sciendo DOI: 10.2478/ats-2024-0013 AGRICULTURA TROPICA ET SUBTROPICA, 57 OV, 125–136, 2024

Original Research Article

Effects of variety and organomineral fertiliser rate on cucumber yield and nutritional content in early and late seasons

Asimiu Olusegun **Kasali**[1], Eyitayo Adekunle **Makinde**[2], Olamide Oluwatosin **Falaiye**[1], Kafilat Abiodun **Odesola**[3]

[1]*Centre for Excellence in Agricultural Development and Sustainable Environment, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria*

[2]*Department of Horticulture, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria*

[3]*Department of Biological Sciences, Bells University of Technology, Ota, Ogun State, Nigeria*

Correspondence to:
A.O. Kasali, Centre for Excellence in Agricultural Development and Sustainable Environment, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria, e-mail: olusegunkasali@gmail.com

Abstract

Amalgamation of inorganic and organic fertilisers can enhance the effectiveness of fertiliser application. Field experiments were conducted at the Federal University of Agriculture's Teaching and Research Farm in Abeokuta, Nigeria (lat. 7°15′N and long. 3°25′E), to evaluate the impact of cucumber variety and rate of organomineral fertiliser on yield and nutritional value of three varieties of cucumber during the early and late growing seasons of 2019. Three replicates of a randomised complete block design were used in a split-plot layout used for the trial. Poinsett, Greengo, and Monalisa varieties were the main plot, while the subplots were organomineral fertiliser (OMF) rates of 0, 2.5, and 5.0 tons.ha^{-1}. Growth, fruit yield, and fruit proximate composition data were gathered and subjected to analysis of variance. More fruits/plant were produced by the Greengo variety than the Poinsett or Monalisa varieties. In the late season, fruits from the Poinsett variety had higher moisture content than those from the Monalisa variety. OMF rate of 5.0 tons.ha^{-1} produced highest fruit yield, followed by 2.5 tons.ha^{-1} OMF treatment whereas plots with no OMF produced the least fruit yield. Fruits from application of 5.0 tons.ha^{-1} OMF had higher ash content than from 2.5 tons.ha^{-1} OMF. Fruits from 2.5 tons.ha^{-1} OMF in the late season had higher content of crude protein than the 5.0 tons.ha^{-1} OMF in the early season of 2019. Fruits from unfertilised plots had the lowest ash, crude protein, and moisture content in both seasons. The results of the study show that the Poinsett variety with application of 5.0 tons.ha^{-1} can be commercially cultivated for high cucumber yield and nutritional value.

Keywords: Ash content; carbohydrate; crude fibre; crude protein; *Cucumis sativus*; moisture content; varieties

INTRODUCTION

Cucumber (*Cucumis sativus* L.) is an important crop in the Cucurbitaceae family (Efediyi and Remison, 2010; Mallick, 2022). Ranking fourth in importance among vegetables, it comes after tomato, cabbage, and onion. Cucumber is cultivated for its edible fruits which are eaten while still immature, either fresh or cooked. It supplies the human body with anti-oxidants, minerals, and vitamins (Ahmed et al., 2016; Iowa State University, 2020; Mallick 2022).

Food security is an important issue in developing countries due to unreliable rainfall, low input levels, and marginal soil fertility, which cause declining crop yields (Akinrinde, 2006). Major factors that limit tropical soil fertility and sustainable agriculture are moisture stress, low nutrient capital, erosion, high P fixation, low soil biodiversity, and high acidity with aluminum toxicity (Akinrinde et al., 2005).

Most of the essential nutrients for plants, especially potassium (K) and phosphorus (P) occur in complex forms in the soil. Substantial proportions may be transformed into fixed state, making them relatively unavailable for plants to absorb. Monitoring of both soil and crop nutrient status has been advocated among best management practices for fertilisers. Application of fertilisers is important to crops, especially cucumber (Ahmed et al., 2016; Tarantino et al., 2023). Fertilisers promote growth and are usually applied via the soil for uptake by plant roots. For absorption through leaves, they can also be administered by foliar application. Tejada et al. (2005) in the study of application of two organomineral fertilisers (OMF) on nutrient leaching losses in wheat concluded that OMF application gave a 2.9% increase in grain gross protein content. Both the number of grains per spike and the number of spikes per square metre increased by 22% and 3.4%, respectively, and the 1000 grain weight increased by 3.9%, with a significant yield increase of 2.5% as compared to the unfertilised treatment.

Considering the awareness of crops growing environment in recent years, coupled with inadequacy of raw materials for the production of mineral fertilisers, increased recycling of agricultural residues and urban industrial wastes to control pollution of the environment and create alternative products for agricultural uses, such as organomineral fertilisers/bio-fertiliser (Tarantino et al., 2023) is a worthy venture. Most of the OMF produced have not been fully tested on common vegetable fruit crops. Considering the production and the nutritional value of cucumber, it is essential to investigate the performance of some common varieties with the OMF. This study was therefore conducted to assess the growth, yield, and nutritional contents of three cucumber varieties with Alesinloye Organomineral fertiliser. The objectives of the study were to determine the rate for optimum yield and nutritional contents of the three cucumber varieties as well as to identify the variety with the best performance.

The hypothesis was that cucumber yield and nutritional contents are not affected by either the cultivar or the rate of fertiliser and season of application.

MATERIALS AND METHODS

The experiment was conducted at the Federal University of Agriculture, Abeokuta, in the forest-savanna transition agro-ecological zone (latitude 7°15′N and longitude 3°25′E; altitude 144 m above the sea level). Abeokuta has a bimodal rainfall distribution pattern. June/July is the first mode; August is a pause, and September sees the return of the rains. Annual rainfall ranges from 1145 to 1270 mm. The experiment was conducted in the early and late seasons of 2019. The agro-meteorological data of rainfall distribution, total rainfall, and temperature patterns were collected from the agro-meteorological station of the Federal University of Agriculture, Abeokuta (FUNAAB).

Soil Analysis

The soil was analysed to determine its pre-cropping chemical and physical properties. The soil at the experimental site was ferruginous. According to the USDA classification system, the soil was an Oxic paleudolf (USDA, 2014) of the Iwo series. Random soil samples were taken at different locations and bulked to obtain a composite sample that was analysed. Soil pH was obtained using pH in soil–water suspension 1:5 with a pH meter (Thomas, 1996); Organic carbon was by Walkley-Black procedure using dichromate as an oxidising agent as described in Nelson and Sommers (1996); percentage organic matter was estimated by multiplying percentage organic carbon by Broadbent's factor of 1.72 (Broadbent, 1953). Total nitrogen was determined by the amended Kjeldahl digestion method (Bremner, 1996). Available phosphorus was by Bray's P1 test, using 0.03 NH_4F in 0.02N HCl as an extractant and measuring the extracted phosphorus colorimetrically at 660 nm by molybdenum blue method (Bray and Kurtz, 1945). Exchangeable bases were determined with normal ammonium acetate buffer at pH 7. Sodium and potassium in the extracts were determined by flame photometry while calcium and magnesium were determined by atomic adsorption spectrophotometry. Exchangeable acidity was determined by titration of 1M KCL extraction against 0.05M NaOH to the pink endpoint using phenolphthalein as an indicator (Mclean, 1982). Soil particle size distribution was determined with a hydrometer (Bouyoucos, 1951), using sodium hexametaphosphate as a dispersing agent.

Land preparation and planting

Ploughing was done twice and harrowing once for both the early and late seasons of 2019. Seeds were planted on the flat.

Design of Experiments

The experiment was laid out in a randomised complete block design (RCBD). It was a split-plot factorial arrangement with three replications. Plot size was 3×3 m with 75×25 cm spacing.

Treatments

Organic fertiliser rate of 10 $t.ha^{-1}$ of untreated, plain manure has been recommended for cucumber (Emma-Okafor et al., 2022). The Alesinloye organomineral fertiliser was, however, a commercial fertiliser of cured cow dung from an abattoir fortified with 10% inorganic NPK. It was therefore applied at reduced rates due to the fortification.

Experimental treatments consisted of three cucumber varieties (Monalisa, Poinsett, and Greengo) as the main plot; sub-plots were the rate of the organomineral fertiliser (OMF) of 0, 2.5, and 5 $tons.ha^{-1}$.

Source of Seeds

Seeds were obtained from a seed marketer in Abeokuta.

Planting

Planting was done on 24th of June 2019 and 1st of September 2019.

Cucumber varieties

The three cultivars of cucumber used were:

1. Monalisa F1 hybrid cucumber seeds are produced by the East West Seeds brand. It is monoecious, deep green, uniform, and cylindrical. The seeds are tolerant to some pests and diseases and are high-yielding. It is hardy and resistant to diseases like cucumber mosaic virus disease and powdery mildew disease.
2. Poinsett is an open-pollinated monoecious plant. The plants grow dark green, white-spined, and straight cucumbers. They are disease-tolerant.
3. Greengo F1 hybrid cucumber seeds are produced by the East West Seeds brand. It is gynoecious, and it matures within 40–45 days. It has a very high yield compared to the open-pollinated varieties and other hybrid cucumber varieties. Fruits produced by the seeds are deep green. The variety is resistant to cucumber powdery mildew disease and mosaic virus disease.

Culture practices

A routine analysis of the chemical and physical properties was conducted on soil samples collected from the experimental site, reaching depths of 20 cm. Two weeks after seeding (WAS), seedlings were thinned down to one plant per stand. At the same time, non-germinating seeds were supplied. Two weeks after planting (WAP), the organomineral fertiliser was applied using the side placement technique. At three and five weeks following planting, hand weeding was carried out with a hoe.

Weather conditions

Total rainfall was 373.2 mm between June and July, during the early season, but 406.3 mm during the late season between September and October (Figure 1).

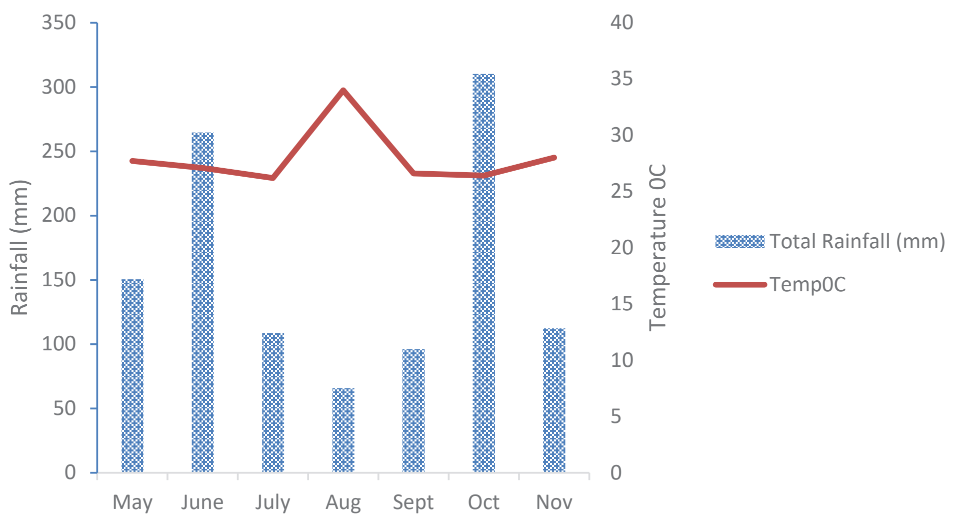

Figure 1. Rainfall and temperature observations during the experimental period.
Source: Department of Agro-meteorological and Water Management, Federal University of Agriculture, Abeokuta.

Average monthly temperature was 27.1 °C in June but 26.2 °C in July. Mean monthly relative humidity was 83.1% in June and 87.4% in July (Figure 1).

Pre-cropping soil condition

Pre-cropping soil analysis had 0.92% organic matter content, 1.78 $g.kg^{-1}$ Total N. Available P was 18.64 $mg.kg^{-1}$ and 0.29 $mg.kg^{-1}$exchangeable potassium. The soil had 74.5% sand, and 23.7% silt, 1.8% clay. It had a C/N ratio of: 1:1.3. It was loamy sand (Table 1).

Organomineral fertiliser (OMF)

OMF was obtained from Alesinloye Fertiliser Company, Ibadan, Oyo State, Nigeria. It had a pH 7.4 and 50.30 $mg.kg^{-1}$ organic matter (Table 1). Nitrogen content was 950 $mg.kg^{-1}$, available phosphorus was 4.87 $mg.kg^{-1}$, potassium content was 3565.9 $mg.kg^{-1}$, magnesium was 740.4 $mg.kg^{-1}$, and calcium was 1036 $mg.kg^{-1}$ (Table 1).

Proximate composition

The AOAC (2010) procedures were followed to analyse the proximate constituents of the cucumber fruits.

Data and statistical analysis

The acquired data were subjected to an analysis of variance using Genstat 12th Edition. At the 5% probability level, significant means were distinguished using the Least Significant Difference (LSD) for the main factors and the Duncan Multiple Range Test was used for the interactions.

RESULTS

Fruit yield

Cucumber yield was only significantly affected by sole factors of cucumber variety and the rate of OMF used in both the early and late seasons but not by their interaction (Table 2). The Greengo variety produced the highest fruit yield in the early planting season. Cucumbers fertilised with 5.0 $tons.ha^{-1}$ OMF in the early growing season produced higher fruit yield than those with 2.5 $tons.ha^{-1}$ rate or the unfertilised treatment. In the late growing season, application of 5.0 $tons.ha^{-1}$ OMF did not increase fruit yield compared to 2.5 $tons.ha^{-1}$ OMF application. Fruits from unfertilised plots had the least fruit yield (Table 2).

The number of fruits per plot

The number of cucumber fruits was significantly affected by variety and OMF rate in both seasons (Table 2). Across both seasons, the Greengo variety produced more fruits than those of the Poinsett or Monalisa varieties. Application of 5.0 $tons.ha^{-1}$ OMF produced the highest number of fruits while the unfertilised plot had the lowest (Table 2).

Table 1. Pre-cropping soil and organomineral fertiliser (OMF) analysis

Parameter	Soil	OMF
pH(H_20)	6.2	7.4
Organic matter (%)	0.92	5.03
N ($g.kg^{-1}$)	1.78	9.50
P ($mg.kg^{-1}$)	18.64	4.87
K ($mg.kg^{-1}$)	0.29	3565.92
Na ($mg.kg^{-1}$)	0.245	36.80
Ca ($mg.kg^{-1}$)	0.20	1036.00
Mg ($mg.kg^{-1}$)	0.26	740.40
Mn($mg.kg^{-1}$)	ND	3.14
Zn ($mg.kg^{-1}$)	ND	1.86
Fe ($mg.kg^{-1}$)	ND	4.15
Cu ($mg.kg^{-1}$)	ND	2.89
Sand (%)	74.5	––
Silt (%)	23.7	––
Clay (%)	1.8	––
Textural Class	Loamy sand	––
C/N	1:1.3	––

ND – Not Determined

Table 2. Effect of variety and rate of organomineral fertiliser on number of fruits/plot, fruit length, fruit girth, and fruit yield of cucumber in early and late seasons of 2019

	No. of Fruits/plot	Fruit Length (cm)	Fruit girth (cm)	Fruit yield (t.ha^{-1})
EARLY SEASON				
Variety (V)				
Poinsett	30.67	16.83	4.98	6.78
Greengo	32.78	11.98	3.40	8.56
Monalisa	30.89	14.53	4.28	6.71
LSD ($p < 0.05$)	0.69*	NS	NS	1.39*
OMF (R)				
0 t ha^{-1}	26.11	13.19	3.88	3.83
2.5 t ha^{-1}	32.22	15.83	6.68	7.93
5.0 t ha^{-1}	36.00	14.33	4.10	10.30
LSD ($p < 0.05$)	1.27*	NS	NS	1.19*
V × R	NS	NS	NS	NS
LATE SEASON				
Variety (V)				
Poinsett	23.78	14.81	5.14	3.94
Greengo	28.00	15.95	4.90	10.35
Monalisa	26.11	17.67	4.82	9.56
LSD ($p < 0.05$)	1.33*	NS	NS	2.61*
OMF (R)				
0 t.ha^{-1}	16.67	11.39	4.13	2.38
2.5 t.ha^{-1}	29.00	17.34	5.25	9.91
5.0 t.ha^{-1}	32.33	19.71	5.47	11.57
LSD ($p < 0.05$)	1.54*	1.35*	0.27*	4.22*
V × R	NS	NS	NS	NS

NS – non-significant; *– significant at 5 % probability; **– significant at 1 % probability; OMF – Organo-mineral fertiliser

Fruit length

Cucumber fruit length was only significantly affected by OMF rate in the late season of 2019 (Table 2). Application of 5.0 tons.ha^{-1} OMF resulted in longer cucumber fruits than 2.5 tons.ha^{-1}in the late growing season while fruits from unfertilised plots had the least length (Table 2).

Fruit girth

Cucumber fruit girth was significantly affected by OMF rate only in the late season (Table 2). Application of 5.0 tons.ha^{-1} OMF did not produce significantly thicker fruits than 2.5 tons.ha^{-1} but significantly thicker than fruits from plots not fertilised, which had the thinnest fruits (Table 2).

Proximate contents

The proximate contents of cucumber fruits were significantly affected by both main factors of cucumber variety and OMF rate (Tables 3 and 4). They were also affected by the interaction of cucumber variety and the rate of OMF, except for carbohydrate content in the late season. In the early season, variety was not significant but fertiliser rate (Table 5).

Moisture content

Both the cucumber variety and rate of OMF as the sole factors (Table 3) and in interaction had significant effects on the moisture content of cucumber fruits in both seasons (Table 6). Moisture contents were generally lowest with the three varieties from unfertilised fruits. In the early season, the Monalisa variety fertilised with 2.5 tons.ha^{-1} OMF had the highest cucumber moisture content which was only comparable with the Greengo variety fertilised with 2.5 tons.ha^{-1} OMF. Fertilisation with 5.0 tons.ha^{-1} OMF generally had lower contents relative to 2.5 tons.ha^{-1} OMF treatment. In the late season, moisture contents were generally lower, relative to the early season, with the highest moisture content in the Greengo variety fertilised with 5.0 tons.ha^{-1} OMF (Table 6).

Fat content

The variety and OMF rate are the sole factors that significantly affect fat content in cucumber fruits in

Table 3. Effect of variety and rate of organomineral fertiliser on moisture, fat, Ash and crude fibre content (g/100 g) in cucumber in early and late seasons

	Moisture content	Fat	Ash	Crude fibre
EARLY SEASON				
Variety (V)				
Poinsett	97.05	0.15	0.25	0.35
Greengo	97.12	0.13	0.23	0.32
Monalisa	97.17	0.14	0.24	0.33
LSD ($p < 0.05$)	NS	0.01*	0.01*	0.01*
OMF (R)				
0 t ha^{-1}	96.93	0.13	0.22	0.30
2.5 t ha^{-1}	97.38	0.14	0.25	0.35
5.0 t ha^{-1}	97.03	0.15	0.26	0.36
LSD ($p < 0.05$)	0.07**	0.005*	0.01*	0.01*
V × R	0.12**	0.01*	0.01*	0.01*
LATE SEASON				
Variety (V)				
Poinsett	96.72	0.17	0.26	0.38
Greengo	96.80	0.15	0.25	0.35
Monalisa	96.78	0.15	0.26	0.36
LSD ($p < 0.05$)	0.02*	0.002*	NS	0.004*
OMF (R)				
0 t.ha^{-1}	97.00	0.13	0.22	0.32
2.5 t.ha^{-1}	97.02	0.17	0.26	0.38
5.0 t.ha^{-1}	96.84	0.17	0.29	0.38
LSD ($p < 0.05$)	0.02*	0.002*	0.02*	0.002*
V × R	0.04*	0.004*	0.03*	0.005*

NS – non–significant; *– significant at 5 % probability; **– significant at 1 % probability; OMF – Organo–mineral fertiliser.

both seasons (Table 3) and interaction (Table 6). In the early season, fruits from the unfertilised Monalisa variety had the highest fat content whereas fruits from the Greengo and Monalisa varieties fertilised with 5.0 tons.ha^{-1} OMF had the lowest contents. In the late season, unfertilised Greengo fruits had the highest fat content. The fat content of the unfertilised Poinsett was similar to the highest fat content of the Greengo variety and also to the unfertilised Monalisa variety (Table 6).

Ash content

The ash content was significantly affected by both sole factors of variety and organomineral fertiliser rate (Table 3) and also by the interaction of the rate of OMF on cucumber in the early and late seasons (Table 6). In the early season, the Monalisa fruits from 5.0 tons.ha^{-1} OMF application had the highest ash content whereas the unfertilised Greengo and Monalisa fruits had the lowest fat contents. Fruits from plots with no fertiliser generally had the least fat content in both early and late seasons. In the late season, the Greengo variety fertilised with 2.5 tons.ha^{-1} OMF had the highest ash content (Table 6).

Crude fibre content

The crude fibre content of cucumbers was significantly affected by both sole factors of variety and organomineral fertiliser rate (Table 3) and also by the interaction of cucumber variety and OMF rate in both seasons (Table 5). Fruits from unfertilised plots generally had higher crude fibre in both early and late seasons than fruits from fertilised plots. Without fertiliser in the early season, the Monalisa variety had the highest fat content but the Greengo variety in the late season. In the late season, fruits from the Poinsett variety had higher crude fibre contents than those from Monalisa (Table 7).

Crude protein content

The crude protein (CP) content of cucumbers was significantly affected by both sole factors of variety and organomineral fertiliser rate (Table 4) as well as the interaction of the variety and OMF rate (Table 7). In the early season, the Greengo variety had the highest CP contents without fertiliser. With the application of 5.0 tons.ha^{-1} OMF, the Monalisa variety had the highest CP content. With 2.5 tons. ha^{-1} OMF CP contents were similar. In the late season,

Table 4. Effect of Variety and rate of organomineral fertiliser on crude protein, carbohydrate and dry matter content (g/100 g) in cucumber in early and late seasons

	Crude Protein	Carbohydrate	Dry Matter
EARLY SEASON			
Variety (V)			
Poinsett	0.38	1.89	2.95
Greengo	0.37	1.86	2.88
Monalisa	0.36	1.75	2.83
LSD ($p < 0.05$)	0.01*	0.01*	0.004*
OMF (R)			
0 t ha^{-1}	0.34	1.68	2.62
2.5 t ha^{-1}	0.39	1.87	2.97
5.0 t ha^{-1}	0.40	1.95	3.07
LSD ($p < 0.05$)	0.01*	0.003*	0.01*
V × R	0.02*	0.01*	0.01*
LATE SEASON			
Variety (V)			
Poinsett	0.44	2.08	3.28
Greengo	0.40	1.92	3.20
Monalisa	0.40	2.12	3.22
LSD ($p < 0.05$)	0.01*	NS	0.02*
OMF (R)			
0 t.ha^{-1}	0.36	1.82	3.00
2.5 t.ha^{-1}	0.44	2.11	3.29
5.0 t.ha^{-1}	0.43	2.20	3.40
LSD ($p < 0.05$)	0.01*	0.30*	0.02*
V × R	0.01*	NS	0.03*

NS – non-significant; *– significant at 5 % probability; **– significant at 1 % probability; OMF –Organo-mineral fertiliser.

Table 5. Summary of significance of analysis of variance of proximate contents of cucumber with variety and rate of organomineral fertiliser

	Moisture Content		Fat Content		Ash Content		Crude Fibre	
	Early season	**Late season**	**Early season**	**Late season**	**Early season**	**Late season**	**Early season**	**Late season**
Variety (V)	**NS**	**0.03***	**NS**	**0.01***	**NS**	**NS**	**0.01****	**0.01****
OMF Rate (R)	0.07**	0.02**	0.004**	0.004**	0.01**	0.01**	0.01**	0.01**
V × R	0.12**	0.04**	0.01**	0.01**	0.01**	0.02**	0.02**	0.01**
	Crude Protein		**Carbohydrate**		**Dry Matter**			
	Early season	**Late season**	**Early season**	**Late season**	**Early season**	**Late season**		
Variety (V)	**NS**	**0.01****	**NS**	**NS**	**NS**	**0.13***		
OMF Rate (R)	0.01**	0.004**	0.12**	0.19**	0.12**	0.09**		
V × R	0.02**	0.01**	NS	0.42**	0.20**	0.16**		

NS – non-significant; * – significant at $p < 0.05$ probability level; ** – highly significant at $p < 0.01$ probability level

Table 6. Interaction of variety and rate of organomineral fertiliser on moisture, fat, ash and crude fibre contents (g/100 g) in cucumber in early and late seasons of 2019

Variety	Rate (t ha^{-1})	Moisture content		Fat		Ash		Crude Fibre	
		Early season	Late season	Early season	Late season	Early season	Late season	Early season	Late season
Poinsett	0	96.95	96.41	0.15	0.20	0.23	0.21	0.35	0.43
	2.5	97.15	96.97	0.13	0.15	0.24	0.26	0.31	0.38
	5.0	97.17	97.10	0.13	0.12	0.24	0.30	0.31	0.30
Greengo	0	96.92	95.98	0.14	0.23	0.21	0.21	0.36	0.47
	2.5	97.29	97.23	0.14	0.12	0.24	0.33	0.34	0.29
	5.0	97.00	97.26	0.12	0.13	0.25	0.21	0.32	0.31
Monalisa	0	96.77	95.97	0.17	0.17	0.21	0.21	0.37	0.36
	2.5	97.41	97.12	0.14	0.15	0.23	0.25	0.35	0.34
	5.0	97.02	97.01	0.12	0.14	0.27	0.27	0.29	0.33
	LSD	0.12**	0.04**	0.01**	0.03**	0.01**	0.02**	0.02**	0.01**

* – significant at $p < 0.05$ probability level and ** – highly significant at $p < 0.01$ probability level

Table 7. Interaction of variety and rate of organomineral fertiliser on crude protein, carbohydrate and dry matter contents (g/100 g) in cucumber in early and late seasons of 2019

Variety	Rate (t ha^{-1})	Crude Protein		Carbohydrate	Dry matter	
		Early season	Late season	Late season	Early season	Late season
Poinsett	0	0.34	0.36	1.75	2.68	2.71
	2.5	0.38	0.42	2.11	2.89	3.28
	5.0	0.38	0.48	2.25	2.90	3.79
Greengo	0	0.36	0.32	1.30	2.75	2.70
	2.5	0.38	0.55	2.52	3.01	4.05
	5.0	0.39	0.37	1.85	3.12	2.84
Monalisa	0	0.31	0.37	1.93	2.35	2.90
	2.5	0.39	0.55	2.13	3.01	3.28
	5.0	0.42	0.38	1.99	3.01	3.04
	LSD	0.02**	0.01**	0.43**	0.18**	0.16**

* – significant at $p < 0.05$ probability level and ** – highly significant at $p < 0.01$ probability level

fruits from the Greengo and Monalisa varieties fertilised with 2.5 tons.ha^{-1} OMF had the highest contents. Fruits from unfertilised plots generally had lower CP contents (Table 7).

Carbohydrate content

The **c**arbohydrate content of the fruits was significantly affected by both sole factors of variety and organomineral fertiliser rate (Table 4) and also by interaction only in the late season (Table 6). In the early season, only fertiliser rate differed, with the application of 2.5 tons.ha^{-1} OMF giving a yield of 1.91 t.ha^{-1} that was lower than 2.03 t.ha^{-1} from application of 5.0 tons.ha^{-1} OMF but was higher than 1.71 t.ha^{-1} from the unfertilised treatment. In the late season, Greengo fruits treated with 2.5 tons.ha^{-1} OMF had the highest carbohydrate content comparable to contents from fertilised Poinsett and Monalisa varieties fertilised with 2.5 tons.ha^{-1}. Unfertilised Greengo had the lowest carbohydrate content (Table 7).

Dry matter content

Dry matter (DM) content of cucumbers was significantly affected by both sole factors of variety and organomineral fertiliser rate (Table 4) and also by the interaction of the variety and OMF rate (Table 7). In the early season, fertilised Greengo and Monalisa varieties had higher DM relative to fruits from all unfertilised treatments. In the late season, fruits of the Greengo variety fertilised with 2.5 had the highest DM content. The least dry matter content was observed from fruits of plots without fertilisers.

DISCUSSION

Each cucumber variety has a distinct genetic composition, accounting for the variations in fruit yield and output between varieties. This factor is essential in explaining the differences in fruit output across the various cultivars. According to Ene et al. (2016) and Kasali et al. (2024), the variety used has an impact on the yield characteristics. The Greengo variety seems to have a quicker rate of environmental adaptation than the Monalisa and Poinsett varieties, leading to a strong source-sink relationship and the variety's high yield. Variations in cucumber cultivars were also noted by Ahmed et al. (2016), who reported that the Squees Green variety performed better than the Liza and Sindhi Wango varieties.

Late planting which resulted in better yield than early planting season, suggests a moderate rainfall requirement for cucumber. This suggested that the optimal time to grow cucumbers in this agro-ecological zone is in the late planting season when the rains are not too intense. This is in agreement with the findings of Makinde and Bello (2009) who noted higher cucumber fruit yields during the late planting season compared to the early planting season in their study on maize/cucumber intercrop in the guinea savanna zone.

The study has shown that as the rate of OMF increased, the fruit yield also progressively increased. The findings concur with earlier research conducted by Ahmed et al. (2007 and 2016) who also revealed a linear correlation between cucumber fruit weight and nitrogen fertiliser dosage. Similarly, Choudhari and More (2002) noted that cucumber plants produced the most fruit (g) at 150: 90: 90 kg NPK ha^{-1}. Once the proper nutrients are added, the cucumber plant develops more quickly and yields more fruits. Waseem et al. (2008) verified this for cucumber when 80 $kg.ha^{-1}$ of nitrogen was administered. Chatterjee and Thirumdasu (2014) also reported that organic fertiliser significantly improves the vegetable yield over the control.

The proximate analyses revealed the presence of various compositions in varying quantities, a result of the effects of OMF used at different rates. The proximate compositions of the three different cucumber varieties are similar to those of other native vegetables including cowpea leaves and amaranth, as reported by Onyango et al. (2008). It also agrees with the results of Husni et al. (2020). According to Kuhlein (2000), the nutrient contents of food are influenced by a variety of factors, including natural variations within the species, soil quality, genetic diversity, seasonal changes (such as moisture and sunlight availability during key developmental periods), maturity level, and the effects of processing. These causes may contribute to some of the differences in nutrient contents among the three cucumber varieties.

The significant increase in cucumber moisture content may be linked to the increased amount of organomineral fertiliser used. This shows that plants improve and perform better when treated with an adequate amount of OMF. This helps the production of more fruits that will contain the right minerals needed by the plant and consequently, the animals or humans that consume them. According to Naz et al. (2011), using a higher dose of NPK fertiliser caused the moisture content of potatoes to increase. This is consistent with the findings of Tarantino et al. (2023). The significant increase caused by an increase in the rate of OMF on the nutritional value of cucumber implies that its moisture content could be increased by OMF. The outcome was accurate since fruits from plants in the Cucurbitaceae family are known to contain large amounts of water. Thus, when the weather is hot, it can aid human consumption by quenching thirst. This agrees with Olayinka and Etejere (2018), who indicated that *Cucumis sativus* has a high moisture content. Additionally, fleshy fruits with a high proportion of moisture facilitate digestion and serve as a solvent in chemical interactions in the body of the consumers according to Aina et al. (2012). The high moisture content is consistent with research by Okoye (2013). Egan et al. (1981) and Husni et al. (2020) reported that semi-ripe and ripe *Cucumis sativus* have 96.4% and 97.8% moisture content, respectively. However, according to Ozioma et al. (2013), high moisture content may contribute to the quick deterioration of these fruits, if not kept properly for long. The results indicated that an increased rate of OMF reduced the fat content of cucumbers. The human and animal body depends heavily on fats which are the main energy source. Fats are essential for preserving the nervous system's optimal performance and boosting male fertility. They also serve as a lubricating agent within the digestive tract of humans. The analysis showed that increasing the fertiliser amount decreased crude fat. This supports the results of Nazet al. (2011). The low fat content of cucumber fruits discovered through this research suggested that using them regularly in the food is suitable for people following a low-fat diet.

The amount of starch, proteins, and mineral components is associated with the dry matter content. Current findings have shown that increasing the rate of OMF increases plant dry matter content. This supports the results of Naz et al. (2011) who found that increasing fertiliser rate increased the dry matter content of plants. Additionally, Naikwade et al. (2014) observed that applying compost to nutrient-limiting soil enhanced the quantity and quality of maize proximate components and biomass.

The amount of minerals in the cucumber is indicated by its ash content. Better proximate compositions were seen in cucumbers treated with varying amounts of OMF, presumably a result of the availability of adequate minerals. Akhtar et al. (2010) reported a linear relationship between the quality of compost constituents and vegetative development and nutrient uptake in lettuce and amaranthus. Oyeyemi et al. (2017) also noted an increase in the ash content of *Amaranthus cruentus* as the nitrogen content of compost increases.

The proportion of organic material (food or feed) made up of cellulose and other carbohydrates soluble in only a mild acid or alkali solution is known as crude fibre. This study has revealed that as the rate of organomineral fertiliser increases, the crude fibre content decreases.

The increase in protein contents corresponding to the increasing rate of OMF could be attributed to the increased production of amino acids due to fertilisation. The outcome is consistent with Muhammad's (2002) findings, which showed a significant rise in crude protein levels for every increase in nitrogen.

Fertilisation may have enhanced the production of amino acids, which could explain the notable rise in protein levels observed with an increase in the rate of organomineral fertiliser. The protein content of tiger nuts experienced a notable increase, owing to a significant increase in soil nitrogen, resulting from this compared to the control (Brady and Weil, 2008). Nitrogen is a vital element for the synthesis of amino acids in plants. Amino acids are the fundamental constituents of proteins and facilitate enzymatic reactions, which play a crucial role in catalyzing a vast array of biochemical processes. Application of the OMF influenced the cucumber production and its quality in terms of protein content. The result is consistent with Muhammad's study (2002), which stated that at each increase in the amount of nitrogen, significant increases in crude protein concentrations were noted. Vegetables provide protein, a vital part of the human diet since it aids in the development of muscular tissue and the production of enzymes that regulate all the hormones that affect any organ. It is responsible for the contraction of muscle fibers, illness prevention, blood coagulation, and the haemoglobin-mediated transport of oxygen in the blood by haemoglobin (Olaniyi et al., 2010).

The findings agree with the views of Ojo et al. (2014) that organo-mineral fertiliser appears to be a cheap, readily available, environment-friendly, and reliable source of nitrogen needed for growing watermelon. The authors further stated that OMF is a low-input technology for improving the nutrient status of tropical soils for sustainable crop production as it combines the attributes of both organic and inorganic fertilisers. This is in agreement with the report that the chemical composition (accumulation of certain macro- and micronutrients) in fruit is directly influenced by the chemical composition of the fertiliser on which the crop is grown (Massri and Labban, 2014; Fabiane-Bach et al., 2018). The study revealed that increasing the organomineral fertiliser rate improved most of the variables tested improved.

CONCLUSION

The study investigated the effects of variety, planting season, and organomineral fertiliser on cucumber yield and quality. The results showed that the Greengo variety had a higher yield due to its quicker environmental adaptation. Late planting season resulted in better yields, and increasing the rate of OMF led to a progressive increase in fruit yield. It also improved the nutritional value of cucumber, increasing its moisture and protein content, while decreasing fat and crude fiber content. The use of OMF was beneficial for cucumber production, leading to improved yield and quality. The findings suggest that the optimal time to grow cucumbers is in the late planting season, with the application of adequate organomineral fertiliser. For optimum nutritional content of cucumber, the Poinsett variety can be planted with the application of 5.0 tons.ha^{-1} OMF.

CONFLICT OF INTEREST

The authors declared no conflicts of interest concerning the research, authorship, and publication of this article.

ETHICAL COMPLIANCE

The authors have followed ethical standards in conducting the research and preparing the manuscript.

REFERENCES

Ahmed N., Baloch, M.H., Haleem A., Ejaz M. (2007): Effects of different levels of nitrogen on the growth and production of cucumber. Life Science International Journal 1: 99–102.

Ahmed N., Muhammad I.K., Tanveer F.M., Noor-un-Nisa M., QadirBux B., Khalid H.T., Lubna R. (2016): Growth and Yield of Cucumber (*Cucumis Sativus* L.) Cultivars in Response to different Nitrogen levels. Science International (Lahore) 28: 2691–2695.

Aina V.O., Sambo B., Zakari A., Hauwa-Haruna M.S., Umar H., Akinboboye R.M., Mohammed A. (2012): Determination of nutritional and antinutrient content of *Vitis vinifera* (Grapes) grown in Bomo (Area C) Zaria, Nigeria. Advanced Journal of Food Science and Technology 6: 445–448.

Akhtar J.M., Young I., Irvine R.J., Sturrock C. (2010): Assessing nitrogen supply potential and influence on growth of lettuce and Amaranthus of different aged composts. Pakistan Journal of Botany 42: 527–536.

Akinrinde E., Bello O.S., Ayegboyin K.O., Iroh L. (2005): Added benefits of combined organic and mineral phosphate fertilizers applied to maize and melon. Journal of Food Agricultural Environment 3: 75–80.

Akinrinde A.A. (2006): Strategies for improving crops use efficiencies of fertilizer nutrients in sustainable Agricultural systems. Pakistan Journal of Nutrition 5: 185–193.

AOAC Association of Official Analytical Chemists (2010): Official methods of analysis of Association of Official Analytical Chemists. 18th Edition, Washington, DC.

Bouyoucos G. J. (1951): A recalibration of the hydrometer method for mechanical analysis of soils. Agronomy Journal 43: 434–438.

Brady N.C., Weil R.R. (2008): Nature and Properties of Soils (14th Ed). Pearson Prentice Hall, New Jersey. pp. 739–793.

Bray A.H., Kurtz L.T. (1945): Determination of Total, organic and available forms of phosphorus in soils. Soil Science 59: 45–59.

Bremner J. M. (1996): Nitrogen-total. In: Methods of soil analyses chemical methods, ed. D. L. Sparks, pp. 1085–1122. Madison, WI: American Society of Agronomy/Soil Science Society of America.

Broadbent F.E. (1953): The soil organic fraction. Advances in Agronomy 5: 153–183.

Chatterjee R., Thirumdasu R K. (2014): Nutrient management in organic vegetable production. International Journal of Food Agricultural Veterinary Science 3: 156–170.

Choudhari S.M., More T.A. (2002): Fertigation, fertilizer and spacing requirement of Tropical gynoecious cucumber hybrids. ISHS. Tsukuba, Japan. Acta Horticulturae 61: 588.

Eifediyi E.K., Remison S.U. (2010): Growth and yield of cucumber (*Cucumis sativum* L.) as influenced by farm yard manure and inorganic fertilizer. Journal of Plant Breeding and Crop Science 7: 216–220.

Egan H., Kirk R.S., Swayer R.R. (1981): Pearson's Chemical Analysis of Foods. 8th Edition. Churchill Livingstone, London, pp. 200–514.

Emma-Okafor L.C., Obijuru E.E., Nwokeji I.M., Echereobia C.O., Okoli N.A. (2022): Effects of poultry manure and wood ash on the growth and yield of cucumber (*Cucumis sativum* L.) in Owerri Southeastern Nigeria. Net Journal of Agricultural Science 10: 49–53. doi: 10.30918/NJAS.102.22.006

Ene C.O., Ogbonna P.E., Agbo C.U. (2016): Studies of phenotypic and genotypic variation in sixteen cucumber genotypes. Chilean Journal of Agricultural Research 3: 307–313. doi: 10.4067/s0718-58392016000300007.

Fabiane-Bach F., Helm C.V., De Lima E.A., Bellettini M.B., Haminiuk C. (2018): Corn yield in sandy soil treated with poultry litter. Emirate Journal of Food and Agriculture 12: 1006–1013.

Husni A., Shariff M., Noor P., Megat Z., Abdul M., Jahurul A.H., Huda N., Romes N.B., Zakaria M., Roslan J., Wahab R.A., Huyop F. (2020): Nutrient composition, total phenolic content, and antioxidant activity of tropical Kundasang-grown cucumber at two growth stages. Chilean Journal of Agricultural Sciences 81: 220–227. https://doi.org/10.4067/S0718-58392021000200220

Iowa State University (2020): How do gynoecious cucumber varieties differ from other varieties? https://hortnews.extension.iastate.edu/faq/how-do-gynoecious-cucumbervarieties-differ-other-varieties.

Kasali A.O., Makinde E.A., Bodunde J.G., Sobukola O.P., Falaiye O.O. (2024): Response of cucumber cultivars to organomineral fertilizer rate in rainforest savannah. Trends in Horticulture 1: 35–82. https://doi.org/10.24294/th.v7i1.3582

Kuhlein H.V. (2000): Finding food sources of vitamin A and pro-vitamin A. Food and Nutrition Bulletin 2: 130–133.

Makinde A.A., Bello N.J. (2009): Hydrothermal effects on the performance of maize and cucumber intercrop in a tropical wet and dry climate in Nigeria. African Journal of Agricultural Research 3: 225–235.

Mallick P.K. (2022): Evaluating Potential of Cucumber (*Cucumis sativus* L. – Cucubitaceae). International

Journal of Applied Sciences and Biotechnology 1: 12–15.

Massri M., Labban L. (2014): Comparison of Different Types of Fertilizers on Growth, Yield and Quality Properties of Watermelon (*Citrullus lanatus*). Agricultural Science 5: 475–482.

Mclean E.O. 1982. Soil pH and Lime Requirement. In: Page, A.L., Ed., Methods of soil analysis. Part 2. Chemical and microbiological properties. American Society of Agronomy, Soil Science Society of America, Madison, pp. 199–224.

Muhammad A.N., Asif T., Azhar H. (2002): Effects of Different Levels of Nitrogen and Harvesting Times on the Growth, Yield and Quality of Sorghum Fodder. Asian Journal of Plant Sciences 4: 304–307.

Naikwade P.V., Gaurav S., Sharayu D., Kailas J. (2014): Evaluation of antibacterial properties of *Musapara disiaca* L. Leaves. In: Proceeding of the National Conference on Conservation of Natural Resources &Biodiversity for Sustainable Development. Bioscience Discovery 6: 80–88.

Naz F., Ali A., Iqbal Z., Akhtar N., Asghar S., Ahmad B. (2011): Effects of different lNPK fertilizers on the proximate composition of potato crop at Abbottabad. Sarhad Journal of Agriculture 3: 353–356.

Nelson D.W., Sommers L.E. (1996): Total carbon and organic matter. In: Methods of soil analyses. Part 3. Chemical methods, ed. D. L. Sparks, pp. 961–1010. Madison, WI: American Society of Agronomy/Soil Sciences Society of America.

Ojo J.A., Olowoake A.A., Obembe A. (2014): Efficacy of organomineral fertilizer and un-amended compost on the growth and yield of watermelon (*Citrullus lanatus* Thumb) in Ilorin Southern Guinea Savanna zone of Nigeria. International Journal of Recycling of Organic Waste in Agriculture 4: 121–125.

Okoye N.R. (2013): Proximate analysis and protein solubility of four cucurbits found in Nigeria. Pakistan Journal of Nutrition 1: 20–22.

Olaniyi J.O., Akanbi W.B., Olaniran O.A., Ilupeju O.T. (2010): Effects of organo-mineral and inorganic fertilizers on the growth, fruit yield, quality and chemical compositions of okra. Journal of Animal and Plant Sciences 1: 1135–1140.

Olayinka B.U., Etejere E.O. (2018): Proximate and chemical compositions of watermelon (*Citrullus lanatus* (Thunb.) Matson and Nakai cv. red and cucumber (*Cucumis sativus* L. cv Pipino). International Food Research Journal 3: 1060–1066.

Onyango C.M., Shibairo S.I., Imungi J.K., Harbinson J. (2008): The physico-chemical characteristics and some nutritional values of vegetable amaranth sold in Nairobi-Kenya. Ecology of Food and Nutrition 4: 382–398.

Oyeyemi A.D., Francis I., Anifowose E.M. (2017): Growth and Proximate Composition of *Amarathus cruentus* L. on poor soil amended with compost and Arbuscular mycorrhiza fungi. International Journal of Recycling Organic Waste inAgriculture 16: 1–8.

Ozioma A.D., Onisogen S.E., Ebirien P.F. (2013): Proximate and mineral composition of some Nigerian fruits. British Journal of Applied and Technology 4: 1447–1454.

Tarantino A., Disciglio G., Frabboni L., Lopriore G. (2023): Organo-mineral Fertilizers Increases Vegetative Growth and Yield and Quality Parameters of Pomegranate cv. Wonderful Fruits. Horticulturae 9: 164. https://doi.org/ 10.3390/horticulturae9020164.

Tejada M., Benitez J., Gonzalez L. (2005): Effects of Application of two Organomineral Fertilizers on Nutrient Leaching Loses and Wheat Crop. Agronomy Journal 3: 960–967.

Thomas G.W. (1996): Soil pH and soil acidity. In: Methods of soil analysis. Part 3 Chemical methods. 5: 475–490. Madison, WI: Soil Science Society of America.

USDA (2014): Soil Survey Staff. Keys to soil taxonomy. 12th Edition, USDA-Natural Resources Conservation Service, Washington DC.

Waseem K., Jilani M.S., Afzaal M.F. (2008): Effect of different nitrogen levels on growth and yield of brinjal. Journal of Agricultural Research 46: 245–251.

Received: June 15, 2024
Accepted after revisions: October 13, 2024