Effect of Different Fermented Fruit Juice as Foliar spray on the Growth and Yield of Maize (*Zea mays* L.)

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Abstract

The research was conducted from January 2017 to May 2017 at Vegetable and Fruits Research Development Center (VFRDC) Yangon Division. Fermented fruit juices were used as foliar sprays on the yellow sweet corn plants to evaluate the growth and yield. In this research three different concentrations of fermentent fruit juice (PPY+WM+BNN) were used. The experimental designs were Randomized Complete Block Design (RCBD) with four treatments and each treatment with four replications. In this research, determination of plant height, number of leaf, length of internodes, SPAD chlorophyll meter reading (SCMR),relative water content, ear length, cob length, cob perimeter, ear length, ear weight, cob weight, 100 seeds weight and cod yield for maize plants were recorded. The treatments were different rates of fermented fruit juices T_1-7ml/L; T_2 -9ml/L ; T_3 -11 ml/L and T_4 Control – water treatment. Among all treatments, the result showed that T2-9 ml/L was observed the high yield and good quality of yellow sweet corn plant.

Keywords: FFJ, SCMR, RCBD

Introduction

Maize (*Zea mays* L.) is a grain crop belonging to the grass family poaceae (Paliwal, 2000) and it originated from domestication of the wild grass teosinte (*Zea mexicana*), which is native to Mexico. (IITA & CIMMYT, 2007). Maize is the third most important crop in the world, after rice and wheat. It is one of the most important crops in the tropical and subtropical regions of the world (Harris *et al*., 2007).

The crop is significant economic importance worldwide as human food, animal food and a source for a large number of industrial products (Paliwal, 2000 and Duplessis, 2003). Maize serves as staple food and is prepared and consumed in the multiple ways. The oil from the embryo is used in cooking oils, margarine and salad dressing (Abulrahaman and Kolawole, 1988).

Maize grain has grater nutritional value as it contains 72 % starch, 10 % protein, 4.8 % oil, 8.5 % fiber, 3.0 % sugar and 1.7 % ash (Hauque, 2003). Maize grain is extensively used for the preparation cake, lactic acid and acetone which are used by various industries such as textile, foundry, fermentation and food industries. In developed countries, maize is consumed mainly as second-cycle produce, in the form of meat, eggs and dairy products. In developing countries, maize is consumed directly and serves as staple diet for some 20 million people. Most people regard maize as breakfast (Miracle, 1988).

Fermented Fruit Juice (FFJ) is an artificial honey. It is a nutritional activation enzyme and is very effective in natural farming. FFJ is a kind of FPJ that only uses fruits as its main ingredients. It is used to revitalize crops, livestock and humans. As main fruit ingredients, banana, papaya, mango, grape, melon, apple etc. can be used. Fermented fruit juice (FFJ) can be used to increase the fruiting process of plants as well as to increase yield. It can be used as a foliar spray as well as indirect application to the soil, where it feeds the micro biome and increases soil health (Reickenberg and Pritts, 1998).

Fermented fruit juice (FFJ) is used as foliar Fertilizer, to increase and improve yield and quality of the maize. The foliar application becomes promptly available to

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the crops because form of nutrient application is better than direct fertilization (Naz *et al*., 2011).

Young leaves absorb the nutrient solution through minute hair (trichomes) on the leaf surface and through the stomata, even though the latter is not the major pathway. Most of the absorption takes by diffusion through the cuticle (Salisbury and Ross, 1992). This is in contrast to soil applied fertilizer which is usually in powder or granular form which has to be dissolved by moisture from rainfall or irrigation and to be available to plants. Fertilizer has to dissolve into the soil solution to be available. When soil applied fertilizer is not readily available or insufficient, foliar feeding is usually practiced or used as supplement (Abbas and Ali 2011).

Application of foliar fertilizer is an effective way to correcting soil nutrient deficiencies when plants are unable to absorb them directly from the soil (Liang and Silberbush, 2002).

Foliar applied fertilizers provide a quicker response and are more effective for some nutrients than soil applied fertilizers (Jamal *et al*., 2006).

Material and Method

Experimental design and plant material

The experiment was conducted at the Vegetable and Fruits Research Development Center, Hlegu Township during the period from January to May 2017 and maize variety used in these experiment was 702; a commercial sweet corn from Agro International Co.Ltd. Randomized Complete Block Design (RCBD) by four treatments with four replications in three blocks was used in this experiment .Soil type at the field site has been classified as loamy sand. These FFJ was prepared for 2 months before experiment .The treatments were as follow

(T_1)7 ml/L (PPY+WM+BBN)
(T_2)9ml/L (PPY+WM+BBN)
(T_3)11ml/L (PPY+WM+BBN)
(T_4) control (water –non treated plant)

Preparation of fermented fruit juice

In this experiment, three kilograms of all fruits (Papaya, Watermelon, Banana) were chopped into 3-5 cm small pieces. The chopped materials of the all fruit were put together in a plastic bucket according to the predetermined combination, and then, 3 L of molasses were put into bucket(fruit chopped material containing). They were mixed thoroughly to make sure that all chopped materials were coated with molasses juice could be extracted easily. The bucket was covered and secured with a string and stored for one month in a cool dry place. The fermented extract was collected after one month and preserved in color glass jar for further use.

Preparation of cultivation area

The soil was disk plough thrice, leveled and harrowed a Basel dose of well –decomposed chicken manure was incorporated into the top soil at the rate of 2 ton ac-1, shortly prior to planting. Lime at the rate of 100 kg ac^{-1} was incorporated into the soil during soil preparation. The seeds were at the rate of 5 g Kg^{-1} seed to protect from fungal disease. Plot size was 4m x4.5m with 90 cm spacing of between rows and 30 cm between plants. Seeds were firstly germinated in the germination tray and the plantlets were transplanted into the field at 10 days after emergence. Irrigation was done daily until one month after transplanting and it continued with two days intervals. One month sowing, treatments were applied with 10 days intervals spraying FFJ to maize plants until harvest period.

Data collection

Data were collected at final harvest. Twenty plants from each treatment were harvested and the following were the collected data.

Plant height, No of leaves per plant. Length of internode, SPAD chlorophyll meter reading (SCMR),Relative water content (%) ear length ,ear perimeter. ear weight, Cod length, cod perimeter, cod weight, number of row / cod, number of seed/row /,100 seed weight, sweetness **(˚Brix**)and cod yield (ton/acre).

Relative water content (RWC) was used to evaluate plant water status and it was measured at harvest. It was measured at second top leaf of five plants for each plot at 10:00- 12:00 am (Clavel *et al*., 2006; Girdthai *et al.*, 2010). Leaf discs of (2.5 x 2.5) cm^2 were cut from the central area of the leaves avoiding the midribs. These five leaf discs were put into a vial with a rubber stopper and the vial was sealed with para film. The vials were suddenly kept inside the ice box to prevent moisture loss. After measuring the field weights, the Leaf discs were soaked in the distilled water .for 8 hours and turgid weights were determined again Then ,these leaf discs were oven dried 80degreeCfor 48hours or until the dry weight became constant finally ,RWC was determined as follows.

RWC (%)= [(FW-DW)/(TW-DW)]x100,

Where, FW is sample turgid weight (saturated weight) and DW is sample dry weight.

Statistical Analysis

The data were subjected for analysis of variance according to RCBD design and all calculation was performed using Duncan, multiple range tests (DMRT).

Figure 1. Preparation of Fermented Fruits Juice (FFJ)

Figure 2. Applying with Fermented Fruits Juice (FFJ) on cultivation of maize plants

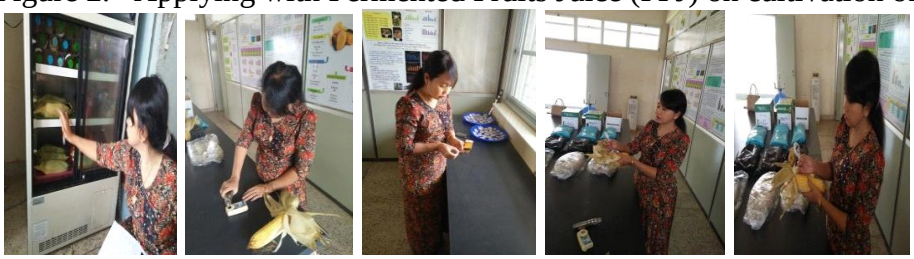


Figure 3. Showing the data counting of Ear and Cod Yield, Sweetness of Cod from each treatment

Results

Table 1 Response of Maize plant to different levels of Fermented Fruit Juices (FFJ)

Treatment (PPY+WM+BNN)	Plant height (cm)	Leaf number/plant	Length of internodes(cm)	SPAD chlorophyll meter reading (SCMR)	Relative water content (WRC)
T_1 (7ml/L)	221.71[a]	11.56[a]	18.97[a]	50.38[a]	93.33[b]
T_2 (9ml/L)	231.95[a]	11.92[a]	19.36[a]	53.75[a]	96.15[a]
T_3 (11ml/L)	235.95[a]	11.95[a]	19.65[a]	48.45[a]	93.41[b]
T_4 (Ctrl)	218.27[b]	10.84[b]	18.35[b]	44.22[b]	90.02[c]
LSD	2.23	0.87	0.73	2.95	2.23

Different letters adjacent to data in the same column show significant difference at $p<0.05$ by Duncan, multiple ranges tests (DMRT)

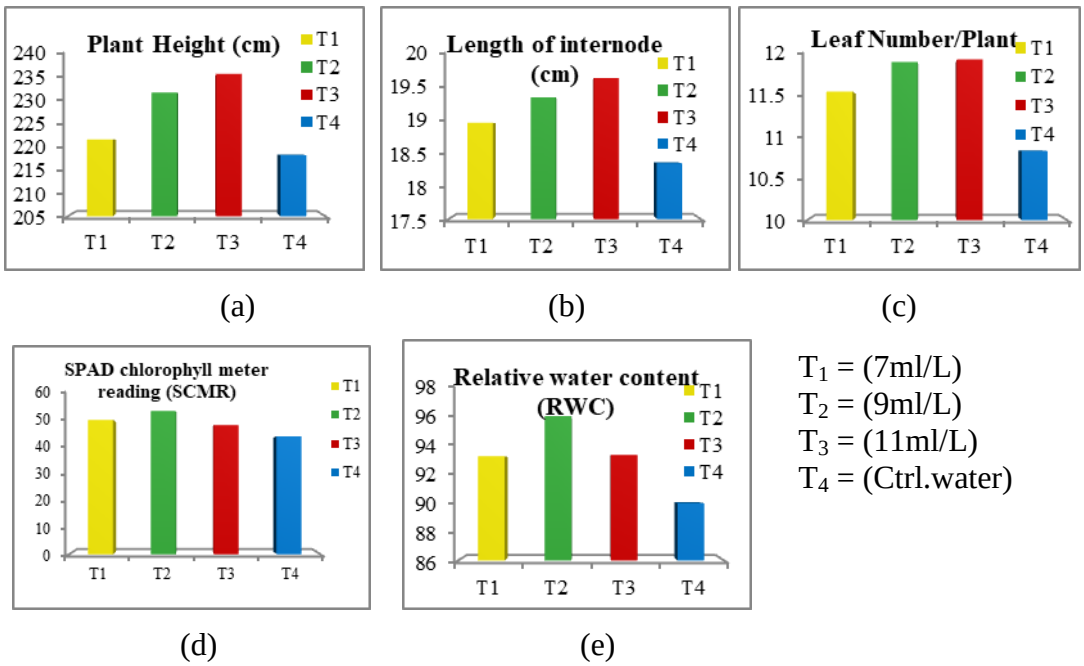


Figure 4. Responses of Maize to Different Levels of Fermented Fruits Juices (FFJ) on (a) Plant Height, (b) Length of Internode (cm), (c) Number of Leaf, (d) PSAD Chlorophyll Meter Reading (SCMR) and (e) Relative Water Content (RWC)

Plant Height

The result showed that Fermented Fruit Juice (FFJ) has significant effect on final plant height. The highest plant height 235.95 cm occurred in T_3 (11 ml/L)treated plants followed by T_2(9ml/L) had 231.95 cm and 221.71 cm in T_1(7ml/L) and the shortest plant height 218. 27 cm was found in T_4, control (watered) plants. It can be noted that all the treated plants were significantly different at 5% DMRT level from the T_4 (Ctrl) plant.

Number of Leaves

The result of the maximum number of Leaves 11.95 was observed from T_3 (11 ml/L) treated plants followed by T_2(9ml/L) had 11.92 and 11.56 in T_1(7ml /L)and the least number of leaves 10.84 was found in T_4 (Ctrl) plants. There were no significant differences on the all treated plants.

Length of internodes

The result of the experiment showed that longest length of internode 19.65 cm was observed from T_3 (11 ml/L) treated plants followed by T_2 (9ml/L),T_1 (7ml/L) and the shortest length of internode18.35 was found in T_4 (Ctrl) plants. There were no significant differences on the all treated plants.

SPAD Chlorophyll Meter Reading

In this experiment ,the response of maize plant to different level of FFJ showed that highest chlorophyll content was observed in T_2 (9ml/L) was 53.75, followed by 50.38 in T_1 (7ml/L) and 48.45 in T_3(11 ml/L). The lowest content of chlorophyll 44.22 was found in T_4 (Ctrl) plants. All of treated plants were significantly similar to one another but significantly different to T_4 (Ctrl) plant.

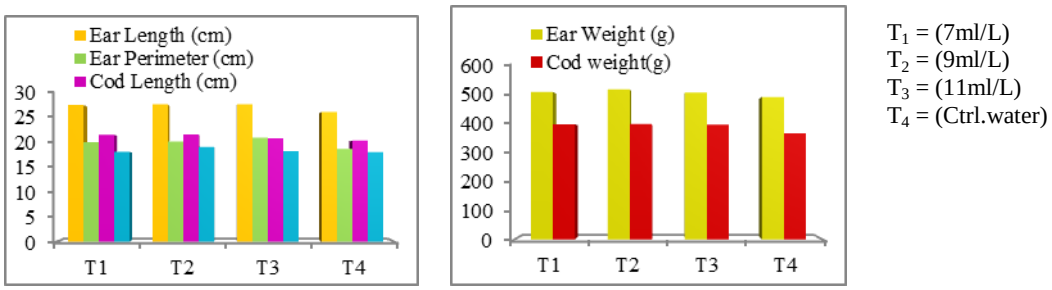
Relative Water Content (RWC)

According to the result of relative water content, the highest content 96.15 was found in T_2 (9ml/L) followed by T_1 (7ml/L) T_3 (11ml/L) of 93.33 and 93.41 respectively in each. The lowest water content 90.01 was resulted from T_4 (Ctrl) plant. As present in table 1, T_1 (7mlL), T_2 (9ml/L) and T_3 (11ml/L) treated plants were significantly similar but all FFJ treated plants were highly significantly difference to T_4 (Ctrl) plant.

Table 2 Response of Maize plant to different levels of Fermented Fruit Juices (FFJ)

Treatment (PPY+WM+BNN)	Ear length (cm)	Ear Perimeter (cm)	Cod Length (cm)	Cod Perimeter (cm)	Ear Weight (g)	Cod Weight (g)
T_1 (7ml/L)	27.72 [a]	20.21 [a]	21.67 [a]	18.21 [b]	512.53 [a]	400.53 [a]
T_2 (9ml/L)	27.85 [a]	20.33 [a]	21.75 [a]	19.21 [a]	521.20 [a]	401.20 [a]
T_3 (11ml/L)	27.88 [a]	21.12 [a]	20.95 [a]	18.39 [b]	510.65 [a]	398.65 [b]
T_4 (Ctrl)	26.32 [b]	18.85 [b]	20.50 [a]	18.15 [c]	495.13 [b]	369.14 [c]
LSD	1.26	0.75	0.31	0.54	25.49	20.31

Different letters adjacent to data in the same column show significant difference at p<0.05 by Duncan, multiple ranges tests (DMRT)



(a) (b)

Figure 5. Responses of Maize plant to Different Level of Fermented Fruits Juices (FFJ) (a) Ear Length (cm), Ear Perimeter (cm), Cod Length (cm), Cod Perimeter (cm) and (b) Ear Weight (g) and Cod Weight (g)Ear Length and Ear Perimeter

In this experiment, the response of maize plant to different level of FFJ showed that highest ear length observed in T_3 (11ml/L) was 27.88 cm, 27.85 cm in T_2 (9ml/L) followed by 27.72 cm in T_1 (7ml/L) and T_4 (Water) in 26.32 cm respectively.

The experiment showed that the highest ear perimeter was 21.12 cm in T_3 (11 ml/L) and the lowest perimeter was 18.85 cm in T_4 (Ctrl) plant. All of all Fermented Fruit Juice treated plants were not similarly significant to one another. But, all treatments were significantly different to T_4 (Ctrl) plant at 5% Level DMRT.

Cod Length and Cod Perimeter

The result of cod length was highest in which T_2 (9ml/L) had 21.75 cm, T_1 (7ml/L) 21.67 cm and T_3 (11ml/L) 20.95 cm.The shortest cod length had 20.50 cm in T_4 (Ctrl) plant. There were no significant differences in all treatments.

The result showed that the highest value of cod perimeter was T_2 (9ml/L) that had 19.21 cm and T_3 (11ml/L) that had 18.39 cm. The shortest cod perimeter was 18.15 cm in T_4 (Ctrl) plant. All treatments were significantly different to one another.

Ear weight and Cod weight

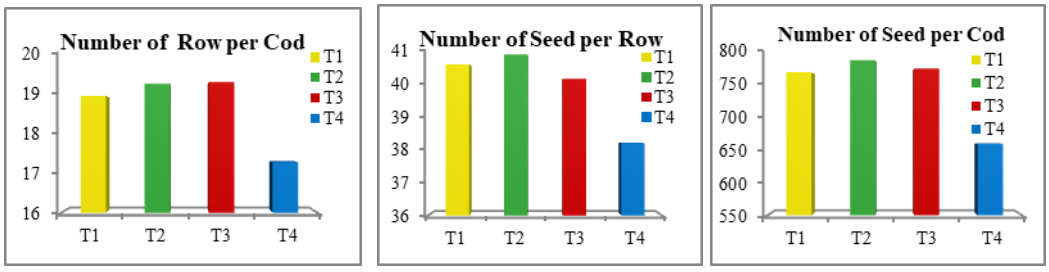
The maximum value of ear weight 521.20 g was observed from T_2 (9ml/L) and followed by 512.53 g in T_1 (7ml/L) and 510.65 g in T_3 (11ml/L).The least value of 459.13 g was observed in T_4 (Water) treated plant. All treated plants were not significantly similar to one another. But there were significant differences to T_4 (Ctrl) plant.

The maximum value of cod weight 401.20 g was observed from T_2 (9ml/L) and followed by 400.53 g in T_1 (7ml/L) and 398.65 g in T_3 (11ml/L).The least weight of 369.14 g was observed in T_4 (Ctrl) plant. All the T_1 and T_2 treated plants were significantly differences to T_3 and T_4 (Ctrl) plant.

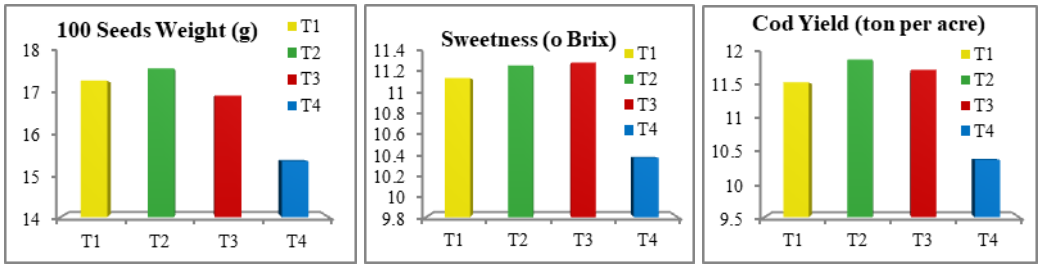
Table 3 Response of Maize plant to different levels of Fermented Fruit Juices (FFJ)

Treatment (PPY+WM+BNN)	No.of Row/Cod	No.of Seed/Row	No.of Seed/Cod	100 Seed Weight (g)	Sweetness (°Brix)	Cod Yield (ton/ac)
T_1 (7ml/L)	18.96 [a]	40.65 [a]	770.76 [a]	17.33 [a]	11.16 [a]	11.57 [a]
T_2 (9ml/L)	19.27 [a]	40.96 [a]	789.28 [a]	17.63 [a]	11.28 [a]	11.92 [a]
T_3 (11ml/L)	19.31 [a]	40.21 [b]	776.46 [a]	16.97 [b]	11.31 [a]	11.76 [a]
T_4 (Ctrl)	17.28 [a]	38.23 [c]	660.31 [b]	15.37 [c]	10.38 [b]	10.38 [b]
LSD	0.35	1.26	29.36	1.69	0.35	0.71

Different letters adjacent to data in the same column show significant difference at $p<0.05$ by Duncan, multiple ranges tests (DMRT)



(a) (b) (c)



(d) (e) (f)

T_1 = (7ml/L), T_2 = (9ml/L), T_3 = (11ml/L), T_4 = (Ctrl)

Figure 3. Responses of Maize to Different Levels of Fermented Fruits Juices (FFJ) on (a) Number of Row per Cod, (b) Number of Seed per Row, (c) Number of Seed per Cod, (d) 100 Seeds Weight (g), (e) Sweetness (° Brix) and (f) Cod Yield (ton per acre)

Number of Row per Cod, Seed per Row and Seed per Cod

The result of number of Row per cod was highest in which T_3 (11ml/L) had 19.31, T_2 (9ml/L) 19.27 and T_1 (7ml/L) 18.96 receptively. The lowest no. of row per cod in T_4 was 17.28. There were not significant to one another.

The number of seed per row on maize plant had highest value 40.96 in T_2 (9ml/L) and 40. 65 in T_1 (7ml/L) and T_3 (11ml/L) had 40.21. The Lowest value of T_4 (11ml/L) was 38.23. Analysis of variation at 5% level showed that T_1 and T_2 treated plant is highly significant to T_3 and T_4 (Ctrl) plant.

The result showed that the highest number of seed per cod was 789.28 in T_2 (9ml/L), 776.46 in T_3 (11ml/L) and T_1 (7ml/L) had 770.76. The least no. of seed per cod was 660.31 in T_4 (Water). According to analysis of variation, all treatments were highly significant to T_4 (Ctrl) plant**.**

100 Seeds Weight (g), Sweetness and Cod Yield

In this experiment, the result of 100 seed weight was highest in which T_2 (9ml/L) had 17.63 g and was followed by 17.33 g in T_1 (7ml/L), 16.97 in T_3 (11ml/L) and 15.37 in T_4 (Ctrl) receptively .

The sweetness of maize seed was observed highest in T_3 had 11.28 followed by T_2 (9ml/L) had 11.28, T_1 had 11.16 and the lowest sweetness of maize was 10.38 in T_4 (Ctrl).

The maximal yield of cod per acre in T_2 (9ml/L) had 11.92 ton and 11.76 ton in T_3 (11ml/L), 11.57 ton in T_1 (7ml/L). The minimal yield of cod per acre in T_4 (Ctrl) was 10.38. According to analysis of variation, all treatments were highly significant to T_4 (Ctrl) plant.

Discussion and Conclusion

The supply of nutrients via the roots is restricted under drought soil because of the negative effect of drought and nutrient availability .The efficacy of foliar fertilizer application is higher than that of soil fertilizer application because of the supply of the required nutrient directly to the leaf its relative quick absorption (eg.0.5-2 hr for N and 10-24 hr for K) and the independence of root activity and soil water availability (Romheld and El-Fouly 1999). In addition, organic fertilizer is fertilizer that is composed of biodegradable that is found in nature which releases nutrient as it decays. So, the application of organic fermentent fruit juice showed that the highest plant height of 235.95cm,longest internode length of 19.65cm and maximum leaf

number of 11.95 observed from T_3 (11ml/L) treated plant. These values were higher than other FFJ treated plant and significantly higher than control plant. The value of chlorophyll meter reading 53.75 and relative water content 96.15 were highest at T_2 (9ml/L) treated plants. These values were significantly higher than control plant.

This agreed with Reickenberg and Pritts 1996;Jamel et al.,2006 stated that foliar application of fertilizer provides a quicker response and is more effective for some nutrient than soil applied fertilizer. Argenta et al (2003) indicated that a portable chlorophyll meter (SPAD 502) is an instantaneous tool to assess plant nitrogen status. Swiader and Moore (2002) also reported that potential usefulness of the SPAD chlorophyll meter as a nitrogen management and tool in estimating plant nitrogen status yield component result indicated that foliar spray of FFJ had significant effect on control plant. Although the highest ear length 27.88cm and perimeter 21.12 cm were found at T_3 treated plant, T_2 (9ml/L) treated plants showed that highest value of cod length 21.75cm ,cod perimeter 19.21cm and cod weight 401.20g among all treatments (table2).

The highest sweetness was 11.38 at T_3 while 11.31 was found at T_2 treated plant. Finally, the highest yield of 11.96 ton was result from T_2 treated plant. So, it can be concluded that FFJ Foliar fertilizer of 9ml/L (T_2) treatment should be applied for future organic maize cultivation.

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References

Abbas.MK and A.S.Ali, 2011. Effect of foliar application of NPK on some growth characters of two cultivars of rosette (*Hisbiscus sabdariffa* L.).Am.J.Plant physiol.,6:220-227.

Abdulrahaman, A. A. & O. M., Kolawole, 1988. "Traditional Preparations and uses of maize in Nigeria". University of Ilorin, Nigeria.

Argenta et al.Adubacao nitrogenata em milho pelo monitroramento do nivel de nitrogenio na planta planta por meio do **c**hlorofilometro**. Revista Brasileira de Ciencia do Solo,** Vicosa**,** v.27, p. 109-119,2003**.**

Duplessie, J., 2003. Maize production. Department of Agriculture, Pretoria, South Africa 112.118.

Hauque, L., 2003. "Effect cattle slurry on growth biomass yield and chemical composition of maize fodder" in Asia Journal of Animal Science 6: 107-129.

Harris, D., A., Rashid, G., Miraj, M., Arif, & H., Shah, 2007. "On farm seed primins with zinc. Sulphate solution: A cost effect way to increase to maize yields of resource poor permers". Field Crops Research 102, 119.127.

Haute van,2007."The Growth and Yield Response of Bell Pepper to Fermented Fruit Juice and Fish Fertilizer."

IITA CIMMYT., 2007. "Morphology and growth of maize". Research guide of Lagas, Nigeria.

Jamal, Z., Hamayun, N. Ahmad and M. F. Chavdhary, 2006. Effect of soil and foliar application of different concentrational of NPK and foliar application of $(NH_4)_2$ SO_4 on different yield parameters in wheat. J. Agrony 5: 251.256.

Liang, F. and M. Silberbush, 2002. Response of maize to foliar vs. soil application of nitrogen-phosphorus potassium fertilizer J. plant Nutr., 25: 2333-2342.

Miracle, M. P. 1988. "Introduction and spread of maize in African Journal of African History". 6: 29.55.

Naz F., Haq JU., Asghar S., Sharih AS and Rahman A., 2011. "Studies on growth, yield and nutritional composition of different tomato cultivars in Battal Valley of district Mansehra, Khyber Pakhtunkhwa, Pakiston". Sarhad J. Agric 27: 569-571.

Paliwal, R.L., 2000 "Introduction of maize and its importance". In: FAO, 2000. Tropical maize improvement and Production. Rome. Italy.

Reickenberg, R. L. and M. P. Pritts, 1996. Dynamics and nutrient uptake from foliar fertilizers in red raspberry (*Rubusidaeus* L.). J. Am. Soc. Hort. Sci., 121: 158-168.

Romheld V and M.M.El-Fouly (1999).Foliar nutrient application: Challenges and limits in crop production.(proc.of 2nd international Workshop on Foliar…,1999Cited by 100 Related articles .

Salisbury, F. B. and W.c. Ross. 1992. Plant Physiology 4th Edn. Wadsworth Publishing Co., Belmont. Calfonia.USA.,Pages:6.

Swiader J, Moore A(2002)SPAD-chlorophyll response to nitrogen fertilization and evaluation of nitrogen status in dry land and irrigated pumpkins. J Plant Nutr 25:1089-1100