

## STATUS OF AVOCADO PRODUCTION IN KENYA

Lusike A. Wasilwa<sup>1</sup>, Joseph K. Njuguna<sup>2</sup>, Evelyn N. Okoko<sup>3</sup> and Grace W. Watani<sup>2</sup>

<sup>1</sup>**Correspondence author.** Kenya Agricultural Research Institute (KARI) Headquarters

P. O. Box 57811-00200, Nairobi

**Tel:** 020-4183301-20

**Email:** [lwasilwa@kari.org](mailto:lwasilwa@kari.org); [lwasilwa@gmail.com](mailto:lwasilwa@gmail.com)

<sup>2</sup>KARI-Thika

P. O. Box 220, Thika

**Email:** [jknjuguna@yahoo.com](mailto:jknjuguna@yahoo.com)

<sup>3</sup>KARI-Kisii

P. O. Box 523, Kisii

**Email:** [nasambu\\_okoko@yahoo.co.uk](mailto:nasambu_okoko@yahoo.co.uk)

**Mode of presentation:** Poster

**Division:** Horticulture

## ABSTRACT

Avocado (*Persea Americana* Mill.) is grown in several agro-ecological zones mainly by small-scale growers (85%) who grow it for subsistence, local markets and export. Although Kenya has about 7,500 ha under avocado production yielding 81,000 t, about 30,000 to 40,000 t of avocado goes to waste. The objectives of this study were to establish the status of avocado production and document the impact and management of diseases economic of importance. The information was gathered mainly from secondary sources and personal communications. The results show that production doubled from about 10,000 t in 1995 to 19,000 t in 2003. Most (70%) avocado is grown in Central and Eastern Provinces. Avocado is a major export crop constituting about 15,000 t (17%) of the total horticultural exports from Kenya. Most fruit is exported to the European Union. Production is limited by several factors including pre- and postharvest handling practices, insufficient superior varieties or planting materials, poor tree crop management practices, poor roads, poor market information, pests and diseases and limited utilization. The most import constraints in avocado production in Kenya are anthracnose (*Colletotrichum gloeosporioides*), root rot (*Phytophthora cinnamomi*) and Cercospora leaf spot (*Cercospora purpurea*). Anthracnose causes over 60% losses particularly after periods of extended rainfall. To increase production, farmers should be trained on crop management, encouraged to grow varieties grafted on root rot resistant rootstocks, new high yielding varieties should be introduced in marginal areas and farmers should be trained on processing technologies.

**Keywords:** avocado, anthracnose, *Colletotrichum gloeosporioides*, root rot, *Phytophthora cinnamomi*, *Cercospora*

## INTRODUCTION

Avocado (*Persea americana*) belongs to the family Lauraceae. It is native to tropical America where it is divided into three sub-species or races i.e. Mexican (sub-tropical), Guatemalan (semi-tropical) and West Indian (tropical). Several varieties (Bacon, Booth 7, Booth 8, two strains of Fuerte from South Africa and the U.S, Hardy, Hass, Maypan, Linda, Lyon, Lula, Nabal, Puebla, Reed, Simmonds, Tonnage and Zutano) of avocado were introduced in Kenya in the 1930s by the Portuguese (Griesbach, 1985 and 2005). Commercial cultivation of avocado started in the 1960s and 23 t of avocado were exported to Europe in 1970 (Griesbach, 1985 and 2005). Griesbach (1985) reports that the national development plan of 1974 included a programme to increase avocado hectarage from 150 to 1,450 by 1982 to meet with the local and export demand. Several avocado nurseries were established in 1980 as a result exports of Fuerte, Hass and Puebla increased to 1,051 t Griesbach (1985).

A programme to evaluate avocado for adaptability in Kenya started in 1965 (Griesbach, 2005). Findings from these studies showed that the West Indian race (e.g. cultivars Hardy and Simmonds) was adapted from sea level to 1000 m; the Guetemalan race (e.g. Hass and Reed) was best adapted to areas between 1,000-2,000 m and the Mexican race (e.g. Puebla and Teague) from 1,500-2,500 m. Fruits from the Guetemalan race mature late; those from the Mexican race mature early to mid-season whereas those from the West Indian race mature early. In Kenya, avocado cultivation is concentrated in the highlands between 1200 and 1800 m.

Avocado is grown in several agro-ecological zones mainly by small-scale growers (85%) who grow it for subsistence, local markets and export (Cooper *et al.*, 2003). About 70% of avocado is grown in Central and Eastern Provinces. Central Province produces 40%, Eastern 28%, Western 13%, Rift Valley 10%, Nyanza 6 and Coast 2% and Nairobi Province 1% (MoA, 2003). The main production areas are Muranga, Kiambu, and Thika Districts in Central Province, Embu and Meru in Eastern Province, Taita Hills in Coast Province and Kitale in Rift Valley Province.

Although Kenya has 7,500 ha under avocado production yielding about 81,000 t (Table 1), about 30,000 to 40,000 t is lost to poor pre- and postharvest handling practices; limited superior varieties or planting materials, poor tree crop management practices; poor infrastructure, poor market information, pests (thrips, scales, fruit fly and systates weevil) and diseases (root rot, anthracnose and *Cercospora* leaf spot), and limited utilization (MoA, 2005). The objectives of this study were to determine the status of avocado production in Kenya and document the impact and management of diseases of economic importance.

## MATERIALS AND METHODS

Several papers and reports written between 2000 and 2006 were reviewed. The exception was a paper written in the 1980s that gave a comprehensive historical perspective on avocado production in Kenya. Some information was gathered through oral communication from Kenya Agricultural Research Institute (KARI) researchers or the Ministry of Agriculture extension staff. Secondary sources were from refereed journals, local agricultural magazines and the Internet.

Documents from KARI annual and quarterly reports were also used. This study has not gone into any depth on several issues affecting production, utilization and marketing of avocado because of limited information. Most of the information was scanty and was used to contribute to development of this paper.

## RESULTS AND DISCUSSION

**Cultivars.** Most (80%) of the acreage under avocado is planted with Fuerte followed by Hass, Pinkerton, Ettinger, Reed, Simmonds and Puebla (Mugambi, 2002). The common rootstock cultivars are Fuerte and Puebla (Griesbach, 2005). Most registered nurseries that propagate avocado in Rift Valley (31), Central (29) and Eastern (23) Provinces whereas Western, Nyanza, Coast and Nairobi Provinces have between 1 and 6 (HCDA, 2004; Griesbach, 2005).

**Production and utilization.** The world production of avocado in 2004 was 3.2 million tons mainly from North and Central America. Kenya was ranked 6<sup>th</sup> in export of avocado fruit in the world (FAOSTAT, 2004) with about 85% produced by smallholders. Avocado is therefore an important crop to rural communities and economies (Cooper *et al.* 2003). Because avocado is intercropped with vegetables (cowpeas, tomato), groundnuts, maize, sorghum or other fruit trees (banana, citrus, guava and mango), there is reduction in productivity of trees as they age. Hectarage under avocado increased by 1,293 ha (20 %) and production increased by 0.7 % while value decreased by 14% in 2005 compared to 2004 (MoA, 2005) (Table 2).

The main constraint to production in Eastern Province (Embu District) is cultivation of “traditional” varieties (pers. comm. Githingi, 2006). Farms in Kahuro Division have an average of 10 mature trees whereas those in Ndia Division have about 33 trees (Wepukhulu *et al.*, 2006). Marketing is limited and focused on the local market. Most farmers in this region are not interested in growing avocado which competes with agricultural enterprises such as coffee. To increase production, varieties that are adapted to the marginal areas should be introduced. Avocado in this region is consumed fresh or processed to produce soaps and lotions. Constraints in avocado production are diseases (anthracnose and *Cercospora* leaf spot) and drought susceptible varieties.

The hectarage under avocado in Central Province is planted with mainly Fuerte and Hass (pers. comm. Meli 2006). Farmers acquire their planting material mainly from KARI-Thika. Production constraint for this crop is mainly diseases caused by anthracnose, root rot and *Cercospora* leaf spot. Recently, Kakuzzi Limited constructed a modern horticulture produce store. The farm-gate price has increased from KES 1 to 6 per fruit, stimulating interest in this crop. Farmers have contracts with private companies such as Sunripe, VegPro and Kakuzzi Limited that export the fruit.

Avocado is not a priority crop in Western Province (pers. comm. Makheti, 2006) with only 500 ha (Table 2) under this crop (MoA, 2005). Production in western Kenya is highest in Vihiga and Kakamega Districts. The most common variety is Fuerte. Several other “old varieties” such as Puebla are used as the male plants whereas newer varieties such as Fuerte and Hass are female plants. Constraints to production include insufficient planting material and lack of technical

knowledge on crop husbandry. There are no major diseases or pests except premature fruit drop due to overbearing. Marketing in the local market (Kisumu, Eldoret and Kakamega) is not a constraint with farmers fetching KES 5-10 per fruit. Some farmers market fruits through KASSE (Resource Kenya) and Africa Now in Kisumu (pers. comm. Nungo, 2006). The fruit is also processed to get oil, soap and juice which are popular in Kisumu.

In Rift Valley Province, avocado accounts for about 8% of the total acreage under fruit production (Aloo, 2005). It is grown in 18 of 19 districts that produced 5-1700 t of avocado in 2004. In 2004, 5 (Bureti, Koibatek, Nakuru, Uasin Gishu and Trans Nzoia) of 18 districts produced over 900 t. Avocado in Rift Valley Province is grown for both local and export markets. Production constraints are pests (fruit fly, thrips, aphids, mites, scales, false codling moth and Mediterranean fruit fly) and diseases (Phytophthora root rot, anthracnose, scab, Cercospora leaf spot (*Cercospora purpurea*) and *Xyloborou morstati*) (pers. comm. Kwambai, 2006). Because a substantial amount of fruit is exported, farmers are being trained on good agricultural practice in conformance with EUREP-GAP (Euro Retailer Produce Working Group - Good Agricultural Practices) standards.

Avocado cultivation is widespread in Nyanza Province with 3-4 out of 10 households growing the fruit. It is regarded as a food security crop. Its consumption has recently increased whereby it is commonly eaten with Nyoyo (a mixture of maize and beans). Most smallholders grow Puebla and not Fuerte or Hass. Constraints are fruit drop caused by severe infections of anthracnose. In Nairobi there are various cultivars including Fuerte, Hass, Zutano, Reed, Pinkerton, Tonnage and Puebla. From 2004 to 2006 there was 30-100% anthracnose infection on susceptible avocado varieties such as Pinkerton.

**Pests and diseases.** Although avocado is produced in areas with high rainfall and relative humidity, resulting in high levels of fungal disease problems, most smallholders apply little or no pesticides against common diseases and pests. Avocado root rot is the most serious disease in Kenya (Griesbach, 2005). Several controls have been deployed including cultural (field drainage), hot water and fungicide treatment of seed, drenching the soil with fungicides Ridomil (Metalaxyl) and Aliete or injecting trees twice a week with fosetyl-aluminium. Although production constraints in North Rift have not been documented common diseases are Phytophthora root rot, anthracnose and Cercospora leaf spot (pers. comm. Kwambai, 2006).

Anthrachnose causes over 60% losses particularly during extended rainfall (Aloo, 2005). This disease has been reported in Rift Valley, Eastern, Nyanza and Central Provinces. In Embu District, most of the avocado produced in the 2005 to 2006 season had sunken lesions due to latent infection of anthracnose (pers. comm. Githingi, 2006) and Cercospora leaf spot. Cercospora fruit spot is an important fruit rotting disease causing up to 60% losses in Kenya (Griesbach, 2005). No controls measures have been undertaken by the smallholder farmers in Embu District because they cannot afford fungicides and those that can do not because there are no markets.

Little is known on the impact of anthracnose on production and income realized by small (< 1 acre) or large scale growers. Crop losses as a result of direct reduction in quantity and quality cause high rejection of export fruit. Anthracnose is a foliar fungal pathogen that also infects fruit. Efforts to control this disease are hampered by high cost of the fungicides. When environmental conditions are conducive, up to 100% yield loss can be realized. Anthracnose control measures undertaken in Kenya such as breeding for resistance are based on research conducted in other countries. There were no recommendations on when spraying should commence or frequency until a recent publication by Cooper *et al.* (2003).

Minimal research has been carried out to generate data or information that will contribute positively to the management of anthracnose. Several agronomic measures may be used to manage this disease including field sanitation (disposal of fruit mummies and dead twigs), tree management i.e. proper pruning and fertilization and application of fungicides. There is little or no information on spray regimes including rates, frequency and timing. Cultural methods such as fertilization with nitrogen have been reported to affect post-harvest susceptibility of fruits to anthracnose whereby low nitrogen levels correspond to low disease incidence irrespective of the rootstock (Lindy, 2005). Also the type of nitrogen (ammonium or nitrate based) used in tree management could predispose avocado to anthracnose. Willingham *et al.* (2001) gives the first report on the effect of a rootstock on postharvest anthracnose development. They say that Hass grafted on Velvick rootstocks had significantly lower disease than those grafted on Duke 6 because of the high nitrogen levels in the leaves.

**Research.** Research on avocado is conducted by the Kenya Agricultural Research Institute (KARI), the International Centre for Insect Ecology and Physiology (ICIPE), Jomo Kenyatta University of Agriculture and Technology and the Maseno University. The Kenya Agricultural Research Institute receives funding primarily from the Government of Kenya (GoK) and the World Bank. Research efforts are focused on characterizing the genetic diversity of *Colletotrichum gloeosporioides*, prolonging shelf-life and developing processing technologies and should also focus on meeting phytosanitary requirements for both local and international markets because this will entail the development of a research programme with projected results to minimize inputs required for production.

**Marketing and utilization.** Kenya is ranked 3<sup>rd</sup> after Israel and Mexico among avocado exporters to the European market (Griesbach, 2005). Over 60% of the Kenyan avocado cannot be marketed because their low quality emanates from poor production procedures (Chege *et al.*, 2006). Because avocado is a major export fruit crop, smallholder farmers have been forced to adopt several food safety requirements of the international community for market access. The European Union and particularly the United Kingdom have become particularly sensitive to food safety issues. Farmers in Kenya have to comply with EUREP-GAP regulations. Soon avocado farmers will have to comply with KENYA-GAP to which smallholder producers should be trained on quality, traceability and conformity while processors should be trained on Good Manufacturing Practices (GMP) and Hazard Analysis Critical Control Point (HACCP).

The major avocado export companies are Kenya Horticultural Exporters Ltd (KHE), Sunripe Ltd, East African Growers Ltd, Indu Farms Ltd, Kakuzi Ltd and Vegpro Ltd (Cooper *et al.*, 2003). The largest European Union (EU) market for Kenyan avocado is France. The main competitors against Kenya are South Africa (largest producer of avocado in 2001), Spain, Mexico, Chile, Peru and the US. The export market preference has shifted from the traditional export varieties Fuerte (80%) and Hass (20%) to new introductions like Etija and Linda (MoA, 2003). Constraints in marketing of avocado in Kenya include no coordination of fruit exports, limited funds for research on production, pre- and postharvest and product development. Smallholder farmers are not organized association (s) that could cater for their needs. Because of this it is difficult to disseminate new technologies or standards that would make them more competitive in the domestic and world markets. Since the local market for avocado is not streamlined, overproduction, results to low prices and wastage during peak harvesting period. Better marketing tools should be used to promote avocado utilization including campaigns on the radio, television, hospitals and billboards.

Despite multiple uses of avocado including cosmetics, healthcare products, use as a fine lubricant or fuel oil, in Kenya, most avocado is consumed fresh or exported. The domestic consumption of avocado is about 1-2 kg /person/year and is on the increase as the population is sensitized of its nutritional aspects. The high protein (2-4%), minerals (1-2% of K, Mg and S), anti-oxidant (Vitamin E) and oil content (20-30%) of avocado contribute positively to the health of those that consume it (Griesbach, 2005; Njuguna, 2005). Activities that promote utilization of avocado in HIV/AIDS management will also be an added plus considering that about 17% of the population has this disease.

## **CONCLUSIONS**

Avocado is grown widely in several agro-ecological zones and several provinces by mainly by small-scale growers (85%) (Cooper *et al.*, 2003). About 70% of avocado is grown mainly in Muranga, Kiambu, Thika, Embu, Meru, Taita Hills and Kitale. Although the crop has a high potential in Nyanza and Western Provinces, its cultivation remains unexploited. Although Kenya produces over 81,000 t of avocado fruit, production is constrained mainly by fungal pathogens, insufficient recommended planting material, lack technical knowledge on crop husbandry and poor infrastructure that lead to 30,000 to 40,000 t loss. Despite these losses, avocado constitutes of about 17% of the total horticultural exports from Kenya or 15,000 t valued at KES 900 million (MoA, 2005) (Table 3).

## **RECOMMENDATIONS**

To increase production, new high yielding varieties should be introduced; farmers should be encouraged to grow varieties grafted on root rot resistant rootstocks, trained on crop management and processing technologies. The effect of nutrition on susceptibility of avocado to anthracnose should also be investigated.

## **ACKNOWLEDGEMENT**

The authors would like to acknowledge all those without whom this paper would not have been written in particular Ms. Judith Aloo for her detailed report on avocado production in Rift Valley

Province. We would also like to thank Mr. Meli (PDA Central), Ms Mary Githinji (DAO Embu), Mr. Philip Makheti (PDA Western), Mr. Thomas Kwambai (KARI-Kitale) and Ms. Rhoda Nungu (KARI-Kakamega).

## REFERENCES

Aloo, J. 2005. Information on avocado and passion fruit in Rift Valley Province. Ministry of Agriculture. Personal communication.

Chege, B. K., Waturu, C. N., Wepukhulu, S. B. and Mbaka, J. N. 2006. Prolonging avocado shelf life using ethylene synthesis inhibitor, 1-Methylecyclopene. 10<sup>th</sup> KARI Scientific Conference. Nairobi, Kenya.

Cooper, J., Dobson, H., and Orchard, J. 2003. Avocado production protocol- a document in consultation with avocado growers and exporters in Kenya. Natural Resources Institute. University of Greenwich, UK. 63 pp.

FAOSTAT. 2004. Global avocado production. <http://fasostat.fao.org/faostat>

Githinji, M. 2006. Avocado production in Embu District. Ministry of Agriculture. DAO Embu.

Griesbach, J. 1985. The avocado industry in Kenya. Acta Horticulturae. International Society for Horticultural Science. Vol. 158.

Griesbach, J. 2005. Avocado growing in Kenya. World Agroforestry Centre (ICRAF). Kul Graphics Ltd. Nairobi, Kenya

Horticultural Crops Development Authority (HCDA) Export Statistics. 2004

Kwambai, T. 2006. Avocado production in the North Rift. KARI-Kitale

Lindy, C. 2005. Responses in tropical fruit to Colletotrichum. <http://www.tpp.uq.edu.au/disease/research/SP23C.html>

Makheti, P. 2006. Avocado production in Western Province. Ministry of Agriculture. PDA Western.

Meli, J. 2006. Avocado production in Central Province. Ministry of Agriculture. PDA Central.

MoA, 2000 to 2005. Horticulture Division Annual Reports. Ministry of Agriculture: Nairobi, Kenya

Mugambi, D. M. 2002. Market status of avocado and associated products in Kenya. RELMA Working Paper No. 12. RELMA, Nairobi, Kenya.

Wasilwa et al. Status of avocado production in Kenya

Njuguna, J. 2005. Avocado: A leading export fruit crop in Kenya. Farmers Pride. October issue

Nungo, R. A. 2006. Avocado production in Vihiga and Kakamega Districts. KARI-Kakamega

Wepukhulu, S. B., Njuguna, J. K., Kamau, M. W. and Chege, B. K. 2006. Statistical assessment of avocado production survey in Embu, Kirinyaga and Muranga Districts of Kenya. 10<sup>th</sup> KARI Scientific Conference.

Willingham, S. L., Pegg, K. G., Cooke, A. W., Coates, L. M., Langdon, P. W. B. and Dean, J. R. 2001. Rootstock influences postharvest anthracnose development I Hass avocado. Australian Journal of Agricultural Research. 52:1017-1022.

**Table 1.** Summary of avocado production in Kenya

Year	Hectarage	Production (t)	Value
2002	4,880	52,431	464,961,740
2003	5,099	70,948	558,379,555
2004	-	-	-
2005	7,414	80,851	609,230,641

**Source:** Horticulture Annual Reports (MoA 2003 and 2005)

**Table 2.** Production and productivity of avocado in Kenya

Year	Eastern	Western	Central	Rift Valley	Nyanza	Coast	Nairobi
<b>Hectarage</b>							
2000	1,241	593	1,232	451	493	74	35
2001	1,295	609	1,463	414	543	80	30
2002	1,334	633	2,031	483	282	82	35
2003	1,355	648	1,980	638	327	97	54
2004	1,462	651	2,032	643	1,474	101	58
2005	1,770	554	2,175	1,979	1,107	120	10
<b>Production</b>							
2000	15,232	5,872	18,090	4,792	7,357	544	140
2001	17,030	6,041	21,615	5,004	3,826	640	240
2002	17,909	6,078	16,540	6,709	4,265	650	280
2003	18,162	6,420	25,198	8,480	11,619	649	420
2004	17,661	6,560	25,538	8,155	21,061	890	451
2005	19,200	6,447	25,277	9,169	19,538	1,200	20
<b>Value (KES)</b>							
2002	122,132,100	55,960,660	83,882,240	127,830,740	57,900,000	13,000,000	4,256,000
2003	90,165,000	57,528,000	135,143,000	122,575,555	133,500,000	12,976,000	6,492,000
2004	140,728,000	58,782,505	148,520,000	95,910,976	245,590,000	13,380,000	6,972,000
2005	152,991,201	54,470,000	150,094,000	120,035,000	106,400,000	18,040,440	7,200,000

**Source:** Provincial Reports (MoA 2000 to 2005)

**Table3.** Statistics for avocado fruit exports from Kenya

Year	Volume (kg)	Value (KES)
2000	10,716,113	-
2001	15,372,674	-
2002	12,889,807	682,745,535
2003	19,020,028	892,871,043
2004	15,960,150	1,024,941,272
2005	15,242,756	873,296,576

**Source:** Horticultural Crops Development Authority (2000-2005)