International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

Effects of Organic Manure Sources on the Growth and Yield of Watermelon in Abakaliki, Southeastern Nigeria

Longinus Aniekwe[1], Gilbert Nwokwu[2]

Ebonyi State University, Department of Crop Production and Landscape Management, P.M.B 053, 480001, Abakaliki, Nigeria

Abstract: ***Field experiments were conducted in the dry seasons of 2009 and 2010 at the experimental farm of Faculty of Agriculture and Natural Resources Management, Ebonyi State University, Abakaliki, to study the effects of different organic manure sources on the growth and yield of two watermelon varieties in a 2x6 factorial laid out in a randomized complete block design (RCBD) in four replications, manually irrigated two times in a day (morning and evening) until maturity. The organic manure sources significantly (P<0.05) differed in all the parameters measured over the control in the two varieties. Burnt rice husk and poultry manure yielded 6.47kg and 6.32kg of fruits in 2009, but it was reduced to 5.00kg in 2010 among all the organic manure sources except the control. Also, the two varieties produced equal weights of 5.00kg of fruits per plant in both years, but koalack responded better than sugar baby in fruit yields (7.50kg) in 2009 under poultry manure, while swine dung influenced 7.25kg fruits in sugar baby in 2010. All the organic manure sources excelled in improving all the growth and yield parameters, showcasing them as suitable substitutes for inorganic fertilizers plus all the added advantages among which are soil fertility improvement, quality environmental conditioning, mitigation of climate change and enhancement of agricultural production sustainability threatened by global catastrophes and diseases.***

Keywords: Watermelon, Organic manure, Sugar baby and Koalack varieties, soil fertility improvement

1. Introduction

The watermelon, (*Citrullus lanatus* (Thunb.) Matsum. & Nakai) is well known for its nourishing fruit vegetable with high water content and significant amounts of sugar, vitamins A, B and C [12], [14], as well as a herbaceous plant with long stems which prostrate or attach themselves to different kinds of supports by tendrils [17] and is the most popular cucurbitaceous fruits. The sweet watermelon fruit is mainly considered a dessert rather than a vegetable [21] and is most widely cultivated in the world, both tropical and subtropical climates [6]. The most widely grown types have translucid flesh, with very high water content, a sweet taste, red or sometimes yellow in colour and are very refreshing when eaten in hot climates [17]. *Citrullus lanatus* originates from Africa in areas surrounding the two major deserts in Africa (the Kalahari and Sahara) particularly in the western Kalahari regions of Namibia and Botswana and in the southern Sahelian zone of West Africa [14], [23]. Three centers of diversity have been named by [21]; the Kalahari Desert center where the fruits are used as a source of water during periods of drought, the Southern Sahelian zones and neighbouring savannah areas where the fruits of subspecies *mucosospermus* Fursa are useful for their oilseeds, and arid regions in Southern Ukraine where much larger fruits were originally selected for their water holding capacity.

Other synonyms include *Citrullus vulgaris* Schrad. ex Eckl. & Zeyh., *Colocynthis citrullus* (L.) Kuntze and *Momordica lanata* Thunb., and many subspecies which are often confused in the literature with its wild relatives still found in these centers [14]. There are cultivars whose fruits are small and the only edible portion is the seed, generally known as 'egusi', in Yoruba language, or 'beref' in Wolof (Senegal) language, because the pulp of the fruit is usually too bitter for human consumption [1], [4], [22]-[23]. The egusi melon is also very important in West Africa for its protein and oil-rich seeds [4] and also the cooking or fodder melon useful as a source of drinking water particularly the wild watermelon fruit known as 'tsamma' in Khoisan, in the Kalahari regions [14].

[17], reported that most cultivated cucurbits of which watermelon is one of them respond well to organic manure and grow very well when a trench has been filled with farmyard manure or compost and covered with 10 cm of soil before planting the crop. Alternatively, a good spadeful of farmyard manure or compost below each planting hole at 1-2 plants/hole is required by watermelon to grow well. It needs adequate moisture, sunlight and temperature and is negatively affected by low and high temperature [13]. Soil fertility maintenance is a major concern in the tropics, particularly in Abakaliki, a derived savannah zone of south-eastern Nigeria where the traditional farming system of the area for fertility sustainability include: shifting cultivation, bush fallow, use of plant residue, household refuse, animal manure and other organic wastes. Although, the reliance on biological nutrient sources for soil fertility regeneration is adequate with low cropping intensity, it becomes unsustainable with more intensive cropping that characterized the study area, thus resulting in inherent low fertility and consequently low yield. The rapid depletion of poor physical condition of the soil constituents is a strong limitation to crop production [9]. The decline in the soil productivity has led farmers in the area to embrace the use of inorganic (chemical) fertilizers but inorganic fertilizers are expensive, particularly with the removal of all subsidies on fertilizer by the government [18]. This has brought untold hardship on the peasant farmers, who can hardly afford to meet the high cost of inorganic fertilizers. However, frequent use of inorganic fertilizers for a prolonged period deteriorates the surface soil characteristics and affects the availability and uptake of nutrients by plants [11]. In view of the poor economic resource-base of the rural farmers and the

need to prevent the resultant effect of inorganic fertilizers, it becomes exigent that the use of organic wastes being generated in large tons on daily basis be optimized. The positive effects of organic wastes on soil properties and productivity have been reported in literature by other researchers [15]-[16], [19] who evaluated the potential properties of organic wastes on soil conditions.

Some organic fertilizers may be relatively resistant to microbial degradation and consequently exhibit very slow release of nutrient elements to the soil. However, it is essential to establish and maintain the soil in optimum physical condition for good plant growth. Poultry manure is available, affordable, and as such a very effective good source of N for sustainable crop production as the inorganic fertilizer is no longer within the reach of the resource-constrained farmers [20]. However, [10] had advocated for integrated use of organic and inorganic fertilizers to supply plant nutrients required for sustainable maximization of crop production, profitable soil fertility improvement due to increment of organic matter content and minimization of environmental impacts, in a system known as integrated plant nutrient systems [7]-[8]. According to [3] the use of manure application enhances soil productivity, increases the soil organic carbon content, soil micro-organisms, improves soil crumb structure, the nutrient status of the soil and enhances crop yield. [5], reported that the application of poultry manure improved the yield of eggplant, while [2], reported that farm yard manure (FYM) plus poultry manure at the rate of 5 t ha^{-1} resulted in higher fruit yield of eggplant. Hence, the objective of this study was to determine the effect of different organic manure sources on the growth and yield of watermelon in Abakaliki, Southeastern Nigeria.

2. Materials and Methods

The field trial was carried out at the experimental farm of the Faculty of Agriculture and Natural Resources Management, Ebonyi State University, Abakaliki, which measured 52 m long and 8 m wide to give a total area of 416 m^2 and was carried out during the dry seasons of 2009 and 2010. The experimental site is lying on latitude 06^0 19´ 407´´ N and longitude 08^o 07´ 831´´ E at an altitude of about 447 m above sea level with a mean annual rainfall of about 1,700 mm to 2,060 mm and a maximum mean daily temperature of between 27^o C to 31^o C with abundant sunshine and a high humidity all through the year. The treatments were six different organic manure sources (poultry manure, municipal waste, burnt rice waste, swine dung, wood ash and a control) applied at the same rate of 20 tons per hectare on two varieties of watermelon (kaolack and sugar baby), laid out as a 6 x 2 factorial in randomized complete block design (RCBD) in four replications. Each replication consisted of twelve plots to give a total of 48 plots in the experiment. The plot size was 2m x 3m with 0.5m between adjacent plots and 1.0m between replicates. Flat seedbeds were prepared manually in each season, while seeds were sown at inter and intra row spacing of 90cm x 75cm. All the data collected on the growth and yield parameters were analysed using general linear additive model in Minitab, while Turkey's test was used to compare the treatment means and also the residual was tested for normal distribution using Anderson Darling test.

3. Results

In Table1, the manure sources did not significantly ($p<0.05$) influence the leaf area index (LAI) of the two watermelon varieties in both years. However, variety responded better in 2009 than 2010, whereas sugar baby maintained the highest LAI in both years (1.47 and 1.30) respectively. The organic manure sources influenced higher value in 2009 than in 2010, with burnt rice husk being the highest (1.72), followed by municipal waste (1.39) and wood ash (1.38) in 2009, while poultry manure and wood ash gave the highest LAI that were statistically similar (1.43), followed by swine dung with 1.30 in 2010, but were not significant. The control consistently produced the smallest LAI in each year 1.17 and 0.86 respectively. There was no significant variety x organic manure interaction effect on LAI, but the highest LAI (1.83) was produced by sugarbaby, followed by koalack (1.61) when treated with burnt rice husk in 2009, but sugar baby produced the highest (1.91) when treated with wood ash, followed by koalack with 1.75 when treated with poultry manure in 2010.

Table 1: Effect of organic manure sources on leaf area index (LAI) of two watermelon varieties during 2009 and 2010 dry season plantings

		Varieties		
Year	*Treatments*	*Sugar baby*	*Koalack*	*Mean*
2009	Organic Manure (Kg)			
	Control (0)	1.02a	1.33a	1.17A
	Poultry manure	1.44a	1.11a	1.28A
	Municipal waste	1.44a	1.33a	1.39A
	Burnt rice husk	1.83a	1.61a	1.72A
	Swine dung	1.58a	0.89a	1.23A
	Wood ash	1.49a	1.27a	1.38A
	Mean	1.47a	1.26a	
	SE±	SE_V=0.14	SE_O=0.24	E_{VO}=0.34A
2010	Control (0)	1.12ab	0.59b	0.86
	Poultry manure	1.12ab	1.75a	1.43
	Municipal waste	1.20ab	1.03a	1.11
	Burnt rice husk	0.96b	1.20a	1.08
	Swine dung	1.51a	1.09ab	1.3
	Wood ash	1.91a	0.94a	1.43
	Mean	1.30a	1.09a	
	SE±	SE_V=0.20	SE_O=0.18	SE_{VO}=0.29

Means followed by different letter (s) are significant at adjusted P value<0.05

The effect of varieties on number of leaves was not significant in the first year but was significant in the second year (Table 2). The number of leaves produced by sugar baby in 2009 (71.96) and in 2010 (88.89) were higher than that of koalack variety. The effect of organic manure sources on the number of leaves of watermelon was significantly ($p<0.05$) different with the highest obtained from burnt rice husk (95.79), followed by poultry manure (84.94) and wood ash (83.44) in 2010, being higher than 2009 with the highest (84.50) obtained from poultry manure, while the least number of leaves was consistently obtained from the control (56.38 in 2009 and 70.38 in 2010). Variety x organic manure interaction was significantly ($p<0.05$) different when sugarbaby was treated with poultry manure (100.25) in 2009, while sugar baby and burnt rice husk was highest

(105.67) in 2010. The least number of leaves (47.75) was obtained from sugar baby in 2009 under the control.

Table 2: Effect of organic manure sources on the number of leaves of two watermelon varieties during 2009 and 2010 dry season plantings

		Varieties		
Year	Treatments	Sugar baby	Koalack	Mean
2009	Organic manure (Kg)			
	Control (0)	47.75b	65.00ab	56.38B
	Poultry manure	100.25a	68.75ab	84.50A
	Municipal waste	87.25ab	67.75ab	77.50AB
	Burnt rice husk	69.50ab	76.50ab	73.00AB
	Swine dung	75.25ab	66.25ab	70.75AB
	Wood ash	51.75ab	77.21ab	64.38AB
	Mean	71.96a	70.21a	
	SE±	SE_V=12.31	SE_O=7.11	SE_{VO}=17.41
2010	Control (0)	82.31ab	58.45b	70.38B
	Poultry manure	83.90ab	85.98ab	84.94AB
	Municipal waste	83.12ab	76.44ab	79.78B
	Burnt rice husk	105.67a	85.91ab	95.79A
	Swine dung	79.81ab	73.58ab	76.70B
	Wood ash	98.51ab	68.36b	83.44AB
	Mean	88.89a	74.79a	
	SE±	SE_V=8.78	SE_O=5.07	SE_{VO}=12.42

Means followed by different letter (s) are significant at adjusted P value<0.05

The length of vine (175.5cm) produced by sugar baby variety was significantly (p<0.05) different (154.5cm by koalack) in the first year than in the second (Table 3). Equally, sugar baby produced longer vines than koalack in both years (175.5cm and 72.59cm respectively). The longest vine (206.3cm) was obtained from burnt rice husk, followed by wood ash (182.6cm), poultry manure (168.6cm) and municipal waste (168.4cm) in the 2009, while in 2010, swine dung produced the highest vine length (75.78cm), followed by wood ash (74.44cm) and burnt rice husk with 72.86cm). The least vine length (113.6cm) in 2009 and 64.98cm) in 2010 were obtained from the control. Variety x organic manure interaction effect significantly influenced the vine lengths produced by the two varieties of watermelon with the greatest effect obtained when sugar baby and koalack were treated with burnt rice husk (209.0cm and 203.5cm) in 2009, and when sugar baby was treated with wood ash (85.32cm) and koalack was treated with swine dung (79.37cm) in 2010.

Table 3: Effect of organic manure sources on vine lenght (cm) of two watermelon varieties during 2009 and 2010 dry season plantings

		Varieties		
Year	Treatments	Sugar baby	Koalack	Mean
2009	Organic Manure (Kg)			
	Control (0)	127.3b	100.0b	113.6B
	Poultry manure	188.3a	149.0a	168.6A
	Municipal waste	175.3a	161.5a	168.4A
	Burnt rice husk	209.0a	203.5a	206.3A
	Swine dung	178.5a	122.8b	150.6B
	Wood ash	175.0a	190.3a	182.6A
	Mean	175.5a	154.5a	
	SE±	SE_V=19.50	SE_O=11.26	SE_{VO}-27.57
2010	Control (0)	63.8a	66.1a	65.0A
	Poultry manure	73.2a	69.5a	71.4A
	Municipal waste	63.1a	70.8a	66.9A
	Burnt rice husk	77.9a	67.8a	72.9A
	Swine dung	72.2a	79.4a	75.8A
	Wood ash	85.3a	63.6a	74.4A
	Mean	72.59a	69.53a	
	SE±	SE_V=8.93	SE_O=5.15	SE_{VO}=12.63

Means followed by different letter (s) are significant at adjusted P value<0.05

Number of branches of the two watermelon varieties was significantly (P<0.05) influenced by the organic manure sources (Table 4). The effect of organic manure on number of branches was not significant. The highest number of branches (5.00) per plant was obtained from burnt rice husk in 2009, while wood ash had the highest number of branches (5.75) in 2010. The number of branches obtained in 2009 (2.75) and in 2010 (3.50) was from the control showing that there was more favourable plant growth in 2010 than in 2009. Koalack was insignificantly higher in the number of branches (4.29) in 2009 than sugar baby, as sugarbaby was also insignificantly higher (4.42) than koalack variety in 2010. Variety x organic manure interaction significantly influenced the number of branches in both years with sugar baby having the highest number under poultry manure (5.25), while koalack had the highest under burnt rice husk (5.75) in 2009. The highest number of branches was obtained from sugar baby (6.25) and koalack (5.25) when wood ash was applied in 2010, while koalack was equally influenced by poultry manure and burnt rice husk (5.00) in 2010, and both varieties had equally the least (2.75) in 2009.

Table 4: Effect of organic manure sources on number of branches of two watermelon varieties during 2009 and 2010 dry season plantings**.**

		Varieties		
Year	Treatments	Sugar baby	Koalack	Mean
2009	Organic Manure (Kg)			
	Control (0)	2.75a	2.75b	2.75B
	Poultry manure	5.25a	4.25a	4.75A
	Municipal waste	4.00a	4.25a	4.13A
	Burnt rice husk	4.25a	5.75a	5.00A
	Swine dung	4.75a	4.75a	4.75A
	Wood ash	4.25a	4.00a	4.13A
	Mean	4.21a	4.29a	
	SE±	SE_V=0.57	SE_O=0.33	SE_{VO}=0.81
2010	Control (0)	3.25b	3.75b	3.50C
	Poultry manure	3.75b	5.00ab	4.38BC
	Municipal waste	4.25a	3.00b	3.63BC
	Burnt rice husk	4.00b	5.00ab	4.50B
	Swine dung	5.00ab	4.00b	4.50B
	Wood ash	6.25a	5.25ab	5.75A
	Mean	4.42a	4.33a	
	SE±	SE_V=0.52	SE_O=0.30	SE_{VO}=0.73

Means followed by different letter (s) are significant at adjusted P value<0.05

In Table 5, organic manure sources significantly (P<0.05) influenced the number of fruits of the two watermelon varieties in both years. Sugar baby produced the highest number of fruits (11.46 in 2009 and 13.33 in 2010) than koalack (9.08 in 2009 and 11.12 in 2010). The effect of organic manure on the number of fruits was significantly different with the highest number (13.13 in 2009 and 14.00 in 2010) obtained from the application of wood ash,

followed by municipal waste (12.63 in 2009 and 13.50 in 2010) with the least number of fruits obtained from the control. The variety x organic manure interaction effect on the number of fruits was significantly pronounced in sugar baby (16.00) under municipal waste in 2009 and (16.75) in 2010 followed by burnt rice husk (15.00), while koalack under poultry manure had 16.25 fruits in 2010 and 13.25 in 2009 under wood ash.

Table 5: Effect of organic manure sources on number of fruits of two watermelon varieties during 2009 and 2010 dry season plantings

		Varieties		
	Treatments	Sugar baby	Koalack	Mean
2009	Organic Manure (Kg)			
	Control (0)	7.75b	5.50b	6.63C
	Poultry manure	10.00ab	8.50ab	9.25B
	Municipal waste	16.00a	9.25ab	12.63A
	Burnt rice husk	13.50a	9.25ab	11.38A
	Swine dung	8.50ab	8.75ab	8.63B
	Wood ash	13.00a	13.25a	13.13A
	Mean	11.46a	9.08a	
	SE±	SE_V=1.51	SE_O=0.87	SE_{VO}=2.13
2010	Control (0)	9.75a	10.25a	10.00B
	Poultry manure	7.25b	16.25a	11.75AB
	Municipal waste	16.75a	10.25a	13.50A
	Burnt rice husk	15.00a	10.25a	12.62AB
	Swine dung	14.50a	8.50b	11.50AB
	Wood ash	16.50a	11.25a	14.00A
	Mean	13.33a	11.12a	
	SE±	SE_V=1.82	SE_O=1.05	SE_{VO}=2.58

Means followed by different letter (s) are significant at adjusted P value<0.05

Weight of fruits was significantly (P<0.05) influenced by the organic manure sources in the two watermelon varieties (Table 6). Koalack variety did not differ significantly from sugar baby on the weight of fruits produced in both years, approximately 5.00tons per plant. The highest fruit weight was recorded from burnt rice husk (6.47tons), followed by poultry manure (6.32tons) in 2009, while approximately 5.00tons was obtained from all the organic manure sources except the control (4.11tons) in 2010. The highest fruit weight was obtained in koalack under poultry manure (7.48tons) and burnt rice husk (7.28tons) in 2009, while it was sugar baby under swine dung that had the highest (7.25tons) fruit weight, followed by wood ash (6.45tons). Variety x organic manure interaction effect on fruit weight was severely depressed in 2010 where sugar baby was untreated (1.75tons) while, koalack under swine dung produced the least fruit weight (1.88tons) in 2010.

Table 6: Effect of organic manure sources on fruit weight (tons/plant) of two watermelon varieties in 2009 and 2010 dry season plantings

		Varieties		
Year	Treatments	Sugar baby	Koalack	Mean
2009	Organic Manure (Kg)			
	Control (0)	3.08b	2.91b	2.99B
	Poultry manure	5.17a	7.48a	6.32A
	Municipal waste	6.63a	3.56b	5.10A
	Burnt rice husk	5.66a	7.28a	6.47A
	Swine dung	3.75a	3.35b	3.55B
	Wood ash	5.82a	4.45a	5.14A
	Mean	5.02a	4.84a	
	SE±	SE_V=0.88	SE_O=0.51	SE_{VO}=1.24
2010	Control (0)	1.75b	6.48a	4.11A
	Poultry manure	2.95b	6.63a	4.79A
	Municipal waste	2.95b	6.63a	4.79A
	Burnt rice husk	6.00a	3.78a	4.89A
	Swine dung	7.25a	1.88b	4.56A
	Wood ash	6.45a	3.60a	5.03A
	Mean	4.68a	4.56a	
	SE±	SE_V=0.79	SE_O=0.45	SE_{VO}=1.12

Means followed by different letter (s) are significant at adjusted P value<0.05

4. Discussion

The significant performance of treated watermelon in 2009/2010 over the control on the growth and yield parameters definitely agreed with the report of [17] that watermelon responds well to organic manure which may contain essential nutrient elements associated with high photosynthetic activities to have promoted root and vegetative growth [10]. The significant high number of fruits and average fruit weight obtained could also be attributed to the ability of organic manure to promote vigorous growth, increment of meristematic and physiological activities in the plants due to adequate plant nutrient supply coupled with improved soil properties that resulted. The slight increase of 2009 over 2010 in the growth parameters could be due to unfavourable weather condition in 2010. The increase in fruit weight as obtained from the municipal waste was due to its profound effect on the soil fertility as influenced by this waste. This finding is in conformity with results obtained by [2], [5] who reported increase in growth and yield of eggplant treated with organic manure over the control. Long dry spell could lead to low availability of nutrients which might also lead to poor fruit set and formation of smaller fruits [10].

However, the results of this study showed that different types of organic manure increased both vegetative and yield parameters over the control. Burnt rice husk, municipal waste and wood ash produced results that were significantly different over all other treatments. The yield increased with different organic manure applied which suggested that organic manure supplied nutrients that enhanced vigorous growth which are important indices that culminate in increase in the fruit yield. This result agrees with that of [2] who reported significant response in yield to different types of manure rate applications. In terms of fruit weight and number of fruits as observed in 2009 were higher than that of 2010.

5. Conclusion

From the results generally, it is sufficed to suggest that application of different types of organic manure improves watermelon production as good harvests are possible. Increasing yield and production of watermelon can translate to an increase in the standard of living of farmers who engaged in watermelon production because organic manure is cheaper than inorganic fertilizers. Also, there is a global trend towards organic farming with the aim of mitigating global warming and reduction of environmental pollutants.

The use of different organic manure sources in agriculture can harness and render them harmless, as a suitable substitute for inorganic fertilizer thereby helping to achieve environmentally friendly ecosystem.

References

[1] Achigan-Dako, G.E., Fanou, N., Kouke, A., Avohou, H., Vodouhe,S.R. and Ahanchede, A., 2006. *Evaluation agronomique de trios espèces de Egusi (Cucurbittaceae) utilisèes dans l'alimentation au Bènin et élaboration d'un modèle de prédiction du rendement, Biotechnologie Agronomic Société Environment*, vol. 10, pp 121-129.

[2] Aliyu, L., 2000. The effects of organic and mineral fertilizer on the growth, yield and composition of pepper (*Capsicum annum* L). *Biological Agriculture and Horticulture*, 18:29-36.

[3] Beckman, E.O., 1973. Organic fertilization: Vegetable farming luxury or necessity. *Technical communication of ISHA*. pp 29:247

[4] Burkill, H.M., 1985. The useful plants of West Tropical Africa (2nd edition), vol. 1, families A-D, Royal Botanic Garden, Kew, London, UK

[5] Dauda, S.N, Aliyu, L. and Chiezey, U.F., 2005. Effect of seedling age at transplanting and poultry manure on fruit yield and nutrients of garden egg (*Solanum gilo* L.) varieties, *Journal of Tropical Science* 5 (2):38-41.

[6] Huh, Y.C., Solmaz, I. and Sari, N., 2008. Morphological characterization of Korean and Turkish watermelon germplasm, Proceedings of the 9th EUCARPIA meeting on genetics and breeding of Cucurbitaceae In: Pitrat, M. (ed.) INRA, Avignon, France, May 21-24.

[7] IFA (International Fertilizer Industry Association), 1996. 'Plant nutrients for food security', Message from IFA to FAO world food summit, November 1996, 10 pp.

[8] IFA (International Fertilizer Industry Association), 2003. Use of fertilizers in organic farming, IFA position papers, May 2003, 3 pp.

[9] Igwe, C.A., Akamigbo, F.O.R. and Mbagwu, J.S.C., 1995. Physical properties of soils of Southern Nigeria

[10] John, L.W., Jamer, D.B., Samuel, L.T. and Warner, L.W., 2004. Soil fertility and fertilizers: An Introduction to nutrient management, Pearson Education, India, pp 106-153.

[11] Kerenhap, W., Tniagarajan, V. and Kumar, V., 2007. Biochemical and bioassay studies on the influence of different organic manures on the growth of mulberry variety and Silkworm, *Bombyx mori* L., Cospan *J. Env. Sc.* 5, 51-56.

[12] Kutevin, Z. ve Turkes, T., 1987. Sebzecilik. Genel Sebze Tarimi Prensipleri ve Pratik Sebzecilik Yontemleri. İstanbul-Turkey

[13] Locascio, S.J., 1976. Effects of location, cultivar, irrigation and temperature on watersoaking and seed quality in watermelon fruit, Proc. Fla. *Stat. Hort. Soc*. 89:97-100.

[14] Maundu, P., Achigan-Dako, E. And Morimoto, Y., 2009. Biodiversity of African vegetables In: Shackleton, C.M., Pasquini, M.W. and Drescher, A.W. (eds.), African indigenous vegetables in urban agriculture, Earthscan, London, pp 64-104.

[15] Mbagwu, J.S.C. and Piccolo, A., 1990. Carbon, nitrogen and phosphorus concentration in aggregates of organic waste amended soil, *Biol Wastes*. 31 (2) 91-111.

[16] Mbagwu, J.S.C., 1992. Improving the productivity of a degraded Ultisol in Nigeria, using organic and inorganic amendments part ii; Changes in physical properties, *Bio resources Tech*., 42, 167-175.

[17] Messiaen, C-M., 1992. The tropical vegetable garden, Macmillan press ltd, London and Basingstoke in cooperation with CTA, The Netherlands, 514 pp

[18] Mustapha, S., 1992. Keynote address to the 2nd national fertilizer workshop held at Abuja, pp 3-5.

[19] Nnabude, P.C. and Mbagwu, J.S.C. 1999. Soil water relations of a Nigerian typic palustult amended with fresh and burnt rice mill wastes. *Agro-physical*, 14:393-460.

[20] Rahman, S.A., 2004. The place of organic manure in sustaining agricultural development in Nigeria, Paper presented at Science, Technology and Society National Workshop in Lafia Nasarawa State, 11th July 2004.

[21] Schippers, R.R., 2000. African Indigenous vegetables: An overview of the cultivated species, Natural Resources Institute/ ACP-EU Technical Centre for Agricultural and Rural Cooperation, Chatham, UK, 214 pp.

[22] Schippers, R.R., 2004. ´Cucurbitaceae`, in légumes Africains indigènes: présentation des espèces cultivées, Margraf Publishers, CTA, Wuerzburg, pp 113-182.

[23] Van der Vossen, H.A.M., Denton, O.A. and El Tahir, I.M., 2004. *Citrullus lanatus* (Thunb.) Matsum. & Nakai In: Grubben, G.J.H. & Denton, O.A. (eds.) Plant resources of tropical Africa 2, Vegetables. PROTA Foundation, Wageningen, Netherlands/ Backhuys Publishers, Leiden, Netherlands/ CTA, Wageningen, Netherlands. Pp 185-191.