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EFFECT OF POULTRY MANURE APPLICATION TIMING ON CUCUMBER (*Cucumis sativus* L.) GROWTH AND YIELD IN IFITE-OGWARI, ANAMBRA STATE, NIGERIA

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ABSTRACT

Cucumber (Cucumis sativus L.) production in Southeastern Nigeria is often constrained by low soil fertility and poor nutrient management. While poultry manure (PM) is a sustainable organic amendment, its effectiveness depends heavily on the timing of application, which is a critically underexplored aspect of soil fertility management for cucumber production in the region. This study investigated the effect of PM application timing on the growth and yield of cucumber at Ifite-Ogwari, Anambra State of Nigeria. A Randomised Complete Block Design with four treatments (PM applied at 2, 4, and 6 weeks after planting (WAP), and a no-manure control) replicated three times was used. Manure was applied at 300 g per plant using the placement method. Data were collected on days to emergence, days to 50% flowering, number of leaves, number of fruits per plant, fruit length, fruit diameter, fruit weight, and total yield per plant. Soil analysis before planting revealed moderate fertility with a sandy clay loam texture, justifying manure incorporation. PM application at 2 WAP produced the highest values for vegetative growth, fruit size, and yield compared to delayed applications and the control. Specifically, plants at 2 WAP recorded the highest number of leaves (32.10), fruit length (44.9 cm), fruit weight (3.57 kg), and total yield per plant (6.97 kg) compared to the control (22.8 leaves, 28.3 cm, 1.10 g, and 2.67 kg, respectively), representing increases of 40.8%, 58.7%, 224.5%, and 161.0% respectively, although differences were not significant at the 5% level. PM applied at 2 WAP is recommended for smallholder cucumber farmers in Southeastern Nigeria.

Key words: *Cucumis sativus*, poultry manure, application timing, nutrient synchrony

INTRODUCTION

Cucumber (*Cucumis sativus* L.) is a monoecious annual crop in the family Cucurbitaceae that humans have cultivated for over 3,000 years. It is a creeping vine that can grow through supporting frames using thin tendrils (Adinde *et al.*, 2021). The crop ranks fourth after tomatoes, cabbage, and onions in Asia, and second after tomatoes in Europe, although it has not been ranked in tropical Africa due to limited use. It is rapidly gaining popularity in West Africa and is grown in commercial quantities in northern Nigeria, where it is primarily consumed raw, cooked, and used in salads (Ekeoma and Adesoji, 2018; Eifediyi *et al.*, 2011). Cucumbers are a vibrant source of antioxidant nutrients including beta-carotene and manganese, and provide vitamin C, niacin, iron, calcium, thiamine, fiber, and phosphorus (Ojeleye *et al.*, 2018). Regular consumption has been associated with the ability to help control hypertension and kidney-related challenges (Ekeoma and Adesoji, 2018).

Despite the increasing relevance of cucumber in Nigeria, field yields remain low due to declining soil fertility resulting from continuous cropping and inadequate attention to soil amendment materials under heavy rainfall common in Southeastern Nigeria (Enujeke, 2016). Late application, on the (Enujeke, 2016). Poultry manure is the richest of all known animal manures (Chukwuma *et al.*, 2024). It is an inexpensive, good source of nutrients that is essential for enhancing soil structure for sustainable crop production (Nwite *et al.*, 2012, 2013; Nnadi *et al.*, 2020; Onah *et al.*, 2023). Infertile soils often result in bitter and misshapen fruits which consumers reject (Emma-Okafor *et al.*, 2022). Poultry manure has been demonstrated to enhance nutrient recycling and improve soil physical, chemical, and biological properties (Ekeoma and Adesoji, 2018; Obalum *et al.*, 2020; Umeugokwe *et al.*, 2021; Onah *et al.*, 2023; Ogumba *et al.*, 2024; Kallon *et al.*, 2025). It can increase soil organic matter by about 44%, improving porosity by 25% and enhancing moisture retention by up to 16 times (Khan *et al.*, 2017). Use of poultry manure in cucumber production has been found to improve soil fertility and aggregation, leading to increases crop yield in the derived savannah of southeastern Nigeria (Ogunezi *et al.*, 2019).

The timing of poultry manure application influences its effectiveness in crop production. If applied too early, significant nutrient losses can occur through leaching and volatilisation, especially other hand, results in insufficient nutrient availability during the critical stages of cucumber growth,

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leading to reduced yield and poor fruit quality (Emma-Okafor *et al.*, 2022). While the benefits of poultry manure rates are well-documented, the timing of application, which significantly affects nutrient availability and synchronisation with crop uptake, remains a critically underexplored aspect of soil fertility management. The lack of empirical data on the optimal timing of poultry manure application for maximising cucumber growth and yield leaves farmers without reliable recommendations, often resulting in reduced productivity and financial losses. This study therefore evaluated the effect of poultry manure application timing on the growth and yield performance of cucumber under the agro-ecological conditions of Ifite-Ogwari, Southeastern Nigeria.

MATERIALS AND METHODS

Experimental Site

The experiment was carried out at the Ifite-Ogwari Campus of Nnamdi Azikiwe University, Anambra State, Nigeria. The study was conducted during the 2025 cropping season, from late June to August 2025. The study region is situated at 6.6041° N and 6.9507° E, in the South-East, Nigeria. The climate at the site is characterised by rainfall from May to November, with the dry season lasting from November to April. Ifite-Ogwari has a mean annual rainfall of 1740 mm and a mean daily temperature of 25°C (Umeh *et al.*, 2024). Soils in Ifite-Ogwari belong to the texture classes of sandy loam and clay. Soil bulk density can high, ranging from 1.73 to 2.02 g cm^{-3} (Nwosu and Nweke, 2024).

Experimental Design

The study was conducted on a total experimental area of 98.68 m^2 (10.4 m × 9.2 m). The experiment was laid out in a randomised complete block design (RCBD) consisting of four treatments replicated three times, resulting in 12 experimental units. Each individual plot measured 1.3 m × 1.2 m (1.56 m^2). An inter-bed spacing of 1.0 m and an inter-replication spacing of 1.5 m was maintained between plots and blocks, respectively.

Treatments

The treatments consisted of different timings of poultry manure application relative to planting of cucumber. They were T_1, poultry manure applied 2 weeks after planting (WAP); T_2, poultry manure applied 4 WAP; T_3, poultry manure applied 6 WAP; and T_4, Control (no manure). African Giant variety of cucumber was used, and the seeding rate was two seeds per hole at a spacing of 0.50 m × 0.50 m in treatment plots of 1.30 m × 1.20 m (1.56 m^2), giving six seedling stands per plots. Seedlings were thinned to one healthy seedling per stand two weeks after germination. Poultry manure was applied at the rate of 300 g per plant using the placement method, equivalent to ca. 7.50 t ha^{-1}, at the different growth stages. Cucumber plants started fruiting 5 WAP.

Soil Sample and Analysis

Prior to planting, composite soil samples were randomly collected from the experimental site at a depth of 0-30 cm using a core sampler (5 cm × 5 cm). The samples were air-dried and analysed at Spring Board Laboratory, Awka, Nigeria. Soil pH was determined in a 1:2.5 soil/liquid suspension. Total nitrogen was determined using the micro-Kjeldahl method, while organic carbon was analysed via the Walkley-Black chromic acid titration method. Available phosphorus was determined using the Bray-1 method, and cation exchange capacity (CEC) by the neutral ammonium acetate method.

Agronomic Data Collection

Data were collected on some growth and yield parameters of cucumber. These included days to 50% emergence, days to 50% flowering, and number of leaves per plant (at two-week intervals from three randomly selected plants per plot), as well as number of fruits per plant, fruit length (cm), fruit weight (g), and total yield per plant (kg).

Data Analysis

Data collected were subjected to analysis of variance for RCBD experiments. Data analysis was done using GenStat statistical software (VSN Int., Hemel Hempstead, UK). Where treatment effects were significant ($p \leq 0.05$), means were separated using the least significant difference (LSD) test.

RESULTS

1. Pre-planting Soil Properties

The physical and chemical properties of the experimental soil are presented in Table 1. The soil is a clay loam with a slightly acidic soil pH of 6.19. While the soil showed high content of organic carbon (3.88%), the total nitrogen (0.03%) and available phosphorus (17.53 mg kg^{-1}) were moderate. The CEC was very low (7.60 cmol kg^{-1}), indicating poor nutrient retention and justifying the application of poultry manure to improve nutrient availability and soil buffering capacity.

Table 1: Pre-planting soil properties of the experimental site

Parameter	Value	Parameter	Value
% Clay	39	Conductivity (μS cm^{-1})	190.60
% Silt	24	Bicarbonate (mg kg^{-1})	12.50
% Sand	37	Chloride (mg kg^{-1})	78
Soil pH	6.20	Nitrate (mg kg^{-1})	3.508
% SOC	3.88	Nitrite (mg kg^{-1})	6.418
% TN	0.03	% Sulphur	9.219
AvP (mg kg^{-1})	17.53	Viscosity (Pa s^{-1})	128.45
CEC (cmol kg^{-1})	7.60	Bulk density (g cm^{-3})	0.989
% Base Saturation	71.05	% Porosity	51.10
		% Moisture content	20.04

SOC - soil organic carbon, TN - total nitrogen,
AvP - available P, CEC - cation exchange capacity

Effect of Poultry Manure Application Timing on Days to 50% Emergence and 50% Flowering

Poultry manure application timing had no significant ($p > 0.05$) effect on days to 50% emergence and 50% flowering (Table 2). Cucumber seeds in plots with and without poultry manure reached 50% emergence 4 and 5 days after planting, respectively. Flowering of cucumber plants showed a somewhat inverse trend, in that 50% flowering was somewhat delayed for plants in manure-amended plots (31 days) compared to those in no-manure control plots (30 days).

Effect of Poultry Manure Application Timing on Number of Leaves per Plant

Poultry manure application timing did not influence leaf production in this study (Table 3). At 6 WAP, however, the number of leaves per plant tended to be higher in treatment of poultry manure application at 2 WAP than the rest, with leaf production in this treatment representing a 40.8% increase relative to no-manure control. Notably, across treatments, number of leaves per plant increased progressively from 2 WAP (mean, 1.98) to 6 WAP (mean, 26.30).

Effects of Poultry Manure Application Timing on Fruit Size and Fruit Weight per Plant

Poultry manure application timing did not influence cucumber fruit characteristics (Table 4). However, fruit length, diameter and weight tended to be highest for manure application 2 WAP (44.9 cm, 37.7 mm and 3.57 kg, respectively). The smallest fruits that were 28.3 cm long and 17.6 mm wide and weighed 1.10 kg were recorded in the control plots. Therefore, treatment 2 WAP produced fruits that were not only 58.7% longer and 114.2% wider, but also 224.5% heavier compared to the no-manure control.

Treatment Effects on Number of Cucumber Fruits per Plant and Total Yield per Plot

The number of fruits per plant and total yield per plot were numerically highest under treatment 2 WAP (9.67 fruits and 6.97 kg, respectively) and lowest in the control (3.00 fruits and 2.67 kg, respectively), as shown in Table 5. The treatment 2 WAP recorded 222.3% more fruits and 161.0% higher total yield per plot than the no-manure control. Plots where manure was applied at later growth stages (4 and 6 WAP) produced relatively low yields of cucumber.

Table 2: Effect of poultry manure application timing on days to 50% emergence and days to 50% flowering

Treatments	Days to 50% emergence	Days to 50% flowering
2 weeks after planting, WAP	4	31
4 weeks after planting, WAP	4	31
6 weeks after planting, WAP	4	31
No Manure	5	30
$LSD_{(0.05)}$	NS	NS

LSD - least significant difference, NS - not significant at $p \leq 0.05$

Table 3: Effect of poultry manure application timing on number of leaves per plant

Treatments	2 WAP	4 WAP	6 WAP
2 weeks after planting, WAP	1.967	11.93	32.10
4 weeks after planting, WAP	2.000	11.27	25.90
6 weeks after planting, WAP	1.867	10.97	24.40
No manure	2.100	10.53	22.80
$LSD_{(0.05)}$	NS	NS	NS

LSD - least significant difference, NS - not significant at $p \leq 0.05$

Table 4: Effect of poultry manure application timing on fruit length, fruit diameter, and fruit weight per plant

Treatments	Fruit diameter (mm)	Fruit length (cm)	Fruit weight (kg)
2 weeks after planting, WAP	37.7	44.9	3.57
4 weeks after planting, WAP	29.2	27.0	1.20
6 weeks after planting, WAP	22.6	29.9	1.23
No manure	17.6	28.3	1.10
$LSD_{(0.05)}$	NS	NS	NS

LSD - least significant difference, NS - not significant at $p \leq 0.05$

Table 5: Effect of poultry manure application timing on number of fruits and total yield per plant

Treatments	Number of fruits per plant	Total yield per plot (kg)
2 weeks after planting, WAP	9.67	6.97
4 weeks after planting, WAP	7.00	2.37
6 weeks after planting, WAP	5.00	2.43
No manure	3.00	2.67
$LSD_{(0.05)}$	NS	NS

NS - not significant at $p \leq 0.05$, LSD - least significant difference

DISCUSSION

The pre-planting soil analysis showed that while the site was moderately fertile, the low nutrient retention capacity (CEC, 7.60 cmol kg^{-1}) provided a clear basis for the application of poultry manure to support cucumber production in the study area. Under such conditions, the timing of organic amendment application becomes even more critical because nutrients released too early are easily lost through leaching, while late release fails to meet the crop's nutritional demands at key growth stages.

In this study, the earliest time of poultry manure application was 2 WAP, i.e., 14 days after planting. So, the slight differences in days to 50% emergence (1 day difference between plots with and without poultry manure) were not due to treatment. Seed quality and inherent soil fertility were the major factors influencing emergence.

Treatment had no effect on number of days to 50% flowering. With appreciable organic matter content, the soil of this investigation can show enhanced phosphorus availability (Obalum and Chibuike, 2017). However, early application and hence early decomposition of manure in treatment 2 WAP and associated increases in organic matter did not encourage earlier flowering through improved mineralisation and availability of phosphorus (Chukwuma *et al*., 2024), known to support flower initiation and transition from vegetative to reproductive stages. Conversely, the rather delayed flowering in treatment 6 WAP (42 days after planting) suggests that by the time nutrients were released, the crop's peak reproductive demand had already passed. Makinde *et al.* (2021) reported that the timing of poultry manure application determined reproductive success in *egusi* melon (*Cucumeropsis mannii*), emphasising that the transition from vegetative to reproductive growth stage in especially cucurbit crops requires timely nutrient availability to maximise flower retention and fruit setting.

The seemingly superior vegetative growth of cucumber (as indexed by number of leaves per plant) observed under treatment 2 WAP at the sampling stage 6 WAP reflects the agronomic advantage of aligning nutrient release with the period of most active plant growth. These apparent increases in vegetative growth due to treatment 2 WAP suggest that nitrogen from the decomposing manure became available during the crop's rapid leaf expansion phase, supporting chlorophyll synthesis, leaf expansion, and canopy development. Ntia *et al.* (2017) reported that applying poultry manure at or near planting improved vegetative growth in okra (*Abelmoschus esculentus*) compared to delayed applications, and attributed this to enhanced nitrogen availability during the initial rapid growth phase.

Nominal differences ($p > 0.05$) existed among the four poultry manure application timing treatments, in terms of fruit quantitative and qualitative yield parameters. Indications from the results are, however, that early manure application represented here by treatment 2 WAP could improve yield potential and fruit size of cucumber by ensuring availability of plant nutrients during fruit setting. Considering that between the implementation of treatment 2 WAP and when the cucumber plants started fruiting (5 WAP), treatments 4 WAP and 6 WAP were just and yet implemented, respectively, the apparent better yield results achieved with treatment 2 WAP compared to treatments 4 WAP and 6 WAP would be logical.

The practical significance of the 2 WAP timing is most clearly illustrated by the data for fruit quality and fruit quantitative yield. Though non-significant differences were detected, this treatment 2 WAP represented about 225%, 222% and 161% increases in fruit weight per plant, number of fruits per plant and total yield per plot, respectively over the control. These improvements represent substantial agronomic gains that are meaningful for smallholder farmers operating under limited-input conditions. These results are consistent with the findings of Ogbonna and Obi (2000) and Ogunezi *et al.* (2019), who demonstrated that poultry manure application increased fruit production and seed yield in *egusi* melon and cucumber, respectively in southeastern Nigeria. This documented effectiveness of poultry manure for Cucurbitaceae crops under southeastern Nigerian conditions could be enhanced with timely application. Early organic fertilization increases cucumber yield and soil water retention in humid tropical soils (Awe and Adelakun, 2024).

Most cucumber studies in Nigeria have focused on the rate rather than timing of poultry manure application (Enujeke, 2016; Khan *et al.*, 2017). The importance of poultry manure application timing in cucumber production could be inferred from the better performance of cucumber with than without poultry manure being largely in response to its soil liming and aggregation-enhancing effects in the soil (Ogunezi *et al.*, 2019), both of which have been demonstrated to vary with time since its application (Onah *et al.*, 2023; Obalum *et al.*, 2024a, b). Such temporal effects of animal manures in soils of the derived savannah agro-ecology translate into time-dependent differences in their mineralisation and release of plant nutrients (Uzoh *et al.*, 2015). This is particularly true for poultry manure whose acidity-neutralising and soil aggregation-enhancing effects define the temporal pattern of phosphorus release in these humid tropical soils (Chukwuma *et al.*, 2024). The observation in the present study that manure applied at 4 and 6 WAP produced progressively lower yield values implies that, at those times, the critical windows for vegetative establishment, flower initiation, and fruit set had already passed, leaving the crop unable to fully utilise the nutrients provided.

CONCLUSION

Poultry manure applied at 2 WAP tended to produce the best growth and yield performance in cucumber under the agro-ecological conditions of Ifite-Ogwari, Anambra State of Nigeria, and is recommended as the optimal timing for smallholder cucumber farmers in southeastern Nigeria. Further studies should investigate the residual effects of the post-seeding application timing done here, as well as the effects of pre-seeding application timing for poultry manure of contrasting nutrient composition and hence quality on soil productivity across cropping seasons.

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