Response of Water Melon (Citrus lanatus L.) Varieties to Different Time of Poultry Manure Application

Abdulmaliq, S. Y., Kumar, N., Adekola, O. F., Kareem, I. and Mahamoud, J.

1Department of Crop Production, IBB University, Lapai, Niger State, Nigeria.
2Department of Agronomy, University of Ilorin, Kwara State, Nigeria.
3Lower River Basin, Ministry of Water Resources, Ilorin, Kwara State, Nigeria.

Correspondence e-mail: drsmaliq@gmail.com

Abstract
Field experiments were conducted between April and November 2016 at the Teaching and Research Farm of Ibrahim Badamasi Babangida University, Lapai (Latitude 09° 02' N and Longitude 06° 34' E) and Research Farm of College of Agriculture, Mokwa (Latitude 09° 08' N and Longitude 05° 04' E) to examine the effects of poultry manure time of application on the growth and yield of water melon varieties. The experiment was a 4 x 3 factorial laid in a Randomized Complete Block Design (RCBD) replicated three times. The treatments consisted of four (4) varieties of water melon and three (3) different times of application of poultry manure; a week before planting, during planting and a week after planting. The poultry manure was applied to all the treatments at the rate of 10 tonnes per hectare. Parameters evaluated were vine length per plant (cm), number of leaves per plant, number of branches per plant, days to first flowering, days to 50% flowering, number of fruits per plant, weight of fruits per plant (kg) and fruit yield (t/ha). Data collected were subjected to analysis of variance (ANOVA), significant means were separated using Least Significant Difference (LSD0.05). The results indicated that, out of the four varieties evaluated, variety Koloss F1, and Kaolak significantly produced longest vine, higher number of leaves and branches, higher number of fruits per plant, heavier fruits weight per plant and higher yield (t/ha). Also the application of poultry manure at a week before planting significantly supported higher growth rate and yield in all the four water melon varieties evaluated. Based on the outcome of this research, Koloss F1 and Kaolak varieties planted in the plots with the application of poultry manure a week before planting showed appreciable growth responses at the two locations considered.

Keywords: Application time, Fruit yield, Poultry manure, Variety, Watermelon

Introduction
Watermelon (Citrus lanatus L.) is an important fruit vegetable cultivated worldwide (Huh et al., 2002) and Nigeria inclusive. Its centre of origin has been traced to the Kalahari Desert in Africa, South of the Equator (Jarret et al., 1996). Watermelon consumption is higher than any other member of his family cucubitaceae. About 6.8% of world cultivated area is devoted to water melon production (Goreta et al., 2005). Very large number of water melon varieties are being cultivated in Africa (Zohary and Hopf, 2000).

Total world annual water melon production was estimated at 104, 472, 354 tonnes (Wikipedia, 2013). China is the leading watermelon producers in the world with about 69, 576, 643 tonnes, followed by Iran- 4, 501, 250 tonnes, Turkey-3, 864, 490 tonnes, Brazil- 2, 864, 490 and United States- 1, 769, 230 tonnes in 2011 (Wikipedia, 2013). Despite the increasing demand for watermelon in Nigeria, the yield is...
not encouraging because of rapid reduction in soil fertility caused by both continuous cropping and negligence of soil amendment materials (Enujeke, 2013) in addition to the use of a good cultivar (Tailor et al., 2013).

Tailor et al. (2013) attributed the low yield of watermelon to improper cultural practices such as irrigation, cultivation, planting distance, pests and diseases management, proper nutrition as well as time of nutrient application and choice of cultivars. These cultural practices and others play vital roles in improving the growth and yield of watermelon, therefore, it is very important to screen the available varieties in the study areas with the aim of selecting the best performing ones in terms of higher yield and the appropriate time of nutrient application in other to synchronize the nutrient supply with the plant need. Currently, there is paucity of information on the best varieties of watermelon that can guaranty high yield as well as the right time for nutrients supply. Therefore the objective of the study was to evaluate some varieties of watermelon in the Southern Guinea Savanna and to determine the appropriate time of poultry manure application for optimum fruit production.

Materials and Methods
Two field trials were conducted between April 2016 and November 2016, at two experimental sites (Lapai and Mokwa locations) in Niger state. The sites are located in Southern Guinea Savannah agro ecological zone of Nigeria. The trial in Lapai was sited in the Teaching and Research farm of Ibrahim Badamasi Babangida University located on latitude 9°02’ N and longitude 06°34’E with average temperature of 23-34.4°C and minimum rainfall of 107.3mm. The trial in Mokwa was conducted at the research farm of the College of Agriculture Mokwa, which lies at latitude 09°08’ N and longitude 05°04’E of the equator, with average temperature of 24 – 27°C and annual rainfall of 1517mm.

Improved watermelon varieties used for the trials were sourced from seed vendors in Minna and kaduna, North central Nigeria. The experimental field at the two locations were cleared, ploughed, harrowed and ridged at the onset of the raining season. Prior to the planting, soil and poultry manure samples were collected and analysed for the two locations (Lapai and Mokwa). The treatments, which were arranged in a 4 x3 factorial in a randomized block design (RCBD), comprised of four varieties of watermelon (Kaolak, Koloss F1 hybrid, Charleston grey and sugar baby) and three application time for poultry manure (10t/ha) (a week before planting, during planting and a week after planting). The treatments were replicated three times. Plot size of 4 x 3m, and inter and intra row of 1 x 1m were adopted. Two times weeding was carried out. Pests and diseases were controlled using neem oil extract applied weekly. Data collected include vine length/ plant (cm), number of leaves per plant and number of branches per plant, days to first flowering, days to 50% flowering, number of fruits per plant, weight of fruits per plant and cumulative fruit yield (t/ha). The data collected were subjected to analysis of variance (ANOVA) and the means were separated using the Fisher’s Least Significant Differences (LSD) at P<0.05 probability level. Genstat Discovery 10.3DE Statistical Package (2011) was used for the data analysis.

Results and Discussion
Table 1 showed the result of poultry manure time of application on the vine length of watermelon varieties. The result indicated that there were significant differences among the four (4) varieties tested at Lapai and Mokwa. At 4 weeks after sowing (WAS), the vines of kolos F1 and kaolak varieties were significantly different from charlston grey variety of water melon in the two locations, at 5% probability level. However, at 8 and 12 WAS, koloss F1 variety produced significantly longest vines in the two locations at 5% probability level.

The effects of poultry manure application time on the vine length of the watermelon varieties was not significantly different at 4 WAS, however at 8 and 12 WAS there were significant differences among the vine length of the varieties. The application of poultry manure at a week before planting showed significant highest positive effects on the vine lengths of the varieties (Table 1). The Interactive effects
between the water melon varieties and poultry manure time of application were not significant at P ≤ 0.05 for the parameter (Table 1).

The number of leaves produced by the water melon varieties evaluated was significantly different at 8 and 12WAS (Table 2). Kaolak, Kolos F1 and Sugar Baby varieties were not significantly different from one another but significantly different from Charleston Grey variety in number of leaves/plant throughout the experiment. With regard to the effects of poultry manure time of application, number of leaves from the application at a week before planting and application at planting were significantly higher than those from the application at a week after planting throughout the experiment. The interaction effects were not significantly different for number of leaves/plant among the varieties (Table 2).

Table 3 showed the effects of varieties and poultry manure application time on the number of branches of four water melon varieties at Lapai and Mokwa. The results indicated that Kaolak, Kolos F1 and Sugar Baby varieties were not significantly different in number of branches/plant. However, they were significantly different from Charleston Grey variety which produced lowest number of branches at the two locations. In another vein, the effects of poultry manure time of application on number of branches per plant indicated that the application of poultry manure a week before planting and application at planting were significantly different from the application of poultry manure a week after planting. The least number of branches/plant was produced when poultry manure was applied a week after planting. The interaction effects were not significant.

The differential behaviour of water melon varieties in the growth parameters (vine length, number of leaves and number of branches) can be attributed to genetics and adaptability of these varieties (kolos F1, kaolak and sugar baby) to the southern guinea ecological zone of Nigeria. The varieties have been in cultivation since time immemorial (Dauda et al., 2008). This similar pattern of response in growth parameters exhibited by watermelon cultivars in this study agrees with the findings of Davis et al. (2008). These workers reported differential growth performance in watermelon varieties under different environments conditions. Longinus and Gilbert (2014) reported better growth of kaolak variety of water melon over sugar baby in Abakaliki, Southeastern Nigeria. However, Dantata (2014) reported similarity in the growth parameter of sugar baby, kaolak and paradise varieties of water melon.

The flowering characteristics of water melon which included day to first flowering and days to 50% flowering were not significantly different among the water melon varieties as shown in Table 4. Also, the poultry manure application did not significantly affect flowering characteristics of water melon in 2016 cropping seasons at the two locations (Table 4).

Table 5 showed the effects of water melon varieties and poultry manure application time on the fruiting characteristics of four water melon varieties at Lapai and Mokwa in 2016 cropping season. The results indicated that, in the two locations, the Koloss F1 and Kaolak varieties significantly produced higher number of fruits/plant and heavier fruit weight/plant which were significantly different from Sugar Baby and Charleston Grey varieties. Also, the effect of the water melon varieties on fruit yield (t/ha) is presented in Table 5. The results showed that, at Lapai location, Kaolac, Kolos F1 and Sugar Baby varieties recorded significantly higher fruit yields (tonnes/ha) which were far apart from the yield obtained from Charleston Grey variety. At Mokwa, the Kaolak and Kolos F1 varieties produced higher fruit yields which were significantly different from those of Sugar Baby and Charleston Grey varieties. The variations observed in the number of fruits/plant, fruit weight/plant and fruit yield/ha can be attributed to the genetic variability in each of the varieties and the influence of environmental condition. This result corroborates the earlier report of Granberry et al. (1986) who reported variations in the fruit yield parameters of water melon varieties. It is also in agreement with Abdulmaliq et al. (2016) who reported varied yield of okra varieties in the Southern Guinea Savanna.

Table 3 showed the effects of varieties and poultry manure application time on the number of branches of four water melon varieties at Lapai and Mokwa. The results indicated that Kaolak, Kolos F1 and Sugar Baby varieties were not significantly different in number of branches/plant. However, they were significantly different from Charleston Grey variety which produced lowest number of branches at the two locations. In another vein, the effects of poultry manure time of application on number of branches per plant indicated that the application of poultry manure a week before planting and application at planting were significantly different from the application of poultry manure a week after planting. The least number of branches/plant was produced when poultry manure was applied a week after planting. The interaction effects were not significant.

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The poultry manure application time significantly influenced the fruit yields of the four watermelon varieties in the two locations. The result showed that the plants under application of poultry manure at a week before planting and the application at planting were similar in their responses on fruit yield (t/ha) (Table 5). This result is in line with Abdulmaliq et al. (2015) who worked on the poultry manure application time and rates on the yield of okra and observed that the application of poultry manure before planting significantly lead to higher yield of okra in the Southern Guinea Savannah.

Conclusion
The results of the experiments in the two locations revealed that vine length, number of leaves, number of fruits and fruit yield of watermelon cultivars were significantly varied based on cultivars. These growth and yield parameters of watermelon were statistically higher in koloss followed by kaolak and sugar baby varieties while charlston grey variety recorded lowest growth and yield. Also, the results of the poultry manure application time revealed significantly better growth and yield from the application of poultry manure a week before planting and the application at planting. It is therefore recommended that the varieties kaolak, k0llos F1 and sugar baby could be nominated for further yield performance evaluation in the Southern Guinea Savannah, while the organic nutrient such as poultry manure should be applied a week or at planting to the water melon for better growth and yield.

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### Table 1. Effects of poultry manure application time on the vine lengths of four water melon varieties at Lapai and Mokwa

| Parameters          | Lapai | Mokwa |
|---------------------|-------|-------|
|                     | 4WAP  | 8WAP  | 12WAP | 4WAP | 8WAP  | 12WAP |
| **Varieties**       |       |       |       |       |       |       |
| Sugar baby          | 14.42a| 125.40b| 134.00bc| 14.20ab| 152.80b| 158.80bc|
| Charlston grey      | 8.75b | 102.40c| 145.00b| 9.25b | 130.30c| 144.00c|
| Koloss F1           | 15.65a| 134.20a| 185.00a| 16.43a| 182.80a| 189.00a|
| Kaolak              | 13.48a| 125.80a| 126.40c| 15.20a| 104.20d| 168.52b|
| LSD<sub>0.05</sub> | 4.56  | 10.65  | 15.24  | 5.22  | 11.53  | 15.80  |
| **Time of Application** |       |       |       |       |       |       |
| A week before planting | 20.55 | 128.50a| 172.40a| 25.55 | 125.50a| 170.40a|
| At planting         | 16.60 | 120.20b| 163.52b| 20.40 | 110.35b| 145.30b|
| A week after planting| 15.30 | 121.20b| 162.55b| 19.80 | 104.20b| 139.25b|
| LSD<sub>0.05</sub> | NS    | 7.30   | 8.25   | NS    | 9.65   | 10.45  |
| Interaction         | NS    | NS     | NS     | NS    | NS     | NS     |

Note: WAP – Week(s) after planting

### Table 2. Effects of poultry manure application time on number of leaves of four water melon varieties at Lapai and Mokwa

| Parameters          | Lapai | Mokwa |
|---------------------|-------|-------|
|                     | 4WAP  | 8WAP  | 12WAP | 4WAP | 8WAP  | 12WAP |
| **Varieties**       |       |       |       |       |       |       |
| Sugar baby          | 5.85  | 64.60a| 88.60a| 5.60ab| 64.45a| 86.40a|
| Charlston grey      | 5.20  | 40.20b| 64.60b| 3.85b | 41.65b| 62.50b|
| Koloss F1           | 6.40  | 64.25a| 80.10ab| 6.20ab| 64.25a| 89.80a|
| Kaolak              | 6.65  | 66.25a| 82.40a| 6.60a | 64.35a| 81.20a|
| LSD<sub>0.05</sub> | NS    | 3.84   | 16.95  | 2.45  | 14.65  | 15.34  |
| **Time of Application** |       |       |       |       |       |       |
| A week before planting | 6.75  | 58.20a| 80.50a| 9.50  | 62.80a| 82.40a|
| At planting         | 5.95  | 50.40a| 78.20a. | 8.60  | 60.40a| 81.50a|
| A week after planting| 5.60  | 44.10b| 66.60b| 8.50  | 48.20b| 60.80b|
| LSD<sub>0.05</sub> | NS    | 5.80   | 6.50   | NS    | 6.50   | 7.50   |
| Interaction         | NS    | NS     | NS     | NS    | NS     | NS     |

Note: WAP – Week(s) after planting
Table 3. Effects of poultry manure application time on Number of Branches of four water melon varieties at Lapai and Mokwa

| Parameters                  | Number of Branches |          |          |          |          |
|-----------------------------|--------------------|----------|----------|----------|----------|
|                             | Lapai              | 4WAP     | 8WAP     | 12WAP    | Mokwa    |
|                             |                    | 4WAP     | 8WAP     | 12WAP    |          |
| Varieties                   |                    |          |          |          |          |
| Sugar baby                  | 4.32a              | 16.25a   | 30.25a   | 4.40a    | 16.40a   | 33.50a   |
| Charlston grey              | 2.50b              | 13.80b   | 22.50b   | 2.70b    | 13.80b   | 25.40b   |
| Koloss F1                   | 5.65a              | 16.45a   | 30.25a   | 5.40a    | 16.70a   | 32.60a   |
| Kaolak                      | 4.80a              | 16.50a   | 30.70a   | 5.45a    | 16.80a   | 32.90a   |
| LSD_{0.05}                  | 1.45               | 2.25     | 5.32     | 1.50     | 2.30     | 5.45     |
| Time of Application         |                    |          |          |          |          |
| A week before planting      | 4.60               | 16.40a   | 35.20a   | 5.20     | 19.50a   | 45.50a   |
| At planting                 | 3.80               | 15.20a   | 33.20a   | 4.60     | 18.80a   | 44.20a   |
| A week after planting       | 3.60               | 12.80b   | 28.60b   | 4.80     | 14.20b   | 35.80b   |
| LSD_{0.05}                  | NS                 | 2.50     | 4.20     | NS       | 2.80     | 4.50     |
| Interaction                 | NS                 | NS       | NS       | NS       | NS       | NS       |

Note: WAP – Week(s) after planting

Table 4. Effects of poultry manure application time on flowering characteristics of four water melon varieties at Lapai and Mokwa.

| Flowering characteristics | Lapai |          |          |          |          |
|---------------------------|-------|----------|----------|----------|----------|
|                           | Days to 1st Flowering | Days to 50% Flowering | Days to 1st Flowering | Days to 50% Flowering |
| Varieties                 |       |          |          |          |          |
| Sugar baby                | 30.00 | 35.00    | 30.00    | 36.00    |
| Charlston grey            | 29.00 | 32.00    | 31.00    | 37.00    |
| Koloss F1                 | 32.00 | 36.00    | 31.00    | 36.50    |
| Kaolak                    | 31.00 | 36.00    | 30.00    | 32.00    |
| LSD_{0.05}                | NS    | NS       | NS       | NS       |
| Time of Application       |       |          |          |          |          |
| A week before planting    | 26.00 | 32.00    | 25.00    | 32.00    |
| At planting               | 30.00 | 35.00    | 29.00    | 34.00    |
| A week after planting     | 30.00 | 36.00    | 30.00    | 36.00    |
| LSD_{0.05}                | NS    | NS       | NS       | NS       |
| Interaction               | NS    | NS       | NS       | NS       |
Table 5. Effects of poultry manure application time on fruiting characteristics of four varieties

| Varieties    | Number of Fruits/plant | Fruit weight/plant (kg) | Fruit yield (t/ha) | Number of Fruits/plant | Fruit weight/plant (kg) | Fruit yield (t/ha) |
|--------------|------------------------|-------------------------|--------------------|------------------------|-------------------------|--------------------|
| Sugar baby   | 4.00ab                 | 4.25ab                  | 3.58a              | 1.85b                  | 4.10ab                  | 2.85b              |
| Charlston grey | 3.20b              | 2.90b                  | 0.48b              | 1.80b                  | 2.83b                  | 0.32c              |
| Koloss F1    | 4.70a                  | 3.45ab                  | 3.36a              | 4.20a                  | 5.20a                  | 3.42a              |
| Kaolak       | 4.00ab                 | 4.80a                  | 3.53a              | 4.60a                  | 5.70a                  | 3.42a              |
| LSD<sub>0.05</sub> | 1.10              | 1.40                   | 0.66               | 1.20                   | 2.08                   | 0.46               |

Time of Application

|                   | Lapai          |                     |                     | Mokwa           |                     |                     |
|-------------------|----------------|---------------------|---------------------|-----------------|---------------------|---------------------|
| A week before planting | 4.00          | 4.35a               | 3.10a               | 3.50            | 4.20a               | 3.50a               |
| At planting       | 3.00          | 4.25a               | 2.80a               | 3.00            | 3.90a               | 3.20a               |
| A week after planting | 3.00         | 3.00b               | 1.45b               | 2.50            | 2.60b               | 1.94b               |
| LSD<sub>0.05</sub> | NS            | 1.20                | 1.30                | NS             | 1.20                | 1.25                |
| Interaction       | NS            | NS                  | NS                  | NS             | NS                  | NS                  |