Agricultural Development
Vol. 10, No. 4, 72-79, 2025
ISSN(E) 2576-683X
DOI: 10.55220/25766740.v10i4.393
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The Influence of Poultry Manure Application on Eggplant (*Solanum Aethiopicum L.)* Tolerance to Weed Interference

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Abstract

Garden egg is a vegetable valued for its nutritional and economic benefits. Its production is often constrained by poor soil fertility and weed competition interference. Improving soil fertility could enhance crop tolerance to weed competition. Therefore, this study investigates the influence of poultry manure (PM) on garden egg's resilience against weed competition. In a 4×2 factorial combination, PM at 0, 15, 30, and 45 kg N/ha represented as control, low, moderate, and high soil fertility conditions, respectively, and weed management (weedy check and regular weeding) were evaluated in a randomized complete block design replicated three times. Garden egg (L01 variety) seedlings were transplanted at 40,000 plants/ha. Data on growth and yield were subjected to ANOVA, and significantly different means were separated using Duncan's Multiple Range Test at $p<0.05$. The results showed that applying 45 kg N/ha of PM significantly increased plant height, number of leaves, and canopy spread compared to the other treatments in the first and second seasons. Variations in the growth parameters observed were significant ($p < 0.05$) for weed control. Weeded plots had 1274.67 and 1359.98 cm^2 leaf area, while non-weeded plots had 862.89 and 905.16 during the first and second seasons, respectively. The combination of 45 kg N/ha and regular weeding resulted in the highest fruit yield (6502.47 and 6004.10 kg/ha) and the lowest in the control treatment (0.00 and 125.00 kg/ha) in the first and second seasons, respectively. Applying poultry manure at 45 kg N/ha, with regular weeding, is more effective for garden egg production.

Keywords: Eggplant resilience, Organic fertilizer, Sustainable production, Weed infestation.

1. Introduction

Garden egg (*Solanum aethiopicum* L.) is a highly nutritious horticultural crop widely consumed in Africa and other regions [1]. The crop is grown in various agroecological zones and *Solanum aethiopicum* is a dominant species that includes the four groups: Aculantum, Kamba, Gilo, and Shum [2]. It is known by various names, such as bitter tomato, garden egg, scarlet eggplant, and African eggplant. Garden egg is a vital fruit vegetable in global diets due to its health-promoting properties [3]. Garden eggs are an important source of essential macro and micronutrients [4], contributing to various health benefits such as cholesterol reduction, enhanced vision, and weight loss, which is good for overall health and well-being.

Despite these nutritional and health benefits, the productivity of garden egg crops faces significant challenges, particularly in tropical regions like West Africa, where poor soil conditions, soil fertility depletion, and inadequate weed management severely limit crop yields and compromised food security [5]. As the global demand for food increases, ensuring adequate soil fertility becomes crucial for sustaining crop yields. Fertilizer application has proven vital for improving soil health and promoting crop productivity. The poultry industry is one of the largest livestock sectors globally, producing significant amounts of manure that contribute to environmental pollution, affecting soil, land, water resources, and contributing to global climate change [6]. Poultry manure is an affordable, sustainable alternative to chemical fertilizers [7], and reduces environmental degradation when used as fertilizer. Nevertheless, poultry manure is a key organic amendment to preserve soil fertility and achieve high agricultural crop yields [8]. Farmers and researchers have acknowledged the impact of fertilizers like PM application on weed control in agricultural lands, noting that the relationship between fertilizers and weeds can be positive or negative. Weeds compete with cultivated crops for nutrients from the applied fertilizers, which can lead to reduced crop quality and yield [9, 10].

Weed interference complicates garden egg production. Weeds compete with crops for vital resources such as light, water, and nutrients, significantly reducing crop yields and quality [11]. Effective weed management options are essential to improving garden egg production, yet traditional manual weeding methods remain labor-intensive and costly, highlighting the need for more sustainable approaches [12]. Weeds naturally compete intensely with any plant, including other weed species. In areas with limited rainfall and extreme temperatures, certain weeds thrive by efficiently utilizing resources before crops can use them [13]. While total weed elimination isn't

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necessary, effective management options should aim to minimize their impact as much as possible. The goal is to reduce weed competition during critical growth periods when it can significantly affect crop yields, ensuring minimal losses [14].

Several weeding options are available to ensure crop health and optimize yields. These include cultural methods like crop rotation and cover crops, which disrupt weed life cycles and reduce competition for resources, mulching, and soil solarization can also prevent seed germination and eliminate weed seeds [15]. Mechanical methods like hand weeding, tillage, and mowing can physically remove weeds but require careful management to avoid soil disturbance. Herbicides are another common approach, targeting weeds at various growth stages, but they require careful application to minimize environmental impact [11]. Biological methods, such as introducing natural weed predators or using allelopathic plants, offer eco-friendly alternatives for weed suppression. While these weeding options can significantly improve crop health and yields, some farmers may struggle to afford the costs of implementing them. The financial burden of these methods, such as the cost of herbicides, equipment, or labor, may be too high for some farmers to bear, making them inaccessible to those with limited budgets. Similarly, the availability of labor to implement these operations is limited, due to rural-urban migration experienced in many farming communities [16]. The cultural practices for garden egg cultivation requires tillage which could take care of the early weed that causes significant damage to crop development [13]. However, limited information exists on the interaction between poultry manure application and weed management options for garden egg production. This study aims to investigate the influence of poultry manure application on garden egg response to weed interference, exploring the potential of integrated soil fertility management and weed control options to enhance sustainable garden egg production.

2. Materials and Methods

The experimental study was conducted from May to September 2023 and August to December 2024 at the research field of the Department of Crop and Horticultural Sciences Research Field located along Parry Road, University of Ibadan, Ibadan, Oyo State, Nigeria. The coordinates of the location were 07°27′07″N, 03°53′29″E, and 187 meters above sea level. The site is situated within the Savannah agroecological zone of southwestern Nigeria. The region experiences an average annual rainfall ranging from 1250 to 1500 mm, with a bimodal pattern consisting of long and short rainy seasons between April to July and September to November, separated by a dry spell in August. The mean relative humidity is 75%, and the atmospheric temperature ranges between 27°C and 31°C (REF) [17].

2.1. Experimental Design, Treatment and Layout

The field experiment was designed as a 4×2 factorial combination, implemented using a randomized complete block design with three replications. The first factor consists of poultry manure application rate (0, 15, 30, and 45 kg N/ha) and the second factor includes the weed management options (No Weeding, Weeded,). The total experimental plot area covered was 161 m^2, and each plot size was 2 m × 3 m. There are 24 plots, each containing 16 garden eggplants, spaced at 50 cm x 50 cm, with a 1 m pathway. Two weeks before planting poultry manure was applied to each plot (0, 15, 30 and 45 kg N/ha)

2.2 Materials Used in the Study

Fresh poultry manure was collected from the Teaching and Research Farm of the University and subjected to a curing process to reduce its moisture content and stabilize its nutrients. The manure was initially spread in a thin layer to facilitate aeration and drying. During the curing process, the manure was regularly turned to ensure uniform drying and prevent the development of anaerobic conditions. This process takes seven weeks. The curing period helps to reduce the levels of volatile compounds and pathogens, making the manure safer for use on the field. After curing, the manure was transported to experimental plots.

The garden egg *Solanum aethiopicum* L. variety (L01) was sourced from the National Horticultural Research Institute (NIHORT) in Ibadan, Nigeria. Seedlings were raised in a nursery tray at the screen house at the Department of Crop and Horticultural Science, University of Ibadan Seeds were sown in a seedling tray, covered with a thin layer of sand, and watered regularly until the seedlings were transplanted to the filed. Transplanting was carried out in the evening, six weeks after sowing. Adequate watering was performed before transplanting to maximize water uptake and ease of removal from the seedling tray. The seedlings were watered immediately after transplanting in the morning and evening to minimize transplant shock. The seedlings were transplanted at 50 cm × 50 cm for the inter-row and intra-row, respectively.

2.3. Data Collection

Systematic sampling was used and data from each plot were collected and the averages per plant were used. This entailed choosing four plants per plot from the middle row of each plot, data collection commenced 2 weeks after transplanting and continued until 10 weeks are transplanting. The parameters measured were plant height (determined from ground level to tips of the youngest expanded leaves on the main stem using a measuring tape); stem diameter (using a Vernier caliper to measure the thickness of the stem); number of expanded leaves per plant (by counting); and canopy spread (measured using a measuring tape to measure the widest expanse of the canopy of the plant). Leaf area per plant was calculated using the formula [18].

$$LA = 0.75\ (L \times W)$$

Where L is the length of the Leaf from the base to the tip, and W is the width of the widest portion of the leaf. Furthermore, the measurement of above-ground fresh and dry biomass, mature fruit yield and weed biomass was made using a portable top-loading laboratory weight balance (GX-10K Precision Balance), and weed biomass.

2.4. Data Analysis

Data collected were subjected to Analysis of Variance using version SAS 9.0 and significant differences among treatment means were separated using the Duncan Multiple Range Test (DMRT) at $p \leq 0.05$.

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3. Results and Discussion

3.1. Soil Properties

The physical and chemical properties of the experimental site before cropping are presented in Table 1. The particle size analysis showed that the textural class of the soil for the experiment was sandy loam, containing 78.2 g/kg sand, 13.6 g/kg silt and 8.2 g/kg clay. The soil has a pH of 6.17, 0.10% nitrogen, 37.68 mg/kg of available phosphorus, and 1.150 cmol/kg exchangeable acidity. 0.08 cmol/kg potassium, 0.86% organic carbon, 7.63 cmol/kg of magnesium and 2.27 cmol/kg of calcium. The micro elements of the soil are as follows; copper is 0.40 mg/kg, manganese is 7.63 mg/kg. The soil analysis before planting indicated a sandy loam texture with low organic carbon and nitrogen content, highlighting the need for soil fertility improvement through organic amendments. The low organic carbon observed in the soil is a characteristic of tropical soils [19]. According to Warncke *et al.* [20], applying N fertilizer on such fine-textured soils has some economic advantages, but the environmental risks (leaching) generally outweigh the economic benefits. Due to its sandy nature, the soil is prone to nutrient leaching. The moderate exchangeable acidity and adequate phosphorus levels provided a supportive but suboptimal environment for crop growth [21]. Under such conditions, crops like garden eggs respond significantly to soil fertility treatments. The application of poultry manure significantly improved plant height, number of leaves, canopy spread, and yield, demonstrating the essential role of soil amendments in enhancing crop productivity [7].

Table 1. Physical and chemical properties of the soil (0-20 cm) at the site before planting.

Properties	Values	Critical range [21]	Remarks
Sand (g/kg)	78.2	0-85	
Clay (g/kg)	8.2	0-85	
Silt (g/kg)	13.6	0-85	
Textural Class	Sandy Loam		
pH (1:1, H_2O)	6.17	6.0-7.5	Neutral
Exchangeable acidity	1.15	0-2.00	Moderate
Organic Carbon (g/kg)	0.68	1.00-5.00	low
Total nitrogen (g/kg)	0.1	0.1-0.5	Moderate
Available P (mg/kg)	28.43	10.00-30.00	High
Ca (cmol/kg)	2.27	2.00-5.00	Low
Mg (cmol/kg)	0.67	0.5-1.5	Moderate
K (cmol/kg)	0.08	0.07-0.15	Moderate
Na (cmol/kg)	0.22	0-2.0.5	Moderate
Mn(mg/kg)	7.63	4.0-40.00	Moderate
Fe(mg/kg)	4.63	4.0-20.00	Low
Cu (mg/kg)	0.4	0.2-2.0	Moderate
Zn (mg/kg)	1.16	0.5-5.0	Moderate

3.2. Chemical Analysis of the Poultry Manure

The chemical properties of poultry manure are presented in Table 2. The nitrogen is 0.35%, phosphorus 0.537%, and potassium 1.505%. The poultry manure has a pH of 8.39, organic carbon 8.316, calcium 1.996%, magnesium 3.556%, iron 2682.85 mg/kg, copper 772.5 mg/kg and zinc 479.8 mg/kg.

Table 2. Chemical properties of the poultry manure.

Properties	Values
Total N (%)	0.35
Total P (%)	0.537
Organic Carbon (%)	8.316
Ca (%)	1.996
Mg (%)	3.556
K (%)	1.505
Na (%)	0.626
Mn (mg/kg)	605.15
Fe (mg/kg)	2682.85
Cu (mg/kg	772.5
Zn (mg/kg)	479.8
pH (H_2O)	8.39

3.3. Effects of Fertilizer and Weeding on Garden Eggplant Heights and Stem Diameters

Applying 45 kg N/ha of poultry manure resulted in significantly ($p < 0.05$) higher plant height and stem diameter compared to the other treatments (control and lower poultry manure levels) during both the cropping seasons (Table 3). In the first cropping season, the 45 kg N/ha treatment produced the tallest plants (31.68 cm) and the thickest stems (6.62 cm) compared to the control (17.05 cm and 4.26 cm, respectively). In the second cropping season, the same trend was observed with the 45 kg N/ha treatment showing a significant increase in plant height (33.42 cm) and stem diameter (6.52 cm). This aligns with findings by Ibrahim *et al.* [22], who reported that applying 10 t/ha (higher rate) of poultry manure produced the highest plant height and stem girth among eggplant varieties compared to adding a lower rate of poultry manure.

Weed control had no significant ($p < 0.05$) effect on both plant height and stem diameter. The no-weeding plot had taller plants (24.86 cm) compared to plants (22.18 cm) in the weeded plot. The plant heights for the weeded and no-weeding plots was similar during the second season. The weeded plots had a slightly larger stem diameter in the second cropping season (5.45 cm vs 4.88 cm in non-weeded plots). However, the differences between the two

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weed control treatments were relatively small not statistically significant across both seasons for both plant height and stem diameter across both cropping seasons.

The interaction between poultry manure fertilizer and weed control was significant ($p < 0.05$). The combination of 45 kg N/ha × No Weeding resulted in the highest plant height (39.04 cm) and stem diameter (7.48 cm) in the first cropping season. The same combination during the second cropping season resulted in a 35.42 cm plant height and 6.50 cm stem diameter. This indicates that high poultry manure and no weeding treatment can promote better growth, especially in the first season. However, in the second cropping season, the combination of 45 kg N/ha × Weeded showed slightly better results in stem diameter (6.54 cm) compared to the non-weeding treatment (6.50 cm). This aligns with Oke *et al.* [23] that those plants treated with higher rates of poultry manure exhibited significant increases in vine length and diameter, leading to higher yields than the ones treated with lower poultry manure. Applying poultry manure without weeding encourages taller plants. This observation could be attributed to the diversion of assimilates to different parts of the plants for the weeded plots, while in the no-weeded plots, the photosynthates were directed towards the multiplication of cells at the meristem for height increase [28].

The control treatment (0 kg N/ha) × No Weeding showed the lowest values for both plant height (17.38 cm in the first cropping and 18.44 cm in the second cropping) and stem diameter (3.93 cm in the first cropping and 3.82 cm in the second cropping), demonstrating the detrimental effect of insufficient nitrogen and lack of weed control. Other poultry manure treatments (15 kg N/ha and 30 kg N/ha) showed moderate increases in plant height and stem diameter, but they were still lower than the 45 kg N/ha treatment. The 15 kg N/ha treatment produced plants with a height of 22.12 cm in the first cropping season and 25.94 cm in the second season, with a stem diameter of 4.47 cm and 5.25 cm, respectively. Similarly, the 30 kg N/ha treatment showed an intermediate response (23.22 cm in the first season and 23.19 cm in the second season for plant height, and 5.10 cm and 4.91 cm for stem diameter, respectively), which were still significantly lower than the 45 kg N/ha treatment .poultry manure at 45 kg N/ha, especially when combined with no weed control, resulted in the best overall plant height and stem diameter in both cropping seasons. The control treatment (0 kg N/ha) with no weed control resulted in the poorest growth, showing the importance of adequate nitrogen and effective weed management for optimal garden egg growth.

The application of poultry manure significantly influenced plant growth, with higher poultry manure levels leading to increased plant height. Response to the growth components was significantly affected by the poultry manure level at the end of the experiment. A similar result for the increase in vegetative growth in the treatment that receives high poultry manure rates was reported by Snr *et al.* [24] At 10 WAP, plants treated with 45 kg N/ha exhibited the highest growth performance, reaching an average height of 33.42 cm compared to 17.14 cm in the control. This may be due to the poultry manure's capacity to provide essential nutrients and organic matter to the soil, as well as enhance its physical properties. Plants that received 45 kg N/ha of poultry manure were taller than those that received 30 kg N/ha, 15 kg N/ha and the control with no poultry manure application. This could be attributed to the higher concentration of nutrients and minerals made readily available and easily absorbed by the plants, promoting faster growth and development. This observation aligns with the findings of Bature *et al.* [25], who reported increased plant height with poultry manure application across both years, and, the highest grain yield was recorded with the highest application of poultry manure. These results are also consistent with those of (Fagimi and Odebode [26], who reported increased plant height and number of leaves in pepper due to high poultry manure application. The higher total plant height observed in plots treated with higher amounts of poultry manure can be attributed to the increased availability of nutrients, which mineralized rapidly, facilitating plant uptake and utilization. This, in turn, contributed to improved plant height, similar to the findings of Enujeke *et al.* [27]. This study revealed that even though weeding increased garden eg stem diameters, the variations across fertilizer application levels were similar.

Table 3. Effects of fertilizer and weeding on garden eggplant heights and stem diameters at 10 weeks after planting in two cropping seasons.

	Plant height (cm)		**Stem diameter (cm)**	
	First cropping	**Second cropping**	**First cropping**	**Second cropping**
Poultry manure				
0 kg N (Control)	17.05b	17.23b	4.26b	3.97b
15 kg N/ha	22.12ab	25.94ab	4.47b	5.25ab
30 kg N/ha	23.22ab	23.19ab	5.10ab	4.91ab
45 kg N/ha	31.68a	33.42a	6.62a	6.52a
SE	3.52	3.49	0.58	0.63
Weed control				
No Weeding	24.86	24.92	5.08	4.88
Weeded	22.18	24.97	5.14	5.45
SE	2.48	2.47	0.41	0.44
interaction				
T1 × W1	17.38b	18.44bc	3.93b	3.82b
T1 × W2	16.71b	16.01c	4.58b	4.12ab
T2 × W1	22.89b	27.44a-c	4.41b	5.10ab
T2 × W2	21.34b	24.45a-c	4.52b	5.41ab
T3 × W1	20.11b	18.40bc	4.49b	4.09ab
T3 × W2	26.33ab	27.99a-c	5.70ab	5.74ab
T4 × W1	39.04a	35.42a	7.48a	6.50a
T4 × W2	24.32ab	31.41ab	5.75ab	6.54a
SE	4.97	4.94	0.83	0.89

Note: T1- 0 kg N (Control); T2- 15 kg N/ha; T3– 30 kg N/ha; T4- 45 kg N/ha; W1- No Weeding plot; W2- Weeded plot. Values having the same alphabet along the same column are not significantly different at $P \leq 0.05$.

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3.4. Effects of Fertilizer and Weeding on Garden Egg Number of Leaves and Canopy Spread

Applying 45 kg N/ha of poultry manure resulted in significantly ($p < 0.05$) higher number of leaves and canopy spread compared to the other treatments (control and lower poultry manure levels) during both cropping seasons (Table 4). In both cropping seasons, the 15 kg N/ha treatment produced a significantly higher number of leaves and canopy spread than the control (0 kg N/ha). However, the 45 kg N/ha treatment consistently resulted in the highest values. The responses of eggplants to the application of poultry manure fertilizer did not vary significantly for the number of leaves and canopy spread between the first and second cropping seasons. However, the plants treated with 45 kg N/ha had a 27% higher number of leaves and 15.44% higher canopy spread compared to the 30 kg N/ha treatment, while the lowest values were observed in the control. Similar trends were observed in the number of leaves and leaf area, reinforcing the role of poultry manure in promoting vegetative growth [4]. These findings align with previous research demonstrating that organic fertilizers enhance crop productivity by improving nutrient uptake and photosynthetic efficiency [5, 28].

Weed control had a significant ($p < 0.05$) effect on the number of leaves and canopy spread. Weeded plots showed significantly ($p < 0.05$) higher number of leaves (12.61 in the first season and 14.21 in the second season) and canopy spread (25.51 cm^2 in the first season and 26.72 cm^2 in the second season) compared to no weeding plots, where the number of leaves and canopy spread were lower (11.73 and 12.18 leaves, respectively, and 23.53 cm^2 and 24.45 cm^2 canopy spread, respectively). This aligns with Bature *et al.* [25] that regular weeding at 3 to 6 WAP, resulted in taller plants, and increased relative growth rates and suggests that integrating appropriate rates of poultry manure with effective weed management practices can significantly enhance crop performance.

The interaction between poultry manure fertilizer and weed control was significant ($p < 0.05$). In particular, the combination of 45 kg N/ha × Weeded resulted in the highest values for both number of leaves (16.82 in the first season and 17.24 in the second season) and canopy spread (27.07 cm^2 in the first season and 31.89 cm^2 in the second season), indicating that both poultry manure and weed control synergistically improve growth. The control treatment (0 kg N/ha) × No Weeding consistently had the lowest values for both the number of leaves (9.34 in the first season and 8.91 in the second season) and canopy spread (20.40 cm^2 in the first season and 20.57 cm^2 in the second season), demonstrating the negative impact of insufficient fertilization and lack of weed control on plant growth. This aligns with Maghfoer *et al.* [29] that applying a higher rate of organic manure yielded the highest mean values for the number of leaves.

The other poultry manure treatments (15 kg N/ha and 30 kg N/ha) showed varying responses to weed control. For the 15 kg N/ha treatment, weeding had a noticeable positive effect, with plants in weeding treatments having a 14.73% higher number of leaves and 5.7% higher canopy spread compared to non-weeding treatments during the second cropping season. For the 30 kg N/ha treatment, the effect of weeding was less pronounced, with only a slight increase in both the number of leaves and canopy spread when weeds were controlled. Ahmed [30] found that poultry manure application led to the highest mean number of leaves and canopy spread in garden eggplants. The results of the canopy spread showed that the tolerance of garden egg to weed interference was promoted by poultry manure at higher level (45 kg N/ha of poultry manure). The tolerance of garden egg to weed interference was negligible in this study as no significant variation was observed among the treatments.

Table 4. Effects of fertilizer and weeding on garden egg number of leaves and canopy spread at 10 weeks after planting in two cropping seasons

	Number of leaves		**Canopy spread (cm^2)**	
	First cropping	**Second cropping**	**First cropping**	**Second cropping**
Poultry manure				
0 kg N (Control)	9.90b	9.31	20.26b	20.08b
15 kg N/ha	12.96a	15.82	24.29ab	26.53a
30 kg N/ha	12.00a	11.57	24.97ab	25.24ab
45 kg N/ha	13.82a	16.08	28.56a	30.49a
SE	2.02	2.54	2.25	2.18
Weed control				
No Weeding	11.73	12.18	23.53	24.45
Weeded	12.61	14.21	25.51	26.72
SE	1.42	1.79	1.59	1.54
interaction				
T1 × W1	9.34	8.91	20.40bc	20.57cd
T1 × W2	10.45	9.71	20.13c	19.60d
T2 × W1	11.59	16.44	23.55a-c	27.41a-d
T2 × W2	14.34	15.19	25.03a-c	25.65a-d
T3 × W1	9.17	8.44	20.13c	20.73b-d
T3 × W2	14.84	14.69	29.81ab	29.75ab
T4 × W1	16.82	14.93	30.06a	29.09a-c
T4 × W2	10.82	17.24	27.07a-c	31.89a
SE	2.85	3.59	3.18	3.08

Note: T1- 0 kg N (Control); T2- 15 kg N/ha; T3– 30 kg N/ha; T4- 45 kg N/ha; W1- No Weeding plot; W2- Weeded plot; Values having the same alphabet along the same column are not significantly different at $P \leq 0.05$.

3.5. Leaf Area and Yield of Garden Egg as Affected by Fertilizer and Weed Management Options

Applying 45 kg N/ha of poultry manure resulted in significantly ($p < 0.05$) higher leaf area and yield compared to the other treatments (control and lower poultry manure levels) during both the cropping seasons (Table 5). In both cropping seasons, the 45 kg N/ha treatment produced the highest leaf area (1725.67 cm^2 in the first season and 1891.17 cm^2 in the second season) and yield (450.13 kg/ha in the first season and 499.48 kg/ha in the second season), indicating that higher poultry manure application enhances both leaf development and fruit production.

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This aligns with Amalia's *et al.* [31] report that improved nitrogen availability, benefits vegetative growth (including leaves, stems, and roots), and could further improve increased soil microbial activity leading to increased yield.

In the first cropping, the leaf area in the 45 kg N/ha treatment was more than three times larger than in the control (0 kg N/ha), which had the lowest values (576.78 cm²). Similarly, the yield at 45 kg N/ha was significantly higher than in the control treatment, which showed minimal yield (111.67 kg/ha). The 15 kg N/ha and 30 kg N/ha treatments showed moderate improvements in leaf area and yield but were still much lower than the 45 kg N/ha treatment.

Weed control significantly ($p < 0.05$) affected leaf area and yield. Weeded plots showed consistently higher leaf area and yield than no-weeding plots during both cropping seasons. In the first cropping season, the weeding treatment increased leaf area by 47.97% (1274.67 cm² vs 862.89 cm²) and yield by 397.66% (2147.99 kg/ha vs 431.33 kg/ha) compared to the no weeding treatment. Similarly, during the second cropping, weeding increased leaf area by 50.42% (1359.98 cm² vs 905.16 cm²) and yield by 231.45% (2062.12 kg/ha vs 622.06 kg/ha). This conforms with Akinrinola, and Fagbola [10] weed interference leads to competition and frequent weeding is most appropriate.

Likewise, the control treatment (0 kg N/ha) × No Weeding showed the lowest leaf area (433.65 cm² in the first season and 420.26 cm² in the second season) and yield (0.00 kg/ha in the first season and 125.00 kg/ha in the second season). This highlights the detrimental effect of insufficient poultry manure application and poor weed control, which resulted in stunted growth and zero or minimal yield in the first cropping season. Other poultry manure treatments also showed significant effects, but the differences were not much. For the 15 kg N/ha treatment, the plants in weeding plots had higher leaf area (1123.43 cm² vs 725.46 cm²) and yield (999.23 kg/ha vs 551.00 kg/ha) than no weeding. However, the yield and leaf area were still lower than higher poultry manure levels (30 kg N/ha and 45 kg N/ha). Poultry manure at 45 kg N/ha combined with weed control resulted in the best overall leaf area and yield in both cropping seasons. The control treatment (0 kg N/ha) with no weeding resulted in the poorest performance, indicating the importance of poultry manure application and effective weed management for optimal garden egg growth and production. The interaction between poultry manure fertilizer and weed control was significant ($p < 0.05$). In particular, the combination of 45 kg N/ha × Weeded resulted in the highest leaf area (1926.70 cm² in the first season and 2398.04 cm² in the second season) and yield (6502.47 kg/ha in the first season and 6004.10 kg/ha in the second season), This aligns with Carey *et al.* [32] that demonstrates that both high poultry manure application and effective weed control enhance plant growth and fruit production. The observed results for the interactions between poultry manure and weeding options revealed that garden egg yields were subjected to regular weeding for better performance. Across the levels of poultry manure, the higher the level of application, the more the yield difference between the weeded and the no-weeding plots. Thus, poultry manure application could not suffice for the competition experienced by garden egg in tolerating the presence of weeds.

Table 5. Leaf area and yield of Garden egg as Affected by Fertilizer and weed management options.

	Leaf area (cm²)		**Yield**	
	First cropping	**Second cropping**	**First cropping**	**Second cropping**
Poultry manure				
0 kg N (Control)	576.78c	521.98c	111.67c	209.88c
15 kg N/ha	924.45b	1138.91b	3821.73a	3793.30a
30 kg N/ha	1048.24b	978.22bc	775.12b	865.71b
45 kg N/ha	1725.67a	1891.17a	450.13bc	499.48bc
SE	179.55	215.03	292.55	282.86
Weed control				
No Weeding	862.89b	905.16b	431.33b	622.06b
Weeded	1274.67a	1359.98a	2147.99a	2062.12a
SE	126.96	152.05	206.86	200.01
interaction				
T1 × W1	433.65d	420.26c	0.00d	125.00c
T1 × W2	719.90cd	623.70bc	223.33d	294.75c
T2 × W1	725.46cd	1076.99bc	551.00cd	682.00bc
T2 × W2	1123.43b-d	1200.84bc	999.23bc	1049.43bc
T3 × W1	767.82b-d	739.07bc	33.33d	98.75c
T3 × W2	1328.65a-c	1217.36bc	866.93c	900.20bc
T4 × W1	1524.64ab	1384.31b	1141.00b	1582.50b
T4 × W2	1926.70a	2398.04a	6502.47a	6004.10a
SE	253.93	304.11	413.73	400.03

Note: T1- 0 kg N (Control); T2- 15 kg N/ha; T3– 30 kg N/ha; T4- 45 kg N/ha; W1- No Weeding plot; W2- Weeded plot; Values having the same alphabet along the same column are not significantly different at $P \leq 0.05$.

3.6. Weed Dry Biomass in Garden Egg Plots as Affected by Fertilizers and Weed Management Options

The dry weed biomass was significantly higher under 45 kg N/ha of poultry manure compared to the control during the first cropping, while during the second cropping the treatment significantly increased dry weed than the others. This finding is supported by Akinrinola and Fagbola's [10] report that improvement in soil nutrient status enhances weed dry matter in maize. The increase in dry matter accumulation was attributed to the availability of nutrients that enhances both the crop and weeds. According to Shah et al. [9] the nutrients applied for improved crop performance also encourage weed developments. This was apparent in the response observed when the fertilizer level increase, the weed dry biomass also increased.

The dry biomass of weeds observed for the no-weeding plots increased significantly than the weeded plots during the first and second cropping. The above ground crop-weed competition could explain the reason for taller

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garden egg plants observed during the first cropping. As the plants compete for space most of the assimilates are directed towards the apical meristem for the interception of light. This explains the lower values for the plants' stem diameter, number of leaves, leaf area, and canopy spread. The channeling of assimilates to the apical portion coupled with the belowground competition for nutrients deprived the plants of the ability to adequately amass enough carbohydrates for storage as yield.

Table 6. Weed dry biomass (g/m^2) as affected by fertilizer and weed management option.

	First cropping	Second cropping
Poultry manure		
0 kg N (Control)	184.80b	143.10b
15 kg N/ha	205.06ab	181.78b
30 kg N/ha	231.00ab	190.37b
45 kg N/ha	278.37a	260.02a
SE	19.24	30.84
Weed control		
No Weeding	338.51a	266.60a
Weeded	111.11b	104.75b
SE	13.60	21.80
interaction		
0 kg N × No Weeding (Control)	290.40b	210.16b
0 kg N × Weeded	79.20c	74.01c
15 kg N/ha × No Weeding	313.28ab	220.03b
15 kg N/ha × Weeded	96.85c	110.10c
30 kg N/ha × No Weeding	330.00ab	251.15b
30 kg N/ha × Weeded	132.00bc	100.21c
45 kg N/ha × No Weeding	420.34a	385.98a
45 kg N/ha × Weeded	136.40	135.03bc
SE		25.99

Note: Values having the same alphabet along the same column are not significantly different at $P \leq 0.05$.

The combined effects fertilizers and weeding options resulted in significant variation among treatments for weed biomass (Table 6). The observed dry weed biomass during the first and second cropping were lowest (79.20 and 74.01 g/m^2) in the 0 kg N × Weeded plots and highest (420 and to 385.98 g/m^2, respectively) in the treatments with 45 kg N/ha × No Weeding. Across the fertilizer levels, the weed plots had lower dry weed biomass. The removal of weeds from the weeded plots must have caused minimal competition for available resources, thus encouraging better crop growth that cumulated into increased yields in the weeded plots [9, 13]. The intense competition for resources coupled with limited inherence soil fertility status could explain the magnitudes of the observed reduction in growth and yields for the no-weeding plots. Despite the expected increase in garden egg yield through its tolerance to weed at higher level of poultry manure application, rather weed biomass were favored [28]. This suggested that improving soil nutrient status in an attempt to increase the resilience of garden egg would only promote weed biomass.

4. Conclusion

The results indicated that applying 45 kg of nitrogen per hectare from poultry manure enhanced the growth parameters of garden eggplants, including plant height, stem diameter, number of leaves, and canopy spread, in both cropping seasons. Additionally, weeding positively influenced plant growth and yield, with plots that were weeded showing a larger leaf area and higher yields compared to those that were not weeded. The interaction between poultry manure application and weed management was in the best overall growth and yield performance with the combination of 45 kg N/ha poultry manure and regular weed control. Conversely, the control treatment (0 kg N/ha) combined with no weeding consistently resulted in the poorest growth and minimal yield, highlighting the detrimental impact of insufficient fertilizer application and poor weed management. In conclusion, poultry manure at 45 kg N/ha, particularly when combined with regular weed control, is an effective strategy for improving the growth and yield of eggplants. Effective management of both nutrient inputs and weed interference is crucial for maximizing garden egg production.

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