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Influence of Compost Tea Concentrations on the Morpho-physiological Characteristic and Qualities of Okra (*Abelmoschus esculentus*) in Maiduguri

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Abstract: *Compost tea has been used in agronomy as a good source of organic substance and soil modifications that provides plants with mineral nutrients and other aids. An experiment was conducted at Teaching and Research Farm of Ramat polytechnic located in Maiduguri withthe aim to determine the effect of various concentrations of compost tea on morpho-physiological development and qualities of okra. Five concentrations of compost tea were used at 0, 30, 60, 90 and 120ml/L to the foliar of the cultivated okra crop. Plant growth and yield parameters were measure at interval of one using simple tools and manual counting whereby recording data on log books, while the physiological characteristics such as Leaf chlorophyll were measured by SPAD meter, the total soluble solid content of pod was studied using a hand refractometer, measurement of Stomatal conductance was determined by using leaf porometer and chlorophyll content was measured by SPAD meter. Summary of results it can be reported that the highest concentration of compost tea produces the higher results in number of branches, number of leaves, number of flowers, number of fruit, Fruit weight and total soluble solids. Highest of healthy pods and least aborted pods were recorded in 120ml/L. Moreso, results of Chlorophyll Content and Stomatal Conductance were recorded high in 120ml/L and 90ml/L. Number of fruits and fruit weights correlates with number of branches, number of leaves and number flowers.At the end of this it can be recommended higher concentrations should be studied and tested.*

Keywords: *Okra, compost tea, growth, yield, quality*

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I. Introduction

Vegetable crops are grown and consumed worldwide as source of fibres and nutraceutic compounds in human diets. Consumers tend to prefer organic foods compared to others, because they are perceived more nutritious and tasty. Moreover, food security reasons and environmental concerns are orienting the market and the growers toward sustainable agricultural systems, based on natural-deriving methods with the reduction of synthetic inputs.

Okra (*Abelmoschus esculentus* L.) is an annual crop grown mainly as fruits and leafy vegetables in both green and dried state in the tropics. Okra is cultivated under rainfed and in irrigated areas on a wide range of soils (Adetuyi et al., 2011). Soils in the tropics have been reported to be low in nutrients.Nitrogen is akey and universallylacking nutrient element in tropical soils and it is the primary element of concern in vegetable production. In order to ameliorate nutrient depleted soils, inorganic fertilizer has been used by researchers and farmers. For centuries, farmers and gardeners have mixed and soaked plant wastes, manures and compost in water and used the rich decanted brew as a liquid fertilizer or "organic tea. The nutrients from fresh manure teas tend to be soluble salts especially macro nutrient (N, P, K Ca, Mg and S) with micronutrients (e.g. Fe, Zn, Mn and Cu). Farmers have complained of the bulkiness of Organic manure and therefore a need for another alternative fertilizer(Adewole et al., 2011).

Relatively new compost-derived products, such as compost teas (CTs), although they are less common, show remarkable perspectives for diffusion and development among organic growers (Akani et al., 2008). They are gaining great interest in many country of North America and Asia (Siddiqui et al.,2008) and, recently, scientific attention for these products started also to expand in Europe (Litterick et al.,2004). CTs are obtained by aerobic liquid extraction of quality composts from few hours to some days that essentially results in dissolved organic and inorganic molecules and useful microorganisms (Siddiqui et al., 2009). The use of compost as organic fertilizer allows improvement in fertility, in addition to being excellent soil conditioner, improving their physical, chemical and biological characteristics, such as retention water, aggregation, porosity, the cation exchange capacity, fertility and life soil microbial, however, the value compound fertilizer depends on the material used as raw material (Miyasaka *et al.*,1997; Ahmad *et al.,* 2008; Fiorentino and Fagnano, 2011).

In modern terminology compost tea is a compost extract product of the fermented compost in water (Litterick *et al.,* 2004). Compost tea is suitable than compost because it contains on soluble nutrients so it can be

used for soaking seeds or seedlings before planting. It can be applied to soil through irrigation systems or to plant leaves. Also, compost tea is very rich in phytohormones and growth regulators. It stimulates the microorganisms that have a direct or indirect proper effect on the plant rhizosphere, besides improves soil physical and chemical properties as well as overwhelm some plant pathogen causing disesases (Meshref *et al.,* 2010). Crop nutrition and soil properties are two important factors that must be taken into consideration, for the proper agronomic use of cattle manure as a fertilizer. The experiment was conducted to investigate the effects of concentrations of composts tea on morphological, physiological and qualitative characteristicof Okro.

II. Materials and Methods

The study was conducted at Ramat polytechnic Teaching and Research Farm is located in Maiduguri. The climatic condition as dry sub-humid in nature during cropping season Temperature Ranging between 23.2 to 34.3^0 C. The Raining season is usually short from May to October with low relative Humidity and average rainfall is 440-600mm.One hundred fifty okra plants were used for the treatment application. Okra seeds were sown in germination trays at the nursery and seven days after sowing (DAS) at 3-5 leaf stage, all the seedlings were transplanted to polybags containing garden soil.Experimental plants were arranged under a Completely Randomized Design (CRD) with four replicates. Compost Tea at 0, 30, 60, 90 and 120ml/L concentrations were applied to the experimental plant. Foliar spray techniques were used to apply the composttea (Khandaker, 2018).

Manure tea Preparation

Compost manure were mixed with tap water in a ratio of 1:5 (v/v) in polyethylene non-degradable 25 L containers at room temperature for a brewing period lasting 14 days. Water had been previously aerated for 8 h to reduce the amount of chlorines present in it. The mixture was measured using a 1-liter container and diluted with 2 liters tap water.The chemical contents of the compost were illustrated in Table (1).

Table 1: Chemical analyses of the compost tea

pH	EC	OM	Macro elements (%)					Micro elements (ppm)			
			N	P	K	Ca	Mg	Fe	Zn	Mn	Cu
7.56	4.76	32.12	1.21	0.72	1.43	0.66	0.32	2543	182	223	165

Plant Growth and Yield Measurements

Plant height (cm), number of leaves, number of branches, number of flowers, number of pods, pod size and weight (g) were recorded once a week after the treatment application. Plant height was measured from above the ground level up to the uppermost tip of the leaves. Numbers of leaves, branches, flowers, pods and pod weight were counted and measured on each treated and control plant. For seed production, the percentage of healthy seeds and aborted seeds were recorded and calculated using a modified method of Mekhled (2011). Leaf chlorophyll content of treated and control plants were measured by SPAD meter (Minolta Japan). The total soluble solid content of pod wax was evaluated using a hand refractometer (Atago 8469) and expressed as percentage (%) of Brix. Measurement of physiological parameters such as Stomatal conductance was determined by using leaf porometer which was recorded in mmol m^{-2}sand chlorophyll content was measured by SPAD meter. The readings were taken a week after the treatments for three consecutive weeks.

Statistical analysis

The data obtained were analyzed by using One-way repeated ANOVA in Statistical Analysis Software (SAS version 20.0). Pearson correlation was analyzed using the Statgraphics Centurion software.P value of less than 0.05 were considered to be statistically significant.

III. Results and Discussion

Table 2. Effects of different concentrations of Compost Tea (CT) on growth, development and fruit quality of okra

Conc. of CT	No of branches	N of leaves	N of flowers	N of fruit	Fruit weight (g)	TSS (BRIX)
0	3.00± 0.55c	20.00 ± 1.11b	4.70±0.31b	3.27±0.23c	20.23±0.31b	2.26±0.02b
30	4.77±0.42bc	26.66 ± 1.45b	7.67±0.88a	6.10±1.00a	25.39±0.13ab	3.37±0.02ab
60	5.00 ± 0.00bc	28.67 ± 0.88b	7.33±0.33a	6.57±0.33a	25.17±0.43ab	3.43±0.02a
90	6.00 ± 0.58ab	30.33 ± 1.12b	8.43±0.25a	7.69±0.35b	26.72±0.23ab	3.46±0.03a
120	7.67 ± 0.43a	35.67 ± 0.78a	9.67±0.33a	8.70±0.35ab	30.24±0.62a	5.46±0.08a

All the data were mean of three replications ± indicates the standard of error

Results from table shows that number of branches was significantly higher at higher concentration of 120ml/L, however lower at control treatment with a mean value of 3.00. Treatment two and three are not

statistically different from each other that might be so because compost tea rates were not so high nor low in counting number of branches of okra, this can be attributed to the content of NPK in compost tea, NPK increases the number of branches in wheat production (Chhipa and Lal, 1998). Number of leaves counted also proves that high rate of 120ml/L produces the highest significant mean leaves count at 35.67, lowest number of leaves was recorded in the control at 20 mean leaves, however there was no significant differences the control and the other treatments tested, application of IAA increases the leaf area of plants and number of leaves of vegetable crops (Vamil et al., 2010). Data from the table indicates that average number of flowers was significantly lowest at the control treatment, moreover all the treatments tested remains the same statistically, this result might be in connection with the content of auxins on in the plant which in turn facilitates cell division and cell elongation and promotes flower production in extension (Ranjan et al., 2003).. Mean number of fruits in control treatment was low as significant to other treatments, higher concentration of CT at 120ml/L was not statistically different from the other tested treatments, number of fruit has directed correlation with number of flowers produced (Dalorima et al., 2018). Weight of fruits tested showed that higher concentration at 120ml/L produces the higher significant weight of fruits tested, while low weights of fruits was measured in the control treatment moreover the other treatments are not statistically different from the control or the higher concentration, Mukhtar (2008) reported that IAA hormones which are found in CT inhibits growth potentials of crops, According to Naylor et al.(1999) organic nutrient sources such as manure and compost tea are some of best way of improving crop yield and fruit. Total soluble solids were observed as a qualitative parameter of the okra fruit, it was recorded from the study that highest concentration of CT at 120ml/L measured the high Brix of TTS of Okra crop, it was reported that Stem and foliar application of any stimulant which contents exogenous GA3 significantly enhanced the total soluble solids of a fruit (Ilias et al., 2007). Results from this study collaborates with that of Akanbi et al., (2004) whom used organic nutrient sources such as compost tea to improve the yield and quality of crops.

Table 3. Effects of different concentrations of Compost Tea (CT) on leaf chlorophyll, stomatal conductance and pods quality of okra.

Conc. of CT	Healthy Pods (%)	No Aborted Pods	Chlorophyll Content	Stomatal Conductance (mmol $m^{-2}s$)
0	91.46 ± 0.55a	6.54 ± 0.55b	40.9 ± 0.69a	83.24 ± 0.59e
30	92.7 ± 0.48b	6.3 ± 0.48a	39.74 ± 0.29a	85.59 ± 1.38d
60	93.2 ± 0.08b	6.8 ± 0.08a	40.78 ± 0.29a	93.8 ± 0.69c
90	95.63 ± 0.39b	5.37 ± 0.39a	45.63 ± 0.18b	97.11 ± 1.01b
120	96.28 ± 0.28b	4.72 ± 0.27a	55.83 ± 0.72c	117.19 ± 0.69a

All the data were mean of three replications ± indicates the standard of error

Results in table 3 illustrates that percentage healthy pods of okra were lowest in in the control treatment, however other tested treatments did not show significant differences amongst them. Number of aborted pod of okra was significantly high in the control treatment however other treatments are not significantly different from each another. Mekhled (2011) reported that highest concentration growth hormones applied to flower ovary through injection inhibited seed production and prevented 100% abortion of seed, known as stenospermocarpy. He added that significant increase in seed abortion were observed at lower concentration of growth regulating hormones. Treatment high concentration of 120ml/L had the highest significant chlorophyll content with an average of 55.072 however, the least mean value of chlorophyll content was in the control treatment. Moreso, the control is not statistically different with 30ml/L and 60ml/L. Highest rate of stomatal conductance was recorded in 120ml/L which is statistically different with the control which has the least mean value of measured stomatal conductance. It can be sufficing to report that chlorophyll content and stomatal conductance correlates in the same stimulatory manner as affected by the higher concentration of CT, growth regulatory hormones such as Indole Acetic Acid and Gibberellins inhibits or stimulates the physiology of plants (Vamil et al., 2010).

Table 4: Correlations Matrix of Morpho-physiological characteristic and qualitative properties of treated Okra crop

	NoB	NoL	NoFl	NoFr	FW	TSS	HP	AP	CC	SC
NoB	1									
NoL	.990**	1								
NoFl	.970**	.975**	1							
NoFr	.971**	.985**	.987**	1						
FW	.987**	.989**	.992**	.979**	1					

TSS	.953*	.942*	.901*	.877	.948*	1				
HP	.954*	.927*	.908*	.935*	.910*	.834	1			
AP	-.856	-.774	-.773	-.752	-.794	-.798	-.901*	1		
CC	.862	.800	.724	.720	.787	.887*	.846	-.923*	1	
SC	.937*	.913*	.826	.842	.883*	.949*	.890*	-.847	.959*	1

**Correlation is significant at the 0.01 level

*Correlation is significant at the 0.05 level

NoB: Number of Branches, NoL: Number of Leaves, NoFl: Number of Flowers, NoFr: Number of Fruits, FW: Fruit Weight, TSS: Total Soluble Solids, HP: Healthy Pod, AP: Number of Aborted Pods, CC: Chlorophyll Content, SC: Stomatal Conductance

Results from table 4 indicates the correlation between growth and performance characteristics, a highly positive correlation between number of branches, number of leaves, number flowers and number of fruits can be observed. So also there is a significant relationship fruit weight and number of branches, number of leaves, number of fruits and number of flowers. Significant correlations have been reported between the plant growth parameters and yield in an organic fertilized crop (Palm and Sanchez, 1991; Mafongoya et al., 1997). Correlation between TSS and number of branches, number of leaves, number of flowers, number of fruits and fruit weight. Number of aborted pods has a significant negative correlation with percentage of healthy pods, similarly chlorophyll content relates negatively with number of aborted pods. From the results it can be observed that stomatal conductance has significant positive correlation with number of branches, number of leaves, fruit weight, TSS, number of healthy pods and chlorophyll content. Positive relationships between photosynthetic rates and crop yields have been reported for many crops (Efthimiadou et al., 2009).

IV. Conclusion

From the overall results it can be concluded that the highest concentration of compost tea produces the higher results in number of branches, number of leaves, number of flowers, number of fruit, Fruit weight and total soluble solids. Highest of healthy pods and least aborted pods were recorded in 120ml/L. Moreso, results of Chlorophyll Content and Stomatal Conductance were recorded high in 120ml/L and 90ml/L. There was high positive correlations between growth and performance characteristics, number of fruits and fruit weights correlates with number of branches, number of leaves and number flowers.

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Bunu A, et. al. "Influence of Compost Tea Concentrations on the Morpho-physiological Characteristic and Qualities of Okra (Abelmoschus esculentus) in Maiduguri." *IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS),* 13(6), 2020, pp. 01-05.