Effect of Cleopatra mandarin rootstock age on bud 'take' of Late Valencia sweet orange

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ABSTRACT

Cleopatra mandarin is preferred to rough lemon as rootstock material for budding because of the susceptibility of the latter to major citrus diseases such as gummosis and phytophtora infections. However, Cleopatra mandarin rootstocks have poor bud 'take'. The experiment was conducted at CSIR-Plant Genetic Resources Research Institute, Bunso to determine the effect of Cleopatra mandarin rootstock age on bud 'take' of Late Valencia sweet orange variety. Cleopatra mandarin rootstocks of ages 9 months, 10 months, 11 months and 12 months were budded with Late Valencia sweet orange variety using the chip budding technique in a randomised complete block design. There were 25 budded seedlings for each age group and replicated four times. Results obtained indicated that younger Cleopatra mandarin rootstock favoured bud 'take'more than older ones. Higher bud 'take' was recorded in the 9-month old rootstocks followed by the 10-month old ones. Bud 'take', however, decreased with age of the rootstock. Differences in bud 'take'between younger rootstocks (9 and 10 months old) were insignificant. There were, however, significant differences between bud'take' of younger rootstocks and older rootstocks (11 and 12 months old).

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Introduction

Establishments of large scale citrus orchard in Ghana started in 1913 when West Indian lime was introduced as budding rootstock. Citrus production in Ghana, however, declined significantly by 1947 (Ofosu-Budu *et al*., 2007). Investigations into cause of the decline by Godfred-Sam-Aggrey (1971) and Adansi (1972) identified citrus tristeza virus (CTV) disease as the main cause. The virus was known to be vectored by*Toxoptera citricida* Kirkaldy. An effort to revive the citrus industry led to the introduction of rough lemon (*Citrus limon* L.), which served as a rootstock for budding citrus varieties susceptible to CTV. Rough lemon was, however, found to be susceptible to gummosis, a potent citrus disease. Cleopatra mandarin (*Citrus reshni* Hort. ex Tan) and Rangpur lime (*Citrus limonia* Osheck), which had shown tolerance to gummosis in addition to resistance to CTV, exocortis, viriod, and xyloporosis in Brazil were then introduced to be used as rootstock (Ofosu-Budu *et al*., 2007).

Many citrus orchards in Ghana were established using varieties budded on rough lemon rootstock. Rough lemon rootstock

imparts vigour and tolerance to disease scaused by CTV, exocortis, viroid and xyloporosis, however, it makes the budded citrus vulnerable to phytophthora infections and gummosis (Molina *et al.*, 2000). Molina *et al.* (2000) also reported that rough lemon rootstock imparts traits such as poor fruit quality, thick and puffy fruit peel, low total soluble solids and low titratable acidity. Rehn & Espig (1991), however, reported that Cleopatra mandarin rootstock, in addition to being resistant to phytophthora infections, imparts adaptability to light and heavy clay soils, high salinity, high *p*H and dwarfing, which stimulates early fruiting and results in high yield. Demand for citrus budded using Cleopatra mandarin as a rootstock is on the increase. This challenge has discouraged the use of Cleopatra mandarin rootstocks by citrus budders in Ghana. Hartmann *et al*. (2002) reported that age at which rootstocks are budded was critical to bud 'take'.

The study aimed at determining the effect of Cleopatra mandarin rootstock age on the union between rootstock and bud (Bud 'take') of Late Valencia sweet orange.

Materials and methods

The study was undertaken at the general nursery of CSIR-Plant Genetic Resources Research Institute (CSIR-PGRRI) at Bunso from January to December 2010 with temperatures from 24 °C to 28 °C and average annual rainfall of 1750 mm.

Seeds were extracted from healthy matured fruits picked from a matured Cleopatra mandarin tree in the CSIR-PGRRI citrus orchard at Bunso. The seeds were washed with clean tap-water and sown by broadcasting on a nursery bed in a lath house of 60 per cent light intensity and average day temperature of 28 °C. Seeds were sown in January, February, March and April 2010. Germinated seeds, therefore, had 1 month age interval; from January to April 2010. Seedlings at the 6th leaf stage were potted in polythene bags containing top soil and 1 g of fertilizer (NPK- 15:15:15) applied to seedlings at 2 months interval after potting until November 2010.

The design of the experiment was a randomised complete block design, with four treatments being ages of rootstock (9 months, 10 months, 11 months and 12 months) replicated four times. There were 25 seedlings per treatment. Budding was done using the chip budding technique described by Hartmann *et al*. (2002) at stock height of 25 cm from the soil surface. Budding was carried out in a lath house of 60 per cent light intensity and an average day ambient temperature of 28 °C. There was regular watering of seedlings and picking of weeds from the polythene throughout the period of the experiment.

Budding tapes were removed 12 days after budding and the number of successful union between rootstock and bud (bud 'take') recorded. Number of budded Late Valencia with sprouted leafbuds or leaves were also recorded 1 month later.

Data collection and analyses

Data was collected after 12 days of budding. Number of successful bud 'take' and number of sprouted buds were recorded for each rootstock age. Data collected were analysed using Microsoft Excel Analysis of Variance (ANOVA). The Duncan's multiple range test was used to determine differences between means at least significant difference (LSD) of 1 per cent.

Results and discussion

There were differences in bud 'take' amongst different ages of Cleopatra mandarin rootstocks. There were no significant differences between rootstock ages 9 months and 10 months and between 11 months and 12 months (Table 1). However, bud 'take' of younger rootstocks (9 months and 10 months) were significantly higher than older rootstocks (11 months and 12 months). These results were in agreement with reports of Asante & Barnett (1997) and Hartmann *et al*. (2002), which indicated that bud 'take' was faster in younger rootstock than in older ones.

Table 1

Effect of Cleopatra mandarin Rootstock age on Bud 'take' and Bud sprout of Late Valencia

Rootstock age (months)	*Per cent bud 'take'*	*Per cent bud sprout*
Nine	72.2a	47.1a
Ten	70.3a	47.5a
Eleven	2.1b	5.4b
Twelve	2.6b	4.3b

Note: Per cent bud 'take' with the same letter are not significantly different at ($P = 0.01$) according to Duncan's multiple range test.

Soule (1971) and Asante & Barnett (1997) also reported that resin secretion and callus formation in rootstocks are from parenchyma cells, the cortex, pith, xylem and phloem ray. The secretions unite rootstocks and buds and are faster and more in younger parenchyma cells than in older ones. Differences in bud 'take' of the Cleopatra mandarin rootstocks could be attributed to age of their parenchyma cells.

Sprouting of the Late Valencia buds followed the same trend as the rootstock bud 'take'. Per cent bud sprout of Late Valencia was significantly higher in those budded on younger rootstocks than on older rootstocks (Table 1). Rootstock age of Cleopatra mandarin appears to have affected Late Valencia bud sprouting.

Conclusion

It is concluded from the study that age of Cleopatra mandarin rootstock had effect on bud 'take' of Late Valencia sweet orange. Younger rootstocks had more successful bud 'take' than older ones. Nine and 10-month old rootstocks promoted bud 'take'. Successful bud 'take' also promoted rapid leaf sprout of budded rootstocks.

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