KVK-HKD/Training Manual No. 01

TRAINING MANUAL ON

SOIL HEALTH MANAGEMENT, QUALITY SEED PRODUCTION AND MUSHROOM CULTIVATION

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद
Agrisearch with a human touch

ICAR RC FOR NEH REGION
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LAKSHMISAHAR, HAILAKANDI 788 152

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PREFACE

A strategic policy initiative has been taken up by Indian Council of Agricultural Research (ICAR) to secure overall development of Schedule Tribes of the North Eastern Region by introducing the Tribal Sub-Plan (TSP). The prime aim of TSP is to secure budgetary allocation for tribal development at least in proportionate to their population, in order to bring them at par with other sections of society and to protect them from exploitation. The TSP has four main objectives which include substantial reduction in poverty and unemployment of STs, creation of productive assets in their favour and provide them with livelihood opportunities on a sustainable basis, human resource development of STs by providing adequate educational and health services and provision of social, physical and financial security to them against all types of exploitation.

Keeping these facts in mind, Krishi Vigyan Kendra (KVK) Hailakandi, ICAR has taken initiative to demonstrate and disseminate various agricultural technologies *viz.,* mushroom cultivation, soil testing and quality seed production among the ST communities of Hailakandi District with an aim to improve their socio-economic condition with special focus on livelihood improvement and reduction of poverty level.

Authors

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Chapter I

INTRODUCTION

The richness and variety of tribal life is a most valuable heritage of the great Indian tradition. The life is nowhere more spontaneous and vivid in its fullness than in the small traditions of our tribal communities. More than two hundred – fifty communities have been specified as scheduled tribes (excluding sub-groups) and they are spread over the length and breadth of the country. Among them are groups as large as a few lakhs and as small as a few hundreds. Each of these groups, no matter what their number is, is a proud community participating in the national life yet retaining its own identity.

The basic objective of the TSP is to channelize the flow of outlays and benefits from the general sectors in the Central Ministries/ Departments for development of Schedule Tribes at least in proportion to the population, both by physical and financial terms.

In view of the above facts and realizing the importance, KVK Hailakandi has demonstrated winter mushroom cultivation and Boro paddy cultivation and paddy seed production among the ST peoples of the District under TSP. Moreover, KVK has organized various extension activities like awareness programmes, trainings, method demonstrations, and distribution of technical folders on mushroom cultivation, soil testing and quality seed production for educating and motivating the ST beneficiaries for adopting these technology to improve their socio-economic condition with special focus on livelihood improvement and reduction of poverty level.

Soil sampling

Introduction

The soil test is an important measure of the soil's ability to supply nutrient elements needed for good plant growth. It is very essential to test the soil prior to any fertilizer schedule. After testing his soils a farmer will know the exact amount of fertilizer to be applied to the crop and thus can save money and environment pollution by checking excessive use of chemical fertilizers. The test also tells how much lime (calcium) is needed to establish the most desirable soil pH for the crops to be grown. A correct soil testing programme requires correct soil sample collection at the beginning.

Soil sampling- what is it?

- It is the collection of soil samples for testing in such a way that it reflect the true fertility status of the targeted field/ area

Soil samples- how many are enough?

- Depends on size and level of variability of the field/ area
- If the area is uniform, 1 sample is enough for 4-5 ha area
- Uneven areas viz. Low land, medium land and high land should be sampled separately
- Only a small amount of soil is required in each test. Therefore, a composite soil sample containing 10 to 15 cores/ sub samples should be collected over the designated area.

Depth of soil sampling:

- The roots of most field crops are confined in 0-15 cm depth. Therefore, generally soil samples for field crop are collected from 0-15 cm depth
- For analyzing soils under plantation crops whose roots go beyond several meters, samples should be collected from greater depth

Time of sampling:

- Samples can be collected at any time except the rainy season provided there is sufficient time for analysis
- Winter is the best time for sample collection
- For delineating any specific problem, samples can be collected as and when required

Method of Collection of Soil Samples - Collection for field crops

Equipments/tools

1. Spade
2. Auger
3. Plastic bucket
4. Scale/ Ruler
5. Polythene sheet (2ft x 2ft)
6. Aluminium tag/ sheet of paper
7. Polythene bag
8. Rubber band

Steps in soil sampling:

The process of soil sampling is divided into three steps-

I. Collection of soil samples

II. Sample preparation

III. Storage of samples

I. Collection of samples

Procedure:

1. Determine the soil unit (or plot).
2. Make a traverse over the soil unit (or plot).
3. Select the sites at random in a zigzag (or criss-cross) manner. Distribute the sites throughout the entire soil unit (plot). (**Plate -1)**
4. Clean the site (with spade) from where soil sample is to be collected. **(Plate-2)**
5. Insert the spade into soil. **(Plate-3)**
6. A lump of soil is removed.
7. A pit of vee (V) shape is formed. Its depth should be 0-6" or 0-9" (i.e., depth of tillage). **(Plate-4)**
8. Take out the soil-slice (like bread-slice) of ½ inch thick from the exposed surface of the pit from top to bottom. This slice is also termed furrow-slice.
9. Discard the soils from both the sides of the furrow slice and collect the middle portion of soil of the furrow-slice in a plastic bucket. **(Plate-5)**
10. Collect furrow-slices from 10-15 or sometimes 20-30 sites.
11. In lieu of spade auger may be used. Do not take the prohibited samples and local problem soils.

12. Furnish the following information in two sheets of thick paper with the sample. One sheet is folded and kept inside the bag. Another sheet is folded and attached with the bag.

Do not's in soil sampling

- Do not collect soil samples when there is standing crop at the field
- Do not collect soil samples after heavy rainfall or immediately after lime or fertilizer application
- Avoid sampling from border area of the field, burn sites, old building sites, pet dropping spots
- Never dry soil samples under direct sun

Information to be collected

- Name and address of the farmer (or farm owner).
- Name of the block.
- Plot number or any other number that identifies the plot (or Soil unit).
- Soil texture (sandy/clay/loam).
- Availability of irrigation facilities.
- Availability of drainage system.
- Upland/Medium land/Lowland.
- Depth of soil sample.
- **Information of the previous crop**.
    1. Name and variety of the crop.
    2. Dose of organic manure, if applied.
    3. Dose of fertilizers, if applied.

4. Yield.

- **Information of the crop that will be grown**.
    1. Name and variety of the crop.
    2. Season (pre Kharif/Kharif/rabi).
- Problem, if any.
- Date of sample collection.
- Signature of the farmer (or farm owner).

II. Sample preparation

i. Drying: Wet soil samples collected from the field cannot be stored as changes occur.

- For drying, soils in the polythene bags are spread over the paper/floor and allowed to air dry **(Plate-6)**
- Samples should never be sun dried

ii. Sample size reduction: large amount of soil is collected for making a composite sample, whose volume is to be reduced for making storage convenient. The quartering method of sample size reduction is as follows

- Divide the sample on the paper into four parts **(Plate-7)**
- Discard the soils of the opposite corners and mix the remaining soil **(Plate-8)**
- Repeat the mixing and sorting procedure until almost 500 g of soil remains

iii. Grinding

- After reduction of size of soil sample, soil clods should be crushed with a wooden roller or pestle & mortar **(Plate-9)**

iv. Sieving

- Ground soil samples should pass through a 2 mm sieve to separate roots, stones and other debrishes **(Plate-10)**

III. Sample storage:

After reducing the volume of collected soil, the sample should be stored in a polythene bag with proper labelling **(Plate-11)** as mentioned above and send the sample to the nearest soil testing laboratory for analysis by sophisticated instruments or Krishi Vigyan Kendra where they can get their sample analysed with the help of Rapid Soil Health Test Kit and get the idea of exact amount of fertilizer to be added to different crops for optimizing yield and economic returns.

Conclusion

The quantity and availability of plant nutrient elements in the soil change as a result of removal by the growing or harvested crop, leaching, erosion, or the addition of fertilizer, manure and compost. Therefore correct sampling and an accurate evaluation will result in more efficient fertilizer use, which can increase yields, reduce costs and potentially reduce environmental pollution.

x				x
	x		x	
		x		
	x		x	
x				x

Plate 1

Plate 2

Plate 3

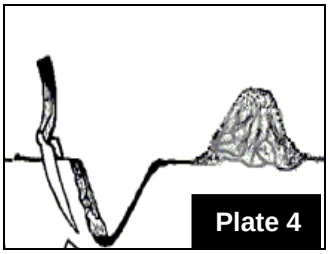

Plate 4

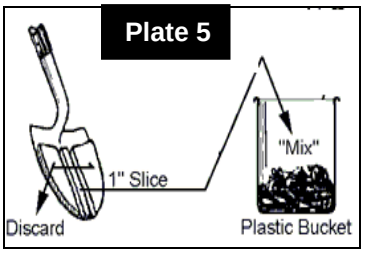

Plate 6

Plate 7

Plate 8

Plate 9

Plate 10

Plate 11

Basic Principals of Quality Seed Production

Introduction

Seed is a vehicle for delivery of improved technologies and is a mirror for portrayal of inherits genetic potential of a variety/hybrid. Seed offers to integrate production, protection and quality enhancement technologies in a single entity, in a cost effective way. Use of quality seeds alone could increase productivity by 15 – 20% indicate the critical role of seed in agriculture. Our nation has witnessed a momentous food grain production of 252.56 million tonnes during 2011-12 from meager 50.5 million tonnes during 1950-51, which is largely credited to the use of quality seeds of improved varieties/hybrids, improved farming practices along with ingenuity and industry of Indian farmers.

Production of genetically pure/otherwise quality pedigree seed is an exacting task requiring high technical know-how, skill and comparatively high financial investment. During seed production strict attention must be given to the maintenance of genetic purity and other qualities of seeds in order to exploit the full dividends sought to be obtained by introduction of new superior crop plant varieties. In other words, seed production must be carried out under standardized and well-organized condition.

Two principles need to be taken care with

I. Genetic principles
II. Agronomical principles

I. Genetic principle:

Causes of genetic deterioration of varieties:

Genetic purity of a variety deteriorates due to several factors during multiplication cycle. Factors responsible for deterioration of varieties are:

- Developmental variation
- Mechanical mixtures
- Natural crossing
- Mutations
- Selective influence of diseases
- Minor genetic variations
- Technique of plant breeder

Maintenance of Genetic purity during Seed Production:

The various steps for maintaining genetic purity are.

a. Providing adequate isolation distance to prevent contamination by natural crossing or mechanical mixtures.
b. Roughing of seed field, prior to the stage at which they could contaminate the seed crop.
c. Periodic testing of varieties for genetic purity.
d. Avoiding genetic shift by growing crops in areas of their adaptation only.
e. Certification of seed crops to maintain genetic purity and quality seeds.
f. Adopting generation system (the seeds produced is restricted to four generation only i.e. starting from breeders seeds) and the seeds can be multiplied up to three more generations i.e. foundation, registered and certified.

g. Grow out test.

The important factors/safeguards for maintaining genetic purity during seed production are:-

Control of seed source: For raising a seed crop the seeds should be required from an approved source and from an appropriate class is necessary. Four classes of seeds are generally recognized in seed certification namely breeder seed, foundation, registered and certified. But as per Indian system of seed multiplication, registered seed class is absent but there is provision for certified seed stage I & II depending on quality of seed class.

Breeder's seed: Is a seed or vegetative propagating material which is directly controlled by originating breeder or breeder of sponsoring institution and provides basis of foundation seed.

Foundation seed: It is a seed stock so as to maintain specific genetic identity and purity and is managed by personnel having technical expertise from relevant production centres. Foundation seed is the source of certified seed class.

Certified seed: Is the progeny of foundation seed, that is handled to maintain genetic identity and purity and comes under purview of certifying agencies.

Preceding crop requirement: Preceding crop requirement has been fixed to avoid contamination through volunteer plants and also from soil borne diseases. (Volunteer plants mean plants grown in the field from previous crops).

Isolation: Isolation is required during seed crop production to avoid contamination due to natural crossing and diseases infection by

wind and insects from neighboring field and to avoid mechanical mixtures during sowing, harvesting, threshing and handling of seeds.

Isolation distance is different from crop to crop and among different classes of seeds. i.e. certified and foundation.

Minimum isolation requirements of crops

Sl. No.	Crop	Isolation distance required (in meter)	
		Foundation seed	Certified seed
1	Paddy, Wheat, Barley, Oat	3 (150)*	3 (150)*
2	Hybrid sorghum	300 (400)*	200 (400)*
3	Pearl millet	1000	200
4	Maize (OPVs & Composite)	400	200
5	Soybean	3	3
6	Rapeseed and Mustard	100	50
7	Groundnut	3	3
8	Cotton	50	30
9	Berseem	400	100
10	Peas	10	5
11	Cabbage and Cauliflower	1600	1000
12	Carrot	1000	800
13	Brinjal	200	100
14	Chillies and Okra	400	200
15	Tomato	50	25
16	Cucurbits	1000	500

*Infection of diseases i.e. 0.1% infection of loose smut disease in cereal crops results in isolation distance from 3m to 150m.

a. Expectation of natural crop between wild grass or plantations i.e. the isolation in sorghum increases from 25m to 400 m if Jhonson grass (Sorghum halepense) is found in the region.
b. Differentially maturity between receptive stigma and pollen.
c. Isolation distances are sometimes reduced, by growing some border rows which on harvesting are discarded.

Roguing: The off type plants i.e. plants differing in their characteristics from those of the seed variety is another source of genetic contamination. Their continued presence would certainly deteriorate the genetic purity of the variety. The removal of such type of plant is referred as “Roguing”.

Seed certification: Genetic purity n commercial seed production is maintained through a system of seed certification. The objective of seed certification is to maintain and make available crop seeds, tubers, bulbs, etc., which are of good seeding value and true to variety.

Grow out test: Varieties being grown for seed production should periodically be tested for genetic purity by grow out test, to make sure that seed being maintained in their true form.

II. Agronomical Principles:

Selection of agro-climatic region: A crop variety to be grown for seed production in an area must be adapted to the photoperiod and temperature conditions prevailing in that area.

Selection of seed plot: The plot selected for seed crop must be free from volunteer plants, weed plants and have good soil texture and fertility. The soil of the seed plot should be comparatively free from soil borne diseases and insect pests.

Isolation of seed crop: The seed crop must be isolated from other nearby fields of the same crops and the other contaminating crops as per requirements of the certification standards.

Preparation of land: Good land preparation helps in improved germination, good stand establishment and destruction of potential

weeds. It also aids in water management and good uniform irrigation.

Selection of variety: The variety of seed production must be carefully selected, should possess disease resistance, earliness, grain quality, a higher yielder and adapted to the agro-climatic conditions of the region.

Seed treatment: Depending upon the requirement the following seed treatment may be given

- Chemical seed treatment.
- Bacterial inoculation for the legumes.
- Seed treatment for breaking dormancy.

Time of planting: The seed crops should invariably be shown at their normal planting time. Depending upon the incidence of diseases and pests, some adjustments, could be made if necessary.

Seed rate: Lower seed rates than usual for raising commercial crop are desirable because they facilitate roguing operations and inspection of seed crops.

Method of sowing: The most efficient and ideal method of sowing is by mechanical drilling.

Depth of sowing: Depth of sowing is extremely important in ensuring good plant stand. Small seeds should usually be planted shallow, but larger seeds could be planted a little deeper.

Roguing: Adequate and timely rouging is extremely important in seed production. Rouging in most of the field crops may be done at following stages as per needs of the seed crop.

- Vegetative/pre- flowering stage.

- Flowering stage.
- Maturity stage.

Supplementary pollination: Provision of honey bees in hives in close proximity to the seed fields of crops largely cross pollinated by the insects, ensure good seed set thereby greatly increase seed yields.

Weed control: Good weed control is the basic requirement in producing good quality seed. Weeds may cause contamination of the seed crop, in addition to reduction in yield.

Disease and insect control: Successful disease and insect control is another important factor in raising healthy seed crops. Apart from reduction of yield the quality of seeds from diseased and insect damaged plants is invariably poor.

Nutrition: Regarding nutrition of seed crop, nitrogen, phosphorus, potassium and several other elements play an important role for proper development of plants and seed. It is therefore, advisable to know and identify the nutritional requirements of seed crops and apply adequate fertilizers.

Irrigation: Irrigation can be important at planting for seed crops. Excess moisture or prolonged drought adversely affects germination and results in poor crop stands.

Harvesting: It is of great importance to harvest a seed crop at the time that will allow both the maximum yield and the best quality seeds.

Drying of seeds: In order to preserve seed viability and vigour it is necessary to dry seeds to optimum moisture content.

Oyster mushroom cultivation for entrepreneurship development and livelihood improvement

Mushrooms are the fruiting bodies of macrofungi that lacks chlorophyll and cannot therefore make its own food. It grows on dead organic matter either parasitically or symbiotically with other living organisms. They include edible/ medicinal and poisonous species. Till date it has been estimated that there are more than 10,000 species of mushrooms are available throughout the world, out of which half of them are edible and few of these edible varieties can be scientifically cultivated. Among the various mushroom species, button mushroom (*Agaricus bisporus*), Oyester mushroom (*Pleurotus spp*.), paddy straw (*Volvariella spp*.), milky mushroom (*Calocybe indica*) are most suitable in Assam condition.

In this bulletin cultivation of Oyster Mushroom has been discussed which is the 3rd largest cultivated mushroom in the world and belongs to the genus *Pleurotus.* It is mainly grown on paddy straw under indoor condition which grows well in the temperature range between 18 -30 ºC and relative humidity of 80 – 85 %. The climatic condition of Assam, especially Barak Valley region, is highly suitable for Oyster mushroom cultivation and availability of straw in the valley offer good prospects.

Nutritional values of mushroom:

- In terms of the amount of crude protein, mushrooms rank below animal meats, but well above most other foods, including milk, which is an animal product.

- They are relatively good source of fat, phosphorus, iron and vitamins including thiamine, riboflavin, ascorbic acid, ergosterine and niacin. They are low in calories, carbohydrates and calcium. Mushrooms also contain a high proportion of unsaturated fat.
- The moisture content of fresh mushrooms varies within the range of 70 - 95 % depending upon the harvest time and environmental conditions, whereas it is about 10 – 13 % in dried mushrooms.

Table: Nutrient value of oyster mushroom.

PARAMETERS							
Protein (%)	**Water (%)**	**Potassium (%)**	**Fat (%)**	**Fiber (%)**	**Calcium (mg/100 g)**	**Phosphorus (mg/100 g)**	**Calories (kcal)**
2.78	90.80	1	0.65	1.1	98	476	24.40

Medicinal Benefits of mushroom:

- This wonder food is called the delight for patients of diabetes, heart problem, hypertension, hyper acidity, constipation, obesity, anemia etc.
- It is good for growing children to enhance brain and physical growth; it has antitumor, anti cancer, anti AIDS and antibiotic properties.

Why mushroom cultivation?

- Easy cultivation method, minimum land required and abundant availability of raw materials, i.e. paddy straw.
- At minimum cost maximum profit can be earned because of its fast and high yielding capacity.
- It can grow in wide range of temperatures. (i.e. 18 °C – 30 °C)
- Round the year production can be done.

- It is suitable for rural areas and can create self employment to people.
- Easy post harvest processing, particularly dehydration.
- Its production by poor can help to bring them above poverty line and improve their socio-economic status.
- In addition to nutritional value, mushrooms have unique colour, taste, aroma and texture characteristics, which attract their consumption by human.

Materials required for oyster mushroom cultivation:

- Good quality paddy straw, mushroom spawn, plastic bag (size: 60 cm × 40 cm), rope, detol or sprit, cotton, fire wood, iron drum etc.

Cultivation procedure of oyster mushroom:

Steps involves in oyster mushroom cultivation has been briefed as follows-

Step I. Selection of good quality paddy straw and chop into 3-5 cm pieces **(Plate 1)**

Step II.

Hot water treatment	**OR**	**Chemical sterilization techniques**
Chopped straw filled in a gunny bag and soaked in clean water for about 10 to 12 hours **(Plate 2)** ↓ Sterilize the soaked paddy straw for 20 – 30 minutes in boiling water **(Plate 3)**		Soak the chopped paddy straw in a solution of formaldehyde + carbendazim (@ 25 ml formaldehyde and 3 g carbendazim per 20 liters of water) for 18 hours and cover with a lid **(Plate 4)**

Step III. Take out soaked paddy straw, spread in a clean floor/ sieve to drain out excess water up to that point where water should not drip when squeezed but hand should be wet **(Plate 5)**

Step IV. Punch 30 – 40 holes in the polythene bag (60 cm x 40 cm) and put 3 kg of prepared straw thoroughly mixed with 100 g of spawn **(Plate 6).**

OR

Put a layer (4") of boiled and cooled paddy straw in the bag (60 cm x 40 cm). Put approx. 25 g of spawn in the periphery, put the 2nd layer of straw and press tightly. Repeat it till 4 to 5 layers (4 layers of spawn & 5 layers of straw) **(Plate 7)**

Step V. Compress the bag and tie up the top opening **(Plate 8)**

Step VI. Keep the bag in a humid room **(Plate 9)** until the bags turns white (apprx. 15 - 20 days) **(Plate 10)**

Step VII. Remove the plastic bag after developing white outgrowth (mycellium) inside the polybag **(Plate 11)**

Step VIII. Hang the bags properly with plastic ropes **(Plate 12)**

Step IX. Spray water regularly to protect from drying out and provide ventilation for fruiting. Maintain humidity by hanging wet gunny bags inside the room **(Plate 13)**

Step X. After 5-6 days of pinhead **(Plate 14)** stage harvesting **(Plate 15)** can be done

Crop duration: 45 – 60 days

Harvesting

- The right stage for harvesting can be judged by the shape and size of the fruit body.
- In young mushrooms, the edge of the cap is thick and cap margin is enrolled while the cap of mature mushroom becomes flat and inward curling starts.
- 3 to 4 harvest can be done per bag at an interval of 7-10 days from each other.
- It is advisable to harvest all the mushrooms at one time so that the next crop starts early.

Yield: 0.8 kg – 1.0 kg of fresh mushroom per kg of dry straw

Marketing

Fresh mushroom fetch better price. The debris from the lower portion of stalk is removed before marketing and then packed in perforated polythene bags for sale in fresh form. Hotels, departmental stores, Chinese restaurants, pizza shop, and other fast food shops could be the target area for sale. Surplus produce can be stored as dehydrated mushroom, can be pickled or processed into various processed products in absence of market.

Precautions to be Taken

- Oyster mushroom produce millions of spores which can be seen as spore clouds in the cropping rooms in early morning. Therefore mushroom pickers are advised to open the doors and ventilator for some time before entering to prevent problems of headache, high fever, coughing and joint pains.
- Do not spray water in the mushroom before 24 hrs of harvesting.
- To dry the mushroom, put the mushroom in the sun with a covering of black cloth or dry it in hot air oven.

Glimpses of steps involves in oyster mushroom cultivation


Plate 1


Plate 2


Plate 3


Plate 4


Plate 5


Plate 6


Plate 7


Plate 8


Plate 9


Plate 10


Plate 11


Plate 12


Plate 13

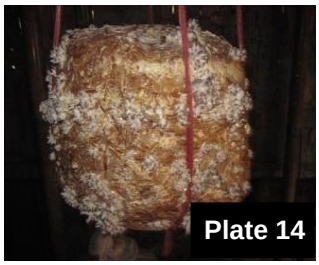
Plate 14


Plate 15

Layout design by

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