Impact of compost doses based on pig slurry and poultry droppings on germination and growth of zucchini (*Cucurbita pepo* L.) in Yamoussoukro, in the central region of Côte d'Ivoire.

Abstract

In Côte d'Ivoire, zucchinis are widely used in gastronomy, as are eggplants. However, their production remains very low, due to the effects of climate change, a shortage of arable land and the increasing degradation of their fertility.To help improve productivity, a study was carried out to assess the impact of different doses of compost on zucchini growth.To achieve this, composts based on broiler droppings, pig slurry and NPK fertilizer were used.The results showed that the application of 4 kg/m² of pig manure favoured good germination. On the other hand, optimal plant growth was stimulated by the same dose (4 kg/m²) of compost made from broiler droppings.Based on these results, an application of 4 kg/m² of compost is optimal for promoting zucchini growth.

Keywords: zucchini, compost, broiler droppings, pig slurry, growth

1. INTRODUCTION

Côte d'Ivoire's development relies heavily on the agricultural sector. Its fertile soils, water resources, favorable climate and abundant vegetation make it an ideal country for a diversity of crops.These assets are crucial to the diversification of agricultural production in West Africa (Sangaré *et al*., 2009). Agricultural activities account for around a third of gross domestic product and generate 75% of the country's export earnings.What's more, they provide jobs for a large proportion of the Ivorian population (FAO, 2017).However, this agriculture is mainly based on industrial crops (such as timber, coffee, cocoa, cotton, rubber, oil palm, etc.), to the detriment of food crops and vegetables, which are essential to the daily diet of the population.Market garden produce plays a crucial role in providing vitamins and micronutrients often lacking in staple foods (AGRA, 2021).Zucchini (*Cucurbita pepo* L.), a member of the Cucurbitaceae family, is rich in water, amino acids, minerals, vitamins, fiber, fatty acids, carotenoids and, above all, antioxidants (Mohanty *et al*., 2023).In Côte d'Ivoire, zucchinis are used mainly in cooking, as are eggplants.According to Erard (2002), the production cycle for zucchinis lasts an average of 45 days, while that for eggplants is around 120 days.This makes zucchini an excellent substitute for eggplant, and it can be grown in both dry and rainy seasons.Thus, growing zucchini could help mitigate rising vegetable prices, as it plays a similar role to some other vegetables (Bancal & Tano, 2019). Despite its importance, zucchini production in Côte d'Ivoire remains very low (Koné *et al.*, 2019).This is due to the effects of climate change, the reduction in arable land, and the degradation of agricultural soils (Useni *et al.*, 2013).To meet these challenges, chemical inputs are seen as a solution. However, while they can yield positive results, the excessive and haphazard use of these fertilizers represents a new threat to soil quality, the environment and human health (Kitabala, 2016).Faced with this problem, the exploration of organic fertilizers could be an alternative to not only increase production, but also solve environmental issues.It is within this framework that this study was initiated, with the aim of assessing the impact of different doses of compost based on pig slurry and poultry droppings on zucchini growth.

2. Materials and methods

2.1.Study area

The work was carried out in Zambakro, a village in central Côte d'Ivoire, part of the Yamoussoukro autonomous district.Zambakro is 20 km from Yamoussoukro, the country's political capital.Yamoussoukro department is located between 6°49′13″ North latitude and 5°16′36″ West longitude.It is bordered to the north by Tiébissou, to the south by Toumodi, to the east by Didiévi and Attiégouakro, and to the west by Sinfra and Bouaflé (Yao, 2011).Yamoussoukro's climate is transitional humid tropical, characterized by bimodal rainfall.The soils on the plateaus are ferralitic and humus-bearing, while the plains have reddish, reddish-yellow and sandy-clay hues, with fine- to medium-textured gravelly elements, offering good drainage.These characteristics are favorable to traditional agriculture (Nomel *et al.*, 2019).

2.2.Plant material

The species used for our experiment is zucchini (*Cucurbita pepo*), known for its moderate tolerance to salinity.The variety tested was super quarantine, with seed supplied by Semivoir (Figure 1).

Figure 1: Zucchini seeds

2.3.Fertilizing equipment

The fertilizing material (Figure 2) used for zucchini cultivation includes compost made from broiler droppings, compost made from pig slurry, and NPK fertilizer (12-22-22).

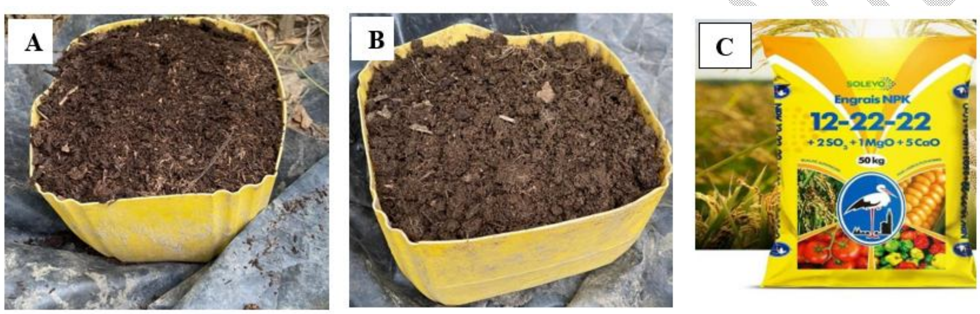

Figure 2: Types of fertilizer

A: Broiler manure-based compost; **B**: Pig slurry-based compost; **C**: NPK fertilizer.

2.4.Methods

2.4.1. Compost preparation

The technique used is the rapid composting method of Misra *et al.* (2005). It relies mainly on frequent windrow turning (every 3 days for 90 days).Composting was carried out under a 3 m 85 long, 3 m 20 wide and 2 m 25 high shade structure.Under the shade, the ground wascovered with a black tarpaulin film measuring 3 m long by 2 m wide, to isolate the composts from the soil.Next, 50 kg of fresh Panicum sp leaves and 100 kg of broiler droppings and pig manure, depending on the type of compost, were placed on the tarpaulin.When assembling the inputs, the layers were arranged as follows: a 50 kg layer of base input, followed by a 50 kg layer of fresh Panicum sp leaves, then another 50 kg layer of base input.After this operation, the piles were moistened with water until they were saturated.

2.4.2. Experimental setup

The system used is a complete randomized block, made up of two sub-blocks. Each sub-block comprises five elementary plots, each corresponding to a type of treatment or fertilizer.The sub-blocks are separated by a distance of 3 m, while the individual plots are 1.5 m apart.Each ridge contains 15 bunches, spaced 0.6 m apart. Two seeds have been sown in each poquet.

2.4.3. Application of fertilizer doses

After the ridges had been formed, manure was applied at doses of 3.4 and 5 kg/m² depending on the type of compost, then ploughed into the soil with a hoe a week before sowing the zucchinis.The ridges were watered regularly as needed until the end of the plant's life.Each dose of compost was incorporated using the furrow method, by creating a furrow along the entire length of the ridge and distributing the corresponding dose, with the exception of NPK, which was applied at 0.042 kg/m² two weeks after germination.

2.4.4. Measured parameters

2.4.4.1.Germination parameters

This parameter evaluates the germination rate, determined by the percentage of germinated seeds in relation to the total number of seeds sown.It was measured from day 4 to day 8 after sowing.

2.4.4.2.Growth parameters

Growth parameters taken into account in this experiment include stem collar diameter measured with an electronic caliper, stem height measured with a tape measure, average number of leaves determined by counting from germination to the appearance of the plant's first flowers.The length (L) and width (l) of the leaves determined using a tape measure.Leaf area (LA) was determined according to the Blanco & Folegatti (2005) formula: SF = 0.88 (L*l) - 4.27 and plant vigor determined by the ratio of plant height (H) and crown diameter (D) was determined according to the formula Ige & komolafe (2022): $V = \frac{Plant\ height}{stem\ diameter}$

2.5.Statistical data analysis

The data for the various parameters collected were first processed and analyzed by analysis of variance (ANOVA) using IBM SPSS software.In the event of a significant difference at the 5% threshold, a Student-Newman-Keuls post hoc test was performed to classify the different means obtained.

3. Results

3.1. Effect of fertilizer doses on germination rate

The impact of fertilizer type and dose on zucchini seed germination is shown in Table I.The results show a highly significant effect (P < 0.05) for both fertilizer type and dose.The germination percentage of the control was higher than that of the two types of biofertilizer (all doses combined) on days 6 and 8 after sowing.However, on day 4, pig manure recorded the highest germination rate compared with the control and chicken droppings (all doses combined).In terms of fertilizer doses, a dose of 4 kg/m² of pig manure produced a higher germination rate than the control 8 days after sowing.

Table I: Germination rate of zucchini seeds as a function of fertilizer doses

Type of treatment	Dose (kg/m^2)	D4	D6	D8
Control	0	13.16 ± 1.66^{c}	73.25 ± 2.65^{a}	93.58 ± 2.5^{b}
broiler manure	3	0.33 ± 0.66^{d}	60 ± 1.82^{b}	80 ± 2.44^{c}
	4	23.25 ± 2.74^{b}	53.33 ± 0.81^{c}	60.75 ± 2.17^{e}
	5	13.33 ± 1.23^{c}	40.25 ± 1.25^{d}	80 ± 1.63^{c}
Pig slurry	3	23.41 ± 2.06^{b}	73.83 ± 2.08^{a}	93.41 ± 2.45^{b}
	4	27.17 ± 2.08^{a}	50.83 ± 3.04^{c}	100 ± 0^{a}
	5	0.27 ± 0.59^{d}	60 ± 2.12^{b}	66.67 ± 1.41^{d}
Slur-man	4	0.42 ± 0.50^{d}	26.67 ± 0.81^{e}	67.42 ± 0.89^{d}
F		221.282	258.008	245.013
P		**0.001**	**0.001**	**0.001**

In the same column.means followed by the same letter are not significantly different at 5 % probability according to the Student-Newman-Keuls test. **P**: Approximate test probability; **F**: Fischer constancy; **Slur-man**: slurry + manure; **D**: days.

3.2. Effect of fertilizer doses on growth parameters

Results concerning the impact of fertilizer type and doses on growth parameters are presented in Tables II and III.The effect of fertilizers was evaluated on seven zucchini growth parameters. Compared with the control.data analysis revealed that there was no significant difference (p > 0.05) in plant height and diameter.regardless of the type or dose of fertilizer applied.On the other hand.highly significant differences (p < 0.05) were observed for the number of leaves.vigour and leaf area of the plants.All fertilizer types and doses showed superior results.but chicken droppings-based compost gave the best averages for leaf number.width.length and leaf area.The 4 kg/m² dose of chicken droppings-based biofertilizer showed the highest averages. All fertilizers produced vigorous plants.with the NPK fertilizer showing the greatest vigour.However. NPK showed the lowest averages for all the parameters studied.remaining statistically comparable to the control.

Table II: Influence of fertilizer doses on the height.diameter and number of leaves of zucchini plants

Type of treatment	Dose (kg/m^2)	HA (cm)	Diam (mm)	nbsheet
Control	0	44 ± 7.64[a]	12.92 ± 1.61[a]	10.8 ± 1.09[bc]
NPK	0.042	55.6 ± 6.80[a]	13.12 ± 0.84[a]	11.2 ± 2.49[bc]
	3	56.8± 8.10[a]	11.62±2.10[a]	13.4±2.19[ab]
broiler manure	4	60 ±5.87[a]	15.16 ± 2.4[a]	14.6±1.67[a]
	5	55 ± 5.33 [a]	13.08 ± 1.47[a]	11.6 ± 1.81[bc]
	3	55.2 ± 10.70[a]	12.74 ± 2.93[a]	10.6 ± 0.89[bc]
Pig slurry	4	56.8 ± 10.59[a]	12.84 ± 1.82[a]	13 ± 1.22[ab]
	5	59.2 ± 7.59[a]	11.72 ± 1.87[a]	12 ± 1.41[bc]
Slur-man	4	59.6 ± 6.6[a]	12.6 ± 2.17[a]	9.6 ± 1.7[c]
F		**1.687**	**1.3**	**4.323**
P		**0.135**	**0.275**	**0.001**

In the same column.means followed by the same letter are not significantly different at 5 % probability according to the Student-Newman-Keuls test. **P:** Approximate test probability; **F**: Fischer constancy; **Slur-man**: slurry + manure;**HA**: height; **diam**: diameter; **nb sheet**: number of sheets

Table III: Influence of fertilizer doses on length, leaf width, vigour and leaf area of zucchini plants

Type of treatment	Dose (kg/m^2)	larg feuil (cm)	longu feuil (cm)	Vigor	SF (cm^2)
Control	0	29.93±4.86^{b}	29.79±5.23^{b}	42.93±6.84^{ab}	787.69±288.6^{bc}
NPK	0.042	29.46±1.16^{b}	30.06±1.87^{b}	33.86±3.32^{b}	797.30±75.21^{c}
broiler manure	3	35.19±3.2^{ab}	34.46±3.01^{ab}	49.06±1.67^{a}	1069.52±188.03^{bc}
	4	39.53±4.1^{a}	38.53±1.28^{a}	40.05±4.54^{ab}	1338.45±170.1^{a}
	5	37.33±6.64^{ab}	37.73±1.83^{a}	42.43±5.97^{ab}	1243.21±277.7^{bc}
Pig slurry	3	32.73±6.11^{ab}	33.53±6.68^{ab}	44.63±11^{ab}	989.46±344.12^{bc}
	4	32.86±5.37^{ab}	33.33±4.92^{ab}	44.04±2.82^{ab}	978.04±286.61^{bc}
	5	34.93±3.40^{ab}	35.79±2.84^{ab}	51.29±8.25^{a}	1102.12±181.3^{ab}
Slur-man	4	33.26±2^{ab}	31.84±1.77^{ab}	48.14±8.13^{a}	930.32±98.21^{bc}
F		**2.664**	**3.424**	**3.24**	**3.33**
P		**0.021**	**0.005**	**0.01**	**0.01**

In the same column.means followed by the same letter are not significantly different at 5 % probability according to the Student-Newman-Keuls test. **P:** Approximate test probability; **F**: Fischer constancy; **Slur-man**: slurry + manure;larg feuil: leaf width; longu feuil: leaf length; SF: leaf area

4. Discussion

This study demonstrated the influence of compost doses on the germination and growth of zucchini plants in Côte d'Ivoire.The phenological parameters studied, such as germination rate, seedling height and diameter and number of leaves, are essential for understanding plant response to the physico-chemical conditions of growing media (Obella *et al.*, 2021; Abobi *et al.*, 2021).Grain germination analyses were significant ($P < 0.05$) for fertilizer type and dose.The results indicate that, irrespective of the type and dose of biofertilizers used, pig manure achieved a higher germination rate than broiler droppings and the control.This could be explained by the presence of the necessary mineral elements in this dose, and by the fact that this compost, being a finely degraded organic matter, favors significant microbial activity, which stimulates grain germination.These results concur with those of Kouakou (2019), who showed that increasing doses of chicken droppings delayed seedling emergence in two cucumber varieties.In addition, Nair *et al.* (2024) reported that compost improves the germination rate of bean seeds. Nzengue *et al.* (2024) also reported that tomato germination rates were higher on substratesenriched with sawdust and potting soil.

Fertilizers had significant effects on several growth parameters, including leaf number, length, width and area.Analyses revealed that, irrespective of the type and dose of fertilizer applied, compost based on chicken droppings recorded the highest averages.However, NPK showed the lowest averages for all the parameters studied, proving to be statistically similar to the control.These results could be explained by the gradual release of minerals, the availability of essential nutrients in organic fertilizers, and their high water retention capacity, thus promoting crop growth and development.Compost also improves the physical and biological properties of soils, promoting gas and nutrient exchange between soil and plant (Badji & Sahraoui, 2020).These results are in line with studies by Agaba *et al.* (2023) and Djinet *et al*. (2024), who showed that plants treated with chicken dung manure promoted increased growth of tomato and okra.According to these authors, the manure applied would provide a sufficient quantity of nitrogen for better growth.Sood *et al.* (2023) report that biofertilizers promote optimum growth in bean plants.On the other hand, according to Nzengue *et al.* (2024), although the addition of local materials (sawdust or potting soil) improves soil fertility and releases essential nutrients, a significant inhibition of the height growth of tomato plants was observed.This inhibition could be attributed to the slow decomposition of organic matter, resulting in low bioavailability of mineral elements in soil solutions.

5. Conclusion

At the end of this study, it appears that the application of 4 kg/m² of pig manure favors good germination.However, compost based on broiler droppings, at the same dose, encourages better plant growth.

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