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The effect of excision of cotyledons on the growth, flowering and yield of melon (*Cucumeropsis manni* Naudin)

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ABSTRACT: The effects of excision of cotyledons on the growth, flowering and yield of the melon (*Cucumeropsis manni* Naudin) were studied. Parameters investigated were vine length, number of leaves, leaf area and number of flowers. The number of fruits, weight of fruits, number of seeds per fruit as well as the weight of these seeds were also considered. There were significant differences in these parameters investigated between the melon seedling which had their cotyledons excised at the early stage of growth and those with intact cotyledons (control). Our results demonstrate reduced growth, delayed blooming and fruiting as well as poor yield from these melon plants whose cotyledons were excised at the early stage of seedling growth.

Key words: *Cucumeropsis manni*, Excision, Cotyledons, Growth, Yield.

Introduction

Melon (*Cucumeropsis manni*) is one of those crops which store their food reserve in their cotyledons, even though some other plants store their food in the endosperm. The food reserves usually form the source of food supply to the developing embryo until the foliage leaves are photosynthetically mature enough to supply needed nutrients to the developing seedlings (1). At maturity some of the cotyledons of plants such as the melon become green and assume the photosynthetic functions of the leaf. Even though the developing seedlings depend on the cotyledons as the main source of food supply, it has been found that the metabolic activities occurring in the cotyledons are normally initiated and controlled by signals from the root-shoot axis tissues (12).

C. manni is a creeping annual whose pinnately lobed leaves distinguish it from *Cucumis* and *Cucurbita* (6). The melon is locally referred to in most parts of Nigeria as “egusi” (Igbo). Variants of this name are ‘agusi’ (Hausa) and ‘egunsi’ (Yoruba). It is a warm season frost tender plant, which requires either tropical or a warm summer environment in temperate region for satisfactory production (11).

In Nigeria, melon is cultivated principally for its seeds which serve as a source of protein and an important soup condiment in African diet (2). When ground and cooked with pepper, onions, palm oil, fish, meat, salt and green vegetable, it forms the 'egusi' soup which is highly cherished all over this country. In the South Eastern part of Nigeria, among the Igbos, the whole seed is fermented after soaking in water, boiled, dried and ground into a paste called "ogirinni", a spice used in preparing most Igbo soups.

In the Northern part of Nigeria, melon seeds are beaten into fat gummy paste and stored or used as spice for cooking.

Melon seed oil is a clear pale yellow oil used locally as edible oil with a value comparable to that of groundnut oil (13). The oil is sometimes extracted for use as vegetable oil and the residue wrapped in leaves, boiled and eaten as "Igbalo" or fried in groundnut oil to form "Irobo" and served as delicacy (3).

Although several authors have studied the influence of the cotyledons on seedling development, from the available literature, no work has been done on the influence of the cotyledons of the melon on their seedling growth.

C. manni sometimes loose their cotyledons prematurely to rodents and lizards while growing in the farms. It was the objective of this study to investigate the effect of the excision of the cotyledons on the growth of melon.

Materials and Methods

The seeds of the melon (*Cucumeropsis manni* Naudin) were purchased as a single batch from a local market in Benin City.

The viable seeds, determined by flotation method were sown in plots behind the Biological Science building of the University of Benin (lat. 6.5^{o}N long. 6.0^{o}W). Three seeds were sown per stand in rows at a planting distance of 60cm by 60cm. There were ten stands per row and a total of five rows per plot.

Five plots (A to E) divided into A1 to E1 and A2 to E2 were used for the study while plants in the former did not receive fertilizer, those in the latter did.

Germination was noticed in about 60% of the total stands in the entire plots 4 days after sowing.

Five seedlings in each of these subdivision (A1 to E1 and A2 to E2) were marked immediately after germination was noticed (4 days after sowing) and screened off from insects and rodents using netted wire cage until seedling establishment. And these served as replicates on which treatments were subsequently carried out.

There was no excision (NE) of cotyledons in plot A1 and A2 (control). Seedlings in plot B1 and B2 had their cotyledons removed 4 days after sowing. Those in plot C1 and C2 had theirs removed 8 days after sowing, D1 and D2, 12 days after, while those in E1 and E2 were removed 16 days after sowing. A 44g weight portion of N.P.K. 15:15:15: fertilizer was applied in 10cm radius around each seedling (A2 to E2) 7 days after excision of the cotyledons.

The vine length of the plants was measured from the soil level to the terminal bud. Measurement was taken using white nylon ropes and the readings obtained from the meter rule. Leaf area was determined by comparing the weight of a traced area with standard paper of known weight to area ratio (5).

Number of leaves was determined by visual counting of the leaves. These growth parameters were measured 14 days after sowing and subsequently at 14 days interval up to 42 days. Number of flowers was obtained by counting the flowers as they bloomed on the vine. Counting was done at a regular interval of 5 days until fruiting.

The number of fruits and seeds per fruit were counted and recorded. The weight of fruits and the mean weight of the seeds were determined.

Analysis of variance of the means was carried out. The least significant difference (LSD) test was done using the raw data and was used to compare the means.

Results and Discussion

After 12 days of sowing, a mean of 96% ± 5.7 germination was obtained from all of the plots (A1 – E1 and A2 – E2).

The mean vine length obtained after 42 days of sowing for the control plants was 99.8 ± 0.6cm.

This value (Table 1) was not significantly different from that of whose cotyledons were removed 16 days after sowing (98.4 ± 0.2cm). These two values were however significantly higher than those of plants whose cotyledons were removed 4 days (39.3 ± 0.2cm) and 8 days (39.3 ± 0.3cm) after sowing respectively at $p = 0.01$. The mature seeds of *Cucurbits* contain nutrient reserves principally in cotyledons (12). It was reported that in the okra, there was usually a decrease in the nutrient content, dry weight, chlorophyll content and dry matter content of cotyledons and subsequent increase in such values, as the seedlings increased in age up to 20^{th} day after emergence (1). This indicated that there was mobilisation of nutrient reserves from the cotyledons through the axis tissues to the growing regions of the seedling. Removal of cotyledons in the present study 4 and 8 days after sowing prior to mobilisation of mineral elements, could probably have affected the vine length and other growth parameters. The melon seedlings whose cotyledons were removed 16 days after sowing compared favourably with control. It could be that mineral nutrient mobilisations have already occurred before cotyledons were excised.

It is observed in Table 2 that 42 days of sowing, there were more leaves respectively on control plants (32 ± 0.4) and those whose cotyledons were removed 16 days after sowing (32 ± 0.3), than those removed 4 days (15 ± 0.4) and 8 days (15 ± 0.8) after sowing. There was however a little increase in the number of leaves of the melon plants with fertilizer application (Table 2).

The mean leaf area measurements are shown in Table 3. Control plants gave significantly higher area values after 42 days (75.0 ± 0.7cm^2) than plants whose cotyledons were excised 4(28.4 ± 0.5cm^2) and 8 days (28.8 ± 0.6cm^2) after sowing respectively at $p = 0.01$. The leaf area values are of importance as they reflect the amount of nutrients taken up by the developing leaves.

It has been reported that young leaves are sinks because they cannot fix enough carbon to support their growth (7). However, the status of the leaf progressively changes from sink to source as its photosynthetic capacity increases. It was reported that okra seedlings whose cotyledons were excised before the 14^{th} day of seedling growth had their growth rate and development retarded for varying period of up to two weeks and flowering time delayed by up to five days, while those seedlings whose cotyledons were excised after 14 days showed no such effects (1). In the present study, flowering of control plants and those whose cotyledons were removed 16 days after sowing was observed within 29 days of sowing (Table 4). Flowering of melon plants whose cotyledons were removed 4 and 8 days after sowing occurred 44 days after sowing (those that receive fertilizers, see table 4). After 49 days of sowing, the mean number of flowers on plants whose cotyledons were removed 4 days after sowing was 1.0 and this was significantly fewer than control (18.0 ± 0.3) at $p = 0.01$.

The fruit (Table 5) and seed weights (Table 6) show that control plants had fruits and seeds which weighed significantly more (2000 ± 2.7g and 0.17 ± 0.01g respectively) than those whose cotyledons were excised 4 days (225 ± 1.5g and 0.07 ± 0.00g) and 8 days (226g ± 1.8 and 0.07 ± 0.00g) after sowing at $p = 0.01$. The mean weights of fruits and seeds obtained from melon plants whose cotyledons were excised 16 days after sowing compared favourably with control (table 5 and 6).

The number of seeds per fruit are as shown in Table 7. The control plants and those whose cotyledons were excised 16 days after sowing gave the same value (257 ± 0.8). Melon plants whose cotyledons were excised before nutrient mobilisation in this study had fewer seeds. It was mentioned earlier in this text that melon plants whose cotyledons were removed earlier than 16^{th} days had fewer leaves. This may have reduced the quantity of available nutrients at plant source and consequently caused a reduction in the mobilisation to sinks being fruits and seeds. Any excision of the cotyledons of melon seedlings before the 16^{th} day of sowing would affect seedling growth and consequently plant yields. This means that cotyledons of melon seedlings are more important with respect to seedling development before the foilage leaves become photosynthetically active.

Farmers and gardening enthusiast must be persuaded to apply insecticides and pesticides on their emerging crops especially melon seedlings to prevent insect and rodents from picking off the cotyledons.

Table 1: Vine length (cm) of melon plants grown with (NE) or without (after 4 to 16 days) cotyledons at 14, 28 and 42 days after sowing (mean values ± standard error).

Days excised after sowing	TIME (DAYS)					
	14		28		42	
	N	F	N	F	N	F
No Excision	5.2a ± 0.2	6.1a ± 0.2	42.6a ± 0.2	62.8a ± 0.4	99.8a ± 0.6	107.8a ± 0.8
4	2.8b ± 0.1	3.4b ± 0.2	4.7c ± 0.2	9.8c ± 0.2	39.2c ± 0.2	53.0c ± 0.4
8	2.8b ± 0.1	3.4b ± 0.1	4.7c ± 0.2	9.8c ± 0.2	39.3c ± 0.3	53.0c ± 0.3
12	3.4b ± 0.2	3.7b ± 0.2	25.3b ± 0.3	31.8b ± 0.5	64.4b ± 0.5	71.6b ± 0.6
16	5.0a ± 0.2	6.1a ± 0.1	42.6a ± 0.2	62.7a ± 0.2	94.4c ± 0.6	107.0a ± 0.6

Means within columns followed by the same letter are not significantly different at the 5% level (LSD test)
N = No fertilizer application; F = fertilizer applied

Table 2: Number of leaves on melon plants grown with (NE) or without (after 4 to 16 days) cotyledons at 14, 28 and 42 days after sowing (Mean values ± standard error).

Days excised after sowing	TIME (DAYS)					
	14		28		42	
	N	F	N	F	N	F
No Excision	4	4	14a ± 0.5	16a ± 0.3	32a ± 0.4	36a ± 0.8
4	4	4	6c ± 0.3	6c ± 0.3	15c ± 0.4	17c ± 0.6
8	4	4	6c ± 0.3	6c ± 0.3	15c ± 0.8	17c ± 0.6
12	4	4	8b ± 0.3	8b ± 0.3	26b ± 0.5	27b ± 0.4
16	4	4	14a ± 0.3	14a ± 0.3	32a ± 0.3	35a ± 0.3

Means within columns followed by the same letter are not significantly different at the 5% level (LSD test)
N = No fertilizer application; F = Fertilizer applied

Table 3: Leaf area (cm^2) of melon plants grown with (NE) or without (after 4 to 16 days) cotyledons at 14, 28 and 42 days after sowing (mean values ± standard error).

Days excised after sowing	TIME (DAYS)					
	14		28		42	
	N	F	N	F	N	F
No Excision	53.4a ± 0.5	63.7a ± 0.8	60.9a ± 0.4	66.2a ± 0.4	75.0a ± 0.7	77.8a ± 0.5
4	16.8c ± 0.5	20.6b ± 0.5	23.3c ± 0.5	28.8c ± 0.6	28.4c ± 0.5	31.6c ± 0.6
8	16.7c ± 0.5	21.0b ± 0.4	23.4c ± 0.5	29.4c ± 0.6	28.8c ± 0.6	31.8c ± 0.6
12	28.1b ± 0.8	33.8b ± 0.4	41.9b ± 0.6	47.5b ± 0.8	47.8b ± 0.9	52.5b ± 0.0
16	53.1a ± 0.7	63.4a ± 1.2	60.0a ± 0.9	65.9a ± 0.5	74.7a ± 0.6	77.8a ± 0.2

Means within columns followed by the same letter are not significantly different at the 5% level (LSD test)
N = No fertilizer application; F = Fertilizer applied

Table 4: Number of flowers from melon plants grown with (NE) or without (after 4 to 16 days) cotyledons at 29, 34, 39, 44 and 49 days after sowing (mean values ± standard error).

Days excised after sowing	TIME (DAYS)									
	29		34		39		44		49	
	N	F	N	F	N	F	N	F	N	F
No Excision	2a ± 0.0	2a ± 0.0	5a ± 0.4	5a ± 0.3	8a ± 0.5	9a ± 0.7	13a ± 0.7	14a ± 0.3	18a ± 0.3	19a ± 0.4
4	-	-	-	-	-	-	-	2c ± 0.3	1c ± 0.0	4c ± 0.3
8	-	-	-	-	-	-	-	2c ± 0.0	1c ± 0.0	4c ± 0.0
12	-	-	1b ± 0.0	2b ± 0.3	4b ± 0.3	5b ± 0.4	7b ± 0.4	9b ± 0.6	12b ± 0.5	13b ± 0.5
16	2a ± 0.0	2a ± 0.0	4a ± 0.3	4a ± 0.3	7a ± 0.5	8a ± 0.7	12a ± 0.5	13a ± 0.3	18a ± 0.3	19a ± 0.4

Means within columns followed by the same letter are not significantly different at the 5% level (LSD test)
Standard paper area 100cm
Standard paper weight = 0.64g
N = No of fertilizer application
F = Fertilizer applied

Table 5: Weight of fruits (g) obtained from melon plants grown with (NE) or without (after 4 to 16 days) cotyledons

Days excised after sowing	WEIGHT (g)	
	N	F
No Excision	2000a ± 2.7	2046a ± 1.8
4	225c ± 1.5	327c ± 2.5
8	226c ± 1.8	334c ± 4.5
12	926b ± 1.8	1032b ± 4.6
16	2000a ± 3.5	2045a ± 2.2

Means within columns followed by the same letter are not significantly different at the 5% level (LSD test)
N = No fertilizer; F = Fertilizer applied.

Table 6: Weight seeds (g) obtained from melon plants grown with (NE) or without (after 4 to 16 days) cotyledons.

Days excised after sowing	WEIGHT (g)	
	N	F
No Excision	0.17a ± 0.012	0.17a ± 0.01
4	0.07 ± 0.00	0.07c ± 0.00
8	0.07c ± 0.00	0.07c ± 0.00
12	0.12b ± 0.01	0.13b ± 0.01
16	0.16a ± 0.01	0.17a ± 0.00

Means within columns followed by the same letter are not significantly different at the 5% level (LSD test)
N = No fertilizer; F = Fertilizer applied.

Table 7: Number of seeds obtained from melon plants grown with (NE) or without (after 4 to 19 days) cotyledons.

Days excised after sowing	Mean Number of Seeds per Fruit	
	N	F
No Excision	257a ± 0.8	262a ± 3.7
4	74c ± 1.3	75c ± 1.1
8	75c ± 1.2	77c ± 1.3
12	173b ± 1.1	176b ± 1.2
16	257a ± 0.8	260a ± 3.9

Means within columns followed by the same letter are not significantly different at the 5% level (LSD test)
N = No fertilizer; F = Fertilizer applied.

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