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Effect of mineral supplements (NPK) on sex expression in fluted pumpkin (*Telfairia occidentalis)* Hook F.

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ABSTRACT

Effect of three major mineral supplements (NPK) on sex expression of fluted pumpkin, *Telfairia occidentalis* Hook F. was investigated. The potassium containing nutrient supplements K, NK and PK promoted staminate flowering or caused a shift toward maleness while nitrogen and phosphorous containing nutrient supplements (N, P, NP and NK) promoted pistillate flowering or caused a shift toward femaleness. The influence of mineral nutrients on the hormonal balance for sex expression in the species is discussed.

Keywords: Mineral supplements (NPK), hormonal balance, floral primordia, sex expression, *Telfairia occidentalis* Hook F

INTRODUCTION

Telfairia occidentalis belongs to the Cucurbitaceae family and is found commonly in South Eastern Nigeria. The edible parts include the young vines or shoots, leaves, seeds and petioles. Nutritional studies of seeds, fruits and leaves have been extensively dealt with considering its wide acceptance by most communities in southern Nigeria (Oyenuga, 1968, Asiegbu, 1983, Anyim and Akoroda, 1983, Asiegbu, 1987). *T. occidentalis* is usually dioecious. The plant produces floral buds 15-17 weeks after planting. Several efforts have been made to determine the male and female ratio in *T. occidentalis* (Anyim and Akoroda, 1983).

In most cases, out of five open flowers produced by female plant, only two or three set fruit and only one or two are retained and developed fully (Anyim and Akoroda, 1983). Female plants are more important than male plants in terms of seed and leaf production. However improving present genotypes for high seed output requires introducing certain external factors that may likely trigger other factors physiologically to alter the sex ratio. The pistillate flower is known to be genetically controlled (Heslop-Harrision, 1957, Shiffris and Galum, 1956). The staminate and pistillate flowers can be modified by various factors such as mineral nutrients, photoperiod, temperature, growth regulators and also by irradiation (Heslop-Harrison, 1957, Nitsch *et. al*. 1952, Omini and Hossain; 1987). Modification of sex expression especially in favour of pistillate flower can lead to increase number of fruits per plant and has the potential of higher yield of leaves and seeds.

In this study the effect of three major mineral elements, nitrogen (N), phosphorus (P) and potassium (K) on sex ratio (pistillate and staminate) of *T. occidentalis* was investigated.

MATERIALS AND METHODS

The research was carried out in the Post-Graduate Research Farm within the University of Uyo main campus between 2000-2002. The plot was cleared, ploughed and harrowed to the depth of 20-25cm before beds were made. Beds were 1m x 3m and were also spaced by 1.0m. The soil was sandy – loam. Healthy pods of *T. occidentalis* were cut open and the larger seeds (≥ 3cm) were selected. Ninety-six large and healthy seeds were taken for the experiment and four seeds were planted per bed at a space distance of one metre. The beds were treated as follows N, P, K, NP, NK, PK, NPK and control (no mineral) (Table 1) in three replicates using a completely randomized block design.

Table 1. Mineral nutrients applied per plant stand

Mineral nutrients	Sources
Control	No mineral
Nitrogen	Ammonium sulphate (40g)
Phosphorus	Superphosphate (50g)
Potassium	Muriate of potash (35g)
Nitrogen and phosphorus	Ammonium sulphate (40g) + superphosphate (50g)
Nitrogen and potassium	Ammonium sulphate (40g)+muriate of potash (35g)
Phosphorus and potassium	Superphosphate (50g)+Muriate of potash (35g)
Nitrogen, phosphorus and potassium	Ammonium sulphate (40g) + superphoshate (50g) + muriate of potash (35g)

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The minerals were applied in the form of standard fertilizer treatments in two instalments as shown in Table 1. The first treatment was at the two-leaf stage (14 days after planting) and the second treatment was at the six-leaf stage (twenty-nine days after planting). The method of application involved, making a ring round the base of the plant and applying the measured quantity of the fertilizers in the furrow and subsequently the fertilizers were covered up with soil (Akoroda, 1990). The plants were grown to the flowering stage (84 days after planting) and observed for 14 days during the period of flowering. The following parameters were recorded for individual plants:

(a) Total number of staminate flowers per plant

(b) Total number of pistillate flowers per plant

The staminate / pistillate flower ratio was calculated for each treatment. The data on number of staminate and pistillate flowers were subjected to one way analysis of variance. Where analysis of variance was significant, the means of the treatments were compared with those of the control, using the least significant difference (LSD) method.

RESULTS

The summary of result is presented in Table 2. The values are the means of 12 plants. It was observed that K treatment caused a highly significant increase in the number of staminate flowers per plant (p < 0.001) and also significantly reduced the number of pistillate flowers per plant (p < 0.001) as compared to all other treatments except NK treatment. The sex ratio (staminate/pistillate flower) was higher under K treatment (6.4:1) as compared to the control (5.9:1), indicating a shift toward maleness. Treatment NK and PK did not cause any significant change in the number of staminate flowers but NK treatment caused a significant reduction in the number of pistillllate flowers compared to the control. Treatment PK caused a significant change in the number of pistillate flowers as compared to the control (p < 0.001) but without a change in the sex ratio (Table 2). Treatments N, P, NP, and NPK each caused a significant reduction in the number of staminate flowers per plant as compared to all other treatments (P < 0.001). These treatments, also, significantly increased the number of pistillate flowers per plant (P < 0.001). Under each of these treatments, therefore, the sex ratio (staminate/pistillate flowers) was reduced, indicating a shift towards femaleness.

DISCUSSION

There is a lack of precise information to explain the role of mineral nutrition in sex expressions in plants (Frankel and Galum 1977). All types of flowers (male, female, and hermaphrodites) pass through a common ontogenic stage. Mineral nutrition has no direct effect on sex differentiation; but the idea that hormones are involved in floral bud differentiation is favoured (Heslop-Harrison, 1956). It has long been known that hormones influence sex expression in plants. Information on this is available both from studies of exogenous hormone applications and determinations of endogenous hormone levels of plants. Heslop-Harrison (1956) observed that female plants of *Cannabis sativa* contained thirty times more auxin than the male plants. All these results led to hypothesis that sex expression in monoecious plants is controlled by an endogenous auxin – gibberellin balance (Bose and Nitsch, 1970). In dioecious plants, cytokinins have been reported to have a strong influence in increasing femaleness (Hashizume and Lizuka, 1971). However, while the effects of hormones in sex expression appear to be relatively clear and direct the effect of mineral nutrients seems to be indirect. Mineral nutrients might alter sex expression in plants through effects on hormonalbalance (Salisbury and Ross, 1969; Devlin, 1975). The increase in uptake of nitrogen and phosphorus results in the increase in auxin content or cytokinin content, thus altering the hormonal balance in the plant (Crane *et. al;* 1960, Devlin and Demoranville; 1967, Omini. and Hossain 1987). This can be deduced from the fact that the precursor of auxin is the amino acid, tryptophan and precursor of cytokinin is the purine base adenine (Wareing and Phillips, 1978). Increased availability of nitrogen and phosphorus in the plant can cause an increase in tryptophan and adenine as well as other amino acids, protein, enzymes and coenzymes, nucleotides and nucleic acids in the shoot apex and other parts of the plant (Wareing and Phillip, 1978). This leads to increased activities in the meristems and young leaves leading to increase in auxin and cytokinin content in these regions (Matthew, 1969). The increase in auxin and cytokinin content, in turn, will promote early development of floral primordia into female flowers buds (Lang; 1957, Wareing and Phillip, 1978).

Table 2. Mean and standard deviation (±SD) number of staminate, pistillate flowers per plant and sex ratio under different mineral nutrient treatments.

Treatment	No. of staminate flowers	No. of pistillate flowers	Sex ratio s/p
Control	462.5 ± 57	77.3 ± 0.87	5.9:1
N	421.3 ± 43 *	88.3 ± 0.76 *	4.7:1
P	308.9 ± 2.8 *	85.6 ± 0.82 *	3.6:1
K	485.8 ± 4.7 *	75.7 ± 0.35 *	6.4:1
NP	442.6 ± 9.6 *	86.7 ± 0.72 *	5.1:1
NK	458.7 ± 6.9 *NS*	73.4 ± 1.30 *	6.2:1
PK	456.5 ± 4.6 *NS*	75.6 ± 0.62 *	6.0:1
NPK	445.4 ±6.4 *	85.6 ± 8.87 *	5.2.1
LSD (p< 0.001)	8.23	1.18	

* - indicates significant difference from the control at p < 0.001 level.
NS - indicates no significant difference from the control.

The highest concentration of potassium is found in the meristematic regions of the plant (Nason and Mc Elroy; 1963).

Potassium is an essential activator for enzymes involved in the synthesis of certain peptide bonds and carbohydrate metabolism (Webster 1953, 1956). It is possible that a high level of potassium leads to reduction in meristematic activity and consequently lowers the concentration of auxin (Wareing and Phillips, 1978). This will upset the hormonal balance causing a tilt towards more concentration of gibberellin. This in turn may cause the floral primodia to develop into male flowers (Heslop – Harrison, 1956; Lang; 1957). The larger seeds have advantage over the smaller seeds partly because of the higher reserve food material and partly because of the mineral nutrients that are able to trigger vital physiological activities during the plants growth (Devlin, 1975). The amylase activity in the endosperm is controlled by the gibberellin which in turn promote a healthy shoot and early development of flora primordia (Paleg, 1960).

CONCLUSION

Mineral nutrients play important role in hormonal production in plant, and might indirectly affect flower production (Chrispeels and Varner, 1967a, b). Thus, varying the concentration of mineral nutrients might invariably cause variations in auxin and gibberellins concentration in plants Gibberellins and auxins act independently of each other. Higher concentrations of one hormone over the other would have a profound effect on flower bud initiation, than when present at equal levels (Lang and Reinhard, 1961).

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