

Organic Paddy Cultivation

K. Vijayalakshmi, T.D. Nirmala Devi
Subhashini Sridhar & S. Arumugasamy

Centre for Indian Knowledge Systems
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Preface

Paddy has been cultivated for countless ages. In the past farmers cultivated traditional rice cultivars which were suited to specific agroclimatic conditions. After the introduction of chemical farming and high yielding varieties several changes were brought about in paddy cultivation. As a result of this several pests and diseases attack the rice crop. The use of pesticides has also decreased the number of beneficial organisms in the field. Pests have also developed resistance to pesticides. Chemical fertilisers and pesticides pollute the environment in various ways. The fertility of the soil is also affected to a great extent. The only solution to all these problems is reverting to organic paddy cultivation.

Our centre has been providing training to farmers on organic paddy cultivation. We also bring out a large number of publications for farmers and NGOs providing information on organic cultivation methods. This book provides detailed information on various aspects of organic paddy cultivation. Several techniques described in this book have been tested out in our experimental farm and also in farmers fields.

This book is a revised edition of the publication brought out in December 2004. We have got an excellent feed back from the farming community. We hope that this current edition would continue to serve as a guide for those who want to shift to organic paddy cultivation.

Chennai
November 2007

K. Vijayalakshmi

**Centre for Indian Knowledge Systems :
A Brief Profile**

Contents

Objectives

The Centre for Indian Knowledge Systems is an organisation devoted to exploring and developing the contemporary relevance and applications of traditional Indian knowledge systems – with the focus areas being agriculture and health care. Our aim is to strengthen and revitalize indigenous sciences and practices.

Activities

Some of the major programmes of the centre are :

- 1 Action Research and Training Programmes on various aspects of sustainable agriculture.
- 1 Setting up of Rural Gene Banks for the conservation of Traditional Seed Varieties.
- 1 Developing organic packages for crops such as paddy and cotton.
- 1 Research on the applications of Vrکشayurveda (Traditional Indian Plant Science) .
- 1 Preparation of audiovisuals on various aspects of organic farming.
- 1 Publication of books, posters and newsletters on Traditional Health Care and Traditional Agriculture.

For further information contact :

Centre for Indian Knowledge Systems

No.30, Gandhi Mandapam Road

Kotturpuram, Chennai – 600 085

Ph: (044) 24471087, 24475862

e-mail : info@ciks.org / ciksorg@gmail.com

website : www.ciks.org

	Pages
1 Introduction	1
2 Seed Selection, Preparation of Nursery and Main Field	3
3 Increasing Soil Fertility	9
4 Pests and Rodents Attacking Paddy and their Control Measures	27
5 Diseases Attacking Paddy and their Control Measures	44
6 Storage Pests and their Control Measures	48
7 Beneficial Organisms in the Paddy Field	54
8 Botanicals in Pest and Disease Management	64
9 Non-Chemical Methods of Pest and Disease Management	70
10. General Techniques for Organic Paddy Cultivation	76
11. Traditional Paddy Varieties	81
References	98
List of Common Names and Scientific Names	100

Introduction

Rice, which is being cultivated for several years in our country, is not just a grain. It is the lifeline. Rice being the second most important crop next to wheat, forms the staple food for half of world's population. The global annual production of rice from a total area of 151.54 million hectares is 593 million tonnes with an average productivity of 3.91 t/ha. The area and productivity of rice has been steadily increasing since 1961. Rice is grown in Asia, Africa, Latin America, the United States, Australia and to a small extent in the European Union.

More than 90% of the global rice production is from Asia. Its rice production has slowly increased from 286 million tonnes in 1961 to 520 million tonnes. Today, China and India are the leading rice producers among the Asian countries. The rice growing regions in India are highly diverse. The major rice producing areas in India include Orissa, Madhya Pradesh, Bihar, Uttar Pradesh and West Bengal. Rice is the staple food for more than 65% of India's population. Constant supply of rice is highly essential for India's food security.

After the advent of green revolution, a large number of chemicals were used in agriculture in the form of fertilizers and pesticides. Although the use of chemicals increased the production initially in course of time it caused several problems. The fertility of the soil was also highly affected. The pests developed resistance to these chemicals and caused severe damage

Seed Selection, Preparation of Nursery and Main Field

to the crops. The beneficial insects which kept the pest population under control were also destroyed by these chemical pesticides. Today, there is a worldwide awareness about the ill effects of chemical farming. The farmers and the scientists are trying to find an alternative solution for this. Several farmers who have faced problems with chemical farming are converting to organic farming. Several other farmers are also willing to convert. Such farmers require a proper guidance and complete information about organic cultivation techniques.

This book on “Organic Paddy Cultivation” describes in detail about the various organic methods of paddy cultivation, increasing soil fertility by organic methods are described in detail. Paddy crop is attacked by various kinds of pests and diseases. This book explains the methods of identifying such pests and diseases and the various nonchemical methods of pest and disease control with descriptive pictures. It also provides details about the storage pests affecting paddy and the various beneficial insects found in paddy fields. The various cultural and non-chemical pest control practices have also been explained.

This book will serve the needs of the farmers involved in organic paddy cultivation.

Good quality seeds is the basic requirement for healthy crops. It plays an important role in crop protection and biodiversity conservation. The seedlings that are raised from good quality seeds are healthy, pest and disease resistant and exhibit uniform growth. When good seeds are used, the crops grow faster and are also free from soil borne diseases. The seedlings raised from contaminated seeds are greatly affected by pest and disease attack. Hence the seeds we select for cultivation should be of good quality and with good germination capacity.

Nursery and main field preparation play a vital role in obtaining healthy crop and high yield. Pest incidence can be greatly reduced by using organic manures in nursery preparation. It also helps in plant growth. In this chapter, we will deal about the methods for identifying good quality seeds, various seed treatment techniques, nursery and main field preparation methods in detail.

Seed Rate

The seed rate varies according to the varieties to be cultivated. The seed rate required for one acre of land under irrigated condition is given below.

Short duration variety (90-110 days)	-	24-28 kg
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Medium duration variety (110-125 days)	-	16-24 kg
Long duration variety (above 125 days)	-	12-24 kg
Dry and Rain fed sowing	-	35-40 kg

Seed Selection

Seed selection plays an important role in paddy cultivation. The seeds selected for cultivation should be of uniform size and age and free of contaminants. They should also have good germination capacity.

Separation of Quality Seeds

- ✪ When the seeds are soaked in water, the unviable seeds will float on the surface of the water. These seeds can be removed and the seeds that sink into the water can be used for cultivation. By this method, the damaged seeds can be removed easily.
- ✪ Take some water in a vessel and drop an egg in it. Keep adding salt to it slowly until the egg reaches the surface of the water. When the seeds are dropped in this water, the good quality seeds will sink into the water. Remove the unviable seeds that float on the surface of the water. Wash the selected seeds in good water for 2-3 times to remove the salt deposits. If this is not done, the germination capacity of the seeds will be affected. By this method, the unviable seeds can be removed completely. This method should be followed when there is more of chaff.

Seed Treatment

Improving the Germination Capacity by Soaking the Seeds in Water

Tie the seeds in a small gunny bag or cloth bag and soak them in water for 12 hours. Later, remove the bags from water and cover it with a wet gunny bag. Again, soak the seeds in water for 8 hours the next day. Later, remove the seeds from water and sow them in the nursery. This method helps to improve the germination capacity of the seeds.

Seed Treatment Using Cow Dung Extract

Treating the seeds in cow dung extract enhances the germination capacity of the seeds. Dilute fresh cow dung in water. Soak the seeds which have low germination capacity in water for 10-12 hours and then in cow dung extract for 5-6 hours. Dry the seeds in shade before sowing in the nursery.

Seed Treatment using Biofertilisers

Biofertilizers can be used for seed treatment. 500 g of biofertilizer (Azospirillum/Acetobacter) is needed for treating the seeds required for 1 acre of the crop. Mix the biofertilizers in ½ a litre of cooled rice gruel. Spread the sprouted seeds on a clean floor and mix it along with the biofertiliser mixture. Before sowing dry the seeds in shade for 30 minutes.

Seed Treatment using Cow's Urine Extract

Dilute 500 ml of cow's urine in 2½ litres of water. Tie the seeds to be sown in small bags and soak them in cow's urine extract for half an hour. Shade dry the seeds before sowing.

Seed Treatment using Sweet flag Extract

Powder 500 g of sweet flag rhizome and dilute it in 2½ litres of water. This is the quantity required for treating seeds to be sown in one acre. Tie the seeds in small bags and soak them in this extract for half an hour. Dry the seeds in shade before sowing.

Seed Treatment with Pseudomonas

250 g of the fungus pseudomonas should be mixed with one litre of cooled rice gruel. The sprouted seeds required for one acre should be spread on a cement floor. Pseudomonas extract should be sprinkled all over the seeds and mixed well.

Advantages of Seed Treatment

Seed treatment helps to improve the germination capacity of the seeds and to increase the yield. The seedlings that are raised from the treated seeds exhibit pest and disease resistance.

Nursery

Preparation of Nursery

Eight cents of nursery is required for cultivating one acre of land. After ploughing the nursery for 4 times, spread neem leaves on the soil. The leaves should be allowed to decay in water for 6-7 days. When the leaves decay completely, the land should be ploughed again for 4 times and levelled. The sprouted seeds should be sown in the nursery. In case, the neem leaves are not available, 8-10 kg of neem cake and 10-15 kg of vermicompost should be added to the soil during the last ploughing. Later, the soil should be levelled and the seeds should then be sown.

Note : One would encounter more weeds if farmyard manure is added to the nursery. Hence, it is advisable to avoid it.

Pest and Disease Management in the Nursery

Pests such as green leafhopper, green horned caterpillar and diseases such as brown leaf spot and blast generally attack the seedlings in the nursery. Hence, the crop is damaged at very early stages. This can be prevented by spraying two doses of 10% cow's urine extract at 7 days interval at the appearance of the first symptom. This should be immediately followed by pest management techniques (Refer Chapter-4).

Before plucking the seedlings, the nursery should be irrigated and 15-20 kg of gypsum should be added to prevent any damage to the rootlets.

Application of Biofertilisers

One kg of Azospirillum is needed for one acre of land. It is mixed with 10 kg of farmyard manure and applied in the nursery 30 minutes before plucking. The seedlings are kept submerged in the nursery for 30 minutes and then transplanted.

Main Field

Preparation of Main Field

The main field should be irrigated and ploughed 6-8 times. The bunds should be trimmed and plastered to prevent water leakage. The rat holes found in the field should be sealed. Basal manure should be applied during the last plough and the land should be levelled before sowing.

Transplantation

2-3 saplings should be planted per hill at a depth of 3 cm. The spacing between the seedlings varies according to the variety cultivated.

Note : For old seedlings, varieties with low tillering and soil with very high pH, lesser spacing should be given while transplanting and more number of seedlings should be used (5-7 seedlings per hill).

Spacing

Spacing inter row x inter crop

Short duration variety	-	15 x 10 cm
Medium duration variety	-	20 x 10 cm
Long duration variety	-	20 x 15 cm

Chapter 3

Increasing Soil Fertility

In ancient days our ancestors practiced ecofriendly methods of farming. The soil was very fertile then with a high population of earthworms and microbes. After the introduction of Green Revolution in 1968, this scenario has changed. Large amounts of chemical fertilizers were dumped into the agricultural fields to increase the food production. Initially the farmers were cured by the high yields brought about by the use of chemical fertilisers. In course of time, continued use of chemical fertilisers led to the destruction of soil fertility and brought about drastic changes in soil pH. Farmers are now looking for alternatives to chemical fertilizers. Use of organic manures such as farmyard manure, vermicompost, green manure and amirthakaraisal help to increase the soil fertility. In this chapter, we will deal in detail about preparation and application of various organic manures such as farmyard manure, panchakavyam, vermicompost, green leaf manure and green manure.

Soil Testing

During paddy cultivation, it is always good to study the type, nature and the nutrient content of the soil before adding the fertilizers. This can be easily done by testing the soil samples in any soil testing laboratory. The manure can be applied based on the nitrogen, potassium and phosphorus content of the soil.

Based on pH, the soil can be classified into four major types.

- ✪ The soil is highly acidic when the pH of the soil is below 6.5.
- ✪ The soil is medium type when the pH is between 6.5 and 7.5.
- ✪ The soil is alkaline when the pH is 7.9 and above.

In paddy, the yield will be high when the pH of the soil is between 5 and 6.5. The yield will be poor when the pH of the soil is below 5 or above 9.

Soil Type

Alluvial soil, sandy clay and clayey soil are suitable for paddy cultivation.

Season

Paddy is cultivated in various districts of Tamil Nadu. The season of cultivation varies according to the districts. Although paddy is cultivated throughout the year, there are seasons that are specially suitable for its cultivation. They are listed below.

Sornavari (or) Summer	: April 15 – August 14
Samba	: July 15 – January 14
Late samba (or) Thaladi	: September 15 – January 14
Navarai	: December 15 – March 30
Kuruvai	: June 1 – August 31

The varieties should be selected according to the district in which it is cultivated (varieties vary according to the districts).

Organic Manures

From the day of sowing till the harvest, the plants take in several nutrients from the soil. It is highly essential to replace the used nutrients back in the soil for the next season crop and to retain soil fertility. The nutrients required by the plants can be supplied by means of organically available manures such as farmyard manure, green manure, green leaf manure, vermicompost and biofertilisers. These manures prevent soil erosion and improves the infiltration rate of the soil.

Farmyard Manure

The waste of cattle, goat and pig are generally used as farmyard manure. All the nutrients required by the plants are present in small quantities in this manure. They remain for longer periods in the soil and produce good results.

Required Quantity

Cow dung	-	5-7 tonnes/acre
Goat dung	-	5 tonnes/acre
Poultry waste	-	2 tonnes/acre
Pig dung	-	1 tonne/acre

Method of Use

Any one of the above mentioned manure should be applied as the basal manure during the last plough. The farmyard manure should be allowed to decay and then used. The farmyard manure should be applied and ploughed into the soil on the same day. When farmyard manure is allowed to remain in the soil for longer periods, there are chances for more than 50% of the nutrients to get wasted due to soil erosion and high temperature.

Biofertilisers

The atmosphere contains about 78% nitrogen. Some of the microorganisms found in the soil fix atmospheric nitrogen and convert it into a form that can be absorbed by plants. Some of the microbes that are commonly used in paddy cultivation include Acetobacter, Azospirillum and Phosphobacteria. They not only reduce the expenditure but also increase the yield and improve the fertility of the soil.

Method of Application

Biofertilisers can be applied to the plants in four different ways.

- ✦ Direct mixing with seeds
- ✦ Use in Nursery
- ✦ Direct mixing with soil
- ✦ Root immersion and planting

Direct mixing with seeds

500 g of Azospirillum is needed for treating the seeds required for one acre of land. The seeds that are ready for sowing are taken in a wide mouthed vessel. In another vessel ½ litre of cooled rice gruel is mixed with Azospirillum and stirred well. This semisolid solution is added little by little to the vessel containing the seeds and mixed well. Later the seeds are dried in shade for 30 minutes and immediately sown.

Use in Nursery

One kg of Azospirillum is required for the seedlings to be transplanted in one acre of land. It is mixed with 10 kg of farmyard manure and strewn in the nursery 30 minutes before transplanting. Then the seedlings are plucked and placed for

30 minutes in the nursery soil itself so that their roots are submerged. The seedlings are then transplanted.

Direct Mixing with Soil

About 2 kg of any nitrogen fixing biofertiliser (Azospirillum / Acetobacter) and 2 kg of phosphorus fixing Phosphobacteria are mixed with 25 kg of farmyard manure or compost and then added to the soil.

Root Immersion and Planting

This method is suitable for seedlings in the nursery. The roots of seedlings are dipped in a solution containing Azospirillum and then planted. 500 g of Azospirillum is mixed well with 50 litres of water. The roots of seedlings are dipped in this solution for 10 minutes and then planted. This enables the microbe to stick to the roots and grow well.

Characteristics and Uses of Some Biofertilisers

Azospirillum

Azospirillum is a type of bacteria that grows around the roots of cereal plants and grasses. It is capable of absorbing the atmospheric nitrogen and convert it to the form that can be utilized by the plants. Since it grows in the root regions, it helps the plant to absorb the nitrogen from the soil. It works effectively in land where phosphorus content is less. Studies indicate that Azospirillum can fix 50–200 g of nitrogen per day in paddy.

Advantages of using Azospirillum

- ✦ Azospirillum fixes atmospheric nitrogen in the root regions of crops thereby enabling easy assimilation of nitrogen by crops. This enables the plant to grow well.

- ✪ The cost of adding nitrogen fertilisers for one acre of land is reduced by 10%.
- ✪ Azospirillum produces plant growth hormones in the root region thereby increasing plant growth, the number of tillers, grains and straw yield.

Azotobacter

Azotobacter is a kind of bacteria that grows around the roots of the plants and utilizes the carbon present in the soil. It is capable of absorbing the atmospheric nitrogen and convert it to the form that can be utilized by the plants. It is affected by high acidity, high salt content and high temperature. It grows well in waterlogged paddy fields.

Phosphobacteria

It is a type of bacteria that is capable of growing around the root surface of the plant. The growth of this microorganism helps in conversion of insoluble phosphate (a source of phosphorus) into a soluble form in the soil. Thus it aids in absorption of phosphorus by plants.

Method of Application

For every acre of crop, 2 kg of Azospirillum or Acetobacter and 2 kg of Phosphobacteria should be mixed with 25 kg of well decayed manure or wet sand and applied before transplanting. This helps to increase the microorganisms in the soil.

Advantages of using Phosphobacteria

- ✪ It converts insoluble form of phosphate into soluble form that can be absorbed by plants.
- ✪ Yield is increased by 10-20% in all crops.

- ✪ It helps in flowering and development of ear heads and roots.
- ✪ It helps in nitrogen fixation.

Algae

Growing algae along with paddy supplies the crop with the required nitrogen and phosphorus. Azolla or blue green algae should be strewn to the field 5-10 days after transplanting. 25 days and 45-50 days after strewing, the field should be drained and the algae should be stamped into the soil.

Azolla

It is a floating fern that grows in the stagnant water of rice fields. This plant contains an alga called *Anabaena azollae* in the cavities of the fronds. It provides the necessary nutrients and space required for the growth of this algae. In turn, the algae provide azolla with the fixed atmospheric nitrogen and other nutrients essential for its growth. Azolla grows well in marshy land where paddy is cultivated. It is capable of providing 40-60 kg of nitrogen per hectare of land.

Method of Application

2-3 kg of Azolla is required per acre of land. First, the water should be allowed to stagnate in the land to be cultivated. Then Azolla should be sown. After one week, these plants are stamped into the soil before transplanting is done. It degrades in about 7-10 days and provides nitrogen to the rice crop.

Growing Azolla along with Paddy

After 10 days of planting, Azolla should be strewn in the rice fields. It grows along with rice as an intercrop. It grows well in about 25 days and spreads uniformly over the field. Then

the water in the field is allowed to drain and Azolla is stamped beneath the soil. Once again, Azolla grows profusely. This is again stamped at the time of second weeding. Burying Azolla beneath the soil once helps in fixing 15-20 kg of nitrogen.

Advantages of using Azolla

- ✪ It provides nitrogen to the crops.
- ✪ By growing it along with paddy crop, weeds can be eliminated.
- ✪ Use of Azolla as a green manure is equivalent to the use of Ammonium sulphate fertiliser.

Blue Green Algae

It is a type of photosynthetic cyanobacteria that belongs to the plant kingdom. It is found in paddy fields where good sunlight, water, high temperature and high nutrients are found. It fixes atmospheric nitrogen. It can be seen floating as dense mats in paddy fields. It is a filamentous form found on the water surface. It grows well in clayey and alluvial soil.

Method of Application

Blue Green algae is added to the soil within 10 days of transplanting at the rate of 4 kg/acre. They are available as small bits in plastic packets. This should be powdered and directly added to the soil. Water should be allowed to stagnate to a depth of 3-5 cms in fields where algae are grown. Blue green algae should be added to the field continuously for 4 cropping seasons. Thereafter, it grows naturally in the land and produces the desired result.

Advantages of using Blue Green Algae

- ✪ Crops obtain 60% nitrogen content by use of blue green algae.
- ✪ The algal filaments decompose in the fields and increase the humus content of soil.
- ✪ It dissolves phosphorus and makes it available to the crop.
- ✪ It dissolves iron and sulphur salts stagnating in the soil thereby increasing soil fertility.
- ✪ It not only increases soil fertility but also enhances the chemical properties of soil.
- ✪ Plant growth hormones produced by it increases plant growth.

Amirthakaraisal

This extract can be prepared easily.

Method of Preparation

Fresh cow dung – 10 kg

Cow's urine – 10 litres

Jaggery - 1 kg

Water – 100 litres

The above mentioned ingredients should be added to a cement tank and mixed well. The extract would be ready for use the next day. 500 litres of this extract is required for one acre of the crop. The extract should be mixed with water during

irrigation. When it is used as a spray, 10 litres would be required. This improves the soil fertility and gives good yield.

Green Manure

These crops are generally cultivated in the field before cultivating the main crop. They are ploughed into the soil before the flowering stage and used as green manure. Green manure is a highly essential organic manure for paddy. Plants belonging to the family *Leguminosae* are commonly used as green manure. These plants absorb atmospheric nitrogen with the help of certain microorganisms found in their root nodules and convert it into a form which can be used by the plants. These plants should be cultivated before cultivating the main crop.

Method of Application

Green manure plants such as Sun hemp, Dainchaa, Indian indigo should be planted before cultivating paddy. They should be ploughed into the soil 45-50 days after sowing. The plants should be allowed to decay in the water for 10 days and then ploughed.

Uses of Green Manure

- ✪ Cultivation of green manure plants between two cropping seasons prevents soil erosion due to rain and wind.
- ✪ As the plants decompose they convert unavailable form of calcium, phosphorus and micronutrients present in the soil to the form that can be easily absorbed by the plants.
- ✪ In clayey soils, these plants help in increasing the soil porosity by loosening the soil particles. They aid in increasing the aeration and infiltration rate of the soil.

- ✪ When green manure plants are ploughed into the soil, they decompose and increase the carbon content as well as the humus content of the soil.
- ✪ These crops are cultivated as trap crops and fodder crops. They also help to prevent soil erosion.
- ✪ The cost of cultivating green manure plants is also quite nominal.

Commonly used Green Manure Plants

Sun hemp (*Crotalaria juncea*)

Dainchaa (*Sesbania cannabina*)

Sesbania (*Sesbania speciosa*)

Wild indigo (*Tephrosia purpurea*)

Indian indigo (*Indigofera tinctoria*)

Tephrosia noctiflora

Green Leaf Manure

It is a common practice among farmers to plough in the green leafy twigs of certain plants into the field. The plants that are used for this purpose are termed as green leaf manure plants. *Azadirachta indica*, *Gliricidia*, *Pongamia pinnata*, *Morinda pubescens* are some of the most commonly used green leaf manure plants.

Uses of Green Leaf Manures

- ✪ The leaves of these plants are used both as green manure and in preparation of certain biopesticides.
- ✪ These plants help to increase the nitrogen content of the soil and reduce the expenses towards pest management.

Commonly used Green Leaf Manure Plants

Siris tree (*Albizia lebbek*)

Gigantic swallow wort (*Calotropis gigantea*)

Indian beech (*Pongamia pinnata*)

Neem tree (*Azadirachta indica*)

The spotted gliricidia (*Gliricidia sepium*)

The tanner's cassia (*Cassia auriculata*)

The white gulmohar (*Delonix elata*)

Oil Seed Cake

The pith that is left behind after oil extraction commonly called as oil seed cake is a good source of organic nitrogen. There are different kinds of oil seed cakes such as groundnut cake, neem seed cake and castor seed cake. Generally, neem and groundnut cakes are used for paddy. They supply paddy crop with the nitrogen that is essential during its initial growth.

Cake	Basal manure	Top dressing
Neem seed cake (or) Groundnut cake	60 kg / acre	25 kg / acre
	40 kg / acre	25 kg / acre

Crop Rotation

Crop rotation is an agronomic practice followed by the farmers to make use of nutrients present in the soil in the best possible way. When the same crop is planted every season the soil becomes deficient of the particular nutrient that is utilized by the plant. This can be avoided by cultivating different crops that have different nutrient requirements. When leguminous

plants are cultivated, they trap the atmospheric nitrogen and convert it to the form that can be easily utilized by the plants. When the root nodules and leaves of these plants gets into the soil, they increase the nitrogen content and help to retain the soil fertility.

In various district of Tamil Nadu such as South Arcot, North Arcot and Chengalpattu, banana, sugarcane and betel is cultivated as alternative crops for paddy. Cultivating *Sesbania* as an intermediate crop between two paddy crops gives good results.

C R O P S	Seasons		
	Samba (July-Jan.)	Navarai (Dec.-Mar.)	Sornavari (April - Aug.)
	Paddy	Black gram	Sesame
	Paddy	Ground nut	Paddy
	Paddy	Cotton	-
	Paddy	Vegetables	Green manure crops (for seeds)

The crops should be planned in such a manner that the nutrients used by the first crop should be replaced by the following crop. The nutrient requirement of the 2nd crop should be also different. This helps to maintain the nutrient balance in the soil.

Panchakavya

Panchakavya is a growth promoter produced with the combination of five products obtained from the cow along with few other bioproducts.

Method of Preparation

Cow dung	- 5 kg
Cow's urine	- 3 litres
Ghee	- 1 litre
Cow's Milk	- 2 litres
Curd	- 2 litres
Tender coconut	- 3 litres
Cane juice or jaggery	- 3 litres (or) 1 kg
Yellow plantain	- 12 nos (or) honey ½ kg

Add cow dung, cow's urine and ghee in a mud or cement tank of 30-litre capacity. Stir this well in morning and evening for a week. The methane gas gets released from this. To this mixture, add milk, curd, tender coconut, yellow plantain (ripe) and jaggery. After a week's time, this extract can be filtered and used.

Method of Using

3% panchakavya should be sprayed during the tillering and bootling stage for coarse varieties to increase the yield. For thin varieties, 3% panchakavya should be sprayed once during the bootling stage.

During the flowering stage 10% buttermilk extract or 3% tender coconut extract should be sprayed. This helps in uniform flowering and also increases the yield.

Composting Techniques

Composting is the method of converting the organically available, non decayed plant and cattle waste into a dark brown textured, fluffy organic material rich in humus and low in density. Compost helps in easy intake of nutrients from the soil. It also increases the microorganism level in the soil.

Land Selection

- ✦ The land selected should not be a low lying or water logged area.
- ✦ An upland or an elevated land that has shade is ideal for compost preparation.
- ✦ The soil should not be sandy.
- ✦ The soil where compost is to be prepared should not be penetrated by roots of trees.

Materials to be Avoided

Plastic products, polythene covers, bones of cattle, stones, thick stem of plants and glass bottle pieces should be avoided while preparing the compost.

Different Types of Compost

- ✦ Biodung Compost
- ✦ Cycle Method
- ✦ Vermicompost

Biodung Compost

A place of 6 m x 1.5 m x 1.2 m dimension should be selected. (The length can be adjusted according to the requirement). Spread the twigs to a thickness of 0.25 m as the basal material. Spread coconut fronds uniformly over it. Follow this with fresh or dry agricultural waste to a thickness of 0.25 m. Sprinkle water over this in a such a way that all the waste material becomes moist. After this, sprinkle cow dung mixed with water on the agricultural waste. Repeat the above steps upto a height of 1–1.2 m from the ground level. Care should be taken to see that each layer is atleast 0.25 m thick. Leave a small gap on the under surface and cover the whole surface with a black polythene sheet. Sprinkle water periodically at an interval of 2–3 days. The water that evaporates due to heat condenses on the polythene sheet and returns back to the heap. In about 5 days, the temperature raises to 50–60° C. Insert a twig into the heap and remove it. The tip of the twig should be hot when touched. This is an indication of proper composting. The heap should be turned over once on the 30th day. The compost would be ready in 60 days.

Cycle Method

This method of composting requires 3 pits of 1 x 1 x 1 m length, breadth and height with a spacing of 0.3 m in between them. Fill the first pit with all kinds of kitchen waste, farm waste, litter and cow dung. A few days later, transfer the decayed contents from the first pit to the second pit. Now, the first pit should be filled with fresh waste. When this gets decayed, the contents in the second pit should be shifted to the third pit and the second pit should be filled with the contents of the first pit. This process should be continued till the third pit gets completely filled. The compost in the third pit can be used 10 days after it is filled.

Vermicomposting

For setting up a compost pit, dig a pit of size 2 m x 1 m x 1 m (The length and breadth can be adjusted according to the requirement). Fill the basal 0.15 m of the vermibed with broken bricks or pebbles. This is to avoid excessive water logging in the pit. Follow this by a layer of coarse sand to a thickness of 0.05 m to ensure proper drainage. This is followed by a 0.15 m moist layer of loamy soil. Into this soil, inoculate about 3000 locally collected earthworms. Scatter small lumps of cattle dung (fresh or dry) over the soil. The dung serves as food for the worms in their early stages. Cover this with dried leaves or hay upto 0.05 m. Sprinkle water and keep the entire set up moist. Keep the unit covered with coconut fronds. After 30 days, small earthworms start appearing which is a healthy sign. Add organic refuse from the 31st day as a spread on the bed after removing the fronds. The spread should not exceed 0.05 m in thickness at each application. Spread waste twice a week. After a few applications turn over the refuse without disturbing the bed. When enough refuse has been added into the unit, keep it moist and 45 days later the compost is ready for harvest.

Composting can be done in pits, concrete tanks, well rings, wooden or plastic crates appropriate for a given situation.

Water Management

- ✦ Water should always stagnate in the rice field.
- ✦ 2 cm of water should stagnate in the field during transplantation.
- ✦ From the 10th day of transplantation to the day of maturity, 3 cm of water should stagnate.

- ✦ There should be no water shortage during tillering, flowering and milky stage.
- ✦ Top dressing should not be done in marshy fields where there is water stagnation. The water should be drained and the land should be allowed to dry before adding the manure. The field should be irrigated immediately after manuring.

Chapter 4

Pests and Rodents Attacking Paddy and their Control Measures

Paddy crop is attacked by a variety of pests and diseases. Pests such as stem borer, brown plant hopper, green leaf hopper and ear head bug have challenged our farmers to a great extent. A large portion (10-51%) of our country's rice production is being lost due to pest and disease attack. This decreases the yield to a great extent. It will be easy for the farmers to take preventive measures if they are provided with the details regarding the pests and the symptoms of attack. In this chapter, we will deal in detail about the major pests attacking paddy, the damage caused by them and their control measures.

Pests of Paddy

The pests of paddy can be classified into three major categories. They are :

- I. Leaf eating insects and caterpillars
- II. Sap feeders
- III. Stem borers

I. Leaf Eating Insects and Caterpillars

1. Leaf Folder

Scientific Name : *Cnaphalocrocis medinalis* – Lepidoptera

Life Cycle

The adult moth is small, brownish orange in colour with wavy lines on fore and hind wings. The female moth lays its egg on the upper surface of the leaves. After 7 days, pale yellow green larvae emerges out from these eggs. In about 15-27 days, the larvae turns into pupae. After 6-8 days, the adult moths emerge from the pupae.

Symptoms

- ✪ The leaves will be found rolled in the field. Eggs and larvae can be seen inside the folded leaf blades.
- ✪ In a severely infested field, the whole crop gives a sickly appearance with white patches.

Damage Pattern

Larvae remain inside the leaf and feed on the leaf tissues. As a result of this, longitudinal white streaks are found on the leaf blade. When infestation is severe, the leaves lose their chlorophyll content and turn pale. The growth is affected and the yield reduces.

Economic Threshold Level (ETL)

The management methods should be implemented immediately when more than 10 leaves / hill are damaged.

Control Measures

- ✪ 3-5% *Andrographis paniculata* kashayam should be sprayed (Refer page 68).
- ✪ Garlic, Ginger, Chilli extract should be sprayed (Refer page 66).

- ✪ 5% neem kernel extract should be sprayed (Refer page 64).

2. Rice Case Worm

Scientific Name : *Nymphula depunctalis* – Lepidoptera

Life Cycle

The adults are small delicate moths with white coloured wings. The female moth lays the eggs on the upper surface of the leaves. Orange headed green caterpillars emerge from these eggs in about 2-6 days. The larvae turns into pupae in about 14-20 days. In 4-7 days, the adult moths emerge from these cases.

Symptoms

The caterpillar cuts the leaves into small pieces and rolls it longitudinally into a box like structure. The damaged leaves hang as longitudinal rolls at the tips of the leaves. Some of these can also be found floating on the surface of water. The larvae can be found inside the cut leaf rolls. Hence they are called “case worms”.

Damage Pattern

The damage begins within 20-40 days of transplantation. The larvae feed on the inner tissues of the leaves and affect the growth of the plant. They pupate inside the case itself.

Economic Threshold Level (ETL)

When more than 10 leaves are damaged/hill, the management methods should be implemented immediately.

Control Measures

The larvae found in the field can be controlled using the rope method (Refer page 72).

3. Green Horned Caterpillar

Scientific Name: *Melanitis leda ismene* – Lepidoptera

Life Cycle

The adult is a butterfly, which is dark brown with a few black and yellow eye markings. It lays white rounded individual eggs on the upper surface of the leaves. The green coloured larvae which hatches out of the eggs have two red coloured horns. They turn into green coloured pupae and are found on the surface of the leaves. The adult butterflies hatch out from these pupae after 15 days.

Damage Pattern

- ✪ The larvae mostly attack the plants in the seedling stage and during the tillering stage.
- ✪ Since these larvae attack the leaves as a group, the growth is affected.

4. Yellow Hairy Caterpillar

Scientific Name: *Psalis pennatula* – Lepidoptera

Life Cycle

The adult is yellow in colour. The female lays its eggs on the surface of the leaves. Orange headed yellow coloured caterpillars emerge out from these eggs. They have red stripes

and tufts of hairs all over the body. The two hairs found in the front portion of the larva and the single hair found at the back emerge out. They turn into dull white pupae when mature. Pupae are silky in nature. From the pupae the adults emerge.

Damage Pattern

The larva infests the crop during the growth stages and during the ear head forming stage. Since the leaves are damaged, the growth is affected.

Economic Threshold Level (ETL)

The management methods should be implemented immediately when more than 10 leaves/hill are damaged.

5. Army Worm

Scientific Name: *Spodoptera litura* – Lepidoptera

Life Cycle

The adult moth is dark brown with a conspicuous black spot on the forewing. It lays 200-300 spherical eggs on the leaves and cover them with greyish hairs. In about a week's time, green coloured caterpillars emerge out from these eggs. These caterpillars reach a length of 4-5 cms in about 20-25 days. They are dark green or dull grey in colour with yellow back and side stripes. Pupation occurs in the soil and in about 7 days, the adult moths emerge out.

Symptoms

The larvae attack the leaves during the night times and eat away the leaves completely leaving behind the midribs. Hence the infested crop gives an appearance of a field grazed by cattle.

Damage Pattern

The growth is affected when the infestation occurs at the early stages of the crop. If the infestation occurs in the later stages of the crop, panicles are cut at the base resulting in heavy loss.

Economic Threshold Level (ETL)

The management methods should be implemented immediately when more than 10 leaves/hill are damaged.

6. Skipper

Scientific Name : *Philopidus mathyas* – Lepidoptera

Life Cycle

The adult butterfly lays its eggs on the upper surface of the leaves. The larvae which are long and green in colour possess a 'V' shaped dot on the forehead. They are found as pupae in the leaf folding. The adult butterflies are brownish in colour with two prominent dots on their forewings.

Symptoms

The leaves are longitudinally folded.

Damage Pattern

The larva remains in the leaf folds and feed on the inner tissues of the leaves. This gives a skeletal appearance to the leaves. The infestation can be found both in the nursery and the main field.

Management of Leaf Eating Insects and Caterpillars

- ✪ 10 kg of neem cake should be applied as basal manure/acre of transplanted field. This prevents the entry of leaf eating caterpillars into the field.
- ✪ A simple way to keep away the caterpillars is by keeping neem leaves in bunches at different places of the field. These can be placed at 10 places in an acre.
- ✪ The caterpillars can be easily controlled by using wood ash. For one acre, 10-12 kg of wood ash should be mixed with sand and strewn in the field. This is a low cost technology which can be followed even by a small farmer.
- ✪ The field should be flooded and then drained. By this method the larva and pupa hiding in the soil can be exposed and then removed.

7. Gall Midge

Scientific Name : *Orseolia oryzae* – Diptera

Life Cycle

The adult fly is yellowish in colour. It lays about 100-200 elongated eggs on the under surface of the leaves. Yellow coloured maggots emerge out from these eggs in about 3-5 days. These larvae turn into brown coloured pupae in about 8-10 days. In 8 days, the adult flies emerge out. Its longevity is about 1-5 days.

Symptom

The terminal portion of the crop turns into a tubular gall. When the infestation is severe, the growth is affected. Tubular galls resembling onion leaves are found in the terminal portion.

Damage Pattern

As the larvae and adults suck the sap, they insert a poisonous substance called “Sesitogen” into the leaves. Hence the leaves roll and attain the shape of an elephant trunk. The growth of the crop and ear head formation is affected.

Economic Threshold Level (ETL)

When more than 10% of the ear heads in the field are infested, the management measures should be immediately implemented.

8. Short Horned Grasshopper

Scientific Name : *Hieroglyphus banian* – Arthroptera

Life Cycle

The adult grasshoppers are green in colour. Sometimes brown grasshoppers are also seen in the field. The adults mate and lay eggs in the soil during October – November preferably on the sides of the bunds. After 7 days, nymphs emerge out on the onset of monsoon rains. After 80 days, they become adults.

Symptoms

The grasshoppers not only damage the leaves but also nibble the tender florets and grains. As a result, the ear heads turn white even before they emerge out.

Control Measures

- ✪ Spreading of *Calotropis* leaves besides the bunds of the field prevents the entry of grasshoppers.
- ✪ To manage grasshoppers a solution of cow dung or goat dung could be used. 30-50 kg of the dung should be

taken and filled in a gunny bag. The gunny bag is balanced on a pole. Below the gunny bag a drum filled with 100-200 litres of water is kept. The tip of the gunny bag should be kept in such a way that it touches the surface of the water. The gunny bag is shaken twice a day for 15 days. After 15 days the water in the drum will be brown and a foul smell will emerge. This should be diluted with twice the amount of water and sprayed. This acts as a repellent for grasshoppers.

II. SAP FEEDERS

1. Green Leaf Hopper

Scientific Name : *Nephotettix virescens* – Hemiptera

Life Cycle

The adults lay eggs under the epidermis of the leaf sheath. After 6 days, nymphs emerge out from them. They turn into adults in about 16-18 days. The adults are green in colour with black coloured dots on their back, measuring about 3-5 mm in length.

Symptoms

The tip of the leaves turn yellow.

Damage Pattern

The indirect damage caused by these pests is higher than the direct damage. The nymphs and adults remain on the leaf surface and suck the sap from the leaves. Initially, the tip of the leaves turn yellow and gradually the growth is affected. They also transmit the viral particles of Tungro virus.

Economic Threshold Level (ETL)

If more than 5 adults are found per hill during the growth stages the management measures should be immediately implemented. 10 insects/hill is the ETL during flowering stages.

Control Measures

- ✪ Transplanting the seedlings after dipping them in neem kernel extract for 24 hours increases pest resistance.
- ✪ Neem oil and pongam oil should be mixed in the ratio of 1:4 and sprayed on the field. This controls the pest effectively.
- ✪ Wild grasses and weeds should be removed from the field bund and field since these are the favourite egg laying spots of the pests.

2. Brown plant hopper

Scientific Name : *Nilaparvata lugens* – Hemiptera

Life Cycle

The adults which are similar to the colour of the soil, lay about 200 eggs on the leaf and leaf sheath. In about 10 days, dull white coloured nymphs emerge out from these white coloured eggs. These wingless nymphs measure about 3 mm in length. These nymphs gradually turn into adults in 12-18 days.

Symptoms

- ✪ The crops show a burnt appearance.
- ✪ The affected crop dries up in patches.
- ✪ While walking across the field, hoppers can be seen flying.

Damage Pattern

The adults remain on the basal part of the crop and suck the sap. Infested plants first turn yellow and later starts drying up causing browning of the leaves referred to as hopper burn. The field exhibits a burnt appearance. As they move from one plant to the other, they spill the sap on other plants also. This results in the spread of sooty mould fungus. Hence, stem rot disease is commonly found in brown plant hopper affected areas.

Economic Threshold Level (ETL)

If more than 15 pests are found per hill, the management measures should be immediately implemented.

Conducive Atmosphere

Cloudy weather, closer spacing and heavy application of nitrogenous fertilizers are favourable for the rapid multiplication and outbreak of BPH.

Control Measures

- ✪ Use of high level of nitrogenous fertilizers favours the increase of BPH population. Hence it should be used judiciously.
- ✪ Water stagnation should be avoided in the field.
- ✪ Light traps can be used to monitor and attract adults. The trapped insects can be killed (Refer page 73).
- ✪ Field and bunds should be cleaned thoroughly without weeds which forms the alternate host for pests.
- ✪ BPH can be controlled by allowing sunlight to enter the under parts of the plant (Refer page 72).

- ✪ The plants should be provided with proper spacing (Refer page 71).

3. Mealy Bug

Scientific Name : *Heterococcus rehi* – Hemiptera

Life Cycle

The adults are stout, round and whitish in colour. They lay about 100-300 eggs on the upper surface of the leaves and cover them with yellow silky structures. They are mostly found on the leaf axils. The nymph stage continues for about 17-37 days. Later, they turn into adults.

Symptoms

- ✪ Stunted crops can be found in various regions of the fields.
- ✪ When the infestation is severe, the panicle formation is affected.

Damage Pattern

The plants show stunted growth since the nymphs and adults suck the sap. The grain size is reduced since the panicles are affected during the milky stage.

Conducive Atmosphere

Dry spell and drought favours the increase in population.

Control Measures

Neem kernel extract can be sprayed (Refer page 64).

4. Ear Head Bug

Scientific Name : *Leptocorisa acuta* – Hemiptera

Life Cycle

Adults are brown with long legs. The female lays about 300 eggs on the leaf blade in long rows. Green coloured nymphs emerge out from these eggs in about a week time. They complete five nymphal instars in about 15 days time and turn into adults. The longevity of the adults is about four months.

Symptoms

- ✪ A foul odour present in the field is an indication of presence of ear head bugs in the field.
- ✪ The pest infestation is severe during the milky stage.
- ✪ The infested grains show characteristic brownish round dots.

Economic Threshold Level (ETL)

If more than 5 pests are found per 100 panicles, the management measures should be immediately implemented.

Control Measures

- ✪ The *Cycas* (*Cycas circinalis*) flower called 'Sannampu' in Tamil has to be cut and tied to a stick, which is taller than the crop level. This has to be placed in about 10-15 places in the field. This repels the adult bugs and prevents the entry of ear head bugs for about two weeks. By this time, the milky stage is completed and the crop attains maturity.

- ✪ 1 kg of *Achyranthus aspera* root and 1 kg of neem bark should be dried and powdered. This should be mixed with water and sprayed. This level is applicable for 1 acre of land.

5. Black Bug

Scientific Name : *Scotinophora coarctata* – Hemiptera

Life Cycle

The adult bug is black in colour. It lays eggs on the surface of the leaves in two rows. After a few days nymphs emerge out. As they move on the surface of the leaves, they feed on the chlorophyll content of the leaves. After moulting for five times, the adults emerge out.

Symptoms

Blast lesion occurs on the leaf and leaf sheath. They feed on the chlorophyll content present in the central portion of the leaves. Hence the leaves break and hang. The pest remains in the tillers, leaves and terminal axils.

Damage Pattern

The nymphs and adults remain on the under surface of the leaves and feed on the leaf tissue. When the infestation gets severe, the crop turns yellow. They feed on the tissues of the midrib and break the leaves. The crop appears stunted.

Economic Threshold Level (ETL)

When more than 5 beetles are found per hill or when more than 10% of the leaves are damaged/hill during tillering stage, the management measures should be immediately implemented.

Control Measures

Applying neem cake as top dressing controls the entry of beetles.

III. STEM BORERS

1. Yellow stem borer

Scientific Name : *Scirpophaga incertulas* – Lepidoptera

Life Cycle

The adult female moth has a bright yellow forewing with a black spot. It lays about 200 eggs on the leaf tips and cover them with yellow coloured hairs. The eggs are flat and oval in shape. In about 5-8 days tiny caterpillars hatch out from these eggs. The caterpillars are green headed and light yellow in colour. After 28-30 days they turn into brown coloured pupae. In about 8-10 days the adults emerge from these pupae.

Symptoms

- ✪ A hole made by these larva can be found on the under surface of the stem.
- ✪ White chaffy ears can be seen at irregular intervals all over the field.
- ✪ When the crop is infested at early stages, the growth and tillering is affected.

Damage Pattern

Stem borers bore into the leaf sheath and destroy the growing tip by feeding the internal contents. This in turn disrupts the flow of water and nourishment to the plant thereby causing drying of the central shoot. This results in white ears. The larva

can be found inside the central shoot. When infestation occurs during the growth stages, the growth and tillering is affected and if infestation gets severe the yield is affected.

Economic Threshold Level (ETL)

Occurrence of two egg masses or 2% white ears per square metre indicates that the pest has attained the economic threshold level.

Control Measures

- ✦ Apply 42-50 kg of neem cake as basal manure.
- ✦ Neem cake bags can be placed in the irrigation channel (Refer page 74).
- ✦ Trichogramma cards can be used. The egg cards of the Parasitoids, *Trichogramma japonicum*, *Trichogramma presiliensis*, *Telenomus pelefecienes* are available commercially. These parasitoids are capable of destroying the egg masses of stem borers (Refer page 75).
- ✦ The male adult moths can be attracted and trapped using pheromone traps. Three pheromone traps should be used per acre. By this method, the population of the pest can be controlled (Refer page 73).
- ✦ The adult moths can be attracted using light traps and can be destroyed (Refer page 73).
- ✦ The land should be ploughed immediately after harvest to destroy eggs and pupae (Refer page 70).
- ✦ The seedlings should be planted with proper spacing (Refer page 71).

RAT

The rats feed on the seeds sown in the nursery and destroy the seedlings. They also cause great damage during panicle initiation. They cut the panicles when they are mature and store the grains in their holes. They also cause damage to the grains in the storage godowns.

Control Measures

- ✦ Take unripe papaya fruits and cut it into small pieces. Spread these pieces over the bunds. A chemical substance present in the raw papaya causes tissue damage in the rats mouth. For 1 acre, 4-5 fruits are required. Ripe fruits should not be used.
- ✦ Take 2-3 kg of *Ipomoea fistulosa* and add 3-5 litres of water. Boil for half an hour and filter the extract. Take 2-3 kg of sorghum seeds and add the above extract to it. Boil it again for half an hour. Spread these seeds in the rat burrows. Rats feed on these and die.
- ✦ Take a mud pot and fill it with straw. Sprinkle water over the straw. Make a hole at the bottom of the pot. Invert it over the rat hole near the bunds. Light the straw and cover the hole with mud paste before the smoke escapes. This smoke will suffocate the rats due to which they die.
- ✦ Spread screw pine tree's bark and leaves over the bunds of the field. When rats try to cross the bunds, thorns spread on the margin of the leaves scratches the lower belly of the rats. This prevents the entry of rats into the field.

Diseases Attacking Paddy and their Control Measures

Diseases such as blast, brown leaf spot and tungro virus have from time to time caused great damage. Nearly 75% loss can occur due to blast disease. This disease is found to occur in all districts of Tamilnadu where rice is cultivated. The loss of rice yield in India in the year 1961 due to the blast disease alone was 2,65,000 tones or 0.8% of total rice production. Brown spot disease was held to have been the major factor contributing to the Bengal Famine in 1942. Hence knowledge of the diseases and early diagnosis will help to prevent the losses considerably. This section deals with important diseases of paddy and their control.

Fungal Diseases

1. Rice Blast

Causal Organism - *Pyricularia oryzae*

Symptoms

It is an air-borne fungal disease. Small specks on the leaves enlarge into spindle shaped spots of varying lengths with a whitish grey centre and brown margin. Nodes and neck of the panicle blacken leading to breaking (neck blast) at the point of infection. The affected panicle breaks due to the weight of the grains. These symptoms occur from the seedling stage upto the third week of harvest. The above symptoms can be seen in the stem also. A black shaded region is seen above and below the node. When the infection occurs during the milky stage, the panicle gets poorly filled.

2. Rice Brown Leaf Spot

Causal Organism - *Helminthosporium oryzae*

Symptoms

This is a seed-borne fungal disease. The leaves show round to oval or irregular brown spots which may coalesce to cause withering of tissues. A velvety growth may be seen on the glumes. Sometimes browning or greyish browning may be seen at the neck region. The grains show reddish brown discolouration. These spots are like sesamum seeds. Hence this is also called as sesamum leaf spot.

3. Sheath blight

Causal Organism - *Rhizoctonia solani*

Symptoms

This is a fungal disease that spreads through weeds and pathogens. The first symptom seen on the leaf sheath is the appearance of greenish grey lesions. Later, lesions turn to straw colour and increase in size which girdles the stem. The leaf blade of the affected sheath dries up from the tip downwards. The grains are shrivelled and poorly filled.

4. Stem Rot

Causal Organism - *Leptosphaeria salvinii*

Symptoms

This is a soil-borne fungal disease. The disease appears after transplanting in the form of small black irregular lesions at the water line on the leaf sheath and stem. Such infected stem rots and falls down. Spikelets appearing in the affected plants remain

chaffy. Disease is more severe in the fields where water remains stagnant and lack proper drainage facility.

Bacterial Disease

Bacterial leaf blight

Causal Organism - *Xanthomonas campestris* p.v. *oryzae*

Symptoms

This is a seed-borne bacterial disease. It is characterized by the appearance of yellow colour water soaked lesions on both the edges of the leaves. Later they coalesce and the entire surface turns into straw colour. The affected leaves roll completely, droop and ultimately the tillers wither away. These symptoms usually appear 4 to 6 weeks after transplanting. Affected plants produce chaffy grains. High nitrogenous fertilizer rates favour blight epidemics especially where susceptible cultivars are grown.

Viral Diseases

Tungro or leaf yellowing

Causal Organism - *Virus complex*

Symptoms

This disease is spread through viral particles. Older leaves turn yellow orange starting from the tips and spreads downwards covering the entire leaf. Young leaves are mottled with pale green to whitish spots. Root development is poor and grains are usually covered with a dark brown blotch. Plants become stunted and bear poor panicles with empty glumes. This disease is transmitted by green leaf hopper (*Nephotettix virescens*).

Disease Management

- ✦ Take cow's urine in a mud pot and allow it to ferment for one week. Spraying this over the crop controls bacterial and fungal diseases. According to the intensity of the disease, the quantity can be reduced from ½ to 1 litre per tank.
- ✦ Mix one litre of cow's urine with one litre of buttermilk and 8 litres of water. Spraying this extract over the crop controls bacterial and fungal diseases.
- ✦ Mix 300 ml of sweet flag extract with one litre of cow's urine and 8.7 litres of water. Spraying this extract controls the spreading of diseases.

Note : Sweet flag extract required for one acre of the crop can be prepared by mixing 400 g of sweet flag powder with 2 litres of water. This should be kept undisturbed for 3 hours and then filtered.

Storage Pests and their Control Measures

The pests in storage godowns destroy the food grains, which are protected by the farmers with great care at the field level. Nearly 30% of the food grains are lost due to pests, rats and fungal attack. Very often, the food grains lose commercial value due to the pest attack during storage. The storage pests should be identified and controlled at initial stages. Ignorance of storage pests at initial stages may lead to increase in their population and excessive damage of food grains. Sometimes these pests appear in the field level itself. Hence it is essential to know about the pests, their identification and control measures. In this chapter, we will deal about the important pests attacking food grains, their appearance and the damage caused by them. This chapter will also explain in detail about the control measures of major storage pests.

1. Rice Weevil

Scientific Name : *Sitophilus oryzae* – Coleoptera

Life Cycle

Adults are reddish brown or black in colour. They have four light reddish or yellowish spots on their elytra. The adult lays about 200 eggs inside the grain kernel. The eggs are oval, whitish and transparent. Tiny whitish grubs emerge out from these eggs in 3-6 days. The grubs are yellowish with a brown head. The larval stage lasts for about 19-34 days. They enter pupation stage inside the grain. Pupal period lasts for 3-6 days. They complete five generations in a year.

Damage Pattern

The larvae generally feed on the endosperm that reduces the weight and the food value. They make the food grains unfit for consumption. Moreover, the larvae also produce large quantities of powdery excreta. This makes the food grains dusty and creates an unpleasant odour.

2. Lesser Grain Borer

Scientific Name : *Rhizopertha dominica* – Coleoptera

Life Cycle

Adults are tiny, shiny, dark brown or black in colour. The head is bent under the thorax. Adult female lays about 300-500 eggs among the grains. The egg stage lasts for 5-11 days. The larvae that emerge out of the eggs are white coloured and brown headed. The larval stage lasts for 24-50 days. They undergo pupation on the surface of the grain, which lasts for 7-8 days. They complete about 3-4 generations in a year.

Damage Pattern

These larvae bore holes into the food grains and eat the flour. Both larvae and adults feed voraciously and cause serious damage.

3. Angoumois Grain Moth

Scientific Name: *Sitotroga cerealella* - Lepidoptera

Life Cycle

Adults lay about 400 eggs on the surface of the grains. They lay eggs on the panicles and on the grains. The eggs are initially

whitish and gradually turn reddish. The eggs are oval in shape. The larvae emerge out from these eggs in about 7 days. The larval stage lasts for 7-14 days. They enter into pupation among the grains. The adults emerge from these pupae in 4-6 days. The adults are yellowish brown in colour with tiny sharp wings.

Damage Pattern

The infestation begins at the field level. In the storage godowns, the pest attack is found on the upper surface of the grains. They bore into the grains and remain inside them until they turn into adults. The pests attack the grains and make them powdery. The larval excreta can be found along with the grains. The infested grains appear as lumps.

4. Rice Moth

Scientific Name : *Corcyra cephalonica* – Lepidoptera

Life Cycle

The adults are greyish brown in colour. Their wings measure about 14-24 mm in length. The adults lay 90-200 white coloured eggs, which lasts for 3-5 days. The larvae that emerge from these eggs are white in colour. The larvae group the grains with their excreta, remain inside them and feed on the food grains. The larval and pupal stages lasts for 20-30 days and 8-10 days respectively. They turn into pupae among the grains.

Damage Pattern

The infested grains are found as lumps.

Pest Management in Storage

- ✪ The storage godowns should be kept clean. The waste and unwanted materials in the godown should be periodically removed.
- ✪ The cracks on the floor, walls and roof should be sealed.
- ✪ The grains should not have more than 12% moisture content.
- ✪ The gunny bags should be stacked with proper aeration between them.
- ✪ If the grains are to be stored in the gunny bags for longer periods, the gunny bags should be dried in the sun once in three months to prevent pest attack.
- ✪ The grains stored in gunny bags should not be placed directly on the floor. They should be placed on the wooden logs one foot above the ground level to prevent the grains from getting moist and to prevent pest attack.
- ✪ When the grains are stored in mud pots, the mouth of the pot should be properly sealed with neem leaf paste to avoid entry of pests.
- ✪ Pest attack during storage can be avoided by mixing the seeds with neem oil. One kg of paddy seeds should be mixed with 10 ml of neem oil and dried in shade. This should then be stored.
- ✪ The gunny bags used for seed storage should be treated with 10% neem kernel extract (Refer page 64) before use. The neem kernel should be used immediately after

preparation. The gunny bags should be soaked in the extract for 15 minutes. The gunny bags should be dried in shade and then used for storage. In case the gunny bags are new they should be soaked for half an hour. If the gunny bags are with close meshes and small pores, thinner solution should be prepared. By this method, the grains can be protected from pests for about 4 months.

- ✧ In store rooms, along with the cowdung that is used for cleaning the mud floor, neem kernel extract (Refer page 64) or neem oil should be used directly (in the same concentration used for spraying purposes). The same could be also be used for the mud walls.
- ✧ If bamboo bins are used for storage, the bins can be painted with thick neem kernel extract. This prevents the pests from getting into the bin.
- ✧ The seeds and grains stored in the godowns can be protected from pests by placing the leaves of vitex, neem and pongam on the gunny bags and in different places of the godown.
- ✧ While filling the gunny bags, for every 20 kg of seeds, two handful of powdered vitex, neem and pongam leaves should be spread. By this method the grains can be protected from pests for more than one year.
- ✧ The storage godowns or rooms should have proper aeration.
- ✧ The adult moths can be controlled by fumigation. An iron pan with hot coal should be placed in the godown. Fresh neem leaves or vitex leaves should be spread over the coal. All doors, windows and ventilators should be

shut during this process to facilitate proper spreading of the smoke. The smoke should be allowed to remain in the room for 30-45 minutes. When the doors are opened, the adults which get affected by the smoke can be found lying on the floor. Later the room should be cleaned properly. This method should be followed when the adult population is more.

Beneficial Organisms in Paddy Field

There is a rich diversity of beneficial insects and spiders in the paddy field. These beneficial insects are destroyed when chemical pesticides are used. Without these beneficial organisms, the insect pests would multiply quickly and they would completely devastate the rice crop. Hence the control measures we implement should not be destructive to these beneficial organisms. It is highly essential to be able to identify the insect pests and beneficial insects before control measures are implemented. This section provides information regarding important beneficial organisms.

1. Lady Bird Beetles

Three types of ladybird beetles are found in paddy fields.

a) *Micraspis crocea*

This is a typical coccinellid beetle. The body is oval shaped and brightly coloured in shades of red. Adults are yellow in colour with different spots behind the head. These are active during the day time. They are mostly seen on the upper half of the rice canopy in dryland and wetland habitats.

Prey

Small brown plant hopper, small larvae and exposed eggs, aphids, coccids and other soft-bodied insects.

b) *Harmonia octomaculata*

These are black spotted ladybird beetles that catch slow moving prey. A lady bird beetle takes 1-2 weeks to develop from egg to adult and produces 150-200 offsprings in 6-10 weeks.

Prey

Brown plant hopper eggs, nymphs and adults. They are more voracious and consume 5-10 prey/day.

c) *Menochilus sexmaculatus*

Adults are round in shape with size ranging from 6-7 mm. Each female lays 45 eggs. Larvae are long and segmented. They are more active and gregarious feeders. They are seen all over the rice plant. Their life span is 150 days.

Prey

Brown plant hopper, green leaf hopper, rice aphids, leaf folder, stem borer.

2. Ground Beetle

Scientific Name : *Ophionea nigrofasciata*

Ground beetles are active hard bodied insects. Their body is about 8 mm in length. Each female lays about 28-30 eggs. Larvae are shiny and black in colour. They pupate in the soil of wetland rice or dryland fields. Adults are reddish brown in colour with stripes spread over the body. They are long legged, swift running beetles. They are mainly seen within the folded leaf chambers and lower stems. They are active searchers during daytime. Their life span is 120 days.

Prey

Leaf folder larvae, brown plant hopper, green leaf hopper, white backed plant hopper, hairy caterpillars, green semilooper and stem borer. An adult consumes 3-5 larvae per day.

3. Crickets

Scientific Name : *Metioche vittaticollis*

They occur in wetland and dryland paddy fields. Nymphs are pale brown in colour with stripes and adults are black in colour. Adult has a sword like ovipositor. It is used to insert eggs into leaf sheaths of rice and grasses. The life cycle from egg to adult lasts for 60-80 days. A female produces 40-80 young ones.

Prey

Striped and dark headed stem borers, leaf folders, armyworms, nymphs and adults of brown plant hoppers.

4. Damselflies

Scientific Name : *Agriocnemis pygmaea*

Damselflies are weak fliers compared to their dragonfly cousins. Their body is slender, mostly red, orange, grey or bluish in colour. Their size ranges upto 30 mm. Complex network pattern are seen on the wings. Males are more colourful than the females. The tips of the abdomen of *A. pygmaea* males are orange in colour and that of *A.f.femina* are blue green in colour. The characteristic feature of these insects is that they can fly while mating to escape from their enemies. Each female is capable of laying 30-50 eggs. Nymphs are aquatic and can climb up the rice stems in search of hopper nymphs. Adults fly below the rice canopy in search of flying insects as well as hoppers on plants. Their life span is about 30 days.

Prey

Brown plant hopper, green leaf hopper, leaf folder, white backed plant hopper.

5. Earwig

Scientific Name : *Euborellia stali*

Earwigs are shiny black in colour with white bands between abdominal segments and a white spot on the tip of each antenna. They are mostly seen in dryland habitats and nest in the soil at the base of the rice hills. Digging the soil is the best way to identify them. Each female is capable of laying 200-350 eggs. Their life cycle lasts for about 3-5 months. They are nocturnal insects. Earwigs have a characteristic hind pair of forcep like pincers. It is used as a defence organ. One special feature of earwigs is that they can enter the stem borer tunnels in search of the larvae.

Prey

Stem borer larvae and leaf folder larvae. Each earwig consumes 20-30 prey daily.

6. Ants

Scientific Name : *Solenopsis geminata*

Ants are red or black in colour. They make nests in the dryland fields as well as in bunds of wetland rice. They are otherwise called fire ants, which inflict a painful bite on the feet and legs of any person walking on the bunds. Fire ants are quick to colonize a newly established field. They make nests for hundreds and even thousands of workers and soldiers.

Prey

Wide variety of insects. e.g. adult black bugs and their eggs.

7. Wasps

Wasps belonging to different families are found in the paddy field. Generally, they are small with reduced wing veins. Wasps are of different colours.

Prey

Stem borer larva, brown plant hopper, green leaf hopper, skipper and green hairy caterpillar.

8. Long Horned Grass Hoppers

Scientific Name : *Conocephalus longipennis*

Meadow grasshoppers are large insects with slanted faces. They are green in colour. Their body size ranges from 25-32 mm. Antennae are 2-3 times longer than the body. Adults lay eggs on the bunds. Each female can lay 15-30 eggs. Nymphs emerging are green in colour and can be distinguished from adults by the absence of wings and ovipositors. Life cycle lasts for 3-4 months. They are more active at night. They are seen mainly on leaves and panicles.

Prey

Rice bugs, stem borer eggs, brown plant hopper and green leaf hopper, nymphs and adults. Each predator can consume 1- 4 yellow stem borer egg masses daily.

9. Small Ripple Bug

Scientific Name : *Microvelia douglasi atrolineata*

They are fast moving small ripple bugs seen mostly in flooded fields. Their body size is about 1.5 mm. Each female lays 20-30 eggs in the rice stem above the water line. Their life

span is 1-2 months. Adults are broad shouldered, black in colour and are seen either with or without wings. They occur mainly on the water surface and occasionally on the lower stem. They are fast moving insects attracted towards the light.

Prey

Brown plant hopper, stem borer - Ist instar larva, green leaf hopper and other soft bodied insects.

10. Water Strider

Scientific Name : *Limnogonus spp.*

These are large, long legged, fast moving insects. Adults are black in colour with 2 pairs of very long hind legs. Their body size ranges from 6-15.5 mm. Each female can lay 10-20 eggs in the rice stem above the waterline. They are very fast swimmers and attack the prey very quickly. Their life span is 1-1½ months.

Prey

Green leaf hopper, brown plant hopper, rice leaf roller, armyworm and cutworms.

11. Water Treader

Scientific Name : *Mesovelia vittigera*

Water treaders are found only in wetland habitats. Adults are pale green in colour with or without wings. Their body size ranges from 3-4 mm. Legs are seen with small spines. They mainly occur on the water surface and the basal part of the plant. Each female lays 28 eggs. They are non-gregarious feeders. Their life span is about 45 days.

Prey

Green leaf hopper, brown plant hopper, white backed plant hopper and zigzag leaf hopper.

12. Mirid Bug

Scientific Name : *Cyrtorhinus lividipennis*

Adults are green in colour. The head and shoulder region are marked with black colour. Their body size ranges from 2.5-3.25 mm. Each female lays about 30 eggs. They are seen in rice plants and weeds. They are attracted towards light at night. They are mobile like hoppers. Their life span is about 30 days.

Prey

Brown plant hopper, green leaf hopper, stem borer, white backed plant hopper. Each adult can consume 1-5 hoppers a day.

13. Assassin Bug

Scientific Name : *Polytoxus fuscovittatus*

They are solitary predators seen in both wetlands and dry lands. Adults are brown in colour with three prominent spines on the back. They have needle like mouthparts, which is used to pierce the insect body and inject the toxin.

Prey

Larvae of moths and butterflies.

14. Orb Spider

Scientific Name : *Argiope sp.*

They are otherwise called as cross spiders. Their body size ranges from 4-25 mm. Each female lays 600-800 eggs. The female has

yellow and greyish white markings on the abdomen. The male is comparatively smaller than the female and they are reddish brown in colour. Eggs are seen inside a light brown cocoon mostly hanging on the web. Their life span is 2-3 months. They are seen mainly on the upper surface of the rice canopy in circular webs. Males do not spin webs but occupy the periphery of the female's web.

Prey

Leaf folders, brown plant hopper, green leaf hopper, white backed plant hopper and stem borers.

15. Long Jawed Spider

Scientific Name : *Tetragnatha sp.*

The body size of long jawed spider ranges upto 25 mm. They have long legs often extended in one line and are greenish brown in colour. They are commonly seen lying outstretched along the rice plants. Males have enlarged jaws. Each female is capable of laying 120 eggs. Eggs are seen in a cottony mass mostly on the upper half of rice plants. Their life span is about 3 months. Normally, they spin a ring shaped weak web. When the prey hits the web, these spiders wrap them quickly.

Prey

Green leaf hopper, white backed plant hopper and brown plant hopper.

16. Wolf Spider

Scientific Name : *Lycosa pseudoannulata*

They are highly mobile and readily colonize wetland and dryland rice fields. Their body size ranges upto 18 mm. Each female lays around 200-400 eggs. A special feature of the female

spider is that it carries the hatched spiderlings on its back for quite sometime. Adults have fork shaped markings on the back. Abdomen has white markings over the surface. Their life span is 3 months. They are mostly seen among tillers at the base of the plants. These spiders do not make webs but attack their prey directly.

Prey

Stem borers, brown plant hoppers, green leaf hoppers (both adults and nymphs). An adult consumes about 15 hoppers/day.

17. Lynx Spider

Scientific Name : *Oxyopes sp.*

These are called hunting spiders. They do not build webs. Their body size ranges from 7-10 mm. Legs have long spines. Females have 2 pairs of white or brown bands on the sides of the abdomen. Each female is capable of laying 350 eggs. Their life span is 3-5 months. They are seen within the rice canopy. They normally hide from their prey and attack them preferably from a striking distance.

Prey

Brown plant hopper, case worm, green leafhopper and white backed plant hopper.

18. Jumping Spider

Scientific Name : *Phidippus sp.*

They are hunting spiders. They have brown hairs all over the body. Their body size ranges from 5-9 mm. They have two

bulging eyes, which is an important feature. Each female is capable of laying 90 eggs and they guard the egg mass till birth. Their life span is about 2-4 months. These spiders prefer dryland habitats and always remain within the rice foliage. They hide themselves within the folded leaves and wait for the prey.

Prey

Green leaf hopper, brown plant hopper, white backed plant hopper and stem borer moths. Each spider consumes 2-8 prey/day.

19. Dwarf Spider

Scientific Name : *Atypena sp.*

They are very small in size (1-3 mm). Hence spiderlings and adult spiders cannot be differentiated based on size. Adult spiders have 3 pairs of grey markings on the back of the abdomen. Each female lays 80-100 eggs. Eggs are covered with a thin layer of silk or dried leaf sheath. Absence of maternal care is a characteristic feature of spiders. They make irregular webs within the base of rice tillers above the water line. They are both hunters and web catchers. Their life span is 1½-2 months.

Prey

Green leaf hoppers and brown plant hoppers (both adults and nymphs). An adult consumes 4-5 prey a day.

Botanicals in Pest and Disease Management

Botanicals play a very vital role in pest and disease control. By nature several plants possess pest control properties. Studies indicate that around 2400 plants have pest control properties. Research is being conducted on several other plants also. The use of plant extracts minimises the use of chemical pesticides. Most of them are also not harmful to beneficial insects. Moreover, they safeguard the farmers and environment from the toxic chemical pesticides. This chapter deals with the plant extracts used in plant protection, the method of preparation and use.

I. Plant Extracts

Neem Kernel Extract

3–5 kg of Neem kernel is required for an acre. Remove the outer seed coat and use only the kernel. If the seeds are fresh, 3 kg of kernel is sufficient. If the seeds are old, 5 kg is required. Pound the kernel gently and place it in an earthen pot. To this, add 10 litres of water. Tie the mouth of the pot securely with a cloth. Leave it as such for 3 days. Filter it after 3 days. On filtering 6–7 litres of extract can be obtained. The shelf life of this is about one month. 500–1000 ml of this extract is used for one tank (a tank of 10 litre capacity). 500–1000 ml of extract should be diluted with 9½ or 9 litres of water before spraying. Khadi soap solution @ 10 ml/litre (100 ml/tank) should be added to help the extract stick well to the leaf surface. The concentration of the extract can be increased or decreased depending on the intensity of the pest attack.

Note : This extract can be stored for a period of one month. The seeds used for preparing this extract should be at least 3 months old. When they are less than 3 months or more than 8 months old, the pest control property in these seeds will be less. The extract prepared should be milky white in colour. If they are prepared from aged seeds, the extract will be brownish in colour.

Neem Cake Extract

5 kg of Neem cake is required for an acre of land. Powder the neem cake well and place it in a cotton cloth and tie it. Soak it in a vessel containing 10 litres of water for 3 days. After 3 days squeeze the pouch well into the water. About 7–8 litres of extract can be obtained. About 500–1000 ml of this extract is used for one tank (a tank of 10 litre capacity). 500–1000 ml of the extract should be diluted with 9½ or 9 litres of water before spraying. Khadi soap solution @ 10 ml/litre (100 ml/tank) should be added to help the extract stick well to the leaf surface. 10 tanks of the extract can be sprayed for one acre of the crop. The concentration of the extract can be increased or decreased depending on the intensity of the pest attack. The shelf life of this extract is one month.

Neem Oil Spray

1200–1800 ml of neem oil is required for one acre. 200–300 ml of oil is required for one tank (a tank of 10 litre capacity). Take the required neem oil and the soap solution and mix it well. To this slowly add the required quantity of water (9.8 or 9.7 litres) and stir it well.

Note : This spray should be used immediately after preparation. Otherwise oil droplets will start floating on the surface. Power sprayers should be used for spraying this extract.

Preparation of Khadi Soap Solution

Khadi soap solution should be added with all neem extracts before spraying. This is a neem based soap without any detergent. It should be soaked overnight in water and used. The soap solution should be sticky and thick in nature.

Ginger, Garlic, Chilli Extract

This extract is made from three plants. For preparing the extract require for one acre, 1 kg of garlic, ½ kg of ginger and ½ kg of green chillies are required. Take all the three separately and make them into a fine paste. Dissolve all the three pastes in 7 litres of water and mix them well. On filtering this, 6 litres of extract can be obtained. The concentration of the extract can be increased or decreased from 500-1000 ml/tank (10 litre capacity) depending on the intensity of the pest attack. This extract should be used immediately after preparation. This extract can be stored for a maximum of 3 days.

Five Leaf Extract

This extract is prepared using leaves of five different plants. Leaves with five different characteristics are used for this purpose.

- ✪ Plants with milky latex - *Calotropis*, *Nerium*, *Cactus* and *Jatropha*.
- ✪ Plants which are bitter - *Neem*, *Andrographis*, *Tinospora* and *Leucas*.
- ✪ Plants that are generally avoided by cattle - *Adathoda*, *Ipomea fistulosa*

- ✪ Aromatic plants – *Vitex*, *Ocimum*
- ✪ Plants that are not affected by pests and diseases – *Morinda*, *Ipomea fistulosa*

One plant in each category should be taken in equal quantities (1 kg in each) and pound well. Take them in a mud pot and add twice the quantity of water. To this, add 1 litre of cow's urine and 100 g of Asafoetida. Tie the mouth of the pot tightly with a cloth. This extract should be mixed well daily in the evening.

This extract should be used after a period of one week. If this extract is to be used for prophylactic as a precautionary measure, 500 ml of the extract should be added for a tank of 10 litre capacity. This should be diluted with 9½ litres of water and used. If the pest infestation is severe 1000 ml of extract should be used per tank and diluted with 9 litres of water. This extract can be stored and used for a period of 25-30 days.

Note : Cow's urine is used for disease control and Asafoetida prevents flower dropping and enhances the yield.

6. Jatropha Leaf Extract

For preparing the extract required for one acre of land 5 kg of *Jatropha* leaves are required. 5 kg of leaves should be collected and pound. This should be taken in a mud pot. To this 5 litres of water should be added and allowed to ferment for 3 days to 1 week. Later, the water should be filtered and the extract can be used. ½ litre of extract should be diluted with 9½ litres of water for obtaining one tank of extract.

II. Preparation of Kashayam

The plants selected for kashayam preparation should be collected without the roots. The plants should be cut into small pieces and used. For one acre of crop, 2 kg of the cut plants should be mixed with 8 litres of water. This has to be taken in a wide mouthed vessel and boiled until the extract reduces to 2 litres. This has to be cooled and filtered. 300 ml of this extract should be diluted with 100 ml of soap solution and 9.4 litres of water to obtain one tank capacity of the extract.

Plants used in kashayam preparations	Pests and diseases controlled
1. <i>Andrographis paniculata</i>	All kinds of larvae
2. <i>Sida spinosa</i>	Aphids and Sap feeders
3. <i>Adathoda zeylanica</i>	Fungal diseases
4. Panchathiktha kashayam*	All kinds of pests
* Panchathiktha kashayam is prepared by using equal quantities of five types of bitter leaves.	

Note:

- The extracts that are kept closed should be stirred well daily.
- The extracts should be sprayed using the hand sprayer.
- Power sprayers should be used for controlling winged pests such as green plant hoppers, ear head bugs and white flies.
- For one tank of the extract 100 ml of khadi soap solution should be added.
- The extracts should always be sprayed in the morning (between 7.00 a.m.–10.00 a.m.).

Plant Extracts to Control Pests and Diseases

Sl. No.	Pests / Diseases.	Plant Extracts Used and their quantity
Sap Feeders		
1.	Green plant hopper	5% <i>Sida spinosa</i> extract (or)
2.	Gall Midge	5% Neem kernel extract (or)
3.	Brown plant hopper	2-3% Neem oil extract (or)
4.	Mealy bugs	10% Neem cake extract (or)
5.	Ear head bug	3-5% Panchathiktha kashayam.
Larvae		
1.	Army worm	5% Neem kernel extract (or)
2.	Stem borer	3-5% <i>Andrographis</i> extract (or)
3.	Yellow hairy caterpillar	<i>Jatropha</i> extract - 500 ml / tank (or)
4.	Leaf folder	Ginger, garlic, chilli extract - 500 to 1000 ml/tank (or)
5.	Green horned caterpillar	3-5% Panchathiktha Kashayam (or)
6.	Case worm	10-20% Cow dung extract
7.	Skipper	
1.	Short horned grass hopper	Application of neem cake - 25 kg/acre (or)
2.	Black bug	5% Neem kernel extract
Diseases		
1.	Blast	10% Cow's urine extract - twice in 10 days interval (or)
2.	Brown leaf spot	Sweet flag + Cow's urine extract (300 ml sweet flag extract + 1 litre cow's urine + 8.7 litres water) (or)
3.	Bacterial leaf blight	
4.	Tungro virus	Cow's urine + buttermilk extract (1litre buttermilk + 1 litre of cow's urine + 8 litres of water)
5.	Stem rot	

Non-Chemical Methods of Pest and Disease Management

The number of pesticides used in agriculture is increasing day by day. They not only pollute the environment but also affect farmer's health. Pests are not new to agriculture. They have been in existence for centuries. But our ancestors have never faced the problems that are now being faced by the farmers. Our ancestors practiced ecofriendly agriculture by cultivating the right crop in the right season, planting during the correct season and implementing the control measures at the right time. Although these practices are not very popular today, they are still practiced by certain groups of farmers. Non-chemical methods of pest management not only ensure pest control but also provide a healthy environment. This chapter deals in detail about the various non-chemical methods of pest and disease management.

I. Cultural Methods

Summer Ploughing

Summer ploughing is an important cultural practice for pest control. When the land is ploughed, the inactive stages of pests like egg masses, larvae, pupae, present within 5-10 cms of the soil get exposed. They are killed by the intense heat of summer and are also eaten away by the predatory bugs.

Keeping Bunds Clear

Field and field bunds are the favourite egg laying spots of most of the pests. Hence the wild grasses and weeds found in the field and the bunds should be removed periodically and kept clean. The long horned grasshopper lay their eggs mostly in the weeds found near the bunds.

Plastering of Bunds

The weeds found in the bunds should be removed and they should be plastered. By doing this, the rat holes found near the bunds can be sealed and rodent damage can be controlled. It also prevents water leakage.

Proper Spacing among the Seedlings

When the seedlings are transplanted to the main field, they should be planted with proper spacing. This prevents pest and disease incidence and helps the crop to grow well.

Providing sufficient gaps

While planting the seedlings, 1 feet gap should be given after every 8 feet to enable sunlight to reach the under parts of the plants. This reduces the incidence of brown plant hoppers which are found on the under surface of the crop. This spacing also helps during application of manures and spraying of biopesticides.

Planting at the right season

Cultivating paddy at the right season protects the crop from pest and disease attack.

Rope method

The field should be filled with water upto 5 cms. One litre of kerosene should be mixed with 25 kg of sand and strewn on the field. Later, a string should be dragged over the surface of the leaves vigorously so that the caterpillars fall into the water. These caterpillars are killed by the kerosene present in the water. Later, the water should be drained to remove the dead caterpillars. The field should be dried and then irrigated. This method should be practiced only during the vegetative growth stages of the crop.

Provision for Sunlight

“Neekal Podum Murai” is a traditional practice that has been followed in the Chengalpet district for a number of years. In this method, women stand in a line in between the plants and walk from one end to the other end of the field by pressing the under parts of the plants. This enables sunlight to reach the lower parts of the plants. This method not only kills the nymphs of brown plant hoppers sticking to the under surface of the plants but also help to check rodent population.

II. Trapping of Pests

Yellow Sticky Trap

An empty tin or plate smeared with castor oil should be placed 1ft above the crop canopy in the field. Pests such as green leaf hopper and brown plant hopper that are attracted by the bright yellow colour get trapped in the oil smear. These pests should be wiped out every day and oil should be applied again.

Light Trap

Light traps can be used to monitor and trap the adults there by reducing their population. Some common light traps that could be used are electric bulbs, hurricane lamp and bonfire. A large plate or vessel with kerosene mixed with water is kept near the light. The light trap should be 2-3ft. above the crop canopy. The trap should be set up in the field between 6 p.m. and 9 p.m. If it is kept after 9 p.m., there are chances of beneficial insects getting trapped and killed. The adult moths, which get attracted by the bright light, fall into this water and die.

Pheromone Trap

Pheromones are organic compounds secreted by insects, mostly females to attract males for mating. Such chemicals are synthesized in the laboratory and supplied as “Lures”. Lures are species specific.

Depending upon the type used, the male moths are attracted to the lure and are trapped. The female moths in the field are deprived of mates and fail to reproduce. This is a monitoring activity employed in integrated pest control measures. For one acre, 2-3 traps are recommended. These traps have to be tied to a stick and kept in the field atleast 1-2 feet above the crop canopy. The lure is effective for atleast 15 days. It has to be changed fortnightly. Based on the catches, the pest population is monitored effectively.

Bird Perch

‘T’ shaped bird perches should be erected in the field at the rate of 15-20 per acre. They should be 1ft above the crop canopy. These perches serve as resting places for the birds. The

birds, which rest on these perches predate upon the larvae in the field.

III. Preventing the Entry of Pests and Diseases into the Field

Use of *Cycas* flowers

Sannampu, the flower of *Cycas* is cut into pieces and wrapped along with the straw and placed in the field. About 10–15 pieces should be placed per acre. The odour which is emitted from this flower prevents entry of earhead bugs for two weeks. By this time, the milky stage is completed and the grain matures.

Use of Plants with Pest Repellent Properties

Neem cake / Neem leaves, *Vitex* leaves, *Morinda* leaves, *Calotropis* leaves and *Jatropha* leaves are used for this purpose. Any two of the above mentioned leaves are taken and pound well. The pound leaves are taken in a mud pot and thrice the quantity of water is added to it. The mouth of the pot is tied with a cloth and left as such for three days. Then, these pots are placed on all the four corners of the field. In the evening, the mouth of the pots should be opened and stirred well. The unpleasant odour which emanates from this pot prevents the entry of pests into the field.

Neem Cake for Pest Control and Manuring

The gunny bags should be filled with neem cake and placed along the water canals. Neem cake gets dissolved in the water flowing along the canals and irrigates the field. This practice prevents attack of pests and diseases affecting the roots and

tillers of the crop. The bags should be replaced once in 15 days.

V. Biological Method

Use of Trichogramma Cards

The egg cards of the parasitoid *Trichogramma japonicum* are available commercially. Egg cards should be used at the rate of 3cc per acre (1cc = 20,000–30,000 eggs). They should be used thrice at 15 days interval. These parasitoids attack the stem borers in the egg stage and kill them. The egg cards should be tied in 12 different places of the field. They should be used in the evening when it is shady.

General Techniques for Organic Paddy Cultivation

This chapter summarizes various techniques used in organic paddy cultivation.

Soil type

Alluvial Soil, Sandy clay and Clayey soil types are suitable for paddy cultivation

Seed Rate

The seed rate required for one acre of land under irrigated condition is given below.

- ★ Short duration variety (90-110 days) - 24-28 kg
- ★ Medium duration variety (110-125 days) - 16-24 kg
- ★ Long duration variety (above 125 days) - 12-24 kg
- ★ SRI (System of Rice Intensification Method) or Madagaskar method - 2-3 kg
- ★ Dry and rain fed sowing - 35-40 kg

Seed Treatment

- ★ Separation of good quality seeds
- ★ Separation of good quality seeds using salt water
- ★ Seed treatment with pseudomonas, cow's urine or sweet flag extract to induce disease resistance

Preparation of Nursery

6-8 cents of nursery is required for cultivating in one acre of land. The land should be ploughed 6-8 times and neem leaves should be applied as basal manure. For high yielding varieties, 1 kg of neem cake should be applied per cent of nursery. Then, the sprouted seeds should be strewn in the nursery. 15-25 kg of gypsum should be applied to the nursery before plucking the seedlings to avoid any damage caused to the roots.

Preparation of Main Field

Green manure seeds should be sown on the main field. The green manure plants should be ploughed into the soil when they are 45-60 days old. The main field should be ploughed well for 6-8 times and levelled.

Basal Manure

- i) Farmyard manure - 5-7 tonnes/acre
- ii) Poultry waste - 2 tonnes/acre
- iii) Vermicompost - 2 tonnes/acre

Any one of the above mentioned manure should be applied during the last ploughing.

- iv) 40-50 kg of neem cake should be applied as a basal manure.
- v) 10% Amirthakaraisal should be sprayed before transplanting. Otherwise for 1 acre of land, 300-500 litres of Amirtha karaisal should be mixed with water and irrigated.

Application of biofertilisers

2 kg of Azospirillum or 2 kg of phosphobacteria should be mixed with 25 kg of sand or compost and strewn on the field.

Transplantation

- ✪ 2-3 seedlings should be planted per hill.
- ✪ For SRI method, only one seedling should be planted per hill.

Spacing

Short duration variety	-	15 x 10 cm
Medium duration variety	-	20 x 10 cm
Long duration variety	-	20 x 15 cm
SRI Technique	-	25 x 25 cm

Growing of Azolla or Blue Green Algae

Azolla or Blue Green Algae should be strewn on the field 5-10 days after transplanting. After 25 days and 45-50 days of strewing, the field should be drained and the algae should be stamped into the soil.

Top Dressing

After weeding, 25 kg of neem cake or groundnut cake should be applied as top dressing. 50-75 kg of vermicompost or 50 kg of bone meal can be applied as top dressing. For medium and long duration varieties, 25 kg of ground nut cake should be applied as top dressing after 50-60 days of transplantation.

Spraying of Panchakavya

- ✪ For coarse varieties, one spray of 3% panchakavya should be given during tillering and bootling stage.
- ✪ For fine varieties, one spray of 3% panchakavya should be given during the bootling stage.

Spray of Tender Coconut and Buttermilk Extract

To maintain uniform flowering, one spray of 10% buttermilk extract or 3% tender coconut should be given during the bootling stage.

Pest, Disease Management

Proper management measures should be taken for specific pest and disease attack (Refer chapter 4&5).

Keeping Neem cake bags in Irrigation Canals

Neem cake bags can be placed in the irrigation canal (Refer page 74).

This should be kept until the crop attains the milky stage.

Placing Bird Perches

Once the crop develops a dark green colour, about 10-12 bird perches should be placed per acre of the field. The bird perch should be 2-3 feet above the level of the crop. The perches should be removed once the crop attains the tillering stage.

Tying of Trichogramma Cards

The egg card of the parasitoid *Trichogramma japonicum* should be tied to the crop from the 25th day of transplantation. This

Traditional Paddy Varieties

should be done thrice at 15 days interval (ie. On 25th, 40th and 55th day).

Using Pheromone Traps

The male adult moths of yellow stem borer can be attracted and trapped using pheromone traps. About 3 pheromone traps should be placed in one acre of the field. This trap should be 2ft above the crop level.

Using Light Traps

Once the crop develops a dark green colour, about 3 light traps should be placed in one acre of the field. The light trap should be 2-3 feet above the level of the crop.

Water Management

Paddy crop requires continuous irrigation. At least one-inch level of water should stagnate in the field.

Harvest

The grains should be harvested once they turn yellow.

*F*armers in every part of our country have deep knowledge of their own rice varieties, of their environmental and nutritional requirements and their properties and peculiarities. This has enabled them to harvest a crop even under the most severe stress situations. Traditional seed varieties and their diversity play a vital role in organic farming. After the introduction of high yielding varieties the traditional varieties are becoming extinct at an alarming rate. However, some of the traditional varieties of Tamil Nadu are still conserved by a few farmers for a variety of reasons. There are several evidences to prove that TamilNadu harboured hundreds of traditional paddy varieties since ancient days. Several of these varieties are also cited in our ancient literature and proverbs.

Use of Traditional Varieties

The farmers who are interested in cultivating traditional varieties can choose the varieties themselves based on the criteria listed below.

1. Soil type (Clayey, Sandy, Sand mixed with clay etc.)
2. Rain / water availability (Drought resistant varieties, varieties resistant to water logging etc.)
3. Resistance to pests, diseases and weeds.
4. Uses
5. Medicinal value

The traditional paddy varieties mentioned below are classified based on these criteria.

Drought Resistant Varieties

Kattu samba, Sornavari, Puzhudikar Puzhudisamba, Mattakar, Vadansamba, Kullakar, Jil Jil Vaigunda, Pisini, Kuzhiyadichan.

Varieties Resistant to Water Logging

Neelansamba, Kudiraival Samba, Kaliyan Samba, Samba Mosanam, Perungar, Koomvazhai, Kudaivazhai

Varieties Resistant to Both Drought and Water Logging

Kappakar, Vaigunda, Pichavari, Kurangusamba

Varieties Suitable for Saline Soil

Karuppu Nel, Samba, Kuzhiyadichan

Varieties Resistant to Pest and Disease Attack

Kappa Samba, Vadan Samba, Kudiraival Samba, Kaliyan Samba, Kurangu Samba, Kichali Samba, Muttakar, Kullakar, Perungar, Sigappu Kuruvikar, Thooyamalle, Sembalai, Kallimadayan, Pitchavari, Sadakar

Variety Resistant to Brown Plant Hopper and Earhead Bug

Neelansamba

Variety Resistant to Brown Plant Hopper & Rice Caseworm

Sigappu Kuruvikar

Variety Resistant to Weeds

Vaigunda

Varieties used for Specific Foods

Traditional rice varieties are used in preparation of special dishes. Some of those varieties are listed below.

Puffed Rice - Sembalai

Puttu - Karuppu nel, Pitchavari, Karudan Samba

Biriyani - Thinni, Seeragasamba, Kandasali, Kitchali Samba

Flattened Rice - Samba Mosanam, Kappakar, Pisini

The cultivation details, agronomical features, yield and special features of a few traditional varieties are listed in the following table. Some of these details may vary according to the place and season of cultivation. The special features of these varieties can be obtained from experienced farmers.

Traditional Paddy Varieties

Sl. No.	Name	Cultivation Aspects		Agronomical Features		Yield (per Acre)	
		Season, Cultivation Method	Soil Type	Crop Duration	Nursery Age	Grains (Kg)	Straw (Kg)
1.	Neelan Samba	Samba, Transplantation	Clayey	175-180	45-50	1500	1800
Special Features : A highly suitable variety for areas which are prone to water logging. It is best suited for cultivation in the vicinity of lakes. Resistant to brown plant hopper and earhead bug. It increases the milk yield in lactating mothers and hence suitable for them. Since the straw is very long it is used as a roofing material.							
2.	Kappa Samba	Samba, Transplantation	Clayey, Sandy clay	160-165	40	1500	1500
Special Features : It is highly suitable for preparing the traditional South Indian delicacies such as the idly and dosa. During the flowering stage there is a needle-like awn at the tip of all grains. However, on maturity some of them drop off. Highly resistant to pest and disease.							
3.	Vadan Samba	Samba, Dry sown, Transplantation	Sandy clay	155-160	40-45	1125	1200
Special Features : It is highly suitable for preparing the traditional South Indian delicacies such as the idly and dosa. Since the grains shatter, it is important to harvest them when they are still green. Highly resistant to pest and disease. It is also a highly drought resistant variety.							

Traditional Paddy Varieties

Sl. No.	Name	Cultivation Aspects		Agronomical Features		Yield (per Acre)	
		Season, Cultivation Method	Soil Type	Crop Duration	Nursery Age	Grains (Kg)	Straw (Kg)
4.	Kudraival Samba	Samba, Dry sown, Transplantation	Clayey Sandy clay	165	40-45	1500	1800
Special Features : It is better to grow this variety by transplantation. The rice is suitable for the South Indian meal. Can be grown in areas prone to water logging. Highly resistant to pest and disease.							
5.	Kalian Samba	Samba, Transplantation	Clayey	155-160	40	1200	1600
Special Features : It grows very tall to a height of 167 cm. Extremely suitable for making idli and dosa. It can be grown in areas prone to water logging and low lying areas. Highly resistant to pest and disease.							
6.	Kurangu Samba	Samba, Transplantation	Sandy clay	150	35-40	1725	1800
Special Features : The earheads are very long. There are up to 267 grains in one earhead. The rice of this variety is suitable for the South Indian meal. It grows in areas prone to water logging as well as dry areas. Highly resistant to pest and disease.							
7.	Samba	Samba, Dry sown Transplantation	Clayey	160-165	40-45	1650	1800
Special Features : This variety is highly suitable for making idly and dosa. It is also suitable for the South Indian meal. It can be grown in areas prone to water logging and also in saline soils. Highly resistant to pest and disease.							

Traditional Paddy Varieties

Sl. No.	Name	Cultivation Aspects		Agronomical Features		Yield (per Acre)	
		Season, Cultivation Method	Soil Type	Crop Duration	Nursery Age	Grains (Kg)	Straw (Kg)
8.	Samba Mosanam	Samba, Dry sown, Transplantation	Clayey soil	160-165	40-45	1800	1950
<p>Special Features : This variety is also called Puzudikal, Eri nel and Maduvu muzangi. It is suitable for growing in the vicinity of lakes. It is said that people travelled by boats and harvested the 'Samba mosanam' in the lakes. The variety is good for preparing aval (flattened rice), idly and dosa.</p>							
9.	Kitchil Samba	Samba, Dry sown Transplantation	Sandy clay	135-140	30-35	1125	1050
<p>Special Features : This variety is highly suitable for the South Indian meal and also used for making a special dish called 'biryani'. This variety is highly suitable for dry sowing. Highly resistant to pest and disease.</p>							
10.	Muttakar	Navarai, Wet sown Transplantation	Clayey Sandy clay	120	30	1350	1200
<p>Special Features : It is highly suitable for preparing the traditional South Indian delicacies such as the idly and dosa. Highly resistant to pest and disease.</p>							

Traditional Paddy Varieties

Sl. No.	Name	Cultivation Aspects		Agronomical Features		Yield (per Acre)	
		Season, Cultivation Method	Soil Type	Crop Duration	Nursery Age	Grains (Kg)	Straw (Kg)
11.	Kullakar	Somavari, Navarai Dry sown, Wet sown Transplantation	Clayey, Sandy clay	100-110	21	1500	1500
<p>Special Features : This variety is highly suitable for preparing the idly and dosa. It is also used in the preparation of porridge. Since it is a short duration variety it can be grown in all the three seasons. Highly drought resistant. However, there should be no water logging. Highly resistant to pest and disease. The straw is preferred as a roofing material.</p>							
12.	Kappakar	Samba, Dry sown, Transplantation	Clayey	150-160	40	1350	1800
<p>Special Features : This variety is highly suitable for making idly and dosa. Gives a high yield in clayey soil. Suitable for growing in water logging areas as well as drought prone areas. Suitable for preparing Aval (flattened rice). This variety is used in the feast given during several rituals like "Seemantham" (a ritual conducted during pregnancy).</p>							
13.	Perungar	Navarai, Transplantation	Clayey	130	30-35	1350	1800
<p>Special Features : This variety is highly suitable for making idly and dosa. Also highly resistant to pest and disease. It is suitable for cultivation in areas prone to water logging.</p>							

Traditional Paddy Varieties

Sl. No.	Name	Cultivation Aspects		Agronomical Features		Yield (per Acre)	
		Season, Cultivation Method	Soil Type	Crop Duration	Nursery Age	Grains (Kg)	Straw (Kg)
14.	Sigappu Kuruvikar	Samba, Late samba, Dry sown, Transplantation	Sandy clay	120-125	25-28	1050	1050
<p>Special Features : This variety is highly suitable for making the idly and dosa. Resistant to brown plant hopper and case worm. Gives a good yield even when dry sown. Since the weight of the grain is high, it gives good yield. Highly resistant to pest and disease.</p>							
15.	Vaigunda	Samba, Late samba, Dry sown, Transplantation	Clayey Sandy clay	145-150	35-40	1350	1800
<p>Special Features : Extremely suitable for making 'Pori' (puffed rice). Also suitable for making idli. It can be grown in areas prone to water logging as well as in drought prone areas. This variety grows faster than the weeds in the field.</p>							
16.	JilJil Vaigunda	Samba, Dry sown, Transplantation	Sandy clay	125-130	35-40	1200	1800
<p>Special Features : This variety is highly drought resistant. This variety is suitable for making idli, dosa and also in the South Indian meal. This variety comes to harvest 10 days before the Vaigunda.</p>							

Traditional Paddy Varieties

Sl. No.	Name	Cultivation Aspects		Agronomical Features		Yield (per Acre)	
		Season, Cultivation Method	Soil Type	Crop Duration	Nursery Age	Grains (Kg)	Straw (Kg)
17.	Thooyamallee	Season, Dry sown, Transplantation	Clayey, Sandy clay	100-110	21	1500	1500
<p>Special Features : The rice of this variety is highly suitable for the South Indian meal. It is also used for making special dishes like 'Biryani'. During the flowering stage the earheads look like flowers. In Tamil 'Thooyamallee' literally means pure jasmine. Since the rice of this variety is white in colour like that of jasmine it is known by this name. Highly resistant to pest and disease. Since this is a fine variety it fetches a good price.</p>							
18.	GEB-24 This variety is a selection from the local variety Kitchilsamba. G.E.B. 24 denotes that the strain was evolved by the Government Economic Botanist.	Samba, Dry sown, Transplantation	Sandy clay	135	28-30	1575	900
<p>Special Features : Since this is a fine variety the rice is suitable for the South Indian meal and also for preparing a special dish 'Biryani'. It is highly resistant to drought.</p>							

Traditional Paddy Varieties

Sl. No.	Name	Cultivation Aspects		Agronomical Features		Yield (per Acre)	
		Season, Cultivation Method	Soil Type	Crop Duration	Nursery Age	Grains (Kg)	Straw (Kg)
19.	Sempalai	Samba, Dry sown, Transplantation	Clayey, Sandy clay	100-105	21-25	1125	1350
Special Features : The rice of this variety is good for the South Indian meal. It is highly suitable for making 'Pori' (puffed rice). Highly resistant to pest and disease.							
20.	Kuzhiyadichan	Samba, Dry sown, Transplantation	Clayey, Sandy clay. Also suitable for saline soil	105-110	21-25	975	900
Special Features : Kuzhiyadichan is highly suitable for making dishes such as idly and dosa. Suitable for saline soil and land which has good drainage facility. Highly drought resistant. Highly resistant to pest and disease. It is also called 'Kulikulichan'. It is ideal for lactating mothers, since it increases the milk flow.							
21.	Kallimadaian	Samba, Dry sown, Transplantation	Sandy clay	150	35-40	1200	1500
Special Features : The rice of this variety is highly suitable for making a South Indian snack called 'Munukku'. The Manapparai murukku became very popular since it was prepared by using this variety of rice. It is also suitable for the South Indian meal. Highly resistant to pest and disease.							

Traditional Paddy Varieties

Sl. No.	Name	Cultivation Aspects		Agronomical Features		Yield (per Acre)	
		Season, Cultivation Method	Soil Type	Crop Duration	Nursery Age	Grains (Kg)	Straw (Kg)
22.	Koomvalai	Samba, Dry sown, Transplantation	Sandy clay. It also grows in coastal areas	128-130	28-30	1350	1800
Special Features : This variety grows up to the height of 4.5 - 5 feet. The straw of this variety is preferred as roofing material. The rice is highly suitable for making dishes such as idly and dosa. This variety is suitable for sandy soil and also areas prone to water logging.							
23.	Kudavazhai	Late Samba, Transplantation	Clayey, Sandy clay	120-125	25-28	1400	1500
Special Features : The earheads of this variety appear like open umbrellas and hence the name 'Kudavazhai' (Kudai = Umbrella). The rice of this variety is highly suitable for making dishes such as idly and Dosa. Since it grows up to 5 feet, the stem is 2.5 cm thick the straw is used as roofing material. This variety is highly suitable for areas where there is water logging. Since this is a short duration variety it can even be cultivated thrice a year.							

Traditional Paddy Varieties

Sl. No.	Name	Cultivation Aspects		Agronomical Features		Yield (per Acre)	
		Season, Cultivation Method	Soil Type	Crop Duration	Nursery Age	Grains (Kg)	Straw (Kg)
24.	Pitchavari	Navarai, Dry sown, Transplantation	Clayey, Saline	110-115	21-25	600	900
Special Features : The rice of this variety is highly suitable for making a special dish called 'Pittu'. It is used for treatment of diarrhoea in cattle. It also increases appetite in cattle. Highly resistant to pest and disease. It is suitable for cultivation in areas prone to water logging as well as drought prone areas.							
25.	Sadakar Best season: Late samba	Samba, Late samba, Navarai, Dry sown, Transplantation	Soil with more sand content preferred	105-108	20-23	1125	1200
Special Features : It is highly suitable for cultivation in the hilly slopes. It is cultivated in the hilly slopes of Kalvarayan range in the Villupuram district of TamilNadu. It is extremely suitable for making dishes like idly and dosa. The rice is also a blend of rice and South Indian meal. Highly resistant to pest and disease.							
26.	Karuppu Nel	Samba, Dry sown, Transplantation	Clayey, Sandy clay	140	35-40	1050	1800
Special Features : It is ideal for making idly, dosa. Suitable for saline soil. It is suitable for making a speciality dish called 'Pittu' of South India.							

Traditional Paddy Varieties

Sl. No.	Name	Cultivation Aspects		Agronomical Features		Yield (per Acre)	
		Season, Cultivation Method	Soil Type	Crop Duration	Nursery Age	Grains (Kg)	Straw (Kg)
27.	Kattusamba	Samba, Navarai, Dry sown, Transplantation	Sandy clay	125	30-32	1125	1800
Special Features : It is ideal for South Indian meals. It can withstand drought conditions.							
28.	Somavari	Somavari Transplantation	Sandy clay	120-125	25-28	1125	1500
Special Features : Ideal for preparing idli, dosa. It can withstand drought conditions.							
29.	Puzhuthikkar	Samba, Direct day sowing or Transplantation	Sandy clay or Alluvial soil	150-155 (130 days if sown directly)	40	1875	2400
Special Features : It is ideal for preparing idli, dosa. It can withstand drought.							

Traditional Paddy Varieties

Sl. No.	Name	Cultivation Aspects		Agronomical Features		Yield (per Acre)	
		Season, Cultivation Method	Soil Type	Crop Duration	Nursery Age	Grains (Kg)	Straw (Kg)
30.	Puzhuthisamba	Samba, Dry sown, Transplantation	Sandy clay, or Alluvial soil	130	30-35	825	960
Special Features: Ideal for dry sowing. Drought resistant variety.							
31.	Mattanel (or) Matraikkar	Navarai, Dry sown, Transplantation	Sandy clay,	120	28-30	1050	1500
Special Features: The rice of this variety is ideal for making idli, dosas. It can withstand drought.							

Farmers' Experiences in Organic Paddy Cultivation

Kappakar for Food Security

Kappakar paddy variety is usually cultivated in clayey soil as a dry sown crop during the Samba (July – January) season. The duration of this crop is 5 months. More than 30 farmers have been conserving seeds of this variety in Thiruvanaikovil village of Thirukazhukundram block for more than 3 generations. When we interviewed the farmers as to why they conserved this variety, they reported the following :

“Every year we cultivate Kappakar variety as a dry sown crop in about 50 acres. This variety can tolerate drought. It can also withstand floods. The incidence of pest attack is quite low. Altogether, the cost of cultivation is very low. Hence we cultivate this variety every year.



The field of Mr. Varadarajan with the green Kappakar and the withered Ponni crop

During the Samba season (August – January) of 2002, our villagers had sown Kappakar as a dry crop in about 50 acres of land. Some farmers had sown a high yielding variety called “White Ponni” as a dry sown crop. Since there was no rain for 2 months subsequent to sowing, the crops withered. As soon as it rained, the Kappakar crop recovered and turned green. On the other hand, the Ponni crop did not recover. The average yield is about 16–18 bags per acre.

The rice of this variety is ideal for making idli, dosa. It also tastes good if the cooked rice is left overnight and then consumed. The hay of this paddy variety is also a good fodder for the cows”.

Source :

Mr. S. Varadharajan, Mr. Sankar, Mr. Krishnan, Mr. Manickam, Thiruvanaikovil, Ozhalur (P.O.), Thirukazhukundram block, Kancheepuram district.

Note : We had personally visited the fields of these farmers. It was quite surprising to note that Kappakar paddy variety remained green even in extreme drought conditions.

Source : Indigenous Agriculture News, Nov. 2002 – Jan. 2003. Vol.1, No. 5 & 6. pp. 1.

Paddy Cultivation in Water Logged Areas



Mr. Palanivel

Mr. Palanivel is a farmer who hails from the Arasankudi village (Tiruvarumbur taluk) of Trichy district. A part of his land is very close to the irrigation canal and there is water seepage in this land continuously. The soil type is a mixture of alluvium and clay. In the rainy season the land looks almost like a pond due to water logging. Mr. Palanivel approached CIKS and got the seeds of Sambamosanam that withstands water logging. Except for 12 - 15 days throughout the duration of the crop there was water logging. In spite of this in 70 cents of land he obtained an yield of 2280 kg. of paddy. His total income from paddy and fodder was Rs.13,170/- and his expenditure was Rs.3,050/-. His net income was Rs.10,660/- from 70 cents of land.

Contact address:

Mr. A. Palanivel, Arasangudi village, Tiruvarambur, Trichy.

Source : Indigenous Agriculture News, March 2003, Vol. 2, No.1 pp. 2

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LIST OF COMMON NAMES AND SCIENTIFIC NAMES

Plants

Asafoetida	<i>Ferula asafoetida</i>
Castor	<i>Ricinus communis</i>
Chilli	<i>Capsicum annum</i>
Cow pea	<i>Vigna catjung</i>
Dainchaa	<i>Sesbania cannabina</i>
Garlic	<i>Allium sativum</i>
Gigantic swallow wort	<i>Calotropis gigantia</i>
Ginger	<i>Zingiber officinalis</i>
Indian Beech	<i>Pongamia pinnata</i>
Indian Indigo	<i>Indigofera tinctoria</i>
Neem	<i>Azadirachta indica</i>
Papaya	<i>Carica papaya</i>
Persian lilac	<i>Melia azederach</i>
Sannampu	<i>Cycas circinalis</i>
Screwpine tree	<i>Pandanus odoratissimus</i>
Siris tree	<i>Albizzia lebbek</i>
Spotted Glyricidia	<i>Glyricidia sepium</i>
Sunhemp	<i>Crotalaria juncea</i>
Tanner's Cassia	<i>Cassia auriculata</i>
Tobacco	<i>Nicotiana tabacum</i>
Turmeric	<i>Curcuma longa</i>
White Gulmohar	<i>Delonix elata</i>
Wild Indigo	<i>Tephrosia purpurea</i>

Pests

Army worm	<i>Spodoptera litura</i>
Black bug	<i>Scotinophora spp</i>
Brown plant hopper	<i>Nilaparvata lugens</i>
Case worm	<i>Nymphula depunctalis</i>
Gall midge	<i>Orseolia oryzae</i>
Green hairy caterpillar	<i>Rivula atimeta</i>
Green leaf hopper	<i>Nephotettix virescens</i>
Horned caterpillar	<i>Melanitis leda ismene</i>
Leaf folder	<i>Cnaphalocrocis medinalis</i>
Mealy bug	<i>Heterococcus rehi</i>
Rice earhead bug	<i>Leptocorisa acuta</i>
Rice stem borer	<i>Scirpophaga incertulus</i>
Short horned Grasshopper	<i>Hieroglyphus banian</i>
Skipper	<i>Pelopidas mathias</i>
Yellow hairy caterpillar	<i>Psalis pennatula</i>

Storage Pests

Angoumois grain moth	<i>Sitotroga cereallela</i>
Lesser grain borer	<i>Rhizopertha dominica</i>
Rice moth	<i>Corcyra cephalonica</i>
Rice weevil	<i>Sitophilus oryzae</i>

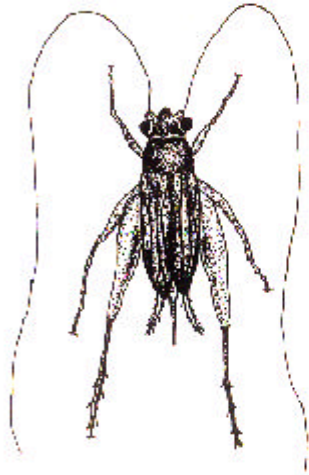
Parasites

Ant	<i>Solenopsis geminata</i>
Assassin bug	<i>Polytoxus fuscovittatus</i>
Cricket	<i>Metioche vittaticollis</i>
Damsel fly	<i>Agriocnemis pygmaea</i>

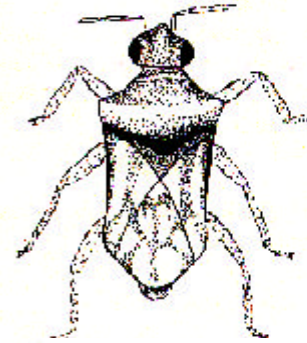
Dwarf spider	<i>Atypena sp.</i>
Earwig	<i>Euborellia stali</i>
Ground beetle	<i>Ophionea nigrofasciata</i>
Jumping spider	<i>Phidippus sp.</i>
Lady bird beetle	<i>Coccinella septempunctata</i>
Long horned grasshopper	<i>Conocephalus longipennis</i>
Long jawed spider	<i>Tetragnatha sp</i>
Lynx spider	<i>Oxyopes sp.</i>
Mirid bug	<i>Cyrtorhinus lividipennis</i>
Orb spider	<i>Argiope sp</i>
Small ripplebug	<i>Microvelia douglasi atrolineata</i>
Water strider	<i>Limnogonus spp</i>
Water treader	<i>Mesovelia vittigera</i>

Diseases

Bacterial leaf blight	<i>Xanthomonas campestris</i> pv. oryzae
Rice blast	<i>Pyricularia oryzae</i>
Rice brown leaf spot	<i>Helminthosporium oryzae</i>
Sheath blight	<i>Rhizoctonia solani</i>
Stem rot	<i>Leptosphaeria salvinii</i>



Crickets

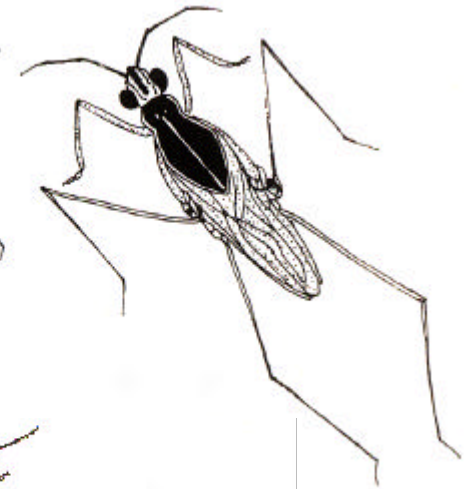


Small ripple bug

Earwig



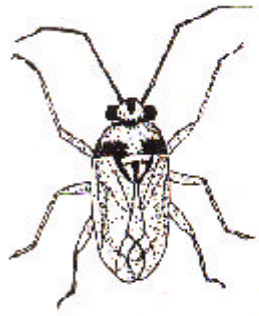
Water strider



Water treader

Ant





Mirid bug



Assasin bug





Rice Weevil



Lesser grain borer



Angoumois grain moth