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Effects of Fish Pond Effluent and Poultry Manure on Growth Performance of Maize (*Zea Mays*) in Port Harcourt, South-South Nigeria

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Abstract: The effect of fish pond effluent and poultry droppings on maize performance was investigated at the Teaching and Research farm of the Faculty of Agriculture, University of Port Harcourt, and Rivers State, Nigeria. The experiment which was laid out in a Completely Randomized Design comprised of twelve treatments and three replications. The study had two levels of fish pond effluent (Diluted and undiluted) the treatments were: The treatments were; control (CTR), 0.2t/ha Poultry droppings (PDA), 0.4t/ha Poultry droppings (PDB), 0.6t/ha Poultry droppings (PDC), 0.8t/ha Poultry droppings (PDD), 0.2t/ha Poultry droppings+ diluted effluent (PFA50), 0.4t/ha Poultry droppings + diluted effluent (PFB50), 0.6t/ha Poultry droppings + diluted effluent (PFC50), 0.8t/ha Poultry droppings + diluted effluent (PFD50), 0.2t/ha Poultry droppings + undiluted effluent (PEA100), 0.4t/ha Poultry droppings + undiluted effluent (PEB100), 0.6t/ha Poultry droppings + undiluted effluent (PEC100) and 0.8t/ha Poultry droppings + undiluted effluent (PED100). At 8 weeks, Plant height ranged from 108.40cm at the control to 162.90 cm at PDD treated plot. Number of leaves ranged from 16.05 at the control to 24.82 at PED100 treated plot. Leaf area ranged from 134.40 cm^2 at the control to 381.20 at the PED 100 treated plot. Results revealed that, fish pond effluent when integrated with poultry droppings significantly influenced all the growth parameters accessed. Based on the results obtained, it is recommended that, Fish Pond Effluent plus poultry manure be applied to increase plant growth, nutrient status and soil fertility level.

I. Introduction

Application of inorganic fertilizers had been the fastest solution to prevail over the nutrient deficiencies in the soils, but due to problems associated with its continuous usage such as: high cost, reduced crop yield, increased soil acidity, nutrient imbalance and limited or untimely availability of inorganic fertilizers made farmers develop interest on usage of organic manure (Jote 2023; Titirmare,*et al.*,2023). In many areas, integrating aquaculture with agriculture has become a channel for increasing the use of limited water resources, decreasing dependence on chemical fertilizers (Halwart and Ajayi 2024,) and providing a greater economic return per unit of water. Fish pond effluent has been used as soil amendment for crop production in the world. It has a strong potential to replace bagged fertilizer in part or full (Firew 2018) Fish Pond Effluent had been reported to contain high content of organic matter and plant nutrients (Onuorah *et al.,* 2021). (Isitekhale and Adamu 2016) reported that Fish Pond Effluent application increased Soil contents of available P, K, Mg, Ca and ECEC significantly. Also, in recent times, interest of researchers towards utilization of poultry manure as organic fertilizer has increased since poultry manure had been reported to contain high content of organic matter and plant nutrients (Rasool *et al.*,2023). Escalating prices of inorganic fertilizers due to the increase in the fuel prices has also prompted the use of poultry manure (Okonwo and Mensa 2012) Similarly, organic wastes are also being advocated for by different environmental organizations world-wide to preserve the sustainability of agricultural systems.

Maize or corn (*Zea mays* L.) is an important annual cereal crop of the world belonging to family Poaceae. *Zea* is an ancient Greek word which means "sustaining life" and *Mays* is a word from Taino language meaning "life giver." The word "maize" is from the Spanish connotation "maize" which is the best way of describing the plant. It is grown mainly in a developing country like Nigeria which provides a source of income to the large population of small holder farmers. No cereal crop is produced annually more than maize in the country due to its high demand from consumers and its great nutritional value (Eleweanya *et. al.,* 2005) It is also rich in dietary fiber and calories which provide a good source of energy, a staple food for humans, livestock and an important raw material for many industrial products (Agbogidi *et al.,* 2007).

Also, Maize has also been a priority crop in Nigeria under the flagship Agricultural programs of the Government since 2012 and as such, maize farmers had received deliberate support in terms of access to subsidized fertilizer and improved seed (Federal Ministry of Agriculture and Rural Development, 2011). However, despite all these supports, low yield of maize remains a key challenge. This may be attributed to the low soil fertility level of the Nigerian soils and therefore requires remedy. Studies have revealed a host of nutrient management exercises embarked on by smallholder African farmers (Parwada *et al.,* 2023). While the relative adoption rates between organic and mineral nutrients vary by location, the incidence of organic practices is often more than the use of mineral fertilizers. Furthermore, poultry droppings are preferred amongst other animal wastes because of its high

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concentration of macro-nutrients (Shehu *et al.*,2019). The objective of this study is therefore to investigate the effect of Fish Pond Effluent and Poultry manure on the growth performance of Maize (*Zea mays*) in Port-H arcourt, South-South, Port Harcourt,

II. Materials and Methods

Experimental Site

The research was carried out in the Teaching and Research farm of University of Port Harcourt. The site is located at longitude 4.9070^0N and 6.9162^0E with an elevation of 13m above sea level. The site has an average annual rainfall of about 2,470mm, relative humidity of 70.90% and a mean annual temperature of 32^0C. (Source)

Land Preparation, Experimental Design and Treatment Allocation

The site for the experiment was cleared and tilled manually with hoe and then marked out into plots. The experiment which was laid out in a Completely Randomized Design (CRD), comprised of two levels of fish pond effluent (Diluted and Undiluted), twelve treatments and three replications. Fish Pond Effluent and Poultry manure were applied to the respective plots two weeks before planting to allow for decomposition and mineralization of nutrients. The treatment included the followings; Control (CTR), 0.2t/ha Poultry droppings (PDA), 0.4t/ha Poultry manure (PDB), 0.6t/ha Poultry manure (PDC), 0.8t/ha Poultry manure (PDD), 0.2t/ha Poultry manure + diluted effluent (PFA50), 0.4t/ha Poultry manure + diluted effluent (PFB50), 0.6t/ha Poultry manure + diluted effluent (PFC50), 0.8t/ha Poultry manure + diluted effluent (PFD50), 0.2t/ha Poultry manure + undiluted effluent (PEA100), 0.4t/ha Poultry manure + undiluted effluent (PEB100), 0.6t/ha Poultry manure + undiluted effluent (PEC100) and 0.8t/ha Poultry manure + undiluted effluent (PED100). Two seeds of the Hybrid Maize (Oba Super 6) were sown per hole at the spacing of 75cm x 25cm and at the depth of 3cm two weeks after the application of the treatment materials. Seedlings were thinned down to one plant per hole and empty stands were supplied thereafter. Weeding was done manually by hand picking at the two weeks intervals until harvest to reduce the competition between the maize plant and weeds for available nutrient, water and light.

Data Collection

Data on Plant height, Number of leaves, Leaf area at 4th, 6^{th} and 8^{th} Weeks After sowing (WAPS) were collected and Number of nodes was collected at 6^{th} and 8^{th} WAP. The following yield parameters were collected; Fresh yield, Length of cob, Diameter of cob and Weight of 1000 kernel. Five maize plants were selected randomly from each plot, tagged and were used for the measurement of the aforementioned growth parameters. The data that were generated from the study were subjected to the statistical Analysis of Variance (ANOVA) while the treatment means were compared using the Least Significant Difference (LSD) at 0.05% level of probability.

III. Results

Chemical Properties of Fish Pond Effluent and poultry dropping used in the study are presented on table 1 below. The two treatments were slightly acidic having pH of 5.6 for poultry manure to 5.9 for fish effluent. Fish effluent contained very high calcium 40.2 mg/l while poultry dropping had 11.6 mg/kg. Fish pond effluent also had high Mg and K when compared with ca, mg and k contents of the poultry manure. Phosphorus, Nitrogen and Sulphur contents of poultry manure are higher than that of fish pond effluent.

Table 1: Chemical composition of Fish Pond Effluent and Poultry Manure

Chemical Properties	**pH**	**Calcium (Ca)**	**Magnesium (Mg)**	**Potassium (k)**	**Phosphorus (P)**	**Nitrogen (N)**	**Sulphur (S)**
Fish Pond Effluent (mg/l)	5.9	40.2	8.27	35.46	2.54	0.78	0.5
Poultry Manure (Mg/kg)	5.6	11.6	2.2	8.3	5.6	15.3	3.5

Effect of Fish Pond Effluent and Poultry Manure on Plant Height.

Effect of fish pond effluent and poultry droppings on plant height is presented on table 2.

At 4WAP, plant height ranged from 64.74 cm at the control plot to 91.12 cm at the PED100 plot. At 6 WAP plant height ranged from 86.20 cm at the control to 138.90 at the PDD plot. And at 8WAP it ranged 108.40 cm at the control to162.90 cm at the PDD plot. At 8WAP there were significant differences among the treatments and the PDD treatment plot recorded the highest.

Table 2: Effect of Fish Pond Effluent and Poultry Manure on plant height (cm)

Treatment	4 WAP (cm)	6 WAP (cm)	8 WAP
PDA	66.43g	99.0ef	123.70d
PDB	70.94ef	114.60c	141.30c

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PDC	73.58e	112.20c	154.50b
PDD	82.54bc	138.90a	162.90a
PFA50	71.42ef	94.20f	115.00f
PFB50	72.86e	106.20d	136.00c
PFC50	67.31fg	98.00f	152.10b
PFD50	78.60cd	130.20b	156.80ab
PEA100	75.54de	104.60d	141.60c
PEB100	74.13e	106.10d	123.60d
PEC100	83.34b	103.70de	136.90c
PED100	91.12a	115.70c	136.60c
CONTROL	64.74g	86.20g	108.40f
L.S.D P<0.05	4.20	5.06	6.58

Means followed by the same letter(s) in the same column are not significantly different from one another at 5% level of probability using least significant different (L.S.D), WAP (Weeks after planting

Effect of Fish Pond Effluent and Poultry Manure on Number of Leaves.

The result of the effects of fish pond effluent and poultry droppings on number of leaves is shown on Table 3. At 4WAP number of leaves ranged from 5.70 at the plot treated PDC to the 8.57 at the plot PFD 50 and at 6 WAP values ranged from 13.22 at the control to 21.33 at the PEA100 and PEC100 treatments plot and at 8WAP number of leaves ranged from 16.05 at the control to 26.16 at the PED100 treatment plot. Number of leaves at PED100 plot was significantly the highest among the treatments for number of leaves.

Table 3: Effect of Fish Pond Effluent and poultry Manure on Number of Leaves.

Treatment	4WAP	6WAP	8WAP
PDA	5.89e	15.92def	21.10cd
PDB	6.07de	17.86cde	24.01abc
PDC	5.70e	18.29bcd	21.61bcd
PDD	5.75e	19.20abcd	24.06abc
PFA50	7.77abc	14.39ef	19.18de
PFB50	7.91ab	19.84abc	23.55abc
PFC50	7.36bc	19.14abcd	22.56bc
PFD50	8.57a	21.61ab	24.02abc
PEA100	7.64abc	21.33abc	24.82ab
PEB100	7.41bc	18.28bcd	21.56bcd
PEC100	6.89cd	21.33abc	24.80ab
PED100	7.85ab	22.56a	26.16a
CONTROL	5.81e	13.22f	16.05e
L.S.D P<0.05	0.93	3.60	3.33

Means followed by the same letter(s) in the same column are not significantly different from one another at 5% level of probability using least significant different (L.S.D), WAP (Weeks after planting)

Effect of Fish Pond Effluent and Poultry Manure on Leaf Area.

The results of the effect of fish pond effluent and poultry droppings on leaf area are shown on table 3. At 4 WAP, leaf area ranged from 136.70 at the control to 367.60 at PED100 treated plot. At 6WAP, value ranged from 137.20 at the control to 373.20 at the

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plot treated with PED100 and 8WAP, it ranged from 134.40 at the control to 381.20 at plot treated with PED100. The highest mean value for leaf area was recorded at PED100 treated plot.

Table 3: Effect of Fish Pond Effluent and Poultry Manure on Leaf Area.

Treatment	**4WAP(cm^2)**	**6WAP(cm^2)**	**8WAP(cm^2)**
PDA	193.60g	195.20g	196.80f
PDB	199.20f	202.30f	204.00e
PDC	200.20f	205.50ef	207.20e
PDD	203.00f	207.20e	208.60e
PFA50	214.60e	217.60d	219.90d
PFB50	216.50de	218.70d	223.70d
PFC50	219.10d	221.40d	224.80d
PFD50	226.70c	232.10c	234.70c
PEA100	227.30c	234.80bc	236.60c
PEB100	229.10bc	232.90c	236.40c
PEC100	232.10b	238.8b	243.80b
PED100	367.60a	373.20a	381.20a
CONTROL	136.70h	137.20h	134.40g
L.S.D P<0.05	4.50	4.81	6.50

Means followed by the same letter(s) in the same column are not significantly different from one another at 5% level of probability using least significant different (L.S.D), WAP (Weeks after planting)

Effect of Fish Pond Effluent and Poultry Droppings on Number of Nodes

The result of the effect of fish pond effluent and poultry droppings on number of node is shown on table 5. Number of nodes at 6WAP ranged from 6.89 to 13.05 at PED100 treated plot and at 8WAP, it ranged from 8.95 at the PDA treated plot to 16.75 at the PED100 treated plot. This value was significantly higher than the other treatment plots as shown on the table while the least number of nodes were obtained from the Control plot.

Table 4: Effect of Fish Pond Effluent and Poultry Manure on Number of Nodes

Treatment	6WAP	8 WAP
PDA	8.03f	8.95g
PDB	9.97de	11.69e
PDC	9.66e	11.26ef
PDD	10.09cde	14.53cd
PFA50	10.75cde	14.14d
PFB50	11.44bcd	13.50d
PFC50	11.46bc	14.42cd
PFD50	12.28ab	13.50d
PEA100	12.65ab	13.64d
PEB100	12.96a	15.97ab
PEC100	12.32ab	15.33bc
PED100	13.05a	16.75a
CONTROL	6.89f	10.18f
L.S.D P<0.05	1.47	1.13

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Means followed by the same letter(s) in the same column are not significantly different from one another at 5% level of probability using least significant different (L.S.D), WAP (Weeks after planting)

Effects of Pond Effluent and Poultry Manure on Diameter of Cob

The result of the mean value for diameter of cob is shown in Figure 1. The highest mean value is recorded in soils treated with PED100 with a mean value of 5.16 while the least is recorded in the Control plot.

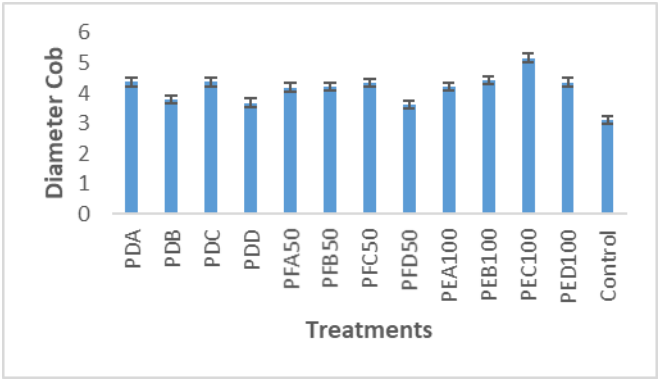

Figure1 Effect of Fish Pond Effluent and Poultry Manure on Diameter of Cob

Effect of Fish Pond Effluent and Poultry Droppings on Fresh Yield

The effect of fish pond effluent and poultry droppings on fresh yield is presented on fig 2 below. The fresh yield of maize recorded the highest value at the plot treated with PED100 with a mean value of 0.34 and the least mean value at the Control with a mean value of 0.18.

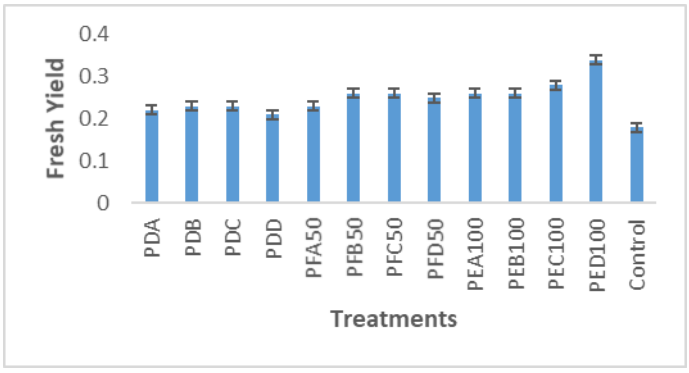

Figure 2: Effect of Fish Pond Effluent and Poultry Manure on Fresh Yield

Effect of Fish Pond Effluent and Poultry Manure on Length of Cob

The effect of fish pond effluent and poultry droppings on length of cob is presented on fig 3 below. Length of cob had a significant difference in soils treated with PED100 with a mean value of 17.39 when compared to other treatments. The least value for length of cob was recorded at the Control plot

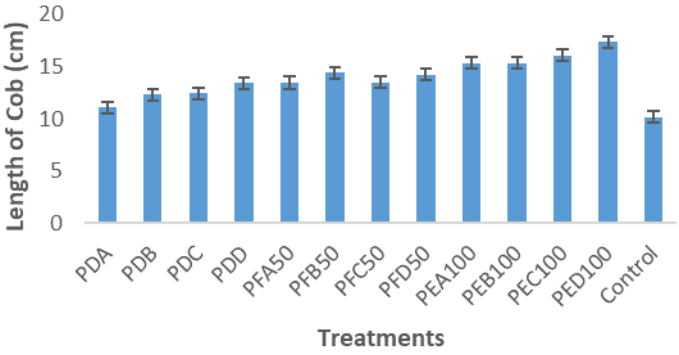

Figure 3: Effect of fish pond effluent and poultry droppings on length of cob

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Effect of Fish Pond Effluent and Poultry Manure on Weight of 1000 Kernel

The effect of fish pond effluent and poultry droppings on weight of 1000 kernel is presented on fig 4. The highest 1000 kernel weight was obtained from the treatment with PEC100 with a mean value of 4.77 followed by treatment with PED100 with a mean value of 4.14 and the least value was recorded with soils treated with PDA with a value of 0.06.

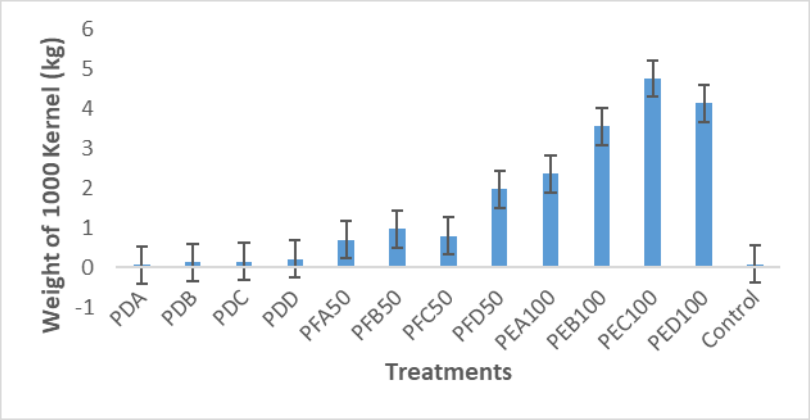

Figure 4: Effect of fish pond effluent and poultry droppings on weight of 1000 kernel

IV. Discussion

Generally, soils treated with poultry manure alone and poultry manure and fish pond effluent combined had a higher plant height compared to the control plot which conforms with the findings of (Nsoanya, 2019) where the plant irrigated with fish water effluent showed better growth attributes than those irrigated with well water. However, the soils that treated with fish pond effluent and poultry manure performed better than the control plot which is in line with the results from a similar study by (Ayeni and Adetunji 2010) where stem, leaf, plant length, and root diameter were higher when irrigated with fish effluent compared to water from well. Soils treated with fish pond effluent and poultry manure combined recorded higher leaf area when compared to soils treated with poultry manures alone. This result is agrees with the findings of (Nsoanya 2019) who recorded higher leaf area values on soils treated with fish effluent. The results from this work revealed higher values for number of nodes for soils treated with fish pond effluent and poultry manure together than soils treated with poultry manure alone which supports the findings of (Bame *et. al.*, 2014; Nsoanya, 2019). In a similar study, Adeniyan *et. al.*, 2011 revealed that cob diameter had a higher value which indicates positive effect of the combined effect of fish pond effluent and poultry manure. The combination of fish pond effluent and poultry manure gave a higher value for fresh yield when compared to the values from soils treated with poultry manure alone which is in line with the findings of (Fonseca *et.al*, 2005) which revealed an increase in the fresh yield when fish effluent was used for irrigation compared when compared to soils treated with canal water combined with fertilizers. The least value for length of cob was recorded at the Control plot which is in line with the findings of (Payebo and Ogidi 2020; Rasool *et al.*, 2023) who fertilized the soil with fish pond effluent and poultry manure respectively. The result of weight of 1000 kernel supports the findings of (Ibeawuchi *et. al.*,2007 and Enujeke *et. al.*, 2013) according to them, fish pond effluent and poultry manure significantly increased the weight of kernel as compared to the inorganic fertilizers treated soils.

V. Conclusion

The results obtained from the study revealed that, application of fish pond effluent can be used as organic fertilizer and good soil conditioner to improve nutrient status and thereby enhance mineral nutrition and plant growth. An integration of fish pond effluent with poultry manure significantly increased plant height, number of leaves and leaf area when compared with the Control. Fish Pond effluent combined with Poultry manure significantly increased soil chemical properties such as pH, Available Phosphorus, Total Nitrogen, Organic Carbon and Organic Matter. Therefore an integration of fish pond effluent and poultry manure is recommended as fertilizers for enhancing plant growth, nutrient status, and soil fertility level.

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