Nayak *et al.*, 2019). The increasing demand for sustainable and environmentally friendly agricultural practices has led to the exploration of alternative methods to enhance crop productivity while minimising the use of synthetic fertilisers (Lau *et al.*, 2022; Zulfiqar *et al.*, 2019). In recent years, researchers have focused on the utilisation of organic materials, such as plant biomass and biofertilisers, to improve soil fertility and plant growth (Boubekri *et al.*, 2022; Gupta *et al.*, 2023; Zaim and Bekkar, 2023). One such promising organic material is the leafy biomass of *Gliricidia sepium*, a leguminous tree widely distributed in tropical and subtropical regions (Mohammed *et al.*, 2022; Sileshi *et al.*, 2020). *Gliricidia sepium*, a fast-growing, multipurpose leguminous tree that belongs to the family Fabaceae, is renowned for its nitrogen-fixing ability, which enables it to enrich the soil nitrogen content and improve soil fertility (Alamu *et al.*, 2023; Suganya *et al.*, 2019). The leaves of *G. sepium* are rich in essential plant nutrients, including nitrogen, phosphorus, and potassium, making them a valuable source of organic matter and nutrients for crop plants (Alamu *et al.*, 2023; Murtiningsih *et al.*, 2023).

Previous studies have shown that the application of *G. sepium* leafy biomass can increase the yield of various crops, including maize, soybean, and cowpea (Kisaka *et al.*, 2023; Kuyah *et al.*, 2020). Notwithstanding these findings, there is inadequate information on the application of *G. sepium* leafy biomass and NPK fertiliser on tomato plant growth and yield in sub-Saharan Africa, especially Ghana. Moreover, there is a need to explore the potential synergistic effects of combining *G. sepium* leafy biomass with conventional fertilisers, such as NPK, to optimise tomato production. Considering the potential benefits of *G. sepium* leafy biomass and the importance of NPK fertilisers, this study aimed to investigate the combined effects of *G. sepium* leafy biomass and NPK on tomato growth and yield. The specific objectives were to assess the effects of *G. sepium* leafy biomass and NPK on tomato growth and yield parameters, such as plant height, stem diameter, fruit yield, and fruit weight.

MATERIALS AND METHODS

Location of the study

The experimental study took place at the demonstration farm of the Agroforestry Department Faculty, situated within the premises of the Kwame Nkrumah University of Science and Technology (KNUST) in Kumasi, Ghana. The location of the farm falls within the humid semi-deciduous forest region of Ghana, and its geographical coordinates are latitude 6.40°N and longitude 1.37°W.

Rainfall

This region has a unique pattern of rainfall that occurs in two main periods every year. The average amount of rainfall is usually between 1250 and 1500 mm. The first period, known as the major wet season, occurs from May to July, while the second period, known as the minor rainy season, occurs from September to November. Additionally, there are two dry seasons, with the longer one lasting from December to March and the shorter one occurring in August.

Temperature and humidity

According to Mohammed *et al.* (2022), the average daily temperature of the site is 25.6°C. During the coldest months from December to February, the average temperature drops to 20°C, while the hottest month, March, has an average high temperature of 33°C. The site's average yearly temperature is 26.61°C, with a relative humidity of 67.6%.

Soil type

Mohammed *et al.* (2022) reported that the soil type at the location of the experiment is Ferric Acrisol, which is strongly acidic and well-drained. The soil texture is described as sandy loam.

Experimental Approach and Procedure

Sources of fertiliser

The *G. sepium* leafy biomass was obtained from the Agroforestry Department of the university research farm. The chemical composition of *G. sepium* consisted of nitrogen (1–3%), hydrogen (5–6%), hemicellulose (20–35%), lignin (10–20%), and carbon (45–50%). Various amounts of *G. sepium* leafy biomass and inorganic fertiliser NPK (15:15:15) were weighed and applied separately or in combination at different dosage levels.

Source of tomato seeds

Seeds of the Eva tomato variety were obtained from the Crop Research Institute of Ghana, Kwadaso-Kumasi.

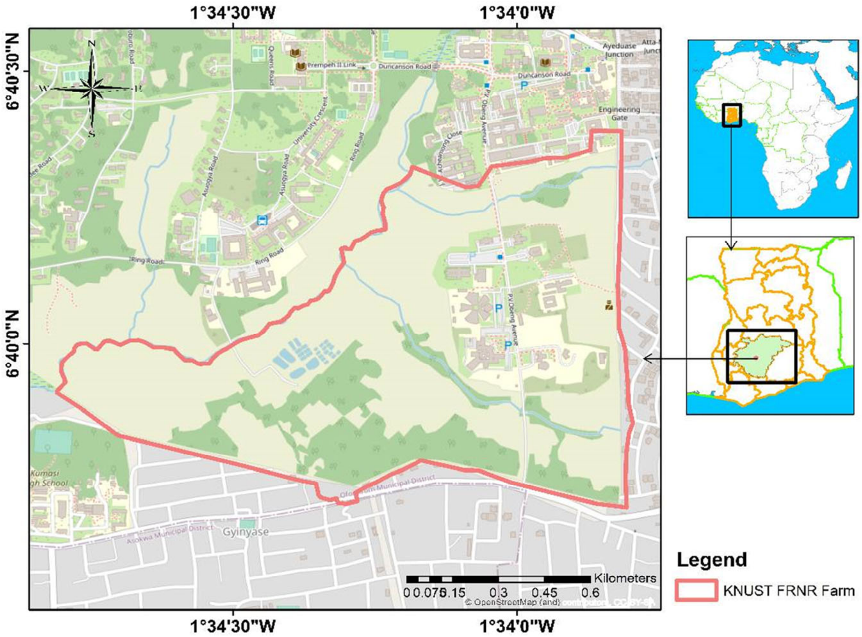

Figure 1 – A visual representation illustrating the layout and structure of the experimental farm

Nursing of seeds

The soil was tilled, and a bed was raised above the surface of the soil. The seeds were spread on the bed and covered with a thin layer of soil. Palm leaves were used to mulch the surface of the nursery bed, and watering was done as required. Monitoring and regular care of the seedlings were ensured from germination until transplant.

Gliricidia sepium leafy biomass and NPK (15:15:15) fertiliser application

Gliricidia sepium leafy biomass was applied to the soil two weeks before transplant (WBT) and inorganic fertiliser two weeks after transplant (WAT), both in proportions of 25, 50, 75, and 100% per plot and 5% according to the experimental protocol.

Seedling transplant

Two weeks after germination, robust, thriving, and evenly sized tomato seedlings were carefully chosen and moved from the nursery bed in Kwadaso to the agroforestry demonstration area located at Kwame Nkrumah University of Science and Technology.

The seedlings were transplanted onto the main beds at a spacing of 0.5 m × 0.6 m at a planting depth of 1.5 m in the evening to avoid shock from transportation and high temperatures.

Weed control was done manually.

Pest and disease control

Five to ten grams of mancozeb per gallon (3.8 litres) of water was used. Spraying was done 2 WAT until maturity to control fungal diseases, such as damping off. Cypermethrin application was carried out at a concentration of 1.2 mm per litre after scouting revealed pest infestation levels exceeding a predetermined threshold. Tomato fruit was harvested manually at maturity.

Experimental design and treatment allocation

This research was conducted using a randomised complete block design (RCBD), in which six treatments were randomly assigned with four replicates. The experimental area covered 7 m × 8 m (56 m^2) and consisted of a total of 24 individual plots. To accurately represent each treatment within a plot, the dimensions of each unit plot were 1.5 metres in width and 1.8 metres in length, resulting in a total area of 2.7 m^2. Within each plot, there were 16 hills, and a narrow space of 0.5 m was maintained between the plots and blocks. This arrangement guaranteed an accurate depiction of each treatment in each plot.

The fertiliser treatments were as follows:

T1 = without *G. sepium* leafy biomass or NPK (control)

T2 = 100% *G. sepium* leafy biomass

T3 = 25% *G. sepium* leafy biomass + 75% NPK fertiliser

T4 = 50% *G. sepium* leafy biomass + 50% NPK fertiliser

T5 = 100% NPK fertiliser

T6 = 75% *G. sepium* leafy biomass + 25% NPK fertiliser

The N demand of tomato is 120 kg/ha (Abu-Alrub *et al.*, 2019).

Data collection and analysis

Growth parameters-plant height and stem diameter-were measured once every two weeks, starting at 2 WAT, while data on yield parameters of the tomato plants-number of fruits, and weight of fruits-were collected at maturity/harvest. The height of the plants was determined by measuring the distance from the soil surface to the topmost leaf using a metre ruler. The stem diameter was measured at a point 5 cm above the ground using a digital calliper. Information regarding the yield of the plants was gathered by recording the number of fruits through visual counting, and the weight of the fruits was determined using a weighing balance.

The data recorded were processed using analysis of variance (ANOVA) in STATISTIX 10 software at a 5% level of significance.

RESULTS

Effect of *Gliricidia sepium* leafy biomass and NPK (15:15:15) on tomato growth

Height (cm)

The effect of the *G. sepium* leafy biomass and NPK on the height of tomato plants from 2 to 8 WAT is shown in Table 1. On a weekly basis, from 2 to 6 WAT, there were significant differences between the means of the applied treatments, with p-values ranging from 0.0024 to 0.0331. At week 2, T2 recorded the greatest height (18.4 cm), followed by T4 (15.9 cm), T6 (13.0 cm), T3 (9.9 cm), and T5 (8.4 cm), and T1 recorded the lowest height (7.6 cm). Similar results were registered at 4 to 6 WAT. In contrast, there was no significant difference between the means of the applied treatments at 8 WAT, with a p-value of 0.3452.

The mean values of the weeks showed that there was a significant difference between the treatments, p = 0.0027 (*Table 1*). The tallest plants were registered in T2 (27.6 cm), followed by T4 (27.0 cm), T6 (24.2 cm), and T5 (18.1 cm), and the shortest plants were registered in T1 (15.2 cm). There were no significant differences between T2 and T4, but they differed significantly from the remaining treatments. T6 came next and was significantly different from T3 and T5, which differed significantly from T1.

Diameter (mm)

The effect of the applied *G. sepium* leafy biomass, NPK, and their combinations on the diameter of tomatoes from 2 to 8 WAT is illustrated in *Table 2*. On a weekly basis, from 2 to 8 WAT, there were significant differences between the means of the applied treatments, with p-values ranging from 0.0000 to 0.0000. At week 2, T4 had the largest diameter (12.3 mm), followed by T6 (10.8 mm), T2 (9.9 mm), T3 (6.9 cm), and T5 (5.7 mm), and T1 had the smallest diameter (3.2 mm). Similar results were recorded from 4 to 8 WAT.

The overall treatment means indicated that there was a significant difference between the various treatments, p = 0.0000 (*Table 2*). The largest diameter was registered at T4 (15.4 mm), followed by T2 and T6 (12.9 mm and 13.5 mm, respectively) and T3 and T5 (8.7 mm and 8.4 mm, respectively), and the smallest diameter was recorded in T1 (5.1 mm). There were significant differences between T4 and the other treatments.

There was no significant difference between T2 and T6, but they differed significantly from the remaining treatments. T3 and T5 were not significantly different from each other but were significantly different from T1 (control).

Effect of *Gliricidia sepium* leafy biomass and NPK on tomato yield

Fruit yield/ha

The effects of the amended *G. sepium* leafy biomass, NPK, and their combination on tomato yield are represented in *Figure 2*. There was a significant difference between the various treatments (F=4.76, CV=80.9, LSD=6.67, p=0.0009). Most fruits were registered by the group of T2 and T4 (22,012 and 20,988 fruits, respectively), followed by T6 (14,914 fruits) and T3, T1, and T5 (10,531, 8025, and 7407 fruits, respectively).

Table 1 – Effect of *Gliricidia sepium* leafy biomass, NPK and their combinations on the height (cm) of tomato plants from 2 to 8 weeks after transplant (WAT)

Treatments	2 WAT (±SeM)	4 WAT (±SeM)	6 WAT (±SeM)	8 WAT (±SeM)	MEANS (±SeM)
T1	7.6±2.7^{d}	11.6±3.5^{d}	18.4±5.6^{c}	22.8±7.5^{a}	15.2±2.8^{c}
T2	18.4±1.5^{a}	31.5±2.8^{a}	36.9±3.8^{a}	35.0±4.9^{a}	27.6±2.5^{a}
T3	9.9±2.1^{cd}	17.2±2.0^{bcd}	23.4±4.7^{bc}	27.6±6.1^{a}	19.7±2.7^{bc}
T4	15.9±1.0^{ab}	24.6±1.8^{b}	31.9±2.2^{ab}	35.5±2.0^{a}	27.0±2.4^{a}
T5	8.4±0.6^{cd}	15.9±0.6^{cd}	22.2±1.2^{bc}	25.7±2.2^{a}	18.1±2.1^{bc}
T6	13.0±0.5^{bc}	21.6±1.5^{bc}	28.8±2.2^{abc}	33.3±3.0^{a}	24.2±2.5^{ab}
P-VALUE	0.0024	0.0006	0.0331	0.3452	0.0027
LSD	4.92	6.87	11.16	14.61	7.05
CV (%)	19.6	17.2	21.1	24.7	43.5

Means followed by the same letter(s) are not significantly different at (p ≤ 0.05%) by the least significant difference (LSD); SeM = Standard Error of the Mean; LSD = Least Significant Differences; CV = Coefficient of Variation; WAT = Weeks after Transplanting; T=Treatment

Table 2 – Effect of *Gliricidia sepium* leafy biomass, NPK and their combinations on the diameter (mm) of tomato plants from 2 to 8 weeks after transplant (WAT)

Treatments	2 WAT (±SeM)	4 WAT (±SeM)	6 WAT (±SeM)	8 WAT (±SeM)	MEANS (±SeM)
T1	3.2±1.1[d]	4.5±1.3[d]	5.6±1.4[d]	7.2±1.1[d]	5.1±0.7[d]
T2	9.9±0.3[b]	12.3±0.3[b]	13.9±0.6[b]	15.3±0.8[b]	12.9±0.6[b]
T3	6.9±0.5[c]	8.0±0.3[c]	9.3±0.2[c]	10.6±0.3[c]	8.7±0.5[c]
T4	12.3±0.3[a]	14.5±0.2[a]	16.1±0.2[a]	18.3±0.2[a]	15.4±0.6[a]
T5	5.7±0.2[c]	17.7±0.4[c]	9.5±0.3[c]	10.5±0.5[c]	8.4±0.6[c]
T6	10.8±0.3[b]	13.3±0.3[ab]	14.3±0.4[ab]	15.6±0.6[b]	13.5±0.6[b]
P-VALUE	0.0000	0.0000	0.0000	0.0000	0.0000
LSD	1.61	1.86	1.99	2.05	1.68
CV (%)	9.14	8.07	7.53	8.02	38.3

Means followed by the same letter(s) are not significantly different at (p ≤ 0.05%) by the least significant difference (LSD); SeM = Standard Error of the Mean; LSD = Least Significant Differences; CV = Coefficient of Variation; WAT = Weeks after Transplanting; T=Treatment

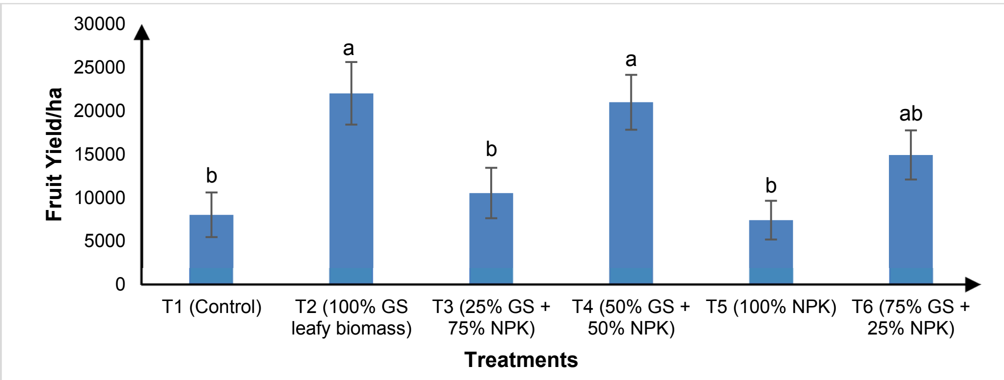

Figure 2 – Effect of *Gliricidia sepium* leafy biomass, NPK and their combinations on tomato fruit yield/ha

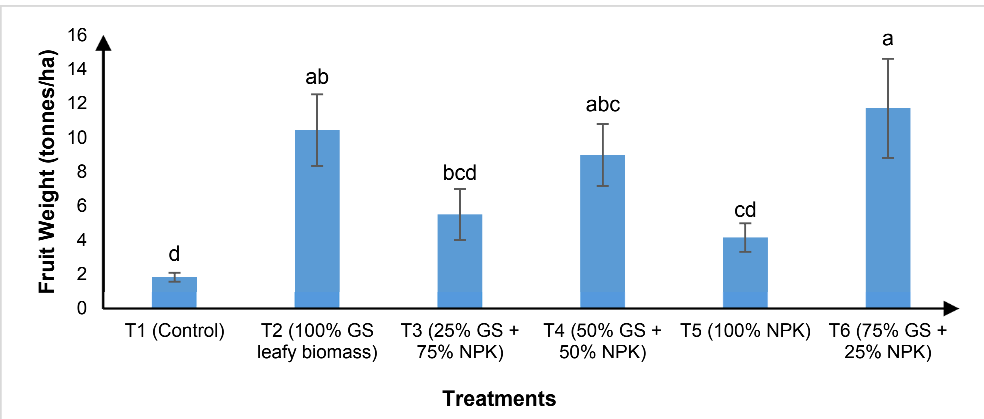

Figure 3 – Effect of *Gliricidia sepium* leafy biomass, NPK and their combinations on tomato fruit weight (tonnes/ha)

Fruit Weight (tonnes/ha)

The effects of the amended *G. sepium* leafy biomass, NPK, and their combination on tomato fruit weight are represented in *Figure 3*. There was a significant difference between the various treatments p<0.05 (F=4.73, CV=120.9, LSD=4.99, p=0.0006). The highest fruit weight was registered in T6 (11.7 tonnes), followed by T2 (10.4 tonnes), T4 (8.98 tonnes), T3 (5.5 tonnes), and T5 (4.1 tonnes), and the lowest fruit weight was registered in T1 (1.82 tonnes).

DISCUSSION

Effect of *Gliricidia sepium* leafy biomass on tomato growth and yield
Height (cm)

The findings of the experiment suggest that the combination of *G. sepium* leafy biomass and NPK fertiliser had a positive effect on the growth in the height of tomato plants. Treatments T2, T4, T6, and T3 showed better growth than T5 (100% NPK) and T1 (control).

Among all treatments, T2, which consisted of 100% *G. sepium* leafy biomass, registered the greatest height. This might be attributed to the fact that *G. sepium* leafy biomass, when used alone as the sole source of nutrients, may provide all the necessary nutrients required for optimal plant growth. *Gliricidia sepium* leafy biomass is known to be rich in organic matter and certain essential nutrients, such as nitrogen, phosphorus, and potassium (NPK) (Kuyah et al., 2020; Sileshi *et al.*, 2020). Therefore, the presence of these essential nutrients in T2 could have contributed to the increased height growth of tomato plants.

T4, which comprised a combination of 50% *G. sepium* leafy biomass and 50% NPK, showed better growth in height compared to the remaining treatments. The addition of NPK fertiliser to the *Gliricidia* leafy biomass likely provided the essential nutrients that were lacking in the sole NPK-amended plots and the control (T1) (Alabi *et al.*, 2020; Chakraborty and Akhtar, 2021). The NPK fertiliser, with its balanced ratio of nitrogen, phosphorus, and potassium, could have supplemented the nutrient requirements of tomato plants, leading to improved height growth. Similar results were obtained from a study on tomatoes by Turhan and Ozmen (2021). Mahmood *et al.* (2017) and Mohammed *et al.* (2020) indicated that the combination of *Leucaena leococephala* leafy biomass and NPK improved the growth and yield of okra. T6, with a higher proportion of *Gliricidia* leafy biomass (75%) and a lower proportion of NPK (25%), exhibited slightly lower height growth compared to T2 and T4. This suggests that a higher proportion of *Gliricidia* leafy biomass relative to NPK might have limited the availability of certain essential nutrients for plant growth. Although *Gliricidia* leafy biomass contributes organic matter and some nutrients, the lower proportion of NPK in T6 might not have fully compensated for the nutrient requirements of tomato plants, resulting in slightly reduced height growth (Ajeng *et al.*, 2020; El-Beltagi *et al.*, 2023).

T3, with a higher proportion of NPK (75%) and a lower proportion of *Gliricidia* leafy biomass (25%), showed improved growth in height compared to

T6. The increased availability of NPK nutrients in T3 might have provided the necessary elements for optimal plant growth, compensating for the limited nutrient content in *Gliricidia* leafy biomass (Devi *et al.*, 2022; Sabesan and Krishnaraj, 2019).

Surprisingly, T5, which consisted of 100% NPK fertiliser, registered lower height growth compared to T4 and T3. This finding could be attributed to the fact that the excessive application of NPK fertiliser may have led to nutrient imbalances or nutrient toxicity, negatively affecting the height growth of tomato plants (Rahi *et al.*, 2019). Additionally, excessive reliance on chemical fertilisers, such as NPK, can potentially harm soil health and microbial activity in the long run (Mohammed *et al.*, 2022).

Stem diameter (mm)

The findings of the experiment suggest that a combination of *Gliricidia* leafy biomass and NPK fertiliser (T4) resulted in the best growth in stem diameter among the treatments tested. T2, which involved the use of 100% *Gliricidia* leafy biomass, and T6, which consisted of 75% *Gliricidia* leafy biomass and 25% NPK, also showed improved stem diameter growth. However, T3 (25% *Gliricidia* leafy biomass + 75% NPK) and T5 (100% NPK) had less significant effects, while the control group (T1) exhibited the least stem diameter growth. This could be attributed to several factors including nutrient availability and balance and the slow release of nutrients. *Gliricidia* leafy biomass is known to be a good source of organic matter and essential nutrients for plant growth, such as nitrogen, phosphorus, and potassium (Hombegowda *et al.*, 2022). The NPK fertiliser used in the experiment also provided these essential nutrients (Darjee *et al.*, 2022). The combination of *Gliricidia* leafy biomass and NPK in T4 may have provided a more balanced and readily available nutrient supply for tomato plants, leading to improved growth in stem diameter (Aboyeji *et al.*, 2021; Mohammed *et al.*, 2022). Organic matter, such as *Gliricidia* leafy biomass, releases nutrients slowly over time as it decomposes.

This slow-release characteristic can ensure a continuous and sustained nutrient supply to plants. The combination of *Gliricidia* leafy biomass and NPK in T4 might have facilitated the gradual release of nutrients, supporting prolonged stem diameter growth (Osumah *et al.*, 2019). Additionally, *Gliricidia* leafy biomass can improve the soil structure by increasing its organic matter content. This can enhance the water retention capacity and improve nutrient availability to plants (Murugaragavan *et al.*, 2022; Singh *et al.*, 2020). The addition of *Gliricidia* leafy biomass to T2 and T6 might have positively influenced the soil structure, resulting in better stem diameter growth. It is possible that the combination of *Gliricidia* leafy biomass and NPK in T4 created synergistic effects in which the interaction between the two components resulted in better growth outcomes. This synergy could be due to improved nutrient uptake, increased microbial activity, or other beneficial interactions between organic and inorganic components (Tilahun and Assefa, 2015).

Fruit Yield/ha

The findings of the experiment, in which different treatments were applied to assess the effect of *Gliricidia* leafy biomass and NPK (15:15:15) fertiliser on tomato growth and yield, suggest that T2 (100% *Gliricidia* leafy biomass) and T4 (50% *Gliricidia* leafy biomass + 50% NPK) resulted in a better fruit yield compared to other treatments. T6 (75% *Gliricidia* leafy biomass + 25% NPK) also exhibited improved fruit yield, albeit to a lesser extent. However, the lowest fruit yield was observed in T3 (25% *Gliricidia* leafy biomass + 75% NPK), T5 (100% NPK), and T1 (control). Several factors, such as nutrient composition, organic matter, and soil health, might have contributed to these findings. *Gliricidia* leafy biomass is known to possess a significant amount of essential nutrients, including nitrogen, phosphorus, and potassium, which are important for plant growth and fruit production (Mng'omba and Akinnifesi, 2020). When used as the sole fertiliser source (T2), the nutrient content in the *Gliricidia* biomass might have provided adequate nutrition to support tomato plant growth and enhance fruit yield. *Gliricidia* leafy biomass contains organic matter that can improve soil structure, moisture retention, and nutrient availability (Franzluebbers, 2023; Neto *et al.*, 2022). The presence of organic matter helps enhance soil fertility and microbial activity, thereby promoting better root development and nutrient uptake by tomato plants (Manirakiza and Seker, 2020; Ye, 2020). This improved soil health could have positively influenced the fruit yield in the T2 and T4 treatments. The combination of *Gliricidia* leafy biomass and NPK fertiliser in T4 might have resulted in synergistic effects. NPK fertiliser supplies readily available nutrients, while *Gliricidia* biomass contributes slow-release nutrients and organic matter. The combination of these two inputs could have provided a balanced nutrient supply, ensuring optimal growth conditions for tomato plants and a higher fruit yield (Cozzolino *et al.*, 2021).

T3 (25% *Gliricidia* leafy biomass + 75% NPK), T5 (100% NPK), and T1 (control) showed lower fruit yield. These results could be attributed to an imbalance in nutrient ratios. Excessive reliance on NPK fertiliser (T5) or an inadequate proportion of *Gliricidia* biomass (T3) may have disrupted the nutrient balance required for optimal plant growth and fruit production. The control group (T1) lacked additional nutrient inputs, which further negatively affected the yield (Mohammed *et al.*, 2022; Muyayabantu *et al.*, 2019).

Fruit Weight (tonnes/ha)

Based on the given experiment, the findings indicate that T6, which consisted of 75% *Gliricidia* leafy biomass and 25% NPK (15:15:15) fertiliser, resulted in the highest fruit weight among all treatments. This can be attributed to several factors, including organic matter nutrient content, the synergistic effect of *Gliricidia* and NPK, and nutrient balance and availability, which may have contributed to the observed results. *Gliricidia* leafy biomass is rich in organic matter and nutrients, including nitrogen, phosphorus, and potassium (Hombegowda *et al.*, 2022). Incorporating this biomass into the soil can enhance soil fertility and provide a slow release of nutrients to plants (Oladoye *et al.*, 2020). This improved nutrient availability may have positively influenced the growth and development of tomato plants in T2, where 100% *Gliricidia* leafy biomass was used. The combination of *Gliricidia* leafy biomass and NPK fertiliser in treatment T6 might have resulted in a synergistic effect on plant growth. Previous studies have shown that a combination of organic matter and inorganic fertilisers can enhance nutrient uptake efficiency and promote plant growth (Karami *et al.*, 2011; Subedi *et al.*, 2016). The organic matter in *Gliricidia* biomass can improve soil structure and nutrient retention, while NPK fertiliser provides readily available nutrients. This synergistic effect may have contributed to the superior growth and yield observed in T6. The findings suggest that a balanced nutrient supply is essential for optimal tomato growth. Treatment four (T4), which consisted of a 50% mixture of *Gliricidia* leafy biomass and NPK fertiliser, showed a lower fruit weight compared to T6. This result might indicate that the nutrient balance was not optimal in T4 and that the plants did not receive sufficient nutrients to achieve their maximum growth potential (Thangavel *et al.*, 2018; Yadav *et al.*, 2020). The lower fruit weight observed in treatment T5 (100% NPK) compared to T6 suggests that the exclusive use of NPK fertiliser may have certain limitations. Excessive or imbalanced use of chemical fertilisers can lead to nutrient imbalances, nutrient leaching, or soil acidification, which can negatively affect plant growth (El-Masry *et al.*, 2018). In contrast, the presence of *Gliricidia* leafy biomass in T6 may have mitigated these issues and provided a more balanced nutrient supply.

CONCLUSIONS AND RECOMMENDATIONS

Gliricidia leafy biomass combined with NPK fertiliser positively affected tomato plant growth and yield. The treatments that included *Gliricidia* leafy biomass, either alone (T2) or in combination with NPK fertiliser (T4 and T6), resulted in improved growth in height, stem diameter, and fruit yield. This suggests that *Gliricidia* leafy biomass can serve as an effective organic amendment in enhancing tomato plant growth and productivity when used in conjunction with NPK fertiliser. The treatment comprising 50% *Gliricidia* leafy biomass and 50% NPK fertiliser (T4) demonstrated improved growth in height, stem diameter, and fruit yield. This indicates that a balanced combination of organic and inorganic inputs can result in optimal plant development and productivity. The treatment with 75% *Gliricidia* leafy biomass and 25% NPK fertiliser (T6) resulted in a superior fruit weight compared to the other treatments. This suggests that a higher proportion of *Gliricidia* leafy biomass in the nutrient mix could promote enhanced fruit development and weight in tomato plants. The remaining treatments not mentioned specifically (T1, T3, and T5) did not exhibit significant improvements in growth parameters or fruit yield compared to the treatments that included *Gliricidia* leafy biomass and/or NPK fertiliser. This implies that the presence of *Gliricidia* leafy biomass or a balanced combination with NPK fertiliser might be crucial for obtaining substantial benefits in terms of tomato plant growth and yield. Further studies should be carried out to assess the nutrient status of the soil before and after the experiment since the present study did not look at soil analysis of the study site. Additionally, the sole application of *G. sepium* (T2) and the combined applications of T4 and T6 can be adopted by farmers with poor resources to produce tomato in Ghana and sub-Saharan Africa.

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