NSPM -13

Requirements for Establishment of Pest Free Area for Mango Nut (Seed) Weevil (*Sternochetus mangiferae*) and Pulp Weevil (*S. frigidus*)

Government of India
Ministry of Agriculture
Department of Agriculture & Cooperation
Directorate of Plant Protection, Quarantine & Storage
N.H.IV., Faridabad-121001

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CONTENTS

Endorsement

This standard on **'Requirements for establishment of pest free areas for mango nut (seed) and pulp weevils'** provides necessary guidelines and requirements for establishment, maintenance and verification of pest free areas for mango nut (seed) and pulp weevils and use as a risk management option for undertaking phytosanitary certification of export of fresh fruits of mango from pest-free areas or provide scientific justification for phytosanitary measures for protection of endangered pest free area. This standard would enable the recognition of pest free areas in line with provisions of international agreements and thus facilitate the trade.

This standard is approved for adoption on 12th May 2005 by:

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(P.S. Chandurkar)
Plant Protection Adviser
Dte of Plant Protection, Quarantine & Storage,
NH-IV., **Faridabad-121001.**

Review and Amendment

This standard would be subject to periodic review and amendment. The next review date for this standard would be April 2007 or any other date as may be considered by Plant Protection Adviser (PPA). The standard would be updated and revised if necessary. The standard holders should ensure that the current edition of this standard is being used.

Control & Distribution of the standard

The master copy of this standard shall be held with PPA and controlled copies would be distributed by Joint Director (PQ), Directorate of Plant Protection Quarantine & Storage, Faridabad to the National/Regional Plant Quarantine Stations; State Department of Agriculture/ Horticulture; ICAR Research Institutes/State Agriculture Universities: APEDA as listed below and to any other organization, to whom the distribution has been approved by the PPA. Any clarifications/enquiries regarding this standard would be made to the Joint Director (PQ), Dte of PPQS, Faridabad-121001**.**

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INTRODUCTION

SCOPE

This standard describes the requirements for the establishment and use of pest free areas (PFAs) for mango nut (seed) and pulp weevils as a risk management option for phytosanitary certification of fresh fruits of mango exported from the PFA or scientific justification for phytosanitary measures taken for protection of an endangered PFA.

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Specifications for the development of monitoring survey for mango pulp weevil (Sternochetus frigidus Fabricus) and mango seed weevil (S. mangiferae Fabricus) in India. 2004.AQIS, Department of Agriculture, Fisheries and Forestry, Canberra ACT, Australia.

DEFINITIONS AND ABBREVIATIONS

Area:	An officially defined country, part of a country or all or parts of several countries.
Buffer zone:	An area in which a specific pest does not occur or occurs at a low level and is officially controlled, that either encloses or adjacent to an infested area, an infested place of production or a pest free production site, and in which phytosanitary measures are taken to prevent the spread of the pest.
Delimiting survey:	Survey conducted to establish the boundaries of an area considered to be infested by or free from a pest.
Detection survey:	Survey conducted in an area to determine if pests are present.
IPPC:	International Plant Protection Convention as deposited in 1951 with FAO, Rome and as subsequently amended.
Monitoring survey:	Ongoing survey to verify the characteristics of a pest population.
National Plant Protection	

Organization (NPPO): Official service established by a government to discharge the functions specified by the IPPC.

Official: Established, authorized or performed by a NPPO

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Pest: Any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products.

Pest free area (PFA): An area in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained.

Pest record: A document providing information concerning the presence or absence of a specific pest at a particular location, at a certain time, with in an area (usually a country) under described circumstances

Pest status (in area): Presence or absence, at the present time, of a pest in an area, including where appropriate its distribution, as officially determined using expert judgment on the basis of current and historical pest records and other information.

Phytosanitary certification: Use of phytosanitary procedures leading to the issue of phytosanitary certificate

Phytosanitary measure: Any legislation, regulation or official procedure having the purpose to prevent the introduction and/or spread of pests.

Phytosanitary regulation: Official rule to prevent the introduction and/or spread of quarantine pests, by regulating the production, movement or existence of commodities or other articles, or the normal activity of persons, and by establishing schemes for phytosanitary certification.

Quarantine pest: A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled.

Survey: An official procedure conducted over a definite period to determine the characteristics of a pest population or to determine which species occur in an area.

Surveillance: An official process, which collects and records data on pest occurrence or absence by survey, monitoring or other procedures.

1. REQUIREMENTS FOR ESTABLISHMENT OF PESTFREE AREAS (PFAs)

1.1. Determination of Pest free area

Agriculture Products Export Development Authority (APEDA), with a view to gain market access for fresh fruits, has organized surveys involving the experts from Indian Institute of Horticulture Research, Bangalore and Central Institute for Sub-tropical Horticulture Research, Lucknow for determination of pest status of mango nut (seed) weevil in the states of Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Tamil Nadu and Uttar Pradesh States. The initial survey results has revealed that the production areas of Navsari and Valsad of Gujarat State; Devgad, Kudal, Malvan, Sawantwadi & Vengurla of Maharashtra State; and Barbanki, Malihabad & Saharanpur of Uttar Pradesh State can be considered for the establishment of pest free areas for the mango nut (seed) and pulp weevils. The various steps involved for establishment of pest free areas (PFAs) described in Appendix-1 and the details of biology of mango nut (seed) and pulp weevil described in Appendix-2 and 3.

1.2. Delimiting surveys

Delimiting surveys would be organized as per the survey plan approved by the Directorate of Plant Protection, Quarantine & Storage (Ministry of Agriculture) to establish the boundaries of an area considered to be infested by or free from a target pest (s) viz., mango nut (seed) and pulp weevils. These surveys would involve the experts from Directorate of Plant Protection, Quarantine & Storage (Dte of PPQS); Indian Institute of Horticulture Research (IIHR), Bangalore; Central Institute for Sub-tropical Horticulture Research (CISHR), Lucknow; Konkan Krishi Vidya Peeth (KKVP), Dapoli, Maharashtra State; Gujarat Agriculture University (GAU), Navasari, Gujarat State; Sardar Vallabhbhai Patel University of Agriculture & Technology (SVPUAT), Modipuram, Meerut, Uttar Pradesh State; Department of Horticulture/Agriculture, Maharashtra/Gujarat/Uttar Pradesh States; and APEDA. These surveys would be carried out at fruiting stage (>65days after flower induction) for at least two cropping seasons to establish pest free areas in above considered production areas as per section 1.10..

1.3. Detection Surveys

Detection surveys would be organized on regular basis, in order to determine, if target pest(s) are present in the PFAs and the adjoining buffer zones. The Department of Agriculture/Horticulture of the respective States of Maharashtra, Gujarat & Uttar Pradesh would be responsible for organizing such surveys with the help of SAUs on annual basis. The surveys would be conducted as per the survey plan approved by PPA. The technical personnel involved in the survey would be adequately trained in appropriate field of plant protection and data management at the Indian Institute of Horticulture Research, Bangalore Audit checks of the trained personnel would be conducted in sampling methods, preservation and transportation of specimens for identification and record keeping and identifying ability. Detection surveys would be organized during every season at the stage of >65 days after flower induction as per section 1.10. At the end of survey a copy of the report should be forwarded to PPA.

1.4. Implementation of Quarantine measures

Domestic quarantine legislation, if feasible, should be considered for restricting the movement of plant material of Mango (*Mangifera indica*, *Mangifera foetida*) including fresh fruits from the States of Assam, Meghalaya, Manipur, Tripura & West Bengal to any other States in India so as to prevent the spread of mango pulp weevil (*S. frgidus*).

1.5. Recognition of PFAs

Department of Agriculture & Cooperation (MOA) would notify the import contracting party, the designated pest free areas or any additional areas for consideration.

1.6. Phytosanitary security of the fruits from PFAs to packinghouses and treatment facilities

Department of Agriculture & Cooperation (MOA) would authorize APEDA to undertake registration of packinghouses for maintaining the phytosanitary security of the product from the above stated quarantine pests after harvest, transport, processing & storage at the packinghouses.

Department of Agriculture & Cooperation (MOA) would advise the import contracting party on how the export fruits from pest free areas would be kept secure during storage and transport (to prevent mix up with fruit from non-pest free areas) from the orchards to packing houses and from packinghouses to treatment facilities and the procedures would be documented.

1.7. Routine Monitoring

Regular monitoring to confirm on-going freedom of pest free areas should be undertaken by the Dte of PPQS and the results would be submitted through Department of Agriculture & Cooperation (MOA) to import contracting party for consideration before the commencement of each export season.

1.8. Notification of detection of pest in PFAs

Department of Agriculture & Cooperation (MOA) would notify the import contracting party of any detection of mango seed (nut) weevil or pulp weevil in designated PFAs during routine monitoring and surveys conducted in the production season.

Pest free area status would be reinstated only after two years of monitoring surveys showing nil pest infestation.

1.9. Phytosanitary Inspection of Export Consignments

Directorate of Plant Protection, Quarantine & Storage (MOA) would organize inspection of export consignments at the registered packinghouses. A phytosanitary certificates would be

issued confirming that mango seed (nut) weevil and mango pulp weevil are not known to occur in designated pest free area (s) and that the consignment is free from the pests indicated above.

Any pest detection in export consignments would be informed to the import contracting party and further export of consignments would be suspended from that area until the pest free status of that area is reinstated.

1.10. Monitoring surveys

Department of Agriculture & Cooperation (MOA) will undertake monitoring survey to confirm pest free status of the designated PFAs established for the production areas of Barbanki, Malihabad & Saharanpur of Uttar Pradesh State; Navsari and Valsad of Gujarat State; Devgad, Kudal, Malvan, Sawantwadi & Vengurla of Maharashtra State.

1.10.1. Survey Area

- Maps sowing the boundaries of nominated pest free areas/municipalities/and location of orchards in each area/municipality covered by the monitoring survey

- Information on the size of each area/municipality, list of properties/orchards in each area/municipality, size of each orchard and number of trees in each orchard

- Fruit bearing trees for inspection and fruit sampling should be selected from each orchard in each area/municipality using grid map and random numbers

1.10.2. Frequency of survey

- Monitoring surveys would be conducted during each year of mango production for each currently designated pest free area and any additional areas before consignments would be permitted for export..

- Monitoring would involve field inspections and fruit cutting done at least once during the growing season before harvest.

- The results of the monitoring survey would be submitted to import contracting party before access can be considered.

1.10.3. Sampling Unit

- Each fruit bearing mango tree (4 years and above for grafted trees and 7 years and above for seeded trees), regardless of variety.

1.10.4. Sample Size

- Minimum number of fruit-bearing trees to be inspected and minimum number of fruits to be collected for pest detection from each area/municipality to ensure that the survey

would detect pest infestation with 99% confidence level, if at least 1% of trees were infested and 15% of fruits were infested per infested tree, should be as detailed in Table 1.

Table 1

Minimum number of fruit-bearing trees and number of fruit to be sampled per each area/municipality

Total number of fruit-bearing trees per each area/municipality*	Minimum number of trees to be inspected and sampled per each area/municipality	Minimum number of fruit to be collected for pest detection per each area/municipality @ minimum of 8 fruit/tree
400-500	414	3312
501-600	442	3536
601-1000	506	4048
1001-2000	564	4512
2001-3000	585	4680
3001-4000	596	4768
4001-5000	603	4824
5001-10000	617	4936
>10001	631	5048

* Areas/municipalities with <400 fruit bearing trees may not be considered as commercial mango production area and sampling of <400 trees does not achieve 99% level of confidence of pest detection. If numb er of trees per area/municipality are >400 but <414, all trees should be sampled.

- Minimum of 8 fruit from each selected tree should be collected for pest detection. Divide each tree into 4 quadrants where in from each quadrant, no less than 2 fruit should be collected randomly.

1.10.5. Stage of Fruiting

- Fruit selected for sampling should be at a stage of >65 days after flower induction. The survey should be conducted before the commencement of harvesting

- No fruits should be included in the survey results, if picked at <65days after induction of flowering.

1.10.6. Detection technique

- Fruits should undergo inspection by longitudinal cutting and dissection of nut (seed) and fruit pulp to check for the presence of mango nut (seed) or pulp weevil.

- Seed (nut) or fruit suspected of either mango seed (nut) weevil or pulp weevil infestation should be placed in a specimen container with a preserving solution of 80% alcohol and 5% glycerine and labeled with the following information viz., collection site, property name or owner's name, name of collector, collecting date. Specimens should be sent to the technical expert for identification.

- Other internal pests (e.g. *Bactrocera* spp. (fruit flies) and *Deanolis sublimbalis* (red banded cater pillar) detected during the fruit inspection should also be recorded on data recording form (Appendix-4).

1.11. Documentation & Review

The establishment and maintenance of a PFA should be adequately documented and reviewed by the Directorate of Plant Protection, Quarantine & Storage (Ministry of Agriculture). The documentation should include supporting evidence describing official controls including phytosanitary regulations, survey and monitoring protocols and results of survey and phytosanitary measures undertaken.

Appendix-1

Steps involved in Establishment of Pest–free areas for Mango nut (seed) and pulp weevils

1. Agriculture Products Export Development Authority (APEDA) would prepare a technical dossier giving geographic description of the proposed PFAs, places of production, size of area, natural barriers, buffer zones including mapping of pest distribution, climatic data, seasons, production systems etc., and submit to Department of Agriculture & Cooperation (Ministry of Agriculture).

2. Dte of PPQS would prepare protocols for establishment of PFAs in considered production areas and submit to Department of Agriculture & Cooperation (MOA) for approval

3. Department of Agriculture & Cooperation (Ministry of Agriculture) may hold consultation with Dte of PPQS/Scientists of ICAR Research Institutes (IIHR/CISHR)/Agriculture Universities (KKV/GAU/SVPUAT)/Department of Agriculture/ Horticulture of Maharashtra/Gujarat/Uttar Pradesh States/APEDA on proposed PFAs and requirements of establishment of PFAs and would finalize the protocols for establishment of PFAs in considered production areas.

4. A team of experts dawn from Dte PPQS/ICAR Research Institutes (IIHR/CIMR)/Agriculture Universities (KKV/GAU/ SVPUAT)/Department of Agriculture/ Horticulture of Gujarat/Maharashtra/Uttar Pradesh would conduct the delimitation surveys in proposed PFAs and submit the report for consideration of PPA and. approval of Department of Agriculture & Cooperation (MOA).

5. Department of Agriculture & Cooperation (MOA) may hold consultation with Dte of PPQS/State Department of Agriculture/Horticulture on the survey results and recommendations and adopts the report.

6. Department of Agriculture & Cooperation (MOA) would inform the designated PFAs to the NPPO of the importing country for consideration.

7. Department of Agriculture & Cooperation (MOA), if feasible, should issue a domestic regulatory measures for restricting the movement of plant material of mango (*Mangifera indica* and *M. foetida*) including fresh fruits from mango pulp weevil infested States to any other Sstate.

8. State Department of Agriculture/Horticulture (as indicated above) with the help of SAUs should organize detection surveys in designated PFAs as per protocols of survey approved by PPA and at the end of survey submits the reports to PPA.

9. Dte of PPQS would regularly monitor the implementation of appropriate phytosanitary measures by the respective State Department of Agriculture/Horticulture so as to maintain pest-free status of area. Such monitoring would include auditing of pest records, review of survey programmes, evaluation of measures undertaken and quality control protocols.

10. APEDA would undertake registration of packinghouse facilities located in un-infested zones in association with Dte of PPQS.

11. Department of Agriculture & Cooperation would bring out package of practices including pre-harvest control measures for use by the producers.

12. Dte of PPQS would organize inspection of export consignments at registered packinghouses and issue phytosanitary certificates confirming that mango seed (nut) weevil and mango pulp weevil are not known to occur in designated pest free areas and that the consignment is free from the pests indicated above.

13. Any pest detection in export consignments would be informed to the trading partner and further export of consignments would be suspended from that area until such time the pest free status of that area is reinstated.

14. Dte of PPQS would conduct monitoring survey to verify the characteristics of pest population in established PFAs

15. Department of Agriculture & Cooperation (Ministry of Agriculture) would periodically reviews the documentation for establishment of PFAs with trading partner.

Appendix-2

Description of Biology of Mango Nut (Seed) Weevil (*Sternochetus mangiferae*)

The mango nut (seed) weevil (*Sternochetus mangiferae*) belongs to the Family Curculinoidae of Order Coleoptera. It is restricted to mango (*Mangifera indica)* and affects the plant at fruiting stage. It infests fruits and seeds (nuts).

It is reported in India from union territory of Andaman & Nicobar Islands and states of Andhra Pradesh, Assam, Karnataka, Kerala, Maharashtra, Manipur, Orissa, Tamil Nadu, Tripura and West Bengal. The pest is reported to occur in Australia (Australian Northern Territory, New South Wales and Queensland.

Adults of *S. mangiferae* feed on the leaves and tender shoots of mangoes during March and April. They are nocturnal, fly readily and usually feed, mate and oviposit at dusk. After emergence, adults enter a diapause, which varies in duration with the geographic range. For example, in southern India, all adults emerging during June enter a diapause from July until late February of the following year. Adults are capable of surviving long, unfavourable periods. During non-fruiting periods, weevils diapause under loose bark on mango tree trunks and in branch terminals, or in crevices near mango trees. A few adults live through two seasons with a diapause period in between. Females begin oviposition 3-4 days after mating, when the fruit is about marble-size. This occurs about mid-March and reaches a peak during the first week of April. The oviposition period varies from 3-5 weeks. Females will oviposit on fruits and lay eggs mostly on the sinus of the fruit or sometimes on the stalks. The female makes a boat-shaped cavity in the skin (epicarp) into which an egg is deposited. She then covers each egg with a brown exudate and cuts a crescent-shaped area 0.25-0.50 mm in the fruit, near the posterior end of the egg. The wound creates a sap flow, which solidifies and covers the egg with a protective opaque coating. The eggs require an incubation period of 5-7 days. After hatching, the larva burrows through the flesh of the fruit and into the seed.

As the fruit and seed develop, the tunnel and seed entry are completely obliterated, so that in time it is impossible to distinguish infested from non-infested seeds, unless they are cut open. The minimum time from hatching to seed penetration is one day. Complete larval development usually occurs within the maturing seed. In southern India, larvae developed in the field between March and May and pupated in late May and early June, taking about a month to develop. There are five or seven larval instars. Pupation usually occurs within the seed and rarely in the flesh. The pupal period lasts about a week. Often only one adult will mature in each seed, but as many as six have been recorded. They cut their way out of the naked seed, usually via a small circular hole made in the concave edge of the endocarp, generally 4-8 weeks after the fruit falls and decays. Rarely, weevils emerge from the seed before fruit fall and eat their way through the flesh of the ripe fruit, ruining it completely. They rapidly move out of the seeds and seek hiding places by crawling, rather than flying. In south India, adults of the new generation emerge during June. The estimated time required for development from egg to adult is 35-54 days. Adults usually remain in the vicinity of the parent tree until the following fruiting season and high infestations appear year after year in some locations, while low infestations occur in others nearby.

The freshly laid eggs are creamy-white. They are elliptical, 0.72-0.87 mm (mean 0.79 plus or minus 0.20 mm) long and 0.24-0.34 (mean 0.29 plus or minus 0.01 mm) wide. First instar larvae are elongate, cylindrical, legless and extremely slender; they are 1.34-1.44 mm (mean 1.39 plus or minus 0.01 mm) long, and 0.30-0.41 (mean 0.35 plus or minus 0.02 mm) wide. The body is white and the head is black. Final instar larvae (4th or 5th instar) are white and leg less, they have a curved, typical curculionid form, and are 16.0-18.0 mm (mean 16.7 plus or minus 0.28 mm) long, and 6.0-9.0 mm (mean 8.0 plus or minus 0.32 mm) wide The head is black, and is not retracted into the prothorax. The pronotal plate is strongly transverse. The typical abdominal segment is tripartite. The terga does not have coarse asperities, and the spiracles are annular biforous. The pupae are whitish when newly formed, but change to a very pale red colour just before eclosion. They are 7.0-10.0 mm (mean 8.6 plus or minus 0.27 mm) long and 6.0-8.0 mm (mean 6.95 plus or minus 0.22 mm) wide. The abdominal apex has paired urogomphi. The adults have a compact body, 7.5-9.5 mm long. They are black, and covered with black, greyish or yellowish scales. The pronotum is subparallel-sided in the basal third only. Interstices 3, 5 and 7 of the elytra are strongly carinate. There is an indistinct oblique pale humeral stripe on the elytra, which is elongate (6:4) and gradually declivous behind. The femora have a single large tooth ventrally. The profemora are stout, and distinctly clavate. The tarsal claws are simple and free. The female has an elevated ridge at the pygidial apex, which is absent in the male.

The adults of *S. mangiferae* are similar to those of *S. frigidus*, but can be distinguished from them because in the latter the pronotum is parallel-sided in the basal half, the elytra are shorter (5:4) and strongly declivous behind, and the profemora is slender, not clavate.

Appendix-3.

Description of Biology of Mango pulp weevil (*S. frigidus*)

The hosts of *S. frigidus* are cultivated and wild *Mangifera spp*, including all varieties of *M. indica* as well as *M. foetida*. However, oviposition on the latter species is rare. Unlike mango nut (seed) weevil, the pulp weevil usually infests the fruit pulp but not the nut (seed).

Un like the mango nut (seed) weevil, pulp weevil has restricted distribution in India and is reported from Assam, Manipur, Meghalaya, Tripura and West Bengal

The immature adults of *S. frigidus* over winter inside seeds or other protective places from May until February in Tripura area of India,. Mating occurs 10-15 days after termination of hibernation. Oviposition occurs from March to May on immature mango fruits. The male to female ratio is approximately 1:1.4. The adult weevils hide during the day, for example in bark crevices or under epiphytic plants. They are well camouflaged because of their cryptic colouration. They feed at night on the gum that exudes from puncture wounds on young fruits. *S. frigidus* are strong fliers but do not move far from their emergence sites. The adults mate repeatedly. The eggs are laid on fruits with a minimum diameter of 6 cm. The females remove a piece of peel, oviposit, and cover the eggs with a brown layer of gum and faeces. A crescent-shaped incision is found around the oviposition site. A female will often lay her total daily quota of eggs in one fruit. If suitable fruits are available, females lay about eight eggs daily, producing a total of 75 (maximum 180 eggs) in 3 weeks. However, if deprived of suitable fruits for 5 months, the egg production drops to three eggs per day; additional delays lead to further reduction in oviposition. The female dies soon after oviposition. The eggs hatch after 4-65 days depending on the temperature. The newly hatched larva tunnels directly through the fruit pulp to the kernel, avoiding the gum-laden tissues because contact with them may cause its death. The shell of the kernel is not attacked but while boring through the pulp, the larvae imbibe the exuding sap, so that the tunnel remains relatively dry. The granular faeces accumulate in the hole formed by feeding. The larvae form a chamber adjacent to the kernel from which they tunnel into the pulp. Pupation takes place in a brown cocoon, constructed of frass, within these chambers. The weevils leave the ripe fruit through a hole in the peel. Before they emerge, the fruit shows no outward sign of infestation. After 6 weeks they are fully mature and are able to mate. Studies on the survival of newly hatched larvae reveal that exuding gum is responsible for 30-50% mortality. Dry conditions are thought to affect young adults adversely. Large populations of *S. frigidus* are generally only found in sites with high humidity, containing large stands of cultivated species of mango (*M. indica*) and wild species of mango (*M. foetida*), which flower more than once a year. Weevils that survive from the preceding year infest fruit formed after the earliest flowering. If early flowering does not occur, they attack the fruits formed after the main flowering period. An extended flowering period leads to the production of large numbers of weevils. In a dry year, or if only one flowering period occurs, the weevil population remains low (on average four eggs per fruit). Up to 20% of the larvae die when the fruits are harvested, because they are unable to complete their development. Adults found in the fruits usually survive and may assist in the dispersal of the pest.

The eggs of *S. frigidus* are white or pale yellow and elliptical in shape; the average length is 0.6 mm, and the average width is 0.28 mm. The larval body is white to creamy-white, about 7.5-10.0 mm long, moderately curved, and sub-cylindrical with a terminal anal segment. The head is pale yellow-brown, it is about 1.0 mm wide and slightly longer than it is wide. The head is not retracted into the prothorax. There is one ocellus on each side of the head. The frons has a dark median line posteriorly. The labial palpi are two-segmented. The apical palpal segments are very short. The mandible is bidentate apically, with angulation near the middle of the dorsal edge. The pronotal plate is strongly transverse. The typical abdominal terga has three folds. The anal segment has four lobes. Skin with sparse extremely small asperities is generally distributed over the entire body. The spiracles are biforous. The air-tubes of the spiracles are well developed on the abdomen; the air-tubes of the posterior pair are at least half as long as the peritremes. The pupae of *S. frigidus* are about 7.5-8.0 mm long and robust. The pupae are white, and the setae are reddish brown. The apex of the urogomphi is black. The pupal eyes are prominent. The rostrum is about one quarter the length of the body and is slightly broadened apically. The pronotum bears nine setae on each side; the mesonotum bears three setae on each side and the metanotum bears two setae on each side. The abdominal segments each bear four setae on each side above the spiracle, plus one seta below the spiracle; segment nine bears a pair of sharply pointed and posteriorly curved urogomphi, each bearing a seta. There are spiracles on the first seven abdominal segments.

Adults of *S. frigidus* and *S. mangiferae* are similar; they can be distinguished because the pronotum of *S. frigidus* is parallel-sided in the basal half; the elytra is only one quarter as long as it is broad and is strongly declivous apically; the profemora is slender, not clavate**.**

Appendix-4

Data Recording Form

1. Name of Survey Area/Municipality: **2. Date of Survey:**

3. Total No. of Properties/Orchards in Survey Area/Municipality: **4. No of Properties/Orchards:**

5. Name of the Surveyor/Authorized Agency: **6. Whether conditions:**

7. Survey Results:

S. No.	Name of Orchard/ Property surveyed	No. of fruit bearing trees present	No. of fruit bearing trees sampled	Total No. of fruits sampled @ minimum of 8 fruits/tree	No. of fruits infested with			Comments/Any specific observations mango varieties/ Name of other pests detected)
					Mango seed weevil	Mango pulp weevil	Other pests	