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Poultry Manure Rate Affects Growth, Yield and Pest Infestation of Cucumber (*Cucumis sativus* L.)

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ABSTRACT
Cultivation of cucumber (*Cucumis sativus* L.) is on the increase in Obafemi-Owode Local Government Area of Ogun State in response to increasing demands. However, nutrient deficiency and insect pests are major constraints to its cultivation. This study determined the poultry manure (PM) rate required for optimum growth, fruit yield and reduced pest infestation on cucumber from field trials carried out in Sedfort Farms, Ogbe-Eruku (7° 00' N 3° 47' E) between July and September 2023 for first planting (FP) and between October and December 2023 for residual planting (RP). Trials were laid out in a randomized complete block design with four replicates. The PM was applied at 0, 5, 10 and 15 t ha^{-1} on the plots. Data collected on growth between 2 and 8 weeks after planting, as well as data on fruiting were subjected to Analysis of Variance. Significantly different treatment means ($P \leq 0.05$) were separated using Least Significant Difference at 5% probability level. In both trials, cucumber treated with 10 or 15 t ha^{-1} PM had longer vines, higher number of leaves and wider average leaf area than no PM. Cucumber that received 10 or 15 t ha^{-1} PM had higher yield per hectare than no PM in FP (50.25% or 52.19%) and in RP (50.20% or 69.66%) respectively. Cucumber that received 0 or 5 tha^{-1} PM in RP, had the least insect population density (IPD) while 10 or 15 tha^{-1} PM treatments had higher IPD, with 46.03% or 49.21%, respectively. Leaf damage was least for unfertilized cucumber. Plants treated with 5, 10 and 15 t ha^{-1} PM had leaf damage of 62.41%, 70.43% and 102.41% in FP and 60.47%, 57.27% and 70.49% in RP, respectively. Optimum cucumber fruit yield was from application of PM at 10 t ha^{-1}. This study concluded that application of PM at 10 t ha^{-1} could be adopted for reduced insect pests' infestation and optimum cucumber growth and yield fruit production in Obafemi-Owode Local Government Area of Ogun State and environments with similar climate.

Keywords: Cucumber, Ogun State, Organic crop production, Insect-pest infestation, Nigeria.

Introduction

Cucumber (*Cucumis sativus* L.) is indigenous to Africa and Asia (Sebastian *et al*., 2010). It is grown predominantly by smallholder farmers in various regions of northern and eastern Nigeria (Ekwu, 2007). Botanically, cucumbers are classified as fruits. However, like tomatoes and squash, they are frequently seen, prepared and eaten as vegetables. Cucumbers are generally characterized by having over 90% water (Oke *et al.,* 2020).

Fertilizer is critical for crop growth, as it provides one or more vital nutrients required for optimal development. Plants require these minerals in either substantial or minimal amounts (Shukla *et al*., 2014). Organic fertilizers are crop enhancers from

plant or animal origin that support plant growth and development. Organic manure application increases soil organic matter which serves as food for soil floral and soil fauna, like earthworm, springtail and termite (Gomiero *et al*., 2011). Organic manure application improves crop yields through improved soil aggregation, better soil aeration, augmented water retention capacity as well as offering good environmental conditions for plants root systems (Tian *et al*., 2022); improved soil structure (Dauda *et al*., 2009) and microbial biomass proliferation (Singh *et al.,* 2018).

Organic manures improve crop yields through enhanced soil aggregation, soil aeration, increasing water holding capacity, offer good environmental condition for the root system of plants (Tian *et al*., 2022) for improving soil structure and organic carbon (Yang *et al.,* 2021) and microbial biomass multiplication (Singh *et al.,* 2018). Organic fertilizers derived from livestock, including cattle, sheep, goats, and chickens, have been utilized by smallholder farmers to improve soil fertility (Ntalli *et al*., 2020). It has been shown that sole applications of poultry manure are superior to wood ash and rice bran in cucumber cultivation (Moyin-Jesu, 2015) and to NPK (Ogedegbe and Law-Ogbomo, 2013). Poultry manure contains high nitrogen content compared to phosphorus, potassium and other essential nutrients (Mochiah *et al*., 2011).

Poultry manure has drawn interest as a possible organic fertilizer source because of its high nutritional content and affordable price (Kallon *et al*., 2025). Rich in nitrogen, phosphorus, potassium and other vital elements, poultry manure has been demonstrated to raise crop output, improve soil fertility and improve agricultural products (Jansson and Hofmockel, 2020). The use of chemical fertilizers has been reported to increase crop yields, but their use is limited by the high cost, scarcity during the time of its need (planting season), soil acidity and nutrient imbalance (Kallon *et al.,* 2025). Cucumber requires substantial amounts of nitrogen, phosphorus, and potassium (Mohammed *et al*., 2021). Biologically active soils with sufficient organic matter typically provide an adequate supply of these nutrients (Tarafdar, 2022). Current global trends indicate that organic fertilizers surpass chemical fertilizers in promoting growth, yield, and quality of numerous vegetable crops (Ogedegbe and Law-Ogbomo, 2013).

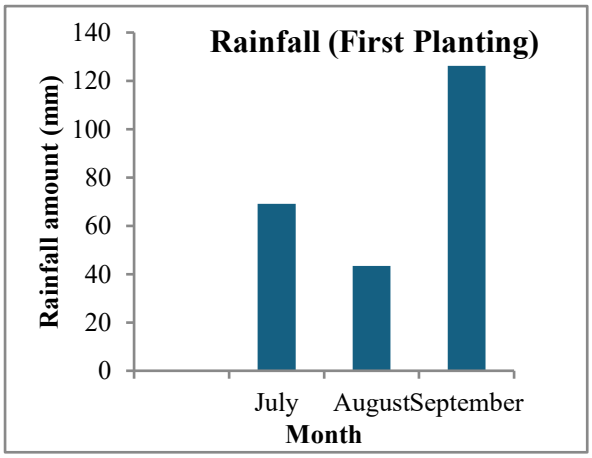
Tropical soils have high acidic and low organic matter due to continuous degradation (Fujii, 2014). These soils need to be fortified to support proper plant growth and development. Poultry manure application is a form of soil improvement practice that improves soil fertility through gradual nutrient release. Oke *et al.* (2020) recommended 15 tha^{-1} of poultry manure for commercial cultivation of cucumber in Ibadan southwest Nigeria. Mineral imbalances or surpluses may arise in some organic management practices, particularly when substantial quantities of poultry manure or compost are utilized (Patriquin *et al*., 1995; Echezona and Nganwuchu, 2006). Excessive application of nutrients may exacerbate pest issues by enhancing the reproduction, longevity, and overall fitness of specific pests (Jahn, 2004). Soil enhancement management strategies influence the physiological vulnerability of crop plants to insect pests by either modifying the resilience of individual plants to infestation or by changing plant palatability to specific herbivores (Chau and Heong, 2005). Meyer (2000) posited that soil nitrogen availability influences the extent of damage plants incur from herbivores and their capacity for recovery from such damage. In view of this, this experiment was conducted to determine poultry manure rate for optimum growth and yield of cucumber

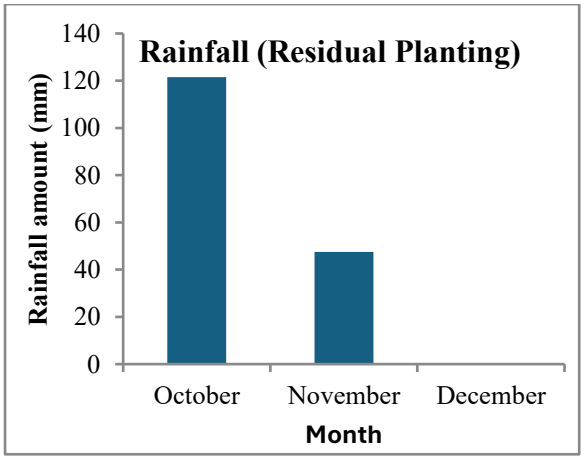
with reduced insect pests in Obafemi-Owode, Local Government Area in Ogun State.

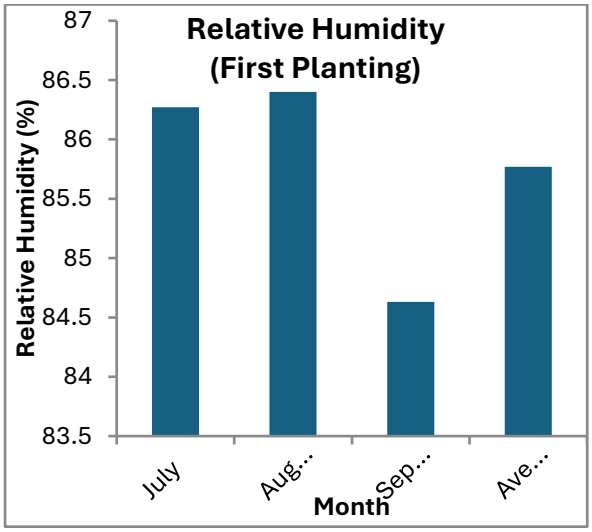
Materials and Methods

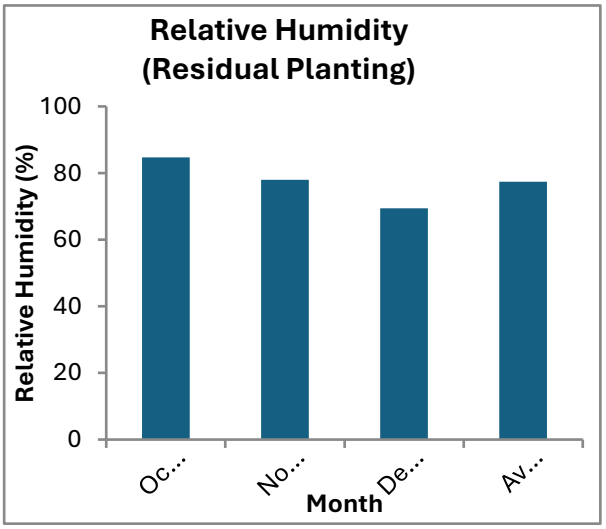
Experimental site

The experiment was conducted in Sedfort Farms, kilometer 12 Ogbe Eruku in Obafemi-Owode Local Government, Ogun State, Nigeria (7°00′N, 3°47′E). The first planting was carried out between July and September 2023; residual planting was between October and December 2023. The residual planting started two weeks after the termination of the first trial. The weather records taken during this field experiment were rainfall, temperature and relative humidity. During the first planting from July to September, total rainfall was 238.66 mm with September recording the highest rainfall of 126 mm and August with the least rainfall with 43.40 mm. During the residual planting from October to December, total rainfall was 169.00 mm with October recording the highest rainfall of 121.50 mm and December with no rainfall (Figure 1). Maximum temperature during first planting and residual planting was 39 ^{0}C while the minimum temperature ranged from 33.21 – 33.44 ^{0}C and 32.20 – 34.34 ^{0}C in the first planting and residual planting respectively (Figure 1). In the first planting, average relative humidity was 85.77% and the highest relative humidity of 86.40% was observed in the month of August while the lowest was 84.63% in September. During the residual planting, the average relative humidity was 77.36% and the highest (84.69%) was observed in the month of October and the lowest (69.39%) in December (Figure 1).









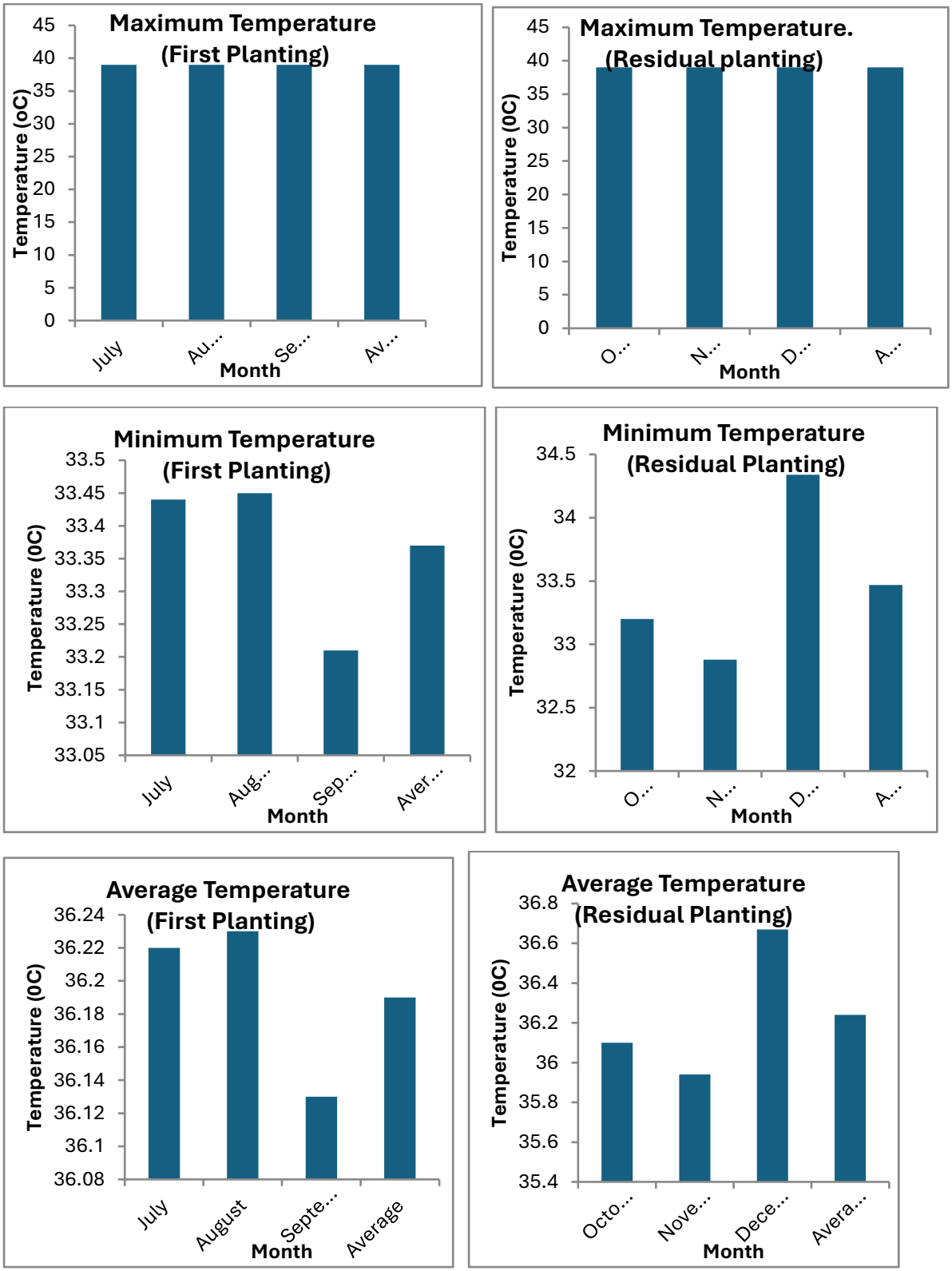


Figure 1: Monthly rainfall, maximum and minimum temperatures and relative humidity of the experimental area
Source: Ogun-Oshun River Basin Development Authority, Abeokuta

Planting material

Cucumber (Lilly F_1) seeds used for the experiment were sourced from Agriwas Agri-services Hub in Ibadan, Oyo State while poultry manure was sourced from Alao Farms beside Sedfort Farms at Ogbe Eruku, Obafemi-Owode Local Government, Ogun State.

Soil and Poultry manure composition

Surface soil samples were randomly selected from various spots within the experimental site with the aid of a soil core sampler, which is appropriate for spot sampling, at 10 cm depth and bulked to form a composite. The soil was air-dried and sieved through 2 mm mesh size and analyzed for physical and chemical properties, using conventional analytical procedures. The soil textural class was found to be loamy sand with a slightly basic pH of 7.67. The soil was low in organic matter (2.87%) and nitrogen content (0.13%). The Available phosphorus level (68.48 mg/kg) was moderate. The exchangeable acidity of 0.05 cmol/kg, while exchangeable bases: calcium, magnesium, potassium and sodium were 7.98 cmol/kg, 1.97 cmol/kg, 0.41 cmol/kg and 0.24 cmol/kg. Micronutrients found in the soil were manganese (31.3 mg/kg), iron (9.55 mg/kg), copper (3.69 mg/kg) and zinc content of 15.54 mg/kg (Table 1). Poultry manure samples were randomly selected from the manure bag packed from deep litter system with the aid of a core sampler at various depths and bulked to form a composite. The manure was air-dried and sieved through 2 mm mesh size and analyzed for its chemical properties using conventional analytical procedures. Poultry manure analysis was near neutral with a pH of 7.22, low nitrogen and available phosphorus contents of 0.27% and 2.00% respectively. The exchangeable bases: calcium, magnesium, potassium and sodium were 937.00%, 132.00%, 1.36% and 0.53%. Micronutrients level was manganese (517.00 mg/kg), iron (2311.00 mg/kg), copper (54.10 mg/kg) and zinc content of 288.80 mg/kg (Table 1).

Table 1: Soil and poultry manure composition

Properties	Soil	Poultry manure
pH (water)	7.76	7.22
N (g/kg)	1.30	2.70
Organic C (g/kg)	16.70	44.80
Organic matter (g/kg)	28.70	77.10
C/N	16.34	16.34
Available Phosphorus (mg/kg)	68.48	200
Exchangeable Bases (cmol/kg)		
Ca	7.98	937.00
Mg	1.97	132.90
K	0.41	1.36
Na	0.24	0.53
Al + H	0.05	-
ECEC	10.66	-
Base saturation (%)	99.53	-
Micro-nutrients (mg/kg)		
Mn	31.3	517.00
Fe	9.55	2311.00
Cu	3.69	54.10
Zn	15.54	288.80
Particle size (g/kg)		
Sand	786	-
Silt	134	-
Clay	80	-
Textural class	Loamy sand	

Organic matter was: 1.72 (Organic C)

Experimental Design:
The experiment was arranged in a randomized complete block design with four replications. Poultry manure rates were four levels at 0, 5, 10 and 15 t ha^{-1}.

Land preparation and plot layout
A land area measuring 31.5 m by 11 m was cleared using hoe and cutlass and thereafter demarcated with pegs and mapped out into 64 plots rounded with twines. Each plot measured 2 m by 1.5 m, separated by 0.5 m within blocks and 1 m between blocks. Each plot was tagged, then a spade was used in incorporating poultry manure into the soil at 0, 5, 10 and 15 tha^{-1} at 2 weeks before planting. Seeds were sown directly on the field and plants were established at 50 cm by 50 cm spacing which resulted in a population of 40,000 plants per hectare.

Cultural practices

Land was cleared manually in July, 2023 using cutlass and hoe. Cucumber seeds were sown directly on the field on July 17, 2023, two weeks after application of poultry manure. Missing stands were supplied within 2 weeks after planting. Weeds were manually cleared starting from 10 days after planting and subsequently at 3 weeks interval. Cucumber plants were suspended by twines attached to a bamboo pole to prevent the fruits from lying on the ground. Cucumber fruits were manually harvested using knife when they were mature green from 6 – 10 WAP.

Residual planting started 2 weeks after termination of the first trial. Same methodologies as the first planting were followed, but without reapplication of poultry manure.

Data collection

Growth parameters of vine length and number of leaves per plant were measured at weekly intervals from 2 – 8 weeks after planting (WAP). Data were collected on the following parameters-

Vine length (cm): This was measured with the aid of a measuring tape as the distance from the ground level to the uppermost leaf of five randomly selected cucumber plants from the middle row of each plot.

Number of leaves per plant: Fully expanded leaves of the cucumber plants were counted from the five randomly selected plants.

Average leaf area - ALA (cm^2): Determined using:

$$ALA = 12.9X - 54.31$$

X is leaf breath in cm (Adedokun and Aiyelaagbe, 2009).

Insect population density: Assessment of the population density and species of different insect pests encountered in the study area commenced from 2 to 8 weeks after planting. This was done at weekly interval by visual counting on five randomly selected plants from the middle row of each subplot between 6 and 7 a.m. when the insects were less active.

Leaf damage (%): Determined at 6 WAP using the formula;

$$\text{Leaf damage} = \frac{\text{Number of damaged leaves}}{\text{Total number of leaves}} \times 100\%$$

Plant maturity and yield variables: Mature fruits were harvested from each plot from 6 – 10 WAP.

Number of days to first female flowering: Number of days to first female flower opening was counted.

Number of days to first male flowering: Number of days to first male flower opening was counted.

Number of days to first fruiting: Number of days to first fruiting was counted.

Fruit size (g): Fruit weight was measured with the aid of a sensitive scale.

Yield per plant (g/plant): Weight of total fruits harvested from five tagged plants were measured with the aid of a sensitive scale and the average determined.

Yield per hectare (t ha^{-1}): Weight of all fruits from each plot was measured with the aid of a sensitive scale and expressed on a hectare basis.

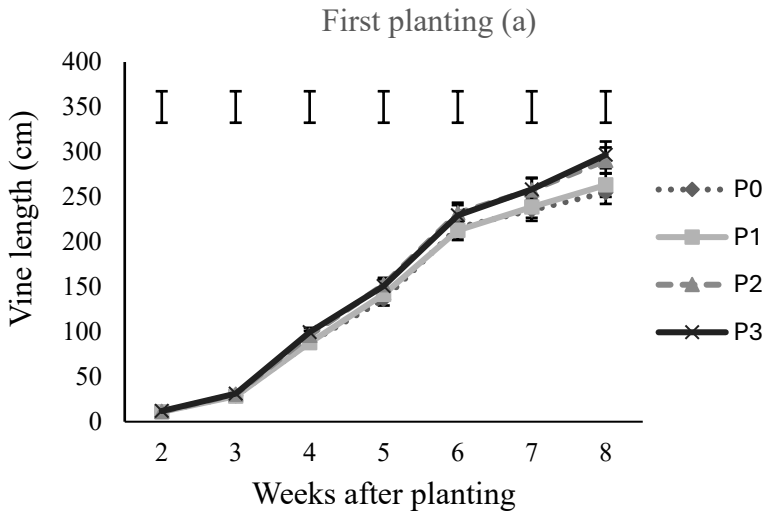
Data analysis

Data collected were subjected to analysis of variance (ANOVA) using GENSTAT discovery (12th ed., VSN International, Hemel Hempstead, UK), and significant treatment means were separated using least significance difference (LSD) at 5% probability level.

Results

Growth characteristics of cucumber as influenced by rates of poultry manure

In the first planting, vine length was not significantly affected by rates of poultry manure from 2 – 7 weeks after planting (WAP) but was significantly affected at 8 WAP (Figure 2a). Cucumber that received 10 t ha^{-1} and those that received 15 t ha^{-1} of poultry manure had the longest vines while cucumber that received 0 t ha^{-1} of poultry manure had the shortest vines. However, in the residual planting, vine length was significantly affected by rates of poultry manure at 2 – 4 WAP but vine lengths were similar from 5 – 8 WAP (Figure 2b).



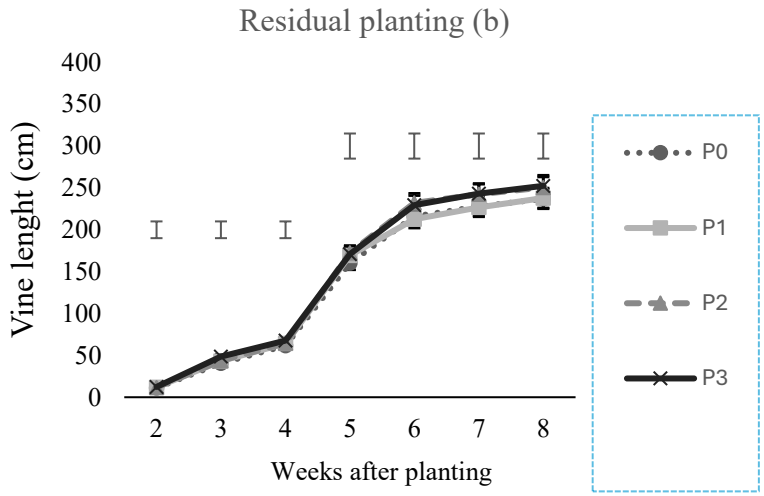
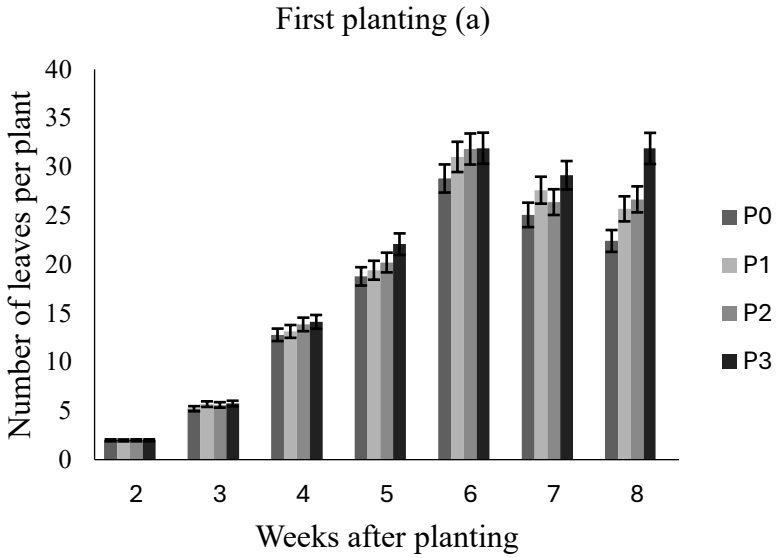


Figure 2: Vine length of cucumber as affected by rate of poultry manure. P0- no poultry manure, P1- poultry manure at 5 t ha^{-1}, P2- poultry manure at 10 t ha^{-1}, P3- poultry manure at 15 t ha^{-1}

The number of leaves per plant in the first planting experiment was not significantly different from 2 – 7 WAP but was significantly different at 8 WAP (Figure 3a). Cucumber that received 15 t ha^{-1} had the highest number of leaves per plant while those that received 0 t ha^{-1} had lowest number of leaves per plant. In residual planting, at 2 – 4 WAP, there were significant differences between the treatments (Figure 3b). Cucumber that received 15 t ha^{-1} had the highest number of leaves per plant while those that received 0 t ha^{-1} had the lowest number of leaves per plant. However, at 4 – 8 weeks after planting, there were no significant differences between the treatments.



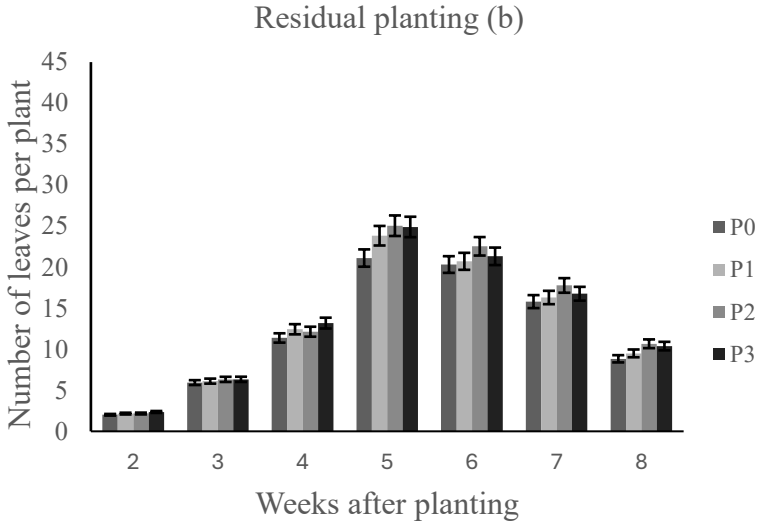


Figure 3: Number of leaves per cucumber plant as affected by rate of poultry manure P0- no poultry manure, P1- poultry manure at 5 t ha^{-1}, P2- poultry manure at 10 t ha^{-1}, P3- poultry manure at 15 t ha^{-1}

Average leaf area was not significantly affected by rate of poultry manure in the first planning experiment (Figure 4a). Average leaf area ranged from 62.43 – 72.01 cm^2 at 2 WAP to 193.25 – 210.79 cm^2 at 8 WAP. In the residual planting, at 2, 3, 8 WAP cucumbers that received 15 t ha^{-1} had the largest average leaf area while those that received 0 t ha^{-1} had the lowest average leaf area (Figure 4b). However, between 4 and 7 WAP average leaf area was not significantly affected by rate of poultry manure application.

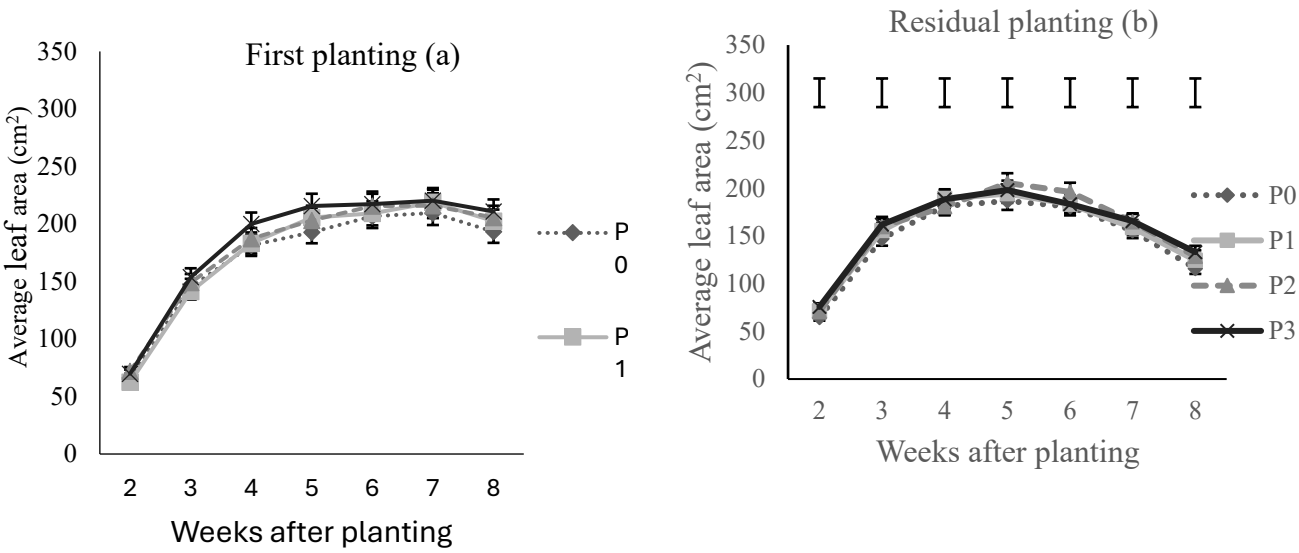


Figure 4: Average leaf area of cucumber as affected by rates of poultry manure
P0- no poultry manure, P1- poultry manure at 5 t ha^{-1}, P2- poultry manure at 10 t ha^{-1}, P3- poultry manure at 15 t ha^{-1}

Insect pests' infestation on cucumber as influenced by rate of poultry manure

Insect population density

Cucumber cultivation in both experiments was infested by several species of insects. The insects found on the cucumber plants were red pumpkin beetles (*Aulacophra spp*), spotted cucumber beetle (*Diabrotica undecimpunctat*), flea beetle (*Podagrica spp*) and elegant grasshopper (*Zonocerus variegatus*). The insect pest of interest to the study was the red pumpkin beetle due to its population density on the crop plant.

In the first planting, insect population density was not significantly affected by rate of poultry manure (Table 2). Insect population density ranged from 9.30 in cucumber plants that received no poultry manure to 13.83 in cucumber plants that received 15 t ha^{-1} of poultry manure during the first planting. However, in the residual planting, treatment applied significantly affected insect population density. Cucumber plants that received 0 t ha^{-1} or 5 t ha^{-1} had the lowest population density of insects while plants that received either 10 t ha^{-1} or 15 t ha^{-1} had the highest population density of insects.

Table 2: Insect population density of cucumber as influenced by rate of poultry manure

Poultry manure (t ha^{-1})	Insect Population Density	
	First Planting	Residual Planting
0	9.30	4.41
5	9.42	5.12
10	10.09	6.44
15	13.83	6.58
LSD (P≤0.05)	NS	1.24

NS: Not Significant, LSD: Least Significant Difference

Leaf damage (%)

Rate of poultry manure application significantly affected leaf damage in both planting seasons (Table 3). In the first planting, Cucumber that received 0 t ha^{-1} of poultry manure had the least percentage of leaf damage while plants that received 15 t ha^{-1} appeared to have higher percentage leaf damage but similar compared to leaf damage of cucumber with 5 and 10 t ha^{-1} poultry manure. The result in the residual planting was like the first planting. Cucumber that received 0 t ha^{-1} of poultry manure had the least percentage leaf damage while plants that received 5 t ha^{-1}, 10 t ha^{-1} and 15 t ha^{-1} had the most percentage leaf damage.

Table 3: Leaf damage on cucumber plant as influenced by rate of poultry manure application

Poultry manure (t ha^{-1})	Insect Population Density	
	First Planting	Residual Planting
0	12.85	14.37
5	20.87	23.06
10	26.01	22.60
15	7.31	24.50
LSD (P≤0.05)	22.56	6.82

NS: Not Significant, LSD: Least Significant Difference

Plant maturity and yield variables of cucumber as influenced by rate of poultry manure

Plant maturity variables

Rates of poultry manure did not significantly affect days to first male and female flowering in first planting (Table 4). However, in the residual planting, rates of poultry manure significantly affected parameter measured. Cucumber that received 15 t ha^{-1} of poultry manure attained days to first male flowering earlier while plants that received 0 t ha^{-1} attained days to first male flowering later. Also, cucumber that received 15 t ha^{-1}, 10 t ha^{-1} and 5 t ha^{-1} reached days to first female flowering earlier than plant that received 0 t ha^{-1} (Table 4).

Table 4: Number of days to male, female flowering of cucumber as affected by rate of poultry manure

Poultry manure (t ha^{-1})	Number of days to male flowering		Number of days to female flowering	
	First Planting	Residual Planting	First planting	Residual Planting
0	27.94	27.81	27.56	27.75
5	27.81	27.69	27.75	27.19
10	27.75	27.44	27.62	27.31
15	27.75	27.31	27.69	27.19
LSD (P≤0.05)	Ns	0.35	Ns	0.43

NS: Not Significant, LSD: Least Significant Difference

Yield variables

In first planting, rate of poultry manure did not significantly affect days to first fruiting and fruit weight but significantly affected number of fruits per plant, yield per plant and yield per hectare (Table 5). Cucumber that received 15 t ha^{-1} and 10 t ha^{-1} had the higher number of fruits per plant by 50.2% and 49.2%, respectively compared with cucumber without poultry manure. However, number of fruits produced from 15 t ha^{-1} (3.02) and 10 t ha^{-1} (3.00) poultry manure was similar, compared to fruits produced from 5 t ha^{-1} poultry manure (2.44). Cucumber that received 15 t ha^{-1} and 10 t ha^{-1} poultry manure produced greater yield per plant relative to cucumber plants without poultry manure by 52.15% and 50.20% respectively. However, yield per plant from cucumber with 15 t ha^{-1} (763.98 g) and 10 t ha^{-1} (754.16 g) poultry manure were similar compared to yield per plant from cucumber with 5 t ha^{-1} poultry manure (610.37 g).

Cucumber that received 15 t ha^{-1} and 10 t ha^{-1} produced greater yield per hectare relative to cucumber without poultry manure by 52.19% and 50.25% respectively. However, yield per hectare of cucumber with 15 t ha^{-1} poultry manure (30.56 t) and 10 t ha^{-1} poultry manure (30.17 t) were similar compared to yield per hectare of cucumber with 5 t ha^{-1} poultry manure (24.41 t).

Table 5: Yield characteristics of cucumber as influenced by rate of poultry manure

Poultry manure (t ha^{-1})	NDF	NFP	FW (g)	YPP (g/plant)	YPH (t ha^{-1})
0	33.31	2.01	248.38	502.11	20.08
5	33.50	2.44	249.38	610.37	24.41
10	33.25	3.00	249.88	754.16	30.17
15	33.44	3.02	251.50	763.98	30.56
LSD (P≤ 0.05)	NS	0.77	NS	194.54	7.78

NDF, number of days to first fruiting, NFP, number of fruits per plant, FW- fruit weight,

YPP- yield per plant, YPH- yield per hectare NS: Not Significant, LSD: Least Significant Difference

In the residual planting, poultry manure significantly affected all variables observed (Table 6). Cucumber plants that received 15 t ha^{-1} and 5 t ha^{-1} attained number of days to first fruiting earlier by 1.69% compared with cucumber plants without poultry manure. However, number of days to first fruiting from 15 t ha^{-1} (33 days) and 5 t ha^{-1} (33 days) poultry manure was similar, compared to days to first fruiting from 10 tha^{-1} poultry manure (33 days). Also, cucumber plants that received 15 t ha^{-1} had higher number of fruits by 63.08% compared with cucumber plants without poultry manure. However, number of fruits produced from 15 t ha^{-1} poultry manure (2.12) was similar, compared to fruits produced from 10 tha^{-1} poultry manure (1.87). Cucumber that received 15 t ha^{-1} and 10 t ha^{-1} poultry manure produced higher fruit weight relative to cucumber plants without poultry manure by 4.02% and 5.28% respectively. However, fruit weight from cucumber with 15 t ha^{-1} (247.25 g) and 10 t ha^{-1} (250.25 g) poultry manure were similar compared to yield per plant from cucumber with 5 t ha^{-1} poultry manure (610.37 g). Cucumber that received 15 t ha^{-1} produced greater yield per plant relative to cucumber that received 5 tha^{-1} and cucumber without poultry manure by 29.65% and 69.57% respectively. However, yield per plant from cucumber with 15 t ha^{-1} poultry manure (529.68 g) were similar compared to yield per plant from cucumber with 10 t ha^{-1} poultry manure (468.96 g). Cucumber plants that received 15 t ha^{-1} produced significantly greater yield per hectare relative to cucumber without poultry manure by 69.66%. However, yield per hectare of cucumber with 15 t ha^{-1} poultry manure poultry manure (21.19 t) was similar compared to yield per hectare of cucumber with 10 t ha^{-1} poultry manure (18.76 t).

Table 6: Yield characteristics of cucumber as influenced by rate of poultry manure and botanical type in residual planting

Poultry manure (t ha^{-1})	NDF	NFP	FW (g)	YPP (g/plant)	YPH (t ha^{-1})
0	33.75	1.30	237.69	312.37	12.49
5	33.19	1.67	243.88	408.56	16.34
10	33.31	1.87	250.25	468.96	18.76
15	33.19	2.12	247.25	529.68	21.19
LSD (P≤0.05)	0.433	0.42	8.44	107.48	4.30

NDF- number of days to first fruiting, NFP- number of fruits per plant, FW- fruit weight,

YPP- yield per plant, YPH- yield per hectare NS: Not Significant, LSD: Least Significant Difference

Economic assessment

The estimated revenue generated from cucumber production due to increased poultry manure rate which increased in both first and residual planting (Table 7). In the first planting, the highest estimated profit was from cucumbers that received 10 t ha^{-1} while cucumbers that received 15 t ha^{-1} had the highest estimated profit in residual planting.

Table 7: Partial budget analysis for organic cucumber with four rates of poultry manure application in 2023

Variable cost	0 t ha^{-1}	5 t ha^{-1}	10 t ha^{-1}	15t ha^{-1}
A) First planting	5,000	5,000	5,000	5,000
Land lease @ ₦5000 ha^{-1}				
Ploughing @ ₦5000 ha^{-1}	5,000	5,000	5,000	5,000
Harrowing @ ₦5000 ha^{-1}	5,000	5,000	5,000	5,000
Planting materials				
1 kg of seeds/ha ₦2000@ 50g	40,000	40,000	40,000	40,000
Poultry manure @ ₦3000/50kg	0	300,000	600,000	900,000
Twine	16,000	16,000	16,000	16,000
Labour				
Manure application:15-man day ha^{-1}	0	40,000	40,000	40,000
Marking and pegging: 4man day ha^{-1}	8,000	8,000	8,000	8,000
Bed making: 8-man day ha^{-1}	16,000	16,000	16,000	16,000
Planting: 12-man day ha^{-1}	22,000	22,000	22,000	22,000
First weeding:15man day ha^{-1}	30,000	30,000	30,000	30,000
Second weeding:15man day ha^{-1}	30,000	30,000	30,000	30,000
Harvesting:15-man day ha^{-1}	30,000	30,000	30,000	30,000
Total cost: ₦ ha^{-1}	207,000	547,000	847,000	1,147,000
Quantity harvested: t ha^{-1}	20.08	24.41	30.17	30.56
Sales (₦3,500/40kg)	1,757,000	2,135,875	2,639,000	2,674,000
Profit: ₦	1,550,000	1588,875	1,792,875	1,527,000
B) Residual planting				
Manual land preparation: 10-man day ha^{-1}	30,000	30,000	30,000	30,000
Planting materials				
1 kg of seeds/ha: ₦ 2000@ 100g	40,000	40,000	40,000	40,000
First weeding:15-man day ha^{-1}	30,000	30,000	30,000	30,000
Second weeding :15-man day ha^{-1}	30,000	30,000	30,000	30,000
Harvesting:15-man day ha^{-1}	30,000	30,000	30,000	30,000
Total cost:₦ ha^{-1}	160,00	160,000	160,000	160,000
Quantity harvested: t.ha^{-1}	12.49	16.34	18.76	21.19
Sales: ₦3,500/40kg	1,092,875	1,269,750	1,641,500	1,854,125
Profit: ₦	932,875	1,429,750	1,481,500	1,694,125

Discussion

The findings of this study showed that rates of poultry manure had significant effect on growth and yield of cucumber. The result of this study agrees with Enujeke (2013) who reported improvement in growth and yield characteristics of cucumber because of soil amendment with poultry manure application. Crop productivity largely depends on existing environmental conditions for growth and development of plants. Cucumber is thermophilic in nature requiring optimal temperature of 22^{o} C to 27^{o} C (Singh *et al.,* 2018). Average temperature in the first planting which was 36.19 ^{o}C but was 33.47 ^{o}C with residual planting, was higher compared to optimal temperature needed for optimal growth and development of cucumber plants. These temperatures are high enough to encourage emergence and infestation of pests, and it resulted in flower and fruit abortion during the experiments. Relative humidity affects rate of respiration and susceptibility of plants to fungal

infections. Optimum relative humidity for cucumber is between 60 and 70% but during this study, relative humidity ranged from 84.63 - 86.40% in first plant planting and 69.39 – 84.69% in residual planting, which was not too ideal for cucumber cultivation, and this resulted in downy mildew infection at 5WAP. Infection was more in first planting compared to residual planting. Older leaves were firstly infected and then, infection moved gradually upward along cucumber vine. In the first planting, total rainfall of 238.00 mm was sufficient for cucumber life cycle. However, total rainfall in the residual planting which was 169.00 mm was not sufficient in sustaining the cucumber plant in the last 4 weeks of the experiment due to no rainfall. Cucumber plants were artificially supplemented with water. Cucumber requires well-drained, high water holding capacity, structurally stable, fertile soil with high pore volume and pH of 5.5 – 7.0 (Adedokun and Aiyelaagbe, 2009). The soil used for this study was loamy sand with pH of 7.76 which was fair for cucumber cultivation.

Rate of poultry manure increased vegetative characteristics of cucumber in both experiments. In the first planting, the longest vines and highest number of leaves at 8 WAP were observed from the highest poultry manure doses. Also in the residual planting, cucumber that received 15 t ha^{-1} of poultry manure had the longest vine length and highest number of leaves. This observation agrees with the finds of Enujeke (2013) who reported that fortifying soil nutrient with poultry manure increases vegetative characterize of cucumber plant. The decline in number of leaves and reduced leaf area from 5 weeks after planting in both experiments were because of partitioning of assimilate for the reproductive stage. As more photosynthates were channeled to younger leaves and flower production which resulted in chlorosis of older leaves subsequently leaf abscission. Collectively, cucumber vegetative characteristics were more influenced in first planting compared to residual planting. This suggests reduction in nutrients supplied in the poultry manure since no soil amendment was carried out during the residual planting. Cucumber is a heavy feeder and lot of the nutrient supplied would have been used in the first planting.

Rate of poultry manure affected infestation of cucumber. In the first planting, rates of poultry manure did not affect insect population density this suggests delay or slow mineralization of poultry manure applied. However, a different trend was observed in residual planting. Cucumber that received 10 or 15 t ha^{-1} of poultry manure had the highest insect population density. This shows that poultry manure applied had been mineralized and more nutrients were available to cucumber that had higher rate of poultry manure. Increasing nitrogen content of soil improves vegetative properties of soil which soften leaf tissues of plant making it more desirable for herbivorous insects (Bidein *et al*., 2017). In both experiments, poultry manure application increased leaf damage on cucumber plants. Cucumber that received no poultry manure had the lowest leaf damage than others. This suggests that increase in insect population density increases leaf damage of cucumber plant because of increase in activity of insect pests as a result of more population (Bidein *et al*., 2017). However, there was no difference between cucumber that received 5, 10, 15 t ha^{-1} of poultry manure.

Maturity of cucumber plants in attaining days to first male and female flower was not significantly affected by rates of poultry manure application in first planting this could be because of gradual release nutrient mobilization. In the residual planting, poultry manure application influenced days to cucumber maturity. Cucumber that received 5, 10 or 15 t ha^{-1} of poultry manure application attained maturity earlier than cucumber that received 0 t of poultry

manure. Increasing rate of poultry manure reduced the number of days to maturity of cucumber as more nutrients were available for plant usage. In general cucumber attained maturity earlier in the residual planting compared to first planting indicates slow nutrient mobilization.

Fruiting properties of cucumber were significantly affected by rates of poultry manure application. In first planting, days to first fruiting and fruit weight were not affected by rate of poultry manure application but number of fruit, yield per plant and yield per hectare were affected while in residual planting, cucumber that received 5, 10 or 15 t of poultry manure attained days to first fruiting earlier, plants that received 10, 15 t of poultry manure had more number of fruits, weightier fruit weight, yield per plant, yield per hectare while cucumber that received 0 t attained days to first fruiting later, had least number of fruits, lesser weight fruit, yield per plant and yield per hectare. This shows that increasing rates of poultry manure improved fruiting parameters of cucumber. The fruiting properties observed had the highest value from cucumber that received 15 t of poultry manure followed by 10, 5, 0 t of poultry manure. This corroborates the findings of Nwaiwu *et al.* (2025), Jones *et al.* (2023), Enujeke, (2013), and Bidein *et al*., (2017) who reported improved fruiting properties of cucumber due to application of organic manure. Generally, cucumber fruiting properties were more influenced in first planting compared to residual planting. This suggests exhaustion of applied nutrients. The nutrient applied had been greatly removed from the soil by the cucumber in the first planting and little was left for residual planting use. This finding agrees with the observation of Okparaojiego (2021) who reported lower yield in "Egusi" melon at residual planting.

Conclusions

Poultry manure application improves growth and yield properties of cucumber due to availability of nutrients present in the manure. Increasing rates of poultry manure also increased growth and yield characteristics of cucumber. Cucumber that received 15 t ha^{-1} of poultry manure had the highest growth and yield characteristics observed. Due to this increased rate of poultry manure, insect population density also increased, and this may pose threat to gain observed in increased yield. It is therefore necessary to grow cucumber with 10 t ha^{-1} of poultry manure which is the optimum rate to maximize yield and at the same time put insect population density under economic threshold. The highest estimated profits were recorded from cucumbers that received 10 t ha^{-1} and 15 t ha^{-1} poultry manure at first and residual planting respectively.

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