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YIELD PERFORMANCE OF MUSK MELON (*CUCUMIS MELO* L.) AS INFLUENCED BY INTRA-ROW SPACING AND POULTRY MANURE RATE IN SAVANNA ZONE OF NIGERIA

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ABSTRACT

Bilocation trials were conducted during the 2023 rainy season in Dutsin-Ma, Sudan Savanna ecological zone and Malumfashi, Northern Guinea Savanna ecological zone, Nigeria, to determine the yield response of Musk melon (*Cucumis melo* L.) varieties to intra-row spacing and poultry manure. The treatments comprised 2x3x4 factorial combinations of two musk melon varieties (NEPTUNE F1 and URANUS F1), three intra-row spacing treatments (25cm, 50cm, and 75cm), and four poultry manure rates (0, 5, 10, and 15 tons/ha). A Randomized Complete Block Design (RCBD) with three replications was used. URANUS F1 significantly ($P<0.05$) hastened flowering compared with NEPTUNE F1. URANUS F1 produced significantly ($P<0.05$) higher fruit weight/plant and fruit yield/plant than NEPTUNE F1 in Malumfashi. 75cm intra-row spacing produced significantly ($P<0.05$) higher fruit diameter and fruit weight/plant than other intra-row spacings. 75cm intra-row spacing produced significantly ($P<0.05$) higher fresh fruit yield/hectare than other intra-row spacings in Dutsin-Ma, but 50cm intra-row spacing produced significantly ($P<0.05$) higher fresh fruit yield/hectare than other intra-row spacings in Malumfashi. Applying 15 t poultry manure ha^{-1} produced significantly ($P<0.05$) higher fruit diameter, fruit weight/plant and fresh fruit yield/hectare than other rates. Interaction between intra-row spacing and poultry manure was significant on fresh fruit yield/hectare, where 50cm intra-row and 15 t poultry manure ha^{-1} produced significantly higher fruit yield/hectare than other combinations. In conclusion, sowing NEPTUNE F1 in Dutsin-Ma and URANUS F1 at Malumfashi at 50cm intra-row spacing and 15 t poultry manure ha^{-1} is the most suitable for musk melon yield in the study area.

Keywords: Musk Melon, Intra-Row Spacing, Poultry Manure, Variety, Savanna

INTRODUCTION

Musk melon is an emerging crop in Nigeria with nutritional, medicinal, and economic importance (Gupta *et al.,* 2022). However, its yield potential is limited by poor agronomic practices. Despite the usefulness of this crop, the yield remains low due to small-scale cultivation and poor agronomic practices, including incorrect spacing, infertile soil, pest and disease infestations, over-reliance on inorganic fertilizer, among others (Aliyu et *al.,* 2023). The primary aim of every farmer is to achieve higher yields and income, which is only possible when all production factors, including inputs such as organic manure, are applied or available at optimum levels (Ekeoma and Adesoji, 2018). Thus, organic farming has emerged as a sustainable economic, environmental, and social measure (Pacini *et. al.,* 2003). Recent studies have shown that the yield of organically grown melon crops can be similar to or higher than that of conventionally grown melons (Melero *et al.*, 2006). Poultry manure, an affordable and nutrient-rich amendment, has been identified as a potential solution to declining soil fertility (Eifediyi *et al*., 2020). At present, there are few recommended standards for the rate of poultry manure to enhance muskmelon yield in the study area. Determination of the lowest plant population required for optimal yield, a major agronomic goal, has been conducted for many crops, such as watermelon (Adeyeye *et al.,* 2017).

There are no records as yet on the production of different varieties of musk melon with respect to optimum planting density and poultry manure rate, and on their growth and development. Although studies have addressed fertilizer management and spacing in cucurbits species (Moses *et al.,* 2021; Rahman *et al*., 2022), little has been done to evaluate their interaction with varietal performance in the semi-arid region of Nigeria. More research on the agronomic aspects of sweet melon is needed to provide information and knowledge that could help promote the crop's productivity and ensure food security in the study area. Therefore, this study was designed to evaluate the influence of intra-row spacing and poultry manure application on yield and yield components of musk melon varieties in the Savanna zone of Nigeria.

MATERIALS AND METHODS

Two-location trials were conducted during the 2023 rainy season at the Teaching and Research Farm, Faculty of Agriculture, Federal University Dutsin-Ma Permanent Site (Lat. 12°17 'N, Long. 07°27'E, 605 m above sea level) in the Sudan Savanna, and at the Faculty of Agriculture Farm, Umaru Musa Yar'adua University (Layin Minister), Malumfashi (Lat. 11°41' N, Long. 7°30'E, 858 m above sea level) in the northern Guinea Savanna of Nigeria. The treatments comprised 2 x 3 x 4 factorial combinations of two varieties (NEPTUNE F1 and URANUS F1), three intra-row spacings (25, 50, and 75 cm), and four poultry manure rates (0, 5, 10, and 15 t ha^{-1}). The experiment was laid out in a Randomized Complete Block Design (RCBD) and replicated three times. The gross plot size was 4.5 m x 3 m (13.5 m^2) and the net plot was 4.5 m x 1.5 m (6.75 m^2).

The experimental field was ploughed and harrowed to achieve a fine tilth, and ridges 75 cm apart were formed. Musk melon seeds were planted at 4 seeds per hole, with intra-row spacing varying by treatment. Musk melon seedlings were thinned to two seedlings per hill. Poultry manure, according to the treatments, was applied during land preparation two weeks prior to sowing at rates of 0, 5, 10, and 15 t ha^{-1}. Weeds were controlled manually with a hand hoe at 3 and 6 WAS. Cypermethrin (10% E.C.) was applied against insect pests at 4 L ha^{-1} at one-week intervals, starting at flowering and continuing to harvest.

The following data were collected: days to 50% flowering, fruit diameter (cm), fruit weight per plant (g) and fresh fruit yield per hectare (kg). The data were analyzed using analysis of variance (ANOVA) as described by Gomez and Gomez (1984) in SAS version 9.0 (SAS, 2002). Differences among treatment means were assessed using Duncan's Multiple Range Test (DMRT) (Duncan, 1955). Effects were considered statistically significant at the 5% level of probability.

RESULTS AND DISCUSSION

Physicochemical Properties of Experimental Soils and Chemical Properties of Poultry Manure Used

Table 1 shows the physical and chemical characteristics of the soils at the experimental sites during the 2023 wet season at Dutsin-Ma and Malumfashi. The soil at the Dutsin-Ma site was loamy sand, slightly alkaline (pH 7.45), and had a moderate available phosphorus content (15.60 mg kg^{-1}). By contrast, the Malumfashi site had sandy loam soil, an acidic pH (5.37), and a moderate available phosphorus content (16.80 mg kg^{-1}). Organic carbon was high in both locations (12.61 and 14.10), with a higher value in Malumfashi. Total nitrogen was low in Dutsin-Ma (1.65) but higher in Malumfashi (1.86). Exchangeable Mg was slightly high, and Na was moderate in both locations, whereas Ca and K were medium in Dutsin-Ma and high in Malumfashi, respectively. The effective cation exchange capacity was moderate in both locations (4.06 and 4.18).

The chemical characteristics of poultry manure used for the experiment during the 2023 wet season at Dutsin-Ma and Malumfashi are shown in Table 1. The analysis showed that the total nitrogen was 23.60(g kg^{-1}). The exchangeable bases Mg content was 3.96, while Ca and K were 6.40 and 13.20, respectively (Table 1).

Number of Days to 50% Flowering

Varietal effect was significant ($P<0.05$) on days to 50% flowering in both locations, where URANUS F1 produced significantly lower days to 50% flowering than NEPTUNE F1 (Table 2). Intra-row spacing was only significant ($P<0.05$) on days to 50% flowering in Malumfashi where sowing musk melon at 50 and 75cm produced significantly ($P<0.05$) lower days to 50% flowering than sowing musk melon at 25cm intra-row spacing. Poultry manure application was significant ($P < 0.05$) in both locations, with increasing the rate from 0 t ha^{-1} to higher rates significantly hastening flowering in musk melon (Table 2). The interaction between intra-row spacing and poultry manure was significant ($P<0.05$) on days to 50% flowering, with sowing musk melon at any intra-row spacing on no poultry manure plots significantly ($P<0.05$) delaying flowering in musk melon (Table 3). The combination of 50/75 cm intra-row and 15 t ha^{-1} gave the lowest days to 50% flowering, though not significantly different from the combination of 25 cm intra-row and 10/15 t poultry manure ha^{-1}.

Table 1: Physical and Chemical Properties of Soils at the Experimental Sites and Poultry Manure Used During the 2023 Rainy Season

Soil Characteristics	Soil depth (0-30cm)	
Experimental Sites	Dutsin-Ma	Malumfashi
Particle Size Distribution (%)		
Sand (%)	800	540
Silt (%)	120	360
Clay (%)	80	100
Textural Class	Loamy Sand	Sandy Loam
Chemical Composition		
pH in H_2O (1:2.5)	7.45	5.37
pH in 0.01M $CaCl_2$ (1:2.5)	6.55	6.46
Organic Carbon (g kg^{-1})	12.61	14.10
Total Nitrogen (g kg^{-1})	1.65	1.86
Available Phosphorus (g kg^{-1})	15.60	16.80
Exchangeable Bases (Cmol kg^{-1})		
Calcium (Ca)	2.98	3.01
Magnesium (Mg)	0.54	0.48
Potassium (K)	0.20	0.22
Sodium (Na)	0.14	0.17
Aluminium and Hydrogen (Al^{3+} H^+)	0.2	0.3
ECEC	4.06	4.18
Poultry Manure nutrient composition (g kg^{-1})		
Total Nitrogen	23.60	
Calcium (Ca^{2+})	6.40	
Magnesium (Mg^{2+})	3.96	
Potassium (K^+)	13.20	

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

Fruit Diameter (cm)

The effect of variety was not significant ($P>0.05$) on the fruit diameter of musk melon in both locations (Table 3). Intra-row spacing was significant ($P<0.05$) on fruit diameter in both locations, where sowing musk melon at 75cm produced significantly ($P<0.05$) higher fruit diameter than other intra-row spacings; however, intra-row spacing of 25cm gave the lowest fruit diameter. Application of 15 t poultry manure ha^{-1} produced significantly ($P<0.05$) higher fruit diameter than other rates of poultry manure in both locations (Table 3), while no poultry manure plots gave the lowest fruit diameter. The interactions were not significant on the fruit diameter of musk melon ($P>0.05$) in both locations.

Fruit Weight per Plant (g)

The varietal effect significantly (P<0.05) increased fruit weight per plant in Malumfashi only, where URANUS F1 produced significantly higher fruit weight per plant than NEPTUNE F1 (Table 4). Intra-row spacing was significant (P<0.05) on fruit weight per plant in both locations, where sowing musk melon at 75cm intra-row produced significantly (P<0.05) higher fruit weight per plant than other intra-row spacings; however, the plots that carried musk melon sown at an intra-row spacing of 25cm gave the lowest fruit weight per plant. Poultry manure application significantly (P<0.05) increased fruit weight per plant, where application of 15t poultry manure ha^{-1} produced significantly (P<0.05) higher fruit weight per plant than other rates of poultry manure in both locations (Table 4), while no poultry manure plots gave the lowest fruit weight per plant. The interaction between intra-row spacing and poultry manure was significant (P<0.05) on fruit weight per plant in both locations, with sowing musk melon at any intra-row spacing on no poultry manure plots significantly (P<0.05) reduced fruit weight per plant in musk melon (Table 5). The combination of 75cm intra-row spacing and 15t poultry manure ha^{-1} gave the highest fruit weight per plant.

Table 2: Response of Varieties, Intra-row Spacing and Poultry Manure Rate on Days to 50% Flowering and Fruit Diameter of Musk Melon at Dutsin-Ma and Malumfashi during 2023 Rainy Season

	Dutsin-Ma		Malumfashi	
Treatment	**Days to 50% Flowering**	**Fruit Diameter (cm)**	**Days to 50% Flowering**	**Fruit Diameter (cm)**
Variety (V)				
URANUS F1	33.14^{b}	9.07	32.75^{b}	9.65
NEPTUNE F1	34.28^{a}	9.15	33.81^{a}	9.83
SE±	0.235	0.046	0.296	0.056
Intra Row Spacing (S) (cm)				
25	34.17	8.19^{c}	34.50^{a}	8.67^{c}
50	33.58	9.18^{b}	32.71^{b}	9.74^{b}
75	33.38	9.96^{a}	32.63^{b}	10.82^{a}
SE±	0.353	0.069	0.445	0.084
Poultry Manure (P) (t ha^{-1})				
0	42.11^{a}	7.53^{d}	40.72^{a}	8.29^{d}
5	36.33^{b}	8.35^{c}	34.22^{b}	9.58^{c}
10	29.22^{c}	9.80^{b}	30.61^{c}	10.25^{b}
15	27.17^{d}	10.76^{a}	27.56^{d}	10.85^{a}
SE±	0.470	0.092	0.593	0.112
Interaction				
V*S	NS	NS	NS	NS
V*P	NS	NS	NS	NS
S*P	NS	NS	*	NS
V*S*P	NS	NS	NS	NS

Means followed by the same letters within a column in each treatment group are not significantly different at the 5% probability level according to the Duncan Multiple Range Test (DMRT). WAS= Week after sowing. NS= Not Significant at 5% level of probability. * = Significant at 5% level of probability. SE = Standard error.

Table 3: Interaction Between Intra-row Spacing and Poultry Manure Rate on Days to 50% Flowering in Musk Melon during 2023 Wet Season at Malumfashi

Treatment	Poultry Manure Rates (P) t ha^{-1}			
	0	**5**	**10**	**15**
Intra row spacing (S) cm				
25	42.00^{a}	39.33^{a}	27.83^{cd}	28.83^{cd}
50	40.17^{a}	32.83^{b}	30.50^{bc}	27.00^{d}
75	40.00^{a}	30.50^{bc}	33.50^{b}	26.83^{d}
SE±	1.452			

Means followed by the same letters are not significant different at 5% probability level according to Duncan Multiple Range Test (DMRT)

Fresh Fruit Yield (kg ha^{-1})

The varietal effect significantly (P<0.05) increased fresh fruit yield per hectare only in Malumfashi, where URANUS F1 produced significantly higher fresh fruit yield per hectare than NEPTUNE F1 (Table 4). Intra-row spacing was significant (P<0.05) on fresh fruit yield per hectare in both locations, where sowing musk melon at 75cm intra-row produced significantly (P<0.05) higher fresh fruit yield per hectare than other intra-row spacings in Dutsin-Ma while it was 50cm intra-row spacing that produced significantly (P<0.05) higher fresh fruit yield per hectare in Mulumfashi; however, the plots that carried musk melon sown at an intra-row spacing of 25cm gave the lowest fresh fruit yield per hectare. Poultry manure application significantly (P<0.05) increased fresh fruit yield per hectare, where application of 15t poultry manure ha^{-1} produced significantly (P<0.05) higher fresh fruit yield per hectare than other rates of poultry manure in both locations (Table 4), while no poultry manure plots gave the lowest fresh fruit yield per hectare. The interaction between intra-row spacing and poultry manure was significant (P<0.05) on fresh fruit yield per hectare in both locations, with sowing musk melon at any intra-row spacing on no poultry manure plots significantly (P<0.05) reduced fresh fruit yield per hectare in musk melon (Table 6). The combination of 50cm intra-row spacing and 15t poultry manure ha^{-1} produced the highest fresh fruit yield per hectare.

Table 4: Effect of Varieties, Intra-row Spacing and Poultry Manure Rate on Average Fruit Weight per Plant and Fresh Fruit Yield per Hectare of Musk Melon at Dutsin-Ma and Malumfashi during 2023 Rainy Season

Treatment	Dutsin-Ma		Malumfashi	
	Fruit Weight/ Plant (g)	Fresh Fruit Yield (kg ha^{-1})	Fruit Weight/ Plant (g)	Fresh Fruit Yield (kg ha^{-1})
Variety (V)				
URANUS F1	347.5	7485	395.9^{a}	9298^{a}
NEPTUNE F1	353.8	7906	380.3^{b}	8801^{b}
SE±	0.610	35.05	0.858	45.56
Intra Row Spacing (S) (cm)				
25	208.1^{c}	6465^{c}	208.8^{c}	7209^{b}
50	375.2^{b}	7932^{b}	412.9^{b}	10111^{a}
75	468.7^{a}	8690^{a}	542.6^{a}	9829^{a}
SE±	0.915	52.57	1.287	68.34
Poultry Manure (P) (t ha^{-1})				
0	171.2^{d}	1052^{d}	186.6^{d}	1266^{d}
5	290.1^{c}	4025^{c}	346.7^{c}	4974^{c}
10	418.4^{b}	9258^{b}	471.8^{b}	11314^{b}
15	523.0^{a}	16448^{a}	547.2^{a}	18643^{a}
SE±	1.221	70.09	1.716	91.11
Interaction				
V*S	NS	NS	NS	NS
V*P	NS	NS	NS	NS
S*P	**	**	**	**
V*S*P	NS	NS	NS	NS

Means followed by the same letters within a column in each treatment group are not significantly different at the 5% probability level using the Duncan Multiple Range Test (DMRT). WAS= Week after sowing
NS= Not Significant at 5% level of probability. ** = Significant at 1% level of probability. SE = Standard error

Table 5: Interaction between Intra-row Spacing and Poultry Manure Rate on Fruit Weight per Plant (g) in Musk Melon during 2023 Wet Season at Dutsin-Ma and Malumfashi

Treatment	Poultry Manure Rate (p) t ha^{-1}			
	0	**5**	**10**	**15**
Intra-row spacing (S) CM				
	Dutsin-Ma			
25	107.3^{i}	168.3^{h}	247.0^{f}	309.6^{f}
50	186.3^{h}	301.6^{e}	440.4^{c}	572.5^{b}
75	220.1^{g}	400.4^{d}	567.8^{b}	686.7^{a}
SE±	6.342			
	Malumfashi			
25	118.2^{j}	161.0^{i}	240.7^{g}	315.2^{f}
50	206.7^{h}	353.9^{e}	501.3^{d}	589.6^{c}
75	235.1^{g}	525.1^{d}	673.4^{b}	736.8^{a}
SE±	8.919			

Means followed by the same letters are not significant different at 5% probability level according to Duncan Multiple Range Test (DMRT)

Table 6: Interaction between Intra-row Spacing and Poultry Manure Rate on Fresh Fruit Yield per Hectare (kg) in Musk Melon during 2023 Wet Season at Dutsin-Ma and Malumfashi

Treatment	Poultry Manure Rate (P) t ha^{-1}			
	0	**5**	**10**	**15**
Intra-row spacing (S) CM				
	Dutsin-Ma			
25	915.7^{i}	3066^{h}	7774^{f}	14105^{c}
50	1263^{i}	4361^{g}	10733^{d}	18403^{a}
75	977.3^{i}	4647^{g}	9267^{e}	16835^{b}
SE±	364.2			
	Malumfashi			
25	1124^{h}	3297^{g}	8632^{e}	15782^{c}
50	1454^{h}	5589^{f}	12392^{d}	21009^{a}
75	1220^{h}	6037^{f}	12920^{d}	19139^{b}

Treatment	**Poultry Manure Rate (P) t ha^{-1}**			
	0	**5**	**10**	**15**
SE±	473.4			

Means followed by the same letters are not significant different at 5% probability level according to Duncan Multiple Range Test (DMRT)

Discussion

Varieties significantly responded to the yield characters of sweet melon. The results obtained revealed that NEPTUNE F1 outperformed in Dutsinma, and URANUS F1 outperformed in Malumfashi. The varietal difference observed between the two varieties, as noted by Aliyu *et al.* (2023), may be attributed to the variety's adaptability to respond to available nutrients in its cellular growth, photosynthetic processes, assimilate production, and translocation. The genetic composition of each variety under investigation may have contributed to the performance difference observed between the two varieties in this study. This agrees with the findings of Matja *et al.* (2020), who conducted an experiment to assess the response of two sweet melon varieties to combinations of growing media enriched with bag-log waste compost, poultry manure, and cow dung manure.

The intra-row spacing significantly influenced the performance of musk melon in terms of yield and yield components. It was observed that the intra-row spacing of 75cm significantly enhanced the performance of sweet melon in terms of yield and yield characters evaluated. The better performance of crops grown on plots with an intra-row spacing of 75cm could be attributed to adequate spacing during plant production, which increased crop growth and yield. This aligns with Moses et al. (2021), who reported that optimal spacing reduces competition in cucurbits. This agrees with the report of Dean *et al*. (2004). Mangala and Mausia (2006) observed that vegetative parameters increased with increasing melon spacing. One of the most important factors in a flourishing crop is correct spacing, as it allows the plant to develop to its full potential above and below ground. Adlan and Abu-Sarra, (2018**)** stated that cucurbits yield per area unit tends to increase with plant density up to a certain level, and afterwards it tends to decrease due to competition between plants.

Application of poultry manure significantly enhanced the yield and yield components of the musk melon studied. This could be attributed to the fact that poultry manure is an excellent soil amendment that, when applied judiciously, provides nutrients for crop growth and improves soil quality, owing to its high organic matter content, thereby making its nutrients available for plant growth (Oyedeji *et al*., 2014). This supports earlier reports that organic manure improves soil fertility and crop performance (Eifediyi et al., 2020; Duruigbo et al., 2021). Application of 15t poultry manure ha^{-1} produced the highest performance on fresh fruit yield and yield components of musk melon. This made the application of 15 t of poultry manure ha^{-1} a better rate for this study. The increased fresh fruit yield with poultry manure is supported by findings from other researchers who reported increases in musk melon fresh fruit yield (Ijoyah, 2007; Kura *et al*., 2017; Disa *et al.*, 2023). The reduction in flowering time with manure application is consistent with Rahman et al. (2022), who observed that nutrient-rich organic inputs promote earlier reproductive development. The untreated control plots (0 t ha^{-1}) of poultry manure recorded the lowest values in majority of the growth and yield characters of the crop during the experiment, the low performance of the (0 t ha^{-1}) control treatment could be as a result of nutrient stress by the plants poor soil aeration, lower soil microbial activities etc., which agrees with Aujla *et al.*, (2007), and Akanbi *et al*. (2007) where similar reports were also obtained.

The interaction between intra-row spacing and poultry manure on yield indices of musk melon, including the number of days to 50% flowering, fruit weight per plant, and fresh fruit yield, was observed. This suggests that the larger the intra-row space, the better the musk melon was able to express itself and exploit the mineralized nutrients from poultry manure. It also revealed that the highest fresh fruit yield was achieved with the application of poultry manure at 15 t ha^{-1} under an intra-row spacing of 50 cm, which was the best combination for maximum performance of musk melon in the study area. This is consistent with the work of Ojeifo *et al*. (2017) and Sani *et al*. (2018). This could be as a result of the crop possessing morphological characteristics of a creeping sweet melon, which has the ability to position its vines and leaves in response to light (phototropism) to harness an adequate amount of light, and to develop roots in the soil to harness nutrients and avoid water or nutrient competition, utilizing the abundant amount of nutrients present in the soil from the application of 15 t ha^{-1} of poultry manure, which was sufficient for the growth and development of the crop. This observation is in agreement with the findings of Ibrahim *et al*. (2013), who showed that muskmelon grown at 50 cm intra-row spacing and treated with 10 t ha^{-1} of poultry manure recorded the highest fruit yield for a specific local variety in northern Nigeria.

CONCLUSION

In conclusion, NEPTUNE F1 significantly ($P<0.05$) reduced the musk melon number of days to 50% flowering compared with URANUS F1 in Dutsin-Ma. URANUS F1 performed significantly higher on days to 50 % flower, fruit weight per plant and fresh fruit yield per hectare than NEPTUNE F1 in Malumfashi. 75cm intra-row spacing produced significantly ($P<0.05$) higher fruit diameter and fruit weight/plant than other intra-row spacings. 75cm intra-row spacing produced significantly ($P<0.05$) higher fresh fruit yield/hectare than other intra-row spacings in Dutsin-Ma, but 50cm intra-row spacing produced significantly ($P<0.05$) higher fresh fruit yield/hectare than other intra-row spacings in Malumfashi. Poultry manure significantly ($P< 0.05$) increased days to 50% flowering, fruit diameter, fruit weight per plant, and fresh fruit yield per hectare. Applying 15 t of poultry manure per hectare was found to be appropriate for musk melon production in the study area. The interaction between intra-row spacing and poultry manure was significant ($P< 0.05$) on fresh fruit yield per hectare, with 50 cm intra-row spacing and 15 t poultry manure per hectare producing significantly higher fruit yield per hectare than other combinations. In short, sowing NEPTUNE F1 F1 in Dutsin-Ma and URANUS F1 F1 in Malumfashi at 50 cm intra-row spacing and 15 t poultry manure ha^{-1} is the most appropriate for musk melon yield in the study area.

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