Intercooperation (IC) has been working in India for 25 years in close collaboration with the Swiss Agency for Development and Cooperation (SDC).

The Indo Swiss Project Sikkim was started in 1993 with the aim to improve the livelihoods of small and marginal farmers in rural Sikk im by fostering income-generating capacities and strengthening need based service delivery systems of Government of Sikkim.

Ginger is a crop of great importance to farmers of Sikkim. For most, it is the only source of cash. Unfortunately, yields are never guaranteed due to many pests and diseases, some of which can destroy the entire crop. Efforts to overcome these problems began in 1995 with the start of a long-term project between the Department of Horticulture, Government of Sikkim and the Indo Swiss Project Sikkim supported by the Swiss Agency for Development and Cooperation and Intercooperation.

This working document is one among five publications from this project and outlines the roles and responsibilities of the various actors involved in producing ginger seed so that is relatively free of major pests and diseases. It is especially important for field staff working in the major ginger growing areas of Sikkim.

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Natural Resource Management
Rural Economy
Local Governance and Civil Society

WORKING DOCUMENT

Ginger Seed Source & Recipient Monitoring

INDO SWISS PROJECT SIKKIM

inter cooperation
Natural Resource Management
Rural Economy
Local Governance and Civil Society

WORKING DOCUMENT

Ginger Seed Source & Recipient Monitoring

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Contents

Abbreviation & Acronym

AD	Additional Director
GOS	Government of Sikkim
PTD	Participatory Technology Development
DoHCCD	Department of Horticulture & Cash Crop Development
SIRD	Sikkim Institute for Rural Development
JD	Joint Director
IPM	Integrated Pest Management
PDH	Principal Director Horticulture
MLA	Member of the Legislator Assembly
DD	Deputy Director
SDHOs	Sub-divisional Horticulture Officers
HIs	Horticulture Inspectors

Acknowledgements

The writers of this Working Document wish to thank the many farmers of Sikkim who contributed to its development by sharing their knowledge of ginger cultivation gained from years of practical experience. They would also like to acknowledge their colleagues in the Department of Horticulture and Cash Crop Development for useful comments during the editing phase.

The Working Document is an outcome of the support to ginger production under the Indo-Swiss Project Sikkim, a collaboration between the Government of Sikkim and the Swiss Agency for Development and Cooperation, managed by Intercooperation.

Foreword

The Department of Horticulture and Cash Crop Development, with assistance from the Indo-Swiss Project Sikkim, has been investigating improved management practices for ginger production for over a decade. From the outset, it was realised that if progress was to be made, farmers would need to control pests and diseases, and towards that goal access to healthy seed was seen to be pivotal. This in turn meant that improvements were needed in the operation of the Technical Mission which supports ginger at the State level.

Through the Technical Mission for disease control and area expansion, some 4-5,000 farmers are provided with 1 mund of ginger each year to improve the quality of their seed or to encourage them to begin ginger cultivation if they were not already growing the crop. The seed comes mostly from the 'big' growers, and is bought from them and distributed to those chosen as beneficiaries. However, unless care is taken, the distribution of seed can have negative consequences: it can spread diseases, as those of concern in Sikkim are seed borne.

In recent years, the DoHCCD has been instrumental in carrying out a thorough investigation of the pests and diseases that affect ginger in the State. We know that bacterial wilt is present, as well as *Pythium* soft rot and *Pratylenchus* dry rot. We know how to recognise them, how they spread, the factors that are most important in disease outbreaks, and we have developed a package of measures that are now being tested by farmers in several villages.

At the same time, we have applied the results of the research to the provision of healthy seed under the Technical Mission. There is no doubt that the quality of seed is much improved compared to previous years. However, this is no reason for complacency: improvements can still be made. For a number of years, we have been following the guidelines spelled out in this Working Document which provides a framework for healthy seed production. We now want to adopt the guidelines of the Working Document as DoHCCD policy.

The formal adoption of the Working Document is important. Not only does it provide transparency for an important and valuable programme, but having the procedures detailed this way allows the DoHCCD to audit the programme if problems occur.

My congratulations to all those that have taken the time to compile this Working Document: Ginger Seed Source & Recipient Monitoring.

GK Gurung
Secretary
Department of Horticulture & Cash Crop Development
Growing Healthy Ginger III

The aim of this Working Document is to improve the quality of ginger seed and its availability to growers, either under the Government of Sikkim Seed Demonstration Scheme, supported by the Government of India Technical Mission, or for private sale. Ginger suffers from a number of serious disease in Sikkim, all of which are seed-borne. By using healthy seed farmers can reduce substantially the impact of these diseases.

The Working Document outlines the roles and responsibilities of the various actors involved in producing seed so that it is relatively free of major pests and diseases. The actors include the staff of the DoHCCD, those in the districts and at Headquarters, the village Panchayats and farmers - seed producers and recipients of seed.

Notes are provided in the Working Document for field staff on technical aspects of seed-source monitoring as well as the diseases they may find in farmers' fields. These diseases are illustrated to improve recognition, with photographs of early symptoms as well as those that occur in the mature crop. Proformas are included for use by field staff when visiting farmers' fields, for monitoring seed sources and recipients, and information is given how to send samples to the IPM laboratory for analysis, and what to do with the results.

This Working Document is especially important for field staff working in the major ginger growing areas of Sikkim.

Overall programme goal and objective

The seed monitoring programme has a long-term aim or goal. The programme cannot achieve the goal on its own, as it needs other events to occur to make it happen. It is a vision for the future.

The goal is:

To strengthen farmers' capacities to improve productivity of ginger through the control of pests and diseases

In the short term, the programme has an objective that it can achieve through its own activities and outputs.

The objective is:

To improve the availability of good quality ginger seed

Expected results or outputs

The programme will carry out a series of activities. These will achieve results, or they can be called 'outputs'.

The outputs are:

Healthy seed sources
Informed district staff and farmers
Monitored beneficiaries

Output 1: Healthy seed sources

- Evaluate last year's programme for lessons learned
- Set targets for seed distribution
- Select seed source growers
- Collect samples and send to laboratory
- Analyse samples sent from districts
- Visits by laboratory staff to districts
- Compile a list of seed sources

1.1 Evaluate last year's programme for lessons learned

In April/May, the Additional Director Spices will organise a workshop at district level to evaluate the impact of the programme. Experiences gained from the programme will be documented in order to improve the programme in subsequent years. The evaluation should note the lessons learned from the seed monitoring. The Working Document will be reviewed and agreed, and distributed to all staff taking part in the programme.

1.2 Set targets for seed distribution

Targets should be reasonable and related to the resources of districts, and take into account that outbreaks of diseases may occur, and some farmers may not want to sell to the GOS.

1.3 Select seed source growers

Criteria for selection of farmers:

- only those farmers who have planted more than 15 munds[1];
- farmers who are willing to sell their excess seed, if it is found suitable;
- farmers who are willing to allow DoHCCD staff to sample their fields;
- farmers who are recognised as good ginger producers by other farmers.

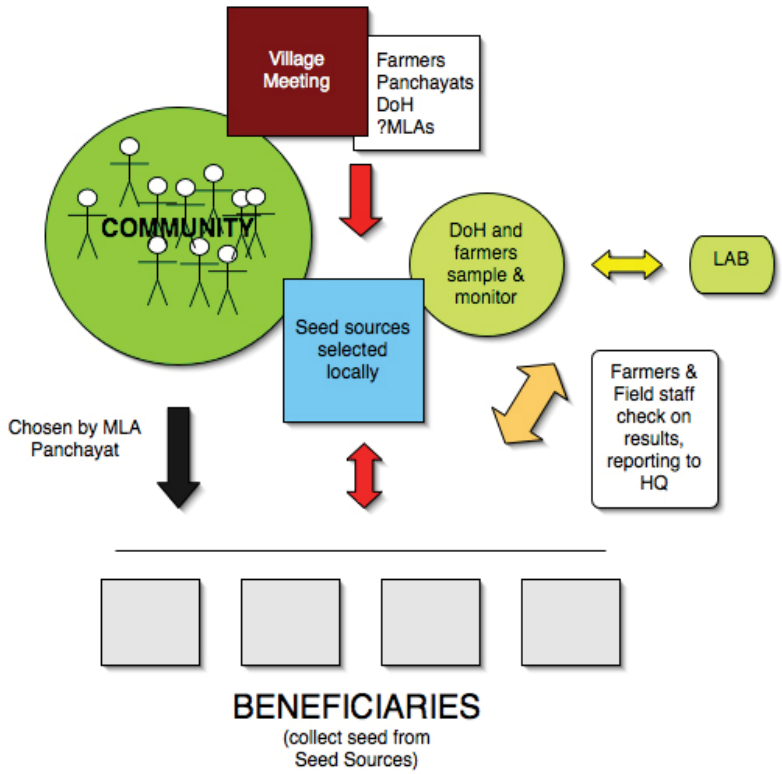
[1] There are exceptions to this: First, smaller fields will need to be chosen in the North district where ginger is a relatively new crop and large farmers are rare; and second, small fields can be chosen in PTD villages where farmers have good management practices and are able to recognise the different diseases with confidence.

Procedures for selecting seed-source farmers:

- identify main ginger growing areas with comparatively less disease based on last year's monitoring and experiences of local farmers;
- Visit the areas identified and locate suitable farmers as per criteria above;
- arrange meedings through Panchayats (Gram Sabhas) to explain to the farmers about the seed-monitoring programme and its objectives (note - do not commit the Government to purchase the seed, but explain the advantages of seed monitoring and the services that extension staff will be providing to the selected seed-source farmers);
- ideally, seed-source farmers (and beneficiaries) should be identified at Gram Sabhas, so that everyone knows who they are. Farmers can keep a watch on the crops as they grow, ensuring that they are monitored properly and the seed is of the standard required.

Using Gram Sabhas to identify local seed sources from which beneficiaries will be supplied seed has a number of advantages. The main one being that seed does not have to be transported around the State, which will reduce the spread of diseases. It will also be relatively easy to select a number of villages to monitor the outcome.

The scheme could look like:



The PTD villages could become the focus of the new way of arranging the choice of seed source farmers and the distribution of seed.

Estimating the number of seed source farmers

The number of seed sources selected for monitoring must be based on the targets set by the DoHCCD, plus extra for private sale. It should also take account the following:

- the number of farmers who may NOT sell their seed to the Government;
- the number of farmers who have diseased fields and who will not be used as seed sources; and
- the number of seed sources needed based on the previous year's experience.

1.4 Collect samples and send to laboratory

A number of points need to be noted (Appendix 2):

- healthy plants should NOT be sent to the laboratory. (Farmers do not like healthy plants to be sampled, and anyway if the plants are healthy there is nothing to analyse);
- Field Men/HIs should be trained to accurately estimate the number of diseased plants as a percentage of the whole field;
- Field Men/HIs should record accurately the amount of seed planted;
- Field Men/HIs should be told to inform senior staff if bacterial wilt is present;
- samples should be collected in August, October and January, according to the Action Schedule (Appendix 7).

1.5 Analyse samples sent from districts

The laboratory will aim to get the results of the analyses to the district JDs within 15 days of receipt of the samples.

1.6 Visits by laboratory to districts

The IPM laboratory staff should visit each district after the three rounds of inspection and discuss any problems at the district monthly meetings. In each district, three seed-source farmers should be checked at each visit. A short report should be written and sent to the district JDs.

1.7 Compile a list of seed sources

Based on the observations of the field staff and the analyses of the IPM laboratory, the expected quantity of healthy seed available with seed source farmers can be calculated. The lists of farmers with relatively healthy seed will be developed by the laboratory and sent by the Director IPM to the seed certification officer (JD) in each district, through the Additional Director Spices, with copies to the PDH. From these lists seed source growers will be chosen.

Output 2: Informed field staff and farmers

- Selection of HIs/Field Men
- Roles of actors defined
- Train SDHOs/HIs/Field Men
- Train seed-source farmers
- Review programme (Workshop)

2.1 Selection of field staff

Select only HIs and Field Men from ginger growing belts. Supplies needed for monitoring (i.e., forms, bags, tags, etc) should be provided to HI/Field Men by the IPM laboratory through the SDHOs at the time of the training (see 2.3).

2.2 Roles of actors defined

The tasks of people involved in the seed monitoring programme should be discussed and clarified. They are set out in Appendix 1. It is important for field staff to tell farmers about the programme and why it is being done. Monthly meetings at district HQ should be used to brief staff and to distribute this Working Document for discussion. All actors should understand and agree to their roles.

2.3 Train SDHOs, HIs and Field Men

Seed source training (SDHOs/HIs/Field Men): March

A 1-day orientation workshop on seed-source monitoring (technical and procedural) is needed for all concerned field staff in order to improve programme implementation (Appendix 3 & 4). The workshop should be held at Karfectar (SIRD), Jorethang in the first week of March. Theory needs to be supported by practicals in seed-source villages to test disease recognition and methods of informing farmers how to select seed for the GOS seed distribution programme. The workshop needs to cover:

- the reasons for the seed source monitoring programme, and how to tell farmers about it;
- identification of different diseases under field conditions (see Appendix 2 & 6);

- how to collect samples and send to the laboratory for analysis, BUT ONLY if the disease(s) cannot be identified in the field;
- how to judge approximate numbers of diseased plants;
- what to do if bacterial wilt is present;
- how to use the extension folder on ginger disease control.

Disease management training (SDHOs/HIs): July/August

If resources are available, training (1 day) should be given to SDHOs/HIs during the time of maximum soft rot outbreaks (fungal and bacterial). The training should include the items listed above for Field Men, but in more detail.

It is hoped that in time this training will provide the information necessary for the SDHOs to act as district identifiers of ginger diseases. Samples from the field would be sent first to the SDHOs for identification, and only to the IPM laboratory when they are unsure. This will allow the laboratory more time to make checks in the districts.

2.4 Train seed-source farmers/beneficiaries

Two trainings will be held:

- In March, before seed distribution HIs will go to the villages of seed recipients (beneficiaries under the GOS Demonstration Scheme) and give training to ALL growers on seed selection, site selection and land preparation; and
- In June/July, HIs will give training to ALL farmers on disease identification and management.

Note: Registers of farmers trained must be kept by SDHOs/HIs in all districts.

2.5 Review workshop

The PDH will organise a mid-programme review workshop in August at Krishi Bhawan with the Secretary (or PDH) as chairperson. Joint Directors, DDs and SDHOs will participate. DDs will be requested to present up–to-date information on the progress of the seed-monitoring programme.

During the Workshop, constraints will be discussed and decisions taken to overcome any difficulties that may have occurred. HIs/Field Men should be told of the decisions of the Workshop at their next monthly meeting.

Output 3: Monitored beneficiaries

- Select seed beneficiaries
- Distribute seed from seed sources to beneficiaries
- Radio messages
- Pay farmers for seed
- Monitor beneficiaries

3.1 Select seed beneficiaries

Lists are to be provided by MLAs and Panchayats to DoHCCD; these lists are required by Additional Director Spices. A computerised database will be developed from the lists.

MLAs and Panchayats should be informed of the importance of the seed monitoring scheme and the need for setting targets that can be managed by the DoHCCD so that beneficiaries receive good quality seed. Wherever possible, the DoHCCD should be involved in selecting beneficiaries in order to facilitate the distribution of seed, and to ensure that it goes to growers who will promote area expansion of ginger production.

3.2 Distribute seed from seed sources to beneficiaries

District JDs will organise seed distribution based on lists of healthy seed sources and beneficiaries. Only monitored seed should be distributed to beneficiaries. If not enough seed:

- reduce the number of beneficiaries, or
- reduce the amount of seed given to each beneficiaries.

Note: If possible, distribute seed in baskets; growers realise that seed in sacks transported by lorries is often damaged in the process, and produces a poor crop.

3.3 Radio messages

Information on healthy seed sources should always be broadcast on the All India Radio. Lists should also be provided to ALL DoHCCD extension staff so that they can tell farmers where they can purchase good quality seed.

3.4 Pay farmers for seed

Funds should be transferred to the districts, with authority given to the JDs to make payments, as soon as possible after the seed has been collected from the seed-source farmers.

3.5 Monitor beneficiaries

It is very important to monitor beneficiaries in order to find out if the programme is having the desired impact. This should be done by:

- each HI selecting at random 3-5 beneficiaries;
- visiting each beneficiary on three occasions (August/October/Harvest) to:
  - ⋆ check that the crop has been planted;
  - ⋆ whether or not disease(s) is present;
  - ⋆ the yield at harvest.
- completing the monitoring forms (Appendix 5) and returning them to the district JD and then the laboratory.

Actors and their roles

1. Seed source farmers

Farmers should be selected based on the following criteria:

- from an area where bacterial wilt is rare/uncommon;
- have planted more than 15 munds seed (smaller seed source growers can be chosen in the north district and for PTD farmers);
- willingness to participate in the programme;
- willingness to sell their excess seed to the DoHCCD or to other farmers.

Appendix 1

1.1 Role

Farmers have the following roles:

- co-operate with extension staff by allowing them to collect samples in August, October and January;
- follow the advice given by the extension staff;
- share their knowledge with other growers (and extension staff).

2. Field Men

2.1 Role

1st week of March

- attend training on seed selection and other activities of the seed monitoring programme organised by DoHCCD;
- receive inputs, eg Working Document, packaging materials, formats and the action schedule from the SDHOs;
- visit field, explain monitoring program to the potential participating farmers, select eligible farmers (criteria of farmers should be as above) and get verbal agreement to participate in the programme; and
- attend Gram Sabhas where seed-source farmers (and beneficiaries) are chosen.

Schedule of sampling

Visit field, check plants and send samples to IPM laboratory (fill up/send forms, but remember to sample and send plants ONLY if he/she cannot identify the disease):

- 1st round: Second week of August
- 2nd round: First week of October
- 3rd round: Third week of January

Monthly: give feed back to SDHOs and DDs during district monthly meetings (at time of salary collection);
March/April: receive list of identified seed sources under his/her jurisdiction from SDHOs/DD and give the information to ginger growers;
April/May: give input in programme evaluation based on last year's experiences.

3. HIs

3.1 Role

July/August:

- attend training on technical and operational aspects of the seed monitoring programme;
- attend Gram Sabhas where seed-source farmers and beneficiaries are chosen (if appropriate);
- oversee activities of Field Men and take part in seed-source monitoring to support this work and to ensure that it is done properly.

Monthly: give feed back to SDHOs and DDs during district monthly meetings (at time of salary collection);
March/April: receive list of identified seed sources under his/her jurisdiction from SDHOs/DDs and give the information to ginger growers;
April/May: give input in programme evaluation based on last year's experiences.

4. SDHOs

4.1 Role

March and July/August:

- assist DDs organise technical/operational training of HIs/FM: ensure trainees attend and receive inputs;
- attend training in technical and operational matters.

February/March: ensure the final lists of seed-source growers are given to the HIs, and they remind the growers that the DoHCCD intends to purchase (some of) their seed;
Continuous: supervise the seed monitoring process and ensure that properly filled up forms and samples (optional) are sent to the IPM laboratory as per schedule;
March/April: Where appropriate, ensure HIs attend Gram Sabhas to select seed-source growers; and ensure lists are received by DDs;
April/May: give input in programme evaluation based on last year's experiences;
Overall: build a strong link between HIs/FM and DDs for effective programme implementation.

5. Deputy Directors

5.1 Role

Continuous: ensure that all the activities described in the action schedule (Appendix 7) occur on time;

Continuous: ensure that roles defined for the SDHOs/HIs/FM are carried out by the respective officials;
Monthly: review progress at district level, and also attend the State-level review workshop in August;
Continuous: build strong linkages between the SDHOs and JDs;
April/May: give input in programme evaluation based on last year's experiences.

6. Joint Director

6.1 Role

Continuous: administrate the program at district level;
January/February: agree to the list of seed-source farmers and ensure that seed is procured only from these sources;
April/May: give input in programme evaluation based on last year's experiences.

7. IPM Laboratory

7.1 Role

Continuous: provide technical services on demand from the districts;
July: provide inputs, eg monitoring forms, plastic bags, tags, rubber bands, etc to districts;
Periodically: give feedback to districts on information provided on forms and the samples sent for analysis.

August/October/January:

- visit districts to collect samples (making arrangements with DDs);
- make checks on seed-source farmers' fields (3 per visit to districts in August, October and January, at time of sample collection);
- produce report after each round of sampling and a final report after completion of monitoring programme, and submit to JDs districts and Spices.

Periodically:

- conduct field visits to check that samples are collected from the field properly, so that analyses can be made accurately;
- check on recipient monitoring at least once in each district during the season August to November.

April/May: give input in programme evaluation based on last year's experiences.

8. Krishi Bhawan (Additional Directors)

8.1 Role

Co-ordinate: ensure that all the actors carry out their respective roles according to the action schedule (Appendix 7);
Periodically: review progress of each district by attending monthly meetings;
August: organise State-level review workshop;
Continuous: keep Secretary and PDH informed on progress;
Continuous: ensure smooth implementation of programme by strengthening linkages between actors; especially ensuring that there is good information flow between Krishi Bhawan and districts, between districts and Krishi Bhawan, and districts and IPM laboratory.

Guidelines for sampling ginger for IPM laboratory analysis

The FM and/or HI should ask the farmers the following questions:

- Ask how much seed was planted
- Ask the weight of the seed pieces: 25 g; 50 g or 100 g
- Estimate the number of diseased plants
- Record the time (week, if possible, and month) when the diseases appeared in the field

How to identify insect pests and diseases

Examine the plants step-wise to find out what's wrong:

- Are leaves chewed?

If yes, look for caterpillars

If no, examine the shoot

- Are the youngest leaves yellow and drooping?
- Are holes present and/or plant debris and/ or insect faeces on the stem?
- Can the shoot be pulled out easily?
- If, yes, look for caterpillars of shoot borer inside stem

If no, look at the leaves

- Are the leaves yellow/green and droopy, and
- Are the leaflets rolled under, and
- Are the stems pulled out easily from the rhizomes, and
- Is the ooze test on the stem positive?
- If yes, bacterial wilt (Ralstonia solanacearum)

If no, look at rhizomes (carefully remove soil); look at the buds (eyes)

- Is it difficult to pull out the stems, and
- Do the eyes have brown, dry, rots, and
- Is there an outer ring of brown rot seen when the buds are snapped off, and

Appendix 2

- Are there patches of rough skin with brown shallow rots beneath?
- If yes, likely to be the dry rot nematode (Pratylenchus)

If no, look at eyes again

- Do the eyes have soft rots, and
- Are there water-soaked rots at the base of the stems, and are the stems easily pulled out of the rhizome, and
- Is the ooze test negative?
- If yes, likely to be soft rot fungus (Pythium)

If no, look at rhizomes

- Are rhizomes chewed
- If yes, look for white grubs

If no, look at roots

- Are the feeder roots absent/dying/dead?
- If yes, this is further evidence that the problem is caused by nematode and/or Fusarium or Pythium.

How to collect samples

- If diseased plants occur in patches, sample 1 plant from the patch;
- If diseased plants are scattered, sample 1 typical plant;
- If plants show different symptoms send samples of each one. Do not mix.

Precautions before sending samples

- Each sample should have leaves, whole rhizome and roots. Do not wash the plants;
- Carefully dig up the plants. DO NOT pull them from the ground. Immediately, place them in plastic bags. Be careful not to spread soil from diseased plant on those that are healthy;
- Take great care to keep rhizome intact;
- Each sample should be labelled (i.e., complete the monitoring form);
- Place the form in a second plastic bag, and put this inside the bag containing the plant;
- Tie bag with rubber bands;
- If rhizome or plant parts have started to rot at the time of sampling ensure samples reach the district headquarters without delay (within 24 hours).

What to do after laboratory analysis and field diagnosis

Bacterial wilt

- If there is bacterial wilt in the field, assess:
  a) whether this can be isolated from the rest of the crop;
  b) whether the farmer understands how to control the disease;
  c) the likelihood of the farmer taking care not to mix seed from the infected area;
- If the farmer has a number of different ginger fields (bays or terraces) and some have bacterial wilt and others are healthy, the healthy crops can be taken for seed. But the HI/Field Man must be confident that the farmer will not mix the seed at harvest;
- If a farmer has a number of different bays or terraces and some have bacterial wilt and others are healthy, the healthy crops can be taken for seed, BUT all the crops below the infected bays or terraces should be rejected for seed. But the HI/Field Man must be confident that the farmers will not mix the seed at harvest.
- In these situations the HI/Field Man MUST inform the SDHO or DD of the outbreak of bacterial wilt in a seed-source farm;
- If there is any doubt that the seed-source will keep to the guidelines, reject the seed.

Soft rot ***(Pythium)***, dry rot (***Pratylenchus*** nematode)

If there are only a few patches of Pythium soft rot, then the extension staff should encourage farmers to remove the infected plants. If possible, the area where the disease occurs should be marked so that the diseased rhizomes and those close to the affected area are NOT taken for seed at harvest.

Dry rot comes late, and it is not possible to remove the plants to control the outbreak of the disease. In this case, mark the area and tell the farmer to sell the seed and NOT to mix it with that from healthy plants.

What do the diseases look like?

Early symptoms of diseases

Ralstonia, bacterial wilt

The leaves are rolled under, but they are still green (below).

Pythium and Pratylenchus

Above-ground symptoms are similar: the plants are stunted and often yellow (right, arrowed). Underground, the mau shows rough brown patches and brown rings where buds have been snapped off (below, left), characteristic of Pratylenchus dry rot. Pythium eye rots (below, right). On both plants, the roots are decayed.

Late symptoms of diseases

Ralstonia, bacterial wilt

The progression of the disease is rapid. At first, the leaves are rolled under but still green, then yellow (below), before turning brown and collapsing (bottom, left). The ends of the stem often show the characteristic white bacterial ooze when pulled from the rhizome (below, right). On the rhizomes, so-called 'water-soaked' areas (bottom, right: arrowed) can be seen; these too contain the milky ooze of the bacteria. Look for this disease in June/July.

Late symptoms: ***Pythium***, soft rot

The disease often occurs as patches of yellow plants, as it spreads out from one or two infected plants (below, left), but the progression is slower than that of bacterial wilt. The leaves turn yellow (below, right), but do not generally roll under, turn brown and collapse as quickly as those with bacterial wilt. Roots are destroyed (bottom, right), and the buds on the rhizome are decayed with soft rots (bottom, left). Look for this disease in June/July.

Late symptoms: ***Pratylenchus,*** dry rot

As with bacterial wilt and soft rot, dry rot often occurs as patches in the field (below, left). But symptoms appear late, in September/October. The roots are attacked and destroyed by the nematode and the plants die. To most farmers it appears as if the crop is maturing early. Inspection of the rhizome shows a lack of roots, scabby surfaces (below, right) and brown rings of rot where the buds are snapped off (bottom, left).

Proforma for monitoring seed sources

(Part 1)

Appendix 3

Sample No.: .....

Date samples sent to laboratory: .....

Name HI/FM: .....

Name of farmer: .....

Name of village: .....

Variety: .....

Land: Paddy ..... Dry .....

When was ginger last grown in the same field (year): .....

Was it healthy or diseased last time? .....

Quantity seed sown: ..... Munds.....

Seed treatment: Yes .... No ..... Chemical ..... Quantity .....

Any chemical applied to crop? .....

What?: ..... Quantity: ..... When?: .....

Any disease(s) present? .....

How many plants affected: 10; 100; 1000; >1000: .....

What do you think is the cause of the problem? .....

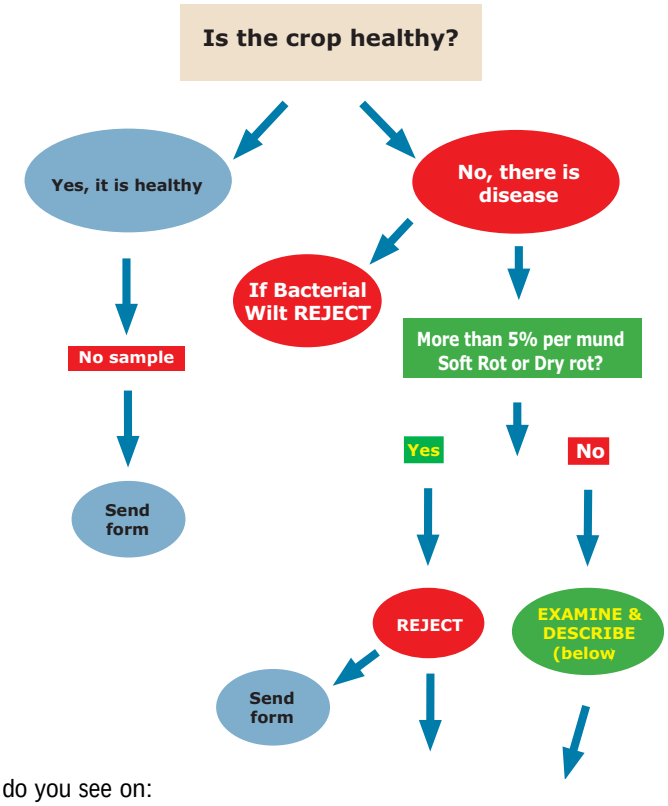
Signature of HI: ..... Date: .....

Step-wise examination of crop

(Part 2)

Is the crop healthy

(tick ✓ against the boxes)



Appendix 4

What do you see on:

leaves: ..... Send sample (if unsure of disease)

rhizomes: .....

roots: .....

Appendix 5

Proforma for monitoring seed beneficiaries

Name HI/FM: .....

Name of farmer: .....

Name of village: .....

Did farmer plant the Government seed? .....

If not, why? .....

Questions	Government seed		Farmer's seed	
Variety:				
Land:	Paddy:	Dry:	Paddy:	Dry:
Year ginger last grown in land:				
Was it healthy or diseased last time:	Yes:	No:	Yes:	No:
Quantity seed sown (munds):				
Seed treatment:	Yes:	No:	Yes:	No:
Chemical on seed:				
Quantity used:				
Chemical applied to crop:	Yes:	No:	Yes:	No:
What:				
When:				
Quantity used:				
Are plants diseased:	Yes:	No:	Yes:	No:
Do you know the cause:				
How many plants affected (10; 100; 1000; >1000):				
Samples sent to laboratory:	Yes:	No:	Yes:	No:
When:				
Sample No:				
Yield (munds):				
Is farmer satisfied with crop:	Yes:	No:	Yes:	No:
If not, why:				
Will farmer save seed:	Yes:	No:	Yes:	No:
If not, why:				

Signature of SDHO/HI ..... Date .....

Technical information on ginger diseases

Name of the disease	Organism
Bacterial wilt	Ralstonia solanacearum (before: Pseudomonas solanacearum)
Soft rot	Pythium spp.
Dry rot	Pratylenchus coffeae nematode alone or with the fungus Fusarium oxysporum

1. Bacterial wilt

1.1 Symptoms

- Water-soaked streaks or patches on the collar region of stems;
- Leaves become yellow to bronze, progressing upwards, often with margins curled under;
- Stems come off easily with gentle pull;
- Leaves dry up rapidly and die;
- Rhizomes rot rapidly producing milky ooze with gentle press;
- Often rot has a strong foul smell;
- White (cloudy) streaks form from cut ends of stems when put in water.

1.2 Source and spread of the disease

The bacterium lives in the seed and in the soil. It can remain alive in the soil for many years, living on the roots of other plants. It can also be present in ginger seed without showing any signs until the seed is planted, and rots occur

The disease appears during heavy rains. It usually starts on one plant and spreads rapidly to those nearby, producing patches of decaying and dead plants. Water moving through the soil spreads the bacteria and within a few days the entire crop can be destroyed. If drainage is poor and water stagnates, the development of the disease is especially rapid.

2. Soft rot

2.1 Symptoms

- Yellowing at tip of lower leaves, gradually spreading down the leaf blade;
- Yellowing progresses from bottom upward with drooping, withering and drying;
- Collar region of stem shows pale brown rot and later stems fall over;
- Infected shoot is easily pulled from the rhizome;
- Rhizomes rot leaving only fibrous tissues;
- At harvest, rots seen on the buds, producing 'eye' rot.

2.2 Source and spread of the disease

The fungus lives in ginger seed and in the soil. It remains alive in the soil for many years, attacking many different kinds of plants, and living on the decaying remains.

Infected seed often shows 'eye' rots (decayed buds) containing the fungus. When the seed is planted, the fungus spreads over the rhizomes and roots, and rots them.

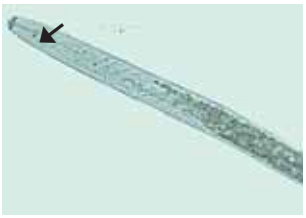
The disease appears during the heavy rains. It starts on one plant or in a small patch and spreads rapidly. Water moving through the soil spreads the swimming spores of the fungus. If drainage is poor and water stagnates, the development of the disease is especially rapid.

3. Dry rot

3.1 Symptoms

- There is a gradual drying of the plants from the top down, i.e. the symptoms are similar to those of plants dying early;
- The plants dry up but do not fall to the ground;
- Shoots cannot be easily pulled from the rhizomes as in the case of bacterial wilt and soft rot;
- The disease occurs in patches, although late in the season (October/ November) the entire crop can be affected.

3.2 Source and spread of the disease



The nematode (Pratylenchus) and fungus (Fusarium) are seed and soil borne. The nematode invades the roots, using a spear in its mouth (arrowed) to damage cells and extract nutrients. Brown, shallow, scabby rots are formed. These often cover large areas of the surface, especially on the underside where it is moist. Rots also occur where the fingers join the rhizome, and can be seen best by snapping off the fingers. The nematode spreads in soil water. The disease builds up slowly and symptoms are seen only late in the season.

The fungus, Fusarium, invades the rhizomes through wounds made by the nematode. Fungus and nematode always occur together. When the rhizomes are kept for storage, either in the store or in the field, extensive, shallow, dry rots occur and the rhizomes shrink rapidly.

Appendix 7

Action schedule for seed source & beneficiary monitoring

Step	What?	When ?	Who?	Where?
1	Review of last year's experience & discussion on future strategy	April/May	AD Spices/JDs/ DDs/Lab	Krishi Bhawan
2	Finalisation of review report	Last week of July	AD Spices	Krishi Bhawan
3	Distribution of seed	March	JDs & staff	Districts
4	Review of Working Document	April/May	AD Spices/JDs & staff	Districts
5	Identification of extension staff for field monitoring	1st week of March	JDs & DDs	Districts
6	Seed selection training for HIs/ FM	1st week of March	DDs/SDHOs	Districts
7	Practical training for SDHOs/HIs technical and operational on procedures.	July/August (depending on resources)	DD/SDHOs/HIs	Districts & Krishi Bhawan
8	Identification of farmers to monitor (seed sources and beneficiaries) in village meetings	March	HIs/SDHOs	Districts
9	Train farmers in villages before seed distribution	March	SDHOs/HIs/FM	Districts
10	Visit seed sources & send samples to laboratory	1: 2nd week August 2: 1st week October 3: Mid-January	SDHOs/HIs/FM	HI areas
11	Send results of laboratory analysis to districts	Within 10-15 days of receipt of sample	IPM Laboratory	Lab. I/C to DDs/ AD Spices
12	Review workshop	August	AD Spices	Krishi Bhawan
13	Finalisation of healthy seed source lists	February	Lab/JDs/DDs	Krishi Bhawan
14	Dissemination of information on healthy seed sources	February	AD Spices	Throughout State by radio