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DIAGNOSTIC MISSION TO DETERMINE CONSTRAINTS TO PRODUCTION AND EXPORTATION OF HIGH QUALITY FRUIT (PASSION FRUIT, PHYSALIS AND APPLE BANANA) FROM RWANDA

ADAR RWANDA AGRIBUSINESS DEVELOPMENT ASSISTANCE

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A Task Order under the RAISE IQC Rural and Agricultural Incomes with a Sustainable Environment

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EXECUTIVE SUMMARY

Rwanda has a good chance of entering into and becoming competitive in the EU and other international fresh fruit markets, particularly with its passion fruit, physalis and apple banana. Much needs to be done, however, in the way of training activities to bring both fruit producers and exporters up to a level where they can reliably produce and prepare air shipments of fruit of the quality demanded.

On the side of the passion fruit producers, disease and pest management, along with pruning and improved trellising techniques need to be introduced and adapted quickly in order to avoid a situation where pest and diseases have risen beyond a manageable level. For both the producers and exporters, information on appropriate harvest and post harvest handling techniques needs to be made available, and put into practice in order to ensure fruit exported meet the quality standards of the EU market.

Physalis producers similarly need training on simple techniques to improve the proportion of export quality fruit which they could produce. For all crops, longer term improvements could be achieved through selection and multiplication of superior plant varieties, perhaps in conjunction with setting up nurseries specialized in the production of the high quality and disease free seedlings.

Given that the European market is looking for new sources of passion fruit, and that Rwandan fruit products have the added attraction of being produced without any pesticides, this is an opportune time for exporters to enter into the EU market. They must be certain that the quality of their product meets the standards required before attempting to send shipments to importers. The market is demanding and unforgiving and if only one shipment of poor quality fruit is sent out from Rwanda, the entire country's reputation for production of acceptable quality produce is at risk.

1. INTRODUCTION

The Chemonics/ADAR project in Rwanda, with support from USAID, has been working on revitalizing the agribusiness private sector in the country through several initiatives. One has been providing assistance to Rwandans involved in exporting fresh fruit, namely passion fruit, physalis and apple banana, to the EU. Samples of fruit sent to potential importers in EU countries were found to be of poorer quality than is required by the EU consumer. In an attempt to determine what factors were contributing to the low quality of fruit produced and sent to the EU, I traveled to Rwanda from March to April 2002 where I visited sites of fruit production and, where possible, packaging for export. Most of the time was spent investigating passion fruit, as several requests had come from importers looking for an alternative supplier of this commodity (the primary sources in Africa being Zimbabwe and Kenya). For all three commodities, problem areas were identified and, where possible, interventions recommended.

2. CONSTRAINTS TO PRODUCTION OF EXPORT QUALITY PASSION FRUIT IN RWANDA AND SUGGESTED CORRECTIVE MEASURES

1. **Lack of any regular, organized pruning (or other management) of vines, with following results**:

- Growth of vines proceeds naturally, producing dense canopy, particularly around top and vertical poles of trellis; this creates humid conditions favoring disease development and prevents growing fruits from receiving adequate exposure to sunlight which is necessary for good color (anthocyanin) development
- Young fruit are often left to grow in close proximity to vines and/or trellising poles, which predisposes them to developing scars (not acceptable for export grade) when blown against them by wind
- Vines are allowed to trail on or close to the ground, where they are more likely to be attacked by disease; fruits on these lower vines are regularly observed to have disease symptoms starting from early stages of development
- Diseased plant parts are rarely pruned out, and their presence within the canopy only serves to further disseminate disease

Corrective measures:

- Pruning from early stage to leave only 2-4 central leaders which are trained up the trellis
- Regular "combing" of vines to prevent their becoming entangled.

- Regular removal of old, unfruitful vines (i.e. those which have already produced fruit); this will both clear out unnecessary and unwanted plant material, and stimulate the growth of new vines which will bear fruit

  Using seedlings grown in plastic bags/pots rather than those grown in seed beds; the former produce less profuse branching when transplanted, and therefore are easier to prune and train from the start

2. Failure to follow good hygiene practices

- It is the RULE rather than the EXCEPTION to find new plantations of passion fruit being established in close proximity to old, infected and infested ones. Pests and diseases readily move from the latter to the former, which makes pest and disease management all the more difficult. Plants attacked at a young stage are much less resistant, and if attacked their productivity will be low and of poor quality.[1]
- Diseased/infested plant materials (from leaves and vines to fruit) are simply left in plantations, rather than being removed and destroyed elsewhere; the resulting pool of disease inoculum/pests builds up within the plantation, and levels of infection/infestation rise accordingly.
- There is no use of a disinfectant (e.g. chlorine solution) on the tools used in the plantations. Diseases, especially ones which easily transmitted by mechanical means such as Woodiness Virus, are therefore spread not just from one plant to another within a plantation, but most likely between plantations. Producers do not seem to be aware of the danger of carrying pests and diseases with them (on clothing, hands, etc.) when moving from one plantation to another.
- While producers claim they rotate land to other crops for a few years after uprooting a passion fruit plantation, I suspect they may be reducing the period between passion fruit plantings, and may be tempted to abandon this practice altogether if they believe they can make good money from passion fruit. Lack of an adequately long rotation period results in pest and disease levels rising very quickly, in addition to impoverishing the soil (given that rotation to leguminous crops is necessary to maintaining soil fertility). Once nematodes and diseases such as *Fusarium* are in the soil, the land may become permanently unsuitable for passion fruit production.
- Plants which serve as alternate hosts to passion fruit pests and diseases (e.g. members of the Cucurbitaceae family) are allowed to grow among and/or in close proximity to passion fruit. They may serve as a reservoir of inoculum for Passion fruit Woodiness Virus (PWV), for example, which can easily be transmitted to nearby passion fruit.

[1] Several farmers visited in the Kigali North area commented that in the past they had been able to harvest fruit from their plantations for up to four years after planting, but that now they find the plants are not productive after just two years; this is a strong indication of the rapid build up of pests and diseases with the expansion in passion fruit production, which could well render passion fruit production a non-viable enterprise in the near future unless control measures are taken.

Corrective measures:

- Situate new plantations at locations distant from existing plantations; where possible, plant a physical barrier such as napier grass around plots (this will also create a favorable environment for natural enemies of crop pests, and help to stabilize the soil). It might help to remind producers that they will have more profitable operations if they take measures to improve the QUALITY of the fruit they produce, rather than putting so much effort into expanding their plantings in order to produce larger quantities.
- Regular scouting followed by removal of infected/infested material from plantations (including uprooting severely affected plants), and destruction of the material (e.g. by burning) at a location outside of the plantation. Removal and destruction of all plant materials cut during pruning operations.
- Introduce the practice of disinfecting tools used in the plantation, and impress upon producers the importance of working first in their younger plantings, then moving along to the older plantations during a given day in the event they have several plantations going at the same time. Explain that their clothes, shoes, and hands can easily carry diseases, insects and other pests from one plantation to the other.
- Ensure all growers cover the soil of their plantations with a thick mulch of organic matter; this will reduce the splash of soil borne diseases up onto passion fruit plants, along with favoring the development of beneficial soil micro-organisms which can aid in suppressing disease. Where thrips are a problem, the mulch helps to suppress their development as the pupation stage is in the soil, and the mulch prevents a physical barrier to the emergence of the larvae.
- Encourage producers to practice a sufficiently long period of rotation between passion fruit plantings, and emphasize the importance of including legumes in the rotation scheme. When uprooting old passion fruit plants, check roots for signs of nematodes and diseases such as *Phytophthora*. In the event nematodes are found, the rotation period should be extended to include a nematode suppressive species such as red sunhemp or *Tagetes*.
- Regularly scout for and remove all alternative hosts of passion fruit diseases, such as any member of the cucurbit family.
- Encourage producers not only to select their seed from healthy mother plants, but to improve their seedling production practices, e.g. using adequate spacing in the seed beds (if they cannot be convinced to grow them in bags/pots), roguing out seedlings which show any signs of infection/infestation as soon as they are spotted, etc.
- For large insects such as stinkbugs (*Bagrada* species), hand removal of the pests can effectively reduce numbers if practiced regularly.

- Suggested (but not yet tested in Rwanda) methods of insect management: *Annona* seed/leaf extracts for aphids, caterpillars, fruit fly; *Tephrosia* [2]leaf extract for aphids, spider mites; tobacco (leaf+stalk) extract for insects in general (including thrips) and spider mites.
- Suggested (not yet tested) disease control measures: For soil borne diseases in the nursery: sprays of castor bean oil and ash; for Anthracnose, sprays of cow urine; for virus, preventative sprays of *Capsicum fructescens* fruit extract (effective against TMV infection, no information on effectiveness for PWV).

3. **Improve trellising: the currently used all-wooden structures have several disadvantages**:

- The use of rough poles, often with dead twigs, branches and leaves still attached, presents a large surface area on which developing fruit are wounded when blown or knocked against same, creating scars which render the fruit unmarketable.
- The structures are unwieldy to work with; it is difficult to achieve the desired growth pattern of carefully trellised and untangled vines hanging freely from the supporting structure.
- When the vines become heavy, the trellis is unable to support the weight and starts to sag (at the least) or falls down entirely.

Corrective measures:

- Introduce, where possible, use of galvanized steel fencing wire for the horizontal support.
- Where trellises are comprised entirely of wooden poles, ensure they are first trimmed of all branches, leaves, and other extraneous material which could come into contact with the fruit during its development and cause scarring.
- Rather than first constructing the trellising system, and then planting the seedlings, have growers use single (narrow, e.g. bamboo) poles to initially train the vines, and construct the trellising system around the established plants.

[2] The leaves are also very useful as mulch/green manure.

3. HARVEST AND POST HARVEST HANDLING OF PASSION FRUIT: ISSUES WHICH NEED TO BE ADDRESSED IF EXPORTERS ARE TO SUCCEED IN MEETINGS THE STANDARDS OF EU AND OTHER INTERNATIONAL MARKETS

3.1. The current situation

Several practices currently used by producers and sellers of passion fruit are resulting in high post harvest losses amongst those fruit which might otherwise be exportable. The most important of these are as follows:

1. NO/little selection of fruit is practiced at harvest, with result that diseased, under-ripe, over-ripe and blemished fruit are mixed together with the small proportion which could meet export grade, if handled properly.
2. Fruit are not handled carefully during harvesting and transport to the collection center, either with regard to preventing mechanical damage or protecting them from exposure to high temperatures. They are packed into very large sacks for transport, where a great deal of mechanical damage results; this consists of both scraping the surface of the fruit, leaving a scar, and bruising which can lead to internal damage. Fruits are sometimes harvested into black polyethylene bags, and not protected from the sun, resulting in rapid temperature increase inside the bag, which hastens the ripening process and therefore reduces the potential shelf life of the fruit.
3. Fruit delivered to a collection point are stored in rooms with no/inadequate ventilation, and in at least one instance where mold was found growing on the walls and ceiling. Storage and sorting rooms have unprotected (uncovered) light bulbs, which present the risk of breaking and leaving pieces of glass in amongst the fruit (NOT allowed under export standards).
4. The peduncle of the fruit is not normally removed, or in rare cases removed by pulling it out (leaving a wound in the fruit, and at times a suture around the attachment point) or cut with scissors (similarly having an undesirable pulling action).

3.2. Suggested methods to improve the harvesting and post harvest handling of passion fruit so as to meet export standards

1. Appropriate **selection of fruit at harvest**: criteria are
   - Fruit medium purple in color, free from disease, insect damage or blemishes
   - Texture (when squeezed) is firm
   - Fruit intact (therefore do not pull peduncle off of fruit at harvest)

- Fruit which do not meet these criteria must NOT be collected together with fruit destined for export

2. Careful handling of fruit from harvest through transport to collection point to sorting and packing into boxes: **ALL THOSE HANDLING FRUIT, FROM HARVESTING TO SORTING AND PACKING MUST BE TRAINED TO AVOID SCRATCHING, BRUISING OR OTHERWISE INJURING FRUIT. THE SKIN IS EASILY BROKEN, AND RESULTING WOUNDS ARE NOT ACCEPTABLE**. Specific suggestions:
   - At harvest, place into containers which will not abrade surface. Pack only small quantities of fruit into harvesting container to avoid having fruit crushed. Avoid letting heat build up inside harvest container by regularly emptying into transport container placed in shade, and preferably with some sort of moistened material over top to provide evaporative cooling.
   - If fruit is carried on top of the head down to collection point, container should be one which prevents/minimizes bruising and other damage to fruit from physical movement. Carrier should avoid jolting movements which increase potential for fruit damage. Some sort of protection of fruit from sun should be employed (eg moistened jute or other material placed over container)
   - When emptying fruit from transport container at collection center, do so in a manner which prevents fruit from dropping onto surface which can lead to wounds. A slow, "pouring" action is preferable to a quick "dumping". Surface of container into which fruit are placed should be free from rough patches, splinters, nails, or other structures which can damage fruit. It is also important to clean surface with a chlorine solution in between batches of fruit in order to reduce the level of storage pathogens.

3. Selection **of only export quality fruit** before putting into boxes:
   - Cut peduncle with sharp knife, taking care not to wound fruit (or self!).
   - Sort fruit according to uniformity of color, size and (to lesser extent) shape.
   - REJECT fruit with the following: pests, diseases, wounds of any sort, signs of dehydration. Soiled fruit are also not acceptable; wash carefully in 10% solution of household bleach.
   - Do not under or overfill boxes: individual fruit should not be allowed to move with respect to each other or to the wall of the package in order to avoid vibration injury, and the package should be full without packing too tightly, which increases compression and impact bruising.
   - Handle boxes carefully once filled to avoid damaging fruit.
   - Room in which fruit are stored and/or graded and packed must NOT have unprotected lights, and there should be adequate ventilation (signs of mould on walls and ceilings are

unacceptable). Avoid locations where fruit might be exposed to smoke or fumes from engines (these will trigger ethylene production and thus hasten ripening, reducing fruit shelf life).

Note: It would be advantageous to sort and pack fruit into boxes as quickly as possible after receiving them, then to store boxes in a cool, well ventilated place until put onto truck for transport to airport. Conditions of high humidity are advisable as long as boxes do not absorb significant amounts of moisture, thereby losing their structural stability.

4. Load the boxed fruit onto trucks for transport to airport carefully, avoiding dropping/throwing/kicking, or any other rough sort of handling. Loading should be done early in the day while temperatures are still cool. If there is a chance of rain, the boxes must be protected from the rainfall (wet boxes not only will not withstand the pressure, but are conducive to disease build up in transit).

4 . CONSTRAINTS TO PRODUCTION OF PHYSALIS FOR EXPORT IN RWANDA AND SUGGESTED METHODS TO ALLEVIATE THESE CONSTRAINTS

1. Plants are not trellised, but left with many of the branches sprawling on the ground which leads to the fruit calyx being soiled (such fruit cannot be exported) and predisposing the plants to infection from soil-borne diseases. Where a heavy mulch covers the soil, these problems are reduced to a considerable extent; however, further benefits would be realized from lifting the branches off the ground with a trellising system.

    - Suggested system: poles (eucalyptus, for example) of ca. 2-3 cm diameter and 1 m height put into the ground at every 4 m, and a pair of strings or wires (one on each side of the pole) attached at 40 and 80 cm above the ground; plants are trained between the strings/wires

2. "Volunteer"[3] plants of Irish potato, with which physalis shares some disease and pest problems, are often found in physalis plantings. Volunteer physalis plants (from fruit dropped by previous plantings and/or compost applied to the fields) are also a frequent occurrence and may also serve to spread disease to the crop plants. Fields need to be scouted regularly for these volunteer plants which should be dug up (in the case of potatoes), removed and destroyed.

3. Production of seedlings in nurseries needs improving: the current practice is to sow the seeds thickly, which results in (a) greater likelihood of diseases which cause damping off, (b) weak,

[3] Volunteer plants are crop plants which are not intentionally planted, but which arise in fields because planting material (seeds or, in the case of potatoes, tubers) has been left or disseminated by birds, etc., in a field where it is not desired.

etiolated seedlings which have a lower success rate at transplanting, and require much longer to recover and commence growing and (c) wastage of seed. Sowing the seed at regular spacing in rows, perhaps with the aid of a marked stick or string (e.g. notches/colored spots at every 2-3 cm) used as a guide has worked well for production of tomato and other vegetable seedlings in other African countries, and is recommended for physalis producers in Rwanda.

4. Splitting of fruit during the heavy rains; this results from fluctuations in soil moisture, and rapid uptake of water by the plant (including fruit) following heavy precipitation (usually preceded by a dry spell). Applying a heavy mulch of organic material to the soil (e.g. dried grass, leaves) helps to reduce soil water evaporation, and incorporating more organic matter into the soil prior to planting the crop increases its water holding capacity. These measures will not prevent fruit splitting from occurring, but will help to maintain a more even soil moisture regime and therefore reduce the proportion of fruit so affected.

5. A fungal pathogen, Entaloma leaf spot, which can also affect the fruit calyx, making the fruit unsuitable for export, was observed in numerous physalis fields. Good field hygiene (removing infected plants, situating new plantings at a distance from older ones, preferably with windbreaks or other physical barriers to separate them) along with proper spacing of the plants, and good weeding to reduce humidity build up within the plant canopy are recommended.

6. Occasional infestation of physalis fruit by *Helicoverpa* (bollworm); this pest can easily spread if not controlled by scouting for, removing and destroying infested fruit. Preventative measures include growing marigold plants as trap plants in the field (plant at same time as physalis so that has reached 40+ day stage before physalis becomes attractive to insect), planting species that host beneficial insects around (if perennial) and in crop fields, and rotation with non-susceptible crops. For infested fields, sprays of pyrethrum and *Tephrosia* may provide some control; these should be directed particularly at the flowers and young fruits.

7. Physalis fruits can be eaten by birds while they are still on the plant. This was observed in one farmer's field only, however, so bird damage to fruit doesn't appear to be a widespread problem. Setting up scare crows or having human "bird scarers" should be tried in the event bird damage to fruit becomes serious.

Note of interest: A variety of physalis with excellent fruit quality characteristics was found growing in Butare by one M. Philippe Tugambire; he had purchased the seed in Bujumbura from a commercial seed dealer. Seed samples have been collected and should be tested in other parts of Rwanda.

- Production of physalis seed from selected plants needs to be conducted in isolation (from other physalis plantings) as this species is very popular with bees, and a high percentage of outcrossing can be anticipated.
- Extraction of seed from physalis fruit (for use as planting material) is recommended as follows:
- Squeeze contents of the fruit into a clean container; washing out the inside of the fruit with a small amount of water will help to remove all the seeds.
- Let the seed/pulp/water mixture ferment at ambient temperatures for 2-4 days.
- Separate the seed from the mixture using filter paper and several washes with water; allow the washed seed to dry completely before packing it into containers for storage.

Harvest and Post Harvest Handling Issues

As no harvesting or post harvest operations have been observed, it is not possible to make any comments at this point.

5. CONSTRAINTS TO PRODUCTION OF APPLE BANANA FOR EXPORT IN RWANDA, AND SOME SUGGESTIONS FOR ALLEVIATING THESE CONSTRAINTS

- Overall, the banana plantations visited revealed few problems insofar as apple banana is concerned. Bunches which had not been enclosed in plastic bags at the appropriate time (and therefore left exposed) were found with symptoms of a disease which may be Speckle Spot (*Deightoniella torulosa*) which is "rarely a serious blemish" according to one reference.[4] This is only a problem during the rainy season, and appears to have no significant effect on production. Rats sometimes get into the plastic bags around bunches, and sometimes the bags are broken open by strong winds; otherwise, no other production problems were mentioned.
- Banana plantations do not receive applications of manure after the initial field preparation, and although a thick mulch of organic matter (primarily old banana plants) is regularly applied to the soil, the plants might benefit from some additional nutrients. Ideas discussed were "manure teas" made from poultry, rabbits and other small animals (cattle not being abundant in the area) and planting sunhemp as a green manure.

Harvest and Post Harvest Handling Issues

No harvesting , grading or packaging operations were observed; one exporter's storage facilities were visited where bananas were found stored in the same room as passion fruit. This is highly undesirable as the high rates of ethylene production by passion fruit would hasten ripening of the bananas, and reduce their shelf life considerably.

[4] Tropical Fruit Diseases Compendium, The American Phytopathological Society. 1994.

6. CONCLUSIONS

Exports of fresh passion fruit from Rwandan to EU markets has the potential to become a profitable venture, but the production and harvest/post harvest handling techniques currently employed must be improved if it is to become a reality. Of particular concern are the high levels of disease found in many plantations, and the absence of appropriate production practices to bring diseases down to a manageable level. Immediate intervention in the form of disease and pest management training for passion fruit producers is essential if successful and sustainable exportation of the fruit to EU markets is to occur.

Passion fruit producers also need training on improved trellising and pruning techniques, with a focus on improving the quality of fruit produced, rather than the quantity. Similarly, producers and those involved in fruit export need training on proper harvest and post harvest handling practices to maintain fruit quality through to its delivery to the airport. Production of simple "fact sheets" and/or training manuals in Kinyirwanda, which provide much of the information in a visual form (i.e. drawings, photographs) would be an essential part of the above training programs, and would allow for dissemination of the information to a wider audience. Providing trainees with hard copies of the most important information along with follow up support need to be part of the training if it is to have a long term impact.

In order for passion fruit production in Rwanda to become both profitable and sustainable over the long term, selection of plants with desired qualities (disease resistance, superior fruit, etc.) should be undertaken and these varieties multiplied in and disseminated from nurseries so as to make them available to the more progressive producers, who can make the most use of the improved varieties. In all cases, it is essential to impress passion fruit producers and exporters with the importance of increasing the quality of the fruit, rather than the quantities harvested.

Production of physalis and apple banana for export appear to be less problematical, although this could change if production were expanded to a large scale, as has occurred with passion fruit. Physalis producers would benefit from training on production techniques which could improve the proportion of export quality fruit, for example by employing trellising systems and improving seedling production. For apple banana, the critical issues appear to be ensuring the fruit bunches are covered with a plastic "sachet" in time to prevent disease infection of the bunch during the rainy season, along with perhaps providing plants with supplemental nutrients in the form of green manures and manure "tea". Both of these commodities might benefit from improved harvest and post harvest handling, and this should be investigated at some point in the near future.

ANNEXES

ANNEX 1: PHOTOGRAPHS OF PASSION FRUIT, PHYSALIS AND APPLE BANANA PRODUCTION AND MARKETING ACTIVITIES IN RWANDA

Photograph 1. The growth pattern produced by passion fruit plants not provided with proper pruning and training. Note the dense foliage, which is conductive to high humidity conditions within the canopy, favoring development of diseases such as Alternaria Brown Spot and Anthracnose.

Photograph 2: Developing fruit positioned close to trellising pole, which often results in scaring, which is unacceptable on the export market.

<u>Photograph n° 3</u>. Passion fruit roughly trellised to eucalyptus pole (branches and leaves still attached) with vines trailing on the ground.

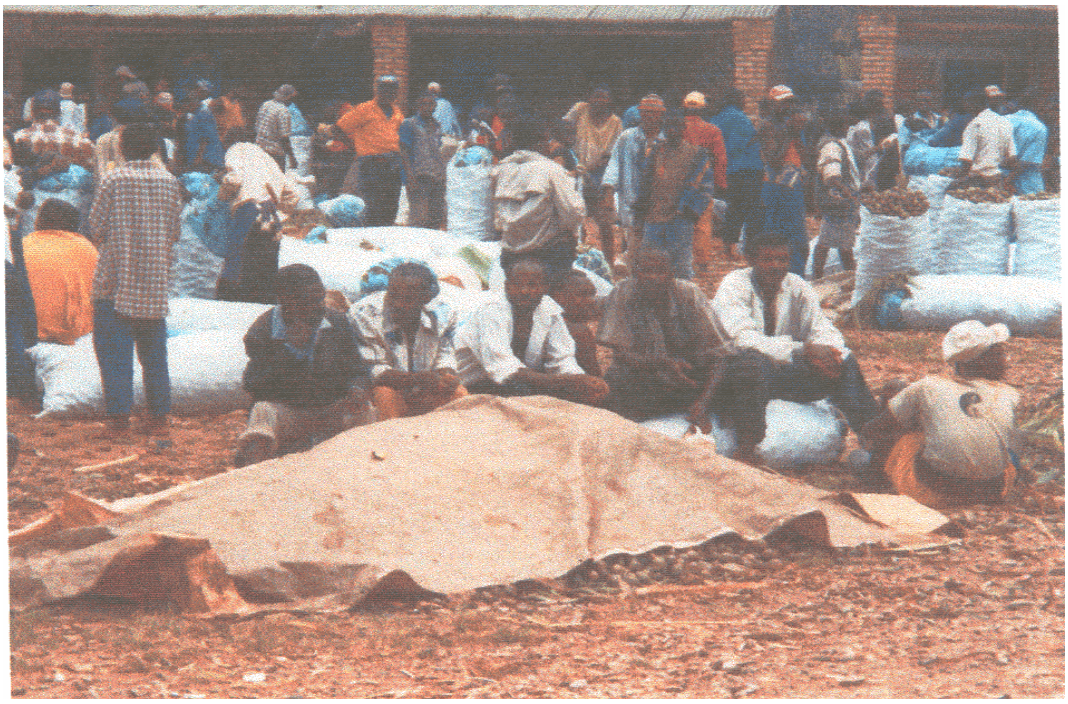
<u>Photograph n° 4</u>. Brown spot (*Alternaria passiflora*), a serious fungal disease affecting passion fruit leaves, stems and fruit.

Photo n° 5. Anthracnose (*Calletotrichum gloeosporioides*). Infection usually occurs where vines have been damaged or cut; anthracnose starts with death of tissue near the wound which later spreads down the plant, causing its death.

Photograph n° 6. Septoria blotch (Septoria passiflorae) ; this fungus attacks leaves ; stems and fruit. Even a light infection results in defoliation and premature fall and loss of fruit.

<u>Photograph n° 7</u>. A severely disease infected passion fruit plantation, a site which will become common in much of Rwanda's passion fruit production area if measures are not taken to improve crop management overall and disease control in particular.

Photograph n°8: An exemplary passion fruit plantation; note well spaced plants, with training of vines along the trellis poles, a thick layer of organic matter as much, and grass planted at the bottom to hold the soil against erosion.



<u>Photograph n° 9</u>. Passion fruit being sold at a market in Gasiza (Kigali-North), primarily for export to Uganda. Fruit handled in this manner (packed into large bags, with no cooling facilities, etc.) is suitable only for processing.

<u>Photograph n° 10</u>. Physalis plants growing without any system of raising the branches up off of the ground. Although the thick mulch present will reduce soiling of fruit, it does not prevent it entirely. Moreover, soil-borne disease can more readily infect such a plant.

<u>Photograph n° 11</u>. Volunteer Irish potato growing in a field of phyisalys; being related, pest and disease problems of the potato can often attach pyysalis as well.

<u>Photograph n° 12</u>. Physalis fruit which has split open following heavy rainfall. Reducing fluctuations in soil moisture by covering with a thick mulch, and incorporating more organic matter into the soil prior to planting both help to diminish the number of fruit which will split open after heavy rain.

<u>Photograph n° 13</u>. Entalona leaf spot, which can also affect the calyx, making fruit unsuitable for export.

<u>Photgraph n° 14</u>. Infestation of physalis fruit with *Helicoverpa* (bollworm). Fields should be regularly scouted for infested fruit which must be collected and destroyed to keep this pest from spreading.

<u>Photograph n° 15</u>. Bird damage to physalis fruit in the field. Setting up scare crows might deter birds from venturing into the field.

Photograph no. 16. Storage of apple banana (destined for export) together in the same room as passion fruit, a practice which hasten the ripening and greatly reduce the shelf life of the bananas.

ANNEX 2: TRIP REPORT FROM VISIT TO VEGPRO KENYA LTD. AND KAKUZI ESTATE PASSION FRUIT FARM

TRIP TO VEGPRO KENYA LTD – 5 APRIL 2002

A.D. TURNER

Technical Issues Discussed:

- There is no need for Sina to weigh the boxes of passion fruit; if they are full to capacity, even if underweight it is better NOT to add more fruit as this will most likely result in crushing of the fruit in transit. Aim for 48-54 fruits/box, and avoid overfilling.
- Plastic box liners were given for trial purposes; if we find higher incidence of disease (molds, etc) in boxes with vs. those without liners after a shelf life test, then may be best not to use them.
- It is important that a reliable carrier be used for shipping the fruit; if by using DAS for the first shipment, there is a risk of delayed/no flight, then Vegpro would prefer to wait until a more reliable carrier is operating out of Kigali. There is no real urgent need to get the first shipment off; quality of the product when it arrives in the EU is of paramount importance.

Packhouse visit with A. Nkundayezu and G. Sina

Main issues covered:

- Strict hygiene standards employed throughout the packhouse – even those working in the room where the cartons are assembled are required to wear protective clothing (hair nets, jackets). Regular cleaning of floor and sorting tables, care taken to prevent waste material from ending up inside the shipped products.
- Labeling system for incoming produce so that it can be traced back to the grower, if need be
- "Spec"sheet filled out for each incoming batch of produce, wherein quality factors are noted (pest, disease, bird or rodent damage, bruising or other mechanical damage, size and shape, freshness, presence of extraneous matter, etc.)
- Photographs suspended over packing tables of what packed product should look like (similarly photographs of passion fruit according to grades, and boxes filled with uniform fruit could be posted in Rwanda fruit packaging areas)
- Shelf life tests: To apply to the Rwandan situation, for each shipment 1 – 2 boxes of packed fruit should be selected at random,put aside and held at ambient temperatures to monitor changes in quality over (for example) a one week period. Could be useful in the event of a claim by the importer that fruit delivered were of substandard quality.

- "Broken Glass" and Blood Spillage" policies: modified versions of these procedures should be drawn up and posted in Rwandan packhouses. Key points to follow are:
    - **a.** For broken glass: all packhouse operations in area are stopped, workers vacate the area, any products which are/might be contaminated (within a 10 m radius area) are removed and discarded, all tables and the floor area are cleaned throroughly and the area inspected before work is resumed.
    - **b.** (b) For blood spillage: all packhouse operations in the area are stopped, those affected by the blood spillage are sent for first aid, all affected produce is discarded, the affected area (including equipment) is washed and disinfected, all persons coming into contact with the spilled blood should report to the hygiene manager. Work in the area is not to be resumed until it has been inspected by the health/Quality Assurance manager.
- Any water used to wash fresh produce must be potable (from borehole, and treated with chlorine and uv radiation in the case of semi-processed products).

Technical Issues Discussed:

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Visit to Kakuzi Estate (Horticulture Division), Richard Collins, Director – 6 April

Points of particular interest insofar as Rwandan passion fruit exports:

- An important advantage of Rwandan passion fruit over Kenyan: EU buyers require strict control of and record keeping on all pesticides used, and Kenyan producers seem to require considerable pesticide (insecticide) applications to control thrips, leaf miner and to some extent mealy bugs in their passion fruit[5]. Kakuzi appears to regularly lose otherwise exportable fruit due to their being harvested before the "spray to harvest interval" has elapsed. Rwandan "pesticide free" fruit not only require far less documentation to be submitted to the buyers, but more be more attractive to EU buyers, especially if sold under a "pesticide free" label[6]
- Kenyans passion fruit producers aiming primarily to the UK market are already producing a *P. edulis* x *P. edulis f. flavicarpa* hybrid which yields larger, more acidic fruit. The advantage of the hybrid is that it is more disease (therefore requiring less pesticide application) and stress (drought) tolerant, and is higher yielding. Disadvantages are fruit are not as sweet as desired by non-UK EU markets, and the plant growth is much more vigorous and thus requires a higher level of pruning. Kakuzi is planning on reducing the proportion of purple and increasing that of the hybrid passion fruit planted; the supply of purple passion fruit from Kenya may therefore become smaller in the near future, if other producers are following this same trend.
- Size of Kenyan purple passion fruit appears to be larger than Rwandan fruit; it is therefore recommended that Rwandan producers be trained on practices such as thinning which will increase fruit size. A longer term measure which is recommended selection of varieties with larger sized fruit.
- Color of the purple passion fruit was fairly dark; for the hybrid, the color is paler and with a green tinge
- Harvesting and post harvest practices observed at Kakuzi, and worth trying in Rwanda, are (1) harvesting fruit into canvas bags and (2) putting them into plastic lined crates for transport to the collection center. These measures reduce the amount of mechanical damage which occurs during these operations. Plastic crates (manufactured for carrying bread) which have adequate slats for ventilation, and are stackable, could be employed by Rwandan producers if they are manufactured locally (and therefore are affordable). Specialized crates designed for carrying fresh produce and widely used in countries such as Zimbabwe and South Africa would be even better, if they could be sourced at an affordable price.

[5] These insects are not expected to become as large a problem in Rwandan passion fruit as they occur primarily in the dry season.

[6] Kenyan passion fruit exports are frequently at risk of earning a bad reputation because of some producers (particularly small holders) selling fruit to exporters which are contaminated with pesticide residues (arising from use of unapproved products, failing to observe the spray to harvest interval, etc.). When importers in the EU find residues on Kenyan fruit, an alarm is raised and all Kenyan producers become suspect.

- Fruit which are soiled are washed with a solution of "Jik" (household bleach); there is some loss of fruit blemished by the additional handling, but soiled fruit are unacceptable and contaminate other, dirt free fruit. Peduncles are cut to just above juncture with fruit.
- Kakuzi does not do the final (for export) packing – this is done by Vegpro.

General information on Kakuzi's passion fruit operations

- Kakuzi has three peaks of production per year (small holders who don't have irrigation have only 2); duration of the peaks ranges from 6 to 8 to 10 weeks. Peak production periods also have the highest percentage packout (i.e. the highest quality).
- Collins estimates the ceiling on exports of passion fruit from their farm to be 10 tonnes/week (i.e. larger quantities are not in demand)
- About 40% of fruit produced are exported, the remainder sold on the local market; when quantities of export quality fruit exceed the demand from the exporter, fruit are held for a few days until they have begun to shrivel in order to prevent them from being sold by middlemen to exporters (thereby flooding the market). Fruit sold locally are used in juice and pulp production, with some being sold for use as fresh product to the hotel and restaurant trade. Collins noted the price for passion fruit pulp is improving due to a reduction in supplies from Colombia.
- Collins feels it is difficult to interest Kenyan exporters in fruit, as their main focus is on fresh vegetables; passion fruit is considered an exotic product, not one with which consumers are familiar and sold as part of a "fruit basket"
- Plantings of passion fruit are maintained on a cycle of three years of production, with 1/3 of the total area (currently 78 ha) being replanted each year. Presently 2/3 of the area is in purple passion fruit, and 1/3 in the hybrid. Yields over the three year cycle are as follows:

  For purple passion fruit: Month 7-18 = 14 tons
  Month 19-30 = 16 tons
  Month 31-36 = 3.5 tons

  For hybrid passion fruit: Month 7-18 = 20 tons
  Month 19-30 = 25 tons
  Month 31-36 = 9 tons

  - Costs of production per unit area for the two types of passion fruit are about the same; the hybrid requires less inputs in the way of pesticides, but more labor for pruning. Since the hybrid is higher yielding (and at present prices for the hybrid higher), the profits are slightly greater for the hybrid. Once production of the hybrid has increased and more fruit is being exported, the price differential between it and the purple passion fruit is expected to decrease.

- Plant spacing and trellising: Single wire along top of poles, with 2-2.5 m between rows, 6-6.9 m between poles (within row), and 5 plants between poles for a spacing of 1.4 m between each. Result is 3000 plants/ha
- Climate is good for passion fruit production on the farm (lowest temperatures around 10-12 C, highest 30 C) with exception of period before rains when high temperatures combined with windy conditions cause such a high transpiration demand that the plants "shut down", according to Collins.
- Major production problems (aside from above mentioned stress period) are insects during the dry season, and diseases during the rains. Main pests are leaf miner *Liriomyza* species), Western Flower Thrips, mites and mealy bugs. They are using a combination of mineral oil and insecticide to control Leaf Miner, in addition to attracting predatory wasps by planting dill and anise in the plantation (the flowers of the umbelliferae are large and contain lots of nectar, which is attractive to the adult wasps). Heavy mulch of residues from pineapple processing are used as mulch to suppress thrip and leaf miner larvae (grass mulch is difficult to procure in large amounts, and breaks down too quickly under their climatic conditions). For thrips Collins is going to try a blue-flowered variety of verbena as a trap crop; since has a creeping growth habit, it will also serve as a ground cover to protect against erosion.
- Fertilizer applications follow the plant growth cycle are as follows:

  Vegetative phase: largest nitrogen application

  Flowering and fruiting phase: largest potassium and some calcium application

  Maintenance phase: reduction in levels of all elements applied

  The amount applied over the year: 200 N – 80 P – 250 K

- Packhouse management includes:
  - **a.** Regular baiting of rodent traps and monitoring rodent activity (on basis of amount of fruit eaten) – traps have to be carefully placed so that there is no risk of fruit crates coming in contact with them
  - **b.** Cleaning schedule, with some items (eg sorting tables) cleaned daily, others weekly (e.g. crates), and others monthly (e.g. walls and lights) – a 10% solution of household bleach is used in the cleaning procedure
  - **c.** Quality control check sheet for incoming fruit: size, color, blemishes, sunburn (all rated on scale of 1-3) plus pesticide application records to ensure spray to harvest interval has been respected.
  - **d.** Fruit are harvested, packed and sent to Nairobi on the same day – thus they are not stored in the farm packhouse for any length of time.

  Packhouse was not "state of the art" but at least had steel topped tables and ceiling fans.

- The peaks in passion fruit production from Kenya coincide (more or less) with those from other African countries, leading to competition between them for markets for their fruit. Factors impinging upon competitiveness of producers include yield+percentage packout, production costs (which in Kenya – and countries such as Zimbabwe and South Africa -include electricity for irrigation, which is very expensive), cost of fertilizers and pesticides, labor costs, packing materials, fuel costs and airfreight ($3.20 per 2 kg box from Kenya)
- Final comment from Collins was that he would like to decrease the area planted to passion fruit and put more effort into improving crop management so that he achieves lower yields but of higher quality fruit so that the bulk of the fruit are sold to the export market.

ANNEX 3: NOTES FROM VISIT TO ISAR, BUTARE (13 MARCH)

Dr. Elie Mugunga, Director General

Overall impression: Coffee appeared to be the major area of interest insofar as research activities, e.g. preparing the tissue culture lab to be used for *in vitro* coffee culture. There is more emphasis on dry beans and staple crops than on horticultural crops.

Notes from discussion with ISAR Staff and tour of facilities

- Have requested passion fruit seeds from Kenya (KARI) and Uganda (Kawanda); also want to accumulate new physalis germplasm to assist women producers in Byumba; also interested in chilli pepper production (*Capsicum fructescens* type)
- With assistance of USAID through MSU and Texas A and M, are strengthening extension capacities to disseminate research results (have students specializing in extension); mentioned in same breath that have program called PEARL which has market specialists looking for EU markets for Rwandan products
- Stated desire to diversify away from coffee and tea into more horticultural commodities
- Do have good agroforestry program with Calliandra and other leguminous species interplanted with coffee to provide green manure/forage.
- In vitro lab just being set up; indications are will be primarily for coffee, but may also include tissue culture of banana, potato
- Plant protection section receiving support in form of IPM specialist from MSU, along with collaboration with CIAT. Focus initially to be on grains, Irish and sweet potatoes, cassava ; horticultural crops will be looked into later on.
- Soil analysis: lab NOT in great shape, said could do "up to 70 percent" of sample. Appears capable of conducting analysis for N,P,K and Ca; but I would question reliability of results
- Do have production of Rhizobium for soy bean inoculation; are trying to extend its usage to farmers.
- Banana research: stated they need to find *Fusarium* resistant germplasm (had a planting of material from Central America which was supposed to be resistant but did not appear to be so). Are considering requesting material from INIBAP.
- Macademia planting: have trees which are around 20 years old; do not appear to have any significant pest or disease problems. Could be source of seed for organic farmers wanting to enter into macademia production.
- Have seed conservation unit with cold rooms for germplasm storage, and conduct viability and purity tests. Emphasis is on beans (including soy beans) and grains (rice, maize, sorghum, wheat)

ANNEX 4: LIST OF USEFUL HORTICULTURE AND ORGANIC AGRICULTURE PUBLICATIONS

PUBLICATIONS RELEVANT TO ORGANIC AGRICULTURE

- Schmidt, H. and M. Haccius, 1998. EU Regulation "Organic Farming": A legal and Agro-Ecological Commentary on the EU's Council Regulation (EEC) No. 2092/91. Margraf Verlag, Germany. ISBN 3-8236-1288-3.
- Stoll, G. 2000. Natural Crop Protection in the Tropics. Letting information come to life. Margraf Verlag, Weikersheim. 376 pp. ISBN 3-8236-1317-0
- Elwell, H. and A. Maas, 1995. Natural Pest and Disease Control. The Natural Farming Network, P.O. Box 301, Causeway, Harare, Zimbabwe. ISBN: 0-7974-1429
- Verkerk, R. 2001. Farmer's Friends : Recognition and conservation of natural enemies of vegetable pests. Imperial College of Science, Technology and Medicine, University of London, UK. 111 pp. ISBN 0 9540132 0 4
- Organic Farming CD, 2002. Bibliographic records of organic farming research worldwide from 1973 to present from CAB International. Price: $450. To purchase contact: orders@cabi.org

PUBLICATIONS ON TROPICAL FRUIT

- Nakasone, HY and RE Paull. 1998. Tropical Fruits. CAB International, Oxon, UK. 445 pp. ISBN 0 85199 254 4
- Ploetz, Zentmyer, Nishijima, Rohrback and Ohr. 1994. Compendium of Tropical Fruit Diseases. The American Phytopathological Society, St. Paul, Minnesota, USA. 88 pp. ISBN 0 89054 162 0
- Passion fruit growing in Kenya : A recommendation for Smallholders. GTZ, Eschborn , Germany 1978. 46 pp. ISBN 3 88 085 056 9
- Fresh Produce Producers' Association Handbook. Printed by the Horticultural Promotion Council of Zimbabwe, 1999. 86 pop. Order from : HC, fax 263 4 575670 or e mail janfppa @icon.co.zw
- Profit from Passion Fruit. Top Farmers Publications (Pty) Ltd., 1322 South Coast Road, Mobeni, Natal. (pre-1977 publication – may no longer be in print)
- Ruggiero, C. 1987. Maracuja. UNESP, Brasil. (In Portuguese, 246 pp. including photographs)
- HORTCD: a sub-set of CAB Abstracts database providing comprehensive and up to date information on horticulture from 1973 to date. Available on CD-ROM at lease price of $3275 per year for non CABI member countries. Order via web site http://www.cabi.org
- Mitra, S.K. (Editor). 1997. Postharvest Physiology and Storage of Tropical and Subtropical Fruits. CAB International, Oxon., UK. 448 pp. ISBN 0 85199 210 2.

- Information Kit on Passion Fruit from Australia (www.dpi.qld.gov.au/agrilink, select Information Products/Passion Fruit)

POST HARVEST INFORMATION

- Very useful web site (includes passion fruit info) : http://postharvest.ucdavis.edu
- Wills, R., B. McGlasson, D. Graham and D. Joyce. 1998. Postharvest : An introduction to the physiology and handling of fruit, vegetables and ornamentals. CAB International, UK (Africa address PO Box 76520, Nairobi, Kenya). 262 pp. ISBN 0 86840 560 4
- Mitra, S.K. (Editor). 1997. Postharvest Physiology and Storage of Tropical and Subtropical Fruits. CAB International, Oxon., UK. 448 pp. ISBN 0 85199 210 2
- Kader Adel A., Technical Editor. Postharvest Technology, Third Edition (ANR Publication 3311). $65 – order from postharvest@ucdavid.edu
- Kitinoja, L. and A.A. Kader. 1994. Small Scale Postharvest Handling Practices – A manual for horticultural crops. Order from postharvest@ucdavis.edu