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YIELD AND YIELD COMPONENTS OF SWEET CORN AND SWEET MELON IN RESPONSE TO ORGANIC AND INORGANIC SOURCES OF CROP NUTRITION

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Abstract
Field experiment was conducted to study the response of sweet melon varieties to rates of poultry manure and NPK (20:10:10) fertilizer in intercrop with sweet corn during 2021 rainy season at the research farm of the Institute for Agricultural Research, Samaru and the National Horticultural Research Institute, Bagauda. The treatments consisted of three rates of NPK (20:10:10) fertilizer (0:0:0, 60:30:30, and 120:60:60kg/ha), three poultry manure rates (0, 4 and 8t/ha) and two varieties of sweet melon (Jupiter and Uranus) which were factorially combined, with NPK and poultry manure laid out in a randomized completely block design and replicated three times. Results showed that yield characters of sweet corn: number of cobs, cob diameter, 100 grain weight, dry and fresh yield per hectare increased with increasing rate of NPK fertilizer up to the highest rate of 120:60:60 kg/ha. Sweet melon yield attributes: number of fruits per plant, fruit length, fruit circumference, shelf-life, brix content, 100 seed weight, fruit weight per plot and weight per fruit were influenced by application of inorganic fertilizer at either 60:30:30 kg/ha or 120:60:60 kg/ha, while the number of seeds per fruit benefitted significantly from inorganic fertilizer application up to the highest rate of 120:60:60 kg/ha. Highest fruit yield per hectare (35.9 t/ha and 70.7 t/ha) were recorded with the application of 60:30:30 kg/ha of NPK at Samaru and Bagauda respectively. Application of poultry manure at either 4 or 8 t/ha, significantly influenced yield characters of sweet corn: number of cobs per plant, cob diameter and dry yield per hectare as well as the number of fruits per plant, fruit length, fruit circumference, brix content, shelf-life, number of seeds per fruit, 100 seed weight, weight per fruit, fruit weight per plot and yield per hectare of sweet melon.
Keywords: *NPK, poultry manure, sweet corn and sweet melon*

Introduction

Sweet corn (*Zea mays saccharate* L.) belongs to the family poacaea that is an important vegetable primarily grown for its immature green ear, as food for man (Sani *et al*., 2011). It is consumed in roasted, boiled or raw forms and can also be added to salad, among other food ingredients (Jibrin and Sarkin-Fulani, 2011; Akintoye and Olaniyan, 2012). It is distinct from other types of maize because of its ability to produce and retain large amount of sugar within the kernel (Jibrin and Sarkin-Fulani, 2011). Substantial evidence has shown that the production of sweet corn in Nigeria is gradually gaining prominence, especially around cities and areas with export capacity (Sani *et al*., 2011). Sweet melon (*Cucumis melo* L.) is a prostrate, highly branched, softly hairy vines possessing rounded, heart-shaped leaves trailing cucurbit with unbranched tendrils. The sweet melon is available in numerous varieties. These varieties are roughly distinguished into three main groups: smooth melons (e.g., honey melons), net melons (e.g. Galia melons) and cantaloupe melons (e.g. Charentis). The Cantaloupe melons owe their name to the village of Cantalupo near Rome. This place is considered to be the ancient origin of the cultivation of honey melons in Europe. The crop is a member of the family *Cucurbitaceae* represented by some 118 genera and 825 species (Jeffrey, 1990). It is rich in bioactive compounds such as phenolics, flavonoids and vitamins as well as carbohydrates and minerals (especially potassium). In addition, it is low in fat and calories (about 17 kcal/100 g). It also has a large amount of dietary fibre (Tamer *et al*., 2010).

Loss of soil productivity on account of bush burning, intensive cropping without nutrient replenishment, removal of crop residues for fuel, fodder etc. and intense rainfall resulting in leaching and erosion of topsoil are important factors that affect crop productivity (Ziadat and Taimeh, 2018; Jones *et al.*, 2013; Kidane, 2015). Although experimental studies on fertilizer application showed increased crop productivity, blanket fertilizer recommendations have obvious limitations (IFDC, 2015) such that nutrients can be applied in excess or inadequate for different locations, thereby reducing the efficient utilization of applied nutrients. Excess application of nutrients can lead to nutrient leakages to the environment, resulting in adverse environmental impacts such as pollution of surface and groundwaters, soil and air pollutions, destruction of soil physical characteristics, accumulation of toxic chemicals in water bodies, as well as loss of biodiversity. Soils of savanna are characteristically low in nutrient status chief among which are low soil organic matter, cation exchange capacity and pH as a result of poor soil management practices.

Chemical fertilizer is becoming a major cost factor in crop production and its cost has been increasing steadily, besides having potentially undesirable effects on the environment.

Organic fertilizers, compared to inorganic fertilizers, maintain soil quality, increase soil organic matter, as well as improve soil physical and chemical properties through the decomposition of its substances and enhances soil nutrients, plant growth regulators, and biodiversity (Mader *et al.*, 2002; Kakar *et al.*, 2019). Therefore, integrated soil fertility management practices such as complementary use of organic and inorganic means of crop nutrition, adoption of green manuring and cover cropping are needed to restore the depleted soils, and ensure long-term environmental and crop production sustainability. Cultivation of crops especially horticultural crops by small holder farmers (subsistence cultivators) are often done in intercrop, mainly because of all advantages accruable from the practice such as saving space and resources, ensuring better yields in case of poor returns of the main culture, repelling pests, reducing weeds, providing nutrients for the neighbouring plants, prevention of soil erosion and crust among others as well as the dearth of resources to manage large sole fields. However, most recommendations of fertilizer and or manure for crops are given as obtained in monoculture hence, information is lacking on nutrients requirement in mixtures and what combination of organic and inorganic nutrient sources is best suited for common mixtures.

In view of the above, as a means of intervention, a study which encompasses the farmer's preferred mixture/intercropping, adoption of green manuring, cover cropping, complementary use of organic and inorganic means of crop nutrition to improve both farmer's earnings and soil (physical, chemical and biological) nutrient status is imperative. Hence, the present study evaluated the poultry manure rates required for optimum yield and yield components of sweet corn/sweet melon mixture, NPK (20:10:10) fertilizer rates required for optimum yield and yield components of sweet corn/sweet melon mixture and the most suitable sweet melon variety for intercrop with sweet corn in the ecologies of study.

Materials and Methods

The experiment was conducted simultaneously at two locations during the 2021 rainy season; one at the Horticultural Garden of the Institute for Agricultural Research, Samaru (latitude $11^0$11’N, longitude $07^0$38’E, 686 m above sea level) in the Northern Guinea Savanna and the other one at the National Horticultural Research Station; Bagauda (latitude $11^0$39’N, longitude $08^0$02’E), 500m above sea level in the Sudan savanna ecological zone of Nigeria. Prior to each trial, composite samples of poultry manure as well as the soil of the experimental sites were analysed for their physical and chemical properties, using standard laboratory procedure at the Analytical laboratory, Department of Agronomy, Ahmadu Bello University Zaria. The treatments consisted of two varieties of sweet melon (Uranus and Jupiter), three rates of poultry manure (0, 4 and 8 t/ha) and three rates of NPK (20-10-10) at 0-0-0, 60-30-30 and 120-60-60 kg/ha. The treatments were factorially combined in split plot arrangement with fertilizer (3) x poultry manure (3) in main plot and (2) varieties of sweet melon in sub-plot in a 3x3x2 with a total of 18 treatments were laid out in a randomized completely block design with three replications. The gross plot consisted of 8 ridges, 0.75 m apart, 6 m wide and 4 m long (24 m^2); the net plot consisted of 4 innermost ridges (12 m^2) while the 4 side rows (12 m^2) formed the discard for destructive sampling. Sweet corn 'Sugar king F1' variety used for the trial was a tropical hybrid sweet corn with strong plant vigoro and root system. It is tolerant to lodging and matures between 71-73 days after sowing. It produces large ears with good shelf life and a very sweet taste. Ears are yellow and between 20 to 21 cm in length. It has a brix content of 13%. Sweet melon 'Jupita F1' variety used is characterized by early maturity (62-65 days). It has a good fruit quality with excellent taste and brix content of between 12-14%.

Mature fruits weighs between 1.0 - 1.2 kg with a flesh colour of salmon red and rind colour of a netted brownish white. While the other sweet melon variety 'Uranus F1' is characterized by high-yield and moderate vigour, which matures between 65-68 days after sowing. The fruits are medium sized usually weigh 1.2-1.4kg and have beautifully smooth, canary yellow rind colour. The flesh is light orange, very crispy and sweet. It has a brix content of 16 – 18%. Chemical weed control using glyphosate at the rate of 1.44 kg a.i ha^{-1} was carried out two weeks prior to land preparation. The land was manually cleared, mechanically harrowed and ridged. The land was then demarcated into 54 plots each measuring 4 m x 6 m. The gross plot consisted of 8 rows (4 m x 6 m = 24 m^2), 4 inner rows constituted the net plot (4m x 3m = 12m^2), 0.75m and 1.5m for alley ways, between plots and replicates, respectively. Basal application of poultry manure was done as per treatment. The seeds of both sweet corn and sweet melon were treated with Apron star (Thiamethoxam + Difenoconazole) 1.2kg a.i ha^{-1} before sowing at the rate of 1 sachet (10g) to 3 Kilograms of seed. This was to ensure that the seeds were protected from seed and soil borne pathogens. Seeds were sown at inter-row spacing of 0.75 m and intra-row spacing of 0.50 m and 0.75 m for sweet corn and sweet melon, respectively at the rate of two seeds per hole and were later thinned to a plant per stand two weeks after sowing. The crops (sweet maize and sweet melon) were sown as intercrop (within row arrangement). Compound fertilizer (NPK 20:10:10) was applied as per treatments in two equal split doses; first half at 2WAS while the other half was top-dressed at 6WAS.

Harvesting in respect of Sweet corn was done in two phases; that is 1^{st} half of the net plot 1.5 x 4 m (6 m^2) at milk/dough stage, while the bract of ears were green and firm and the other half 1.5 x 4 m (6 m^2) was harvested at full physiological maturity (dried). Periodic harvesting of Sweet melon was carried out at maturity when fruits changed colour from dull green to bright yellow, when leaves senescence and fruit yielded a hollow dull sound on tapping. Harvesting was done using a sterilized sharp knife to cut the peduncle along with the fruit at about 5 cm. Harvested fruits were kept under low temperature to prevent the fruit temperature from rising in order to minimize moisture loss thus, extending the fruit shelf life. Data collected were subjected to analysis of variance as described by Steel and Torrie (1987) and treatment means were compared using Duncan Multiple Range Test (Duncan, 1955) at 5% probability level. The magnitude and type of relationship between characters was assessed through simple correlation analysis (Dewey and Lu, 1959).

Results

Sweet Corn

Number of Cobs, Length and Diameter of Sweet Corn

Effect of poultry manure and NPK on number of cobs, length and diameter of sweet corn is shown in table 1: Treatment with either 4 or 8 t/ha of poultry manure produced statistically similar number of cobs and cob diameter of sweet corn while the untreated control produced significantly least number of cobs and cob diameter of sweet corn. At Bagauda, there was significant response on number of cobs and cob diameter of sweet corn when 4 t/ha of poultry manure was applied compared with poultry manure control. Further increase in poultry manure rate from 4 to 8 t/ha was significantly beneficial only to number of cobs. Looking at the effect of NPK on number of cobs and cob diameter of sweet corn at both locations, it indicated significant difference only on cob diameter at Samaru, as well as number of cobs at both locations. At both locations, each increase in NPK rate, significantly and progressively increased number of cobs of sweet corn. At Samaru, plots treated with either 0:0:0 or 60:30:30 kg/ha of NPK fertilizer, produced cobs with statistically similar diameter. Highest mean cob diameter of sweet corn was recorded when NPK fertilizer rate was raised to 120:60:60 kg/ha which was significantly higher compared to the untreated control.

100 Grains Weight

Table 1 shows the response of 100 grain weight of sweet corn to applied poultry manure and NPK fertilizer at Samaru and Bagauda respectively. 100 grains weight showed no significant response to rates of poultry manure at Samaru. However, there was significant response to poultry manure rates at Bagauda, where each increase in poultry manure rate significantly and progressively increased 100 grains test weight of sweet corn. The varying rates of NPK fertilizer evaluated on 100 grains weight at both locations were not significant except at Bagauda, where each increase in NPK fertilizer rate significantly enhanced 100 grains test weight of sweet corn. The interactions between poultry manure and NPK fertilizer on 100 grains weight was highly significant at Bagauda, and is presented in table 4, where increase in poultry manure rate from 0 to 4 t ha^{-1} at applied 0:0:0 and 120:60:60 kg ha^{-1} of NPK significantly increased 100 grains weight of sweet corn. Further increase in poultry manure rate at same NPK rate had no significance on 100 grains weight of sweet corn. At 60:30:30 kg ha^{-1} of NPK, heavier grain yield was only observed with application of 8 t ha^{-1} of poultry manure as against plots without applied poultry manure. Looking at the poultry manure rate, application of NPK from 0:0:0 to 120:60:60 kg ha^{-1} led to heavier 100 grains weight.

Fresh Yield per Hectare

Response of fresh yield per hectare of sweet corn to poultry manure and NPK fertilizer at Samaru and Bagauda is shown in table 1. Increase in application of poultry manure from 0 to 4 t/h significantly enhanced fresh yield per hectare of sweet corn at both locations. Highest fresh yield per hectare of sweet corn was recorded with the application of the highest poultry manure rate of 8t/ha at both locations which was significantly higher than lower rates evaluated. Considering the effect of varying rates of NPK fertilizer on fresh yield per hectare of sweet corn, significant and progressive increase in yield per hectare was notable with each increase in NPK fertilizer rate at both locations. Application of 120:60:60 kg/ha NPK, produced the highest fresh yield per hectare at both locations.

Table 1: Effect of Poultry Manure and NPK Fertilizer on Number of Cobs, Cob Diameter, 100 Grain Weight and Fresh Yield per Hectare of Sweet Corn at Samaru and Bagauda During 2021 Rainy Season

	Samaru				Bagauda			
Treatment	No of cobs/plant	Cob diameter (cm)	S100W (g)	Fresh Yield per hectare (t)	No of cobs/plant	Cob diameter (cm)	S100W (g)	Fresh Yield per hectare (t)
Poultry manure (P) (t/ha)								
0	2.2^{b}	5.7^{b}	12.4	18.0^{c}	2.3^{c}	5.3^{b}	12.4^{c}	13.5^{c}
4	3.0^{a}	6.1^{a}	12.9	28.7^{b}	3.1^{b}	5.7^{a}	13.7^{b}	20.5^{b}
8	3.6^{a}	6.0^{a}	12.6	35.8^{a}	3.7^{a}	5.9^{a}	14.2^{a}	28.1^{a}
SE$\pm$	0.30	0.10	0.43	0.95	0.20	0.10	0.15	0.93
NPK (20-10-10) (F) (Kg/ha)								
0:0:0	2.1^{c}	5.8^{b}	12.0	15.5^{c}	1.9^{c}	5.5	11.9^{c}	12.2^{c}
60:30:30	3.0^{b}	5.9^{ab}	12.7	29.4^{b}	3.2^{b}	5.7	13.5^{b}	21.8^{b}
120:60:60	3.7^{a}	6.1^{a}	13.2	37.6^{a}	4.0^{a}	5.7	14.9^{a}	28.1^{a}
SE$\pm$	0.30	0.10	0.43	0.95	0.20	0.10	0.15	0.93
Interaction								
PXF	NS	NS	NS	NS	NS	NS	**	NS

SE+: Standard Error; a,b,c: Means with the same superscript in the same column are not different statistically at *P=0.05* level of probability using DMRT; NS= Not significant; PXF: Interaction of Poultry manure and NPK fertilizer

Sweet Melon

Number of Fruits, Fruit Length and Circumference

Varietal influence on number of fruits, fruit length and fruit circumference were not significant at both experimental locations, and is presented in table 2. Treatment with 4 t/ha of poultry manure significantly enhanced fruits characters (number, length and circumference) over untreated control at both locations except, for fruit length which was statistically similar with that on plots receiving no manure at Bagauda. Increasing poultry manure rate from 4 to 8 t/ha had no significant effect on these characters at both locations except, for fruit length at Bagauda when the increase in poultry manure rate induced significant increase in fruit length. Similarly, application of fertilizer at 60:30:30 kg/ha significantly improved fruit characters over control. Increasing fertilizer rate to 120:60:60 kg/ha had no significant effect on these characters at Samaru. At Bagauda, fruit dimension (length and circumference) was not significantly influenced by treatment with varying rates of fertilizer. For number of fruits, increasing fertilizer from 60:30:30 to 120:60:60 kg/ha warranted a decrease in number of fruits per plant. The interactions (1st and 2nd order) were not significant at both locations for fruit characters (number of fruits, fruit length and fruit circumference).

Table 2: Effect of Poultry Manure and NPK Fertilizer on Number of Fruits, Fruit Length and Fruit Circumference of Sweet Melon Varieties at Samaru and Bagauda during 2021 Rainy Season

Treatment	Samaru			Bagauda		
	No. of fruit per plant	Fruit length (cm)	Fruit circumference (cm)	No. of fruit per plant	Fruit length (cm)	Fruit circumference (cm)
Variety (V)						
Jupiter	4.6	17.6	32.7	4.9	21.4	40.3
Uranus	4.7	18.0	33.5	5.0	20.5	38.2
SE±	0.16	0.45	0.79	0.11	0.42	0.76
Poultry manure (P) (t/ ha)						
0	3.3[b]	15.9[b]	29.4[b]	3.5[c]	19.8[b]	36.7[b]
4	5.5[a]	18.7[a]	34.7[a]	5.9[a]	20.9[ab]	39.4[a]
8	5.3[a]	18.7[a]	35.2[a]	5.3[b]	22.2[a]	41.6[a]
SE±	0.20	0.55	0.97	0.14	0.51	0.93
NPK (20-10-10) (F) (Kgha^{-1})						
0:0:0	3.3[b]	15.5[b]	28.7[b]	3.5[c]	20.7	38.4
60:30:30	5.7[a]	19.3[a]	36.2[a]	5.8[a]	21.6	40.2
120:60:60	5.1[a]	18.5[a]	34.4[a]	5.4[b]	20.6	39.1
SE±	0.20	0.55	0.97	0.14	0.51	0.93
Interactions						
V*P	NS	NS	NS	NS	NS	NS
V*F	NS	NS	NS	NS	NS	NS
P*F	NS	NS	NS	NS	NS	NS
V*P*F	NS	NS	NS	NS	NS	NS

SE+: Standard Error; a,b,c: Means with the same superscript in the same column are not different statistically at *P=0.05* level of probability using DMRT; NS= Not significant.

Brix Content and Shelf-life

Response of Brix content and Shelf-life of Sweet melon varieties to poultry manure and NPK is shown in table 3. Varietal response to sugar expressed in brix content (%) was not significant for both locations, the effect on shelf-life was however significant. Shelf-life was significantly longer in Uranus and Jupiter at Samaru and Bagauda, respectively. Treatment with manure at 4 t/ha significantly enhanced brix content and shelf-life at Samaru and brix content at Bagauda. Increasing manure rate to 8 t/ha had no significant effect on shelf-life and brix content at Samaru and Bagauda, respectively, while brix content and shelf-life was depressed and enhanced at Samaru and Bagauda, respectively on increasing manure rate from 4 to 8 t/ha. Application of fertilizer at 60:30:30 kg/ha significantly increased brix content at both locations over untreated control. Further increase in fertilizer rate to 120:60:60kg/ha significantly depressed this character at both locations. Similarly, treatment with fertilizer at 60:30:30kg/ha enhanced shelf-life of sweet melon at Samaru over control. Further increase had no significant benefit with respect to this character. While at Bagauda, application of fertilizer at highest rate of 120:60:60kg/ha was significantly beneficial to fruit shelf-life (keeping quality), lower rate (60:30:30kg/ha) was not significantly different from untreated control.

The interactions between poultry manure and fertilizer rates on brix content were highly significant at both locations and are presented in tables 5 and 6. At each of the poultry manure rate, application of NPK was significant only at 0 and 4 t ha^{-1} of poultry manure where application of 0:0:0 kg/ha NPK had higher brix content only when compared to applied 120:60:60 kg ha^{-1} NPK fertilizer on plots without poultry manure. At 4 t ha^{-1}, application of 60:30:30 kg ha^{-1} had brix content that was statistically similar with NPK control, but significantly higher than when a higher rate of 120:60:60 kg ha^{-1} NPK was applied. Considering NPK at different poultry manure rates, increasing the rate of poultry manure from 0 to 8 t ha^{-1} significantly decreases brix content of sweet melon with the NPK control. At NPK 60:30:30 and 120:60:60 kg ha^{-1}, increasing the poultry manure rate from 0 to 4 t ha^{-1} resulted in statistically similar brix content. However, applying the highest poultry manure rate at the NPK rates, significantly decreases brix content. Looking at each poultry manure rate across NPK fertilizer rates at Bagauda, significant difference on brix content was notable only when 8 t ha^{-1} of poultry manure was applied whereas each rate of NPK fertilizer significantly decreased brix content. At each NPK rate along the poultry manure rates, each increment in poultry manure rate significantly decreased brix content of sweet melon only at applied 120-60-60 kg ha^{-1} NPK fertilizer. However, with applied 60-30-30 kg ha^{-1} NPK fertilizer, plots without applied poultry manure, had higher brix content only when compared to those with application of 8 t ha^{-1} of poultry manure. Sweet melon brix content was not significantly influenced where no NPK was applied and with combination of poultry manure rates.

Fruit Yield per Hectare

Response of Sweet melon fruit yield per hectare to poultry manure and NPK is shown in table 3. There was no significant difference in yields of the two sweet melon varieties at the two locations, although variety Uranus had higher yields in both locations than variety Jupiter. However, there was a significant effect of poultry manure and NPK fertilizer on fruit yield per hectare at both locations. At Samaru, application of 4 to 8 t/ha of poultry manure produced similar fruit yields that were significantly higher than 0t/ha. However, at Bagauda, 4 t/ha poultry manure recorded significantly higher fruit yield than 8 and 0 t/ha. Similarly, 8 t/ha poultry manure also produced significantly higher fruit yield compared to 0t/ha. Application of varying rates of NPK fertilizer also had significant influence on fruit yields at the two locations, with 60:30:30 kg/ha NPK fertilizer having significantly higher fruit yield than 120:60:60 and 0 kg/ha. Similarly, 120:60:60 kg/ha of NPK fertilizer also recorded significantly higher fruit yield than 0kg/ha at both locations.

There was no significant influence of interactions on fruit yield at both locations except for the interaction between poultry manure and NPK fertilizer which had significant effect on fruit yield at the two locations presented in table 7 and 8 for Samaru and Bagauda respectively. At poultry manure control rate in Samaru, application of 120:60:60 NPK kg ha^{-1} had heavier yield only when compared to plots without fertilizer, while other rates were statistically similar. With applied 4 or 8 t ha^{-1} of poultry manure, application of NPK from 0:0:0 to 60:30:30 kg ha^{-1} increased fruit yield significantly, but further rate decreased the fruit yield. Looking at each NPK rate along the poultry manure rates, heavier yield was obtained with application of NPK from 0:0:0 to 60:30:30 kg ha^{-1}, but further rate decreased the fruit yield. At Bagauda and on plots that received 0t/ha of poultry manure, each increase in NPK led to increase on fruit yield per hectare of sweet melon. Application of 4 and 8 t ha^{-1} of poultry manure, application of 0:0:0 to 60:30:30 kg ha^{-1} NPK significantly increased fruit yield per hectare, however, when the highest NPK rate was applied at same poultry manure rates, fruit yield significantly decreased. At NPK 0:0:0 rate, each increase in poultry manure rate significantly increased fruit yield per hectare. Similarly, at 60:30:30 and 120:60:60 kg ha^{-1} NPK rates, increasing the poultry manure rate from 0 to 4 t ha^{-1} of poultry manure significantly increased fruit yield per hectare, further increase to 8 t ha^{-1} at same NPK rates significantly decreased fruit yield

Table 3: Effect Of Poultry Manure And NPK On Brix Content, Shelf Life and Fruit Yield per Hectare of Sweet Melon Varieties at Samaru and Bagauda During 2021 Rainy Season

	Brix content, Shelf-life and fruit yield per hectare of sweet melon					
	Samaru			Bagauda		
Treatment	Brix content (%)	Shelf-life (days)	Fruit yield per hectare (t)	Brix content (%)	Shelf-life (days)	Fruit yield per hectare (t)
Variety (V)						
Jupiter	4.8	16.1^{b}	24.9	5.0	18.4^{a}	55.6
Uranus	5.2	19.2^{a}	26.6	5.2	17.2^{b}	56.1
SE±	0.18	0.41	1.65	0.18	0.40	1.36
Poultry manure (P) (t/ha)						
0	4.6^{b}	14.4^{b}	13.6^{b}	4.4^{b}	16.2^{c}	33.8^{c}
4	5.5^{a}	18.6^{a}	33.0^{a}	5.6^{a}	17.7^{b}	71.9^{a}
8	4.8^{b}	19.9^{a}	30.5^{a}	5.4^{a}	19.5^{a}	62.0^{b}
SE±	0.22	0.50	2.02	0.22	0.49	1.66
NPK (20-10-10) (F) (Kgha^{-1})						
0:0:0	4.2^{b}	16.1^{b}	13.3^{c}	4.8^{b}	16.3^{b}	32.9^{c}
60:30:30	6.0^{a}	18.4^{a}	35.9^{a}	5.7^{a}	17.3^{b}	70.7^{a}
120:60:60	4.7^{b}	18.4^{a}	27.9^{b}	4.9^{b}	19.8^{a}	64.1^{b}
SE±	0.22	0.50	2.02	0.22	0.49	1.66
Interactions						
V*P	NS	NS	NS	NS	NS	NS
V*F	NS	NS	NS	NS	NS	NS
P*F	**	NS	**	**	NS	**
V*P*F	NS	NS	NS	NS	NS	NS

SE+: Standard Error; a,b,c: Means with the same superscript in the same column are not different statistically at *P=0.05* level of probability using DMRT; NS= Not significant.

Table 4: Interaction of Poultry Manure and NPK Fertilizer on 100 Grains Weight of Sweet Corn during 2021 Rainy Season at Bagauda

	Poultry manure (t/ ha)		
Treatment	0	4	8
NPK (20-10-10) (F) (kg /ha)			
0:0:0	10.1^{e}	12.5^{d}	13.2^{cd}
60:30:30	12.9^{cd}	13.6^{bc}	14.1^{b}
120:60:60	14.1^{b}	14.9^{a}	15.6^{a}
SE±		0.25	

SE+: Define this; a,b,c,d,e: Means with the same superscript in the same column are not different statistically at *P=0.05* level of probability using DMRT; NS= Not significant.

Table 5: Interaction of Poultry Manure and NPK Fertilizer on Brix Content of Sweet Melon at Samaru during 2021 Rainy Season

	NPK (kg/ha)		
Treatment	0-0-0	60-30-30	120-60-60
Poultry manure (t/ha)			
0	21.8^{a}	19.5^{ab}	18.5^{bc}
4	18.5^{bc}	20.5^{ab}	16.8^{cd}
8	15.0^{de}	15.2^{de}	13.0^{e}
SE±		0.86	

SE+: Define this; a,b,c,d,e: Means with the same superscript in the same column are not different statistically at *P=0.05* level of probability using DMRT; NS= Not significant.

Table 6: Interaction of Poultry Manure and NPK Fertilizer on Brix Content of Sweet Melon at Bagauda during 2021 Rainy Season

	NPK ($kgha^{-1}$)		
Treatment	0-0-0	60-30-30	120-60-60
Poultry manure (t/ha)			
0	21.0^{a}	18.5^{abc}	19.2^{ab}
4	19.0^{abc}	17.5^{bcd}	16.5^{cd}
8	19.5^{ab}	15.8^{d}	13.2^{e}
SE±		0.84	

SE+: Standard Error; a,b,c,d,e: Means with the same superscript in the same column are not different statistically at *P=0.05* level of probability using DMRT; NS= Not significant.

Table 7: Interaction of Poultry Manure and NPK Fertilizer on Fruit Yield per Hectare (T/Ha) of Sweet Melon at Samaru during 2021 Rainy Season

	NPK Fertilizer (kg /ha)		
Treatment	0-0-0	60-30-30	120-60-60
Poultry manure (t /ha)			
0	4.8^{e}	14.4^{de}	21.7^{cd}
4	16.2^{cd}	47.5^{a}	35.5^{b}
8	19.1^{cd}	45.9^{a}	26.6^{bc}
SE±		3.50	

SE+: Standard Error; a,b,c,d,e: Means with the same superscript in the same column are not different statistically at *P=0.05* level of probability using DMRT.

Table 8: Interaction of Poultry Manure and NPK Fertilizer on Fruit Yield per Hectare of Sweet Melon at Bagauda during 2021 Rainy Season

	NPK Fertilizer (kg /ha)		
Treatment	0-0-0	60-30-30	120-60-60
Poultry manure (t /ha)			
0	13.2f	35.8^{e}	52.3^{d}
4	36.1^{e}	102.2^{a}	77.4^{b}
8	49.5^{d}	73.9^{b}	62.5^{c}
SE$\pm$		2.87	

SE+: Standard Error; a,b,c,d,e,f: Means with the same superscript in the same column are not different statistically at *P=0.05* level of probability using DMRT.

Discussion

Sweet corn yield attributes such as number of cobs per plant, cob diameter, 100 grains weight, fresh and dry yield significantly responded to applied poultry manure from 0 to 8 t ha^{-1} at both locations since inherent nutrient and organic matter is relatively low in these soils, the soil tend to benefit from use of poultry manure which has the three prong effect of chemical, biological and physical activities. For each increase in application of poultry manure rate from 0 to 4 and 4 to 8 t ha^{-1} led to increase in yield parameter at both locations. This could be due to adequate supply and availability of nutrients (N, P, K, Ca and Mg) which obviously stimulated rapid crop growth and development in plots nourished with poultry manure. This observation is in consistence with the findings of Udom and Bello (2009) who reported that the application of poultry litter significantly increased grain yield of maize and attributed the increase to the supply of nutrients especially Nitrogen and phosphorus by the poultry litter which promoted better crop performance. This is also in harmony with the findings of Boateng *et al*. (2006) who reported that the application of poultry manure at a rate of 4 t ha^{-1} helps to improve maize yields significantly. Shiyam *et al.* (2017) also reported increase in number of cobs per plant and grain yield of popcorn to increased poultry manure rate.

Yield characters of sweet melon such as number of fruits per plant, fruit length, fruit circumference, brix content, shelf-life and fruit yield per hectare responded significantly to increase in poultry manure rate from 0 to 8 t ha^{-1}, although most of the parameters were significant at 4 t ha^{-1} at both locations. This could be attributed to the role of poultry manure in improving soil conditions for crop establishment, as well as releasing adequate nutrient elements for yield improvement. Ijoyah (2007) reported increased number of matured fruits, fruit length, fruit diameter, fruit weight and yield of sweet melon with applied poultry manure than the untreated control. Adinde *et al*. (2021) opined that the increase in fruit yield per plant of cucumber may be due to high concentration of nutrients provided by the poultry manure which boosted the growth over no manure application (control). This is also in harmony with the reports of Adekiya and Ojeniyi (2002) and Agbede *et al*. (2008). Oke *et al*. (2020) reported cucumber yield increase of 66.15% over control and attributed the increase to the role of poultry manure in improving nutrients availability to plants, bulk density, aeration and water holding capacity of the soil which translated to increase in vegetative growth, accelerated division of meristematic tissue and metabolic reactions and more intake of assimilates as a result of which the increase in the number of fruits per plant occurred.

Sweet corn number of cobs, cob diameter and fresh yield per hectare were significantly increased with increase in NPK fertilizer, with applied 120:60:60 kg ha^{-1} recording the highest fresh yield at both locations. This could be ascribed to the role of NPK fertilizer in supplying essential nutrients (N, P, K) required for physiological activities such as root development, dry matter production transformation of sugars to starch in grain-filling process and crop maturity. This is in line with the findings of Sani *et al*. (2011), who reported that yield components of sweet corn such as 1000-grain weight and fresh cob yield responded significantly to NPK fertilization up to the highest rate of 120:60:60 kg ha^{-1}. Similarly, Lawal (2000) also reported that maize yield responded to fertilizer application up to 600kg/ha (120:60:60 kg ha^{-1}). This result further agrees with the findings of Law-Ogbomo (2009), who reported that NPK fertilizer applications significantly increased plant height, leaf area, dry matter accumulation and yield. All sweet melon yield characters (number of fruits, fruit length, fruit circumference, brix content, shelf life and fruit yield per hectare) significantly responded to NPK fertilizer treatment up to 60:30:30 kg ha^{-1} at both locations. Aluko *et al.* (2020) reported that application of varying rates of NPK 15-15-15 fertilizer increased the vegetative growth and yield of muskmelon with highest fruit yield ha^{-1} on plots that received 500 kg ha^{-1} NPK 15- 15-15 fertilizer, though not significantly higher than applied 333 kg ha^{-1} NPK 15-15-15 fertilizer. Nwofia (2015) reported significant increase in fruit yield of cucumber in response to N:P: K 15:15:15 fertilizer up to 120 kg ha^{-1}. Other researchers El-badawi (1994), Lawal (2000) and Agba and Enya (2005) have all reported increase in growth and yield components of cucumber to applied fertilizer.

The significant interaction of poultry manure and NPK on brix content and fruit yield per hectare of sweet melon could be ascribed to the role of nutrients from inorganic fertilizers which enhanced the establishment of crops while those from mineralization of organic manure promoted yield when both fertilizers were combined. This is in support of the report of Foncha *et al*. (2019) who reported that the treatment of 150 Kg NPK ha^{-1} + 2.5tons PM ha^{-1} gave higher yields of cucumber compared to sole application of fertilizer or manure. Similarly, Opara *et al*. (2012) reported that best results for fruit yield were obtained from plots treated with 5 t ha^{-1} of poultry manure supplemented with 120 kg ha^{-1} of NPK and 10 t ha^{-1} PM supplemented with 60 kg ha^{-1} NPK (18.24 and 19.30 t ha^{-1}) for wet and dry seasons, respectively.

Conclusion

From the study, it can be concluded that yield and yield components of sweet corn and sweet melon increased with increase in inorganic fertilizer rates up to 120:60:60kg/ha and 60:30:30kg/ha, respectively. Based on the results obtained, yield and yield components of both crops (sweet corn and sweet melon) responded significantly to poultry manure rates up to 8 t/ha and 4 t/ha for sweet corn and sweet melon, respectively. Sweet melon varieties showed no significant differences on yield and yield components.

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Appendix I: Physical and Chemical Properties of Soils at the Experimental Sites during the 2021 Rainy Season

Soil Composition	Depth of Soil (0 – 30cm)	
Particle size distribution (g kg^{-1})	**Samaru**	**Bagauda**
Sand	480	560
Silt	380	340
Clay	140	100
Textural class	Loam	Sandy Loam
Chemical composition		
pH in H_2O (1:2.5)	5.64	6.70
pH in 0.01M $CaCl_2$ (1:2.5)	4.85	5.25
Organic Carbon (g kg^{-1})	12.60	14.25
Total Nitrogen (g kg^{-1})	1.50	1.65
Available Phosphorus (mg kg^{-1})	8.65	10.45
Exchangeable cations (cmol kg^{-1})		
Calcium (Ca^{2+})	2.65	3.16
Magnesium (Mg^{2+})	0.46	0.59
Potassium (K^{+})	0.15	0.18
Sodium (Na^{+})	0.21	0.24
Aluminium and Hydrogen (Al^{3++} H^{+})	0.21	0.16
Cation Exchange Capacity (C.E.C)	3.68	4.33

Analysed at the Department of Agronomy, Ahmadu Bello University Zaria.

Appendix II: Meteorological data showing mean of Rainfall amount, Temperatures, Relative humidity and Solar Radiation during 2021 Rainy at Samaru

Month	Rainfall (mm)	Temperature (ºC)		Relative humidity (%)	Solar Radiation
		Min.	Max.		(Sunshine hours)
June	170.90	30.50	23.00	74.17	N/A
July	238.40	28.16	22.58	79.26	N/A
August	341.60	29.10	22.45	82.32	N/A
September	195.60	30.00	22.57	74.73	N/A
October	48.80	32.84	22.19	63.35	N/A
November	0.00	34.00	18.40	26.57	N/A

N/A = Not Available
Source: IAR Meteorological Unit, Ahmadu Bello University, Zaria, Nigeria (2021)

Appendix III: Meteorological Data Showing Mean of Rainfall Amount, Temperatures, Relative Humidity and Solar Radiation During 2021 Rainy At Bagauda

Month	Rainfall (mm)	Temperature (ºC)		Relative humidity (%)	Solar Radiation
		Min.	Max.		(Sunshine hours)
June	85.00	29.2	37.9	56.00	N/A
July	162.00	26.8	34.4	62.00	N/A
August	446.00	24.5	31.3	89.00	N/A
September	124.80	22.8	32.5	85.00	N/A
October	22.30	25.3	33.9	46.00	N/A
November	0.00	23.4	31.2	38.00	N/A

N/A = Not Available
Source: Meteorological Unit, National Horticultural Research Sub-station, Bagauda (2021)