Current Agriculture Updates 9(3) 58-65 (July, 2025)
www.currentagriculture.com

RESEARCH ARTICLE

Postharvest physiology and nutritional qualities of green pepper (*Capsicum annum* l.) fruits to varying doses of manure

I. I. Dominic, N. M. Akpan

Department of Crop Science, Faculty of Agriculture, University of Nigeria, Nsukka, Enugu State Nigeria

Corresponding authors email: akpandueso@gmail.com

Manuscript received: March 10,2025; Decision on manuscript: April 6,2025; Manuscript accepted: April 15, 2025

Abstract

This experiment was conducted to study the response of green pepper fruits to different manure doses (Control (Zero application), 5t/ha of poultry manure (PM), 10t/ha of PM, 300kg/ha of NPK 15:15:15, 5t/ha of PM + 200kg/ha of NPK 15:15:15, 10t/ha of PM + 100kg/ha of NPK 15:15:15). The results showed that there was a significant changes ($p \leq 0.05$) among manure doses on green life as extended green life of 14.0 days was obtained in control plot and the least in 5t/ha of PM and 300 kg/ha of NPK (9.0 days, each). The varying manure doses have been seen positive effect on fruit shelf life. Pepper fruits with longest shelf life of 28.7 and 28.3 days was obtained in 10 t/ha of PM + 100 kg/ha of NPK, and control plot, respectively and the least in 5 t/ha of PM (18.70 days). Varying level of manure application also effected the vitamins, phytochemical and mineral contents of green pepper fruits. It revealed that fruits did not differ significantly, but 10 t/ha of PM + 100 kg/ha of NPK had the highest Vitamin A content while the highest Vitamin B3 and C content was obtained in 5 t/ha of PM + 200 kg/ha of NPK. For phytochemicals, it was observed that 10 t/ha of PM + 100 kg/ha of NPK had the highest alkaloid and flavonoid content while 10 t/ha of PM + 100 kg/ha of NPK had the highest iron, potassium and zinc content.

Keywords: Green pepper, quality, shelf life, manure rate, phytochemical

Introduction

Green peppers (*Capsicum annum* L.) are warm season crops grown mainly for their fruits, contain three to six times as much vitamin C as found in oranges. It is also considered as rich source of vitamin A and C (Bosland and Votava, 2007). It belongs to the family Solanaceae. and requires similar growing conditions as tomatoes and egg plants and performs best in a long, and frost free season. The plants are shrubby perennials, although usually grown as herbaceous annuals in tropic, sub-tropic and temperate regions (Alabi, 2006). Green peppers are eaten raw as salad. Like other vegetable crops, green pepper contributes nutritiously with nutrients that may be lacking in food materials hence improve food intake (Grubben, 1997). It is among the most commonly grown crops throughout Africa because of its utilization in soup, stews and salads (Harlen, 1995; Heiser, 1995).

Pepper, being a very rich source of vitamins A, C, B6, folic acid and beta-carotene, provides excellent nutrition for humans (Nadeem, *et al.*, 2011; Akpan *et al.*, 2024a; Akpan *et al.*, 2024b; Akpan *et al.*, 2025). Antioxidant compounds present in the different colors (green, yellow, orange, and red) in sweet bell peppers give them an antioxidative potential which helps to protect the body from oxidative damage induced by free radicals when consumed (Simmone *et al.*, 1997). This reduces the risk of cardiovascular diseases, asthma, sore throat, headache and diabetes. Pepper is considered as source of revenue for farmers locally and foreign exchange for the country. Based on the enormous important of green pepper, this research was carry out to examine the storage life and nutritional quality of green pepper fruit varied with pre-harvest manure application.

Materials and methods

These experiments were conducted in the teaching and research field and laboratory of Department of Crop Science, University of Nigeria, Nsukka. Nsukka is located at latitude $6^{0}51^{1}$E, and longitude $7^{0}29^{1}$N of 475m above sea level and is characterized by lowland humid condition with bimodal annual rainfall distribution that ranges from 1155mm to 1955mm, a mean annual temperature of 29^{0}C to 31^{0}C and relative humidity that ranges from 69% to 79% (Uguru *et al.*, 2011). Yalo wonder variety of green pepper was used for these experiments and was obtained from a seed store in Jos, plateau state, Nigeria. Physicochemical properties of the poultry manure used, and planting site soil were determined using the method of Association of Official Analytical Chemists (AOAC, 2002). The experiment was carried out to evaluate the effect of poultry manure and inorganic fertilizer on the postharvest physiology and biochemical conditions of green pepper fruits. The treatments were six manure doses control (zero application), 5t/ha of poultry manure (PM), 10t/ha of PM, 300kg/ha of NPK 15:15:15, 5t/ha of PM + 200kg/ha of NPK 15:15:15, 10t/ha of PM + 100kg/ha of NPK 15:15:15). The experiment was laid out in randomized complete block design (RCBD) with three replications. Green pepper seeds were raised in the nursery medium that was prepared at the ratio of 3:2:1 of top soil, poultry manure and river sand respectively. The nursery was covered with white net to prevent the seedlings from insect attack and also shaded to protect the seedlings from harsh weather condition. Healthy seedlings were transplanted from the nursery to the prepared field with a planting distance of 50 cm x 50 cm within and between rows. Matured fruits were harvested from each plot, labelled according to treatment and stored at room temperature of 300C and relative humidity of 58% to observed their green life, shelf life, shriveling, days to onset of ripening, 50% ripening, 100% ripening, days to onset of rot, 50% rot, 100% rot. Weight loss was also observed at 3 days interval until the whole fruits were rot also fresh fruits were taken to the laboratory for the determination of vitamins (A, C and B3), while air dried fruits were also used for the determination of alkaloids, flavonoids and minerals using the method of Association of Official Analytical Chemists (AOAC, 2002). Data collected was subjected to analysis of variance (ANOVA) procedures using Genstat Release 10.3DE Discovery Edition 4 (GenStat, 2010) and GGE biplot software.

Results and discussion

The result of physical and chemical properties of the soil and poultry manure used presented in Table 1 indicated that the soil of the study area before the application of poultry manure (PM) was acidic (pH 4.8 and 4.4 in water and potassium chloride, respectively), and that of poultry manure was slightly above neutral (pH 7.8 and 7.6 in water and potassium chloride, respectively).

Table 1: Physical and chemical characteristics of the soil and poultry manure used in the experiment

Physio-chemical properties	Soil	Poultry manure
Clay	18	_
Silt	5	_
Fine sand	36	_
Coarse sand	41	_
textured class	Sandy loam	
Soil pH (in H_2O)	4.8	7.8
Soil pH (in KCL)	4.4	7.6
Total carbon %	1.48	26.53
Total organic matter %	2.55	45.74
Total nitrogen %	0.14	1.541
Exchangeable Sodium (meq/100g 0f soil)	0.04	0.02
Exchangeable Potassium (meq/100g 0f soil)	0.11	0.09
Exchangeable calcium (meq/100g of soil)	2.2	14.4
Exchangeable magnesium (meq/100g of soil)	2.2	47.2
Exchangeable Aluminum (meq/100g of soil)	_	_
Exchangeable Hydrogen (meq/100g of soil)	1.6	_
Cation exchangeable capacity (meq/100g of soil)	9.6	_
Base saturation %	47.4	_
Available Phosphorus (ppm)	30.76	1.06

The soil textural class was a sandy loam, which contained 18% clay, 5 % silt, 36 % fine sand, 41 % coarse sand. Total organic matter and total nitrogen contents were found to be 2.55% and 0.14% for soil while those of PM where 45.74 % and 1.54 %, respectively. The exchangeable bases [sodium (Na), potassium (K), calcium (Ca), and magnesium (Mg)] were 0.04 meq/100g, 0.11 meq/100 g, 2.20 meq/100g and 2.20 meq/100g respectively for the soil sample. Also those of PM were 0.02 meq/100g, 0.09 meq/100g, 14.40 meq/100g, and 47.20 meq/100g, respectively]. Available soil phosphorus was 30.76 while that of PM was 1.06 parts per million (PPM). Table 2 showed that there was significant difference on postharvest physiology of green pepper among manure doses as it influenced the green life and shelf life of green pepper fruits. The longest green life of 14.0 days was observed in control treatment, followed by the treatment having application of 10 t/ha of PM and 10 t/ha of PM + 100 kg/ha of NPK (13.0 days each) while the least was obtained in both 5 t/ha of PM and 300 kg/ha of NPK (9.0 days each). The longest shelf life of 28.7 days was obtained in 5 t/ha PM + 200 kg/ha of NPK followed by control (28.3 days) while the shortest shelf life (18.7 days) was obtained in fruits grown with 5 t/ha PM

Table 2: Post harvest physiology of green pepper as influenced by manure doses

Manure/fertilizer						**Weight loss, days in storage (%)**			
rate (kg/ha)	Green life	Shelf life	Rot-ripening	Initial fresh weight	9	17	26	35	44
Control	14.0	28.3	14.3	80.0	26.9	41.2	61.4	75.2	86.5
5t/ha	9.0	18.7	9.7	84.9	26.4	51.6	76.3	94.1	100.0
10t/ha	13.0	22.0	9.0	97.3	24.1	46.3	66.4	80.2	94.4
300kg NPK	9.0	23.7	14.7	67.7	26.1	47.2	73.2	89.4	95.1
5t/ha+200 NPK	11.0	28.7	17.7	89.6	23.6	41.2	67.8	84.0	94.3
10t/ha+100 NPK	13.0	28.7	15.7	106.6	24.0	42.6	60.8	78.0	95.5
$LSD_{(0.05)}$	3.3	5.7	5.5	ns	ns	ns	ns	12.4	ns

Green life is a period of time which is from harvesting to the starting of fruit ripening. Green life of green pepper showed a significant difference among fertilizer rate; 10 t/ha of PM + 100 kg/ha of NPK and control plot were found to have the longest green life indicating that planting green pepper with the above mentioned fertilizer doses will make its fruits to remain green for a longer period. Shelf life is a period of time which starts from harvesting and extend up to the starting of rotting of fruits. The shelf life of green pepper was as well influenced significantly by fertilizer application as 5 t/ha of PM and 300 kg/ha of NPK had the shortest time in storage to start rotting. This could be attributed to high nitrogen level in the soil which encouraged plants to produce fruits with soft tissues which probably made them rot faster and then reducing the shelf life of their fruits. Similar findings have been reported by (Osei, 2013) that application of 9 g of NPK +10 g of Ammonium sulphate (A/S) per plant had the shortest shelf life in green pepper when compared to 9 g of NPK + 0g A/S. Weight loss of green pepper fruit was significantly influence by fertilizer doses at 35 days in storage and it was the application of 5t/ha of PM that had the highest percentage weight loss in storage when compared to other fertilizer doses. This could be attributed to high content of water in fruits harvested from plot treated with 5t/ha of PM. Weight loss in fruits may be caused by the loss of water in fruits through transpiration. Water loss is the principal cause of softening and shriveling (Wilson et al., 1991). Table 3 revealed that the vitamins content of green pepper fruits were not influenced significantly by diverse manure doses. Application of 10 t/ha of PM + 100 kg/ha of NPK had the highest vitamin A concentration of 102.8 iu while the least was obtained in 5 t/ha of PM (72.2 iu). For vitamin B3, application of 5 t/ha of PM +200 kg/ha of NK gave the highest vitamin B3 concentration of 6.5 mg/100g while the least was found in 300 kg/ha of NPK (4.5 mg/100g). Application of 5 t/ha of PM and 5 t/ha of PM + 200 kg/ha of NPK had the highest vitamin C concentration of 12.1 g/100g each and the least was obtained in control (9.8 g/100g). Effect of fertilizer application on vitamins content of green pepper revealed that Vitamins content of green pepper fruits did not differ significantly due to varying level of fertilizer application, but 10 t/ha of PM + 100 kg/ha of NPK had the highest Vitamin A content but highest Vitamin B3 and C content was obtained in 5 t/ha of PM + 200 kg/ha of NPK. This result is in line with (Abd El-Hakeen, 2003) who reported that vitamin content of green pepper is mainly affected by variety, ripening stage and less affected by fertilizer application.

Similarly, Altintas and Acikgoz (2012) also observed that the application of organic and mineral fertilizer showed no significant difference in ascorbic acid content of green pepper fruits but application of mineral fertilizer was a little higher than that of organic fertilizer in ascorbic acid content of green pepper. Hence the cited research is in agreement of the present findings. Table 4 showed the effect of manure doses on phytochemical and mineral content of green pepper fruit. The result revealed that there was significant difference in phytochemical and mineral contents across the manure doses. Application of 10 t/ha of PM +100 kg/ha of NPK had the highest alkaloid and flavonoids contents of 1.8 and 28.7 %, respectively, the least alkaloid content was obtained in 10 t/ha of PM (1.0 %) and flavonoids in control (26.7 %). Iron was highest in 5 t/ha of PM and 5 t/ha of PM + 200 kg of NPK (0.99 mg/100g each) while the least was obtained in 300 kg/ha of NPK (0.29 mg/100g). Application of 10 t/ha of PM had the highest magnesium content of 6.99 % and the least was obtained in 5 t/ha of PM (2.86 %).

For potassium and zinc, 5 t/ha of PM + 200 kg of NPK had the highest contents of 57.1 and 17.20 mg/100g, respectively. The least potassium content was obtained in 10 t/ha of PM + 100 kg of NPK (30.90 mg/100g) while the least zinc contents was observed in control (9.10 mg/100g). The biochemical quality of green pepper fruit harvested was also analyzed using GGE biplot. The result presented in Figure 1 revealed that 5t/ha of PM + 200kg/ha of NPK had the highest concentration of Vitamin B3, Zinc and Iron while Vitamin A, Magnesium and Alkaloid concentration was influenced more by 10t/ha of PM + 100kg/ha of NPK. However, Vitamin C was highest in 5t/ha of PM while 300kg/ha of NPK had the highest Flavonoid concentration. Effect of manure doses on phytochemical and mineral content in green pepper fruits showed that alkaloid and flavonoid content of green pepper fruits were not significantly influenced by fertilizer doses but it was observed that 10 t/ha of PM + 100 kg/ha of NPK had the highest alkaloid and flavonoid content. This result is agreement with the findings of (Abd El-Hakeen, 2003; Materska and Perucka, 2005) who reported that flavonoid content of green pepper is more affected by variety and maturity stage. The mineral content of green pepper was not significantly difference among the manure rate but highest iron, potassium and zinc content was obtained in green pepper fruits treated with 10 t/ha of PM + 100 kg/ha of NPK while the highest magnesium content was obtained in 10 t/ha of PM.

This result is in line with the findings of (Altintas and Acikgoz, 2012) who observed that the application of organic and mineral manure showed no significant difference in mineral content of green pepper fruits but those treated with mineral fertilizer gave highest values. Flores *et al.,* (2009) and Chassy *et al.,* (2006) reported that pepper seem to differs from other vegetables for its response to mineral fertilizer as they observed a non-significant difference in green pepper as influenced by fertilizer doses. The green pepper fruits postharvest handling and nutritional quality revealed that manure application significantly influenced postharvest physiology such as green life and shelf life but vitamins, phytochemicals and minerals content of green pepper fruits did not significantly influenced by manure application indicating that planting pepper without manure application gave extended green life and shelf life of green pepper fruits

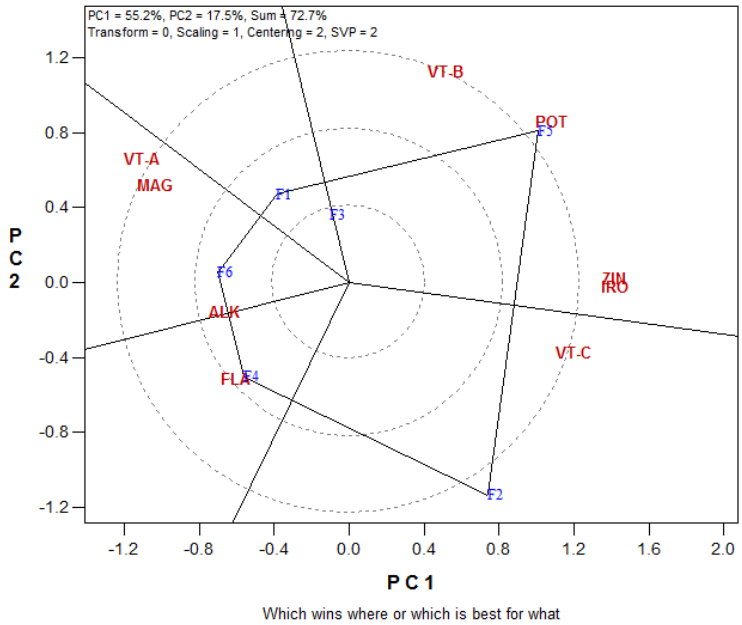
Table 3: Effect of manure doses on vitamins content in green pepper

Manure/fertilizer rate (kg/ha)	Vitamin A (iu)	Vitamin B_3 (mg/100g)	Vitamin C (g/100g)
control	94.4	5.5	9.8
5t/ha	72.2	5.0	12.1
10t/ha	91.7	6.0	11.4
300kg NPK	91.7	4.5	11.1
5t/ha+200 NPK	83.3	6.5	12.1
10t/ha+100 NPK	102.8	6.0	10.8
LSD (0.05)	ns	ns	ns

Table 4: Effect of manure doses on phytochemical and minerals content in green pepper

Manure/fertilizer	Alkaloids	Flavonoids	Iron	Magnesium	Potassium	Zinc
Rate (kg/ha)	(%)	(%)	(mg/100g)	(%)	(mg/100g)	(mg/100g)
control	1.17	26.7	0.52	5.81	35.7	9.1
5t/ha	1.13	27.6	0.99	2.86	33.3	15.2
10t/ha	1.00	27.7	0.58	6.99	35.7	12.1
300kg NPK	1.67	27.4	0.29	6.31	33.3	10.1
5t/ha+200 NPK	1.30	26.6	0.99	3.94	57.1	17.2
10t/ha+100 NPK	1.83	28.7	0.46	5.81	30.9	10.1
LSD(0.05)	ns	ns	ns	ns	ns	ns

Fig. 1: GGE Biplot analysis of fertilizer by fruit nutrient analysisof green pepper



F1: control (PM); F2: 5 t/ha PM; F3: 10 t/ha PM; F4: 300kg/ha of NPK; F5: 5t/ha PM + 200kg/ha of NPK; F6: 10t/ha PM + 100kg/ha of NPK. Alkaloids =ALK; Flavonoids=FLA; Iron= IRO; Magnesium= MAG; Potassium= POT; Zinc = ZIN; Vitamin A= VT-A; Vitamin B=VT-B; Vitamin C= VT-C

References

1. Abd EL-Hakeen, S. H. 2003. Response of Sweet Pepper Crop to Organic and Biofertilizer
2. Akpan, N. M. and Dominic, I.I. 2024a.Gene action and pattern of inheritance for quantitative characters of peppers (*Capsicum spp*). J. Genet. Genom. Plant Breed., 8(4) 110-117.
3. Akpan, N. M., Bassey, E. E., Harry, G.I., Dominic, I.I. 2025. Heterosis and combining ability in full diallel crosses for yield and yield component traits in pepper (*Capsicum spp.*). J. Genet. Genom. Plant Breed., 9 (3):64-73.
4. Akpan, N. M., Bassey, E.E., Harry, G.I., Dominic, I.I. 2024b. Study on genetic variability, heritability and genetic advance among genotypes of pepper in Uyo Nigeria. J. Genet. Genom. Plant Breed., 8(2): 50-60.
5. Alabi, D. A. 2006. Effect of fertilizer phosphorus and poultry droppings treatments on growth and nutrient components of pepper (*Capsicum annum* L.). African J. Biotechn., 5(8):671-677.
6. Altintas, S and Acikgoz, F. E. 2012. The effect of mineral and liquid organic fertilizers on some nutritional characteristics of bell pepper. African J. Biotechn., 11(23):6470-6475.
7. AOAC. 2002. Association of Official Analytical Chemist. Official Method of Analysis of AOAC International. 18th Edition.
   Application. M.Sc. Thesis Department of Horticulture, Faculty of Agriculture, Moshtohor, Zagazig University (Benha Branch).
8. Bosland, P. W and Votava, E. J. 2007. Peppers: Vegetable and spice Capsicum. CABI Nth America, Cambridge, MA. Chassy, A. W., Bui, L., Renaud, E. N. C., Van Horn, M and Mitchell, A. E. 2006. Three-year comparison of the content of antioxidant micro-constitutents and several quality characteristics in organic conventionally managed tomatoes and bell peppers. J. Agric. Food Chem. 54(21):8244-8552.
9. Flores, P., Hellin, P and Fenoll, J. 2009. Effect of manure and mineral fertilization on pepper nutritional quality. J. Sci. Food and Agric. 89(9):1581-1586.
10. GenStat. 2010. GenStat Release 10.3DE (PC/Windows 7) 23 August 2012 09:45:52 Copyright 2011. VSN International Ltd. (Rothamsted Experimental Station).
11. Grubben, G. J. 1997. Tropical vegetables and their genetic resources. IPRGR, Rome, Italy. Pp 197.
12. Harlen, J. R. 1995. Crops and man (2nd ed.). American society of agronomy and crop science of America Madison Wisconsin USA.
13. Heiser, C. B. 1995. Peppers. In: Smart, J and Simmonds, N.W. (eds.). Evaluation of crop plants (2nd ed). Longman Scientific and Technical, Harlow, UK. Pp 449-451.
14. Materska, M and Pereka, I. 2005. Antioxidant activity of the main phenolic compounds isolated from hot pepper fruits (*Capsicum annum* L.). J. Agric. Food Chem., 53(5):1750-1756.
15. Nadeem, M., Muhammad, F., Anjum, S., Khan, A., Saed, M. and Riaz, A. 2011. Antioxidant Potential of Bell Pepper (*Capsicum annum* L.). Pakistan J. Food Sci., 21(14): 45-51.
16. Osei, R. 2013. Effect of age of transplanting, spacing, supplementary application of sulphate of ammonia and harvesting intervals on growth, yield and some postharvest quality of chilli pepper (*C. annum*) Var. Legon 18. M.sc Thesis. School of Research and Graduate Studies, Kwame Nkrumah University of Science and Technology, Kuumsi, Ghana.
17. Simmone, A., Simmone, E., Eitenmiller, R., Mill, H.and Green, N. 1997. Ascorbic acid and provitaminA content in some

unusually coloured bell peppers. J. Food Composition Analysis, 10, 299-311.

18. Uguru, M. I., Bayeri, K. P and Abba, S. C. 2011. Indicator of climate change in the derived Savannah Niche on Nsukka, South-Eastern Nigeria. Agric. Sci. J. Tropical Agril., Food, Environ. Extension 10(1):1-10.
19. Wilson, L. G., Boyette, M. D and Estes, E. A. 1991. Postharvest handling and cooling of fresh fruit vegetables and cut flowers for small farms. North Carolina State University, Horticulture leaflets.