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Full Length Research Paper

Evaluation of fish pond water on the growth and yield of maize at Wilberforce Island, Amassoma

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Abstract

The objective of this research was to investigate the effect of fish pond water on the growth and yield of maize. The research was conducted at Niger Delta University Teaching and Research Farm. The treatments were 0litres/ha, 5000litres/ha, 10000litres/ha and 15000litres/ha of concrete fish pond water and were replicated four times. The treatments were arranged in Randomized Complete Block Design. Growth parameters such as plant height were assessed at different week stages and fruit yields after harvest. Data collected were subjected to analysis of variance. Growth parameters at week four were highest in treatments with 10000litres/ha with means of 25.35cm while at week six, growth parameters were highest and least in treatments with 15000litres/ha and 0litre/ha respectively. Also, at week eight, growth parameters were least in treatment with 0litre/ha while 1000 kernels weight were highest in treatment with 5000litres with the means of 4.21kg. Fresh yield of maize kernels in t/ha was highest in treatment with 15000litres/ha with the mean of 0.22kg and significantly different from other treatments. Least fresh yield was obtained from the treatment with 0litre/ha with a mean of 0.18kg. Highest dry kernel yield in t/ha was obtained from the treatments with 10000litres/ha and 15000litres/ha while treatments with 0litre/ha and 5000litres/ha were the least respectively.

Keywords: Water, growth, treatment, maize, yield.

INTRODUCTION

Maize (*Zea mays*), also called corn, is a member of grass family (Poaceae). It is a cereal crop which produced grain that can be used as food by human beings as well as livestock. The seed/fruit of maize is a caryopsis, i.e, it has its epicarp fused with mesocarp. It is originated in America and has become one of the main food crops in West Africa. It is one of the most important cereal crops, which serves as a staple food for many people in the Limpopo Province. This crop is the most important grain crop in South Africa and is produced throughout the country under diverse environments. Maize is grown mainly in wet, hot climate and strives well in cold, hot dry or wet conditions, as a versatile crop. It requires a rain fall of 250mm to 270mm. *Zea mays* required sufficient water supply at its critical growth period.

Maize plant is one of nature's most important energy storing plant, maize plant can develop to a height of 3m to 4m in two or three months, and can produce 600 to 1000 kernels similar to the one from which it originated. Maize is a short-day plant and required warm sunlight and sufficient water supply during critical growth period. It is ranked as the largest cereal crop in the world. Early planting is advisable with first rain. Maize is sown at 25cm x 75 mixed with other crop between row and for one plant per stand. Sown at 90cm between row and 30cm within row of two plants per stand. The crop is versatile in its use, environmental adaptation and it is also consumed all over the world by both human being and animals.

Aquaculture farmers are restricted to the farming of newly hatched, algae and also aquatic item, cosmetic, like shell buttons and pearl need for fashion. The water used for fish farming in aquaculture was normally disposed, but this has change. Historically, this has changed in recent years, as fish pond water has shown plant growth to be potentially beneficial. Aquaculture depends on the constant supply of freshwater from rivers and other water sources, but discharging waste water from the fish pond to the fresh water sources degrades the water quality and affects the fishes reared in the aquaculture system. Fish ponds have begun to serve as reservoir for the irrigation of plants because the deposits in the water is important for the growth of plants i.e the effluent of fishes.

Irrigation is the artificial supply of water to farm crops and livestock. Irrigation for agriculture consumes 70% of the global water supply (Abdul-Rahman *et al*., 2011). The use of effluents for agricultural irrigation, such as in fish farming, is quite current and well employed (Castro *et al*., 2006; Baumgartner *et al*., 2007; Medeiros *et al*., 2008), and an alternative in family farming properties (Sachs, 2004). Its environmental impact, compared to that of domestic and industrial effluents, is almost negligible (Cyrino *et al*., 2010). In Brazil, the National Environment Council establishes limits for water quality parameters in effluents, including the aquaculture activity (Conama, 2005; Conama, 2009).

Fish farming effluent (FFE) application often benefits plants both in irrigation and fertilization (Valencia *et al*., 2001). Maia *et al*. (2008) found that FFE application did not only supply the plant's need for water, but also for nutrients, which caused an increase in the growth of lettuce plants. On the other hand, Danaher *et al*. (2013) verified that there was no significant difference in plant growth in the presence of FE in pots receiving different proportions of the effluent when compared to those that did not receive it. FFE reuse in agricultural systems can be an important tool for the management of water resources (Nascimento & Heller, 2005). The FFE can influence plant growth favoring the cultivated species, provided that they provide responses to its application (Hussar *et al*., 2002). The use of FFE in plant production has been studied for the cultivation of several species such as lettuce (Baumgartner *et al.*, 2007), tomato (Rodrigues *et al*., 2010), melon (Medeiros *et al*., 2010), radish (Abdul-Rahman *et al*., 2011), petunia (Danaher *et al.,* 2013), basil (Hundley *et al*., 2013), legumes (Meso *et al*., 2004; Santos, 2009; Lacerda *et al*., 2011) and grasses (Valencia *et a*l., 2001; Abdul-Rahman *et al*., 2011; Lôbo, 2011). Waste fish pond water is very rich in nitrogen and other nutrients that plants require for their health and growth. But that same nutrient-rich water could be very detrimental to your fishes if it isn't removed and replaced with fresh water on a frequent basis. Use of manure rich fish pond water on maize give high productivity and yield. Such fish pond water rich in nitrogen, phosphorus, potassium, calcium and magnesium to water maize farm promotes effectively high growth and yield. Remains of feeds and excretes form settled faecal fish waste in the pond rendering the water rich in manure. Maize crop has a greater yield response to nutrient increase (Von Pinho *et al*., 2009), which possibly occurred due to the higher availability of mineralized nutrients from the FFE, mainly phosphorus and nitrogen, which has contributed to the nutritional requirements of the crop (Fonseca *et al.*, 2005; Bame *et al*., 2014). This enables one to save space and engage in two kinds of farming at once. Maize irrigated with waste fish pond water used for proper fertilization can greatly increase crop yields and have potential rate of growth of crops.

MATERIALS AND METHODS

The research was conducted at the Niger Delta University Teaching and Research Farm (NDUTRF) Wilberforce Island, Bayelsa State from July to October 2019.

The Topography of the land used is slightly sloppy and flat. The plot was located at North - west of NDUTRF.

The land was cleared for various operations of Agriculture and it was covered with weeds such as *Aspillaafricana, Panicum maximum, Chromolaenaodoranta, Cutus afar, Stariababata, Melanterascandens, Pennisetum purpureum, Impereta cylindrical, Ipoemeaaquatica, Mimosa pudica*, etc where all identified at the site.

The land was cleared manually with Cutlass and weeds were raked out of the plot also and other pre-planting operations were carried out with hoes and spade. The farm was mapped out into 5m x 5m experimental blocks with 0.5m alley between andamongst experimental plots which amounted to an area of 625m^2. The experiment was laid out in a randomized complete block design (RCBD) to establish homogeneity in all the treatments.

The maize used for the experiment was a local cultivar called yeyere also known as Red maize. It was obtained from ADP Port-harcourt. Seed viability test through floatation test was carried out and the kernels were found to have attained 96 to 98 germination percentage before they were used.

The other material used was fish pond water from a standard concrete fish pond from the Niger Delta University Teaching and Research Farm (NDUTRF). The required volume of fish pond water as treatments were 0lit/ha, 5,000lit/ha, 10,000lit/ha and 15,000lit/ha.

Maize kernels were sown two (2) per hole at a planting Depth of 2cm per hole and spacing of 75cm by 25cm then it was later thinned to one (1) plant per stand to obtain the required plant population.

Application of fish pond was done in the following order. The volume of each treatment was divided to the number of plant stands per block to ensure uniform treatment application. First application of the treatment was done after planting, the second application was at eight (8) leaves stage and the last at flowering stage of the growth of maize.

The fish pond water was irrigated in each of the replicate as a treatment at different levels from the same concrete pond, such as 0lit/ha, 5000lit/ha, 10000lit/ha and 15000lit/ha.

Analysis of variance method was used to analyze both growth and yield parameters as recommended by Steele and Torrie (1960) and means were tested using Tukey means method of grouping at 5% level of probability (Minitab, 2010).

RESULTS AND DISCUSSION

Maize Growth Parameters at 4 Weeks After Planting

The table 1 shows a summary of the means of each treatment with fish pond water at 4 weeks after planting. Plant height was highest in treatment with 10000litres/ha followed by 15000litres/ha with their respective means 25.35cm and 25.5cm, however, there was no significant difference between the two treatments. The least plant height was obtained from the treatment with 0litres/ha (Control) which differs significantly from the other treatments. Treatment with 5000litres /ha also had significant difference from the rest treatments.

Number of leaves were highest in treatment with 15000litres/ha which differs significantly from the other treatments with the mean 8.40 as shown in table 1 while the least number of leaves were obtained from the treatment with 0litre/ha which also had a significant difference from the other treatments. Treatment with 5000litres/ha and 10000litres/ha were not significant from one another but significant from other treatments.

The mean number of internodes are shown in table 1. the highest number of nodes were obtained from the treatment with 15000litres/ha with mean 7.45 which had significant difference from the other treatments while the least was obtained from the treatment with 0litre/ha (Control). The treatment with 5000litres/ha and 10000litres/ha did not had any significant difference from one another as shown in table 1.

Mean number of nodes are shown in table 1 in which the highest was also obtained from treatment with 15000litres/ha followed by treatment with 10000litres/ha, though, both treatments do not differ significantly from one another but significantly different from the rest other treatments. Again, least number of nodes were obtained from the treatment with 0litres/ha with a mean of 8.40 which differ significantly with the rest treatments.

Maize Growth Parameters at 6 Weeks After Planting

The table 2 shows the mean growth parameters assessed at 6 weeks after planting in which plant height was highest in treatment with 15000litres/ha followed by 5000litres/ha with their respective means of 132.85cm and 128cm, although, both treatments had significant difference from one another. The treatment with 0litre/ha (control) had the least mean value on plant height which is significantly different from other treatments. However, treatments with 5000litres/ha and 10000litres/ha had no significant difference from one another but significantly different from the other treatments.

Mean value of numbers of leaves were also shown in table 2 where the number of leaves were also higher in treatment with 15000litres/ha followed by treatment with 10000litres/ha. Although, both treatments had no significant difference from one another but significantly different from other treatments. The least number of leaves were also obtained from the treatment with 0litre/ha (control) with the mean of 12.15 which had no significant difference from the treatment with 5000litres/ha.

Mean number of internodes were also shown in table 2 where the number of internodes were also highest in treatment with 15000litres/ha followed by treatment with 10000litres/h with means 14.10 and 4.01 respectively. Although, both treatments had no significant difference from one another but significantly different from other treatments. The least number of internodes were also obtained from the treatment with 0litre/ha (control) with the mean of 13.2 which had no significant difference from the treatment with 5000litres/ha.

Mean value of number of nodes were also shown in table 2 where the number of nodes were also highest in treatment with 15000litres/ha followed by treatment with 10000litres/ha. Although, both treatments had no significant difference from one another but significantly different from other treatments. The least number of nodes were also obtained from the treatment with 0litre/ha (control) with the mean of 12.4 which had no significant difference from the treatment with 5000litres/ha.

Maize Growth Parameters at 8 Weeks After Planting

Mean plant height of the different treatments are shown in table 3 in which plant height had the highest from the treatment with 15000litres/ha with the mean of 167.9cm and it is significantly different from all other treatments. Though all individual treatments had significant differences from one another. The least mean plant height was obtained from the treatment with 0litre/ha.

Mean value of numbers of leaves were also shown in table 3 where the number of leaves were also higher in treatment with 15000litres/ha followed by treatment with

Table 1. Mean Maize Growth Parameters at 4 Weeks After Planting.

Parameters	0 litre/ha	5000litres/ha	10000litres/ha	15000litres/ha
Plant height (cm)	16.8^{c}	23.05^{b}	25.35^{a}	25.5^{a}
Number of leaves	4.60^{c}	6.80^{ab}	7.60^{ab}	8.40^{a}
Internodes	3.40^{c}	5.95^{b}	5.25^{b}	7.45^{a}
number of nodes	8.40^{ab}	6.68^{b}	8.97^{a}	8.99^{a}

*Means that do not share same letter are significantly different (Turkey method at 95% confidence level).

Table 2. Mean Maize Growth Parameters at 6 Weeks After Planting.

Parameters	0litre/ha	5000litres/ha	10000litres/ha	15000litres/ha
Plant height(cm)	115.85^{c}	128^{b}	127.25^{b}	132.85^{a}
Number of leaves	12.15^{b}	12.95^{b}	13.05^{a}	13.15^{a}
Internodes	13.2^{b}	13.6^{b}	14.1^{a}	14.10^{a}
Number of nodes	12.4^{b}	12.6^{b}	13.01^{a}	13.77^{a}

*Means that do not share same letter are significantly different (Turkey method at 95% confidence level).

Table 3. Mean Maize Growth Parameters at 8 Weeks After Planting.

Parameters	0litre/ha	5000litres/ha	10000litres/ha	15000litres/ha
Plant height (cm)	157.2d	159.7c	166.55b	167.9a
Number of leaves	15.4b	15.8b	16.35a	16.35a
Internodes	16.3b	16.8b	17.55a	18.15a
Number of nodes	14.00c	14.60c	15.67b	17.65a

*Means that do not share same letter are significantly different (Turkey method at 95% confidence level).

10000litres/ha. Although, both treatments had no significant difference from one another but significantly different from other treatments. The least number of leaves were also obtained from the treatment with 0litre/ha (control) with the mean of 15.4 which had no significant difference from the treatment with 5000litres/ha.

Mean number of internodes were also shown in table 3 where the number of internodes were also highest in treatment with 15000litres/ha followed by treatment with 10000litres/h with means 18.15 and 17.55 respectively. Although, both treatments had no significant difference from one another but significantly different from other treatments. The least number of internodes were also

Table 4. Mean Yield of Maize (t/ha).

Parameters	0litre/ha	5000litres/ha	10000litres/ha	15000litres/ha
Fresh yield (t/ha)	0.18^{c}	0.20^{b}	0.20^{b}	0.22^{a}
Dry yield(t/ha)	0.16^{b}	0.17^{ab}	0.18^{a}	0.18^{a}
Length of cob(cm)	11.08^{d}	13.01^{c}	14.35^{b}	16.86^{a}
Diameter of cob(cm)	4.40^{b}	3.96^{bc}	4.48^{b}	5.03^{a}
Weight of 1000 kernels (kg)	0.08^{d}	4.21^{a}	0.1^{c}	0.22^{b}

*Means that do not share same letter are significantly different (Turkey method at 95% confidence level).

obtained from the treatment with 0litre/ha (control) with the mean of 13.2 which had no significant difference from the treatment with 5000litres/ha.

Mean value of number of nodes were also shown in table 2 where the number of nodes were also highest in treatment with 15000litres/ha followed by treatment with 10000litres/ha. Although, both treatments had significant difference from one another with their respective means of 17.65 and 15.67. Treatment with 1000litres had significant difference from treatment with 5000litres/ha. The least number of nodes were also obtained from the treatment with 0litre/ha (control) with the mean of 14.0 which had no significant difference from the treatment with 5000litres/ha.

Yield of Maize (t/ha)

The mean fresh yield of maize kernels is shown in table 4 in which the highest fresh yield was obtained from the treatment with 15000litres/ha with the mean of 0.22kg and it is significantly different from the other treatments.

While treatments with 50000litres/ha and 10000litres/ha did not had significant difference between them though, had significant difference from the rest treatments. The least yield was obtained from the treatment with 0litre/ha (control) with a mean of 0.18kg.

Dry yield of maize kernel was also assessed as shown in table 4. The highest dry kernel yield was obtained from the treatments with 10000litres/ha and 15000litres/ha in which there had been no significant difference between them. Treatments with 0litre/ha and 5000litres/ha had no significant difference and treatment with 5000litres/ha had no significant difference from the treatments with 10000litres/ha and 15000litres/ha. Length of cob is also shown in table 4 in which all treatments had significant difference from one another. However, the highest cob length was obtained from the treatment with 15000litres/ha with the mean 16.86 followed by treatment with 10000litres/ha while the least was obtained from the treatment with 0litre/ha.

The mean diameter of cob is also shown in table 4 in which the highest cob diameter was obtained from the treatment with 15000litres/ha with the mean of 5.03 and it is significantly different from the rest treatments while the rest treatments do not differ significantly from one another. Although, the least cob diameter was obtained from treatment with 5000litres/ha with the mean of 3.96.

Mean weight of 1000 kernels of maize is also shown in table 4. The highest 1000 kernel weight was obtained from the treatment with 5000litres/ha followed by treatment with 15000litres/ha with their respective means of 4.21kg and 0.22kg. The least was obtained from the treatment 0litre/ha, though, all treatments differ significantly from one another.

Findings also show that at week 8, growth parameters were least in treatment with 0litre/ha which was significantly different from the other treatments while Weight of 1000 kernels were highest in treatment with 5000litres/ha followed by 15000litres/ha with their respective means of 4.21kg and 0.22kg. Fresh yield of maize kernels in t/ha was highest in treatment with 15000litres/ha with the mean of 0.22kg and it is significantly different from the other treatments while treatments with 50000litres/ha and 10000litres/ha did not had significant difference between them though, had significant difference from the rest treatments. The least fresh yield was obtained from the treatment with 0litre/ha (control) with a mean of 0.18kg. The highest dry kernel yield in t/ha was obtained from the treatments with 10000litres/ha and 15000litres/ha in which there had been no significant difference between them while treatments with 0litre/ha and 5000litres/ha had no significant difference.

CONCLUSION

Economically and socially, the use of waste fish pond water unlike other synthetic fertilizers, reduces the capital to invest in agricultural businesses such as maize farming. The use of fish pond water is not too common in the rural area, it is necessary to apply it for better growth and yield in crop production. But adding pond water in your crop farm can help to avert money to be spent on fertilizer, the sludge collected by your pond filter (which is filled with nutrients from fish droppings, excess fish food, and decaying leaves) is a natural fertilizer that can be used to feed your landscape. This is because pond water is not only for rearing of fish, but can also contribute to crop irrigation in the dry season thereby increasing the viability of year - round production. It is important because as a source of irrigation water, pond water also contribute nitrogen fixing blue-green algae which can improve soil fertility. After the fish harvest, nutrient-rich pond mud can be used as fertilizer to grow forages and other crops.
Conclusively, that the use of fish pond water actually influenced the growth and yield parameter positively unlike the treatment with olitre/ha (Control) and should be used in the cultivation of maize.

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