ENTOMOLOGY SAMPLING PROTOCOLS
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Sampling Twenty Plants at random in each field unless otherwise indicated. As a rule of thumb, any insect not covered below (i) are collected for identification (ii) counted if numbers permit or damage/numbers assessed on the basis of the scoring systems given below. Insects marked with * below should be brought back to laboratory for identification.

2.2.1. MAIZE

Stem/Stalk borers *(Chilo partellus, Sesemia calamistis, Busseola fusca, Eldana saccharina)* – count numbers of tunnel entrances or exists/plant stalks and in leaf whorl.

African bollworm *(Helicoverpa armigera)* - count larvae in cobs

Cutworms *(Agrotis spp)* - record presence or absence [+/-]

Armyworm *(Spodoptera exempta)* - record presence or absence [+/-]

Leaf Hopper *(Cicadulina mbila)* - vector of msv, count numbers on one leaf.

Chafer grubs - record presence or absence [+/-]

Termites – score damage:
0 = None present
1 = Girdling of stem
2 = Moderate earthing
3 = Stalks fall

Aphids score numbers:
0 = None present
1 = > 50 Individuals/plant
2 = 50-100 Individuals/plant
3 = > 100 Individuals/plant

2.2.2. BEANS

Pod Borer *(Maruca testulalis)* and * bruchids – inspect five pods at random/plant sampled, if borer present, dissect and identify.

African bollworm *(Helicoverpa armigera)* – count number of larvae/plant

Blue Beetle *(Ootheca bennigseni)* - Count numbers on whole plant

Pollen Beetle *(Coryna apicicornis)* – Count numbers on whole plant.

Sucking pests *(Riptortus dentipes, Anoplocnemis curvipes)* – total number on plant.

Spiny brown bug *(Clavigralla spp)* –count numbers on whole plant.

* **Aphids** *(Aphis craccivora, Aphis fabae)* and various other species – samples taken for identification with numbers scored on the following scale.

      0 = No Aphids present
      1 = > 50 Individuals/plant
      2 = 50-100 Individuals/plant
      3 = > 100 Individuals/plant

* **Thrips** (various species) – count numbers on three leaves taken at random and three flowers also taken at random. Retain specimens for identification if necessary.

* **Apion Weevil** *(Apion s)* – count numbers on three leaves taken at random

* **Cutworm** *(Agrotis spp)* – on all crops > 4 weeks old, sample at the base of 20 plants for larvae.

* **Beanflies** *(Ophiomyia spp)* – record presence or absence [+/-].

* **Blister Beetle** *(Mylabris spp)* – Count numbers on whole plant.

* **Thrips** – count numbers in 5 open flowers/plant

* **Mites** *(Tetranyschus spp* and various others) – samples taken for laboratory identification with damage to leaves by mites scored for the whole plant on the following scale:-

0 =   NO LEAF DAMAGE due to mite feeding.
1 =   SLIGHT DAMAGE a few leaves showing slight symptoms of
      mite attack.
2 =   MODERATE DAMAGE many leaves showing moderate symptoms of
      mite attack.
3 =   SEVERE DAMAGE the majority of leaves showing serious damage.

2.2.3. IRISH POTATOES

Using $0.5m^2$ quadrat, take 10 random samples and count insects or score as appropriate.

Tuber moth *(Phthorimaea opeculla)* score at harvest using the following key:
      0 = No damage
      1 = Slight damage <10%
      2 = Moderate damage 10 – 50%
      3 = Severe damage > 50%

Jassids *(Empoasca spp)* – count numphs and adults on 5 leaves/quadrat.

Meal bugs *(Planococcus spp)* score as for Aphids.

Russet Mite *(Aculops app)*

0 =   NO LEAF DAMAGE due to mite feeding.
1 =   SLIGHT DAMAGE a few leaves showing slight symptoms of
        mite attack.
2 =   MODERATE DAMAGE many leaves showing moderate symptoms of
        mite attack.
3 =   SEVERE DAMAGE the majority of leaves showing serious damage.

Cutworm *(Agrotis spp)* – score presence or absence [+/-]

Mole Rats count the number of mounds in a 25m^2 of field.

Aphids *(Aphis gossipi)* – score numbers
      0 = No Aphids present
      1 = > 50 Individuals/plant
      2 = 50-100 Individuals/plant
      3 = > 100 Individuals/plant

2.2.4. SWEET POTATOES

Using 0.5m^2 quadrat, take 10 random samples and count insects or score as appropriate.

Sweet potato weevils *(Cylas puncticollis, C, formicarius, C. brunneus)* – count the numbers of adults, indicate species. If present at harvest, score external tuber damage on a radom sample of 50 tubers.
      0 = No damage
      1 = Fewer than 5 feeding/oviposition holes
      2 = 5 – 10 feeding/oviposition holes
      3 = >10 feeding/oviposition holes

White flies *(Bemisia tabaci)* - count nymphs on 5 leaves/quadrat.

Mole Rats count the number of mounds in a 25m^2 of field.

Leaf Roller *(Brachmia convolvuli)* **–** Count leaf rolls.

* Clear wing moth *(Synanthedon spp)* count numbers

* Snout beetle *(Alcidodes spp)* **–** count numbers

* Tortoise beetles *(Aspidomorpha spp, Cassida spp)* count numbers

* Aphids
      0 = No Aphids present
      1 = > 50 Individuals/plant
      2 = 50-100 Individuals/plant
      3 = > 100 Individuals/plant

2.2.5. TOMATOES

White flies *(Bemisia tabaci)* - count nymphs on 5 leaves/quadrat.

Leaf miner *(Liriomyza trifolii)* – 3 leaves sampled at random from each plant and the total number of live larvae and total mines counted from each. There will be 2 columns needed for this insect, unless the values are represented as live/total mines,

African bollworm *(Helicoverpa armigera)* –Whole plant sampled for (i) visible live larvae and (ii) bollworm damage to fruit but with larvae no longer present.

*Any other Lepidoptera –Whole plant sampled with specimen being brought back for rearing out if there is doubt about identification.

* **Aphids** (various species) – samples taken for identification with numbers scored on the following scale.

      0 = No Aphids present
      1 = > 50 Individuals/plant
      2 = 50-100 Individuals/plant
      3 = > 100 Individuals/plant

* **Mites** *(Tetranyschus spp, Aculops lycopersici)* – samples taken for laboratory identification with damage to leaves by mites scored for the whole plant on the following scale:-

0 = NO LEAF DAMAGE due to mite feeding.
1 = SLIGHT DAMAGE a few leaves showing slight symptoms of
     mite attack.
2 = MODERATE DAMAGE many leaves showing moderate symptoms of
     mite attack.
3 = SEVERE DAMAGE the majority of leaves showing serious damage.

* **Thysanoptera** – three leaves sampled at random from each plant, total numbers counted. Sample brought back for identification if in doubt.

2.2.6. BRASSICA

Diamondback Moth *(Plutella maculipennis)* – score damage to leaves.

      0 = No damage
      1 = <10% of leaves damaged
      2 = 10 – 50% of leaved damaged.
      3 = > 50% of leaves damaged.

Oriental cabbage moth *(Hellula undalis)* –count total larvae on plant.

Flea Beetle *(Haltica pyrutosa)* – total numbers on plant

Slugs – presence or absence [+/-]

* **Aphids** (various species) – samples taken for identification with numbers scored on the following scale.
      0 = No Aphids present
      1 = > 50 Individuals/plant
      2 = 50-100 Individuals/plant
      3 = > 100 Individuals/plant

Cabbage Sawfly *(Athalia sjostedti)* **–** as for Plutella.

* **Bagrada Bug** *(Begrada spp)* – total number on plant

Cutworm *(Agrotis spp)* – on all crops < 4 weeks old, sample at the base of 20 plants for larvae.

*Other Lepidoptera –Total numbers/plant with specimen being brought back for rearing out if there is doubt about identification.

2.2.7. ONIONS

Thrips *(Thrips tabaci)* – Shake leaves by tapping three times over a sheet of paper, count the number of Thrips collected on sheet.

African bollworm *(Helicoverpa armigera)* –Count on newly harvested bulbs.

2.2.8. CUCURBITS

Melon Fruit fly *(Dacus cucurbita)* – Score healthy vs affected fruits.

* **Aphids** Score numbers
      0 = No Aphids present
      1 = > 50 Individuals/plant
      2 = 50-100 Individuals/plant
      3 = > 100 Individuals/plant

* **Leaf eating lady birds** *(Epilachna spp)* – Count adults and larvae on 5 leaves/plant.

2.2.9. ORNAMENTAL FLOWERS

Sample 20 plants at random.

* **Aphids** Score numbers
>   0 = No Aphids present
>   1 = > 50 Individuals/plant
>   2 = 50-100 Individuals/plant
>   3 = > 100 Individuals/plant

* **Scales and mealy bugs** – score numbers present at 20 randomly selected leaves and stems.
>   0 = None present
>   1 = <20
>   2 = 20-50
>   3 = > 50

* **Mites** – Score the umbers present

0 = NO LEAF DAMAGE due to mite feeding.

1 = SLIGHT DAMAGE a few leaves showing slight symptoms of mite attack.

2 = MODERATE DAMAGE many leaves showing moderate symptoms of mite attack.

3 = SEVERE DAMAGE the majority of leaves showing serious damage

* **Leaf miner** *(Liriomyza trifolii)* – Count mines on 3 leaves/plants.

2.2.10. PYRETHRUM

* **Thrips** *(Thrips tabaci)* – Count numbers on 5 open flowers/plant..

* **Red Mites** – Score the umbers present

0 = NO LEAF DAMAGE due to mite feeding.

1 =   SLIGHT DAMAGE a few leaves showing slight symptoms of mite attack.

2 = MODERATE DAMAGE many leaves showing moderate symptoms of mite attack.

3 = SEVERE DAMAGE the majority of leaves showing serious damage

* **Aphids** Score numbers
>   0 = No Aphids present
>   1 = > 50 Individuals/plant
>   2 = 50-100 Individuals/plant
>   3 = > 100 Individuals/plant

2.2.11. FRUIT TREES

As a minimum, record the identity of insects present, indication whether there is LIGHT, MODERATE or HEAVY infestation.

2.2.12. AVOCADO

Mites *(Oligonychus ciffeac)*
Red Scales *(Chrysomphalus aonidium)*

2.2.13. MANGO

Mango Seed Weevil *(Cryptorhynchus mangiferne)*
Red Banded Thrips *(Solenothrips rubrocinatus)*
Midges record the % of leaves affected by galls.
    0 = None affected.
    1 = <10% affected
    2 = 10-50% affected
    3 = > 50 affected.

Fruit Fly *(Ceratitis capitata)* - score % of yellowing fruits
    0 = No yellowing
    1 = <5% of fruit affected
    2 = 5 – 20 of fruit affected
    3 = 21-50% of fruit affected
    4 = > 50 of fruit affected

* Scales – Score numbers present on 20 randomly selected leaves and stems;
    0 = None present
    1 = <20
    2 = 20 – 50
    3 = >50

2.2.14. TEMPERATE FRUIT TREES

False Codling Moth *(Cryptophlebia leucotreta)* – Score %age of yellowing fruits
    0 = No yellowing
    1 = <5% of fruit affected
    2 = 5 – 20 of fruit affected
    3 = 21-50% of fruit affected
    4 = > 50 of fruit affected

Fruit Fly *(Ceratitis capiteta)* – as for Codling Moth
Pear Crown Borer – Score presence or absence [+/-]

* **Aphids** *(Myzus spp)* Score numbers present
    0 = No Aphids present

1 = > 50 Individuals/plant
2 = 50-100 Individuals/plant
3 = > 100 Individuals/plant

* **Mites** – Score the umbers present
0 = NO LEAF DAMAGE due to mite feeding.
1 = SLIGHT DAMAGE a few leaves showing slight symptoms of mite attack.
2 = MODERATE DAMAGE many leaves showing moderate symptoms of mite attack.
3 = SEVERE DAMAGE the majority of leaves showing serious damage

* **Scales** – Score numbers present on 20 randomly selected leaves and stems;
0 = None present
1 = <20
2 = 20 – 50
3 = >50

2.2.15. BANANA

Thrips *(Hercinothrips bicintus)* – if bunches present score damage
0 = NO LEAF DAMAGE due to thrip feeding.
1 = SLIGHT DAMAGE a few leaves showing slight symptoms of thrip attack.
2 = MODERATE DAMAGE many leaves showing moderate symptoms of thrip attack.
3- SEVERE DAMAGE the majority of fruit showing serious damage

If in flowers, record presence/absence of thrips in flowers.

Banana Weevils *(Cosmopolites sordidus)* – Select 5 mats (clamps) at random. Select the oldest (mother) stem from each mat. The stems from newly harvested may also be sampled.
0 = No Weevil damage
1 = Slight Weevil damage: <10% of exposed cord tissue with tunnels
2 = Moderate weevil damage: 10 – 30% of exposed cord tissue with tunnels
3 = Severe Damage: >30% of exposed corn tissue with tunnels.

For weevils, soil and plant debris is cleared away from the base of the mother corn to a depth of 10 – 15 cm. Starting at a point away from the follower (sucker), cut (pare) the corn with a *panga* to expose a band of internal cone tissue approximately 10 cm wide as far around the mother corn as possible without damaging the followers. The amount of weevil damage to the corn is assessed by determining the percentage of total exposed tissue in the band

which is occupied by weevil tunnels using the chart. *(Bridge, J and Gowen, S.R, 1993).*