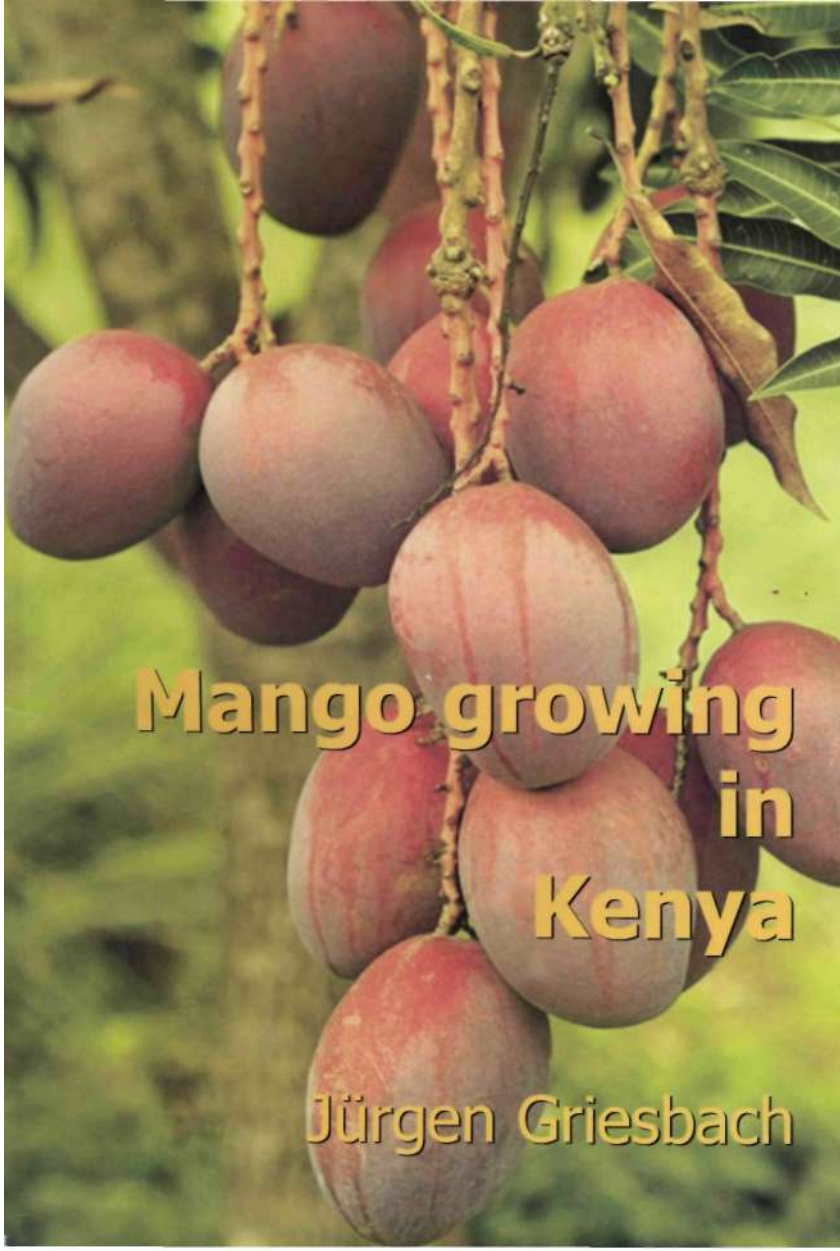
Mango growing
in
Kenya
Jürgen Griesbach

MANGO GROWING

IN

KENYA

JURGEN GRIESBACH

WORLD AGROFORESTRY CENTRE

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FOREWORD

The word fruit is derived from the Latin *word fructus* which means enjoyment. Of all fruits enjoyed throughout the world few are as popular or universally acceptable as the mango. In fact the only tropical fruit which outranks it is the banana. With nearly US$ 500 million worth of mangoes exported each year and 40 times that amount consumed in the countries of production, its role in income generation and household food security is evident.

The dual roles of the mango of providing household nutrition and economic development opportunities overlap with the goals of the World Agroforestry Centre (ICRAF). Established in 1978, ICRAF has evolved from a promotional council to an international scientific research institute to a worldwide centre addressing research and development issues of trees on farms. In tree species prioritisation studies with smallholder farmers, fruit trees routinely emerge as being highly popular although their cultivation is sometimes seen as being highly knowledge intensive. Whilst many efforts are underway to domesticate wild indigenous species in Africa, the regal mango which has been domesticated for 4000 years deserves as much if not more attention.

Kenya is a country with a strong agriculture industry, although the horticulture component of this, with the exception of floriculture, has been under-developed. With a view to increasing the mango industry in Kenya and similar countries ICRAF is pleased to be able to publish this booklet drawing on the decades of experience in East Africa of its author, Jiirgen Griesbach. The production and publication of this booklet was made possible through project grants of the Ministry of Foreign Affairs (Education and Development Division) of the Netherlands Government and the Department for International Development (DFID) of the United Kingdom.

Fruit preferences are as much a cultural phenomenon as they are an agroclimatic or a physiological one. We are confident that the practical information contained in this booklet will engender a greater mango planting culture in Kenya and neighbouring countries. In time it is hoped this will boost export earnings and contribute to rural and urban nutrition through fresh and dried fruits.

Enjoy the mango fruit and enjoy reading this book.

Tony Simons, PhD
Principal Tree Scientist
World Agroforestry Centre

PREFACE

The mango industry in Kenya has expanded considerably over recent years, not only in size but also in the geographical location of commercial and homestead plantings. No longer is commercial mango cultivation restricted to the Coast Province, as significant plantings of improved cultivars now also exist in the Eastern and Central provinces, among other regions.

As a result of this expansion, the mango fruit is becoming more popular with the local population. Despite this increasing popularity, only a few consumers and potential growers are familiar with the characteristics of the many different cultivars of mango that are now grown and available in the country **(see Appendix 1).**

The aim of this booklet is chiefly to familiarize readers with the details of the more common cultivars that are potentially suitable for commercial and backyard production. Their respective origins, characteristics, advantages and disadvantages are discussed. In addition, information regarding propagation, and establishment and maintenance of an orchard of this important fruit species is given.

INTRODUCTION

Although the mango tree is not indigenous to Kenya, it has been cultivated in the Coast Province for centuries. Traders in ivory and slaves brought seed into the country during the 14th century. Mango trees were reported in Somalia as early as 1331. The mango is one of the most important fruit crops in the tropical and subtropical lowlands. It is native to India, Bangladesh, Myanmar and Malaysia, but can be found growing in more than 60 other countries throughout the world (Salim et al., 2002).

The mango is best adapted to a warm tropical monsoon climate with a pronounced dry season (>3 months) followed by rains. However, information from other countries indicates that crops cultivated for a long time over an extended area show a high degree of diversity due to varied environmental influences. This was likely also true for the mango seedlings first introduced in Kenya which were all polyembryonic. They can be multiplied by seeding and generally produce true-to-type progeny. Some of these are still productive, e.g. along the Tana River, and some of them have been given names which to this day are still valued. Kitoovu, Kimji, Klarabu, Punda and Mayai are of poor quality but better known are cultivars like Apple, Ngowe, Boribo, Batawi and Dodo. Of these, a few have steadily lost ground to a generation of cultivars introduced in the 1970s and 1980s distinguished by greater resistance to anthracnose *(Colletotrichum),* powdery mildew *{Oidium),* their very attractive colour and good shelf life.

USES AND FOOD VALUE

The mango—because of its attractive appearance and the very pleasant taste of selected cultivars—is claimed to be the most important fruit of the tropics. It has been touted as 'king of all fruits' but has also been described as a 'ball of tow soaked in turpentine and molasses' by critics! It is one of the most delicious fruits there is, although it has undesirable features including coarse fibrous strands through the flesh and the pungent and turpentine flavours of some cultivars.

Fruits from the scattered mango production areas are mainly consumed locally. During the last 20—30 years, commercial mango production was developed based on locally adapted and newly imported cultivars. This has seen the area under mango cultivation in Kenya rise from 500 ha in 1970 to approximately 15,000 ha in 2000 (source: Annual Report, Ministry of Agriculture, Nairobi). There is a great diversity of mango fruit types which permits considerable manipulation for various purposes and markets: juice, chutney, pickles, jam/jelly, fresh fruit, canned and/or dried fruit etc. Given the multiple products, it is therefore a potential source of foreign exchange for a developing country; it is also a source of employment for a considerable seasonal labour force.

In addition to income opportunities, the mango is noted for combating nutritional disorders. The mango compares favourably in food value with both temperate and tropical fruits. Indeed the fruit contains almost all the known vitamins and many essential minerals. Studies have shown that one mango fruit can provide a large proportion of the daily human requirements of essential minerals, and vitamins (see Table below). The calorific value of mango is mostly derived from the sugars. It is as high as that of grapes and even higher than that of apple, pears or peaches. The protein content is generally a little higher than that of other fruits except the avocado. Mangos are also a fairly good source of thiamine and niacin and contain some calcium and iron.

Calories and nutrients per 100 g edible portion

Fruit	Calories	Protein (g)	Calcium (mg)	Iron (mg)	Vitamin A (IU)	Thiamine (mg)	Vitamin C (mg)
Orange	53	0.8	22	0.5		0.05	40
Banana	116	1.0	7	0.5	100	0.05	10
Mango	63	0.5	10	0.5	600	0.03	30

Source: *Piatt (1962).*

Minimum daily vitamin and mineral requirements for healthy people

Vitamin A	(IU)	=	2500
Vitamin C	(mg)	=	60
Thiamin	(mg)	=	1.5
Niacin	(mg)	=	19
Iron	(mg)	=	18
Calcium	(mg)	=	1000

Source: Mervyn (2000).

BOTANY

The mango is a member of the family Anacardiaceae. This family comprises many other valuable trees such as the cashew and the pistachio nut. The genus *Mangifera* includes 25 species (Mabberly, 1997) with edible fruits such as *Mangifera caesia, M. foetida, M. odorata* and *M. pajang,* although *M. indica,* the mango, is the only species that is grown commercially on a large scale. Worldwide mango cultivation now covers approximately 2.9 million hectares (FAO, 2001) and earns nearly US$ 500 million in export revenues.

There are two races of mango—one from India and the other from Southeast Asia. The Indian race is intolerant of humidity, has flushes of bright red new growth that is subject to powdery mildew and anthracnose and bears mono-embryonic fruit of high colour and regular shape. The Southeast Asian race is tolerant of excess moisture, has pale green or red new growth and resists powdery mildew. Its polyembryonic fruit is pale green and of an elongated kidney shape.

The mango is a deep-rooted, evergreen plant which can develop into huge trees, especially on deep soils. The height and shape varies considerably among seedlings and cultivars. Under optimum climatic conditions, the trees are erect and fast growing and the canopy can either be broad and rounded or more upright. Seedling trees can reach more than 20 m in height while grafted ones are usually half that size. The tree is long-lived with some specimens known to be over 150 years old and still producing fruit! The mature leaves are simple, entire, leathery, dark green and glossy; they are usually pale green or red while young. They are short-pointed, oblong and lanceolate in shape and relatively long and narrow, often measuring more than 30 cm in length and up to 13 cm in width (Salim et al., 2002). New leaves are formed in periodic flushes about two to three times a year.

The greenish-white or pinkish flowers are borne in inflorescences—usually placed terminally on current or previous year's growth—in large panicles of up to 2000 or more minute flowers. Male flowers usually outnumber the bisexual or perfect flowers.

Generally, flowering in Kenya lasts from about late July to early November, depending mostly on weather conditions. At the coast it is not uncommon to find individual trees flowering as early as February and March. Pollinators are usually flies, rarely bees or nectivorous bats. Pollen cannot be shed in high humidity or rain as this might prevent pollination and fruit setting. Mangos are self-fertile, thus a single tree will produce fruits without cross-pollination.

Mango fruits of the various cultivars differ greatly in shape, size, appearance and internal characteristics. The fruit is a fleshy drupe, varying in size from 2.5 to 30 cm long, may be kidney-shaped, ovate or round and weigh from approximately 200 g to over 2000 g. The leathery skin is waxy and smooth and when ripe entirely pale green or yellow marked with red, depending on the cultivar.

The fruit quality is based on the scarcity of fibre, sweetness and minimal turpentine taste. The flesh of the improved cultivars is peach-like and juicy, of a melting texture and more or less free from fibre. The single, compressed ovoid seed is encased in the white fibrous inner layer of the fruit. The seed is enclosed in a stony endocarp, varying in size/shape with two fleshy cotyledons. Each seed contains either one embryo (the so-called mono-embryonic cultivars) or more than one embryo (the so-called polyembryonic cultivars), producing several seedlings without fertilization. Most of the seedlings will be nucellar seedlings which have originated vegetatively, they are mostly true-to-type and genetically identical with the mother tree. Most Indian cultivars are mono-embryonic, while generally cultivars from Indonesia, Thailand and the Philippines are polyembryonic.

PROPAGATION

Mangos are propagated either vegetatively or by seed. Seedlings are grown sometimes to produce new cultivars but mainly for use as rootstocks or to reproduce known polyembryonic cultivars. Mono-embryonic types, however, require vegetative propagation to retain all of the desired characteristics. It is also known that trees grafted on selected rootstocks remain smaller than the rootstock, and bear better and earlier.

The selection of suitable rootstock is as important as the selection of the scion cultivar. It has a strong influence on the growth, yield, fruit maturity and soil adaptability, among other things. In Kenya, the uniform seeds of the polyembryonic cultivars Sabre, Peach and Dodo are routinely used successfully. Seeds must be taken from ripe fruits and should be as fresh as possible at the time of planting. Before planting, the hard woody endocarp should be removed to examine the seed for disease or any damage caused by the mango weevil *(Sternochetus).* Freshly sown seeds should be protected from high temperatures and dessication by providing shade. Once seedlings emerge the shade is removed to harden the plants and produce a sturdy stem for grafting.

Once the seeds have germinated, the seedlings are carefully lifted and culled. This may be about one month after planting when they have reached the 3-5-red-leaf-stage. After transplanting the seedlings into containers not smaller than 18 x 35 cm they remain there until they are of pencil thickness at about 20 cm above soil level. There are many techniques used to graft mango seedlings, but the most common methods are side-graft, side veneer and wedge- and whip-graft. A mango tree must never be transplanted while it is flushing or when the leaves are still tender; the best time to transplant is after the second flush has hardened.

The top-working of fruit trees is a normal orchard practice and is necessary to replace old cultivars/seedlings with improved selections which are developed from time to time. Top-worked trees will start bearing within 2-3 years, i.e. much earlier than a newly planted tree. Furthermore, the survival of newly planted trees is not always guaranteed (drought, fire, animals etc.).

ESTABLISHMENT

Mango is successfully grown on a wide range of soils. The trees do well in sandy soils at the coastline as well as on loam, black cotton and even murram soils at other elevations. The essential prerequisites for good development of the trees are deep soils (at least 3 m), appropriate rainfall (500-1000 mm), good drainage, suitable altitude (0-1200 m) and preferably a pH value of between 5.5 and 7.5. The tree itself is not difficult to grow and, once well established, is relatively tolerant of drought, occasional flooding and poor soil condition. Irrigation in the first years after planting promotes flushing (and suppresses flowering), so that tree size increases quickly. Irrigation also widens the scope for intercropping, for example, with papaya, banana, pineapple or vegetables, during the establishment phase. When the trees are big enough to produce a substantial crop, irrigation is stopped, or at least interrupted long enough to impose quiescence leading to flower initiation.

Among the various climatic factors, temperature, rainfall and humidity have a greater bearing on mango production than irrigation and soils. Furthermore, the production of high quality mango fruit does not depend so much on elevation but on the range of temperatures available. The two important considerations for mango cultivation are a dry period at the time of flowering—in Kenya mainly during the months of August to October—and sufficient heat during the time of fruit ripening. For optimum growth and productivity, 20-26°C is believed to be ideal. Temperatures exceeding 40°C may, especially in hot/dry areas, lead to sunburn of fruits and stunting of tree growth. Although not very impressive, mango trees of selected cultivars like Sabre and Peach have been observed at elevations of up to about 1900 m. However, for more successful crops areas below 1200 m should be considered.

The amount of rainfall in a given locality is not as important as its intensity and distribution. Rainfall of 500-1000 mm at the right time of the year is sufficient for successful cultivation. However, the mango cannot do well in areas which experience frequent rains or very high humidity during the flowering period. Such conditions are not conducive to good fruit set and they increase the incidence of serious diseases like powdery mildew and anthracnose. Anthracnose can be a major problem as the same organism occurs on avocado, coffee and papaya. Powdery mildew is quite common when low temperatures accompany high humidity (see **Appendix 2).**

Since the mango is a long-lived perennial, the planting distance usually depends to a large extent on the vigour of the cultivar/rootstock and on the environment. Most orchards (either solely mango or a few trees on small farms) are planted too densely and trees are forced to grow upright and tall. Overcrowding results in the production of fewer fruits which are apt to be poorly coloured and infected with diseases. Tall trees also present a harvesting problem and create difficulties during spraying and pruning. Normally, grafted trees are spaced at 8 x 10 m or 10 x 12 m, though at the coast seedlings require 12 x 14 m. Intercrops of short-lived fruit trees such as papaya or annual crops could be used for better utilization of land in widely spaced young plantations.

MAINTENANCE

Mango plants should develop into strong well-shaped trees within the first 4 years and do not require pruning unless there are excessive branches or the shape is unusual. Depending on the cultivar and growth pattern selective pruning of branches may be required to encourage growth of lateral branches and to ensure development of good tree architecture for future fruit bearing. Any branches on the trunk lower than one metre from the ground should be cut. In later years, pruning is done mainly to remove diseased and/or dry branches or those touching the ground or crowding others. Grafted trees tend to flower from the first year, and the formation of fruit on year-old mango trees is nothing exceptional. Flowering at this early stage and especially early bearing weakens young trees and often damages them severely. Therefore early flowering has to be avoided by removing the inflorescences; only from the third or fourth year should trees be allowed to bear fruits.

A general criterion regarding mango nutrition is that care must be taken not to over-fertilize thereby promoting vegetative vigour at the expense of flowering and fruit set. This is particularly true for nitrogen application since trees are subject to fertilizer burn. Correct fertilizer requirements can only be determined by means of leaf and soil analyses taken in different agroclimatic regions. With trees in fruit, proper timing is critical and it is recommended that fertilizer be applied just after harvesting, during the rains. In general, a tree at full bearing age (7 years and older) needs about 1.5 to 2.5 kg of Calcium Ammonium Nitrate (CAN) (26%); 2.25 kg superphosphate and 0.75-1.5 kg potassium chloride per year, or the equivalent inputs from manure or compost for small-scale farmers. These quantities can be supplied either at one time or may be split into two doses administered with a two-month interval between them.

Orchards should be kept clean, especially under the canopy of the trees where the fertilizer is spread uniformly in a circular belt around the drip line. This is the zone where the most absorption roots are located.

PRODUCTION

Mango seedlings as a rule start to bear fruit within 4-7 years, while grafted trees (if allowed) may bear a few fruits in their second year in the field. Mango production in Kenya has to be differentiated according to the production system. There is traditional mango growing, and commercial and market-orientated mango cultivation. Out of an average annual mango production in Kenya of about 140,000 tonnes (t) during 1999/2000, approximately 3300 t (2.3%) were exported (source: Annual Report, Horticultural Crops Development Authority (HCDA), Ministry of Agriculture, Nairobi). Some distinct differences between the location of production and the performance of the orchard can be identified, such as the harvest period, the fruit quality and the yield level. Due to the varying ecological conditions in Kenya, mangos are available almost all year round (see Appendix 3).

In the main production area, the Coast Province, two supply seasons can be differentiated. The first and main season runs from November to February and the second from June to August. In areas of higher altitude such as Murang'a and Mwea (Central Province), the harvest season is 4—6 weeks later than at the coast, with a peak in February and March. The mango picking season in Kenya competes with that of other mango producing countries (Mexico, Brazil, India, Pakistan, Israel, South Africa) and extends over a period of between 5 and 6 months (Appendix 4). Interestingly though, Kenya exports only about 3000 t out of the worldwide export tonnage of 580,000 t/year (FAO, 2001).

Productivity depends on a number of factors, including quantity of previous crop, weather and soil conditions, altitude, control of pests and diseases, fertilization and cultivar. Even in the case of the same cultivar, yields vary greatly because mango is grown under widely varying agroclimatic conditions and cultural practices.

Biennial or irregular bearing occurs often with the mango and it is common for some cultivars to bear heavily in one year and sparsely the next. One of the reasons for this phenomenon is that trees over-bear in one year, thus inhibiting adequate flower bud formation the following year. Under these circumstances, it is difficult to get accurate local long-term yield records. However, it is well known that yields of 25 t/ha and more for Kent, Sabine, Tommy Atkins and Keitt are not uncommon.

Cultivar trials carried out under rainfed conditions at government prison farms in Kenya indicate that even higher yields could be achieved. Tables 1 and 2 show the performance of some imported mango cultivars planted in the Central Province of Kenya. Additional performance figures are also shown in these tables which are taken from Griesbach (1992, page 87).

MATURITY

Depending on cultivars and environmental conditons it takes 90 to 160 days after flowering for Kenya mangos to reach maturity. Not all fruits on one tree will ripen at the same time. A great problem is to determine precisely the stage at which the fruit is ripe for picking. Fruits harvested too early will be of inferior quality after storage; however, fruits picked when too ripe cannot be stored for any length of time and may give rise to problems such as jelly seed. The fruit will have its best flavour if allowed to ripen on the tree. None of the tests (acid, sugar content or specific gravity) used to determine ripeness, however, are fully reliable.

The fruits are generally picked when they begin to change colour. This may occur first in a small area or the change will cover most of the fruit's surface. However, one destructive maturity test that can be applied even before the external colour break starts is to examine the colour of the flesh around the seed. When this begins to change from green-white to yellow or orange, it indicates that the fruit is beginning to ripen and may therefore be picked. Also the greater the swelling of the shoulders above the stalk attachment, the riper the fruit is likely to be (see diagram of a mature mango fruit).

Table 1. Yield figures of some imported mango cultivars.

Cultivar	Average fruit weight (g)	Average number of fruits/kg per tree per year						
		2nd	3rd	4th	5'''	6.h	j»	8ih
Sensation	310	50/15.5	120/37.2	176/54.6	360/111	250/77.5	311/96.4	579/179.5
Kent	610	17/10 4	108/65.9	137/83.6	210/128	382/233.0	266/162.3	148/90.3
Haden	398		44/17.5	135/53.7	204/81.2	178/70.8	410/163.1	157/62.5
Maya	335		33/11.0	74/24.8	286/95.8	60/20.3	160/53.6	176/58.9
Sabine	511		112/57.2	216/110.4	328/167.6	452/230.9	420/214.6	275/140,5
Van Dyke	283	12/3.4	73/20.7	98/27.8	84/23.8			
For comparison								
Ngowe	571	22/12.6	30/17.1	88/50.3	198/113.1	153/87.4	217/123.9	148/84.5

Location:	**Elevation**	**Average precipitation**
Government of Kenya Prison Farm, Mwea	1150 m	950 mm
Government of Kenya Prison Farm, Maranjau	1000 m	800 mm

Source: Author's records (1980-1988).

Table 2. Performance Figures of some imported mango cultivars.

Cultivar	Maturity (months)	Fruit colour	Trees/ha 8x 10 m 7 x 9 m	t/ha per year						
				ond	3">	4th	5.h	6>»	r^h	gm
Sensation	February	Purple/red	125	1.94	4.65	6.82	13.95	9.69	12.05	22.44
Kent	Mar/Apr	Green/red/ yellow	159	1.65	10.48	13.30	20.37	37.058	25.81	14.367
Haden	Jan/Feb	Yellow/red	125		2.19	6.72	10.15	0.86	2040	0.81
Maya	Jan/Feb	Yellow/red	125		1.38	3.10	11.98	2.54	6.70	7.36
Sabine	Jan/Feb	Yellow/red	125		7.15	13.79	20.95	28.87	26.83	17.56
Van Dyke	Jan/Feb	Yellow/red	125	0.42	2.58	3.48	2.98			
For comparison										
Ngowe	Dec/Jan	Yellow/ orange	125	1.57	2.14	6.28	14.13	10.92	15.49	10.56

Location:	Elevation	Average precipitation
Governmentof Kenya Prison Farm, Mwea	1150m	950mm
Government of Kenya Prison Farm, Maranjau	1000 m	800 mm

Source. Author's records (1980-1988).

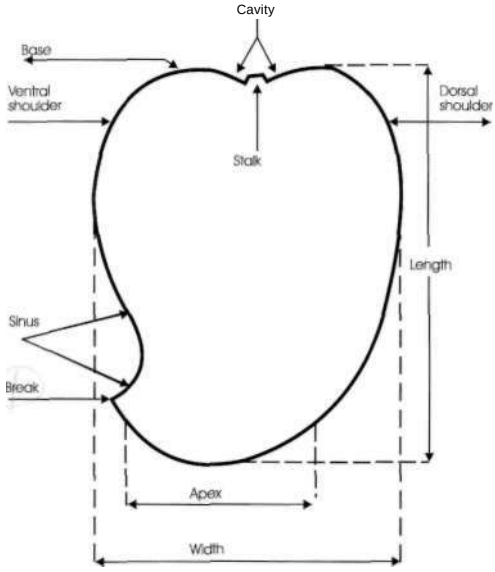


Diagram of a mature mango fruit

During and after harvesting the highly perishable fruit must be handled with the greatest care. The fruit is removed from the tree by cutting the fruit stalk about 2 cm from the fruit. This will prevent the latex (exuded from the cut stalk) adhering to the skin of the fruit, staining it and rendering it unattractive. Ladders or long picking poles with a cutter blade and an attached canvas bag, held open by a ring, are also in use. To avoid physical damage, the picked mangos should be carefully placed into clean wooden or plastic containers and never into gunny bags. If there is a delay in the transfer of the fruits to a store or packing shed they should be kept in a sheltered place to minimize sunburn, loss of moisture and accumulation of dust.

After any sorting, grading, washing, fungicidal treatment and perhaps waxing, the fruits are ready for packing, preferably into shallow single-layered trays of 4-5 kg each. Because mangos are harvested during the summer months, the fruit temperature- may be as high as 35°C and more. This has a detrimental effect on the shelf life of the fruit. It is therefore advisable to move the packed fruits into cold storage as quickly as possible to help them lose this inherent heat. The recommended storage temperature must, however, not drop below 7"C (range: 7-10°C) as otherwise cold injury may

Classification of mango cultivars according to maturity seasons

	Cultivar
Early cultivars (November to mid-January)	Arumanis, Apple, Carabao, Ngowe, Haden, Gesine, Dodo, Kensington, Zill
Mid-season cultivars (mid-January to late February)	Alphonso, Heart, Batawi, Boribo, Golek, Madoe, Peach, Sabre. Sabine, Tommy Arkins, Chino, Matthias, Irwin, van Dyke, Smith
Lite cultivars (late February to April)	Parwin, Sensation, Kent, Zillate, Keitt

Remarks:

Off-season fruits are common in all regions and especially at the Coast where a distinct second cropping season occurs during the months of May to August.

The above classification is more or less valid for the early, mid-season and late mango cultivars. The months mentioned are a yardstick since-—depending on location—the picking season for a certain cultivar which is listed as an early cultivar for Coast Province will definitely be in mid-season in Central Province. Still, this cultivar is an early one for the relevant province.

FLOWER INDUCTION

According to the Horticultural Crops Development Authority (HCDA), mangos in Kenya are available from November to April (and sometimes to July). Because of less competition better prices are fetched in Europe and the Middle East between November and December (see Appendix 5). Many techniques have been used in other countries to improve productivity and to alter the cropping season. Smudging (moist organic material—grass, leaves, etc.—is slowly burnt under the tree canopies and the resulting smoke induces flowering) is an old technique reported from the Philippines for enforcing off-season flowering, but this has largely given way to chemical induction. The application of potassium nitrate has been commercially accepted. The reasons are obvious: to have an altered earlier harvest, to take advantage of the good market price, to fill the gap of under-supply and to have flowering during a dry spell with little or no fungal diseases.

The readiness of a tree to flower is an important factor for a successful operation. For best results, choose trees with leaves that are dull green or greenish-brown and brittle when crushed by hand. The trees should have an appearance of suspended growth or be dormant. It is easier to induce mango trees to flower towards the dry season, and older trees respond better than young ones.

It is recommended that a 1% potassium nitrate solution mixed with a sticker agent (adhesive) be sprayed on to the tree, totally drenching its terminals and leaves. Make sure a knapsack sprayer has no residual herbicide in it before beginning to spray. If the timing is right, flowers will emerge 10-14 days after application. Tentative trials have been successfully implemented in Kenya.

PESTS AND DISEASES

Although the mango in Kenya is spread throughout all feasible agroclimatic zones it has relatively few major problems with pests and diseases. These problems can be significantly reduced through a number of management decisions, for example:

- selection of proper orchard site
- selection of cultivars
- controlled fertilizer application
- timely spray application programmes
- orchard sanitation
- timing of irrigation

However, even when implementing these decisions there is no guarantee that some of these stubborn pests/diseases will not occur. Trees should be examined frequently to check for any infestations so that control measures, particularly for export fruits, can be applied before extensive damage can occur.

Where specific insecticides/fungicides have been mentioned in the following text, these are generally given as examples and should not be regarded as exclusive of others. In addition, trade names have been avoided as much as possible as one active ingredient could have several trade names from different manufacturers. It is important to rotate pesticides so that no resistance can build up especially in the nursery. The author has previously used the pesticides mentioned during his field research trials although the reader is strongly advised to check with his/her horticultural extension officer for the latest control recommendations and the respective recommended pre-harvest intervals (see **Appendix 6).**

In areas where chemical control agents are not available or affordable it is possible to use phytopesticides. *Tephrosia vogelii* and *Azadirachta indica* (neem tree) are probably the most readily available.

Mango fruit fly

Different types of fruit flies are known to attack ripening mangos in almost all mango-producing areas. Yield losses of more than 50% have been reported. *Ceratitis cosyra* followed by *C. rosa* and *C. capitata* have been found to be the major pests of mango.

The females lay their eggs under the surface of the fruit skin. After hatching, the maggots penetrate the flesh and destroy the fruit from inside. The infested part becomes mushy and causes premature colouring of the already useless fruit. Fruits of some cultivars are more susceptible to attack than those of others. Successful control of fruit flies in mango orchards depends on a combination of:

- eradication of non-economic host plants (such as neglected citrus, peach, guava)
- regular orchard sanitation

- determination of population density by using traps
- regular poison-bait applications

Chemical control of adult fruit flies in orchards is based on a weekly bait spray: protein hydrozylate or molasses mixed with Malathion, Trichlorphon, Fenitrothion or Fenthion. The bait is applied in large drops at a rate of 200—1000 ml/tree, depending on tree size. It is not necessary to wet the whole tree; only part of the foliage needs to be covered.

Mango seed weevil

The weevil, *Sternochetus mangiferae* (F), is a common pest in Kenya and can be found in all local mango-growing areas. It is spread mainly by transportation of infested fruits since the weevil develops within the mango seed and can therefore be transported easily from one locality to another unnoticed. The mango weevil does not usually damage the fruit and consequently is not a serious pest as far as local consumption of the fruit is concerned. However, this pest hinders the development of a fresh fruit export market because the leading import countries in the Middle East and other places maintain strict quarantine regulations.

Infestation symptoms are most obvious within the seed where the weevil largely completes its life cycle. Here all stages of the insect development—larvae, pupae and adults—can be found. Externally the affected fruits appear normal, but very often are rotting from inside.

The female usually lays her eggs over a period of 5–6 weeks on fruits before these are half-grown. The hatching period is 3–5 days. The young larvae penetrate the fruit and eat their way to the seed where they feed and develop into adult weevils. These emerge from the stone by tunnelling outwards through the flesh and skin of the fruit, leaving an unsightly patch where rotting soon sets in. Once the weevils have left the fruit they search for a hiding place such as beneath loose bark of trees or in waste material under the trees where they spend the time of the year that is unfavourable for them.

To date, chemical control measures against this pest have not proved economical. However, implementing the following three steps will definitely reduce the weevil population in the orchard.

Sanitation of orchard and yard

The biggest source of infestation is dropped fruits or seeds lying around in which weevils can survive up to about 300 days. Therefore, regular removal and destruction of waste material up to the end of the harvesting period is very important and effective.

Treatment of trunk and branches

The most suitable stage for control is during the emergence and oviposition of the adult weevil. The first step to suppress the weevil population is implemented at the beginning of the mango flowering season by using preferably long-lasting contact

insecticides such as Azinphos, Endosulfan, Malathion and Fenthion. It is important to thoroughly wet (by spraying) the bark of the trunk and scaffold branches or brush the insecticide mixed with a suitable carrier on to the bark.

Fruit treatment

After fruit set, carry out spray treatments mainly focussed on single fruits using Carbosulfan, Malathion, Azinphos etc. mixed with a spreader/sticker liquid. Repeat applications at intervals of 2—3 weeks and combine this with the control of anthracnose.

The mango is usually attacked by three to four key pests which require annual control measures. However, there are a number of occasional pests which may become troublesome only in localized areas or because of the occurrence of unusual circumstances. These pests include mites, thrips, scales, cecid fly and mealybugs.

Powdery mildew

The disease powdery mildew, caused by the fungus *Oidium mangiferae,* is a serious problem in all mango-growing areas in Kenya. Infections can result in complete crop loss and defoliation of trees. The disease favours cool and cloudy weather but also occurs in warm and humid climatic conditions. It attacks leaves, buds, flowers and young fruits. Infected tissues are covered with a whitish, powdery growth of the fungus. Mature spores are easily blown away by wind and produce a fresh infection, or they may remain dormant during the unfavourable season awaiting optimum germination conditions in the next season. Spraying 3-5 times at 10-14 day intervals from the onset of flowering until fruit set can control powdery mildew. Several chemicals are recommended and have been used to control the disease. These include Benomyl, Pyrazophos, Triadimefon, Bupirimate, Triforine and sulphur, all mixed with a spreader/ sticker.

Cultivars treated for powdery mildew in this way show remarkable increases in fruit set ranging from about 40% to more than 500%. The input costs of the spray applied per tree are justified as they are recovered fully by increased returns.

Finally, as already mentioned, all mango cultivars are susceptible to powdery mildew infestation to some extent. The range of resistance (with Sensation being the most resistant) could be: Sensation, Chino, van Dyke, Tommy Atkins, Sabine, Kent, Keitt, Gesine, Batawi, Apple, Ngowe, Haden, Maya.

Anthracnose

Besides powdery mildew, anthracnose, caused by the fungus *Colletotrichum gloeosporioides,* is undoubtedly the most common and widespread fungus disease of mango and is a major factor limiting production in areas where conditions of high humidity prevail. The fungus invades inflorescences, fruits, leaves and twigs. Substantial losses due to this disease are recorded every year not only at premature stages of the crop but also during storage after picking.

Humidity, rains and heavy dew during critical infection periods greatly increase the disease incidence. Most infections occur from the beginning of flowering in gradually decreasing severity until the fruit is about half-grown. Infections on the flower and panicle appear first as minute brown or black spots which slowly enlarge. Infected flowers usually wither and die before fruit set.

Young fruits are readily infected. Spots may remain as pinpoint latent infections or they may enlarge in wet weather. Wet weather also causes characteristic tear-stain symptoms due to the spread of fungal spores by raindrops. The latent infections on young fruits cause much of the decay which occurs in mature fruits. Nearly mature to ripe fruits will have black spots of varied form which may be slightly sunken and show surface cracks penetrating deeply into the fruit causing extensive rotting or complete blackening of the fruit surface.

To control the disease, orchard sanitation and pruning of dead twigs and branches—which may harbour the fungus—are the principal control measures used to reduce the source of a new infection cycle. The widespread occurrence of the inoculum of the fungus makes it impossible to control the disease by pruning and the removal of dropped leaves alone. To be more successful, the above mentioned measures have to be supplemented by spray applications using Mancozeb, copper oxychloride, Maneb, Propineb, Benomyl etc.

It is recommended to start spraying at the stage of flower-bud formation. During flowering/fruit set and until the fruits have developed to half their size, spraying should take place at fortnightly intervals. After this, it is sufficient to treat the trees once a month. It is very important to apply a full cover spray for the first two applications. Since this period is also the critical stage during which powdery mildew and the mango weevil attack, counteractions should be implemented using recommended fungicide/insecticide combinations.

All cultivars are to some extent susceptible to anthracnose. The range of resistance (with Tommy Atkins being the most resistant) is: Tommy Atkins, van Dyke, Sabine, Ngowe, Gesine, Apple, Keitt, Kent, Kensington, Chino, Sensation, Batawi, Boribo, Haden, Maya.

There are several other diseases of mango fruits that have been reported occasionally. These include alternaria rot, mango scab, stem-end rot, algal leaf spot and sooty mould.

DESCRIPTION OF MANGO CULTIVARS

Alphonso

Also known as Appus, Badami, Gundu and Khader. This cultivar originated in Maharashtra State (India).

The fruits are orange-yellow in colour, medium-sized and oval/oblique in shape. They average 11.6 cm in length, 9.3 cm in width, and weigh 300-450 g (mean: 390 g). The skin is thin and smooth. The flesh is firm to soft, low in fibre, yellow, sweet, has a pleasant taste and is of good eating quality. The seed is mono-embryonic in a large, woody stone. The fruit matures in early to mid-season.

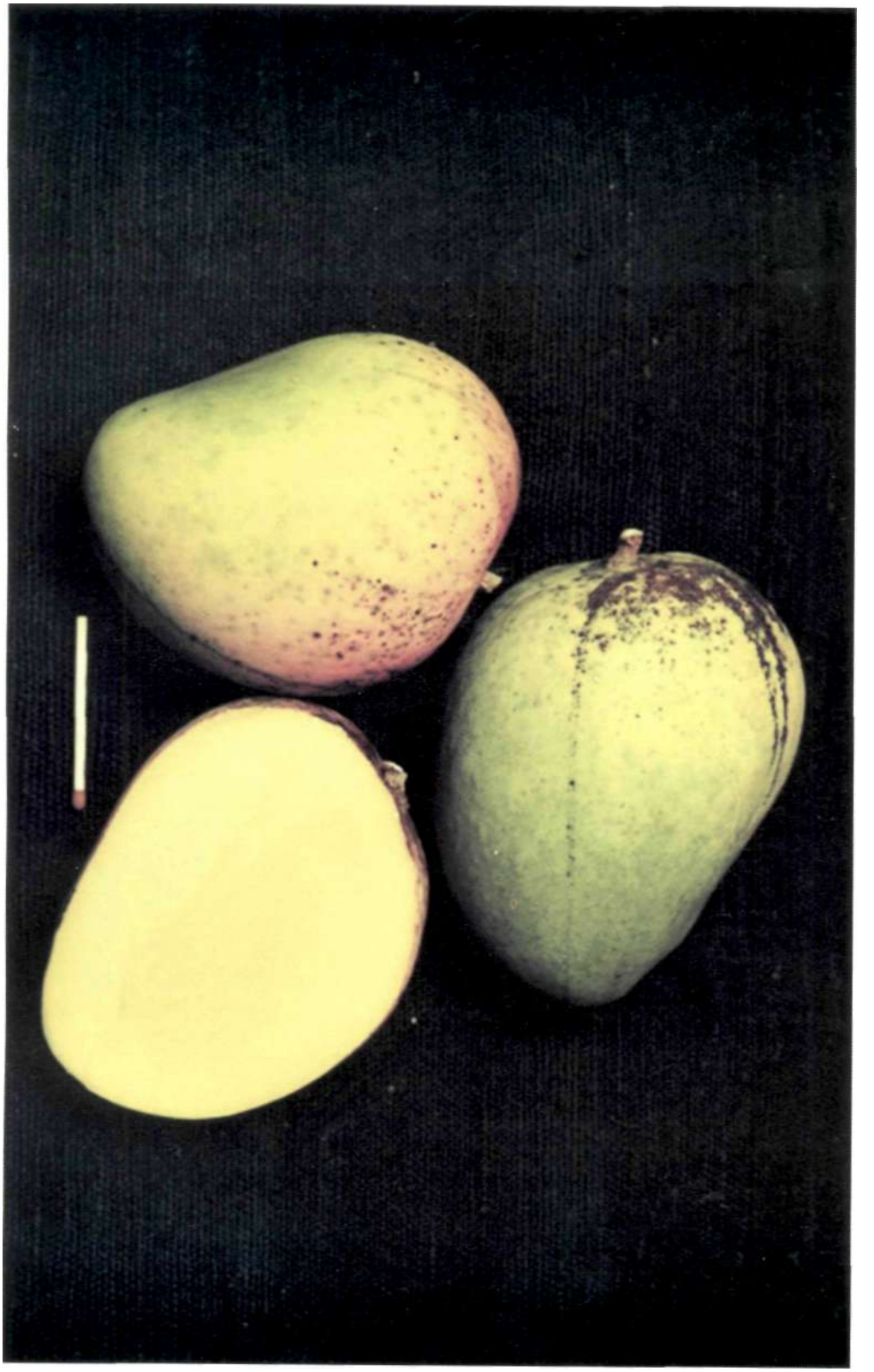
The tree is moderately large and vigorous with a broadly rounded dense canopy. It tends to have irregular bearing, but otherwise yields are medium to heavy.

Advantages:

- excellent fruit quality
- early and heavy cropper
- moderate tree size

Disadvantages:

- tendency towards biennial cropping
- large seed
- skin colour
- susceptible to anthracnose



Apple

This cultivar originated from the Kenya coastline, most probably around the Malindi area. It is a chance seedling and its parentage is unknown.

The fruits are medium to large, nearly round in shape and have a rich yellow/orange to red colour when ripe. Average length measures 9.7 cm by 11 cm in width, and the weight is 280-580 g (mean: 397 g). Normally, if not diseased, the skin is smooth and thin, and the juicy yellow flesh is of excellent flavour and of melting texture virtually free from fibre. This is not a polyembryonic cultivar and trees propagated by seed are very heterogeneous in fruit shape, colour and quality.

The trees are large/vigorous and of pyriform growth habit. Depending on location, harvesting seasons are from December to the beginning of March; the yields are medium.

Advantages:

- early cultivar of excellent fruit quality
- small/medium seed size
- free from fibres

Disadvantages:

- susceptible to anthracnose and powdery mildew
- alternate bearing
- range of altitude adaptation is limited

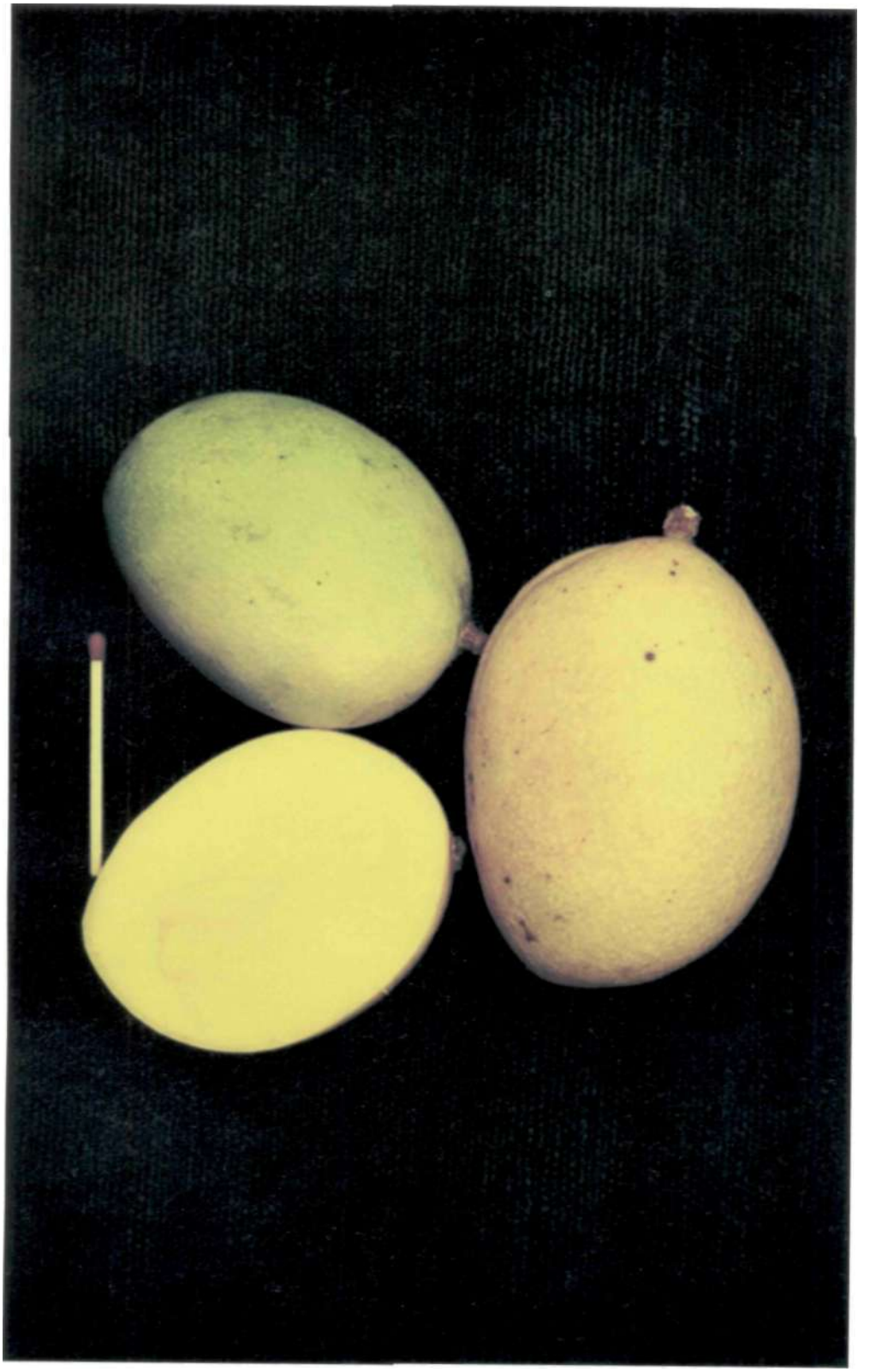
Arumanis

This cultivar is also referred to as Harumanis and it originated from Indonesia. It is widely planted in humid parts of the world where many cultivars of better quality fail to fruit.

The small, oval to oblong fruits are yellow with large yellow-white dots and a rounded base. On average they are 8.3 cm long and 6.3 cm broad and weigh 95—190 g at Mwea in Central Province. The beak is inconspicuous and the skin is thin and tough. The flesh is firm and juicy with little fibre. It is lemon yellow, sweet, slightly insipid with a strong aroma, but with only poor to fair eating quality. The polyembryonic seed is covered in a thick woody shell.

The tree is vigorous and tall with a slightly open canopy. It bears in January but there is a tendency towards low yields and biennial bearing. Resistance to powdery mildew and anthracnose is only low to fair.

The cultivar has not adapted well at an altitude of about 1080 m in Mwea and should be tried in other agroclimatic zones to achieve better results.



Batawi

This mid-season cultivar was discovered in the eastern part of Kenya and its parentage is unknown. Propagation and planting have only been done on a limited scale.

Among the unimproved local cultivars this fruit might be classified fourth in quality after Apple, Ngowe and Boribo. The fruit is very large, round and has a rich olive-green to purple-maroon colour. Average length measures 10.7 cm by 10.6 cm in width and weight ranges from 470 to 590 g (average: 523 g). The internal quality is usually good both in texture—with little fibre—and in flavour. Fruits show a prominent beak and the flesh is pale orange.

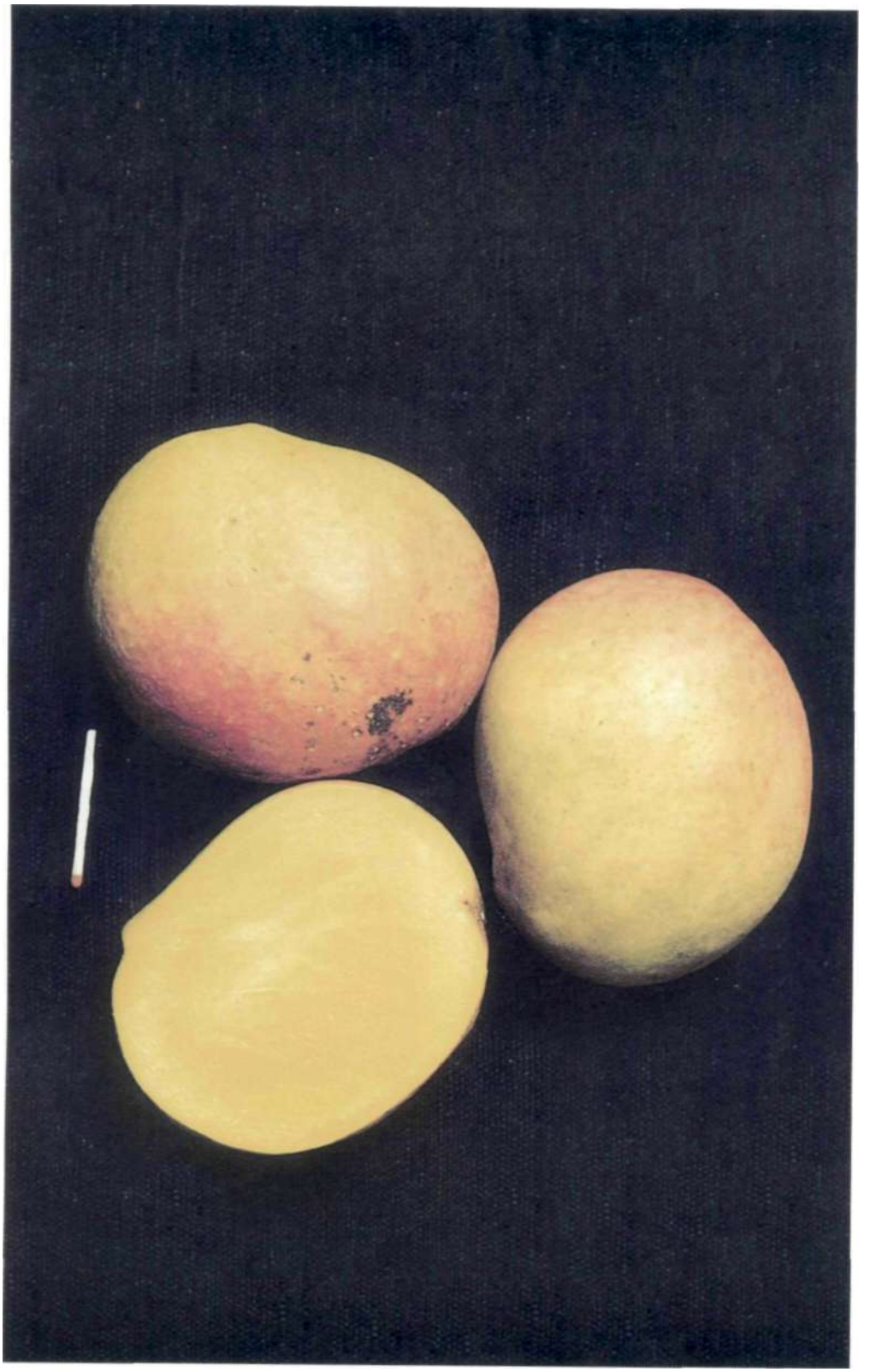
The trees are relatively small, round in shape and bear a medium-sized crop. Maturity season starts in mid-January and ends in March.

Advantages:

- seed propagation possible (polyembryonic)
- resistance to anthracnose rather good
- little fibre, no distinct biennial bearing

Disadvantages:

- very susceptible to powdery mildew
- undesirably large fruits
- only fair productivity



Boribo

This cultivar also originated from a chance seedling found at the Kenya coast. The tree is grown extensively in the Malindi area.

The fruit is large and oblong but not as slender as Ngowe. The shoulders are only slightly curved, and the beak is obscure. The average fruit dimensions are: 11.5 cm long by 7.8 cm broad with a weight range of 430-640 g (mean: 511 g). The fruits are pale olive green with bloom and yellow-apricot when ripe. The internal fruit quality is good to excellent; the flesh is of a deep orange colour, virtually free from fibre, juicy, and of a very strong typical mango flavour. Propagation by seed is possible.

The tree is large and vigorous, and the picking season covers the months of January to February. There is no alternate bearing and the yields are medium to heavy.

Advantages:

- seed propagation possible (polyembryonic)
- regular bearing
- fairly anthracnose resistant

Disadvantages:

- susceptible to powdery mildew
- flavour not liked by everybody
- tree size

Carabao

This early mid-season cultivar originates from the Philippines where it is grown on a large scale for both local consumption and export. Since the seed is polyembryonic, propagation is easily done.

The medium-sized oblong to elongated and light green to yellow fruits are blushed with few small green dots (lenticels); the base is rounded to slightly flattened. The average dimensions are 13 cm long by 7.5 cm wide with weight ranging between 220 and 311 g. The skin is thin and medium-tough. The flesh is tender and melting with only a few fibres, lemon yellow, spicy and sweet with good to excellent eating quality. The fruits are produced in clusters.

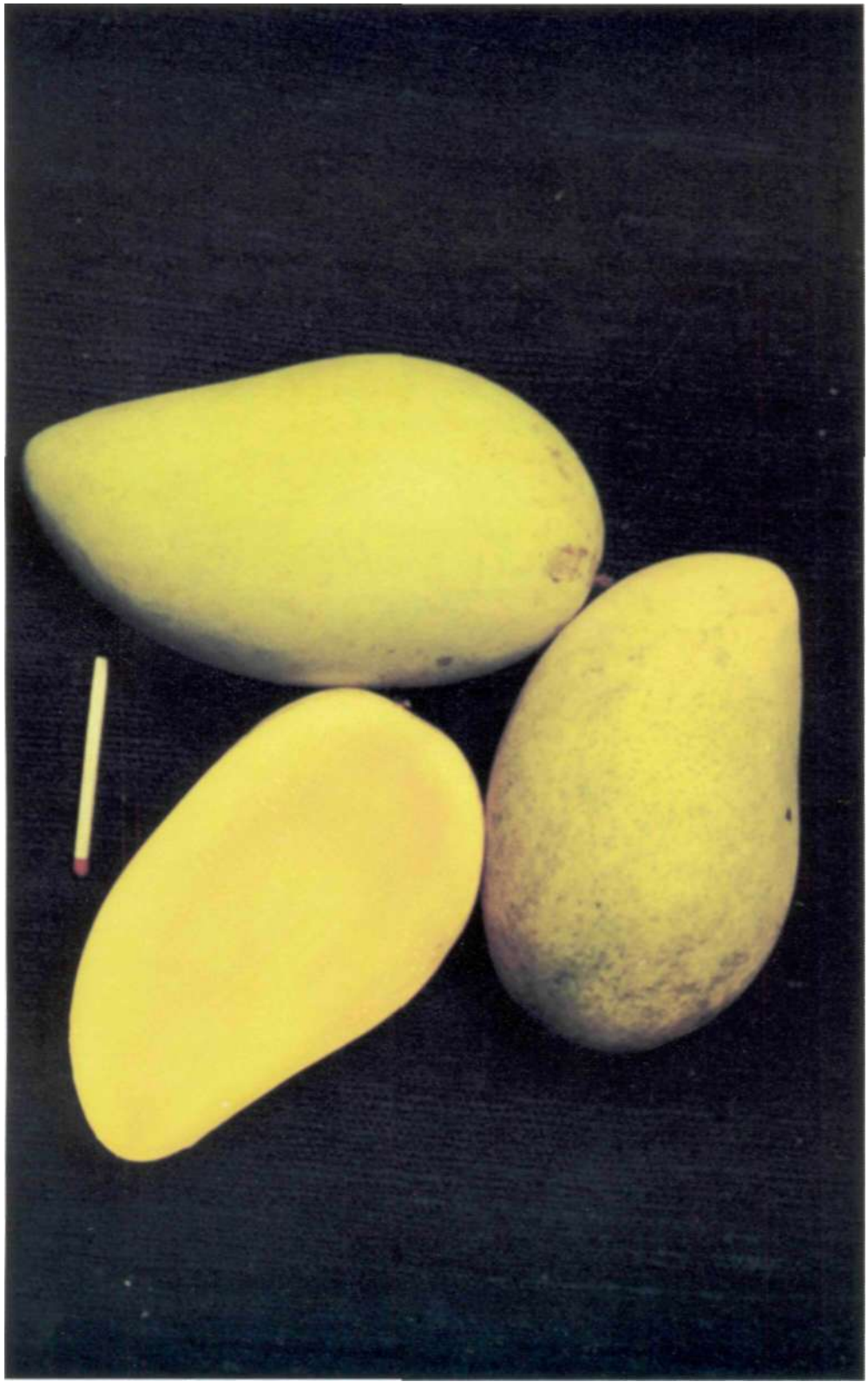
The tree is vigorous, forming a large and dense canopy. It is a medium to heavy bearer but may alternate. Very good resistance to diseases has been recorded.

Advantages:

- seed propagation possible (polyembryonic)
- good yields and excellent quality
- fair/good resistance to anthracnose and powdery mildew

Disadvantages:

- skin colour
- susceptible to fruit fly
- may alternate in bearing fruit



Chino

The provenance of this mid-season cultivar is not known and it will never achieve commercial significance. However, trees produce abundant fruits of good quality and are recommended for backyard planting. Since the seed is polyembryonic, multiplication of true-to-type progeny does not pose any problems.

The medium-sized oblique and plump fruit has a greenish-orange colour often combined with a light red flush. The average fruit dimensions are: length 10.9 cm by 9.5 cm width; weight 386 g (range: 195—490 g). The base is rounded and there is an indication of a tiny beak. Lenticels are few, brown and corky. The yellow flesh is firm, spicy and juicy with only a moderate amount of fibre.

The tree is moderately vigorous, small to medium with a dense rounded canopy. Production (January—February) is heavy and regular, but the cultivar is highly susceptible to anthracnose.

Advantages:

- seed propagation possible (polyembryonic)
- small tree, but a heavy producer
- fair resistance to powdery mildew

Disadvantages:

- fruit lacks eye-appeal
- very susceptible to anthracnose
- the fruits do not store well on the tree

Dodo

This chance seedling must have been grown along the Kenya coast for a long time. Very old and huge trees can be found spread around the Kilifi-Malindi-Tamu area. Its parentage is unknown.

The fruit is large and fairly oval and ripens from dark green to a light green and finally turns yellow. The rounded and obvious beak faces downwards. The flesh is orange and juicy, the fibre content varies from little to much and there is usually a strong turpentine flavour. Lenticels are plenty, first green and later changing to brownish. The average dimensions are: length 11.6 cm by 9.9 cm in width, weight 453 g (range: 339-500 g). The seeds are polyembryonic and the fruit may be classified as one of the best of the more common local cultivars.

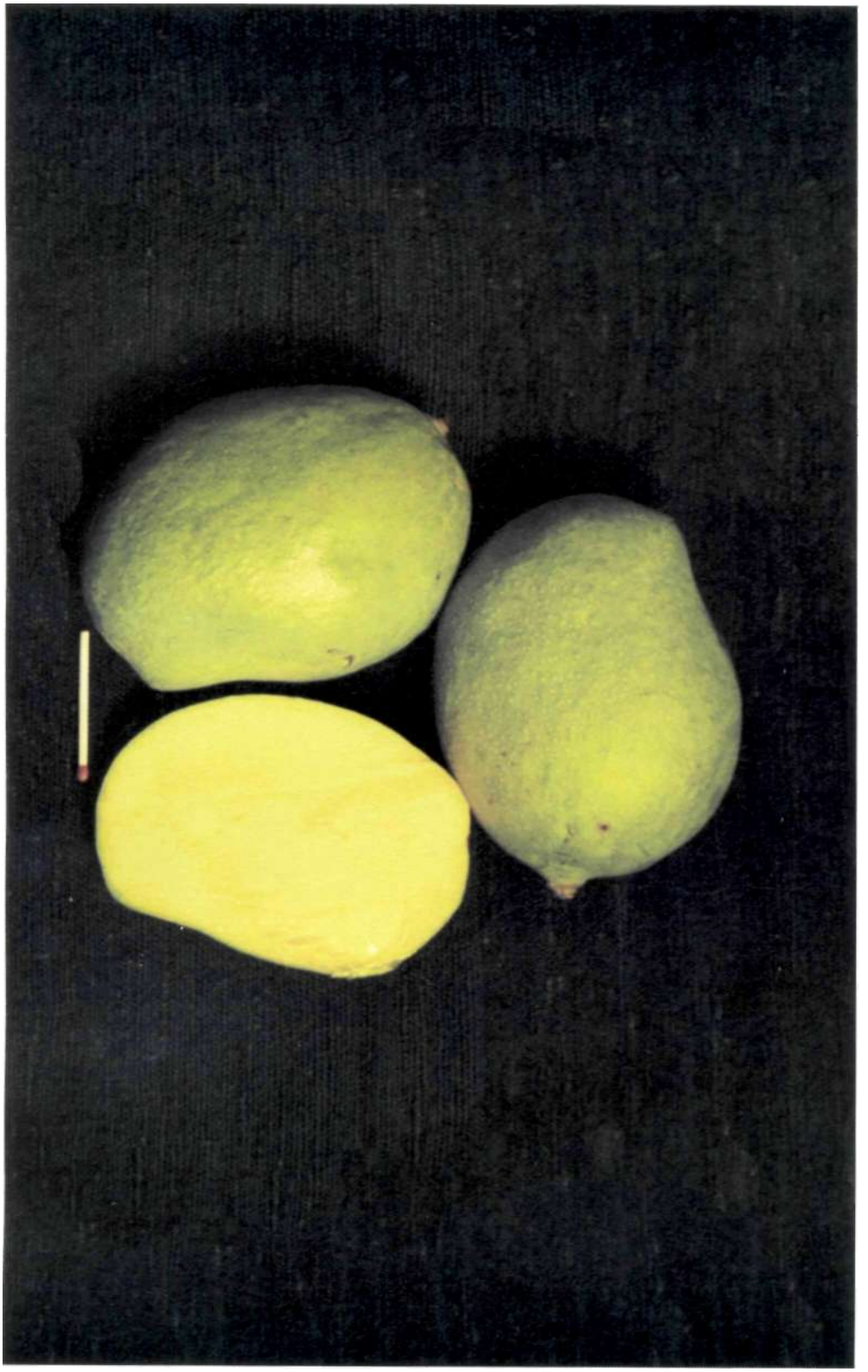
The tree is very large and of a tall, upright growth with dense foliage and small leaves. It is an alternate bearer but produces a considerable crop in productive years. Fruits mature in January and February and show a very good resistance to anthracnose.

Advantages:

- seed propagation possible (polyembryonic)
- good resistance to anthracnose
- travels well to the market

Disadvantages:

- huge tree and therefore difficult to harvest
- tendency towards biennial bearing
- susceptible to powdery mildew



Gesine

This early season (late December to mid-February) chance seedling is of unknown origin. To date trees are only grown in Central Province (Mwea, Maranjau, Ruiru) and may perform even better at lower altitudes.

The medium-sized, oblong brightly coloured fruit is of very good quality. Fruits exposed to the sun are of an intensive red colour, while those developing inside the canopy are apricot with a reddish blush. The fruit flesh is melting, juicy, deep orange, aromatic and relatively free from fibres. The average fruit dimensions are: length 11.7 cm by 7.8 cm width and an average weight of 280 g (range: 240—300 g). Lenticels are white changing to brownish-green at maturity. Without treatment the fruit is heavily attacked by anthracnose and to a lesser degree by powdery mildew.

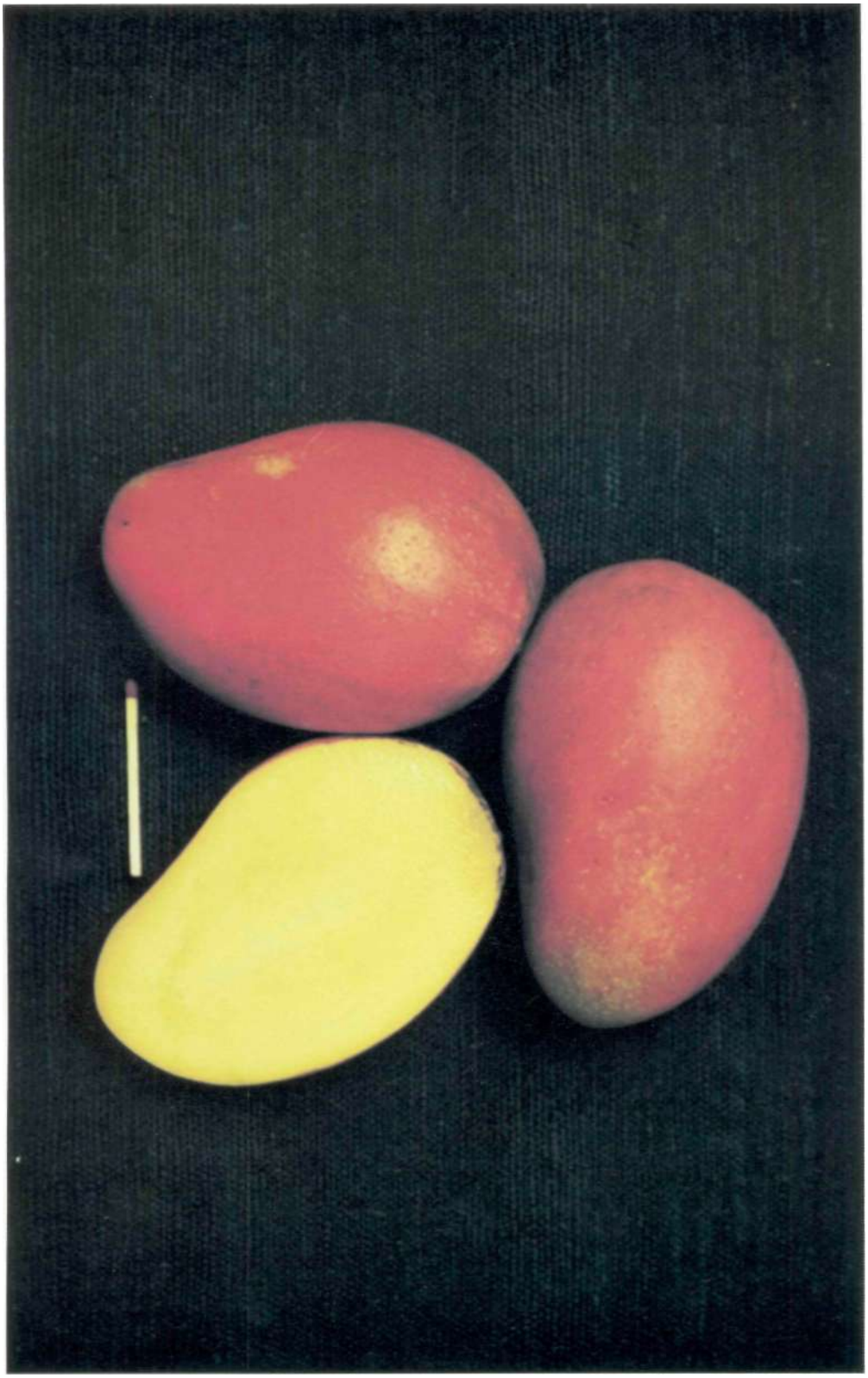
The tree is medium in size and forms a dense canopy. Yields are heavy and regular.

Advantages:

- very attractive fruits of good quality
- crop early and consistently
- small- to medium-sized tree

Disadvantages:

- very susceptible to anthracnose
- fruits do not store well on the tree



Golek

This cultivar originates from Indonesia and was released and planted in 1981 at Mwea in Central Province.

The mid-season fruit is greenish-yellow with an orange overlay and prominent white dots; it is oblong with a rounded base. The average fruit dimensions are: length 10.9 cm by 8.3 cm width and an average weight of 325 g (range: 210-500 g). The skin is thin and easily separated; the flesh is soft and juicy with abundant fibre (not objectionable), deep yellow, sweet, insipid with a mild aroma and a fair eating quality.

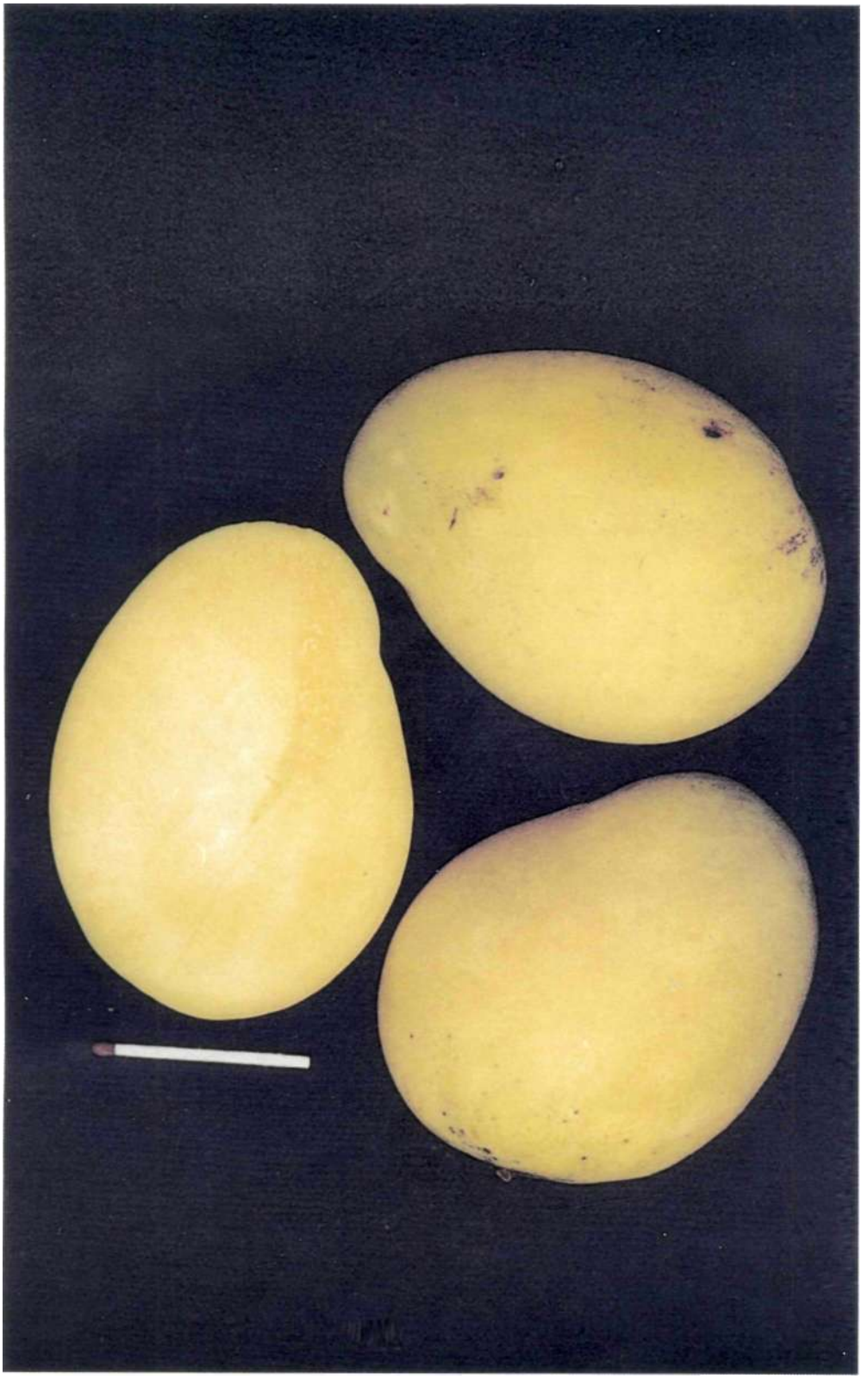
The tree is moderately vigorous with an upright, open canopy.

Advantages:

- seed propagation possible (polyembryonic)
- good resistance to anthracnose
- good shipper

Disadvantages:

- fruit colour
- flavour not very popular
- needs more publicity



Haden

This seedling of Mulgoba (Indian type) originating from Florida was introduced in 1910 and has since been grown in numerous other countries. Because of its excellent quality, the seed is used as parent for several other cultivars.

The medium to large-sized fruit is bright yellow with deep crimson or red blush and numerous large whitish/yellow glands. The shape is regular ovate and plump with a rounded base and depressed beak. Average length is 10 cm with an 8 cm width and an average weight of 431 g. The skin is thick and tough; the flesh is yellowish-orange, firm, very juicy with a pleasant aroma. Moderate fibre occurs only close to the seed which is mono-embryonic and covered in a medium-thick woody shell. This outstanding cultivar is harvested around January to late February.

The tree becomes quite large and spreading; production is erratic but yields are satisfactory.

Advantages:

- very attractive appearance
- excellent fruit quality
- suitable for commercial plantings
- good shipper

Disadvantages:

- susceptible to anthracnose and only moderately resistant to powdery mildew; increased inputs are therefore needed to produce clean fruits

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Heart

This cultivar is a new introduction into Kenya which was released in 1980 and planted around Mwea and Malindi. Mainly because of its relatively unattractive colour, this Indochinese cultivar will never attain any commercial importance in Kenya.

The fruit is small to medium sized and of a bright yellow colour with a few large white dots. It is heart-shaped with a flattened base and beak. It has an average length of 8.4 cm, is 8 cm wide and its weight ranges from 140 to 255 g. The skin is thick. The flesh is firm and juicy with a moderate amount of coarse fibres; it is lemon yellow and has a spicy, resinous aroma. Its eating quality is only fair.

The tree is vigorous with a large, spreading rounded canopy. This mid-season cultivar is a fairly good and regular producer.

Advantages:

- seed propagation possible (polyembryonic)
- no distinct biennial bearing
- resistance to anthracnose is rather good

Disadvantages:

- flavour not very popular among consumers
- colour of skin
- size of fruit

Irwin

As a seedling of Lippens, this cultivar originated in Miami (1945) and has been Florida's leading local market cultivar for a long time.

The fruit is bright yellow with a crimson or dark red blush and numerous large white dots. Its shape is ovate with a rounded base; average size is 12.3 cm long and 8.5 cm wide; average weight is 372 g. Fruits are often produced in clusters. The flesh is soft, tender, melting and juicy; only slightly fibrous, lemon yellow, sweet and mild with a pleasant aroma and of good quality. The seed is mono-embryonic and embedded in a relatively small and thin stone shell.

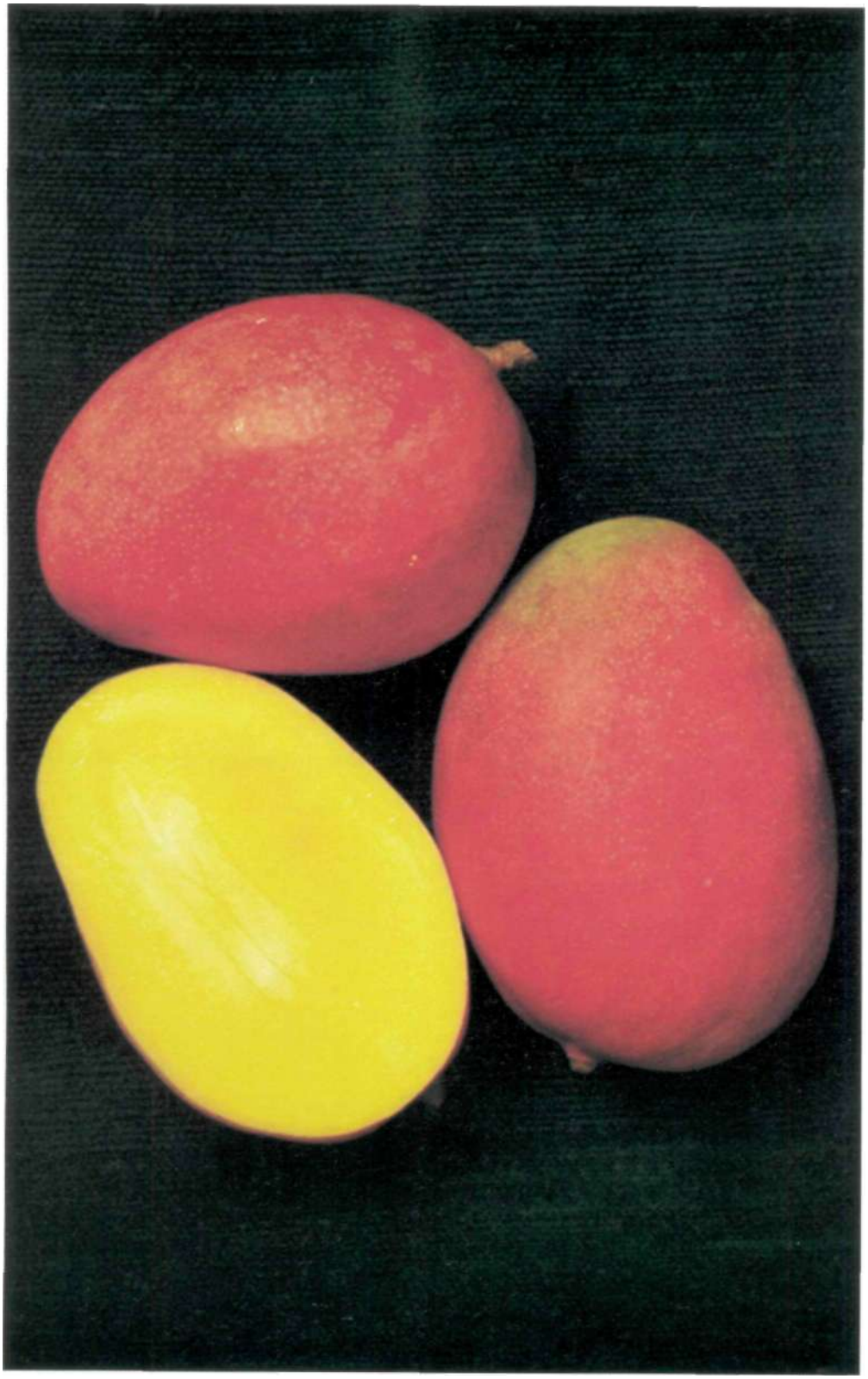
The tree is small to medium, moderately vigorous with an open canopy and produces consistently good yields. The fruits mature from late January until March (mid-season).

Advantages:

- good fruit quality combined with attractive appearance
- one of the most prolific cultivars
- trees are somewhat dwarf-sized

Disadvantages:

- short post-harvest life
- susceptible to anthracnose and fruit fly



Keitt

This open pollinated seedling of Mulgoba originated from Homestead (Florida) and was released in 1946.

It is one of the latest maturing of all the recommended cultivars. It has an exceptional keeping quality and may be left on the trees long after the normal harvesting time (March-April). The fruit is large with an average length of 11.7 cm and a width of 9.2 cm; it has an average weight of 456 g. It has a greenish-yellow colour with pink or red blush and lavender bloom. There are numerous white or yellow/red lenticels on the thick and fairly tough skin. The fruit shape is ovate and plump without a beak; it has a rounded base. The flesh is deep yellow, fairly firm but tender, melting, juicy and with only a little fibre near the seed. The flavour is rich and sweet with a pleasant aroma and excellent quality. The fairly small seed (7.5% of fruit weight) is mono-embryonic.

The tree is medium-sized, moderately vigorous, producing long arching branches and has a scraggy open appearance. It is a heavy and regular bearer.

Advantages:

- a cultivar with late maturity
- good marketing qualities and productivity
- fair resistance to anthracnose

Disadvantages:

- skin coloration often inadequate
- highly susceptible to bacterial black spot and affected by internal breakdown of the flesh (reported from Australia)
- susceptible to sunburn

Kensington

This seedling originated from Queensland, Australia (1960s), and is also known as Kensington pride and Bowen. In the 1980s, this cultivar was released and planted at Mwea (Central Province).

At present, this early mid-season cultivar enjoys only little attention but shows great potential especially for the local market. The fruit is medium in size, almost round with a flattened base and a slight beak, averaging 12.2 cm in length and 8.1 cm in width; average weight is 319 g. When ripe, the skin colour is yellow with a slightly orange/pink blush.

The skin is thick and adherent and the flesh yellow, sweet, soft and juicy with moderate to little fibre. The seed, covered by a moderately thick woody stone (7.8% of fruit weight) is polyembryonic.

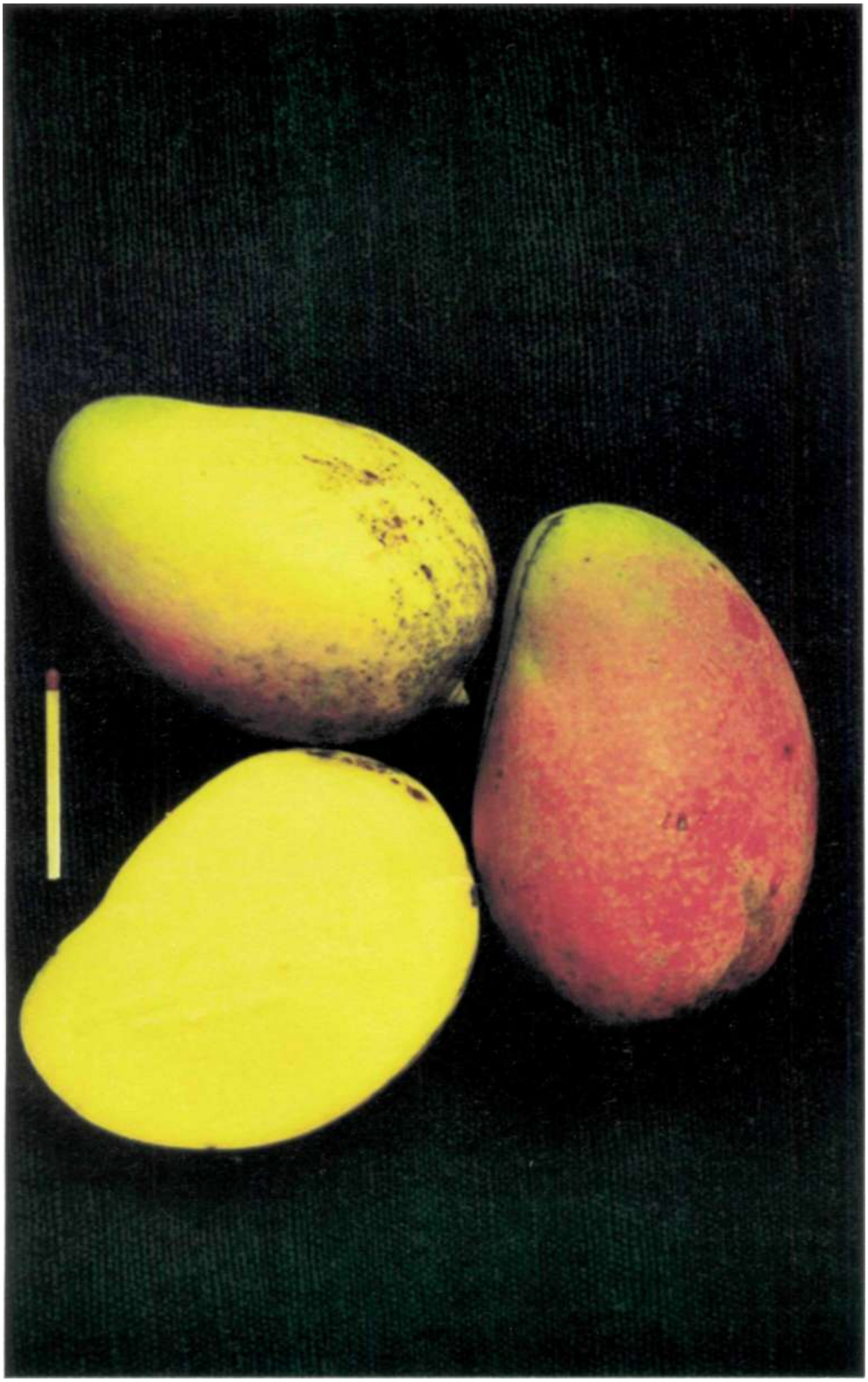
The trees are vigorous/spreading and produce consistent, high yields.

Advantages:

- propagation by both seed (polyembryonic) and grafting
- good shelf life
- excellent eating quality

Disadvantages:

- moderately susceptible to anthracnose
- needs more publicity



Kent

This open pollinated seedling of the cultivar Brooks originated in Miami, Florida, and was released in 1944.

Kent is often mistaken for the quite similar looking cultivar Keitt but (just one difference) Kent matures earlier (March). The large fruit is greenish-yellow with a red or crimson blush on the shoulder. The average length measures 12.4 cm with a width of 9.7 cm and an average weight of 545 g. The fruit-shape is regular ovate with a rounded base and often with two slight beaks. The skin is thick and tough and small yellow lenticels are numerous; the flesh is juicy, melting, deep yellow, fibreless and of a rich flavour. The seed, embedded in a thick, woody stone (8.5% of fruit weight) is mono-embryonic.

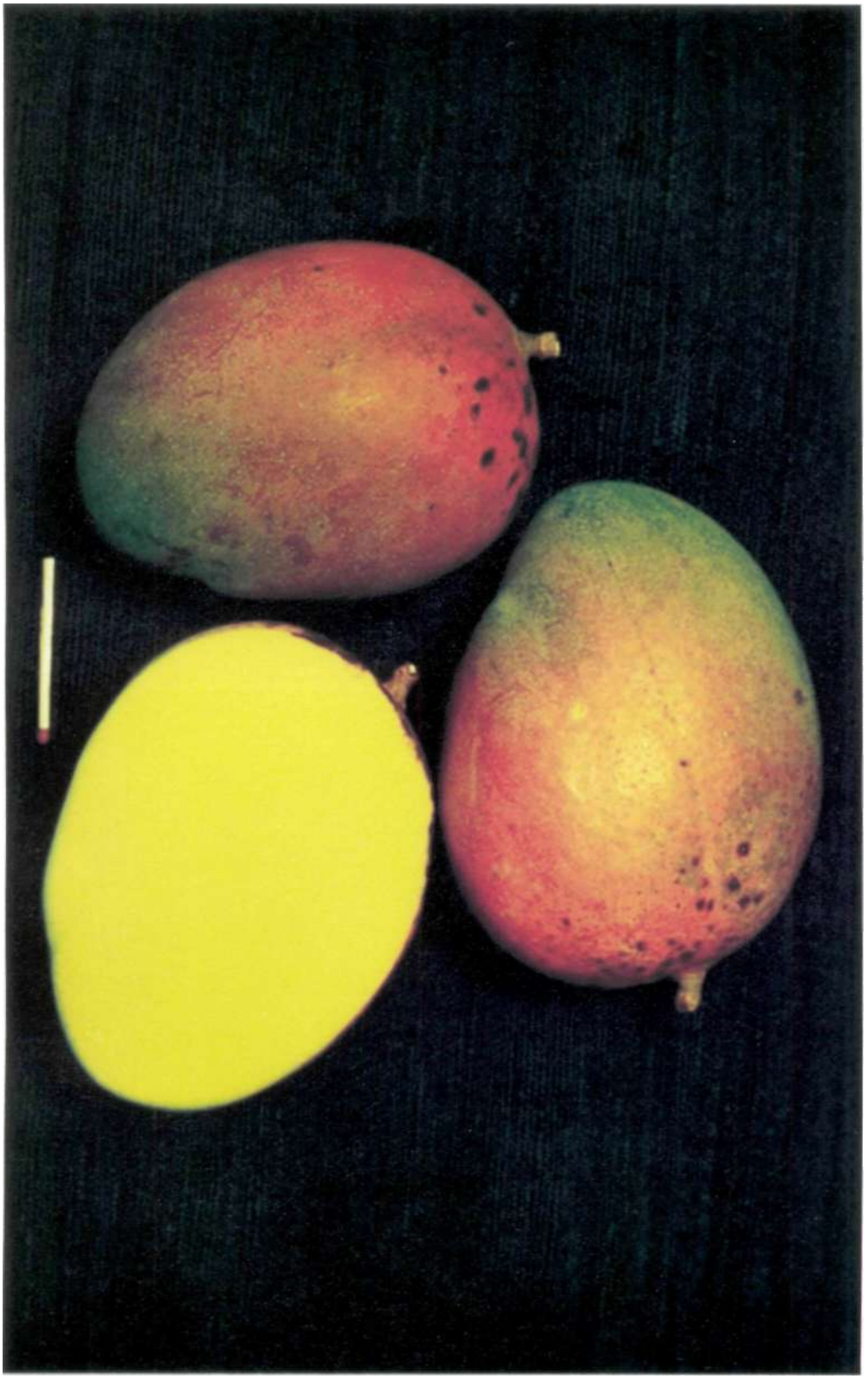
The tree is large and vigorous, with a dense upright canopy, and it produces good yields in the late mid-season.

Advantages:

- late maturity
- fibreless and of excellent internal quality
- fruits ship well

Disadvantages:

- skin coloration is often inadequate
- prone to storage diseases
- may alternate in bearing



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Madoe

This cultivar originated from Indonesia where it is also known as Madu. In Kenya, the cultivar was released and planted in 1981 at Mwea (Central Province), among other locations.

The fruits resemble the local Apple cultivar but are much more resistant to anthracnose. They are medium to large in size, oval/oblique in shape with a rounded base and a slight beak. The average length measures 9.7 cm with a width of 10.7 cm, and the weight varies from 310-450 g (mean: 380 g). The skin colour is deep yellow/apricot with the shoulders showing a reddish flush. The yellow flesh is soft, tender and juicy, almost fibreless and of rich flavour.

The tree is moderately vigorous with a dense, rounded canopy.

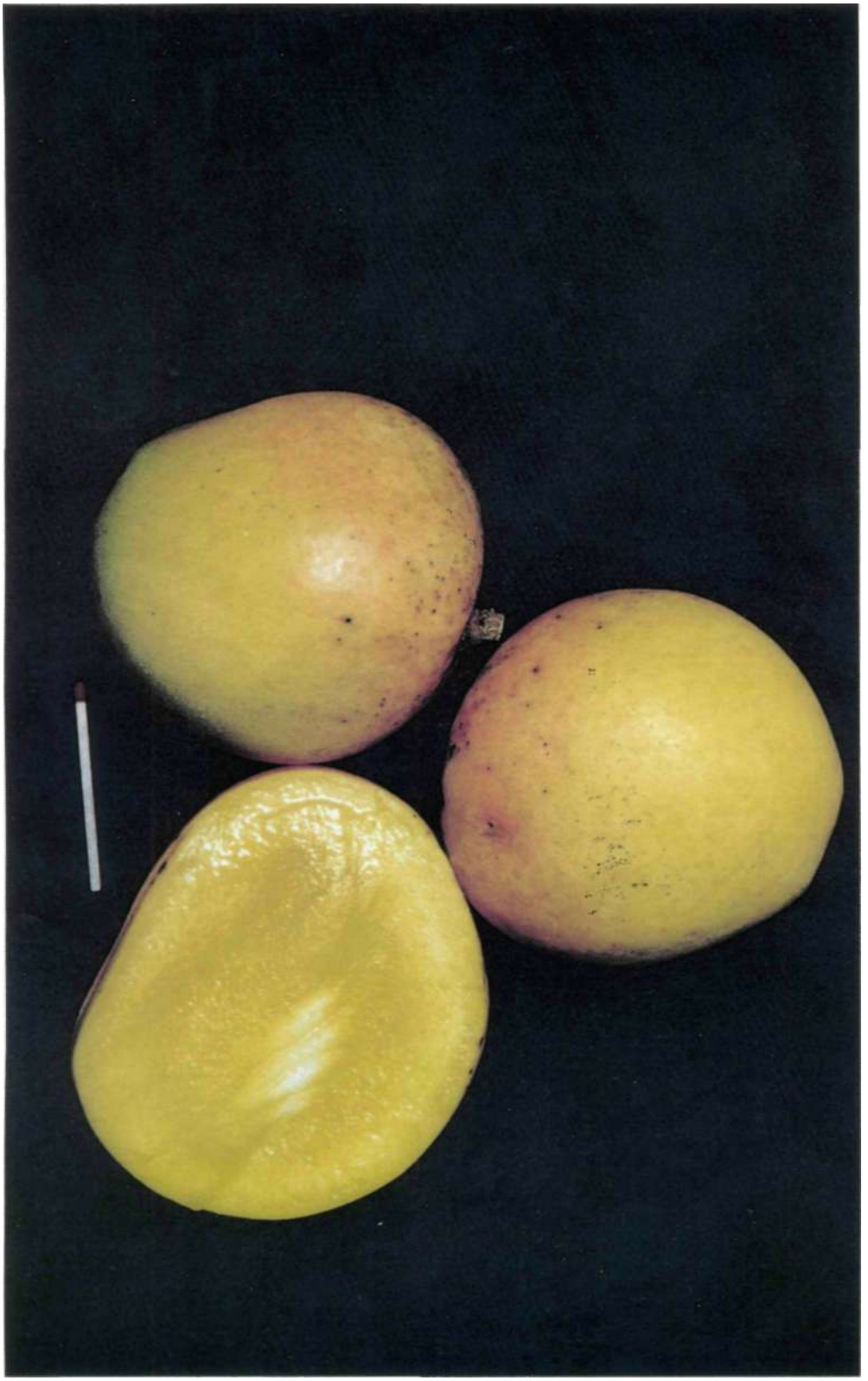
It produces medium-heavy yields during mid-season and has a polyembryonic seed.

Advantages:

- good anthracnose resistance
- outstanding fruit quality
- seed propagation is possible (polyembryonic)

Disadvantage:

- not much known on the local market



Matthias

This mid-season (January to mid-February), open pollinated chance seedling is of unknown origin but comes most probably from West Africa. In Kenya, the single mother tree—propagated by seed—was found in Trans Nzoia District. Progeny was later transferred into Central Province (Mwea, Ruiru).

The medium-sized ovate fruit has a deep-yellow skin and its shoulders are blushed with red. There is only a slight beak; lenticels are at first green and later turn yellow. The average fruit dimensions are: length 10.3 cm and width 7.8 cm, with an average weight of 251 g. The firm yellow flesh is sweet, juicy and relatively free from fibres. There is a moderate resistance to anthracnose and powdery mildew.

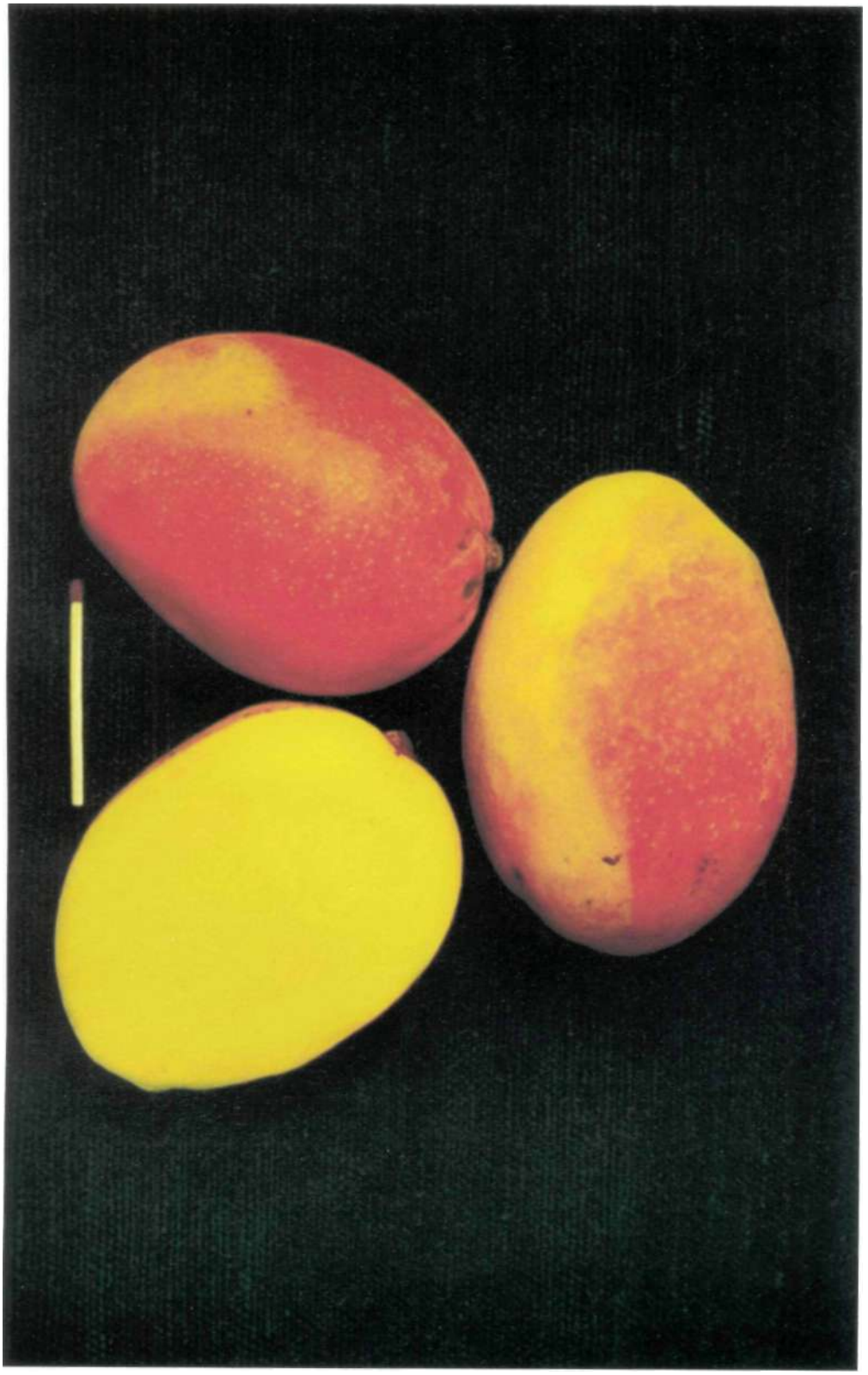
The tree is of medium to large size and forms a dense canopy. Yields are heavy and regular.

Advantages:

- moderate resistance to anthracnose and powdery mildew
- propagation by both seed (polyembryonic) and grafting
- regular bearer

Disadvantage:

- more adaptation trials and more publicity are needed



Maya

A cultivar of unknown parentage (Haden X?), Maya was selected in Israel and very much resembles the Haden cultivar although its fruits are much smaller.

The ovate and plump fruit is yellow with a reddish blush and is medium-sized. The average fruit length measures 10.3 cm with a width of 7.8 cm, and the weight ranges from 250-380 g (mean: 295 g). There is only a small rounded beak. Lenticels are white at first, changing to yellow/brown later. The firm yellow flesh is juicy and aromatic, virtually free from fibre and of high eating quality. The fairly large seed (9.2% of fruit weight) is mono-embryonic.

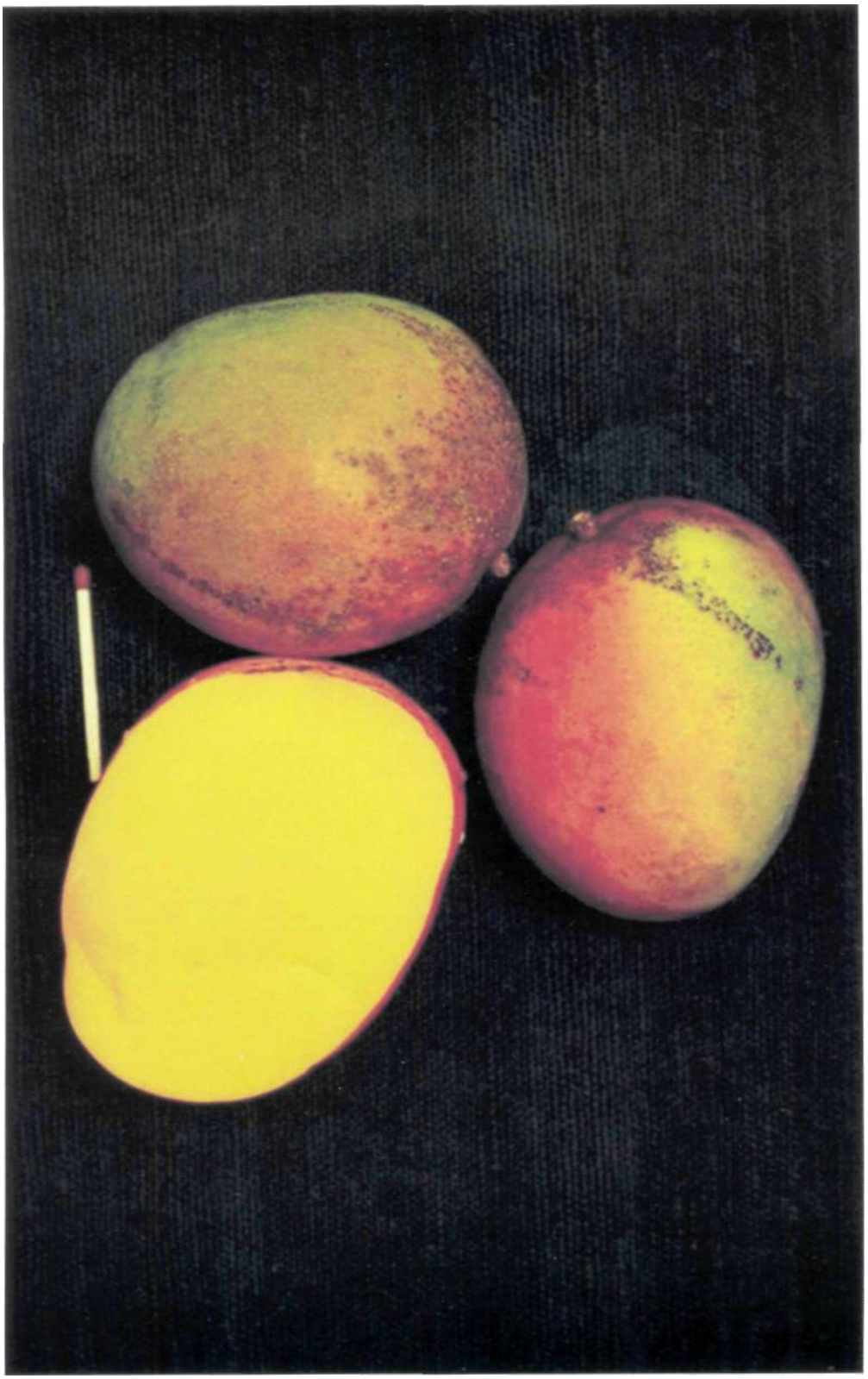
The tree is large and vigorous, tends to alternate bearing and is very susceptible to anthracnose.

Advantages:

- resembles Haden
- good to excellent eating quality

Disadvantages:

- highly susceptible to anthracnose
- danger of internal breakdown of fruit flesh



Ngowe

The original Ngowe tree (so it is believed) was brought from Zanzibar and planted on Lamu approximately 106 years ago. This typical coastal cultivar, also known as Lamu mango, can now be found all along the coastline and has also adapted well to medium altitude locations.

Ngowe is the most easily recognized of the local mango fruits. It is large, oblong and slender with a very prominent hook-like beak at the apex. From pale green, the fruit develops to a most attractive yellow to orange colour when ripe. The deep yellow flesh is of excellent quality, virtually free from fibre, melting, and carries no turpentine taste. The average fruit length measures 14 cm with a width of 9.5 cm, and a weight range of 425—600 g (mean: 523 g). The seeds are polyembryonic which means progeny develops more or less true-to-type.

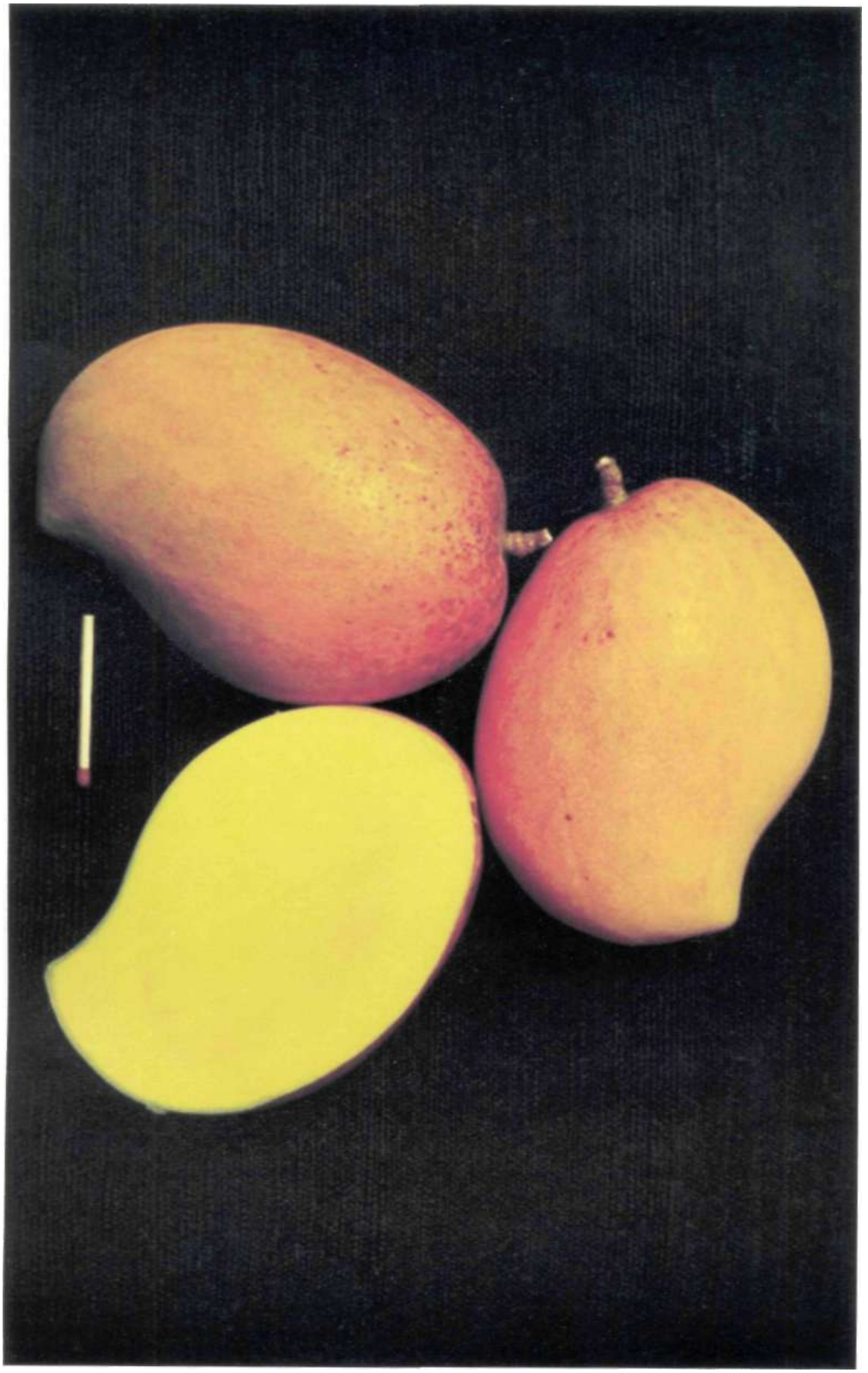
The trees are comparatively small and round in shape. Depending on location, harvesting may start in November and continue until March. Yields are medium and alternate bearing may occur.

Advantages:

- good to excellent fruit quality
- moderate tree size
- good shipper
- seed propagation possible (polyembryonic)

Disadvantages:

- susceptible to powdery mildew
- tendency of alternate bearing



Nimrod

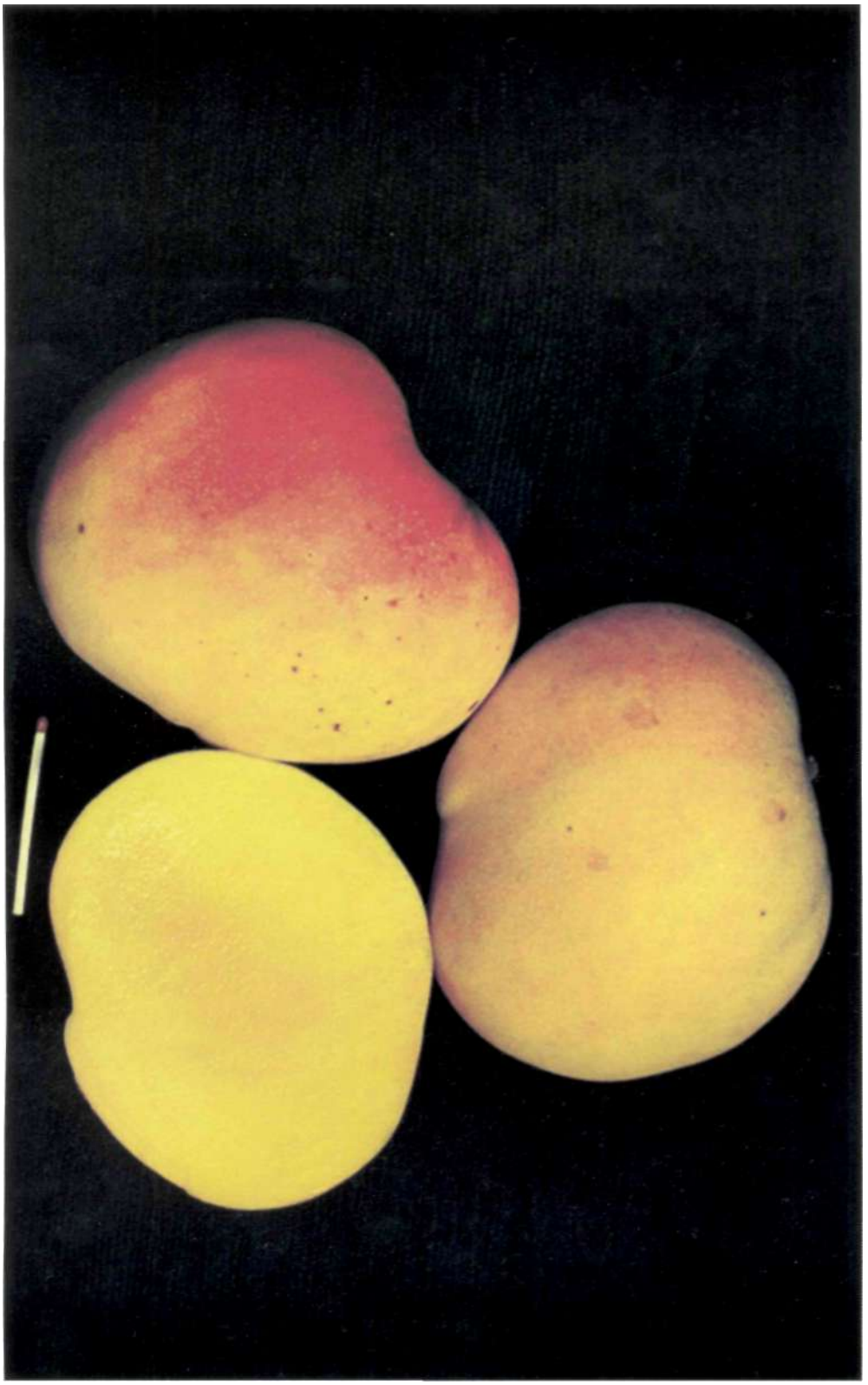
This cultivar originated from Israel and more or less resembles the Apple cultivar found in Kenya.

The large oval/oblique fruit is deep yellow with a light red flush and numerous yellow lenticels when ripe. The base is flattened and there is only a slight indication of a small rounded beak. The average fruit length measures 11 cm with a width of 10 cm, and the weight ranges from 340—580 g. The skin is thick and tough and separates easily; the flesh is soft and juicy with little fibre, yellow, mild, aromatic and of good eating quality. The seed is mono-embryonic and embedded in a medium-thick woody stone (7.6% of fruit weight).

The tree is vigorous, medium-sized, with an upright dense canopy. Harvesting in Central Province starts at the end of December and ends in January.

Comments:

- Since this cultivar is quite a recent introduction, more field research is required before final recommendations can be compiled. Already there are indications that if planted in the proper environment (at least below 800 m) it may do even better than the Apple cultivar.



Parwin

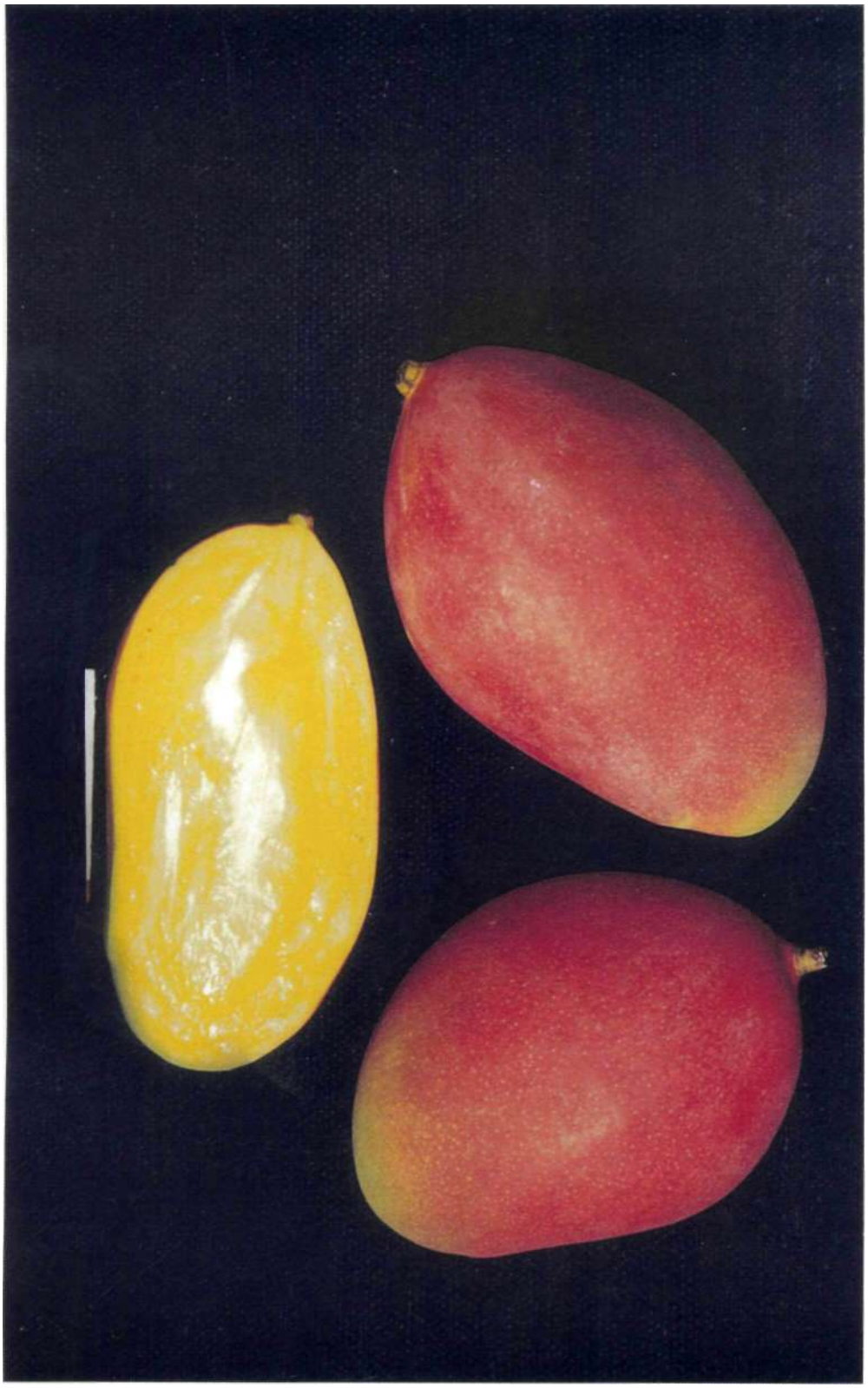
This seedling originated from Bradenton in Florida and was released in 1954. Of unknown parentage, it resembles Haden but lacks the latter's bright red colour.

The fruit is medium to large with an average length of 10.8 cm and a width of 8.5 cm. The average weight is 470 g (range: 380-560 g). The shape is oblong to ovate and tends to be plump; the basic colour is light yellow with a pink/red blush; lenticels are distinct and numerous. The fruits are often borne in clusters. The yellow juicy flesh is relatively free from fibres, moderately sweet with a good flavour. The medium-sized stone (7.5% of fruit weight) covers the mono-embryonic seed.

The tree is vigorous with a slightly open habit and there is a remarkable resistance to anthracnose and powdery mildew. Yields are satisfactory and quite regular.

Comments:

- A very promising new cultivar in Kenya. Since the fruits have a very long storage life, are harvested in late mid-season and are of good quality, planting this cultivar should be encouraged.



Peach

By 1928, this seedling of unknown origin was already described in South Africa where it was ranked as one of the best local unimproved cultivars.

The roundish/oblique medium-sized fruits are fibrous. The average size is 9.3 cm long and 8.1 cm wide with an average weight of 241 g. The apex is broadly rounded with a depression on the ventral side and a slight beak. The thick tough skin is smooth with white lenticels and has an attractive yellow-orange colour. The flesh is apricot-yellow with a tender juicy texture. The eating quality is good; there is a sweet flavour and a very slight turpentine taste. The seed is large (8.1% of fruit weight) and polyembryonic.

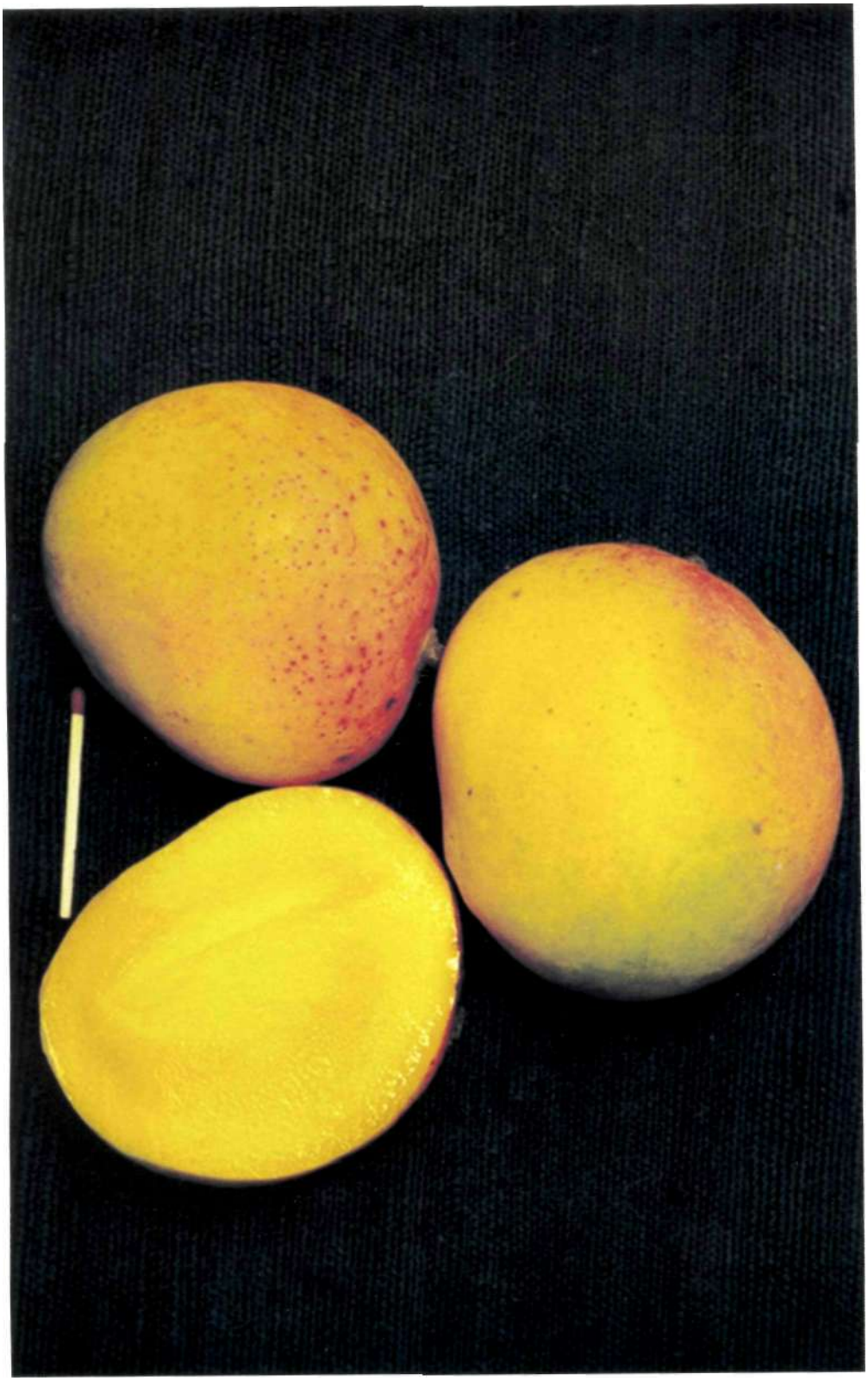
The trees are big and produce consistent high yields. The maturity season starts at the end of December and continues until February.

Advantages:

- fairly resistant to diseases
- good shelf life
- suitable for higher elevations

Disadvantages:

- only suitable for the local market
- contains a rather high amount of fibre



Sabine

In 1969, the author found this chance seedling on the Bowker farm in Trans Nzoia District, Kenya. Due to high altitude (about 1900 m) the fruit-set and quality were very poor. Scion material was later transferred into lower and warmer locations (Central Province) where it developed into a highly demanded cultivar.

The medium- to large-sized, elongated but full fruits are of very good quality. Those developing inside the canopy are deep yellow while those exposed to the sun are bright yellow with a dark red blush. The yellow flesh is of medium texture, fibreless, pleasantly sweet, juicy and of a mild aroma. The average fruit dimensions are: length 14.2 cm, width *6.6* cm and weight 435 g (range: 360-520 g). The rounded apex carries only a small depressed beak. The seed is mono-embryonic and covered by a medium-sized woody stone (9.6% of fruit weight). There are indications that this cultivar may also be multiplied by seed.

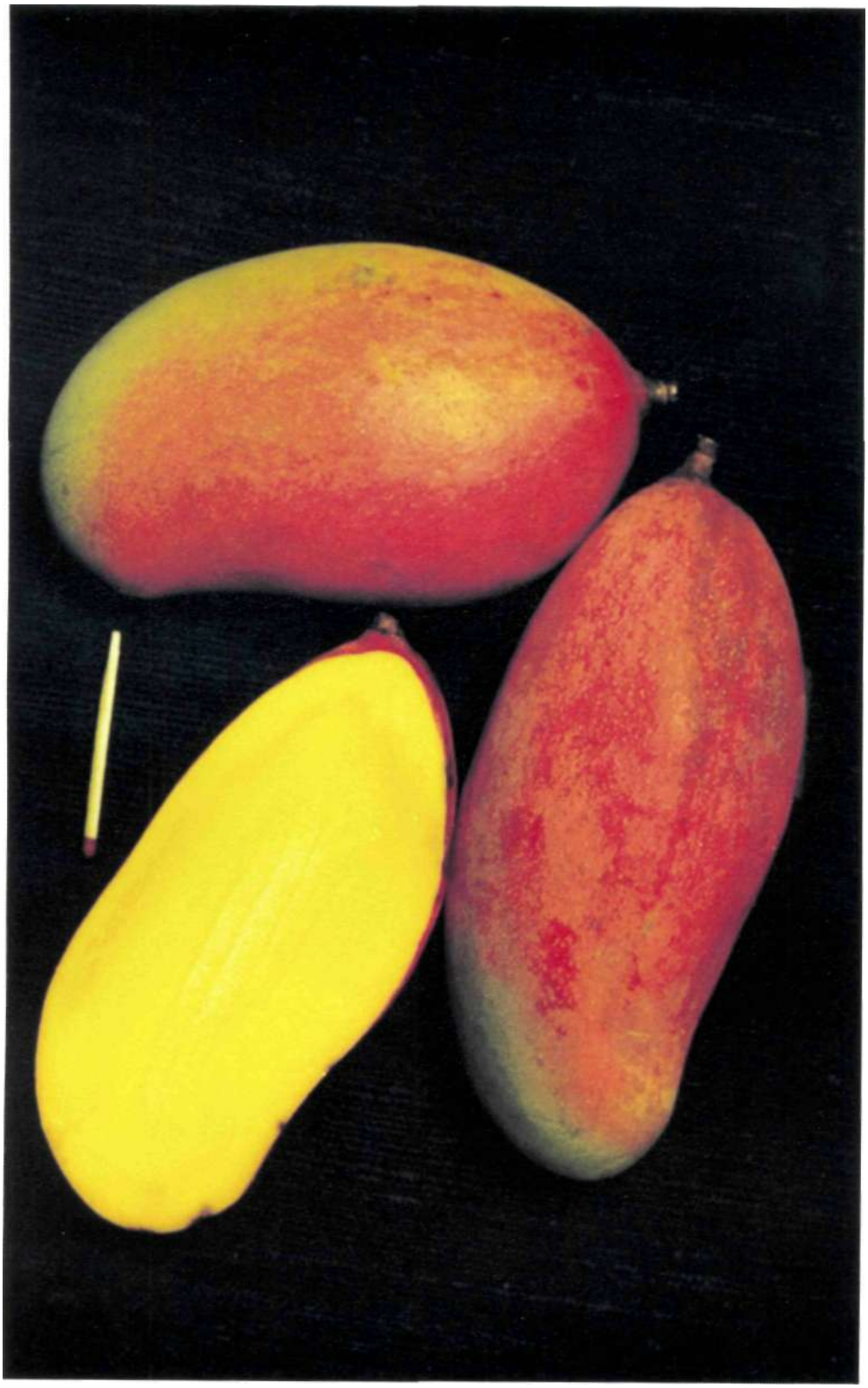
The tree is moderately vigorous and upright with a dense canopy. There seems to be a slight alternation in bearing but yields are satisfactory. Depending on location, fruits mature from late January until late March.

Advantages:

- only slightly affected by anthracnose and powdery mildew
- no distinct biennial bearing
- no fibres

Disadvantages:

- needs more publicity



Sabre

Most probably, this cultivar has its origin in South Africa; already in 1928 it had been described by Davis and in 1947 it was one of the most widely planted cultivars. Besides its fair eating quality, Sabre as a polyembryonic seed producer is better known as a rootstock supplier.

In Kenya, the oblong, kidney-shaped fruits are small to medium sized. On average they are 11.8 cm long and 6.9 cm broad and weigh an average of 233 g (range: 180-290 g), the apex being broadly rounded and curved into a prominent beak. The smooth-surfaced tough leathery skin—yellow-green, often with a reddish blush—is easily removed from the flesh. The flesh is deep orange in colour with a melting texture and a medium amount of fibre. The eating quality is fair, sweet to insipid-flavoured and normally has a turpentine aftertaste. The seed is large, up to 9.4% of total fruit weight.

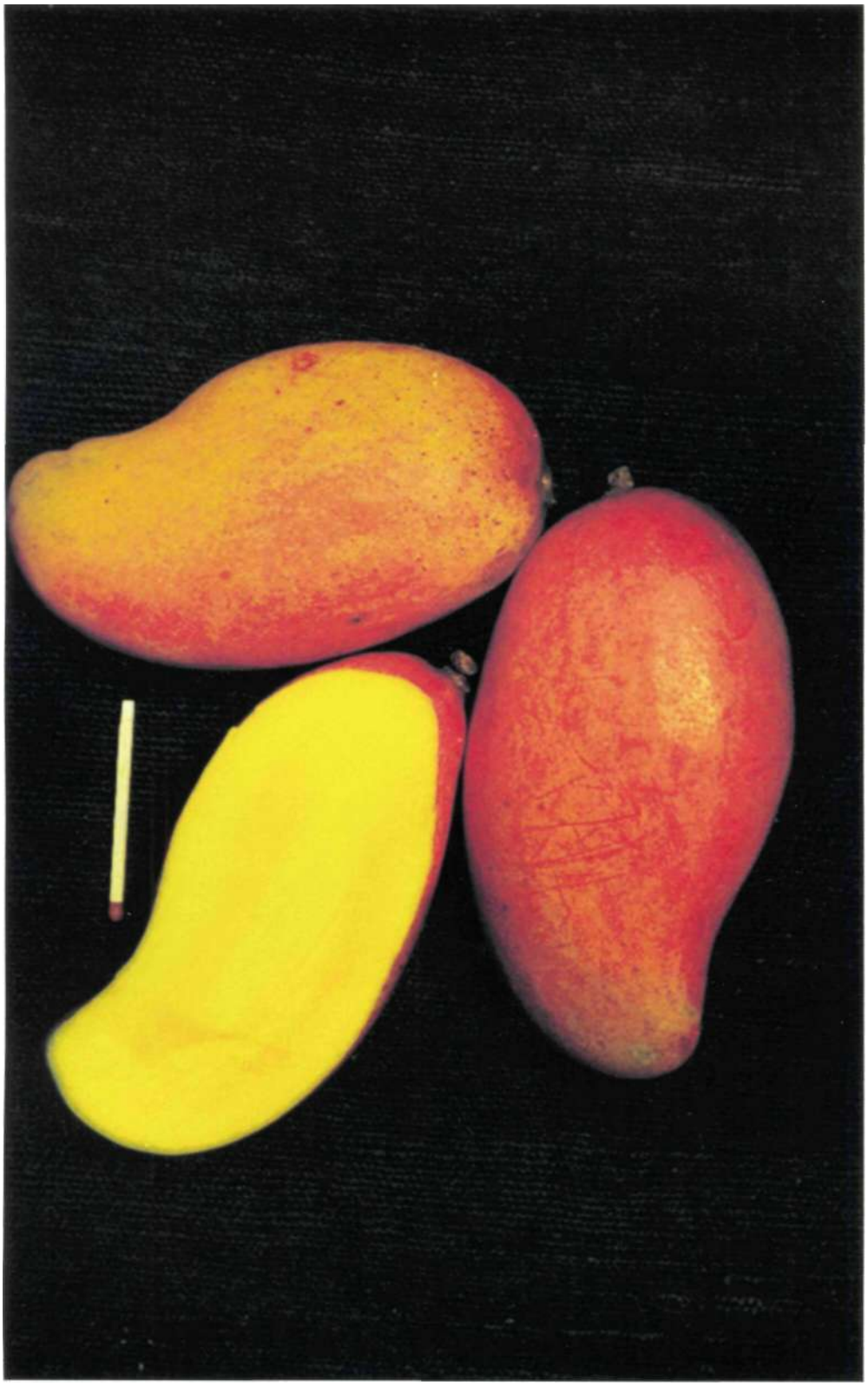
The tree is small to medium, a regular and heavy bearer and fairly resistant to diseases. The maturity season starts in late December and ends at the beginning of March.

Advantages:

- suitable for higher elevations
- fairly good resistance to anthracnose and powdery mildew
- recommended rootstock producer

Disadvantages:

- fruit quality in general
- over-bearing



Sensation

This cultivar originates from Miami, Florida, and was released in 1941.

The oval/oblique, medium-sized fruit is deep yellow with a prominent dark-red to purple blush that covers most of its surface. The rounded apex shows only a slight beak formation. The average fruit-measurements are: length 10.8 cm by 7.8 cm in width and an average of 307 g in weight. Lenticels are numerous and pale yellow in colour; the skin is medium-thick, tough and separates easily from the flesh. The deep-yellow flesh is fibreless, firm and juicy. It is sweet, of a distinctive mild flavour and of good quality. The mono-embryonic seed is covered in a thick woody stone (5.8% of fruit weight). Due to its severely alternate bearing, susceptibility to anthracnose and uneven ripening, Sensation has lost much of its former popularity.

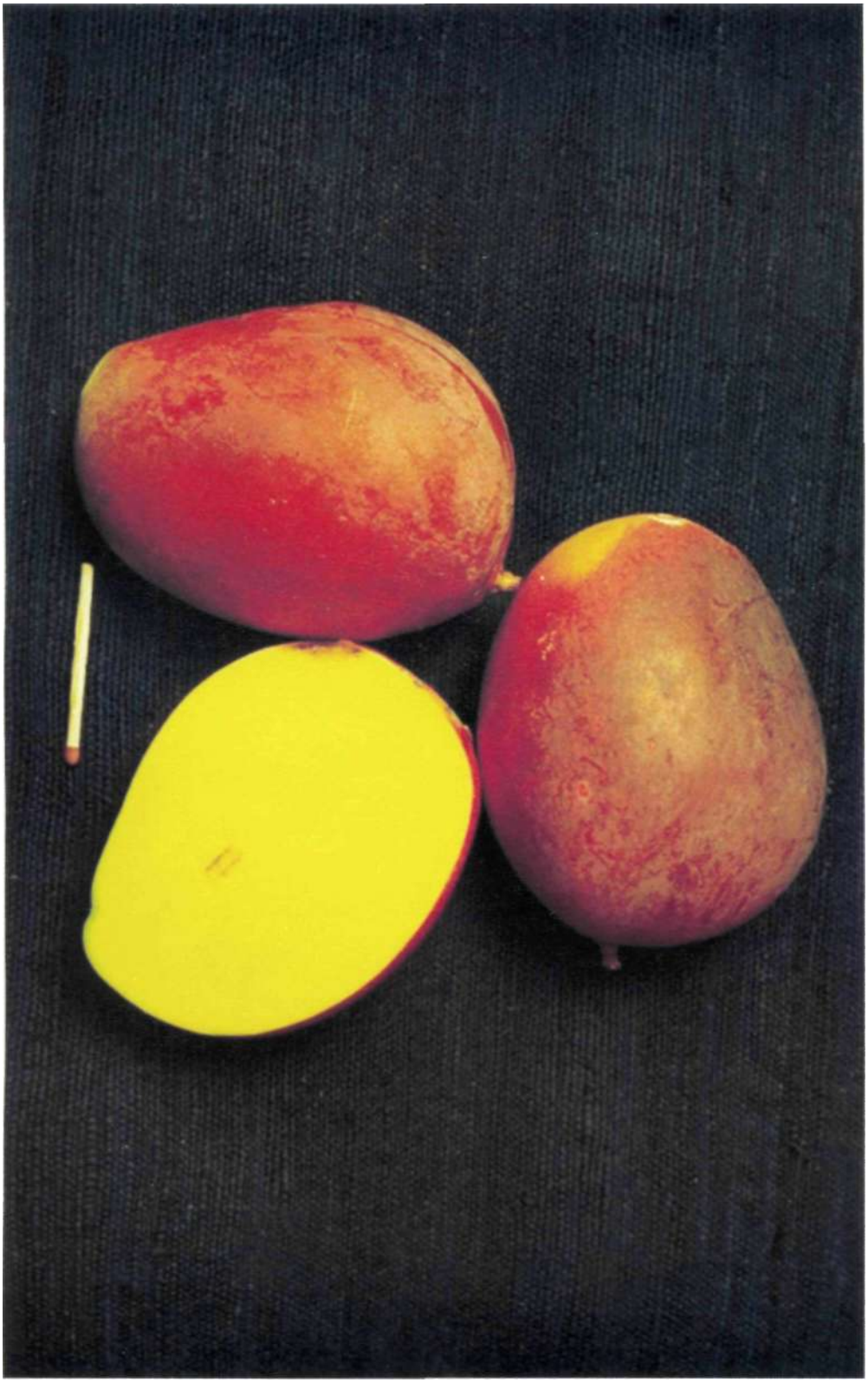
The trees are moderately vigorous and develop into a broad-rounded, symmetrical canopy. It is a late cultivar and, depending on location, will mature from February until the beginning of April.

Advantages:

- beautifully coloured late cultivar
- none to scanty fibres
- heavy yielder

Disadvantages:

- susceptibility to anthracnose
- alternate bearing
- frequent severe internal breakdown (jelly seed)



Smith

This open pollinated seedling of Haden was found growing on the J.T. Smith farm in Honolulu, Hawaii, and was introduced to Florida around 1946.

The elongated large fruits are of an orange-yellow base colour combined with a deep crimson blush. The apex is broadly rounded and there is no beak. The thick tough skin is covered with large white lenticels. The average fruit size is 13.9 cm long and 7.5 cm wide, with an average weight of 550 g. The orange-yellow flesh is juicy, spicy, of a firm texture and almost fibreless. The fruit quality is rated as good and yields are moderate to heavy and regular. The seed is fairly large (7% of fruit weight), long, flat and mono-embryonic.

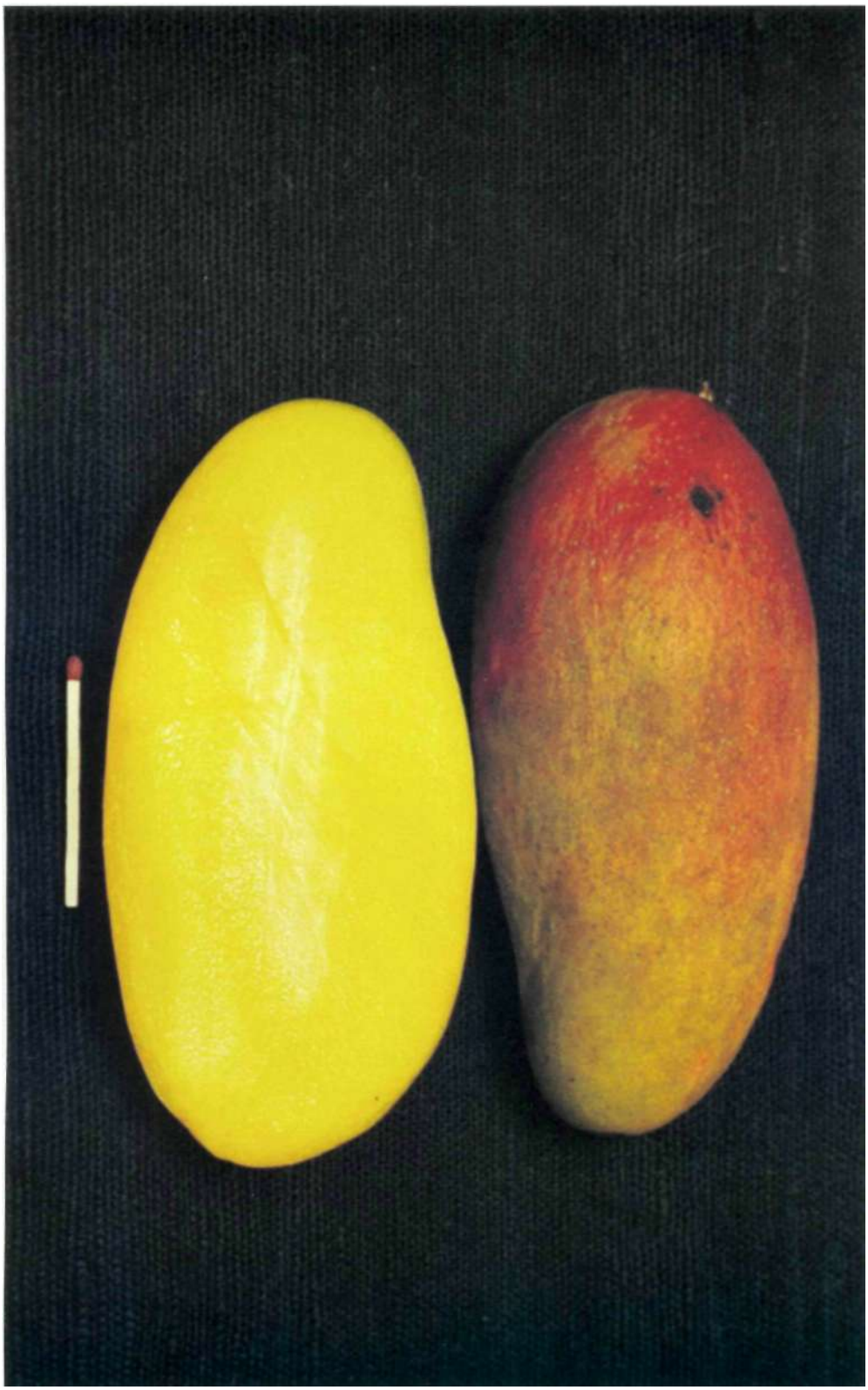
The trees grow upright and vigorously and are harvested at mid-season. Fruits must be left on the tree to maturity if they are to develop their full colour and flavour.

Advantages:

- highly productive
- nearly fibreless
- good coloration

Disadvantages:

- quite susceptible to anthracnose
- tendency to only fair fruit quality



Tommy Atkins

This cultivar originated from a seed planted in the 1920s at Fort Lauderdale in Florida. Parentage is unknown (Haden seedling?); it was released in 1948.

Tommy Atkins has become an important commercial variety. The fruits are medium to large, oval to oblong, orange/yellow with a heavy red blush, numerous white lenticels and a broadly rounded base. They measure an average length of 12.6 cm, are 9.9 cm wide and have an average weight of 522 g. The smooth skin is tough and thick. The flesh is firm and medium juicy with a moderate amount of fibre, yellow to deep yellow in colour, mild and sweet with a strong pleasant aroma. The eating quality is fairly good; the seed is mono-embryonic and covered in a thick, woody stone *(6.6%* of total fruit weight).

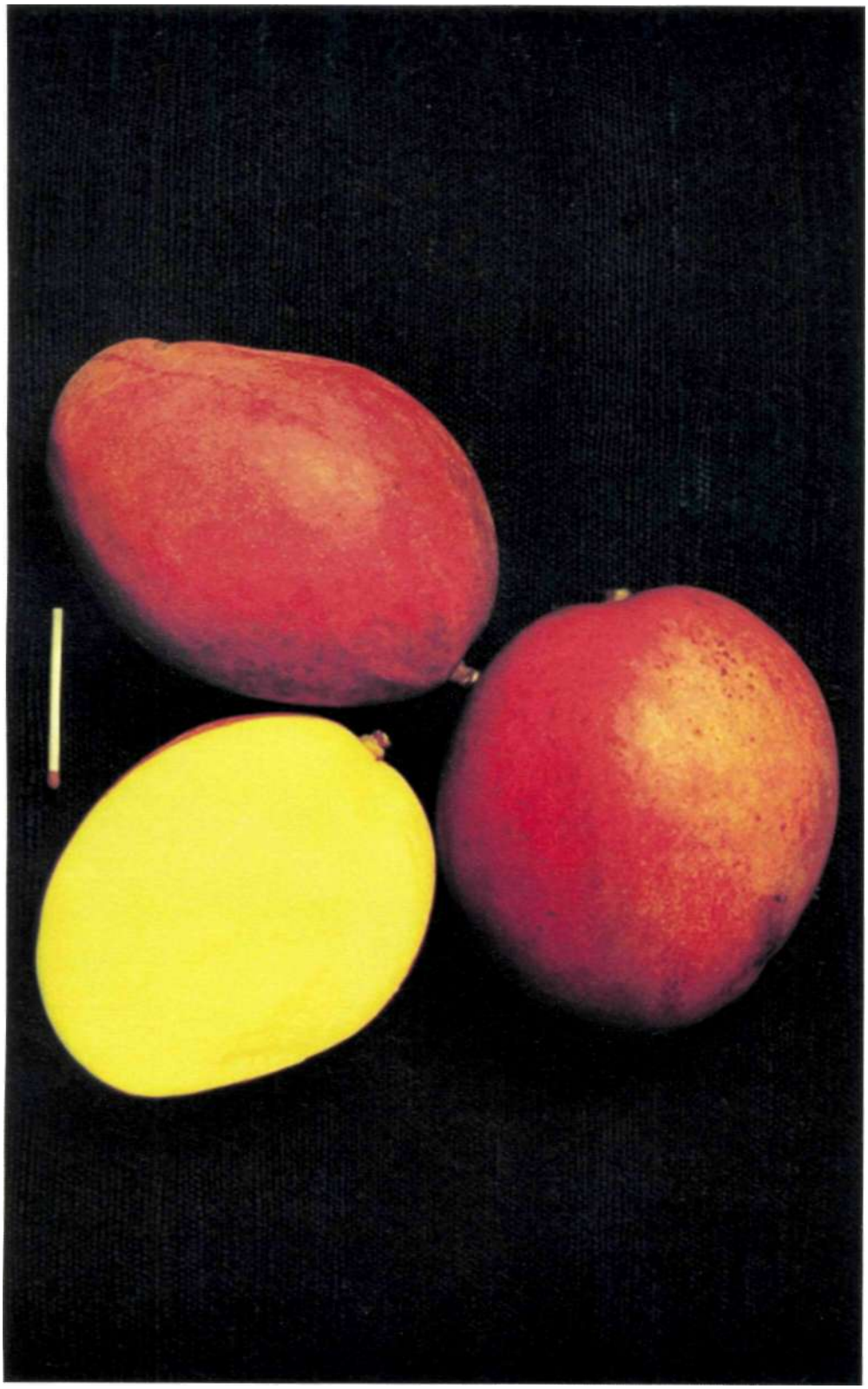
The tree is vigorous/large with a rounded canopy and it produces consistently heavy and good crops. It is an early to mid-season cultivar and is highly resistant to diseases.

Advantages:

- very attractive fruits
- excellent shipping and shelf-life qualities
- consistent producer
- good resistance to anthracnose and powdery mildew

Disadvantages:

- danger of internal breakdown (jelly seed)
- fibre content is slightly higher than average



Van Dyke

This cultivar originated from Homestead (Florida) and belongs to a selected group of seedlings distinguished by a greater resistance to anthracnose, very attractive colour, and good shelf life and shipping qualities. These seedlings appeared in the 1950s and 1960s.

The ovate, small- to medium-sized fruit (average weight 280 g) is very attractive showing a bright yellow ground colour with a heavy crimson blush and prominent beak. The average fruit dimensions are: 10.5 cm length by 7.9 cm width. The skin is thick, though easily separating and covered with numerous white/yellow lenticels. The flesh is quite firm, melting and juicy with little fibre, orange-yellow, rich, spicy and sweet with a strong pleasant aroma. It is of good to excellent quality. The seed is mono-embryonic and covered by a medium-sized woody stone (7.1% of fruit weight).

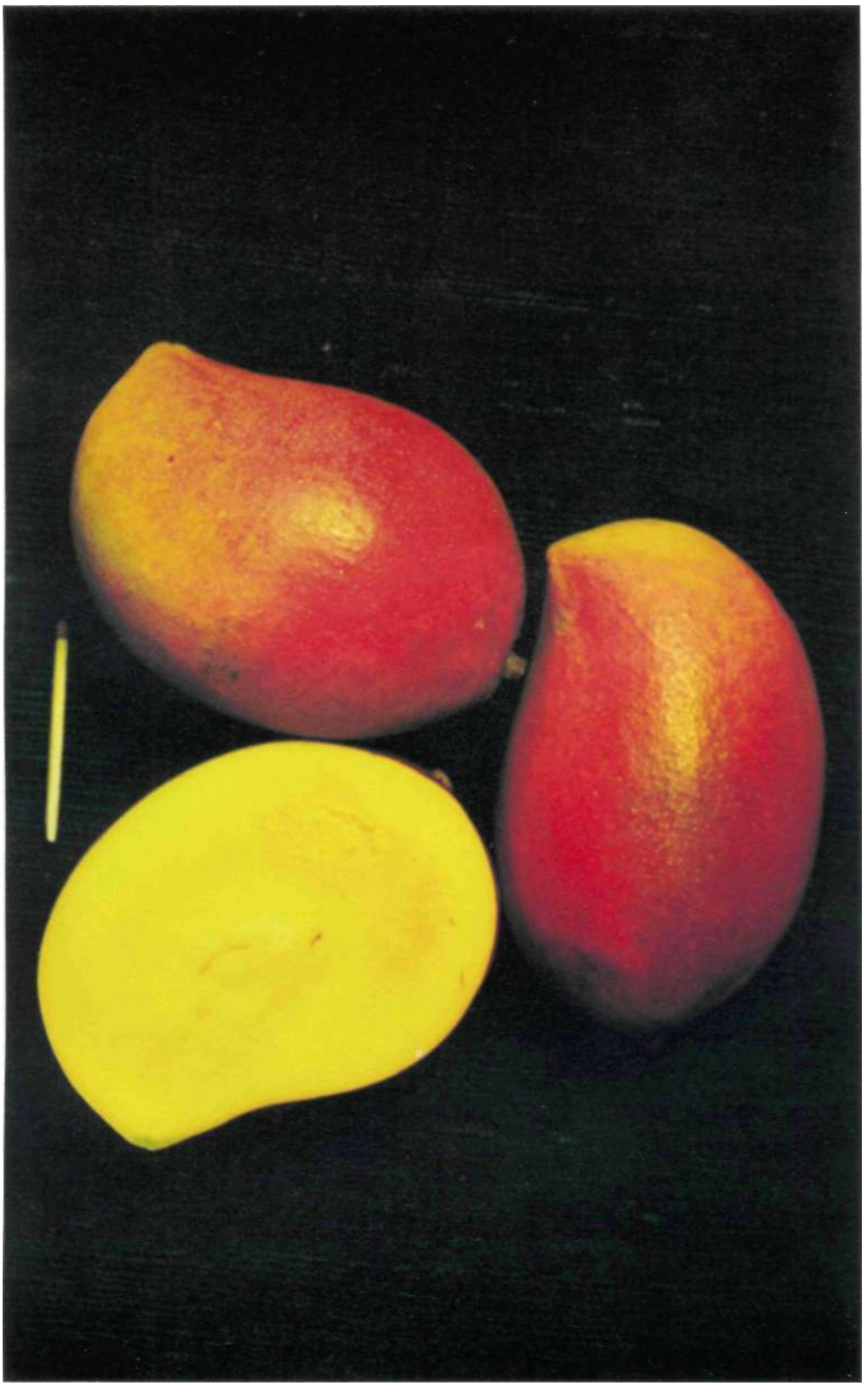
The trees are medium-sized with a large open canopy and are regular producers but yield only moderately.

Advantages:

- attractive colour
- good resistance to anthracnose and powdery mildew
- regular bearer

Disadvantages:

- poor to moderate yields
- fruit size



Zill

As a Haden seedling it originated in Lake Worth, Florida, in 1930.

The small to medium, ovate fruit is yellow with an intense red or crimson blush. The apex is rounded with a small beak. The fruit shape resembles that of van Dyke, and the average dimensions are: length 10.6 cm by 8.2 cm width, average weight 285 g (range: 225-345 g). Lenticels are yellow/brown and the flesh is deep yellow, juicy, soft and without fibre. The flavour is rich and sweet and of good to excellent eating quality. The seed is mono-embryonic and covered by a thick woody stone (8% of fruit weight).

The tree becomes fairly large with an open, spreading canopy. This early to mid-season cultivar produces well and fairly consistently. Zill has a moderate resistance to anthracnose and powdery mildew, but does not withstand storage and shipping stress well.

Advantages:

- early season cultivar
- regular producer
- outstanding quality

Disadvantages:

- not a good shipper
- danger of internal breakdown (jelly seed)
- low/moderate resistance to diseases

Zillate

Not much is known about the origin of this cultivar but it is assumed that the seedling was developed in Florida.

The medium-sized oblong fruit is of a yellow ground-colour and has an intensive red blush. There are numerous small white lenticels covering the thick, tough skin. The rounded apex carries an almost non-existent underdeveloped beak. The average fruit dimensions are: length 12.5 cm by 7.1 cm width, with a weight of 291 g (range: 260-350 g). The firm, juicy, yellow flesh is relatively free from fibre, aromatic and of good eating quality. The fairly large flat seed (7.8% of total fruit weight) is mono-embryonic.

The tree is moderately vigorous, forming an upright tight canopy. The rather late-season cultivar yields quite well and regularly. It shows moderate resistance to powdery mildew but is affected by anthracnose.

Advantages:

- good shelf life
- fibreless and of good eating quality
- attractive appearance

Disadvantage:

- needs more publicity

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acaracide	material toxic to mites
acid soil	pH less than 7.0
active ingredient	toxic component of a formulated pesticide
adhesive = sticker	material added to increase pesticide retention
alkaline soil	pH greater than 7.0
anther	the pollen-bearing part of a stamen
apex	tip of shoot
attractant	material with an odour that attracts certain insects
bait	foodstuff used for attracting pests, usually mixed with a poison
beak	a pointed projection at the tip of a fruit
biological control	control of pests by disease-producing organisms, preditors or parasites
bloom	the delicate waxy or powdery substance on the surface of berries
calyx	the external part of a flowers consisting of sepals
canopy	crown of a plant
carrier	material serving as diluent for the active ingredients
clone	identical individuals propagated vegetatively from a single plant
compatibility	ability of the scion and stock to unite in grafting and form a strong union
contact poison	material killing pests by contact action
control	untreated subjects used for comparison with those given a particular treatment
cotyledons	the primary leaves of germinating plants
culling	discarding of plants that do not meet requirements
cultivar	variety, type
discard	reject
diurnal	active during daytime
dormant	alive but not growing; a resting stage
elongated	longer than it is broad
embryo	part of a seed which will grow into a plant

eradicate	destroy, extirpate
fertilization	pollination
fungicide	chemical to control plant diseases
gall	abnormal growth of plant tissues
genus	a group of plants comprising a number of closely related species
germplasm	any plant part used for regeneration
grafting	joining parts of plants together such that they will unite and continue their growth as one plant
herbicide	any chemical used to kill plants
husk	a stringy shell of a seed
immature	unripe, not ready
indigenous	a plant native to the region
inflorescence	the flowering part of a plant
insecticide	chemical to control crop pests
intercropping	the growing of two crops simultaneously in the same field
latent	dormant
latex	milky plant juice
lenticel	a pore like, slightly raised spot on a fruit skin
maggot	a vermiform, legless larva (Diptera)
maturity	stage of final fruit development (ripeness)
mono-embryonic	mode of reproduction: contains only one embryo
nocturnal	active at night
oblong	longer than broad
oviparous	reproduction by laying eggs
panicle	a loosely branched inflorescence
pedical	the stalk of one flower in a cluster
persistence	chemicals that remain active for a long period of time after application
perfect flower	a flower having both stamens and pistil
pest	an animal or plant causing damage to crops
pesticide	a chemical which by virtue of its toxicity is used to kill pest organisms

pH value	refers to degree of acidity or alkalinity as a scale of numbers from 1 (very acid) to 14 (very alkaline)
phytotoxic	a chemical liable to damage or kill plants
pistel	the female part of the flower
pollination	the transfer of pollen from the anther to the stigma
polyembryonic	mode for reproduction: contains more than one embryo; produces true-to-type progeny
progeny	a plant's 'offspring'
propagate	multiplication of more plants
provenance	germplasm from a single place of origin
quarantine	the prevention of importation or exportation of unwanted organisms into a territory
repellant	a chemical which has the property of inducing avoidance by a particular pest
residue	amount of pesticide remaining in or on plant tissues after a given time
rootstock	plants propagated for further grafting/budding
scion	the plant part grafted onto the stock
self-fertile	fertilization without cross pollination
stalk	also called peduncle
stamen	the pollen-producing organ of a flower
sterile	flowers not capable of producing viable seed
sticker	material added to a spray to increase retention on plant foliage
surfactant	a chemical which modifies the surface tension of spray droplets
susceptible	not resistant
systemic	an insecticide absorbed by plants and translocated throughout
terminal	borne at the end of a stem
tissue	plant cells
tolerance	maximum amount of toxicant allowed in foodstuffs for human consumption
top-working	converting a grown tree by grafting
trunk	the main stem of a tree
variety	a group of closely related plants of common origin

vector	organisms able to transmit viruses either directly or indirectly
vegetativepropagation	plant reproduction, usingvegetative plant parts
volunteer	crop plant growing accidentally from shed seed

Appendix 1

Some characteristics of Kenya-grown mango cultivars

	Alphonso	Apple	Arumanis	Batawi	Boribo
Origin	India	Kenya	Indonesia	Kenya	Kenya
Seed type*	M	M	P	P	P
Fruit shape	Oval/ oblique	Oval/ oblique	Oval to oblong	Nearly oval	Oblong
Fruit size/ weight (average)	Medium 370 g	Medium/ large 397 g	Small 210g	Large 523 g	Large 511 g
Fruit colour	Orange yellow	Yellow/ orange to red	Light yellow	Olive green to purple maroon	Pale olive green to apricot yellow
Flesh colour	Yellow	Yellow	Lemon yellow	Pale orange	Deep orange
Fibre	Low	Low	Low	Moderate	Low
Fruit dimension (average)	Long 11.6cm broad 9.3 cm	Long 9.7 cm broad 11 cm	Long 8.3 cm broad 6.3 cm	Long 10.7 cm broad 7.6 cm	Long 11.5 cm broad 7.6 cm
Seed %	11%	9%	7.9%	8.1%	8%
Eating quality	Excellent	Excellent	Fair	Good	Good
Maturity season **	January (M)	Dec/Jan (M) End-Feb/ March (K)	January (M)	Mid Jan/ Feb(M) March (K)	Jan-mid-Feb(M)
Yield	Medium/ heavy	Medium	Medium	Medium	Medium/ heavy
Regularity of bearing	Moderate	Alternate	Alternate	Moderate	Regular
Anthracnose resistance	Medium	Medium	Medium	Medium	Medium
Tree habit	Moderately large	Large	Vigorous and large	Small to Medium	Large

* M = Mono-embryonic
P = Polyembryonic

** (M) = Mwea
(K) = Kamiti

Cultivar	Carabao	Chino	Dodo	Gesine	Haden
Origin	Philippines	?	Kenya	Kenya	Florida seedling of Mulgoba
Seed type*	P	P	P	P	M
Fruit shape	Oblong to elongate	Oblique	Oval	Oblong	Regular ovate and plump
Fruit size/ weight (average)	Medium 311 g	Medium 386 g	Large 453 g	Medium 280 g	Medium to Large 431 g
Fruit colour	Light green to bright yellow	Green/ orange with light red blush	Dark green to light yellow	Yellow with red blush	Deep yellow with red blush
Flesh colour	Lemon yellow	Yellow	Yellow/ orange	Yellow/ orange	Deep yellow
Fibre	Low	Moderate	Moderate	Low/ moderate	Low
Fruit dimension (average)	Long 13 cm broad 7.5 cm	Long 10.9 cm broad 9.5 cm	Long 11.8 cm broad 9.9 cm	Long 11.7 cm broad 7.8 cm	Long 10 cm broad 8cm
Seed %	7.5%	7.8%	8.6%	9%	7.1%
Eating quality	Good/ excellent	Good	Good	Good/ excellent	excellent
Maturity season**	January (M)	January (M) February (K)	Jan-Feb (M)	Late Dec/ Jan(M) Mid-Feb (K)	Jan (M) Late Feb (K)
Yield	Medium/ heavy	Heavy	Medium/ heavy	Medium/ heavy	Medium
Regularity of bearing	Alternate	Regular	Alternate	Regular	Alternate
Anthracnose resistance	Good	Low	Good	Low	Moderate
Tree habit	Vigorous	Moderate	Very Large	Moderate	Moderate to large

* M = Mono-embryonic
P = Polyembryonic

** (M) = Mwea
(K) = Kamiti

Cultivar	Heart	Irwin	Kent	Keit	Kensington = Bowen
Origin	Indochina	Florida seedling of Lippens	Florida seedling of Brooks	Florida probably seedling of Mulgoba	Australia
Seed type*	P	M	M	M	P
Fruit shape	Heart-shaped	Oblong/ ovate	Ovate to slightly oblong	Ovate, slightly oblique and plump	Ovate to slightly oblong
Fruit size/ weight (average)	Small to Medium 200 g	Medium 372 g	Large 545 g	Large 456 g	Medium 319g
Fruit colour	Bright yellow	Bright yellow with dark red blush	Greenish yellow with dark red blush	Green/ yellow with pink or red blush	Yellow with pink/ red blush
Flesh colour	Yellow	Lemon yellow	Deep yellow to orange	Yellow	Yellow
Fibre	Moderate	None to low	None	None	Moderate
Fruit dimension (average)	Long 8.4 cm broad 8 cm	Long 12.3 cm broad 8.5 cm	Long 12.4 cm broad 9.7cm	Long 11.7 cm broad 9.2 cm	Long 12.2 cm broad 8.1cm
Seed %	7.2%	7.6%	8.5%	7.5%	7.8%
Eating quality	Fair-Good	Good-Excellent	Excellent	Good/ Excellent	Excellent
Maturity season **	January (M)	Late Jan/ Feb (M) March (K)	March (M) Late March/ April (K)	March (M) Late March/ April (K)	Jan (M)
Yield	Medium	Heavy	Heavy	Heavy	Heavy
Regularity of bearing	Regular	Regular	Regular	Regular	Regular
Anthracnose resistance	Tolerant/ Low	Low	Moderate	Moderate	Moderate
Tree habit	Large and spreading	Moderate	Large and upright	Moderate	Large and spreading

* M = Mono-embryonic
P = Polyembryonic

** (M) = Mwea
(K) = Kamiti

Cultivar	Madoe resembles Apple	Matthias	Maya resembles Haden	Ngowe	Nimrod
Origin	Indonesia	Kenya	Israel	Kenya	Israel
Seed type*	P	P	M	P	M
Fruit shape	Oval/ oblique	Ovate/ oblong	Ovate and plump	Oblong	Oval/ oblique
Fruit size/ weight (average)	Medium/ large 380 g	Medium 251 g	Medium 289 g	Large 523 g	Large 480 g
Fruit colour	Deep yellow-apricot with red blush	Deep yellow with bright red blush	Yellow with partly red blush	Deep yellow flushed with orange/red	Deep yellow with light-red flush
Flesh colour	Yellow	Yellow	Yellow	Deep yellow	Yellow
Fibre	Low	Moderate	None	None/low	Low
Fruit dimension (average)	Long 9.7 cm Broad 10.7 cm	Long 10.3 cm Broad 7.8 cm	Long 10.3 cm Broad 7.8 cm	Long 14 cm Broad 9.5 cm	Long 11cm Broad 10 cm
Seed %	7.4%	8.0%	9.2%	7.8%	7.6%
Eating quality	Excellent	Good	Good	Good/ excellent	Good
Maturity season **	January (M)	Dec/Jan (M) Mid-Feb (K)	Jan/Feb (M) Late Feb (K)	Jan/mid Feb (M) Mid-Feb/ March (K)	Late Dec/ Jan(M)
Yield	Medium/ heavy	Heavy	Medium	Medium	Fair
Regularity of bearing	Moderate	Regular	Moderate	Moderate	Moderate
Anthracnose resistance	Moderate	Moderate	Low	Low/ moderate	Moderate
Tree habit	Moderate/ large	Moderate/ large	Large/ vigorous	Moderate/ large	Moderate/ large

* M = Mono-embryonic
P = Polyembryonic

** (M) = Mwea
(K) = Kamiti

Appendix 1 cont.

Cultivar	Parwin	Peach	Sabine	Sabre	Sensation
Origin	Florida	?	Kenya	S/Africa ?	Florida
Seed type*	M	P	M	P	M
Fruit shape	Ovate/ oblong	Roundish oblique	Elongated	Oblong/ kidney shaped	Oval/ oblique
Fruit size/ weight (average)	Medium/ large 470 g	Medium 241 g	Medium/ large 435 g	Small/ medium 233 g	Medium 307 g
Fruit colour	Light yellow with pink/red blush	Yellow with reddish flush	Deep yellow with dark red blush	Green/ yellow with reddish blush	Yellow with plum-red blush
Flesh colour	Yellow	Apricot yellow	Yellow	Orange	Deep yellow
Fibre	Low	Moderate	None/Low	Moderate	None
Fruit dimension (average)	Long 10.8 cm broad 8.5cm	Long 9.3 cm broad 8.1 cm	Long 14.2 cm broad 6.6 cm	Long 11.8 cm broad 6.9 cm	Long 10.8 cm broad 7.8 cm
Seed %	7.5%	8.1%	9.6%	9.4%	5.8%
Eating quality	Good/ excellent	Fair/good	Excellent	Fair/good	Good
Maturity season**	February/ March (M)	Late Dec/ Jan (M) February (K)	Late Jan/ Feb (M) Mid-Feb/ March (K)	Dec/Jan (M) Late Feb/ March (K)	February (M) Late March/ April (K)
Yield	Fair	Fair/ heavy	Medium/ heavy	Heavy	Very heavy
Regularity of bearing	Moderate	Regular	Moderate	Regular	Alternate
Anthracnose resistance	Moderate	Moderate	Moderate	Good-moderate	Very low
Tree habit	Vigorous	Large	Moderate/ large	Small/ medium	Moderate

* M = Mono-embryonic
P = Polyembryonic

** (M) = Mwea
(K) = Kamiti

Cultivar	Smith	Tommy Atkins	Van Dyke	Zill (Seedling) of Haden	Zillate
Origin	Hawaii	Florida	Florida	Florida	Florida
Seed type*	M	M	M	M	M
Fruit shape	Elongated	Ovate to slightly oblong	Ovate	Ovate	Oblong
Fruit size/ weight (average)	Large 550 g	Medium/ large 522 g	Small/ medium 280 g	Small/ medium 285 g	Medium 291 g
Fruit colour	Orange/ yellow with crimson blush	Deep yellow with heavy red blush	Bright yellow with crimson blush	Yellow with crimson blush	Yellow with intensive red blush
Flesh colour	Deep yellow	Yellow	Orange/ yellow	Deep yellow	Yellow
Fibre	None/ low	Moderate	None/ low	None	Low
Fruit dimension (average)	Long 13.9 cm Broad 7.5 cm	Long 12.6 cm Broad 9.9 cm	Long 10.5 cm Broad 7.9 cm	Long 10.6 cm Broad 8.2 cm	Long 12.5 cm Broad 7.1 cm
Seed %	7%	6.6%	7.1%	8%	7.8%
Eating quality	Good	Fair/Good	Good	Good/ Excellent	Good
Maturity season **	February (K)	January (M) Late Feb/ March (K)	January (M) Late Feb/March (K)	January (M) Late Feb/March (K)	Early March (M) Late March/ April (K)
Yield	Moderate/ heavy	Heavy	Moderate	Moderate/ heavy	Moderate/ heavy
Regularity of bearing	Regular	Regular	Regular	Regular	Moderate
Anthracnose resistance	Moderate	Moderate	Moderate	Low	Low
Tree habit	Upright, vigorous	Large, vigorous	Moderate	Moderate	Moderate

* M = Mono-embryonic
P = Polyembryonic

** (M) = Mwea
(K) = Kamiti

Appendix 2

Average rainfall figures (mm) and temperature data (°C) of selected stations located in manqo growing provinces

Province	Station	Altitude (m)	Number of recording years	January	February	March	April	May	June	July	August	September	October	November	December
Coast	Taveta	900	31 (R)	37	31	85	122	64	9	3	4	8	25	78	65
			5(T)	**22.3**	**24**	**24.4**	**23.8**	**21.5**	**20.6**	**20**	**20.2**	**21.7**	**22.7**	**23**	**23**
	Voi	560	**71** (R)	32	70	81	93	29	7	3	8	15	28	99	122
			32 (T)	**25.9**	**26.7**	**27.1**	**25.9**	**24.9**	**23.6**	**22.6**	**22.5**	**23.3**	**24.9**	**25.7**	**25.6**
	Baricho/Galana	67	24 (R)	33	18	58	98	91	44	30	27	47	77	113	89
	Malindi M. St.	20	14 (R)	11	15	42	186	313	160	74	64	46	71	79	30
			8(T)	**26.6**	**27.1**	**28**	**27.4**	**26**	**25**	**24.6**	**24.4**	**25**	**25.8**	**26.5**	**26.9**
	Ngao/Tana	15	19 (R)	15	9	25	95	108	67	44	41	102	73	85	40
	Lamu M. St.	9	67 (R)	6	3	23	136	338	200	70	40	41	39	36	28
			10 CD	**27.4**	**27.9**	**28.8**	**27.9**	**26.5**	**25.6**	**25.1**	**25.2**	**25.6**	**26.6**	**27.4**	**27.6**
Eastern	Kiritiri	1143	35 (R)	20	21	121	227	68	4	2	5	7	**75**	209	91
			11 (T)	**21**	**22.3**	**22.8**	**23**	**22.2**	**20.9**	**19.9**	**20.4**	**21.4**	**22.6**	**22**	**21**
	Kibwezi	914	60 (R)	37	30	91	123	25	5	1	2	4	22	161	140
			Ann. mean temp	24-21,6											
	Kitui	1180	12 (R)	50	17	167	245	60	8	1	6	11	63	322	128
			6(T)	**20.2**	**21.6**	**22.1**	**21.6**	**20.3**	**18.7**	**17.9**	**18.6**	**19.7**	**21.4**	**21.2**	**20.2**
Rift Valley	Perkerra	1066	20 (R)	41	23	62	70	83	52	77	86	37	36	47	40
			12(T)	**24.7**	**25.3**	**25.7**	**25.3**	**24.8**	**24.1**	**23.7**	**23.5**	**24.4**	**24.8**	**24.2**	**23.9**
	Sigor	1060	19 (R)	25	28	61	152	122	62	102	79	49	63	69	30
Central	Muranga	1060	44 (R)	44	37	81	223	183	23	13	21	13	101	197	61
			7(T)	**21.8**	**23.4**	**23.9**	**23.3**	**22.3**	**21.6**	**20.6**	**20.8**	**22.5**	**23.8**	**22.7**	**23**
	Mwea	1158	16 (R)	38	33	77	224	145	10	12	11	11	82	195	52
			14 (T)	**20.9**	**22**	**23.1**	**22.6**	**21.9**	**20.8**	**19.9**	**20.3**	**21.8**	**22.9**	**21.7**	**20.7**
Nyanza	Ahero	1219	14 (R)	82	98	152	204	124	82	72	57	60	81	11	94
			7(T)	**23.4**	**23.7**	**23.7**	**22.8**	**22.7**	**22.2**	**23.3**	**22.3**	**22.8**	**23.1**	**23.1**	**22.9**

R = **rainfall**

T = **mean temperature**

Appendix 3

Provincial mango production statistics, 1999/2000

Province	Area (ha)		Overall production (t)		Yield (t/ha)	
	1999	2000	1999	2000	1999	2000
Central	536	714	4,880	5,999	9.1	8.4
Coast	8,163	8,151	65,858	43,845	8.1	5.4
Eastern	4,400	3,349	66,296	35,546	15.1	10.6
Western	824	846	5,474	5,598	6.6	6.6
Nyanza	1,171	1,352	13,509	14,579	11.5	10.8
Rift Valley	413	475	5,565	5,553	13.5	11.7
N/Eastern	140	140	740	1,488	5.3	10.6

Source: Ministry of Agriculture (2001).

2000/2001

Province	Area (ha)		Overall production (t)		Yield (t/ha)	
	2000	2001	2000	2001	2000	2001
Central	714	543	5,999	4,826	8.4	8.9
Coast	8,151	8,230	43,845	45,592	5.4	5.5
Eastern	3,349	4,655	35,546	99,059	10.6	21.3
Western	846	979	5,598	7,446	6.6	7.6
Nyanza	1,352	1,458	14,579	13,691	10.8	9.4
Rift Valley	475	509	5,553	5,804	11.7	11.4
N/Eastern	140	168	1,488	3,220	10.6	19.2

Source: Ministry of Agriculture (2002).

Main mango fruit harvesting seasons in Kenya

Province	Location	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct
COAST	Lamu												
	Hindi												
	Malindi												
	Kilifi												
	ShimolaTewa												
	Kwale												
	Manyani												
	Wundanyi												
NORTH EASTERN	Garissa												
EASTERN	Isiolo												
	Machakos												
	Kitui												
	Embu												
	Meru												
CENTRAL	Mwea												
	Maranjau												
	Nyeri												
	Kerugoya												
	Muranga												
NAIROBI	Kamiti												
	Ruiru												
Nyanza	Kisumu												
	Homa Bay												

Appendix 4

Main supply seasons of selected mango exporters

Country	November	December	January	February	March	April	May	June	July	August	September	October
Kenya (Coast)												
Kenya (Other areas)												
Australia												
Tanzania												
Dem. Rep. of Congo												
Madagascar												
Peru												
South Africa												
Queensland												
Brazil												
India												
Senegal												
Venezuela												
Mexico												
Israel												
Mali												
Egypt												
Burkina Faso												
Jamaica												
Pakistan												

Scw/re-'COLEACP/Bruxelles; Fintrac Consulting Ltd. (1989)

Appendix 5

Export market statistics figures for mango from Kenya by sea and air (kg and t)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Tota(kg)l	Tonnes (t)
1995													2,227,170	2,227
1996													4,245,470	4,246
1997													2,524,840	2,525
1998	163,679	18,653	8,318	66,724	32,296	13,225	12,412	27,538	239,884	456,472	634,504	831,695	2,505,400	2,505
1999	805,820	528,411	459,670	226,965	61,133	56,368	14,259	3,465	33,265	335,511	626,368	843,522	3,994,757	3,995
2000	304,929	232,126	91,672	38,107	31,684	32,883	15,600	12,434	48,621	188,257	720,500	970,050	2,686,863	2,687
2001	314,111	151,346	151,822	54,186	23,838	18,691	31,068	3,960	26,006	1,300,830	517,654	572,671	3,166,181	3,166
2002	404,981	323,212	259,279	110,522	32,464	18,691	10,180	18,855	54,103	496,623	643,662	498,293	2,870,865	2,871

Source: Horticulture Crops Development Authority, Nairobi.

Appendix 6

Common horticultural insecticides/ fungicides and their recommended pre-harvest intervals

Insecticides			Fungicides		
Common name	**Trade name**	**Pre-harvest interval**	**Common name**	**Trade name**	**P re-harvest interval**
Azinphosmethyl	Gusathion	14 days	Benomyl	Benlate	14 days
Carbaryl	Sevin	7 days	Binapacryi	Morocide	14 days
Carbofuran	Furadan	21 days	Bupirimate	Nimrod	7 days
Chinomethionate	Morestan	7 days	Captafol	Moduna	7 days
Diazinon	Neocid	10 days	Captan	Orthocide	7 days
Dichlorvos	Nogos	2 days	Chinomethionate	Morestan	10 days
Dicofol	Kelthane	7 days	Copper	- Cupravit	7 days
Dieldrin	Kynadrin	28 days	hydroxide/	-Copper 50	7 days
Dimethoate	Rogor	7 days	oxychloride/	- Cobox	7 days
Endosulfan	Thiodan	28 days	sulphate	- Green	
Fenitrothion	Sumithion	10 days		Copper 50	7 days
Fensulfothion	Terracur	8 weeks	Dinocap	Karathane	10 days
Fenthion	Lebaycid	10 days	Mancozeb	Dithane	7 days
Malathion	Kilpest	7 days	Iprodione	Rovral	7 days
Omethoate	Folimat	21 days	Metalaxyl	Ridomil	7 days
Oxydemetonmethyl	Metasystox	21 days	Metiram	Polyram Combi	7 days
Phenamiphos	Nemacur	4 weeks	Propineb	Antracol	7 days
Phosphamidon	Dimecron	14 days	Pyrazophos	Afugan	7 days
Pirimiphos Methyl	Actellic	14 days	Sulphur	Thiovit	7 days
Synthetic pyreth raids	Ambush	14 days	Triadimefon	Bayleton	7 days
Deltamethrin	Decis	14 days	Tridemorph	Calinix	7 days
Cypermethrin	Sherpa	14 days	Triforine	Saprol	2 days
Penvalerate	Brigade	14 days	Zineb	Lonacol	7 days
Decamethrin	Karate	14 days			
Trichlorphon	Dipterex	10 days			

Source: Data from National Agricultural Laboratories, Kabete, Kenya (1988).

Appendix 6 cont.

Common fungicides and their range of effectiveness

Trade name	Description	Range of effectiveness
Afugan	Systemic fungicide	Controls powdery mildew on a wide range of crops
Aliette	Systemic fungicide	Primarily effective against phytophthora and downy mildew
Antracol	Contact fungicide	Broad spectrum: controls a number of important diseases such as blight, downy mildew, anthracnose and various leaf-spot diseases on a wide range of crops
Bayfidan	Systemic fungicide	Broad spectrum: powdery mildew, rusts, sigatoka etc.
Benlate	Systemic fungicide	Broad spectrum: powdery mildew, anthracnose, sigatoka, scab etc.
Cupravit	Contact copper fungicide	Broad spectrum: scab, anthracnose, downy mildew, gummosis, sigatoka etc.
Daconil	Contact fungicide	Broad spectrum: protectant fungicide for the control of CBD and many diseases of fruits, vegetables and ornamentals
Dithane M 45	Contact fungicide	Broad spectrum: scab, rust, anthracnose, downy mildew, blights and various leaf-spot diseases
Kocide	Contact copper fungicide	Broad spectrum: scab, anthracnose, septoria, leaf rust, etc.
Nimrod	Systemic fungicide	Control of powdery mildew on a wide range of crops
Polyram combi	Contact fungicide	Broad spectrum: controls many diseases of fruits, vegetables and ornamentals
Ridomil5G	Systemic granular fungicide	Developed especially for the control of soil-borne fungi causing root/collar and stem rots on crops such as avocados and citrus
Saprol	Contact fungicide	Controls many diseases like rusts and powdery mildew

Source: Compiled by the author.

Appendix 6 cont.

Common insecticides and their range of effectiveness

Trade name	Description	Range of effectiveness
Acetelic	Fast acting insecticide of limited persistence with contact and fumigant action	Broad spectrum: beetles, caterpillars, aphids, bugs, thrips, midges etc.
Ambush	Synthetic pyrethroid insecticide with contact action	Broad spectrum: caterpillars, beetles, moths, white flies, jassids etc.
Basamid	Pre-planting soil fumigant	Nematodes and other soil insects, soil fungi and germinating weed seed
Basudin	Contact and stomach poison with good initial action but limited persistence	Broad spectrum: caterpillars, flies, ants, aphids, leaf-hoppers etc.
Brigade	Synthetic pyrethroid insecticide/miticide	Broad spectrum: caterpillars, aphids, mites, white flies, scale insects etc.
Decis	Synthetic pyrethroid	Broad spectrum: fruit fly, aphids, thrips, false coding moths etc. with contact, stomach and vapour action
Dursban	Insecticide with contact, stomach and vapour action	Broad spectrum: aphids, bugs, caterpillars, ants, army worms, mites etc.
Folimat	Systemic insecticide and acaricide	Broad spectrum: particularly caterpillars, thrips, scale insects, mites, aphids etc.
Furadan	Sytemic soil nematicide/ insecticide	Controls soil insects/nematodes as well as some foliar feeding pests
Hostathion	Insecticide with contact and stomach action	Broad spectrum: controls sucking/ chewing insects: aphids, bugs, miles, psylla, soft-scale-scale insects etc.
Karate	Synthetic pyrethroid with rapid knock-down action	Broad spectrum: mites, beetles, weevils, bugs, white fly, aphids, caterpillars etc.
Kelthane	Non-systemic acaricide	Controls mites on a wide range of crops
Lannate	Systemic insecticide	Broad spectrum: aphids, psyllids, scale insects, leaf-hoppers, bugs, thrips etc.

Appendix 6 cont.

Common insecticides and their range of effectiveness

Trade name	Description	Range of effectiveness
Lebaycid	Contact and stomach insecticide	Broad spectrum action against sucking / biting pest
Malathion	Non-systemic insecticide / acaricide	Broad spectrum: aphids, thrips, mites, bugs, caterpillars, scale insects etc.
Marshal	Insecticide / nematicide with contact and systemic action	Broad spectrum: scale insects, mites, aphids, weevils, fruit flies etc.
Neoron	Contact acaricide with residual activity	Controls mites on a wide range of crops
Pyrinex	Insecticide with contact, stomach and vapour action	Broad spectrum: specifically used against root maggots, aphids, bugs, caterpillars, mites
Rogor	Systemic and contact insecticide / acaricide	Effective against sucking insects: aphids, white flies, scale insects, mites, psyllids, thrips etc.
Sumithion	Contact/stomach action	Broad spectrum: white flies, aphids, scales, psyllids, thrips etc.
Summer white oil	Refined mineral oil	Effective against certain insects: mealybugs, scale insects, thrips, mites
Thiodan	Contact/stomach action	Broad spectrum: caterpillars, beetles, aphids, thrips, bugs, white flies etc.

Appendix 7

List of registered fruit tree nurseries

B Districts						
Number	**Name**	**District**	**Division**	**Sub-location**	**Address**	Types of fruits
1	Makhanga CG	Bungoma	Tongereni	Naitiri	Box 13 Naitiri	Macadamia
2	Bungoma FTC	Bungoma	Sirisia	South Nolondo	Box 33 Bungoma	Passion fruit, Mango, Avocado, Loquat, Tree tomato
3	Pekera resort	Baringo	Marigat	Marigat	Box 32 Marigat	Citrus, Pawpaw, Mango, Banana, Avocado, Grapes, Passion fruit
4	Pekera irrigation scheme	Baringo	Marigat	Marigat	Box 14 Marigat	Citrus, Mango, Pawpaw
E Districts						
5	Embu Prison	Embu	Gachoka	Kamuyu	Box 38 Embu	Avocado, Mango, Pawpaw, Loquat, Apples, Bananas, White sapote, Passion fruit, Custard apple
6	Kamiu Horticul-tural Nursery	Embu	Embu	Municipal-ity	Box 727 Embu	Mango, Pawpaw, Avocado, Passion fruit, Guava, Loquat, Custard apple, Strawberries, Macadamia, Tree tomato
7	Kamurugu Project	Embu	Embu	Gichiche	Box 202 Embu	Mango, Avocado, Guava, Pawpaw, Grapes, Passion fruit

Appendix 7 Cont.

E Districts

Number	Name	District	Division	Sub-location	Address	Types of fruits
8	Anderson N Nguru	Embu	Ishiara	Nguthi	Box 4 Ishiara	Mango, Pawpaw, Passion fruit
9	Johnstone Chelanga	E Marakwet	Tot	Sagat	Box 249 Iten	Citrus, Mango, Avocado, Passion fruit, Pawpaw
10	Nyaru Tree Nursery	E Marakwet	Southern	Ngaru	Box 4006 Eldoret	Plums, Pears, Peaches, Apples, Grapes, Passion fruit
11	Ngeria Prison	Eldoret	Eldoret	Cheppakwai	Box 461 Eldoret	Avocado, Apples
12	Arror Nursery	Eldoret	Eldoret	Arror	Box 2660 Eldoret	Citrus, Mango, Pawpaw, Purple Passion fruit
13	Tot Nursery	Eldoret	Eldoret	Endoo	Box 2660 Eldoret	Citrus, Mango, Pawpaw, Avocado, Purple passion fruit
14	Seko Farm	Eldoret	Eldoret	Kimoning	Box 7610 Eldoret	Yellow passion
15	Weiwei Nursery	Eldoret	Eldoret	Korellach	Box 2660 Eldoret	Citrus, Mango, Pawpaw, Avocado, Purple passion fruit
16	Cheplambus Nursery	Eldoret	Eldoret	Cheplambus	Box 2600 Eldoret	Citrus, Guava, Pawpaw, Purple Passion fruit
H Districts						
17	Afforestation programme	Homa Bay	Township	Township	Box 646 Homa Bay	Mango, Avocado, Citrus, Passion fruit
18	Homa Bay Prison	Homa Bay	Rangwe	Makongeni	Box 42 Homa Bay	Citrus, Mango, Pawpaw, Passion fruit, White sapote

Appendix 7 Cont.

1 Districts						
Number	**Name**	**District**	**Division**	**Sub-location**	**Address**	**Types of fruits**
19	isiolo Prison	Isiolo	Central	Central	Box 1 Isiolo	Mango, Avocado, Pawpaw
KDistricts						
20	Coast Develop-ment Authority	Kwale	Kwale	Diani	Box 1322 Mombasa	Citrus, Mango, Guava, Avocado, Passion fruit, Grapes
21	Samsaad Alzalkhan	Kwale	Matuga	Waa	Box 96246 Mombasa	Citrus, Mango, Pawpaw, Avocado, Passion fruit
22	Kwale Prison	Kwale	Waa	Kitivo	Box 60121 Mombasa	Citrus, Mango
23	Milufarm	Kwale	Matuga	Golini	Box 7 Kwale	Citrus, Mango, Pawpaw, Passion fruit
24	Milu farm	Kwale	Msambweni	Mbokoni	Box 66742 Mombasa	Citrus, Mango
25	Vincent M Kega	Kwale	Matuga	Waa	Box 96246 Mombasa	Citrus, Mango, Pawpaw, Avocado, Passion fruit
26	James Karimi	Kilifi	Bahari	Mtepeni	Box 88444 Mombasa	Citrus, Mango, Pawpaw, Passion fruit, Custard apple
27	Tropical fruit produce	Kilifi	Bahari	Mtwapa	Box 90522 Mombasa	Citrus, Mango
28	Malindi Prison	Kilifi	Malindi	Sabaki	Box 373 Malindi	Citrus, Mango, Pawpaw, Passion fruit, Custard apples

Appendix

K Districts						
Number	**Name**	**District**	**Division**	**Sub-location**	**Address**	**Types of fruits**
29	ADC Kisiwani	Kilifi	Malindi	Malindi	Box 62 Malindi	Citrus, Mango
30	Kilifi Institute of Agriculture	Kilifi	Malindi	Kilifi	Box 195 Kilifi	Citrus assorted, Mango assorted, Grapevine, Grape asward, Coconut assorted
31	Kilifi Prison	Kilifi	Kilifi	Bahari	Box 47 Kilifi	Citrus, Mango, Custard apple, Pawpaw, Passion fruit
32	Kiarwe Products Ltd	Kiambu	Kiambaa	Kiambaa	Box 44982 Nairobi	Avocado, Passion fruit, Pears, Macadamia
33	Karamaini Nurseries	Kiambu	Thika	Karamaini	Box 40 Thika	Macadamia
34	Riara Orchards	Kiambu	Kiambaa	Kiambaa	Box 57093 Thika	Avocado, Passion fruit, Pears
35	Tata Nurseries	Kiambu	Juja	Kiu	Box 47398 Nairobi	Apples, Banana, Mango, Pawpaw, Avocado, Passion fruit
36	Kiambu Prison	Kiambu	Kiambaa	Ndumberi	Box 121 Kiambu	Apples, Banana, Pears, Guava, Peaches, Avocado, Passion fruit
37	Kenya Nut Co.	Kiambu	Kiambaa	Hatwara farm	Box 52727 Nairobi	Macadamia
38	Ruiru Prison	Kiambu	Thika	Katambya	Box 363 Ruiru	Loquat, Banana, Pawpaw, Avocado, Passion fruit
39	Simeon Njuguna	Kiambu	Juja	Ndarugu	Box 1460 Thika	Strawberries, Mango, Pawpaw, Passion fruit

K Districts						
Number	**Name**	**District**	**Division**	**Sub-location**	**Address**	**Types of fruits**
40	Tissue Culture Services	Kiambu	Juja	Kalimoni	Box 2 Kalimoni	Various fruits through tissue culture
41	Elina Plant Nurseries	Kiambu	Gatundu	Ngenda	Box 220 Gatundu	Avocado, Loquat, Guava, Macadamia, Mango
42	Johnson Kabaiku	Kiambu	Lari	Githirioni	Box 112 Uplands	Avocado, Peaches, Pears, Plums
43	Evergreen Nurseries	Kiambu	Kiambaa	Thindigua	Box744414 Nairobi	Strawberries, Mango, Paw-paw, Passion fruit, Grapes
44	Kerugoya Prison	Kirinyaga	Ndia	Kerugoya Township	Box 7 Kerugoya	Avocado, Mango, Tree tomato, Passion fruit, Pawpaw
45	Mwea Prison	Kirinyaga	Ndia	-	Box 112 Wang'uru	Mango, Banana, Pawpaw, etc.
46	Baricho Nursery	Kirinyaga	Ndia	Mwerua	Box 392 Kerugoya	Avocado, Mango, Tree tomato, Passion fruit, Pawpaw
47	Kimbimbi Nursery	Kirinyaga	Mwea	Nyangati	Box 112 Wang'uru	Macadamia, Avocado, Mango, Tree tomato, Passion fruit, White sapote, Pawpaw
48	MubariK.H	Kirinyaga	Kirinyaga	Gatu	Box 233 Kianyaga	Macadamia, Avocado, Mango, Apples, Passion fruit

Appendix 7 Cont.

K Districts						
Number	**Name**	**District**	**Division**	**Sub-location**	**Address**	**Types of fruits**
49	Self employment training limited	Kirinyaga	Kianyaga	Kaguyu/ Kabare	Box 263 Kerugoya	Macadamia, Avocado, Mango, Apples, Passion fruit
50	Kitui Prison	Kitui	Central	Township	Box 122 Kitui	Mango, Avocado, Guava, Custard apple, Pawpaw, Banana
51	Joseph Ndinga	Kitui	Mutomo	Kitui	Box 30 Kibwezi	Citrus, Mango, Pawpaw, Avocado, Grapes, Passion fruits
52	Kisii Prison	Kisii	Keumbu	Municipality	Box 93 Kisii	Tree tomato, Loquat, Apple, Passion fruit, White sapote, Pawpaw
53	Shikusa Prison	Kakamega	Lurambi	Lubao	Box 77 Kakamega	Tree tomato, Avocado, Mango, Pawpaw, White sapote, Passion fruit, Loquat
54	Kisumu Prison Annex	Kisumu	Winam	Kazando	Box 1923 Kisumu	Citrus, Mango, Avocado, Custard apple, Pawpaw, Bananas, White sapote
55	Gem Rae	Kisumu	Lower Nyakach	Gem Rae	Box 1958 Kisumu	Citrus, Passion fruit, Mango, Pawpaw
56	Lake Nursery	Kisumu	Maseno	Municipality	Box 1958 Kisumu	Citrus, Passion fruit, Mango
57	Lake Basin Development Authority	Kisumu	Kisumu	Alego	Box 7516 Kisumu	Mango, Avocado, Citrus
58	Kibos Prison	Kisumu	Winam	Kibos	Box 1725 Kisumu	Citrus, Mango, Avocado, Pawpaw, Passion fruit

Aooendix 7 Cont.

K Districts						
Number	**Name**	**District**	**Division**	**Sub-location**	**Address**	**Types of fruits**
59	Sartur Horticul-tural Farm	Kisumu	Bondo	Kagwa	Box 128 Bondo	Mangos, Citrus, Avocado, Passion fruit, Pawpaw
60	Kericho Prison	Kericho	Belgut	Koengo	Box 329 Kericho	Passion fruit, Avocado, Pears, Tree tomato, Plum, Guava, Mulberries, Strawber-ries, Bananas
61	Athi River Prison	Kajiado	North	Kitengela	Box 12 Athi River	Citrus
62	DAO Kajiado	Kajiado	North	Ngurumani	Box 54 Kajiado	Citrus, Mango
63	Solai Agro-Based Sys. Ltd	Koibatek	Ravine	Kabimoi	Box 267 Ravine	Citrus, Passion fruit, Avocado, Mango, Pawpaw
L Districts						
64	Rumuruti Prison	Laikipia	Rumuruti	Rumuruti	Box 52 Rumuruti	Citrus, Mango, Apples, White sapote
65	Hindi Prison	Lamu	Lamu	Hindi	Box 1 Mokowe	Citrus, Mango, Sweet sop, Passion fruit
M Districts						
66	Shimo laTewa Prison	Mombasa	Kisauni	Utange	Box 90152 Mombasa	Citrus, Passion fruit, Pawpaw, Soursoup
67	Joseph Hungo	Muranga	Makuyu	Kigoro, Maragua Ridge	Box35Murang'a	Mango, Macadamia, Pawpaw, Passion fruit, Avocado
68	Kenya Farm Nut	Muranga	Maragua	Maragua	Box 335 Murancj'a	Macadamia

Appendix 7 C

M Districts						
Number	**Name**	**District**	**Division**	**Sub-location**	**Address**	**Types of fruits**
69	Kenya Nut Co.	Muranga	Gatanga	Maragua	Box 52727 Nairobi	Macadamia
70	Maranjau Prison	Muranga	Kigumo	Maranjau	Box 109 Murang'a	Mango, Guava, Citrus, Pawpaw, Passion fruit, Avocado
71	Kakuzi Ltd	Muranga	Makuyu	Ndera	Box	Mango, Macadamia, Passion fruit
72	PO Kamau Gachamba	Muranga	Kandara	Gakara	Box 1586 Thika	Mango, Macadamia, Pawpaw, Passion fruit, Avocado, Banana, Apples, Grapes
73	Timothy Kamu	Muranga	Kandara	Mukuria	Box 651 Thika	Mango, Macadamia, Tree tomato, Passion fruit, Avocado
74	Riakihagi Centre Nursery	Muranga	Kandara	Gakara	Box 279 Thika	Mango, Macadamia, Pawpaw, Passion fruit, Avocado
75	KNFU Nursery	Muranga	Kiharu	Kamathi	Box 206 Murang'a	Mango, Macadamia, Pawpaw, Passion fruit, Avocado
76	Migori EMPE Camp	Migori	Suna Migori	Suna	Box 2 Suna Migori	Mango, Pawpaw, Avocado, Passion Fruit
77	DAO Machakos	Machakos	Mwala	Mango	Box 27 Machakos	Mango, Avocado, Paw-paw, Passion fruit

Appendix 7 Cont.

M Districts						
Number	**Name**	**District**	**Division**	**Sub-location**	**Address**	**Types of fruits**
78	Bernard Lungu	Machakos	Mbooni	Kalawan	Box 10 Tawa	Pawpaw, Mango, Avocado
79	Peter Mungusa	Machakos	Yatta	Mamba	Box 279 Matuu	Mango, Avocado, Passion fruit, Pawpaw
80	CPK Machakos Diocese	Machakos	Central	Township	Box 282 Machakos	Avocado, Passion fruit, Pawpaw, Mango
81	Machakos Prisons	Machakos	Eastleigh	Gakara	Box 150 Machakos	Guava, Mango, Avocado, Apple, Pears, Passion fruit, Pawpaw
82	Sweeter Land Horticultural Farm	Machakos	Mwala	Mithini	Box 59708 Nairobi	Pawpaw, Mango, Avocado, Guava, Banana, Apples
83	Joseph Musila Mutua	Machakos	Kiatineni	Gakara	Box279Thika	Mango, Macadamia, Pawpaw, Passion fruit, Avocado
84	Thomas M Kitumu	Machakos	Nunguni	Kaiti	Box 123 Nunguni	Avocado, Apples, White sapote, Mango
85	Yatta Farm Limited	Machakos	Yatta	Kiwanza	Box 67121 Nairobi	Mango, Citrus, Passion fruit, Avocado, Pawpaw, Guava, White sapote, Custard apple
86	DrPiusS W Owino	Maseno	-	Sunga	Box 32 Maseno	Mango, Citrus, Pawpaw, Passion fruit, Avocado
87	Simon Mutooni	Mwingi	-	-	Box	
88	Vegecare farm nurseries	Matuu	Matuu	Mamba	Box 279 Matuu	Mango, Passion fruit, Pawpaw, Citrus
89	Kisima farm Ltd	Meru	Ngarndare		Box 477 Nanyuki	

Appendix 7 Cont.

M Districts						
Number	**Name**	**District**	**Division**	**Sub-location**	**Address**	**Types of fruits**
90	Henry M Bururia	Mem	Chuka	Kiangongu	Box 102 Chuka	Mango, Avocado, Grapes, Pawpaw, Apples, Passion fruit, Tamarillos, Indig-enous fruit
91	Alice Mucheke	Meru	S Imenti	Kathera	Box184Nkubu	Avocado, Mango, Pawpaw, Passion fruit, Macadamia nut, Citrus
92	Rural Develop-ment Service	Meru	S Imenti	Mitungu	Box 12 Meru	Mango,
93	Edward	Ngari	Meru	Kirendene	Box 985 Meru	Citrus, Avocado, Pears, Mango, Pawpaw
94	Dedan Chege	Meru	N Imenti	Kithoka	Box 113 Meru	Mango, Avocado
95	Mitunguu Co-op Society	Meru	S Imenti	Kirendene	Box310Nkubu	Mango, Avocado, Citrus, Passion fruit, Pawpaw
96	Muuti Nurseries	Meru	C Imenti	Nkadone	Box 260 Meru	Mango, Pawpaw, Avocado, Passion fruits
97	Kabeere Nurseries	Meru	Mitunguu	Mitunguu	Box 45115 Nairobi	Mango, Passion fruit, Avo-cado, Citrus, Pawpaw, Vegetables, Flowers
98	Menia Nurseries	Meru	Karimune	Kirendene	Box 105 Meru	Pawpaw, Avocado, Mango, Passion fruits, Macadamia
99	Cinnabar Green	Meru	Timau	Ngare-dare	Box 119 Timau	Mango, Citrus
100	Joseph Mwikya	Makueni	Makueni	Nziu	Box 72996 Nairobi	Mango, Banana, Avocado, Pawpaw, Passion fruit
101	Kyee Mwea Self-help Group	Makueni	Makueni	luani	Box220Kilala	Mango, Passion fruit, Avocado, Pawpaw

Appendix 7 Cont.

M Districts						
Number	**Name**	**District**	**Division**	**Sub-location**	**Address**	**Types of fruits**
102	ABC Kibwezi	Makueni	Makueni	Ngandaru	Box 32 Machakos	Citrus, Mango, Grapes, Passion fruit
103	Tarda Kibwezi	Makueni	Kibwezi	Kibwezi	Box 210 Machakos	Citrus, Mango, Passion fruit
104	Umoja SHG	Makueni	Kaiti	Kyamuoso	Box 43 Mukuyuni	Avocado, Tomatoes squash, Citrus, Passion fruit, Mango, Pawpaw
105	Migori EMPE Camp	Migori	Migori	Suna	Box 2 Suna, Migori	Mango, Pawpaw, Passion fruit, White sapote, Custard apple
106	S Nyanza afforestation Programme	Migori	Township		Box646Homa Bay	
107	Kibwezi Horti-cultural Nursery	Makueni	Kibwezi	Kikumbolyo	Box 316 Kibwezi	Mango, Avocado, Citrus, Passion fruit, Pawpaw
108	Joseph Hugo	Muranga	Makuyu	Kigoro Ridge	Box 35 Maragua	Mango, Avocado, Macadamia, Pawpaw, Passion fruit
109	Kenya Farm Nut	Muranga	Maragwa	Maragwa	Box 335 Muranga	Macadamia
110	Kenya Nut Co.	Muranga	Gatanga	Gatanga	Box 52727 Nairobi	Macadamia
111	Maranjau Prison	Muranga	Kigumo	Maranjau	Box 109 Muranga	Box 109 Muranga
112	Kakuzi Ltd	Muranga	Makuyu	Ndera	Box24Thika	Passion fruit, Mango, Macadamia, Tree tomato, Citrus, Grapes, Pawpaw

Appendix • it.

Number	Name	District	Division	Sub-location	Address	Types of fruits
M Districts						
113	PO Kamau Gachamba	Muranga	Kandara	Gakara	Box1588Thika	Banana, Grapes, Pawpaw, Passion fruit
114	Timothy Kamau	Muranga	Kandara	Mukuria	Box 651 Thika	Macadamia, Avocado, Mango, Apple, Tree tomato
115	Riakihagi Centre	Muranga	Kandara	Gakara	Box279Thika	Mango, Macadamia, Pawpaw, Passion fruit
116	KNFU Nursery	Muranga	Kiharu	Kimathi	Box 206 Muranga	Mango, Avocado, Passion fruit, Macadamia, Pawpaw
N Districts						
117	River Bank Nurseries	Nairobi	Langata	Langata	Box 44920 Nairobi	Tree tomato, Mango, Avocado, Grape, Passion unit
118	Nairobi West Prisons	Nairobi	Langata	Langata	Box 30556 Nairobi	Mango, Avocado, Pear, Loquat
119	Rurh Garumbi	Nairobi	Langata	Langata	Box 28123 Nairobi	Passion fruit, Tree tomato, Pear
120	Issac M Ngatia	Nairobi	Nairobi	Kahawa Sukari	Box 53314 Nairobi	Mango, Citrus, Passion fruit, Avocado
121	Gardenia	Nairobi	Langata	Langata	Box 931 Nairobi	Passion fruit, Avocado, Plum, Strawberries, Guava, Loquat
122	Langata Women Prison	Nairobi	Kibera	Mugumoini	Box 44769 Nairobi	Mango, Avocado, White sapote, Pawpaw, Apple, Banana
123	Kamiti Maximum Prison	Nairobi	Kasarani	Kasarani	Box 6551 Nairobi	Guava, Peach, Avocado, White sapote, Apple, Banana, Pear, Loquat

Appendix 7 Cont.

N Districts						
Number	**Name**	**District**	**Division**	**Sub-location**	**Address**	**Types of fruits**
124	Genetics tech-nologies	Nairobi	Lower Kabete	Lower Kabete	Box 46631 Nairobi	Banana, Mango, Other assorted fruits and flowers
125	World Agroforestry Centre (ICRAF)	Nairobi	Nairobi	Gigiri	Box 30677 Nairobi	Whiate sapote, Oyster nut, Mango
126	David Koech	Nandi	Mossop	Biribiriet	Box 1653 Eldoret	Apples, Passion fruit, Avocado
127	Narok Prison	Narok	CMau	CMau	Box 13 Narok	
128	Pauline M Mwangi	Nyeri	Municipality	Mukaro	Box 723 Nyeri	Avocado, Passion fruit, Pawpaw, Macadamia
129	Gardenia Nursery	Nyeri	Municipality	Municipality	Box 931 Nyeri	Avocado, Tree tomato, Passion fruit, Guava, Strawberries, Custard apple, Pawpaw
130	Davud Mugutu	Nyeri	Ekieni	Gathuku	Box 112 Nanyuki	Avocado, Pear, Passion fruit, Guava, Loquat
131	Nyeri Prison	Muranga	Nyeri	Municipality	Box 114 Nyeri	Pear, Avocado, Plum, Tree tomato, Passion fruit, White sapote
132	Kirinyaga Distr. Coop Union	Nyeri	Mukaro	-	Box 171 Nyeri	Macadamia
1a33	Nakuru Prison	Nakuru	Municipal	Nakuru	Box 14 Nakuru	Citrus, Apples, Avocado, Guava, Passion fruit
134	Naivasha Prison	Nakuru	Naivasha	Naivasha	Box 146 Naivasha	Citrus, Avocado, Mango

Appendix 7 Cont.

N Districts						
Number	**Name**	**District**	**Division**	**Sub-location**	**Address**	**Types of fruits**
135	Peppers Ltd	Nakuru	Bahati	Lanet	Box 879 Nakuru	Apples, Avocado, Grapes, Passion fruit, Pawpaw, Banana, Mango, Indigenous fruits, Peach
136	Mwriritu Women Group	Nakuru	Mbogoini	Subukia East	Box 65 Subukia	Loquat, Pawpaw, Avocado, Mango, Guava, Apple
137	James Barno	Nakuru	Molo	Sachangwan	Box 103 Molo	Mango, Avocado, Pawpaw, Passion fruit, Apple, Peach, Pear, Plum
138	Eliaj Thangwa	Nakuru	Bahati	Lanet	Box 715 Nakuru	Pawpaw, Apples, Pears, Plums
139	Joseph Mwangi	Nakuru	Bogoini	Subukia East	Box 65 Subukia	Avocado, Pawpaw, Pear, Mulberry, Passion fruit, Guava, Grapes, Apple, Tree tomato
140	Samuel Mwenji	Nakuru	Elburgon	Gacharage	Box65Thika	Loquat, Avocado, Passion fruit, Pawpaw, Macadamia, Apple, Pear
141	Ayubu Karuri	Nakuru	Gilgil	Karunga Sukari	Box 2 Gilgil	Avocado, Custard apples, Citrus, Pawpaw
142	Kenya Nut Co.	Nakuru	Naivasha	Naivasha	Box 52727 Nairobi	Macadamia
143	Umoja SHG	Nakuru	Njoro	Mugumu	Box 2748 Nakuru	Apples, Tree tomato, Banana, Passion fruit, Avocado
144	Muhoro Muchiri	Nakuru	Bahati	Mahingo	Box 47 Kabazi	Mango, Avocado, Passion fruit, Apple, Plums

Appendix 7 Cont.

N Districts						
Number	**Name**	**District**	**Division**	**Sub-location**	**Address**	**Types of fruits**
145	JohnChegeGitau	Nakuru	Solai	Kabazi	Box 6 Solai	Avocado, Passion fruit, Tree tomato, Pawpaw, Mango, Custard apple, White sapote
146	Mwangi Mucheru	Nakuru	Bahati	Lanet	Box 7411 Nakuru	Avocado, Passion fruit, Mango
147	Naivasha Annex Prison	Naivasha				
148	Thomas M Kitumu	Nunguni				
149	Stephen Nderu	Nyandarua	Olkalau	Mawingo	Box 559 Olkalau	Guava, Peach, Avocado, White sapote, Apple, Banana, Pear, Loquat, Grapes, Passion fruit, Strawberries, Pawpaw, Mulberry, Tree tomato
150	Gardenia Nursery	Nyandarua	Municipality	NdurumWard	Box 873 Nyahururu	Guava, Peaches, Avocado, Apple, Pear, Loquat, Passion fruit, Tree tomato
151	Nyahururu Prison	Nyandarua	Municipality			
152	Joseph Kahiro	Nyandarua	Kipipiri	Miharati	Box 34 Miharati	Cape gooseberry, Avocado, Apple, Pear, Passion fruit, Tree tomato
153	John Kahiro	Nyandarua	S Kinangop	Njabini	Box 138S Kinangop	Apricot, Apple, Pear, Peach, Tree tomato

Appendix 7 Cont.

Number	Name	District	Division	Sub-location	Address	Types of fruits
N Districts						
154	Joel Gathuku	Nyandarua	Ndaragua	Karangoni	Box1012 Nyahururu	Guava, Apple, Pear, Passion fruit, Tree tomato
S Districts						
155	Samuel Mwenji	Samburu	Loroki	Maralal Urban Council	Box 9 Maralal	Citrus
T Districts						
156	Mwangi Mucheru	Tharaka Nithi	Chuka	Kangondu	Box 7043	Macadamia
157	Paul Mwanqi	Trans Nzoia	Sabati	Kapkoi Sual	Box 2221 Kitale	Avocado, Manqo, Grapes
158	Elgon Orchards	Trans Nzoia	Kwanza	Chepchuma	Box 124 Kitale	Roses
159	Kitale Prison	Trans Nzoia	Kitale	Milimani	Box 94 Kitale	Avocado, Mango, Tree tomato, Macadamia
160	YWCA Mango Project	Tana River	Garsen	Box 32 Garsen	Box 52727 Nairobi	Mango
161	Manyani Prison	Taita Taveta	Voi	Ndii	Box 3 Manyani	Citrus, Mango
162	Muka Mukuu	Thika		Matunguru	Box 1281 Thika	Mango
163	Ruiru G K Prison	Thika	Ruiru	Katambaya	Box 363 Ruiru	Mango, Avocado, Pawpaw, Passion fruit, Loquat
164	Karamaini Nursery	Thika	Thika	Karamaini	Box 40 Thika	Macadamia
165	Alfred Manyeki Irigo	Taveta	Taveta	Kitobo	Box 174 Kitobo (Taveta)	Mango, Citrus, Coconut

Aooendix 7 Cont.

U Districts						
Number	**Name**	**District**	**Division**	**Sub-location**	**Address**	**Types of fruits**
166	Nigeria Prison	UasinGishu	Kesses	Chepyakwai	Box 461 Eldoret	Avocado, Apple
167	Eldoret Prison	Uasin Gishu	Municipality	Municipality	Box 824 Eldoret	
W Districts						
168	Kapenguria Prison	West Pokot	Kapenguria	Siaji	Box 10 Kapenguria	Apple, Avocado, Passion fruit

Source: Horticultural Crops DevelopmentAuthority, Jan 2002.

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