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PROTOCOLS FOR THE MANAGEMENT OF THE FALSE CODLING MOTH (*THAUMATOTIBIA LEUCOTRETA*) IN ROSES IN KENYA

kenya flower council
QUALITY ASSURED

FRESH PRODUCE EXPORTERS ASSOCIATION OF KENYA

KALRO
Kenya Agricultural & Livestock Research Organization

KEPHIS

COLEACP

This publication has been prepared by the Kenya Flower Council Technical Committee, with the support of the Kenya Plant Health Inspectorate Service (KEPHIS), Fresh Produce Exporters Association of Kenya (FPEAK), Kenya Agricultural & Livestock Research Organization (KALRO) and the Europe-Africa-Caribbean-Pacific Liaison Committee (COLEACP) in the scope of its NExT Kenya programme.

The objective is to provide growers and exporters of roses with protocols and technical assistance to produce and export roses that are free from false codling moth. Technical information is provided in the main part of the document; identification tools, outline training courses for farm and packhouse staff, and the KEPHIS inspection checklist are presented in the Annexes.

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This publication is an integral part of a COLEACP collection, which is made up of educational and technical tools and materials. All of them are suited to different types of learners and beneficiaries and levels of education found in agricultural supply chains, production and sales.

This collection is available online for COLEACP members and beneficiaries.

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Introduction

Thaumatotibia leucotreta (sometimes *Cryptophlebia leucotreta*) is commonly known as false codling moth (FCM). The caterpillars (larval stage) attack more than 70 host plants, many of them horticultural crops with fruit, pods and berries, such as beans, grapes, citrus, capsicum, avocado, guava, pomegranate and ornamental plants. They also attack macadamia, cotton, tea and a wide range of wild plants. However, this pest is particularly problematic on roses grown for cut flowers, as female moths are attracted to lay their eggs on the flower heads as well as other parts of the plant.

In recent years, consignments of roses from Kenya to Europe have been intercepted due to the presence of FCM. The detection within a consignment of a single living individual of FCM at any stage of development leads to rejection of the whole consignment. This is because the European Commission (EC) includes FCM on its list of harmful organisms recommended for regulation as quarantine pests (Annex II of EU 2019/2072) to prevent its introduction into Europe, where it could attack a range of outdoor and glasshouse crops.

The European Union (EU) has updated its plant health (phytosanitary) regulations. The new plant health regulation (EU 2016/2031) entered in application on 14 December 2019, bringing rigorous new rules to prevent the introduction and spread of pests and diseases in the EU. False codling moth is now a quarantine pest on all crops (Annex II of EU 2019/2072). Special measures have been introduced for crops that are a known pathway into the EU for serious pests that could damage Europe's agriculture or environment. These measures include stringent new requirements covering the export of roses to prevent the introduction of FCM into the EU.

Interceptions of FCM on Kenyan roses have been extremely high (36 in 2018, 36 in 2019, and 24 up to June 2020). This level of interceptions has been attributed to increased inspection levels from 5% in 2011 to 10% currently. As a result of the numbers observed in the past 3 years, a drastic increase to 50% or even 100% checks is envisaged for roses from Kenya in 2021. This will be determined by the end of 2020.

Facts about false codling moth

- It is an indigenous pest, restricted to sub-Saharan Africa.
- It is present in all the rose-growing areas of Kenya year-round.
- It is an economically very important pest.
- It is a quarantine pest with zero tolerance by the EU.
- When it is found by the EU countries inspection services on imported plants/crops, the whole consignment is rejected.
- It has an extensive host range.
- It is a small moth, 7–10 mm long.
- It is active at dusk and during the night.
- It breeds throughout the year on host plants, but with peaks often after the rainy season.
- It can have five to six generations per year.

Biology and life cycle of false codling moth

The female moth lays over 100 eggs at night, usually singly on flower petals or other parts of the rose bush. Eggs are flat, oval discs (0.77 mm long by 0.60 mm wide) with a surface that feels slightly rough. When first laid they are white/cream coloured, and before hatching they change to a reddish colour with a black head capsule. Eggs take from 2 to 22 days to hatch, depending on temperature. They are very sensitive to cold and dry conditions. Temperatures below freezing over 2–3 days can kill the eggs.

When the eggs hatch, the larvae burrow into the flower bud, where they grow and complete their development. Eggs laid on the surface of crown galls allow subsequent larvae to enter the cracks of the gall. In the flower buds they make small holes about 1 mm in diameter. The entrances to these holes are often the first sign of the pest because the larvae leave deposits of faeces (frass). There may also be petal discolouration.

The larvae go through five stages. In the first stage they are 1–1.2 mm long and have a spotted appearance. By the fifth stage, live caterpillars are 12–18 mm long, orange-pink, with pale sides and yellow in the middle. At this stage a brown head capsule is visible.

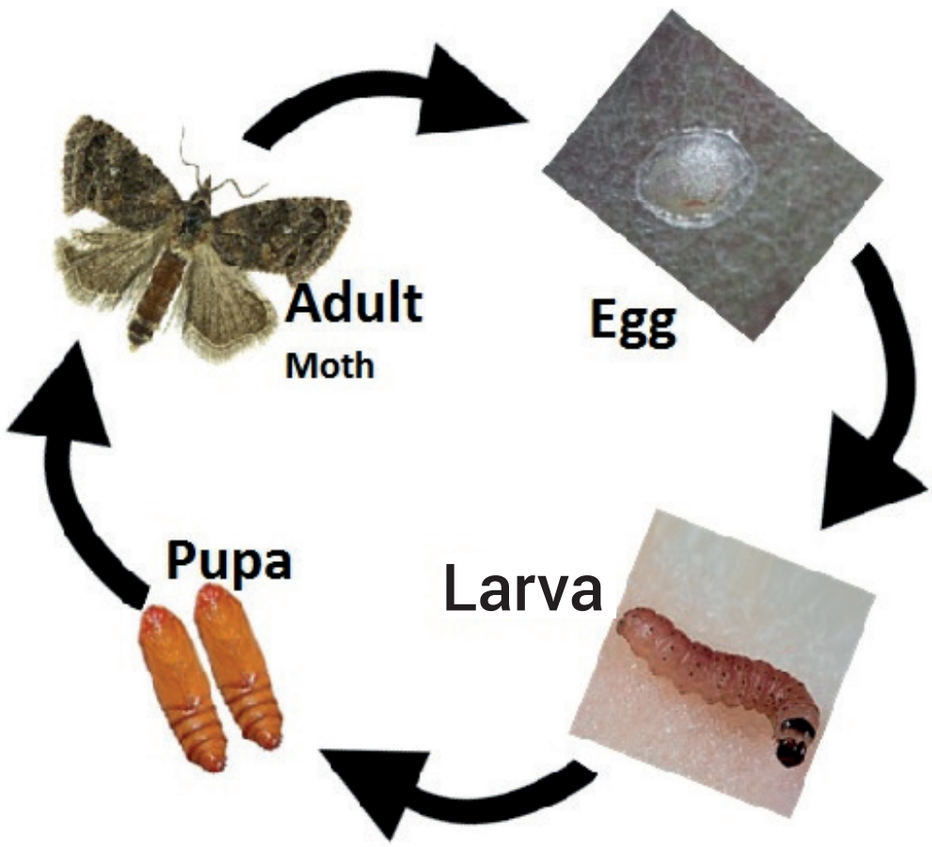

Figure 1. Life cycle of *Thaumatotibia leucotreta* (false codling moth)

The larvae develop inside the flower; this can take 12–33 days in the warm conditions of a rose greenhouse. Generally, only one to three larvae survive in each flower. When fully grown, larvae bore their way out of the flower, descend to the ground on a silken thread, and spin tough silken cocoons in the soil, among debris or in bark crevices for later adult emergence. The development time for each stage varies considerably with temperature (see Annexes 1 and 2).

Management strategies for false codling moth

Management of FCM in roses must involve an integrated approach across all stages of the value chain and through the involvement of all stakeholders. The key to success is in the production and packing stages of the rose crop. The main components of the management strategy involve staff training and communication, as well as a range of integrated control techniques.

Training

Within a rose-exporting company, staff in different positions all play an important role in the identification and rapid reporting of FCM. The following positions can be identified:

- general farm workers: employees who are in contact with the rose crop for various crop management tasks including pruning, weeding and harvesting
- crop scouts: employees who scout the crop for pests and diseases, who obviously play a key role in detecting FCM
- crop protection staff: employees who carry out crop protection activities such as spraying the crop
- packhouse general workers: employees involved in grading and packing the roses
- packhouse quality control team: employees who inspect the roses when they enter the packhouse and after they have been graded and packed.

Training of staff involves a cost for any business, but if it can avoid one consignment being intercepted by the regulators, it will be repaid in full. Training can consist of very short briefing sessions of less than 1 hour. Course content is proposed here for the following training courses detailed in Annexes 3–6:

- General farm worker familiarisation with FCM (Annex 3)
- Scout identification and reporting FCM (Annex 4)
- Packhouse quality control (QC) team identification and reporting FCM (Annex 5)
- Crop protection staff training on FCM (Annex 6).

Continuous training and awareness should be conducted on a regular basis by in-house trainers or by service providers qualified in pest identification and integrated pest management (IPM) strategies.

Images of the life-cycle stages of the pest should be clearly displayed in the packhouse and greenhouses.

Communication

A rapid and effective alert system has been shown to be a very effective method of managing FCM incidences on farms. WhatsApp is universally used in Kenya, and farm and packhouse managers should consider establishing and/or using existing WhatsApp user groups that consist of scouts, supervisors, packhouse QC teams and crop protection managers.

WhatsApp groups already exist on many farms. Instead of joining all the above staff in a single group, which may not be efficient, farm managers can create different groups for scouts, crop protection managers, and supervisors of general farm operations (weeding, pruning, harvesting), and relay relevant information from one group to another and to the

packhouse manager, who can then relay to the QC team WhatsApp group.

Such a group would, for instance, report when FCM is present in particular greenhouses, alerting the crop protection team and packhouse QC team to be extra vigilant and allowing crop protection measures to be implemented speedily.

Pre-harvest management techniques

Monitoring

Pheromone traps

Pheromone traps catch only male FCM; but the capture of males indicates the presence of female FCM that will lay eggs and infest a crop. It is important to clearly establish responsibilities for placing, checking, reporting and replacing traps within the team (farm manager, crop scouting team, crop protection team) to avoid confusion. Make sure the staff in charge are fully trained on the activities described below.

Several aspects must be considered when considering the placement of pheromone traps.

- Place the traps above the crop.
- Position the traps by aligning them to the windward side of the crop.
- Replace the traps following the manufacturer's instructions. Replacement may be required more frequently when it is hot and dry, as the pheromone is highly volatile.
- Avoid contaminating the trap component by using a pair of latex gloves per trap.
- Use the traps at the rate of four per hectare (see "Physical control" section below for recommendations on mass trapping).
- Keep records on the monitoring of pheromone traps (date of setting the trap, expected servicing date, number of moths caught per unit time, etc.).
- Report the presence of FCM immediately through the relevant WhatsApp groups and record it in the crop scouting records.
- Put a mechanism in place to ensure the correct interventions when the presence of FCM is reported, in line with the company's IPM strategy.
- Where relevant (i.e. close to or during harvest), take a decision as to whether or not the crop is still fit for export, or whether increased screening at packhouse level would be sufficient. Alternatively, where infestation levels are considered too high, all harvested crop from that specific greenhouse should be destroyed.
- Place more traps near greenhouses bordering forested areas, as they usually get more infestation than those in the middle.
- Strictly observe practices around opening and closing of greenhouses doors, as infestations are normally higher at the beds near the doors.

There are currently no pheromone products registered specifically for FCM on roses in Kenya. However, one product (CRYTRACK) is registered for the monitoring and mass trapping of FCM in chili peppers. It consists on a rubber impregnated with (E)-8-Dodecenyl acetate (0.06 mg per lure) and (Z)-8-Dodecenyl acetate (0.04 mg per lure) that it is used in combination with a Delta trap and sticky paper. It would certainly be interesting to use this product on roses in case an extension of use is obtained.

Scouting

Scouting is the best tool for pest monitoring and timely management. It involves inspecting the monitoring traps and the plants. On the plant, the flower buds, stems, and any crown galls if present should be examined.

The following must be considered when conducting scouting.

- Ensure all scouts are trained in FCM identification and reporting.
- Undertake proactive scouting – the farmer must anticipate high pest infestation at all times and carry out scouting on a continuous basis.
- Keep and observe documented procedures guiding the scouting process.
- Use the correct signs and symptoms to scout for FCM (eggs, chewing damage and frass). Eggs are light cream in colour and can be easily seen against a darker petal such as a red rose. The larvae mainly chew the petals, so holes and physical damage can be observed. The larvae excrete frass, which is evidence that FCM larvae have been present.
- Report scouting data on a timely and efficient basis. Consider using farm FCM WhatsApp reporting groups, in addition to the classical ways of reporting required by quality management systems (such as GlobalG.A.P.) and KEPHIS inspection (Annex 7).

Cultural control

Cultural control should be carried out regularly to avoid the build-up of FCM populations over the season. Several practices must be considered when practicing cultural control.

- Use clean planting material (ensure planting material is free from crown galls).
- Maintain a high level of field sanitation (crop hygiene) and ensure all prunings and crop debris are removed from the greenhouse. Take plant debris from greenhouses infected with FCM well away from the greenhouse and dispose of it by burying or placing in black bags to allow solarisation to occur. Crop residues may serve as a reservoir for the pest.
- After solarisation, which requires a period of up to 48 hours of sunny conditions, the polythene can be removed, and the debris composted.
- Identify, scout and be prepared to manage FCM in nearby wild hosts. Assess the risk of areas surrounding the greenhouse as potential hosts for FCM. Place monitoring pheromone traps near the greenhouse to assess the presence of FCM. If the surrounding areas are considered a potential source of FCM, consider regular scouting and ultimately management of this infestation.
- Crown galls can be sites for development of larvae and pupae. Remove the galls and place them in plastic bags and expose them to the sun to suffocate before disposal. The larvae gain some protection from insecticides within the crown gall or the stem, or in the petals.

Figure 2. Plastic solarisation bags for elimination of FCM

Physical control

Physical control should be carried out in the following ways.

- Repair/replace worn-out polythene and insect screens.
- Fix fitting doors, and always close the doors to prevent pests from entering the greenhouse.
- Use signs (e.g. "Close the door behind you") to encourage implementation.
- Install insect screens to keep off moths flying into the greenhouses' shade nets and insect nets.
- Mechanically pick and kill any caterpillars, eggs, and moths.

Pheromone traps for FCM can also be used for mass trapping. The recommended rate is a minimum of 10 traps per hectare (follow manufacturer's recommendations). The pheromone in the traps disrupts the attraction of male moths to virgin females. The pheromone traps (usually delta traps) contain a glue, which physically captures the adult male moth. There are no pesticides in an FCM pheromone trap. The staff in charge must ensure that the pheromone is replaced following the manufacturer's instructions.

As mentioned in the *Pheromone traps* section, there are currently no pheromone products registered specifically for FCM on roses in Kenya.

Biological control

Several biological control agents are known to be effective against FCM. These include:

- The bacterium *Bacillus thuringiensis* var. kurstaki and *B. thuringiensis* var. aizawai.
- The virus *Cryptophlebia leucotreta* granulovirus (CrleGV).
- The entomopathogenic fungal species *Beauveria bassiana* (GAR 17 B3), *Metarhizium anisopliae* (FCM Ar 23 B3), *M. anisopliae* (G 11 3 L6), and *M. anisopliae* (ICIPE 69)
- The egg parasitoid species *Trichogrammatoidea cryptophlebiae*

Registered biopesticide products for the control of FCM and caterpillars on roses in Kenya contain *B. thuringiensis* (it is recommended to alternate between *B. thuringiensis* var. kurstaki and *B. thuringiensis* var. aizawai) and CrleGV. These can be found in Annex 8 (Table 1). Before each use, it is important to check whether the product is still registered, by consulting the Pest Control Products Board list of registered biopesticide products (http://www.pcpb.go.ke/biopesticides-on-crops/).

Chemical control

There are several conventional pesticide products registered in Kenya for the control of FCM and caterpillars on roses. The list of these products can be found in Annex 8 (Table 2). Before each use, it is important to check whether the product is still registered, by consulting the Pest Control Products Board list of registered conventional pesticide products (http://www.pcpb.go.ke/crops/).

When using any PPPs it is important to ensure the following.

- Always read the label and directions for use.
- Use the application rates recommended by the manufacturer.
- Take note of which life-cycle stage (adults, eggs, larvae) the application is targeting. Larvae that have penetrated the plant tissue will be particularly hard to control.
- Give preference to products specifically registered for FCM (instead of caterpillars)
- False codling moth can develop resistance if pesticides with the same mode of action are used repeatedly. The mode of action is indicated by the Insecticide Resistance Action Committee (IRAC) number. It is strongly recommended to use insecticides with different IRAC numbers in sequence or in rotation across insect generations to prevent resistance (no more than two consecutive sprays of the same product should be applied).
- Select PPPs that are acceptable to the customers for the crop. There are currently no legal maximum residue levels (MRLs) for ornamentals in the EU.
- Where growers are using biological control agents, use only compatible insecticides. Information on the compatibility of insecticides with selected biocontrol agents is available from your biocontrol supplier or their web-based tools (e.g. Koppert, https://sideeffects.koppert.com/side-effects/; Biobest, www.biobestgroup.com/en/side-effect-manual).
- Supervise spray operators and give them demonstrations and guidance to ensure good performance.

Post-harvest management techniques

Packhouse staff training

- Train all people involved in post-harvest handling, quality control, grading and packing so they are aware of, and apply, good practices at all times to reduce the risk of failing to detect the pest at the packing stage.
- Ensure all operators involved in harvest and post-harvest activities can recognise FCM damage and know what to do when they find it.
- Display identification posters in the packhouse area.

Packhouse management

- Ensure the packhouse is protected from any influx of FCM adults that may enter and lay eggs on flowers in the packhouse (e.g. place insect netting on vents).
- Ensure optimal conditions for inspection (e.g. sufficient lighting, clean white-topped inspection tables).
- Quarantine any plants with FCM or damage.
- Destroy any FCM-affected flowers and stems. Place them in plastic bags and expose the bags to the sun to suffocate the pest before disposal. Bury affected flower buds to stop the pest life cycle.
- Ensure the packhouse team are included in a rapid alert system to identify consignments coming in from the field that might be at risk of FCM contamination. All incoming rose buckets should be identified by lots. For instance, roses from one block/greenhouse are treated as a lot and are identified and traceable.
- Undertake appropriate sampling for FCM inspection by selecting a minimum of five rose buckets from every 100 buckets in a lot (or according to the farm's sampling procedure) and taking these to the inspection table. Visual checks for symptoms of FCM infestation and narrowing down to the suspected flowers can increase the probability of detection. If FCM is detected in a sample, the whole consignment should be reinspected for FCM.
- Ensure the packhouse QC team have clear instructions on what to do with lots of roses that contain FCM.
- Maintain a system for keeping records of packhouse inspections.

Quality control procedures

The producer should develop and observe operating procedures for the following five control points.

- Incoming QC checks (when the crop comes into the cold store from the field).
- Raw material QC (when the flowers are taken from the cold store into the packhouse).
- Line QC.
- Final QC.
- Dispatch QC.

Ensure there is a mechanism for feedback to the crop protection team, to enable them to determine the effectiveness of control measures.

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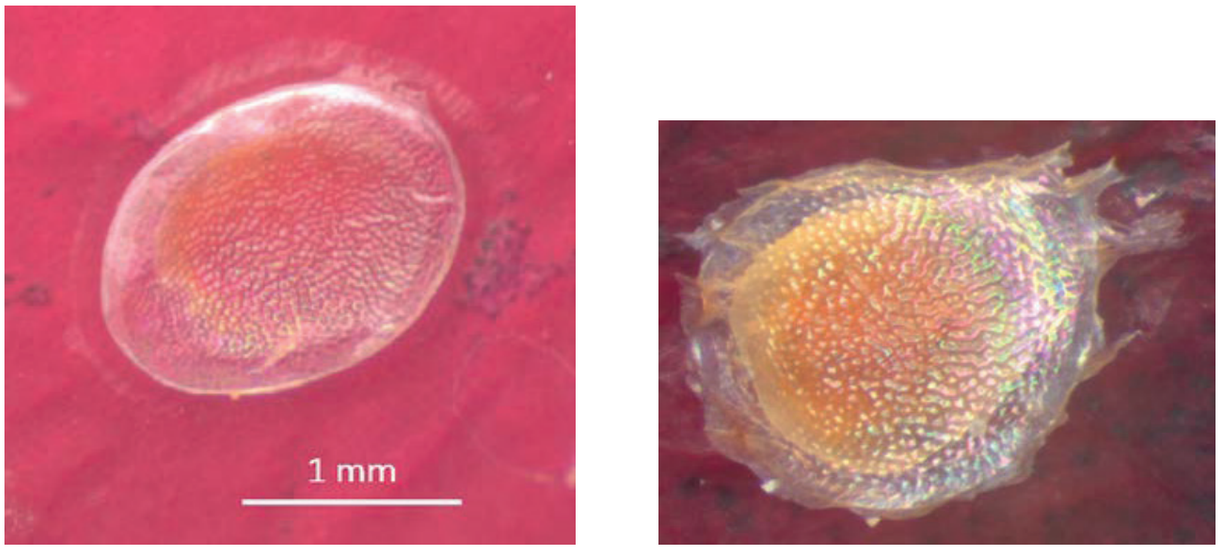
Annex 1. Identification of false codling moth life cycle stages

(Source: COLEACP)

			
An adult moth, resting (7–10 mm long)	Actual size	The adult moth pinned (15–20 mm wingspan)	Actual size
			
The larva (caterpillar) can be up to 15 mm long and is pinkish with a brown head	Actual size	The pupa (5–7 mm long) can be found in the soil or in plant debris	Actual size

Annex 2. Identification of different stages of false codling moth on roses



FCM egg. (Source: Tom van Noort)

FCM eggs are easier to spot and identify when laid on a darker background such as a red rose.

(Source: Tom van Noort)

Larval entry hole into a flower head. (Source: Elijah Gitiro)

Typical caterpillar damage caused by FCM. (Source: Elijah Gitiro)

Larval damage to a rose stem. (Source: Elijah Gitiro)

External frass is a sign of larvae inside the flower head. (Source: Elijah Gitiro)

FCM larvae present in a swollen rose crown gall. (Source: Elijah Gitiro)

FCM larvae exposed when opening up a rose crown gall. (Source: Elijah Gitiro)

Annex 3. FCM training course outline – for general workers (farm and packhouse)

Objective: To ensure the greenhouse workers (e.g. harvesters) and packhouse workers (grading, packing) are familiar with false codling moth (FCM) and FCM damage on the crop, and know what to report, how, and to whom.

Learning outcomes:

- Be able to identify FCM and damage
- Know how to report sightings on the farm, and to whom

Duration: 30 minutes.

Frequency: At least every quarter.

Training aids: Identification charts and live specimens if available.

Activities:

At the beginning of a working day, gather a group of staff (12–15 individuals) in a section of the farm/greenhouses. Go through the key identification features of FCM and clearly explain how and to whom they should report any sightings of the pest.

Annex 4. FCM training course outline – for greenhouse scouts

Objective: To ensure greenhouse scouts are familiar with false codling moth (FCM), know how to collect appropriate data, and know what and how to report.

Learning outcomes:

- Be able to identify FCM and damage
- Know how to operate pheromone traps and collect data from them
- Understand how to complete scouting data-recording systems used by the farm
- Know how to scout for FCM damage and presence in the greenhouse and the surroundings of the greenhouse
- Participate in rapid alert systems (e.g. WhatsApp farm group on FCM)

Duration: 60 minutes.

Frequency: At least every quarter.

Training aids: Identification charts and live specimens if available. Pheromone trap. Mobile phone. Pest data recording sheets/devices.

Activities:

At the beginning of a working day, gather a group of scouts (12–15 individuals) in a section of the farm/greenhouses. Go through the key identification features of FCM. Demonstrate the operation of an FCM pheromone delta trap according to the manufacturer's instructions. Explain how to record FCM catches and how other data are recorded. Train scouts on how the farm's rapid alert system operates, and how they should activate it in response to an alert.

Annex 5. FCM training course outline – for packhouse quality control staff

Objective: To ensure packhouse quality control staff are familiar with false codling moth (FCM), know how to reject and dispose of FCM-infected material, and know what data to report and how.

Learning outcomes:

- Be able to identify FCM and damage
- Know how to reject and dispose of FCM-infected material
- Understand how to complete QC data-recording systems used by the farm
- Participate in rapid alert systems (e.g. WhatsApp farm group on FCM)

Duration: 60 minutes.

Frequency: At least every quarter.

Training aids: Identification charts and live specimens if available. Mobile phone. Pest data-recording sheets/devices.

Activities:

At the beginning of a working day, gather a group of QC staff (12–15 individuals) involved in packhouse QC procedures. Go through the key identification features of FCM. Demonstrate how to reject and dispose of FCM-infected crop material. Explain how to record FCM reports and how other data are recorded. Train QC staff on how the farm's rapid alert system operates, and how they should activate it in response to an alert.

Annex 6. FCM training course outline – for crop protection staff

Objective: To ensure staff responsible for crop protection are familiar with false codling moth (FCM), and know how to implement a crop protection programme for FCM effectively, efficiently and safely.

Learning outcomes:

- Be able to identify FCM and damage
- Know how to interpret scouting data and take the appropriate measures
- Know how to prepare a crop protection programme for FCM management that is coherent with the integrated pest management (IPM) of other pests and diseases on roses, and the natural enemies used on the crop
- Know how to integrate the different control techniques in an FCM programme
- Participate in rapid alert systems (e.g. WhatsApp farm group on FCM)

Duration: One day.

Frequency: At least every quarter.

Training aids: Identification charts and live specimens if available. Mobile phone. Pest data-recording sheets/devices. List of FCM control measures and Pest Control Products Board (PCPB) list of registered products (http://www.pcpb.go.ke/list-of-registered-products/).

Activities:

Gather together a group of staff responsible for designing and implementing the farm's crop protection programme, and review the farm's strategy for controlling FCM. Go through the key identification features of FCM. Review examples of scouting data and ensure pest thresholds are understood. Describe how and when different FCM control strategies should be used (mass trapping, cultural, physical, biological and chemical controls). Explain how to record the crop protection measures used. Train crop protection staff on how the farm's rapid alert system operates, and how they should activate it in response to an alert.

Annex 7. KEPHIS checklist for farm inspections

FCM CHECKLIST FOR ROSE CUTFLOWER FACILITIES- VERSION 3 –YEAR 2020

FARM DETAILS		
Farm name and contacts	Contact person	
Serial No. (Report Book)		
County	Sub-county	
Ward	Nearest town/market	
GPS readings	Quantity (MT) of cut roses exported monthly	
Number of rose varieties	Attach complete list	
SYSTEM 1: FARM INFRASTRUCTURE (Greenhouse)		
Status	**Rate 1–5 (1 very poor, 2 poor, 3 moderate, 4 good, 5 very good)**	**Remarks**
Entrance control of greenhouse (opening and closing of greenhouse door)		
Status of greenhouse cover material – consider the level of damage		
Status of door system – consider double door, water bath and general condition		
General cleanliness status of greenhouse (inside and outside)		
Overall score (15 pass mark)		
Recommendation		

SYSTEM 2: PEST MONITORING AND SCOUTING		
Number of scouts per unit area		
Scouting and monitoring operational procedures in place		
Demonstration on abilities/experience of scouts on FCM detection and identification		
Status of scouting tools (hand lens, knife, tally counter, boots and gloves, sample vial, cooler box, labels, traps, pest cards, reference materials, aspirator, scouting knife, notebook)		
Record-keeping methods in place: status of the scouting system (pest ID, pest count, crop stage, weather, action taken and others)		
Documented reporting mechanisms and auctioning		
Usage of data – early warning/pest forecasting periodic data summaries; trends on populations and correlation with climatic factors		
Status of monitoring traps – number of traps, servicing schedule, locations (provide map for trapping system)		
FCM pest status on traps and rose crop – consider infestation levels and relate to the records		
Retrievability of monitoring and scouting reports		
Correlation between scouting and monitoring results		
Overall score (44 pass mark)		
Recommendation		

SYSTEM 3: FCM MANAGEMENT		
Pest management protocol/procedures for FCM in place		
Understanding and implementation of systems approach to FCM management		
Effectiveness of pest control methods (biological, chemical, physical barriers, cultural, etc.); if chemical control, provide the list of chemicals		
Inspection to evaluate overall effectiveness of FCM management measures (evaluate relationship between monitoring data and inspection outcome)		
Evaluate FCM awareness by quality control staff at greenhouse		
Evaluate FCM awareness by harvesting and general staff at greenhouse		
Overall score (24pass mark)		
Recommendation		

SYSTEM 4: PACKHOUSE		
Quality management procedures/ protocol in place		
Ability of QC staff to detect pest at produce intake stage		
Ability of QC staff to detect pest at produce process stage		
Ability of QC staff to detect pest at produce dispatch stage		
Produce handling procedures to ensure integrity and no reinfestation		
Quality assurance personnel familiar with post-harvest treatments/challenges		
QC staff ability and experience to detect and identify FCM at different life stages, and symptoms		
Graders aware of pests and pest signs of FCM		

Documentation of pest detection incidences and action taken		
Status of reporting channel for pest detection in the packhouse		
Inspection to evaluation FCM status in final produce		
Overall score (44 pass mark)		
Recommendation		
SYSTEM 5: TRACEABILITY AND COMMUNICATION		
Protocol on traceability system in place		
Effectiveness of the traceability system		
Documented communication records of detected pest		
Overall score (12 pass mark)		
Recommendation		
SYSTEM 7: CAPACITY BUILDING AND TRAINING		
Farm management familiarity with market requirements (EU Directive 2019/2072)		
Policy on training and its implementation		
Competence of technical staff on FCM detection, identification and management		
FCM awareness by general staff		
Placement of pest cards and other training materials at strategic points on the farm for use by staff		
Quality assurance personnel familiarity with post-harvest treatments/challenges		
Overall score (12 pass mark)		
Recommendation		

FINAL RECOMMENDATION	
Farm may be allowed to export	Farm not allowed to export

Name of the inspector.....Date..... Time .....

Signature of the inspector.....

Name of the farm manager .....Date ..... Time.....

Signature of the farm manager.....

Scoring criteria

Rating	Score
Absence of an item	Very poor (1)
Present but ineffective	Poor (2)
Partly effective	Moderate (3)
Effective	Good (4)
Highly effective	Very good (5)

Annex 8. Plant protection products

Table 1 – Biopesticide products registered in Kenya for the control of false codling moth (FCM) and caterpillars on roses (according to the Pest Control Products Board list of registered products; http://www.pcpb.go.ke/biopesticides-on-crops/; consulted on 24 August 2020)

Trade name	Active ingredient	IRAC code[1]	Registered use
BACIGUARD 16 WDG	*Bacillus thuringiensis* var. aizawai 16000 IU/mg	11	Caterpillars
XENTARI DF or WDG	*Bacillus thuringiensis* var. aizawai 15000 IU/mg	11	Caterpillars
BIO-T-PLUS (formulation not specified)	*Bacillus thuringiensis* var. kurstaki 9×10^7 spores/mg	11	Caterpillars
DIPEL DF	*Bacillus thuringiensis* var. kurstaki 54% w/w + fermentation solids	11	Caterpillars
BN3 5 WP	*Bacillus thuringiensis* var. kurstaki 5% w/w	11	Caterpillars
FREND 5 WP	*Bacillus thuringiensis* var. kurstaki 32000×10^{11} CFU/g	11	Caterpillars
HALT 50 WP	*Bacillus thuringiensis* var. kurstaki 5% w/w	11	Caterpillars
CRYPTEX SC	*Cryptophlebia leucotreta* granulovirus (CrleGV) 2×10^{13} GV/L	31	FCM

1 All insecticides with the same mode of action (MoA) are grouped together in the internationally recognized IRAC (Insecticide Resistance Action Committee) mode of action classification scheme (each group is represented by a number code), which can be consulted at the following address: https://irac-online.org/modes-of-action/. It is strongly recommended to use insecticides with different modes of action in sequence or in rotation across insect generations to prevent insecticide resistance.

SC – Suspension Concentrate
WDG – Water Dispersible Granules
DF – Dry Flowable
WP – Wettable Powder

Table 2 – Conventional pesticide products registered in Kenya for the control of false codling moth (FCM) and caterpillars on roses (according to the Pest Control Products Board list of registered products; http://www.pcpb.go.ke/crops/; consulted on 24 August 2020)

Trade name	Active ingredient	IRAC code[2]	WHO classification[3]	Registered use
BESTCARB 90 SC	Abamectin 30g/L + Indoxacarb 60g/L	Abamectin: 6 Indoxacarb: 22A	II	Caterpillars
DUDUFIX 90 SC	Abamectin 30g/L + Indoxacarb 60g/L	Abamectin: 6 Indoxacarb: 22A	II	Caterpillars
EVIDENT MAX 150 SC	Abamectin 30 g/l + Indoxacarb 120 g/L	Abamectin: 6 Indoxacarb: 22A	II	FCM
FIREWORKS 90 SC	Abamectin 30 g/L + Indoxacarb 60 g/L	Abamectin: 6 Indoxacarb: 22A	III	Caterpillars
SOLARIS 90 SC	Abamectin 30 g/L + Indoxacarb 60 g/L	Abamectin: 6 Indoxacarb: 22A	II	Caterpillars
DUALIS 2% EC	Abamectin 4 g/L + Lambda-cyhalothrin 16 g/L	Abamectin: 6 Lambda-cyhalothrin: 3A	II	Caterpillars
EMPEROR TOP 100 SC	Abamectin 20 g/L + Methoxyfenozide 80 g/L	Abamectin: 6 Methoxyfenozide: 18	II	Caterpillars
ORTRAN 97% WDG	Acephate 970 g/ kg	1	II	FCM
RUBIPRID 200 SP	Acetamiprid 200g/kg	4A	II	FCM
ELECTRA 120 EC	Acetamiprid 100 g/L + Emamectin benzoate 20 g/L	Acetamiprid: 4A Emamectin benzoate: 6	II	Caterpillars

2 All insecticides with the same mode of action (MoA) are grouped together in the internationally recognized IRAC (Insecticide Resistance Action Committee) mode of action classification scheme (each group is represented by a number code), which can be consulted at the following address: https://irac-online.org/modes-of-action/. It is strongly recommended to use insecticides with different modes of action in sequence or in rotation across insect generations to prevent insecticide resistance.

3 The WHO (World Health Organization) recommended classification of pesticides by hazard sets out a classification system to distinguish between the more and the less hazardous pesticides based on acute risk to human health (that is the risk of single or multiple exposures over a relatively short period of time): Ia - Extremely hazardous; Ib - Highly hazardous; II - Moderately hazardous; III - Slightly hazardous; U - Unlikely to present acute hazard. The all classification document can be consulted at the following address:https://www.who.int/foodsafety/publications/classification-pesticides/en/. It is strongly recommended to use the least hazardous pesticides whenever possible.

Trade name	Active ingredient	IRAC code[2]	WHO classification[3]	Registered use
RAPID 120 EC	Acetamiprid 100 g/L + Emamectin benzoate 20 g/L	Acetamiprid: 4A Emamectin benzoate: 6	II	Caterpillars
BETAFOS 263 EC	Beta cyfluthrin 12.5g/L + Chlorpyrifos 250g/L	Beta cyfluthrin: 3A Chlorpyrifos: 1B	II	Caterpillars
BIFERAN 25 EC	Bifenthrin 25g/L	3A	II	Caterpillars
BRIDGE 80 SC	Bifenthrin 80g/L	3A	II	Caterpillars
SEIZER 80 SC	Bifenthrin 80g/L	3A	II	Caterpillars
EVERTRAP 50 SP	Cartap Hydrochloride 500g/L	14	II	Caterpillars
BETACYDE 25 EC	beta-Cyfluthrin 2.5%	3A	Ib	Caterpillars
VANTEX 60 CS	gamma-Cyhalothrin 60g/L	3A	Not listed	Caterpillars
DUDUTHRIN SUPER EC	lambda-Cyhalothrin 50g/L	3A	II	Caterpillars
FLORATOX 2.5 EC	lambda-Cyhalothrin 25g/L	3A	II	Caterpillars
HALOTHRIN 2.5 EC	lambda-Cyhalothrin 25g/L	3A	II	Caterpillars
LAMBDEX 5 EC	lambda-Cyhalothrin 50g/L	3A	II	Caterpillars
UMEME TOP 5 EC	lambda-Cyhalothrin 50g/L	3A	II	Caterpillars
ALPHACIDE 10 EC	alpha-Cypermethrin 100g/L	3A	II	Caterpillars
DEGREE 100 EC	alpha-Cypermethrin 100g/L	3A	II	Caterpillars
REASON 10 EC	alpha-Cypermethrin 100g/L	3A	II	Caterpillars

Trade name	Active ingredient	IRAC code[2]	WHO classification[3]	Registered use
TATA CYPER 10 EC	Cypermethrin 100g/L	3A	II	Caterpillars
PROFILE 440 EC	Cypermethrin 40g/L + Profenofos 400g/L	Cypermethrin: 3A Profenofos: 1B	II	Caterpillars
ROCKET 44 EC	Cypermethrin 40g/L + Profenofos 400g/L	Cypermethrin: 3A Profenofos: 1B	II	Caterpillars
ATOM 2.5 EC	Deltamethrin 25 g/L	3A	II	Caterpillars
BELLERIN 2.5 % EC	Deltamethrin 25g/L	3A	II	Caterpillars
DOBERMAN 15% OD	Deltamethrin 20 g/L + Thiacloprid 130g/L	Deltamethrin: 3A Thiacloprid: 4A	II	Caterpillars
AMIGUS 500 SC	Diafenthiuron 500g/L	12A	II	Caterpillars
MERCUR 500 SC	Diafenthiuron 500gm/L	12A	III	Caterpillars
PEGASUS 500 SC	Diafenthiuron 500gm/L	12A	III	Caterpillars
DIAZATE 540 EW	Diazinon 540g/L	1B	II	Caterpillars
DIAZOL 60 EC	Diazinon 600g/L	1B	II	Caterpillars
TIAZINON 600 EC	Diazinon 600 g/L	1B	II	Caterpillars
STARKLE 20 SG	Dinotefuran 200g/kg	4A	III	Caterpillars
EABCL CONTEST 5.7 WDG	Emamectin benzoate 57 g/L	6	III	Caterpillars
ESCORT 19 EC	Emamectin benzoate 19 g/L	6	III	Caterpillars
PRESHAUR 5 EC	Emamectin benzoate 50 g/L	6	II	Caterpillars
TATUA 5 EC	Emamectin benzoate 50 g/L	6	II	Caterpillars

Trade name	Active ingredient	IRAC code[2]	WHO classification[3]	Registered use
BENOCARB 10 SC	Emamectin benzoate 15g/L + Indoxacarb 85g/L	Emamectin benzoate: 6 Indoxacarb: 22A	II	Caterpillars
OCCASION STAR 200 SC	Emmamectin benzoate 40g/L + Indoxacarb 160g/L	Emmamectin benzoate: 6 Indoxacarb: 22A	III	Caterpillars
RELAY 150 SC	Emamectin benzoate 50 g/L + Indoxacarb 100 g/L	Emamectin benzoate: 6 Indoxacarb: 22A	II	Caterpillars
LEGACY EXTREME 500 WDG	Emamectin benzoate 100 g/kg + Lufenuron 400 g/kg	Emamectin benzoate: 6 Lufenuron: 15	III	Caterpillars
TOTAL TOUCH 250 SC	Emamectin benzoate 10 g/L + Tebufenozide 240 g/kg	Emamectin benzoate: 6 Tebufenozide: 18	II	Caterpillars
PRINCESS GOLD 100 SC	Imidacloprid 75g/L + Pyriproxyfen 25g/L	Imidacloprid: 4A Pyriproxyfen: 7C	III	Caterpillars
AVAUNT 150 EC	Indoxacarb 150 g/L	22A	II	Caterpillars
FLONEX 15% SC	Indoxacarb 150 g/L	22A	II	Caterpillars
INDOKING 300 SC	Indoxacarb 300 g/L	22A	III	Caterpillars
INDOX 150 SC	Indoxacarb 150 g/L	22A	III	Caterpillars
COVENANT TOP 340 SC	Indoxacarb 140 g/L + Thiamethoxam 200 g/L	Indoxacarb: 22A Thiamethoxam: 4A	II	Caterpillars
HERITAGE GOLD 250 SC	Lufenuron 50 g/L + Thiamethoxam 200 g/L	Lufenuron: 15 Thiamethoxam: 4A	II	Caterpillars
PROCROWN 500 EC	Profenofos 500g/L	1B	II	Caterpillars

Trade name	Active ingredient	IRAC code[2]	WHO classification[3]	Registered use
DELEGATE 250 WDG	Spinetoram 250 g/kg	5	U	FCM
FIDELITY 400 WDG	Spinetoram 100 g/kg + Sulfoxaflor 300 g/kg	Spinetoram: 5 Sulfoxaflor: 4C	III	Caterpillars
SANTORINI 480 SC	Spinosad 480g/L	5	III	Caterpillars
TRACER 480 SC	Spinosad 480 g/L	5	III	Caterpillars[4]

4 This product is registered for cut flowers and vegetables

SC – Suspension Concentrate
EC – Emulsifiable Concentrate
WDG – Water Dispersible Granules
SP – Soluble Powder
CS – Capsule Suspension
OD – Oil Dispersion
EW – Emulsion, oil in water
SG – Water soluble granules