

Agriculture-8

(For Eighth Class)



Punjab School Education Board

Sahibzada Ajit Singh Nagar

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FOREWORD

Punjab School Education Board since its inception has been constantly putting its efforts for re-designing lessons and preparing books according to the needs of national educational view point and occupational requirements of the state.

The present textbook has been prepared in the light of National Curriculum Framework 2005 and Punjab Curriculum Framework 2013. Accordingly, it has been felt that more emphasis should be laid on vocational courses. India is mainly an agrarian economy and Punjab is considered as Food Bowl of the country. This book contains information about agricultural economic development of the country, some common tips about agriculture and information about agriculture based supplementary enterprises and industrial occupations so that students can be made aware to adopt it.

This book prepared by experts of Punjab Agricultural University, Ludhiana will prove helpful for students and teachers.

Suggestions from field are welcome for making the book better.

Chairperson

Punjab School Education Board

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Chapter-1

SOILS AND SOIL MANAGEMENT

For a farmer, soil is an upper layer of earth in which plant roots grow. From this layer plants absorb water and nutrients, it also provides physical strength to roots. Hence, the upper layer of earth which meets the crop requirements is known as soil. For a soil scientist, soil is a dynamic natural body developed by natural forces acting on parent material. Generally it is divided in the layers of mineral and organic matters. According to the farmers, soil is a lifeless thing, but according to a soil scientist it is a lively thing because it has enormous microbes and provides nutrients for plant growth. Soil is blend of organic matter, minerals, water and air. (Fig.1) Mineral and organic matter in a soil is almost stable whereas, water and air can interchange each other.

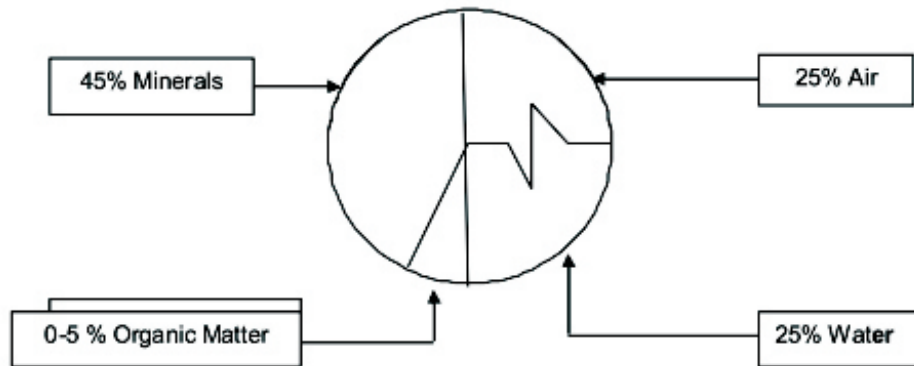


Fig. 1. Basic constituents of a Soil

Various physico- chemical properties are determined to differentiate one soil from the other. These properties are as under:

Physical properties:

Physical properties include size of soil particles, soil structure, pore size and water holding capacity etc. The relative proportion of different sized soil mineral particles (sand, silt and clay) determines the soil texture. The main three soil types are as under:

- i. **Sandy soils:** Ploughing in these soils is very easy and these soils are generally considered as light soil. These soils contain significant amount of sand. When the moistened soil is rubbed between thumb and finger it feels gritty and does not stick to hand. When a ball of moistened soil in the hand is squeezed, it breaks with slight pressure. Handmade balls of properly moistened soil fall apart easily. After application, the water leaches down quickly. Pore size of sandy soils is greater than clayey soils which results in higher infiltration rate of air and water in such soils.
- ii. **Clayey soils:** Soil with clay content more than 40% is called as clayey soil. Irrigation /rain water takes long time to leach down. Ploughing of these soils under low moisture conditions leads to development of clods. Formation of wide cracks upon drying is the characteristic feature of these soils. Balls can be easily made by moist clayey soils. Water holding capacity of these soils is greater than sandy soils. Water stagnation is the main problem with these soils.
- iii. **Loamy soils:** Characteristics of these soils are in between that of sandy and clayey soils. Soil structure, aeration, water movement, water holding capacity and nutrient content are optimum for crop cultivation. These soils are best suited for agriculture. When rubbed between thumb and fingers, it feels like powder.

Chemical properties:

Every soil has different chemical properties such as soil reaction (pH), electrical conductivity (EC), salt content, types of salts present etc. Based on these chemical properties soils are classified as under:

- i. **Acidic soils:** Acidity or basicity of soil is measured by pH. The pH range of 6.5 to 8.7 is considered normal for crop production. If pH is less than 7, soils are considered as acidic. These soils are generally found in areas receiving high rainfall, which is high enough to leach appreciable amount of exchangeable bases from the surface layer.
- ii. **Salt affected soils:** These soil contains some amount of soluble salts. However, under some circumstance when the concentration of salts in a soil is high enough, which adversely affects the crop growth, such soils are known as salt affected soils. Based on types of salts present, pH and EC, the salt affected soils are classified into three groups:

- a. **Saline soils:** Soils with higher concentration of sulphates and chlorides of calcium, magnesium, and potassium are known as saline soils. The pH of these soils is less than 8.7 and EC is more than 0.8 mmhos/cm. A powder white layer of soluble salts is developed on the soil surface upon drying after irrigation. Water stagnation is not a problem in these soils. In local language, these soils are also called as *kallar, reh, thur or shora*.
- b. **Alkali soils:** Carbonates and bicarbonates of sodium are the main salts in alkali soil. The pH of alkali soils is greater than 8.5. Sodium gets attached to clay particles and deteriorates chemical and physical properties of soils. Infiltration rate of these soils is very low which causes water stagnation problem in these soils.
- c. **Saline-alkali soils:** The soils having higher concentration of sodium and soluble salts in it are called saline-alkali soils. So these soils have combined characteristics of saline and alkali soils. These soils have higher amount of sodium attached to clay particles and higher amount of soluble salts in it.

Management of problematic soils:

Following measures should be adopted for the improvement of such soils.

- i. **Management of sandy soils:**
 - Incorporation of **45-50 days** old green manure crop of *dhaincha/sunhemp* helps in improving the sandy soils.
 - Application of well decomposed organic manures viz. farmyard manure, poultry manure, pig manure and compost etc. followed by their proper mixing in soil is beneficial.
 - Cultivation of leguminous crops improves nitrogen availability in these soils.
 - Proper leveling and small plot size (*Kiara*) improves irrigation water use efficiency of sandy soils.
 - Incorporation of clay soil or village pond soil improves sandy soils.
 - Sandy soils can also be improved by removing their surface layer from the top with the help of tractor operated scrapper (*karaha*).

ii. Management of clayey soils:

- Application of organic and green manures make the soil slightly fluffy which improves the aeration and water infiltration rate of clayey soils
- Incorporation of crop residue improves the clayey soils
- Ploughing the field at proper moisture content (near field capacity) prevents formation of large sized clods.
- Proper drainage system should be made to drain out excessive amount of water.
- Rice cultivation should be preferred in clayey soils.

iii. Reclamation of acidic soils:

Acidic soils are reclaimed with the addition of lime. Lime requirement of the soil varies with the extent of acidity and soil texture. Application of press-mud and saw dust helps in reclaiming acidic soils. Application of liming amendment improved physico-chemical environment of the soil and also increased availability of essential nutrients to crop.

iv. Reclamation of salt affected soils:

There are few factors which need to be considered before reclamation of salt affected soils: These factors are sub-soil water level, irrigation water quality, availability of canal water, presence of hard pan in soil profile, drainage conditions, degree of salinity and alkalinity. Based on these factors, reclamation of saline and alkali soils can be done as given below:

a. Reclamation of saline soils: Ploughing of flooded field is recommended to leach down the salts from upper layer. Ploughing in flooded field is known as puddling (*kaddu karna*). If good quality irrigation water is not available, scrape the upper salty layer of soil with help of tractor operated leveler (*karaha*). Scraped soil should be dumped deep into soil profile.

b. Reclamation of alkali soils:

- Level the field properly for equal distribution of water throughout the field.
- Make the strong bunds around the field to prevent outflow of water containing dissolved salts to adjoining fields.

- Get the soil and water tested to know the gypsum requirement.
- Broadcast the recommended dose of amendment (gypsum) as per the soil test and mix it thoroughly with shallow ploughing.
- Irrigate the field to allow the seepage of salts from the surface layer.
- Practice green manure of *dhaincha* before rice transplanting in such fields.
- Application of organic manures also helps in improving physico-chemical properties of alkali soils.

c. Reclamation of soils in water logging areas:

In some areas of Punjab level of underground water table is high. As a result, the soils remain continuously wet due to filling of soil pores and soil air spaces with stagnant water. Such problematic soils are referred as water logged soils. Such a condition is found in some areas of Muktsar districts and along river banks. Due to lack of availability of air and oxygen to the roots, plant growth is retarded and farmers fail to raise a normal crop. Draining out stagnant water, lowering of underground water through tube wells and plantation of water loving crops such as eucalyptus, rice and sugarcane and use of canal water for irrigation may be adopted as measures to reclaim such soils.

Exercises

a. Answer in one to two words:

1. What is pH of a normal soil for crop production?
2. Name any two physical properties of soils.
3. Which soils have highest infiltration rate?
4. What is the percentage of clay particles in clayey soils?
5. Which soil property determines the soil acidity or alkalinity?
6. Which are the prominent salts present in saline soils?
7. The soil with higher concentration of sodium carbonates and bicarbonates are categorized as.
8. Which amendment is used for reclamation of alkali soils?

9. Name two green manure crops.
10. Which crop is best suited for cultivation in clayey soils?

b. Answer in one to two sentences:

1. What is soil?
2. Write the important functions of soil
3. Enlist the physical properties of soil.
4. Compare clayey and sandy soils.
5. What is acidic soil?
6. What is saline soil?
7. Write two main methods to identify a sandy soil.
8. What are the major properties of loamy soils?
9. What are saline-alkali soils?
10. What is puddling?

c. Answer in five to six sentences:

1. Describe the different types of soils according to their physical properties.
2. Give the diagrammatic representation of soil components.
3. Explain the management practices for improving sandy soils.
4. Explain the method of reclamation of alkali soil.
5. Explain in detail the management strategy for clayey soils.

Chapter-2

NURSERY RAISING

The population of our country is increasing but land is decreasing day by day. For getting more income from small land holdings, nursery raising is remunerative occupation. More income can be obtained from nursery raising of vegetables, flowers and fruits. For healthy nursery production, full knowledge and skill about nursery operations is required.

BENEFITS OF NURSERY RAISING

1. Seeds are very expensive and its efficient utilization is done through nursery raising.
2. Seeds of some vegetables are very small and it is difficult to sow them directly in the field but can be easily planted through nursery.
3. There is an appropriate use of land. Fallow land can be used for sowing of other crops till the nursery will be ready for transplanting.
4. It is easy to look after the seedlings in small area of nursery.
5. Nursery can be raised for early and late season crops to get maximum profit.
6. The weak seedlings can be removed in the nursery at the time of transplanting.
7. Seedlings can be protected from extreme cold or heat in small area of nursery.
8. Seedlings can be easily protected from insects and diseases in nursery which minimizes the cost of production.

(A) NURSERY RAISING OF VEGETABLES

There is always shortage of quality seedlings of vegetables. So, there is huge scope to produce nursery of vegetables. Especially, small farmers can earn more income by raising nursery of vegetables. Only the nursery of those vegetables can be raised successfully which can tolerate the transplanting shock e.g. tomato, chilli, capsicum, brinjal, onion, cauliflower, cabbage, Chinese cabbage, broccoli, lettuce etc. The following points must be kept in mind while nursery raising of these vegetables.

1. **Selection of land:** Select the land for nursery raising which got at least 8 hours sunshine. It should be free from stones and shade of any big tree. There should be assured supply of water and drainage of excess water from nursery area. Loamy or sandy loam soil is considered best for nursery raising.
2. **Seed bed preparation:** After well preparation of land, prepare seed bed of 1.0-1.25 m wide and 15 cm high from the ground level. Normally the seed bed should be 3-4 metre in length but if field is levelled well then length can be increased. Before preparing seed bed, apply well rotten FYM @ 3-4 q per marla (25 square metre) area. Irrigate the field atleast 10 days before sowing the seed in the nursery so that all the weeds can germinate and there will be less problem of weeds in the nursery.
3. **Soil treatment:** Treat the soil with formalin @ 1.5- 2.0 % before sowing the seed to protect the nursery from soil borne diseases. For preparation of solution, add 15-20 ml Formalin (1.5-2.0%) in 1 litre of water and apply 2-3 litres of this solution in 1 m² area in such a way that 15 cm upper layer of soil may saturate with this solution. After this, cover the beds with polythene sheet and air tight for 72 hours. Turn the soil in beds once a day for 3-4 days to eliminate formalin and sow the seedlings in the nursery.
4. **Seed treatment and sowing:** Treat the seed with Captan or Thiram @ 3g per kg of seed before sowing to protect it from seed borne diseases. Sow seeds 1-2 cm deep in lines with 5 cm spacing. Irrigate the nursery with sprinkler till the seedlings emerge out.
5. **Caring of nursery plants:** Sometimes seedlings start dying before or after germination in the nursery. Under such circumstances, drench the nursery area with Captan or Thiram @ 3-4 g per litre of water and repeat it after 7-10 days. Transplant seedling of vegetables after 4-6 weeks of sowing. Stop watering 3-4 days before transplanting the nursery so that seedlings can tolerate the transplanting shock. Transplanting should be done in the evening hours and immediately irrigate the field. The detailed information regarding nursery raising of different vegetables for transplanting one acre area is given below:

Vegetables	Time of Sowing of nursery	Seed rate	Area (m ²)
Tomato	First week of November and first fortnight of July	100 g	50
Brinjal	October, November, February-March and July	400 g	25
Chilli	Last week of October to mid November	200 g	25
Capsicum	Last week of October	200 g	25
Rabi Onion	Mid October to mid November	4-5 kg	200
Kharif Onion	Mid March to mid June	4-5 kg	200
Cauliflower	May-June (Early season crop)	500g,	50
	July- August (Mid season crop)	250g	25
	September-October	250 g	25
	(Late season crop)		

(B) NURSERY RAISING OF SEASONAL FLOWERS

The demand of pot plants has been increased with the development of multi-storey buildings for ever growing population. These are used for decoration of offices, hotels, houses etc. There is a huge demand of seasonal pot plants and chrysanthemum, dahlia and seasonal flowers give more profit. The business of flower nursery is beneficial near the big cities. Zinnia, Kochia and Sunflower can be grown in summer season. Marigold, Gul Ashrafi, Ice plant, Garden pea, Phlox etc are winter season flowers.

METHOD OF NURSERY PREPARATION OF SEASONAL FLOWERS

Almost all seasonal flowers are prepared in nursery. Nursery can be prepared on raised seed beds or pots. For preparation of nursery, mix soil, leaf mould, FYM in 1:1:1 proportion and add 75 g CAN, 75 g Super Phosphate and 45 g Murate of Potash per m³ area. Apply 2-3 cm thick layer of this mixture on raised seed beds.

After sowing, cover the seed with this mixture and irrigate it with sprinkler. Keep the seed beds moist. Nursery is ready in 30-40 days.

(C) NURSERY RAISING FOR FRUIT PLANTS

Nursery of fruit plants is prepared by two methods:

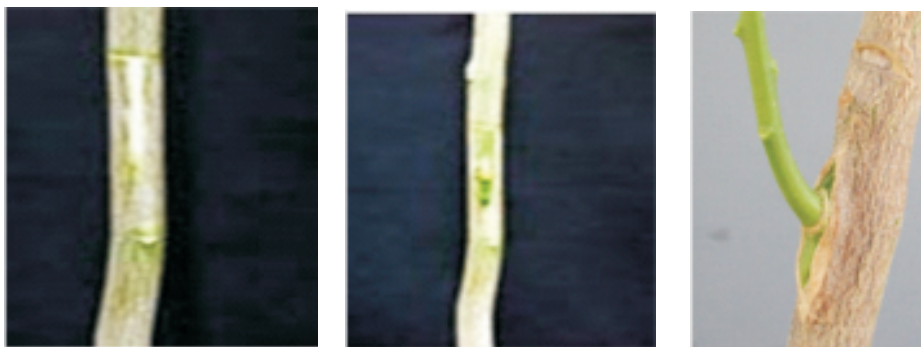
1. From seeds: It is easy and cheapest method to produce plants. Fruit plants like Papaya, Karonda, Jamun and Phalsa are multiplied through seeds. However, the plants prepared from seeds are not true to type, uniform and moreover they attain large size. The management of these plants is very difficult. So the plants which are difficult to prepare from seed are prepared by root stock method.

2. Vegetative propagation: By this method, uniform and true to type plants can be produced. The plants prepared by this method bear fruit early. Mainly, the fruit plants like Mango, Citrus, Pear, Guava, Peach, Grapes, Pomegranate etc are propagated by following methods:

By cutting: It is very cheapest and easy method to grow plants. In this method, stem cuttings are placed in suitable environmental conditions so that rooting and shooting may start and new plants may develop. By this method, commonly citrus, pomegranate and grapes can be prepared. Cutting should be 15-20 cm and have 3-5 buds. Before sprouting in spring season, cuttings should be planted at 6-8' distance in the nursery.

Layering: In this method, new plants are forced to root while attached to the mother plant. In simple layering, the ring of bark is removed from the 20-30 cm tip of the shoot and it is buried in the soil from the place of removed ring keeping the terminal end of shoot exposed. The soil should remain moist and rooting will emerge after few weeks from this portion. Then separate the plant from mother plant and plant it in nursery or pot.

Budding: In this method, healthy scion having 1-2 buds from mother plants are inserted to the root stock (Fig 2.1). The buds should be taken from healthy plants having good quality fruits and free from diseases. A cut should be given in the bark of rootstock so that the bud can be fitted precisely in this cut. After insertion of bud, a tape should be tightly tied around the cut part of root stock keeping the tip of the bud exposed. Budding should be done during spring and rainy season.



Grafting: It is similar to budding except that the scion stick having 3-4 buds is turned in place of single bud. The different methods of grafting are performed in different fruit plants e.g. side grafting in mango and tongue grafting in pear and peach.

(D) NURSERY PREPARATION OF AGROFORESTRY PLANTS

In Punjab, the area under forest cover is negligible. Environmental experts are emphasizing on agroforestry for maintaining natural balance and diversification of agriculture. Poplar, eucalyptus, Drake and Sisham are important agroforestry tree species which are being grown by the farmers of Punjab. Nursery preparation of these tree species is given as:

1. Poplar: It is a major tree of agroforestry landscape. For this species, nursery should be prepared from one year old plant but not from training and pruning of branches of old plants. Cuttings should be 20-25 cm in length and 2-3 cm in diameter. To protect the cuttings from termite and diseases, the cuttings are treated with 0.5 % solution of Chlorpyrifos 20 EC and 0.5 % Emisan solution for 10 minutes each, separately. The ideal time for nursery raising is mid January to mid February. After thorough preparation of beds, dig holes of equal length of cutting in the soil with the help of planting rod at a spacing of 60x60 cm or 50x50 cm. Plant the cuttings in the soil after keeping one bud of the cutting above the soil. Keep the soil moist till the sprouting of cuttings start. Irrigation and hoeing is done as and when required. Remove buds of 1/3 part of plant by rubbing with wet gunny bag. The plants are ready to transplant in the field after one year.

2. Safeda: Safeda is a fast growing tree. For preparing of its quality nursery, select healthy and well grown middle aged trees to collect seeds. Collect seeds from the

branches of trees only and not from the ground surface. Seed collected from good plants will produce healthy planting stock. February-March or September-October is the best time of raising nursery on raised beds or in pots.

3. Drake: Its nursery is commonly propagated from seeds. Seeds should be collected from healthy, well growing and tall plants during winter. The germination of seed is less (30-40%) due to its hard seed coat. Before sowing, the seeds are soaked in water for 24 hours or buried in FYM for 7 days to improve their germination. The best time for nursery sowing is February-March. Seeds are sown in seed beds at 20 cm distance. Seeds start germinating after 3 weeks of sowing. Thinning should be done at 15 cm spacing when plants attain a height of 5-8 cm. The plants are ready for transplanting after one year or even six months.

4. Sisham: Sisham is a state tree of Punjab. Collect riped pods in December-January from healthy and straight trees. Nursery can be prepared in poly bags or in seed beds or in pots. Suitable time for nursery sowing is mid January-February and July- August. Before sowing, soak pods in cool water for 48 hours. Sow the seed 1.0-1.5 cm deep. Germination of seeds start after 10-15 days of sowing. When the plants attain height of 5-10 cm, thinning should be done keeping 15 X 10 cm spacing.

Exercise

(a) Answer in 1 to 2 words:

1. Which fungicide is used for vegetable seed treatment?
2. What is the optimum time for raising the nursery of tomato?
3. When should the Chilli nursery be raised?
4. Write the name of two summer season flowers.
5. Write the of name two winter season flowers.
6. What is the optimum time for raising nursery of eucalyptus?
7. What is the length of poplar cutting for nursery raising purpose?
8. Write the method through which true to type plants can be produced.
9. What is the seed rate of onion for one acre?
10. Write the name of two fruits and flowers which are raised through budding.

(b) Answer in 1 to 2 sentences:

1. Which vegetables are raised through nursery?
2. Write the seed rate and time of sowing for nursery raising of tomato.
3. Which are two winter season flowers and when these can be sown?
4. Which fungicide is used against damping off of seedlings of vegetables?
5. Which fruit plants are vegetatively propagated?
6. Which fruit plants are grown through seed?
7. Write ideal method of nursery raising of poplar.
8. How to collect the seed for preparation of Drake nursery?
9. Which are the methods for nursery preparation of fruit plants?
10. What are the advantages for preparation of plants through cuttings?

(C.) Answer in 5 to 6 sentences:

1. How to develop plants through layering?
2. Describe the methods of budding.
3. Describe briefly about the nursery raising of Sisham.
4. Describe the method of nursery raising of flowers.
5. What are the methods for nursery preparation of fruit plants?

Chapter-3

LAND MEASUREMENT AND DOCUMENTATION OF LAND RECORDS

The measurement of land in India was started in the reign of Mughal Emperor Akbar and Todermal played a significant role in this work. Before that, the measurement of land and its record keeping was not done in a systematic manner. At that time, measurement of land was done with the help of ordinary string. The required tax (*Malia*) was paid to the government in kind i.e. in the form of crop produce. Since 1580 A.D. Emperor Akbar started receiving tax in cash and made the land record systematic. That is why; Emperor Akbar is called the founder of land reforms in India. During British rule and after independence, more land reforms and land measurement improvements were introduced; one of them the Land Consolidation Act (*Murababandhi* Act) of fifties is worth mentioning. Consolidation of land was done in a systematic way in the states of Punjab and Haryana. Both these states are the leading states in ushering Green Revolution in India. The following are the important documents relating to land measurement:

(1) *Zareeb*:

The chain made of iron rings (*Karies*) is called *Zareeb* which is used for measuring the land. The land is measured in acres, kanals or marlas in most parts of Punjab. The length of *Zareeb* is 10 *karms* (a unit of land measurement usually equivalent to two footsteps or 5.5 feet).

(2) *Shijra/Kishatvar/Paarcha/Latha*:

It is a piece of cloth on which map of the village is carved and all the *Khasra* numbers of village are printed on it.

(3) **Measurement of land:**

Whenever boundary of a particular field gets erased and length and breadth of it is not known to the owner and the owner intends to get it measured, then Patwari/ Kanugo marks the length and breadth of that Khasra number with the help of *Shijra* and *Jareeb*. Demarcating the area on all four sides of field is called measurement.

(4) Murababandi:

Consolidation of scattered pieces of land as a one unit at one place is called *Murababandi/Chakbandi*. *Murababandi* was started during fifties. According to Punjab Consolidation Act, land was divided into 25-25 acres of land pieces. A piece of 25 acres of land is called *Muraba* or *Musteel*. With the help of *Murababandi*, every work related to land becomes easier.

(5) Goshwara:

Sum/total of all cultivated crops presented in tabular form is called *Goshwara*.

(6) Registry:

When a piece of land, house, shop, etc. is sold or mortgaged by one person to another on a fixed price, an agreement is entered with photos with mutual consent of both parties in the Register maintained in the office of Tehsildar is called Registry or registered agreement. There are different types of registries like Registry Bhai, *Rehan*, share, transfer of ownership etc.

(7) Intkaal:

Transfer of ownership rights from one person to another is called *Intkaal*. There are 12 columns of an *Intkaal*. *Intkaal* is of different types like Bhai, *Rehan*, hereditary, transfer of ownership, share, exchange (*tabadala*), division (*Takseem*), etc. *Patwari* enters the *Intkaal* and Kanugo checks its contents as per record. After that, Tehsildar summons both the parties at a designated place and time and approve the *Intkaal* on the verification of the Nambardhar in the presence of both the parties.

(8) Jammabandi:

Jammabandi or *Fard* is one of the important documents of Punjab Revenue Act regarding ownership of land. The ownership of land is continuously changing like transacting a part of land on Bhai, *Rehan*, transfer, hereditary, unirrigated to irrigated, change from rental to crop share basis (*mamla* to *bhatai*), change of cultivators, etc. Entering of these changes in record is essential. Earlier, *Jammabandi* was carried out after a span of four years, but now *Jammabandi* of every village is renewed after a span of five years. The changes made during the preceding five years are entered in the record of *Jammabandi/Fard* which consists of 1-12 columns in which particulars of *Khepet number*, *Khatauni*, name of village *Pati* or *Thuley* and name of owner

according to his or her share, existing cultivator and source of irrigation, etc. are kept. This document is called *Jammabandi*.

(9) Division of land (*Zameen dee Takseem*):

When the number of shareholders of a particular piece of land increases, then division of land as per the consent of share holders is called division of land. After division of land, every shareholder becomes owner of his or her share. Now one can sell or mortgage one's land. One can also take loan from banks, transfer any number of his or her share and can have a separate turn for canal water supply. One can also take his or her own electric connection. It facilitates the shareholder to take independent decision about his/her land share such as sell or mortgage, taking loan from banks, separate turn for canal water supply, own electric connection etc

(10) *Girdawary and Darusti Girdawary*:

Girdawary is also called *Gardauri*. It is a type of survey of land and cultivated crops. *Girdawary* is done twice a year during the month of March for *Rabi* crops and October for *kharif* crops. In addition, *Girdawary* is also done twice a year in the months of May and December for the crops falling between *Rabi and Kharif* seasons.

(11) Rectification of *Girdawary* :

Corrections in the *Girdawary* can be made with consent and signatures of both the parties by the Patwari. In case of dispute, then it can be got rectified or corrected in the Court of Tehsildar.

(12) *Theka or Chakota*:

Land given by the owner to another person for cultivation on rent for fixed amount and time period is called *Theka* or *Chakota*. The time period may be one year or two years or five years, etc.

(13) *Rehan (Mortgage)*:

When an owner of the land gives temporarily a piece of his land to another person for cultivation for mutually agreed amount and fixed time, it is called mortgage of land. The land will remain with the person who leases in the land till its original owner returns the whole amount.

(14) Loss (*Khraba*):

Destruction of crops on large scale due to any natural calamities, e.g. excessive rains, drought or the attack of insects/pests *etc.* is called loss (*Khraba*). Although different government departments have their own yardsticks for assessing the crop losses but destruction of crops in the area is assessed assuming 100% production of crop in the area.

(15) Computerization of land record:

These days, land record is being provided through computerization and *Jamabandi* and *Intkaal* can be checked by sitting at home. The certified copies of *Jammabandi* and *Intkaal* can be obtained personally from the nearby office of Sub-Tehsildar/Tehsildar by paying the requisite fee. Land record is also available on the website: www.plrs.org.in

Scales of Measurement of Land:

1 foot	=	12 inch
1 yard	=	3 feet
1 furlong	=	220 yards
1 mile	=	1760 yards or 8 furlongs
1 karm	=	66 inch (5½ feet)
1 square karm	=	1 Sarsahi
1 marla	=	9 sarsahian or 272 sq. feet or 30 sq.yard
1 kanal	=	20 marlas
1 Acre	=	8 kanals or 160 marlas or 220 x 198 sq.ft or 36 x 40 karm or 96 bisweys or 4000 sq.metre
1 hectare	=	2.5 acres or 10,000 sq.metre
1 biswa	=	50 sq.ft
1 Muraba/1 Musteel	=	25 acres

Exercise

a. Answer in one or two words

1. How the land was measured in ancient time?
2. Which Emperor is called the founder of land reforms?
3. How many acres are there in one hectare?
4. How many marlas make one kanal?
5. In which states of India, Murababandi has been done in a systematic way?
6. In which decade, Murababandi was started?
7. Which site is to be seen for *Jammabandi*?
8. How many acres are there in a *Muraba* according to *Murababandi* Act?
9. At what time, Girdawary of a *Rabi* crops is prepared?
10. After how many years, new *Jammabandi* is carried out?

b. Answers in one or two sentences:

1. Who corrects the *Girdawary* of a disputed land?
2. What is *Jammabandi*?
3. What is *Intkaal*?
4. What instruments are required for measurement of land?
5. What is *Goshwara*?
6. What is *Rehan* or Mortgage?
7. What is *Khraba*/loss of crops, how it is assessed?
8. What is *Shijra* and what are its other names?
9. What is *Murababandi* and what are its benefits?
10. What is *Zareeb*?

c. Answers in 5 to 6 sentences:

1. What is *Girdawary* and at what time it is done?
2. Why division of land is essential and how it is done?
3. What is computerization of land record?
4. What is *Theka* or *Chakota* or renting in or renting out of land?
5. Write a brief note on land registry.

Chapter-4

SOLAR ENERGY

Energy is a major constraint in achieving high production and productivity. The stage of development of a country depends upon its energy utilization. The sources of energy present in the whole universe are classified into two categories :-

- (1) Non-renewable sources (such as oil, coal, electricity, etc.) which are very costly and limited in nature. These are depleting very fast.
- (2) Renewable energy sources (such as biogas, solar energy, producer gas, wind energy, chemical energy, tidal power, geothermal power, animal and human energy etc.) which are very cheap and unlimited in nature. These energy sources are easily available everywhere as far as life exists in this universe.

Importance of solar energy

Solar energy is a renewable source of energy. Solar energy is very important because it is a very large source of energy. It is very clean source and available in wide area. Solar energy may be used directly as thermal energy, or can be converted into electricity through photo voltaic cells:

- (1) The thermal route uses the heat for water heating, cooking, drying, water purification, power generation and such other applications.
- (2) The photovoltaic route converts the light in solar energy into electricity which can then be used for a number of purposes such as lighting, pumping, communication and power generation.

2. Solar apparatus or equipments

The description of different solar gadgets is given as follows:

(1) Solar dryers

Solar dryer is required for drying crops, vegetables and fruits. While drying these products in the direct sunlight, the birds, insecticides and dust will spoil these products. The colour of the vegetables and fruits also changes and nutritious ingredients also gets spoiled when dried in open sunshine.

Solar dryer is made up of hot (wooden) box. On one side of the dryer, an insulated door is provided for loading and unloading the perforated trays. For air flow, holes are provided on the bottom and in the back side near the top of the dryer. The interior of the dryer is painted with dull black paint for absorption of solar radiation. A transparent window glass sheet is fixed as glazing on the front of the hot box for solar energy interception. The hot box is supported on the base frame mounted on castor wheels for easy mobility of dryer. The perforated trays are arranged at different levels, one above the other inside the hot box. The product to be dried is placed in these perforated trays.

Solar dryers are of two types:

(i) Domestic solar dryer

Domestic solar dryer is small sized natural circulation solar dryer. Most of the products that are used in powder form in domestic kitchen, e.g. chilies, garlic, ginger, mango powder, coriander, onion, fenugreek leaves etc. are dried in this dryer. It is capable of drying about 2-3 kg of fresh product in 2-3 days. Its photograph is shown in Figure 4.1.



Figure 4.1

(ii) Multi product solar dryer

For drying agricultural products, drying air temperature should be below its maximum allowable temperature because temperature above this causes quality deterioration of dried product. In multi product solar dryer, drying air temperature is maintained below maximum permissible temperature limit of drying product. This solar dryer has capacity to dry 20-30 kg of agricultural products per day. The photograph of this solar dryer is shown in Figure 4.2



Figure 4.2

Multi product solar dryer

(2) Solar cooker

Solar energy is one such source which can save 20% to 50% conventional fuels used for cooking. A solar cooker is a device in which cooking of the food is done by using solar energy. Solar energy is collected in the form of heat by using reflectors / lenses or insulated boxes and the heat thus collected is used for cooking. A solar cooker consists of an insulated box with a transparent window through which sunshine enters the box. With the use of these reflectors, it becomes necessary to make a few adjustments of the cooker towards the sun. *Chapaatti* making and frying cannot be done in the solar cookers. The different types of solar cookers have been shown in Figures 4.3 and 4.4.

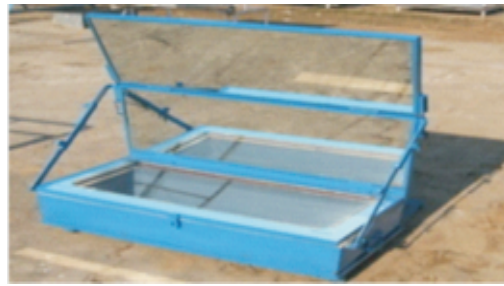


Figure 4.3 Box type solar cooker Figure 4.4 Double reflector solar cooker

Method of cooking in solar cookers:

- (i) Setup the solar cooker in the sun so that it starts getting pre-heated before the ingredients of the food stuffs are placed in it.
- (ii) Put the ingredients of the food in the containers and add just sufficient quantity of water (if water is required e.g. for rice, lentils etc.) along with required quantity of salt, peppers, spices, etc. as per recipe.
- (iii) Vegetables, eggs, potatoes etc. do not require water in solar cookers. Large pieces of vegetables and potatoes be cut into smaller pieces before placing these in solar cooker.

- (iv) The food ingredients along with water should preferably fill about half or less the depth of the containers.
- (v) Lift the double glass cover to open hot box. Clean it from inside and place the food containers in it. Now close the double glass cover fully.
- (vi) Adjust the cooker towards the sun.
- (vii) Do not open lid of the hot box too frequently.

(3) Solar water heater

One of the popular devices that harness the solar energy is solar water heating system for heating water. Where heat energy needed at relatively low temperatures i.e. less than 100°C , solar water heaters are used for heating water. Solar water heater is a device which absorbs solar energy and converts it into heat energy. Solar water heater is also called a solar collector.

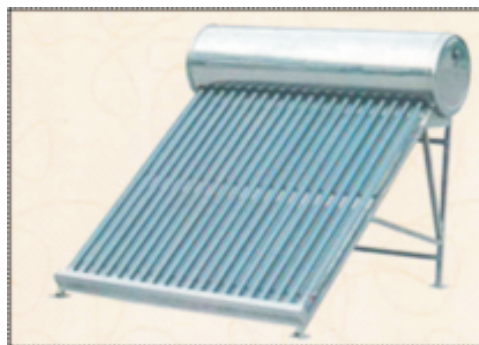


Figure 4.5 Solar water heater

A typical solar water heater is shown in Figure 4.5. The tubes of the collector are joined to header of the bottom and the top. Insulated storage tank is mounted such that its bottom is at least 60-70 cm above the top of the collector. The tube and fin assembly is insulated at the back and the sides and its front is covered with a glass sheet. When the sun rays fall on the tube and fin assembly, water gets heated and moves to the upper part of the storage tank by natural convection and relatively heavier cold water from the bottom of the storage tank flows to the bottom header of the collector.

(4) Solar lantern:

This is an emergency light charged with sunlight and works for 3 to 4 hours. It has been shown in Figure 4.6.



Figure 4.6 Solar lantern

(5) Solar home lighting system

In this system, the inverter is charged with solar light which can operate two lights and two fans for 5 to 6 hours. It has been shown in Figure 4.7.



Figure 4.7 Solar home lighting system

(6) Solar street light

In this system, the battery is charged with solar light which operates solar light after sunset. These lights can be installed in the streets and on the road sides and are operated automatically when sun sets. It has been shown in Figure 4.8.



Figure 4.8 Solar street light

(7) Solar water pump

This system consists of motor which operates during the day time with solar panel for water pumping. It pumps water from water level up to 35 to 40 feet. It has been shown in Fig. 4.9



Figure 4.9 Solar water pump

Exercise

A. Answer in 1 to 2 words:

1. What is the major benefit of solar water heater?
2. Give two examples of renewable sources of energy.
3. Give two examples of non-renewable sources of energy.
4. How many types of solar dryers are?
5. Name any two vegetables which are dried in the solar dryer.
6. What is the capacity of multiple solar dryer for drying agricultural product?
7. What is the major benefit of solar cooker?
8. What percentage of conventional fuel can be saved by the use of solar cooker?
9. For how many hours solar lantern can be used?
10. How many types of solar cooker are?

B. Answer in 1 to 2 sentences:

1. What are the types of energy sources? Give examples.
2. Name of the products which are dried with solar dryer.
3. What is meant by solar cooker?
4. Briefly discuss solar street light.
5. What are the points kept in mind when the cooking is done in solar cooker?
6. Briefly discuss the solar home lighting system.
7. What is solar water pump?
8. Briefly discuss solar lantern.
9. Briefly explain the working of domestic solar dryer.
10. Briefly discuss the multi product solar dryer.

C. Answer in 5 to 6 sentences.

1. Explain the method of cooking in solar cooker.
2. Explain the solar water heater in details.
3. Explain the solar dryer in details.
4. Briefly discuss the different gadgets of solar energy.
5. How the solar energy can be used in different ways?

Chapter-5

MUSHROOM CULTIVATION

Mushrooms are used as a health food product all over the world. In Punjab there is huge potential for production of mushrooms and the primary reason is the easy availability of raw materials and appropriate environmental conditions (season) for the cultivation of mushrooms. There are about 400 mushroom growers in various parts of Punjab and the production of mushrooms in the State is about 45,000 – 48,000 tones per annum.

Mushrooms are used as food because they possess nutritional attributes required for good health. They are rich in proteins which mainly consist of digestible proteins. In addition they contain minerals such as calcium, phosphorus, iron, potassium, etc. in ample amounts. Mushrooms contain low amounts of fats and carbohydrates and are hence good for consumption by patients suffering from blood pressure and diabetes.

Commonly cultivated mushrooms

Punjab has suitable environmental conditions for the production of five different varieties of mushrooms including, Button mushroom (Fig 5.1), Oyster mushroom, Shiitake mushroom, Chinese mushroom and Milky mushroom. In winter two crops of button mushroom (September – March), three crops of oyster (October – March), and one crop of



Figure 5.1 Button Mushroom

Shiitake (September – March) can be taken. In summer, one can have up to 4 crops of paddy straw mushroom (April – August) and 3 crops of milky mushroom (April – October). The production of winter mushrooms is started in mid-September. The most widely grown and commercially produced mushroom is button mushroom. The cultivation of button mushroom is done as follow:-

a) Compost formulation:

Ingredients	Quantity (kg)
Wheat straw (<i>Turi</i>)	300
Wheat bran (<i>Choker</i>)	15
Calcium ammonium nitrate (CAN)	9
Urea	3
Superphosphate (P_2O_5 , 16 17%)	3
Muriate of potash or potassium sulphate (MOP)	3
Molasses	5
Gypsum	30
Gamma BHC (20% E.C.)	60 ml
Furadan (3G)	0.15

b) Stack preparation:

Wheat straw is spread on a “pucca” floor and wetted thoroughly with clean water for up to 48 hours. Side by side, wheat bran/husk powder is mixed with fertilizers (CAN, urea, superphosphate and MOP) and moistened with water. The bran-fertilizers mixture is then broadcasted on the wet wheat straw and mixed with it using pitchforks. Thereafter, a stack (pile) of 5’ x5’ x5’ is prepared with the help of 3 wooden boards. The boards should be removed from the sides of stack as soon as it is ready.

c) Turning of stack:

Proper turning of the stack is important so that microbial activity during decomposition is maximum. To achieve this, turnings of the stack are done, which means outer portions of the stack are exchanged with inner portions. In all 7 turnings are given to get a final grade compost. In all 7 turnings are given. First turning on 4th day when 5 kg molasses are added in the form of its solution in 20 liters of water, second turning on 8th day, third turning on 12th day when 30 kg gypsum is mixed by sprinkling the powder on dismantled stack and mixing it before restacking. The 4th to 7th turnings are given at intervals of 3 days each. Furadan is added at the 5th and

Lindane at the 7th turn. Compost prepared from 300 kg straw is sufficient for 20-25 boxes of 0.25 sq. m each. The final grade compost is checked for quality parameters. The ready compost should be dark brown in colour with no ammonical smell. At the time of spawning it should contain 65-72% moisture and pH of 7-8.

d) Spawning:

After cooling the compost and checking for quality parameters, spawning is carried out. For one sq. meter space, 300 g of spawn is used. Thus for the 3 quintals of wheat straw, 3 kg of spawn is required. Spawn can be procured from Department of Microbiology, PAU, Ludhiana. Generally, the two layered spawning technique is used. For this method, the containers (trays) are filled up to about 3" depth and spawned with 1/3rd of the required quantity of spawn. Then more compost is added to bring it to the level of about 6" depth and the remaining 2/3rd quantity of spawn is evenly distributed on the surface and slightly pressed in. The spawned surface is covered with newspaper sheets. The bags/trays are arranged in tiers in the growing rooms and watered with sprayers regularly to keep these sheets moist. The trays/boxes show initiation of spawn run after 2-3 days of spawning. It takes about 2 weeks for the trays to show 80-100% coverage with white mycelial growth.

e) Casing:

At this stage the newspaper sheets are removed and spawn run surface of compost is covered with 1 to 1.5" thick uniform layer of casing soil consisting of a mixture of well is disinfected with 4-5% formalin solution for 48 hours before using the casing mixture.

f) Disinfection of casing mixture:

The casing soil mixture is disinfected by using 4-5% solution of formaldehyde (formalin) In addition, 20g Furadan per quintal of casing soil may be added to check any possible outbreak of nematodes. The treated soil is heaped and covered with a tarpaulin sheet or polythene sheet for at least 48 hours. Thereafter, it is opened and turned again and again to free it from fumes of formaldehyde.

g) Procedure for casing:

After 2-3 weeks of spawning, remove the newspaper sheets and spawn run surface of compost is covered with 1 to 1.5" thick uniform layer of disinfected casing soil.

h) Arrangement of boxes:

For obtaining high yields of button mushroom and for optimal use of the space of the room, the boxes are arranged one on top of the other. The distance between adjacent row of boxes is kept at 2-2.5 feet and the vertical space between boxes stacked on top of other is one foot.

i) Appearance of Crop:

After 2-3 weeks of casing, mushrooms will start appearing in the form of small pin heads which develop into button mushrooms ready for harvest in 2-3 days.

j) Yield of mushrooms:

A yield of 8-12 kg of fresh mushrooms can be harvested from one sq. meter bed area. As per the calculations based on input raw material costs, the cost of production for button mushroom is about Rs. 33.14 and for oyster mushroom (dhingri) it is about Rs. 31.84.

Control of insect pests of mushrooms

To prevent mushroom flies in the growing rooms, spray the room with 30 ml Dichlorovos per 100 m³. After spraying, the doors and windows of the room are closed for about 2 hours. The spraying should not be done directly on the growing mushrooms and do not harvest mushrooms for up to 48 hours after spraying.

Marketing of mushrooms

Mushrooms should be harvested once a day before the buttons open up. During the process of harvesting, mushrooms are picked by holding the ready to harvest mushrooms by the cap and gently twisting in a clock-wise direction. The mushrooms should not be picked by pulling them directly as this results in damage to the smaller growing mushrooms. The lower end of the harvested mushrooms are trimmed using a knife and packed in poly bags. Each bag contains 200 g of fresh mushrooms and are sold in the local market. The oyster mushroom can also be dried in the sun and dried oyster mushroom can be sold.

Exercise

A) Answer in one to two words:

1. Name two important commercially grown mushrooms.
2. Name the health benefits of mushrooms.
3. How many crops of button mushroom can be obtained in the winter season in Punjab?
4. What is the maximum height of the compost stack during compost preparation for button mushroom?
5. What is the ratio of farm yard manure and sandy soil for preparation of casing soil?
6. Which insecticide is used for control of insect pests of mushrooms?
7. What is the gap period between spray of insecticide for control of flies and next harvest of mushrooms?
8. What is the amount of spawn required for 3 quintals of straw?
9. What is the total mushroom production in Punjab presently?
10. How many turnings are given during preparation of compost?
11. What is the pH of good quality ready compost?

B) Answer in one to two sentences:

1. What are the important nutritional attributes of mushrooms?
2. What are the requirements for growing mushrooms?
3. Why is it important to turn the compost stack during compost preparation?
4. How is the compost prepared for mushroom growing treated?
5. What is the significance of casing? How is casing soil prepared?
6. What are the recommended varieties of mushrooms for cultivation in Punjab and give their technical names?
7. Give the turning schedule for preparation of compost and the details of what all is required for compost production.

8. How is casing soil mixture disinfected before use?
9. What are the quality attributes of well prepared compost?
10. What is the production of mushrooms from one square meter bed area?

C) Answer in 5 to 6 sentences:

1. What is the importance of mushrooms in our diet?
2. Give the procedure for preparation of stack for composting in button mushroom?
3. What do you know about the marketing of mushroom?
4. What is mushroom spawn? How is spawning done in trays for button mushroom?
5. What are the different steps in button mushroom production and briefly discuss each one?