

**EVALUATION OF MANGO (*MANGIFERA INDICA* L.) MINERAL NUTRITION ON  
JELLY SEED DISORDER, FRUIT YIELD AND QUALITY**

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## DECLARATION

This thesis is my original work and has not been presented for award of a degree in any other university.

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## GENERAL ABSTRACT

Mango (*Mangifera indica* L.) is the second most important fruit crop in Kenya after banana in terms of value. The importance of mango is due to its suitability for production in different Agro-Ecological Zones (AEZ), availability of improved varieties and availability of local and export markets. In addition, mango fruit is of high nutritional value and a wide variety of products can be made from it. However, full potential of mango in Kenya has not been exploited largely due to challenges at various stages of the value chain. One of the challenges is inadequate knowledge by producers on the crop nutrition requirements leading to low productivity and poor fruit quality. In addition, jelly seed disorder which is one of the major physiological disorders in mango, has been attributed to nutrient imbalance and aggravated by predisposing agro-ecological conditions. The main objective of this study was therefore to establish the effect of mineral nutrition on yield and postharvest quality of mangoes. The first specific objective was to determine incidence of jelly seed in “Tommy Atkins” and “Van Dyke” mango fruits and their relationship with agro-ecological factors in Muranga, Embu and Meru Counties. The second objective was to determine the effect of calcium and potassium nutrition on mango jelly seed disorder and quality of “Tommy Atkins” and “Van Dyke” mangoes in Embu County. The third objective was to determine the effect of nitrogen and potassium nutrition on yield and quality of “Tommy Atkins” mangoes in Embu County. Consequently, three experiments were carried out in 2014 and 2015. The first experiment was conducted in three AEZs namely: Lower Midland 3 (LM 3), Upper Midland 3 (UM 3) and Lower Midland 4 (LM 4) in Embu, Murang’a and Meru Counties respectively. In each AEZ, three farms with mature “Tommy Atkins” and “Van Dyke” mangoes of homogenous stand were purposively selected and soil and mango leaf mineral status of the selected farms determined. The experiment was laid out in randomized complete design with each farm acting as a block. Twenty five trees of each variety were randomly selected and marked for subsequent data collection. Fifty tree-ripe fruits of each variety were randomly sampled from the marked trees in each farm. The sampled fruits were sliced along the endocarp to expose the seed and visually examined and scored for the incidence of jelly seed using hedonic scale (0=no sign of jelly seed disorder, 5= whole fruit affected). The second experiment involved determination of the effect of dolomitic lime and muriate of potash fertilization on yield, incidence of jelly seed disorder and fruit quality of “Tommy Atkins” and “Van Dyke” mangoes in Embu. To achieve this, a factorial experiment laid out in randomized complete block design with three replicates was set up. Dolomitic lime rates used were: 0 and 2 kg/tree/year and muriate of potash rates were: 0,

1.0 and 2.0 kg/tree/year. A sample of 30 tree-ripe fruits per treatment was scored for jelly seed incidence using hedonic scale. Another sample of nine fruits per treatment was analysed for potassium, calcium and magnesium concentrations. The third experiment involved determination of the effect of muriate of potash and urea fertilization on yield and quality of “Tommy Atkins” mango fruits in Embu County. Five rates of muriate of potash (0, 1.5, 1.0, 1.5, and 2.0 kg/tree/year) and three rates of urea (0, 1.0 and 2.0 kg/tree/year) were used. Consequently, a factorial experiment was laid out in randomized complete block design with three replicates. A sample of nine tree-ripe fruits per treatment were used in the evaluation of quality attributes including major sugars,  $\beta$ -carotene, ascorbic acid and major mineral elements. In the first experiment, mango leaves from Meru had significantly higher calcium and magnesium concentrations than those from Muranga and Embu in both seasons. On the other hand, fruits from Meru had significantly lower jelly seed disorder score than those from Muranga and Embu in both seasons. Linear regression showed that there was a moderate negative relationship ( $R^2=0.54$ ) between “Tommy Atkins” fruits jelly seed disorder score and soil Ca concentration while for “Van Dyke”, the relationship was weak ( $R^2=0.29$ ). Similarly, there was a moderate positive relationship ( $R^2=0.4$ ) between “Tommy Atkins” fruits jelly seed disorder score and soil N concentration. However, for “Van Dyke” the relationship was stronger ( $R^2=0.71$ ). At the same time, there was a strong positive relationship ( $R^2=0.93$ ) between jelly seed disorder score of “Tommy Atkins” fruits and the mean annual rainfall (mm/annum) in the three Counties. Likewise, there was a strong positive relationship ( $R^2=0.74$ ) between jelly seed score of “Van Dyke” fruits and mean annual rainfall (mm/annum) in the three Counties. In the second experiment, dolomitic lime and muriate of potash application increased mango yield significantly ( $P\leq 0.05$ ). On the other hand, dolomitic lime significantly ( $P\leq 0.05$ ) lowered jelly seed score for both “Tommy Atkins” and “Van Dyke” fruits. For fruit mineral concentration, trees treated with 2 kg muriate of potash/tree/year without dolomitic lime had significantly ( $P\leq 0.05$ ) higher mean fruit potassium concentration (99.9 mg/100 g) than control (65.3 mg/100 g) for “Van Dyke” and 128.2 mg/100 g for treated “Tommy Atkins” compared to control 91.0 mg/100 g in season 1. A similar trend was observed in season 2. Similarly, dolomitic lime application significantly ( $P\leq 0.05$ ) increased fruit magnesium concentration in season 1 and season 2. Likewise, fruit potassium to calcium ratio significantly ( $P\leq 0.05$ ) increased with muriate of potash application. Peel firmness of “Van Dyke” fruit significantly increased from 0.99 Newton (control) to 1.90 Newton at fertilization rate of 2 kg dolomitic lime/tree/year combined with 1 kg muriate of potash/tree/year. Fruits of “Tommy Atkins” at fertilization rate of 2 kg dolomitic lime/tree/year combined with same rate of muriate of potash had significantly

( $P \leq 0.05$ ) higher hue angle ( $77.6^0$ ) than those of “Van Dyke” ( $70.5^0$ ) at tree-ripe stage. For sensory qualities, muriate of potash generally enhanced fruit quality attributes while calcium had a negative effect. In the third experiment, fertilization with 2 kg muriate of potash/tree/year combined with same rate of urea significantly ( $P \leq 0.05$ ) increased the mango yield from 3.5 (control) to 15.5 tons/hectare. Fruit potassium concentration significantly ( $P \leq 0.05$ ) increased from 94.33 mg/100 g (control) to 165.69 mg/100 g for trees treated with 2 kg muriate of potash /tree/year combined with 1 kg urea/tree/year. Similarly, fruit magnesium concentration significantly ( $P \leq 0.05$ ) increased from 10.76 mg/100 g (control) to 17.06 mg/100 g with application of 2 kg muriate of potash/tree/year combined with 1 kg urea/tree/year. Equally, fruit ascorbic acid and  $\beta$ -carotene concentrations were significantly ( $P \leq 0.05$ ) increased by fertilization with the highest concentration of 16.88 mg/100 g for ascorbic acid and 3.60 mg/100 g for  $\beta$ -carotene achieved at fertilization rate of 2 kg muriate of potash /tree/year combined with the same rate of urea. For major sugars, fruit glucose at tree-ripe fruit stage was significantly ( $P \leq 0.05$ ) increased by fertilization. The findings from the three experiments therefore show that the incidence of jelly seed disorder in mango is influenced by the agro-ecological conditions of the production areas, varietal characteristics as well as tree nutrition. It can therefore be concluded that selection of a jelly seed disorder tolerable variety and judicious application of calcium, potassium and nitrogen fertilizers can control the jelly seed disorder problem as well as improve yield and quality of mangoes.