APPENDICES

APPENDIX I

The villages selected for the study

Anamalai

1. Angalakurichi
2. Kaliapuram
3. Periapodu
4. Anamalai
5. Thenchittur

Pollachi

6. Samathur
7. Kolarpatti
8. Koolanaickenpati
9. Sinjuvadi
10. Makkinampatti

APPENDIX II

Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore – 641 043

Interview schedule to elicit information on storage practice of pulses in the selected households

A. I. General details

1. Name of the village :
2. Name of the homemaker :
3. Address :
4. Religion :

II. Socio-economic profile

1. Age of the respondent (years)

a. Below 30 ☐ b. 30 – 40 ☐
c. 40 – 50 ☐ d. 50 and above ☐

2. Marital status

a. Married ☐ b. Unmarried ☐
c. Widow ☐

3 Type of family

a. Joint family ☐ b. Nuclear ☐

4 Size of family

a. Small (1-4) ☐ b. Medium (4-6) ☐
c. Large (6 to above) ☐

5. Stages in the family life cycle

a. Beginning ☐ b. Expanding ☐
c. Contracting ☐

6 Monthly income of the family (HUDCO, 2006)

a. Low (`. 2,500- 4,500) ☐ b. Middle (`. 4,501- 7,500) ☐
c. High (Above `.7,501) ☐

7 Type of house

a. Own house ☐ b. Rent house ☐

8. Educational status

Illiterate	☐	Primary	☐
Higher Secondary	☐	Graduate	☐
Post graduate	☐	Diploma	☐

9. Occupational status

Agriculture	☐	Business	☐
Entrepreneur	☐	Government employee	☐
Private employee	☐	Any other	☐

B. Information on purchase and storage practices of pulses in the selected Households

1. Frequency of purchasing provision

Daily	☐	Weekly	☐
Monthly	☐	Once in 3 months	☐
Once in 6 months	☐		

2. Quantity of pulses stored for six months

S.No	Pulses	Quantum of pulses stored for six months
1	Red gram	
2	Green gram	
3	Cowpea	
4	Black gram	
5	Back channa	
6	Peas	
7	Horse gram	

4. Duration of storage

S.No	Types of pulses	Duration of storage			
		1 month	2 months	3 months	6 months
1.	Black gram				
2.	Green gram				
3.	Cowpea				
4.	Pea				
5.	Black Channa				
6.	Horse gram				

5. Storage devices / containers used for storage

S.No	Method used	Responses
1.	Plastic container	
2.	Air tight stainless steel	
3.	Glass bottles	
4.	Gunny bags	
5.	Polythene bags	
6.	Polythene covers	

6. Problems identified during storage of pulses

S.No	Problems faced	Responses
1.	Presence of holes/white spot	
2.	Insect and pest infestation	
3.	Presence of powdery substances	
4.	Fungal and mold attack	
5.	Increased moisture content	
6.	Clustering of pulses	
7.	Presence of worms	
8.	Discolouration	
9.	Decay	
10.	Bad odour	

7. Percentage of loss of pulses during storage

S.No	Name of the Pulses	Percentage of loss				
		6-8%	8-10 %	10-12%	12-14%	14-16%
1.	Black gram					
2.	Black channa					
3.	Cowpea					
4.	Green gram					
5.	Peas					

8. Methods adopted to overcome problems faced during storage of pulses

S.No	Methods Adopted	Please tick
1	**Chemical Method**	
2	**Organic Methods**	
	Use of botanicals	
	Use of sand, ash	
	Use of chilli	
	Splitting and frying	
	Use of salt	
3	**Physical Methods**	
	sun drying	
	winnowing	
	cleaning	
	spraying	
4	**Any Other**	

9. Among the following, indicate which pulses more prone to rapid spoilage and damage by insects and pests
    - Red gram
    - Green gram
    - Cowpea
    - Bengal gram
    - Black gram
    - Peas
    - Black Channa

10. What do you do with the infected pulses

- Remove pest and will be used for cooking
- Discarded
- As cattle feed/animal feed
- Made into flour

10. Are you aware of botanicals used during pulse storage?

Yes ☐ No ☐

a. If yes, what are they ?

I. Neem leaf, II. Tulashi III. Pongamiya IV Turmeric V. Nochi VI .Red Soil VII. Chilli

b. Sources of information gained ?

- Elders practice
- Training
- Radio
- Television
- Newspaper
- Others

c. Do you put them in practice ?

Yes ☐ No ☐

I. If Yes, in what way you have been practicing it ?

11. Have you undergone any training programme in storage practices of pulses?

Yes ☐ No ☐

12. Are you willing to attend training programme practices of safe storage of pulses

Yes ☐ No ☐

13. List the traditional storage practices that you know

14. Opinion of the homemakers regarding the use of botanicals during storage of pulses

15. Suggestion of the homemakers regarding the use of botanicals during storage of pulses

APPENDIX III

Market survey to elicit information on pulse consumption pattern of consumers in Anamalai and Pollachi block

I. GENERAL DETAILS

1. Name of the Interviewer :
2. Name of the Interviewee :
3. Name and Address of the Shop :
4. Year of establishment :

II. SOCIO-ECONOMIC PROFILE

1. Age of the respondent (years)

e. Below 30 ☐ f. 30 – 40 ☐
g. 40 – 50 ☐ h. 50 and above ☐

2. Marital status

d. Married ☐ e. Unmarried ☐
f. Widow ☐

3. Type of family

c. Joint family ☐ d. Nuclear ☐

4. Size of family

d. Small (1-4) ☐ e. Medium (4-6) ☐
f. Large (6 to above) ☐

5. Stages in the family life cycle

d. Beginning ☐ e. Expanding ☐
f. Contracting ☐

6. Monthly Income of the family (HUDCO, 2004)

d. Low (` 2,100 - 4,500) ☐ e. Middle (` 4,501- 7,500) ☐
f. High (Above ` 7,501) ☐

7. Educational status

Illiterate ☐ Primary ☐
Higher Secondary ☐ Graduate ☐
Post graduate ☐ Diploma ☐

III. SPECIFIC DETAILS

1. Frequency of procuring pulses

a. Weekly
b. Fortnightly
c. Monthly
d. Bimonthly

2. Quantum of pulses procured and sold per month

S.No	Name of the pulse	Quantity Procured (in Kgs)	Quantity Sold (in Kgs)
1	Black gram		
2	Red gram dhal		
3	Green gram		
4	Green gram dhal		
5	Black gram dhal		
6	Cow Pea		
7	Black channa		
8	Peas		
9	Horse gram		
10	White channa		
11	Rajma		
12	Soya bean		

3. List the pulses purchased by the consumers more often

4. Specify the problems faced in storing pulses

5. Percentage of loss during storage of pulses in the selected shops

S.No	Name of the Pulses	Percentage of loss				
		6-8%	8-10 %	10-12%	12-14%	14-16%
1.	Black gram					
2.	Black channa					
3.	Cow pea					
4.	Green gram					
5.	Peas					

6. What do you do with the spoiled and infested pulses

7. Any Other opinion would you like say about storage of pulses

APPENDIX IV

Booklets and Pamphlet distributed during training programme

Booklets

- Protection of stored pulses
- இயற்கை வழி வேளாண்மையும், பயிர மற்றும் தானிய சேமிப்பும் (organic agriculture and food grain storage practices) - Tamil Language.
- Neem - “soft” natural pesticides

Pamphlet

- Safe storage practices of pulses using selected botanicals

Protection of Stored Pulses

Candidate

D.Gayathri, Ph.D Research Scholar

Guide

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List of Contents

A. Introduction

Ever since the advent of stabilized Agriculture, storage of produce has remained an issue of utmost concern. Unless the problem of storage is solved satisfactorily the problem of hungry millions may continue even with substantial increase in production. There are a number of estimates of post harvest losses. Most conservative estimates for the post harvest losses in pulses in India even put at about 10%, a quantity good enough to feed at least 60 million people. Out of the total production, about 70% is retained and stored by farmers for consumption, as seed, feed and payment of wages and only about 30% is marketable surplus. Insects are responsible for enormous spoilage in storage they feed on pulses, bore the kernel, and destroy the germ portion, cause heating and deterioration in stored produce.

The storage of pulses has been an age long practice with cultivators and traders. More pest-free storage is needed for handling crops at harvest time and to carry over reserves from year to year. Considerable losses both in quality and quantity of pulses take place in storage due to a number of factors. Organisms directly responsible for causing loss in stored products are insects, mites, rodents, fungi and bacteria. The

basic objective of good storage is to create the suitable environmental conditions which provide sufficient protection to the stored pulses to maintain its quality and its quantity, thus reducing the financial loss.

B. Principles of Storage

Most developing countries are in the tropics, often in areas of high rainfall and humidity. These conditions are ideal for the development of micro-organisms and insects which cause high levels of deterioration of crops in store. Losses during storage are the result of biological, chemical or physical damage.

In order to reduce the amount of pulses lost, the environment in the store needs to be controlled so as to lower the possibility of:

- biological damage by insects, rodents and micro-orgamsms.

-chemical damage through rancidity development and flavour changes, etc.

-physical damage through crushing, breaking, etc.

Good storage thus involves controlling the factors, like temperature, moisture, light, pests and hygiene.

1. Temperature

The temperature within a store is affected by the sun, the cooling effect of radiation from the store, outside air temperature, heat generated by the respiration of both the pulses in store and any insect pest present.

Most of the micro-organisms thrive between 10 and 60°C temperature where as insects between 16 and 45° centigrade. Normally, in tropics and sub-tropics storage temperature lies between 25 and 35°C which is favourable for the survival of the micro-organisms and insects. Direct temperature control is not usually possible, so other measures, particularly reducing the moisture content of the stored produce, are necessary.

Improper maintenance of storage temperature can result in biological and chemical damage to the pulses being stored. Examples include the loss of germination ability in seed materials and the accumulation of sugars in some commodities which need relatively low storage temperatures.

Temperature also controls chemical damage. The speed of chemical change in pulses depends upon the temperature and the pulse's moisture content. A 10°C rise in temperature causes an approximately two-fold increase in the rate of reaction. Thus, cold storage will retard such changes as fat oxidation and vitamin loss. Many dried pulses benefit from even a small reduction in their storage temperature, and cool and dry conditions can greatly reduce the rate of development of brown discolouration and off-flavours.

2. Moisture

All micro-organisms, including moulds, require moisture to survive and multiply. If the moisture content in a product that is to be stored is low, micro-organisms will be unable to grow, provided that the moisture inside the storage structure is also kept low.

All materials that have been dried will try to come back into equilibrium with the climate around them. In tropical countries this usually means absorbing moisture. The moisture level below which micro-organisms cannot grow is referred to as the safe moisture content.

While in general it is essential that all pulses are below their safe moisture content before they enter the store, the safe moisture content is to some extent related to the required storage time. Moisture levels above the safe moisture context can be tolerated if only short storage times are required.

Condensation of moisture can cause storage problems. If the walls of a store are cooled below their dew point by low night temperature, condensation can occur and increase the moisture content in the layers of the produce. The ventilation of the store is important. It is also important to note here that most stored food products are "alive" and respiring, thus giving off moisture, as well as heat.

C. Storage pests

The three major storage pests are fungi, insects and rodents.

1. Fungi

Fungus in stored pulses is the most difficult enemy to be recognized. Fungi are plant-like organisms, and spores are the single-celled bodies by means of which they

reproduce themselves. To stay alive they feed on stored products either in raw or processed form. Due to the breakdown of the product tissue, foodstuffs acquire a bad taste and become less nutritious. The germination power of seeds will then deteriorate. Some fungi produce a sort of poison. In an early stage of infection characteristics such as discolouration, change in texture, the presence of green, blue, grey, white or black fruiting bodies of the fungus or an unpleasant smell are not always very obvious.

Humidity

Fungi develop best in a warm and humid atmosphere. Humidity in particular, is crucial for the development of fungi. Even at a low temperature some mould development may occur if the relative humidity of the air is high, which means that there is a lot of water vapour in the air. A dry atmosphere prevents the germination of fungal spores and thus the development of fungi. However a dry atmosphere will not kill the spores, as they are highly resistant to dry conditions. They can remain viable for quite a long time.

Drying is the best remedy

Drying of the storage product is the best remedy against fungi. Chemicals are not necessary as long as storage product is dried properly and neither water nor humid air can enter the store and make the grain damp.

2. Insects

Insects need food, air and water to live. In many cases stored pulses provides a perfect place for insects to live and grow because food, air and water are available in sufficient quantities. This is why some insect species infest stored products.

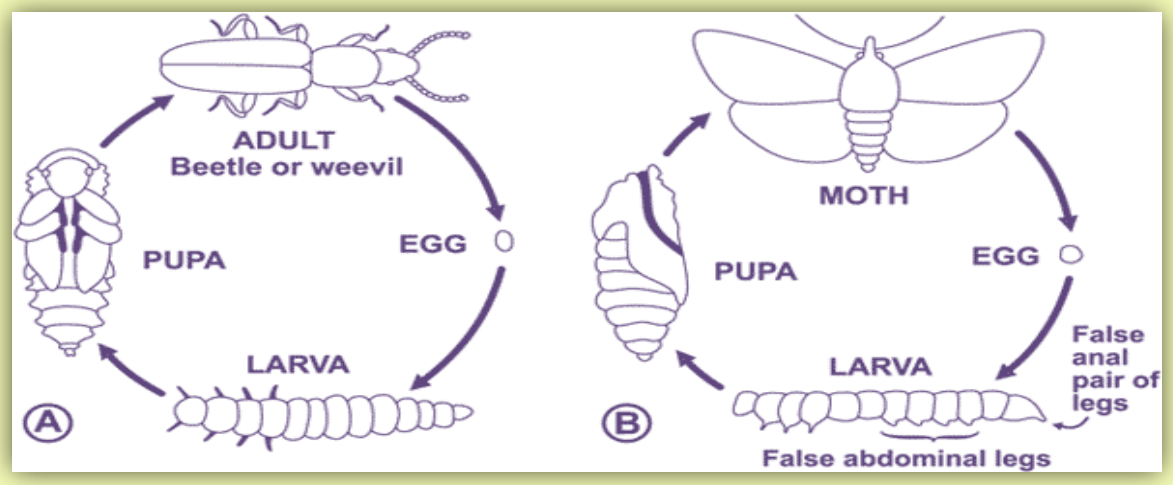
The two major insect pests in stored pulses are beetles and moths. The larvae of both groups of insects are totally unlike the adult forms. They look a little like worms.

Primary, Secondary and Tertiary Pests

Some insects prefer certain kinds of pulses and not all insects eat the same part of the grain kernel.

Storage insects can be divided into three different groups:

i. Some insect species such as the Angoumois grain moth, the Lesser grain borer and the Rice weevil are primary pests. These insects can break down the hard seed coat of the undamaged grain. Some of these species lay their eggs inside the kernel and the growing larvae eat the inside of the kernel. Other species lay their eggs on the outside of the kernel. The hatched larvae eat their own way through the hard seed coat towards the very nutritious inside.



Two examples of a life cycle

ii. Insect species of the so-called secondary pests are not able to break through the hard undamaged seed coat. They follow the first attackers. These secondary pests feed on the grain which has broken and cracked seed coats. Secondary pests, like the Rusty grain beetle, will not attack healthy, undamaged pulses. They will only attack spoiled pulses.

iii. A third group of storage pests feed on broken grains, grain dust, and powder left by the previous groups. Insects belonging to this group are the tertiary pests.

The primary pests are the most dangerous ones. They damage the intact kernel so that the larvae can develop inside the kernel. In this way they also provide secondary and tertiary pests with the opportunity to infest the store, as the damaged

Put only undamaged grains into the store

It is very important to introduce only undamaged kernels and pulses into the store. In kernels with a little puncture there may be larvae of primary pests. Bringing these kernels into the store is the same as introducing an adult primary pest.

kernels become a food source for them.

3. Rodents

Rodents cause considerable damage to field crops and stored products.

There are four ways in which rodents do damage to stored products:

- They consume a quantity of the product.
- They spoil part of the product with their droppings.
- They gnaw holes in the packing material causing waste. Jute bags can be seriously damaged in this way. Products stored in bulk are less vulnerable because rats can only nibble away the surface.
- Rodents are also carriers of diseases which are harmful to man. People can get these diseases from eating and handling pulses contaminated by rodent faeces, urine or parasites which they carry.
- Unlike the insects and fungi which infest the storage, rodents will plunder stores whatever the temperature or moisture content of the pulses or air

D. Inspection and identification

1. Inspection

Inspection of the stored pulses should be carried out frequently so that one can discover an infestation in an early phase and be able to take measures in time. One should check the pulses and store regularly by looking for insects, fungus infestation and rodents.

Insects: If the pulses are stored in sacks, hit a sack against the floor. Then let it rest in a shaded place (no direct sunlight). After a while check to see if there are any weevils on the outside of the sack. Also inspect some pulses from inside the sack or container. Dump part of the pulses out of the sack or take some out from the middle of the storage container. Check the pulses sample for the presence of insects or signs of insects either by putting the pulses through a sieve or sorting through it by hand.

Fungus: Smell inside the sack or container. If the stored product is infested by fungus, there is a mouldy smell. Also inspect some rains from the inside of the sack or container by sorting it by hand, look for mouldy grains. If there is an infestation, put the stored product out in the sun to dry. Do this regularly.

2. Identification of pests

Identifying the main pests in storage is important in order to be able to:

- assess whether the insects found are likely to cause serious damage (e.g. primary pests);
- decide which control measures should be taken since many treatments are selective in their action and many pests have their specific strong and weak characteristics.

Unfortunately the majority of storage pests are so small that it is very difficult for nonspecialists to identify them.

E. Preventive measures against storage pests

Preventive measures against insects and storage pests start already at the time of growing the crops that will be stored later. In general it can be said that a farmer can influence the occurrence of pests in the stored crops by carefully choosing certain resistant varieties, planting or sowing and harvesting in the optimum season, properly treating the crop before storing and keeping it very clean.

1. Measures in the field

a. Choice of varieties

When choosing the pulses for storage, a farmer / shop keepers can already take into account the susceptibility of the crop to storage pests. Through experience the farmer / shop keepers can learn to select varieties which are pest resistant. For example, a hard seed coating or tightly closed husks act as a barrier to larvae which die before they are able to bore their way through to the inside of the kernel.

b. Time of harvesting

Crops should be harvested as quickly as possible to avoid infestation of the pulses in the field. A problem with high yielding and early ripening varieties is that the harvest period will be in the wet period. This causes new storage problems.

2. Measures in and around the store

a. Site selection

Selection of a good place for pulses storage is very important.

- Pulses stores must be built on well-drained ground so that the building or container does not get flooded by ground water run-off during heavy rains or take on too much moisture from the ground.

- The storage should be placed as far away as possible from pulses standing in the fields. This helps to protect the pulses against insects flying from the field to the storage area.
- The storage should not be built near places where animals are kept. Certain insects found near animals and their food also attack stored pulses.

b. Product selection

The risk of losses is reduced if only clean and healthy pulses are retained for long-term storage. This means that farmers / shop keepers have to carefully select the pulses to be stored. Even if the pulses looks clean, insects are almost always there to some degree and mould spores are present every-where. Broken pulses, pieces of straw and dirt increase the chance of storage trouble by insects or mould.

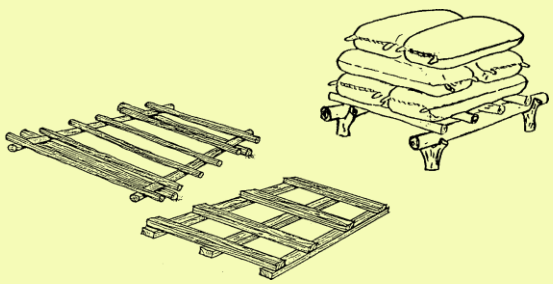
c. Unthreshed products

If undamaged during harvesting and drying, husks or pods offer some protection against insect attack. Traditional maize varieties often have husks that cover the whole cob. In pro-longed storage it is important to select cobs with undamaged husks that cover the whole cob. Unfortunately the husks of improved varieties offer less protection.

Another storage condition is that the moisture content of the kernels inside the unhusked cob should not be too high when put into the storage commodity. If the unhusked cobs are too moist they will soon get mouldy: the husks provide favourable conditions for mould growth. Dry them as well as possible before storing.

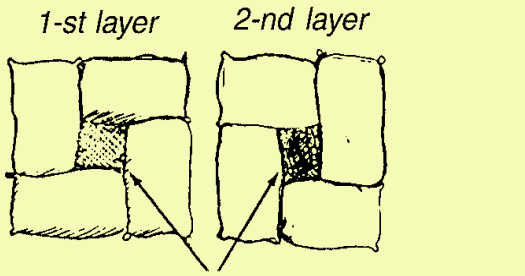
d. Dry and cool storage

Prevent the absorption of water when the product is stacked. The product can be placed on plastic or on a layer of tar paper. When the product is stored in bags these should preferably be stored on pallets. Pallets can be made of wooden laths or poles

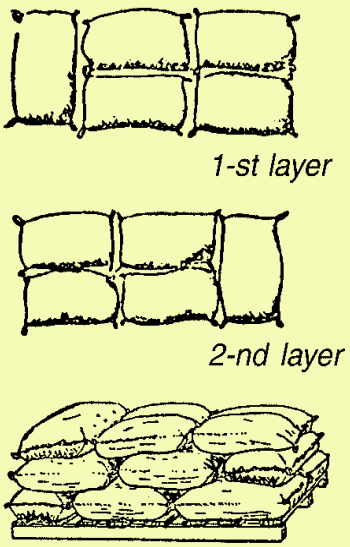


Pallets

The bags should always be neatly stacked, in such a way that air can pass through the sacks to dry and cool the pulses. A few examples of patterns to stack bags are shown here.



Open space in centre for air circulation



Odd Layers	Even layers	Bags per layer
		3 per layer
		5 per layer
		8 per layer

Stacking patterns for bags on pallets

Bag storage is largely practiced in the trade godowns, mainly because of the ease in handling and transport. Bagged pulses should be stacked on racks, at least 30 cm from the walls of the warehouse and far enough apart to allow inspection and cleaning. Infested bags, if any, can be easily segregated and treated. Bags made of paper, paper laminated to cloth or back- filled fabrics, and cartons of fibre board offer more resistance to insect penetration than ordinary cotton or jute bags.

F. Good storage practice

If pulses are to remain in good condition from harvest to the time that it is to be consumed or sold, the farmer must follow the four pillars of good storage practice. This means:

- ensuring that the crop going into store is in good condition;
- keeping the store in good condition;
- practicing good store hygiene; and
- maintaining the condition of crop and store throughout the storage season.

G. Keeping the store in good condition

- A good store will keep the pulses dry and cool. It should provide protection against rodents, birds and browsing domestic animals and poultry. It should be theft proof.
- Stores should be sited in areas that are not prone to flooding; the soil should allow water to drain away readily. They should not be placed where high winds might damage the structure or near trees, which might provide access points from which rodents can jump onto the store roof or platform.
- The store should have a roof to keep rain off the structure and to provide shade during the heat of the day. Without shade, the changes in temperature inside the store between day and night may be so great that as the store cools at night condensation occurs and wets the pulses, which in turn may lead to the development of moulds. This is particularly important for metal pulses bins.
- To prevent groundwater soaking into the store, the structure must be raised off the ground. Mud silos and bins need only be supported on rocks or stones to

create a small air gap. Unplastered structures should be raised at least 1 m above the ground to prevent rodent entry; they should be fitted with rat guards.

- Most types of stores, apart from sealed mud silos, polyethylene and metal tanks, do not provide protection against insect entry; therefore they must be treated with insecticide.
- The store must be kept in good repair to stop the roof leaking or the sides collapsing. A door should be fitted in the wall of the structure for access to the pulses. A door eliminates the need to keep removing the store roof to gain access.
- At the beginning of the new storage season the empty store must be cleaned. Residues of old pulses and other rubbish must be removed and burnt. The roof and walls must be inspected and repaired where necessary; a thatched roof may need only some small repairs but most will need to be replaced every year.

H. Practicing good store hygiene

To prevent damage to stored products it is essential that thorough hygienic practices are used. Stores, silos, cribs etc. and their immediate surroundings must be kept as clean as possible.

- Before use, every storage facility should first be checked for leaks, splits, cracks, etc. and be repaired if necessary. The floor surface should be easy to sweep. Cleaning is simplified if the corners are filled up with cement and rounded off.
- If possible, the walls of the store should be white-washed first. This paint helps to close up very small holes. Insects like to hide in these small holes.
- The floors should be swept at least once a week. Waste (sweepings, infected produce) must be immediately destroyed. They should never be left in rubbish bins for the time being.
- A new harvest / purchased pulses should never be stored with the remainders of a previous harvest/ old purchase. Clean the containers or store before bringing in the pulses. Never store products in used bags without washing and, if necessary repairing them. Bags or sacks should be boiled in hot water and dried in the sun. Bags with holes should be mended.

- The store surroundings should be tidied so that there is no vegetation or rubbish to hinder inspection or to provide breeding grounds for insects and rodents. Clearing the ground around the store will make it easy to spot termite trails.
- Livestock should be kept away from the store; they should not be allowed to browse or sleep under the store; droppings should be cleared up as they attract rodents.
- Pulses residues should be removed from sacks by turning them inside out and thoroughly brushing them. Holes should be stitched.
- Grass should be burnt inside solid walled bins and mud plastered baskets to kill off insects and mould spores. It is good practice to sprinkle the inside walls and floor of the structure with insecticide to kill any remaining insect pests.
- If the pulses are going mouldy it will have a bad smell. The pulses should be spread in the sun to dry and then stored in clean dry bags.
- The store should be quickly repaired if it becomes damaged. If repairs are delayed a lot of pulses may be lost to rats, mice and birds.
- Good storage practice is the key to maintaining pulses quality. Observing the four pillars described above will help farmers maintain the quality and value of their pulses throughout the storage season.

It is important to keep the storage room and the surrounding area as clean as possible, especially when using a non-airtight storage method. Put a clean product into a container, only after all old products, dust, straw and insects have been removed, and all cracks and holes have been filled and sealed. One should distinguish between insects that are already present in the product to be stored and insects that may enter the storage room during storage.

"Like rain water harvesting, safe storage of food grains should become a movement in revolution"

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இயற்கை வழி வேளாண்மையும், பயிர் மற்றும் தானிய சேமிப்பும்

து. காயத்ரி
முனைவர் பட்ட ஆய்வாளர்

முனைவர் திருமதி க. மணிமொழி
இணைப்பேராசிரியர் வளநிர்வாகத் துறை
அவினாசிலிங்கம் பல்கலைக்கழகம்
கோயமுத்தூர் - 641 043.

முன்னுரை

இயற்கைவழி வேளாண்மையை நம்மால் எவ்வளவு தூரம் கையாள முடியும் என்பது இப்போது பரவலாய் எழுப்பப்படும் ஒரு கேள்வி. சில காரணங்களுக்காக சில சந்தர்ப்பங்களில் நாம் சூழ்நிலைக்கு ஏற்ப பண்டைய பழங்கால வேளாண்மை முறைகளை மாற்றிக் கொள்ள வேண்டியுள்ளது. உதாரணமாக பெருகிவரும் மக்கள் தொகைக்கு உணவு அளிக்க புதிய வழி முறைகளை கடைப்பிடித்தே ஆகவேண்டும் என்ற சூழ்நிலைக்கு தள்ளப்பட்டு விட்டோம். அவற்றுள் ஒன்று தான் செயற்கை வழி வேளாண்மை. முற்றிலும் இரசாயன முறையில் செய்யப்படும் விவசாயத்தை செயற்கை வழி வேளாண்மை என்பார்கள். இப்படி வேதிப் பொருள் இரசாயனத்தைக் கொண்டு உற்பத்தி செய்யப்பட்ட தானியங்களில் அதிக அளவு நச்சுத் தன்மையுள்ள இரசாயனம் உள்ளது. அவற்றை உட்கொள்ளும்போது நிறைய உடல் உபாதைகள் உண்டாகின்றன. அவற்றை தவிர்க்க நாம் இயற்கை வழி வேளாண்மை மூலம் வரும் உணவு பொருளை உடகொள்வது அவசியம்.

பொதுவாக தானிய மற்றும் பயிர் வகைகளை பூச்சி மற்றும் நோய் தாக்க கூடும். பூச்சி தாக்குதலால் விளைவித்த தானியங்கள் சேதமாகி மனிதனின் உணவுத் தேவைக்கு பயன்படாமல் வீணாகிறது. அதேபோல நோய்களின் தாக்குதலால் அவற்றில் நச்சு பொருள் உண்டாகி அதன் தரம் குறைந்து மனிதன் உண்பதற்கு தரமற்று போய் விடுகின்றது. இவற்றை தடுக்க இயற்கை முறை வேளாண்மையை கடைபிடித்தல் நன்மை உண்டாக்கும்.

விவசாயிகள் பொதுவாக பூச்சி நோய்களை கட்டுப்படுத்த பூச்சிக் கொல்லி மருந்துகளையே அதிகம் பயப்படுத்துகின்றனர். பூச்சிக்கொல்லி மருந்துகள் அதிகம் பயன்படுத்துவதால் வயலில் உள்ள நன்மை செய்யும் பூச்சிகளும் சேர்த்து அழிக்கப்படுகிறது. மேலும் சுற்றுப்புறச் சூழலும் மாசுப்படுத்தப்படுகிறது. இதனை தவிர்க்க விவசாயிகள் தாவர பூச்சிக்கொல்லி மருந்துகளை பயன்படுத்தி பூச்சி, நோய்களைக் கட்டுப்படுத்தலாம்.

வேம்பு மிகப் பிரபலமான தாவர பூச்சிக் கொல்லியாக திகழ்கின்றது. தோராயமாக வேம்பு 200 வகையான பூச்சிகள், வண்டுகள் மற்றும் புழுக்களைக் கட்டுப்படுத்த உதவுகின்றது. வெட்டுக்கிளிகள், இலையினை உண்ணும் பூச்சிகள் அசுவினி, பச்சை தத்துப்பூச்சி, புழுக்கள் மற்றும் அந்துப்பூச்சி போன்றவற்றையும் கட்டுப்படுத்த வேம்பு உதவுகின்றது. வேம்பின் பாகங்களிலிருந்து எடுக்கப்படும் சாறு, வேம்பு எண்ணெய் கரைசல், வேப்பம்பிண்ணாக்கு கரைசல் போன்ற வேம்புப் பொருள்கள் பயிர்பாதுகாப்பிற்கு உறுதுணையாக செயல்படுகின்றன. பயிர்களை தாக்கும் அனைத்து விதமான தீமை செய்யும் பூச்சிகளையும், வேம்பு பொருள்களை பயன்படுத்தி

கட்டுப்படுத்துவதுடன் நெற்பயிரை தாக்கும் குலை நோய், கதிர் உறை அழுகல் நோய், கதிர் உறை கருகல் நோய், நிலக்கடலையை தாக்கும் துருநோய், பயிறு வகைகளைத் தாக்கும் சாம்பல் நோய், வேரழுகல், மொசைக் வைரஸ் மற்றும் தென்னையை தாக்கும் வாடல் நோய் நோய்களையும் கட்டுப்படுத்தலாம்.

வேம்பின் அனைத்து பாகங்களும் விவசாயிகளுக்குப் பயன்படுகிறது. தழையை உரமாகவும், மாடுகளுக்கு தீவனமாகவும், பூச்சிக்கொல்லியாகவும், வேப்பம்புண்ணாக்கை உரமாகவும் மற்றும் யூரியா போன்ற ரசாயன உரத்துடன் இட்டு இரசாயன உரத்தின் பயனை அதிகரிக்க செய்யவும், வேப்ப எண்ணையை தனியாகவும், இதர பூச்சி நாசினியாகவும் பயன்படுத்தலாம்.

வேப்பிலை

வேப்பிலையில் தழைச்சத்து 2.5%, மணிச்சத்து 0.6%, சாம்பல் சத்து 2.0%, அளவில் உள்ளது. வேப்ப இலைகள் இட்ட நிலத்தில் கரையான் பாதிப்பு இருக்காது மற்றும் நூற்புழுவின் தாக்குதல் வெகுவாகக் குறைந்து விடும். மேலும் வேப்ப இலைகளை பயன்படுத்துவதன் மூலம் அதிலுள்ள வேதிப்பொருள்கள் நேராக பயிர்களுக்கு வேர்களின் மூலம் ஊடுருவிப் பரவி நீண்ட நாள்களுக்கு பாதுகாப்பு அளிக்கின்றது.

வேப்பங்கொட்டை கரைசல்

பத்து கிலோ வேப்பங்கொட்டையை நன்கு தூளாக்கி 20 லிட்டர் நீரில் கரைத்து ஒரு நாள் வைத்திருந்து வடிகட்டி 200 லிட்டர் நீர்சேர்த்து ஒட்டும் திரவம் 200 மில்லி (அல்லது) 100 கிராம் சோப்பு சேர்த்து கைத்தெளிப்பான் கொண்டு தெளிப்பதன் மூலம் பயிர்களில் உருவாகும் புழுக்களையும், நோய்களையும் கட்டுப்படுத்தலாம்.

வேப்பம் புண்ணாக்கு

வேப்பம் புண்ணாக்கில் தழைச்சத்து 5.2%, மணிச்சத்து 1.1%, சாம்பல் சத்து 1.5% உள்ளன. வேப்பம் புண்ணாக்கு யூரியாவுடன் 1.5 என்ற விகிதத்தில் (அதாவது 1 பங்கு வேப்பம் புண்ணாக்கு, 5 பங்கு யூரியா) கலந்துவிட்டால் யூரியாவின் சத்து பயிர்களுக்கு நீண்ட நாட்கள் கிடைக்க வாய்ப்பு உள்ளது. மேலும் தழைச்சத்து வீணாவதும் குறைகின்றது.

நொச்சி, வேம்பு, தழை கரைசல்

நொச்சித்தழை 5 கிலோ மற்றும் வேம்பு இலை 5 கிலோ ஆகியவற்றை ஒரு பானை நீரில் போட்டு கொதிக்க வைத்து அதனைக் கூழாக்கி ஓர் இரவு வைத்திருந்த பின்னர் வடிகட்டி அதனை 100 லிட்டர் நீரில் கலந்து ஒரு ஏக்கர் நிலத்திற்கு

பயன்படுத்தலாம். இது இலை சுருட்டுப்புழு, குருத்துப்புழு மற்றும் கதிர்நாவாய் பூச்சியினைக் கட்டுப்படுத்தும்.

வேப்ப மரம் சுற்றுப்புறச் சூழ்நிலையைப் பாதுகாக்கின்றது. இது மண் அரிப்பைத் தடுக்கின்றது. மேலும் அதிகமான மரங்களை நடுவதால் பூமி குளிர்ச்சி அடைகின்றது. வேம்பு மிக வேகமாக வளரும் தன்மையுடையது.

வேப்ப மரத்தில் இருந்து தயாரிக்கப்படும் பூச்சிக்கொல்லி மருந்துகள் தாவரங்களை அழிக்கும் பூச்சிகளை அவை கூட்டுப்புழு பருவத்தில் இருக்கும் போதே அழித்து விடுகிறது. இதனை பயிர்களுக்குத் தெளிப்பதால், பயிர்களுடன் தொடர்பு கொள்ளும் பறவைகள், தேனிக்கள், மண்புழுக்கள், எறும்புகள், சிலந்திகள் போன்ற உயிரினங்களுக்கு எந்தவித தீமையும் விளைவிப்பதில்லை. மேலும் வேப்ப மரத்தில் இருந்து தயாரிக்கப்பட்ட பூச்சிக் கொல்லி மருந்துகளை தெளிப்பதனால் அம்மருந்தின் வாசனை உள்ள வரை பூச்சிகள் எந்த செடியினையும் அழிப்பதில்லை.

வேம்பில் அசாடிரக்டின், நிம்பிசிடின் போன்ற ராசாயனப் பொருள்கள் இருப்பதால் பூச்சி மற்றும் நோய் தடுப்பதற்கு உபயோகப்படுத்தப்படுகின்றது. எனவே எந்தவித பாதிப்புமின்றி வேம்பின் அனைத்து பாகங்களையும் பயன்படுத்தி பயிர்களை பூச்சி நோய்களின்றி எளிதாகக் காப்பாற்றலாம். மேலும் தரமான விஷமற்ற விளைபொருள்களை விவசாயிகள் உற்பத்தி செய்து பயன் அடையலாம்.

தானிய சேமிப்பும் பாதுகாப்பும்

நமது நாட்டின் மக்கட் தொகைப் பெருக்கத்திற்கு ஏற்ப உணவு உற்பத்தியை அதிகரிக்க வேண்டிய நிலையில் உள்ளோம். மேலும் உற்பத்தி செய்யப்பட்ட தானியங்களைச் சீராக விநியோகம் செய்யும் பொருட்டு, சேமித்து வைக்கப்பட வேண்டியுள்ளது. பயிர்ப் பாதுகாப்பு எந்த அளவுக்கு முக்கியமோ அந்த அளவுக்கு விளைவித்த தானியத்தை விரயமின்றி பாதுகாப்பது முக்கியமாகும்.

மக்கள் தங்களின் ஆண்டு உணவுத் தேவைக்காகவும், விதைக்காகவும், நல்ல விலைக்காகவும் மற்றும் கால்நடைத் தீவனத்திற்காகவும் தானியங்களைச் சேமித்து வைக்கின்றனர். இப்படி சேமிக்கும் தானியப் பொருள்களில், தானியங்களில் ஈரப்பதமும், வெப்பமும் அதிகரிக்கும்போது பலவிதமான பூச்சிகள் பூஞ்சாணங்கள், சிலந்திப் பூச்சிகள், நூற்புழுக்கள் மற்றும் எலிகள் அதிக அளவில் உண்டு சேதம் விளைவிக்கின்றன.

பூச்சிகளால், சேமிப்பு தானியங்களுக்கு ஏற்படும் இழப்பு பலதரப்பட்டது. அவையாவன

- தானியத்தின் எடை இழப்பு

- தானியத்தின் தரம் குறைதல்னள
- தானியத்தில் ஊட்டச்சத்துக்கள் குறைதல்
- விதைகள் முளைப்புத் திறன் குறைதல்
- தானியத்தில் வெப்பம் அதிகரித்தல்
- பூஞ்சாணம் மற்றும் நுண்ணுயிர்கள் வளர்ந்து உணவில் நச்சுத் தன்மையை ஏற்படுத்துதல்
- சேதப்படுத்தப்பட்ட தானியத்தில் உள்ள இறந்த பூச்சிகளை மக்கள், கால்நடைகள் மற்றும் பறவைகள் உண்பதால் அவற்றின் உடல் நிலைகளில் பாதிப்பு

சேதத்திற்கான முக்கிய காரணம் - பூச்சிகள்

சேமிப்பு தானியங்களில் பூச்சிகளினால் சேதம் ஏற்பட சில முக்கியக் காரணங்கள்

- ஊட்டச்சத்துக்கள் நிறைந்த தானியங்களில் பூச்சிகளின் தாக்குதலை எதிர்க்கும் திறன் இல்லாமை
- தானியங்களை ஓரிடத்திலிருந்து மற்ற இடங்களுக்கு அதிவேகமாக ஏற்றிச் செல்லுதல்
- தானியப் பூச்சிகளைக் கட்டுப்படுத்தும் இயற்கை எதிரிகளை அழித்தல்
- பூச்சிகள் அறுவடை செய்யப்பட்ட வயலில் இருந்து சேமிப்புத் தளங்களுக்குப் பரவுதல்
- போரடிக்கும் களத்தில் தானியப் பூச்சிகளின் எண்ணிக்கை மற்றும் நடமாட்டம் அதிகரித்தல்
- தானியங்களை நீண்ட நாட்களுக்குச் சேமித்து வைத்தல்
- சேமிப்பிற்கு இதமற்ற ஈரத்தன்மை மற்றும் வெப்பம்
- சேமிப்புக் களங்களிலும் கட்டிடங்களிலும் உள்ள துவாரங்களில் பூச்சிகள் உற்பத்தியடைந்து சேதப்படுத்துதல்
- அறுவடை செய்யப்பட்ட புதிய தானியங்களை ஏற்கனவே சேதமடைந்த தானியங்களுடன் சேமித்து வைத்தல்.

தானிய சேமிப்பில் பூச்சிகளைக் கட்டுப்படுத்தும் வழி முறைகள்

- தானியங்களைச் சேமிக்கும் முன் நன்கு உலர வைக்கவேண்டும். ஏனெனில் தானியத்தில் உள்ள அதிகமான ஈரப்பதரமே அதன் முதல் எதிரியாகும்.
- உமி பதரடைந்த தானியத்தை நீக்கி விட வேண்டும்.

- சேமிப்புக் களஞ்சியங்களை நன்கு சுத்தம் செய்து தானியங்களைச் சேமிக்க வேண்டும். ஏனெனில் பழைய தானியம், பூச்சிகளால் தாக்குண்ட தானியம் ஆகியவை புது தாக்குதலுக்கு வழிவகுக்கும்.
- கதிரடிக்கும் களங்களைச் சுத்தமாக வைத்திருக்க வேண்டும்.
- அதுபோலவே அறுவடை மற்றும் கதிரடிக்கும் இயந்திரங்களை எப்போதும் சுத்தமாக வைத்திருக்க வேண்டும்.
- புதிய கோணிப்பைகளையே பயன்படுத்த வேண்டும். பழைய கோணிகளாயின் கிழிசல்களைச் சரி செய்து, பழைய மற்றும் புதிய கோணிப்பைகளை வேம்பு இலை கரைசலில் நனைத்து, காய வைத்து சேமிக்க பயன்படுத்த வேண்டும்.
- தானிய மூட்டைகள் வைக்கப்படும் அறை தூய்மையாக இருக்க வேண்டும். தரையிலும், சுவர்களிலும் விரிசல்கள் காணப்பட்டால் அவற்றை சிமெண்ட் கலவை கொண்டு சரி செய்து அவற்றுக்கு வெள்ளை அடிக்க வேண்டும் மற்றும் சேமிக்கும் அறையில் வேம்பு இலை கரைசலைத் தெளித்து காய்ந்தபின் அந்த அறையில் தானியத்தை சேமிக்க வேண்டும்.
- தானிய மூட்டைகளை சுவரிலிருந்து ஒன்றரை அடி தள்ளியே தரையின் மீது மரச்சட்டம், மூங்கில் பாய் அல்லது பாலித்தின் தாள் பரப்பி அதன் மீது சீரான முறையில் அடுக்க வேண்டும்.
- பூச்சிகளால் தாக்குண்ட பழைய தானியங்களை, சுத்தமான புதிய தானியங்களோடு சேர்க்கக் கூடாது.
- வேப்ப இலை (அ) நொச்சி இலை (அ) புங்கம் இலைகளில் ஏதாவது ஒன்றை நன்கு நிழலில் காயவைத்து பொடி செய்து, அவற்றில் 25கிராம் பொடியினை தனியாக துணியில் கட்டவும். இவ்வாறு துணியில் கட்டிய தாவர இலைப் பொடியை தானிய மற்றும் பயறுவகைகளில் 1கிலோவுக்கு 25கிராம் (அதாவது 1 துணி பாக்கெட்) வைப்பதன் மூலம் தானிய வகைகளை புழு, பூச்சி தாக்குதலிலிருந்து பாதுகாக்கலாம்.

எந்தவித பாதிப்புமின்றி தாவரங்களான வேம்பு, நொச்சி மற்றும் புங்கம் இலைகளைக் கொண்டு பயிர்களை பூச்சி மற்றும் நோய்களின்றி எளிதாகக் காப்பற்றலாம்.

“தானியத்தை பூச்சி மற்றும்
நோய்களிலிருந்து காப்போம்
தானிய தட்டுப்பாட்டை முற்றிலும் ஒழிபபோம்”

Neem “soft” natural pesticides

“Neem: A Tree for Solving Global Problems”

Candidate

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Guide

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THE NEEM

Botanical Name	:	Azadirachta indica
Family	:	Meliaceae
Subfamily	:	Melioideae
Tribe	:	Melieae
Common Name	:	Nim, Neem, Limba, and Nimba etc.

In India neem occurs in tropical dry deciduous and thorn forests (Champion and Seth, 1968) and in the drier parts up to 1500m. This amazing tree lives for over 200 years and can thrive well under semi-arid and sub-humid conditions up to 700 meters above sea level. It is tolerant to soil and even drought. It is favored for a forestation of dry areas for checking soil erosion and as windbreak.

India is a largely agrarian society with more than hundred million families dependant on farming for a living. The liberalized Indian economy still depends on the success of agricultural production and 35 – 40% of India's National Income comes from agricultural sources. At the present rate of food production, which is 200 million tones annually, it will not be possible to meet the food needs of the burgeoning population (Sunder, 2006).

Agriculture in India has been practiced for more than 5000 years. Till around 1950, the land was nurtured with care using natural resources and organic materials. Chemical fertilizers and pesticides were unheard of and cattle were a major component of the agriculture. The eminent agricultural scientist, Albert Howard, wrote early in this century that Indian farmers used compost and organic manures, which ensured that they could continue farming on the same land for more than 2000 years without a drop in yields (Srivastava, 2001).

In the traditional Indian farming system nutrient supply and pest management were integrated not only into the cropping system as a whole but also into their way of life. Locally available plant derived substances like Neem, Karanj, Tulsi; Vidang etc. protected the crops and nourished the soils.

In the past two decades, "green revolution technologies" have more than doubled the yield potential of rice and wheat, especially in Asia. These high-input production systems requiring massive quantities of fertilizers, pesticides, irrigation, and machines, however, disregard the ecological integrity of land, forests, and water resources, endanger the flora and fauna, and cannot be sustained over generations. Also, we cannot look to the sea in future as fishing stocks in many parts of the world are already in crisis due to overfishing or pollution. To a great extent, future food security and economic independence of developing countries would depend on improving the productivity of biophysical resources through the application of sustainable production methods, by improving tolerance of crops to adverse environmental conditions, and by reducing crop and post-harvest losses caused by pests and diseases (Kabra, 2000).

For ecologically sound, equitable, and ethical pest management, there is a need for control agents that are pest-specific, nontoxic to humans and other biota, biodegradable, less prone to pest resistance and resurgence, and relatively less expensive. Among various options, neem has been identified a source of environmentally "soft" natural pesticides.

Neem products are safe for the workers. They are no handling risks and no minimum re-entry time interval is allowable. Neem is non-phototoxic and has no adverse effect on beneficial insects. It can be dipped, drenched, mixed with liquid fertilizers in drip systems and applied with all spray equipment including thermal fog and ultra low volume systems.

Industrial and other uses

The neem can form the basis for manufacture of various consumer and industrial products. Properly dried decorticated neem seed yields seed coat and neem kernel. The seed coat is rich in lignin, cellulose etc. and can be used as a low calorific value fuel in brick kilns etc. As it has good mechanical strength it may be incorporated

with wood shavings used for making particle-boards for thermal insulation by mixing with a synthetic resin like phenol formaldehyde, as adhesive.

The neem seed coat after powdering could be mixed with other unwanted organic materials of the industry like discarded neem oil residue or other agricultural wastes and pressed to form briquettes with the help of a machine. These briquettes can be used as fuel in boilers for steam generation.

Neem and Environment

In Indian culture Neem has been referred to as an air purifier and has been traditionally planted either in the backyard or beside the house. Recent scientific studies have indicated that the Neem tree has the capacity to absorb environmental pollutants and act as an air freshener by releasing oxygen and mild odorous principles. In a study done in 1996 by the scientists of National Environmental Engineering Research Institute, Nagpur, India, it was found that sites with Neem as a dominant species have higher SPI (Sink Potential Index). The data also proved that the Neem tree is one of the most suitable species for checking urban pollution in the industrial locations and it has potential in green belt development in hot spots with known history of high air pollution.

Socio-economic benefits of Neem

Neem plantation provides income by collection of neem fruits in rural areas as demand of neem fruits is increasing day by day. Neem can save crop protection expenses to large extent thus may help to increase profit in agriculture. Neem processing technologies like preparation of neem seed powder, neem aqueous extracts, neem oil and neem cake will create large employment in the rural areas. Use of neem in agriculture can reduce the load of poisonous chemicals in the environment as toxication by these pesticides may cause serious health hazards having impact on the working efficiency and financial condition of the farmers (www.neemfoundation.org).

ACTION OF NEEM ON INSECT PEST

Various neem extracts are known to act on various insects by

- Disrupting or inhibiting the development of eggs, larvae or pupae.
- Blocking the molting of larvae or nymphs
- Disrupting mating and sexual communication
- Repelling larvae and adults
- Deterring females from laying eggs
- Sterilizing adults
- Poisoning larvae and adults
- Deterring feeding
- Blocking the ability to “swallow” (that is, reducing the motility of the gut)
- Sending metamorphosis awry at various stages
- Inhibiting the formation of chitin.

METHODS OF PREPARATION OF NEEM EXTRACTS

Neem Kernel Aqueous Extract (NKAE)

Weigh 1 kg of clean neem kernel and make powder of grain size like fine tea powder. It should be pounded in such a way that no oil comes out. Soak it in an about 10 liters of clean water. Add 10 ml of pH neutral adjuvant (mixture of emulsifier, spreader etc.) and stir the mixture. Keep the mixture overnight and filter it on the next day with clean muslin cloth. Put water in the residue and repeat the extraction 2-3 times. Use residue as manure for plants.

Neem Leaf Extract:

For 5 liters of water, 1 kg of green neem leaf is required. Since the quantity of leaves required for preparation of this extract is quite high (nearly 80 kg are required for 1 hectare) this can be used for nursery and kitchen gardens. The leaves are

soaked overnight in water. The next day the leaves are grounds and the extract is filtered. The extract is beneficial against leaf eating caterpillars, grubs, locusts and grasshoppers. To the extract, emulsifier is added as mentioned in kernel extract.

Neem Cake Extract:

100gms of Neem cake is required for 1 liter of water. The Neem cake is put in a muslin pouch and soaked in water. It is soaked overnight before use in the morning. It is then filtered and emulsifier is added -1-ml for 1-litre of water. It can then be used for spraying.

Neem Oil Spray:

15-30 ml Neem oil is added to 1 liter of water and stirred well. To this emulsifier is added (1ml/1litre). It is very essential to add the emulsifier and mix properly. This should be used immediately before the oil droplets start floating. A knapsack sprayer is better for Neem oil spraying in preference to a hand sprayer.

Precautions for using Neem Extracts/Formulations:

Spraying should be undertaken in the morning or late in the afternoon. Insects lay eggs on the underside of the leaves. Hence it is important to spray on the underside of the leaves as well.

Caution

The active principles of Neem are destroyed by

- Heating and boiling the extract- do not boil the mixture
- Acidic or alkaline pH emulsifier- use neutral pH emulsifier
- Ultraviolet rays of sunlight – Spry during moderate sunlight,
- Hydrolysis of water- use aqueous extract on same day

Conclusion

Neem's other descriptions, such as nature's gift to mankind, the tree for many an occasion, the tree that purifies, the wonder tree, the tree of the 21st century, and a tree for solving global problems, are a recognition of its versatility.

India will have to take lead and provide leadership as Azadirachta indica is a tree of Indian origin and more than 60% of its germplasm is to be found in India. India

also has a vast repository of Neem knowledge. The increasing awareness about the potential of Neem and its importance need to be translated into actual economic and environmental benefits for the country.

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Storage practices of pulses in the households using selected botanicals

The following procedure can be adopted in the households for preparing botanicals during storage.

1. Choose the botanicals based on its availability.

- *Azadirachta indica* (Neem)
- *Vitex nigundo* (Nochi)
- *Pongamia pinnata* (Pongamiya)



2. Botanical leaves (Neem / nochi / pongamiya) should be gathered, cleaned, dried in the sunshade.

2. The dried leaves should be grinded into powder using blender


3. Twenty five grams selected botanical (neem / nochi /pongamiya) leaf powder should be weighed and made into a small packet using a thin non- woven eco-friendly material


4. The prepared packets should be placed in all the stored pulses to prevent insect and pest damage.


Safe Storage Practices of Pulses using selected Botanicals

Design

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Safe storage practices and use of botanicals during bulk storage:

- The pulses should be properly cleaned, dried, and graded before storage. The moisture content of the stored pulses should be brought down below the safe level.

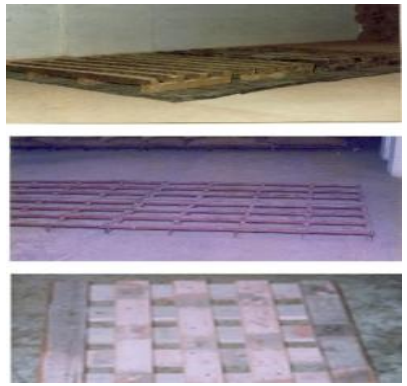
- Dry the selected botanical leaves in the sun so that the leaves stay green. Grind them into a powder. Mix the powder with clay and water. Plaster the inside walls of the storage room.

- The cracks and crevices in the storage room should be closed and the walls should be white washed. The inside and outside surface of the storage room should be sprayed thoroughly with any botanical / neem leaves extracts spray. Disinfect the storage room with neem leaves smoke before storing pulses to avoid insect attack.

- Use neem leaf extract treated gunny bags and polythene bags for storing pulses to avoid insect infestation.

- The storage rooms should be sprayed with neem extract solution once in 15 days in the concentration of 1:100.

- For proper circulation of air in the storage rooms, the dunnage (arrangement on the floor to stack) stacks can be wooden crates (made up of neem wood) or black polythene sheet treated with neem leaves extract.



- Neem leaf powder packets can be placed for every 1 kg of pulses in the storage container to prevent insect pest attack

"Save Grain Save Nation"

APPENDIX V

Knowledge inventory to assess the knowledge of the homemakers towards safe storage practices of pulses

S.No	Knowledge statement	Before training	After training
1	Pulses are sun dried before storage		
2	Pulses are cleaned before storage		
3	Pulses are sun dried in between the storage period and frequent inspection		
4	Pulses are stored in moisture proof container		
5	Insect, pests and fungus are causative factors for pulse spoilage		
6	Pulse with holes and infested has to be rejected for human consumption		
7	Little attention to proper pulse storage is enough to minimize pulse loss to a great extent		
8	Neem, Nochi and Pongamiya leaves have excellent insecticidal property that prevents the insect attack in storage.		
9	Use o chemical method to control pest attack is harmful for human being		
10	Use of botanicals during pulse storage to prevent insect and pest attack is cost effective method		
11	Bringing down moisture level before storage of pulses is essential		
12	Use of botanicals during storage of pulses does not alter the organoleptic quality of the pulses		
13	Neem, Nochi and Pongamiya leaves are non-toxic in nature and also have medicinal properties that could aid the human well being		

S.No	Knowledge statement	Before training	After training
14	Use of botanicals in storage of pulses helps to maintain the keeping quality of pulses		
15	Pulse intake is important to make a diet balanced		
16	It is important to bring back traditional storage practices along with adopting modern techniques to get rid of harmful effects of chemical storage practices		
17	Prevention of insect and pest in stored pulses is not only economical but also helps to maintain health status		
18	Economic benefits can be accrued through proper pulse spoilage control measures		
19	New purchase should never be stored with reminder of previous purchase		
20	Use of botanicals during storage of pulses is feasible and acceptable		

APPENDIX VI

Attitude scale used before and after the training programme

S.No.	Statements	SF	F	N	UF	SUF
1.	Chemicals can be used during storage to control insects and pests	1	2	3	4	5
2.	Chemicals storage methods is not very harmful to health	1	2	3	4	5
3.	Botanicals leaves play a vital role in controlling insects and pests	5	4	3	2	1
4.	Use of botanicals to control insect and pest in storage of pulses maintain the quality of pulses	5	4	3	2	1
5.	Infestation causes acute pulses loss	5	4	3	2	1
6.	12-15% is the safe level of moisture content for pulses	5	4	3	2	1
7.	Use of botanicals during storage ensures good quality seeds for storage for the next season	5	4	3	2	1
8.	Use of botanicals during storage will affect the taste of the cooked pulses	1	2	3	4	5
9.	Fallen Neem, Nochi and Pongamiya can be used effectively to prevent insect, pest and fungal attack in pulses	5	4	3	2	1
10.	Pulses should be washed before cooking	5	4	3	2	1
11.	Indigenous techniques of storage is better when compared to chemical in storage to avoid pulse damage.	5	4	3	2	1
12.	Pulse with holes and insects is safe for human consumption	1	2	3	4	5
13.	Pulses with molds can be washed and used for human consumption	1	2	3	4	5
14.	Pulses are rich sources of protein and promote growth and development of the body	5	4	3	2	1
15.	Removal of botanical leaf powders before cooking of pulses is not essential because it has medicinal properties	5	4	3	2	1

SF – Strongly Favourable; F – Favourable; N – Neutral; UF – Unfavourable,

SUF – Strongly Unfavourable

APPENDIX VII

Adoption scale used before and after the training programme

S.No	Aspects	Yes	No
1	Check for insect pest damage at the time of purchase		
2	Sun drying the pulses before storage		
3	Frequent monitoring of pulses throughout the storage period		
4	Discarding the infested pulses		
5	Using air tight container for storing pulses		
6	Using botanicals in the pulse storage container / devices to prevent incidence of insect pests attack, white powdery substances and holes and damages in the pulses		
7	Preventive measures like drying in case of insect infestation		
8	Avoiding hand usage to dole out pulses to prevent fungal / mold attack		
9	Neem treated gunny bag for bulk storage of pulses		
10	Practice first in first out method of pulse usage		
11	Avoid Storing fresh stock along with the left overs of the old stock		
12	Soaking pulses in water to remove dust and other foreign materials before cooking		
13	Preventive measures to avoid damage caused by increased moisture by placing storage device in a dry and tidy place		
14	Cleaning / washing the storage device before storing the fresh stock		
15	Keeping the kitchen and the surrounding environment clean and tidy to avoid entry of insects and pests		

APPENDIX VIII

Effect of botanicals on moisture content of the selected pulses stored in stainless steel container

Name of the pulse	VARIATIONS (in gms)																							
	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25
	1st month				2nd month				3rd month				4th month				5th month				6th month			
Black gram	**Initial - 12.6**																							
Neem	12.6	12.6	12.6	12.6	12.9	12.9	12.6	12.6	13.2	13.2	12.9	12.9	13.6	13.5	13.3	13.3	14.0	13.8	13.7	13.7	14.2	14.0	13.9	13.9
Nochi	12.6	12.6	12.6	12.6	13.0	12.9	12.8	12.8	13.5	13.3	13.0	13.0	13.8	13.6	13.5	13.5	14.2	14.0	13.9	13.8	14.5	14.2	14.1	14.1
Pongamiya	12.6	12.6	12.6	12.6	13.3	13.2	12.9	12.9	13.6	13.5	13.3	13.3	13.8	13.7	13.6	13.6	14.5	14.3	14.0	14.0	14.6	14.5	14.3	14.3
Control	12.6				13.5				14.0				14.7				15.2				16.5			
Black Channa	**Initial -11.0**																							
Neem	11.0	11.0	11.0	11.0	11.3	11.3	11.2	11.2	11.6	11.5	11.4	11.4	11.8	11.7	11.6	11.6	12.4	12.3	12.2	12.2	12.7	12.6	12.4	12.4
Nochi	11.0	11.0	11.0	11.0	11.4	11.4	11.3	11.4	11.7	11.6	11.5	11.5	12.0	11.9	11.8	11.8	12.5	12.5	12.4	12.4	13.0	12.9	12.6	12.6
Pongamiya	11.0	11.0	11.0	11.0	11.5	11.4	11.4	11.4	11.8	11.7	11.6	11.6	12.2	12.1	12.0	12.0	12.5	12.4	12.4	12.5	13.2	13.0	12.7	12.7
Control	11.0				11.7				12.0				12.4				12.9				13.5			
Cow Pea	**Initial - 13.8**																							
Neem	13.8	13.8	13.8	13.8	14.1	14.0	14.0	13.9	14.5	14.3	14.2	14.1	14.8	14.8	14.5	14.4	15.4	15.3	15.1	15.1	16.1	16.0	15.7	15.7
Nochi	13.8	13.8	13.8	13.8	14.0	13.9	13.9	13.8	14.4	14.2	14.1	14.1	14.6	14.5	14.3	14.3	15.3	15.2	15.0	15.0	15.9	15.7	15.6	15.5
Pongamiya	13.8	13.8	13.8	13.8	14.2	14.1	14.0	13.9	14.6	14.4	14.3	14.3	15.1	15.0	14.9	14.8	15.5	15.4	15.2	15.2	16.2	16.1	15.9	15.8
Control	13.8				14.4				15.0				15.4				16.0				16.9			

Effect of botanicals on moisture content of the selected pulses stored in stainless steel container

Name of the pulse	VARIATIONS (in gms)																							
	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25
	1st month				2nd month				3rd month				4th month				5th month				6th month			
Green Gram	**Initial -11.2**																							
Neem	11.2	11.2	11.2	11.2	11.3	11.3	11.2	11.2	11.8	11.6	11.5	11.5	12.8	12.6	12.3	12.3	13.2	13.1	13.0	13.0	13.6	13.5	13.3	13.3
Nochi	11.2	11.2	11.2	11.2	11.4	11.3	11.3	11.3	12.1	11.9	11.7	11.6	12.9	12.7	12.5	12.5	13.2	13.2	13.1	13.1	13.9	13.8	13.5	13.5
Pongamiya	11.2	11.2	11.2	11.2	11.5	11.4	11.4	11.3	12.2	12.1	11.8	11.8	13.0	12.8	12.6	12.6	13.3	13.3	13.2	13.2	14.1	14.0	13.6	13.6
Control	11.2				11.8				12.5				13.2				13.7				14.5			
Peas	**Initial – 13.6**																							
Neem	13.6	13.6	13.6	13.6	13.8	13.8	13.7	13.7	14.2	14.1	13.9	13.9	14.8	14.6	14.3	14.3	15.3	15.3	14.9	14.9	15.7	15.6	15.3	15.3
Nochi	13.6	13.6	13.6	13.6	13.7	13.7	13.6	13.6	14.1	14.0	13.8	13.8	14.6	14.4	14.2	14.2	15.2	15.2	14.8	14.8	15.5	15.3	15.1	15.1
Pongamiya	13.6	13.6	13.6	13.6	13.9	13.9	13.8	13.8	14.4	14.2	14.0	14.0	14.9	14.7	14.5	14.5	15.4	15.3	15.0	15.0	15.8	15.7	15.4	15.4
Control	13.6				14.2				14.9				15.2				15.9				16.5			

Effect of botanicals on moisture content of the selected pulses stored in polythene bags

Name of the pulse	VARIATIONS (in gms)																							
	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25
	1st month				2nd month				3rd month				4th month				5th month				6th month			
Black gram	**Initial – 12.6**																							
Neem	12.6	12.6	12.6	12.6	13.0	12.9	12.7	12.7	13.3	13.2	12.9	12.9	13.6	13.4	13.3	13.3	14.1	13.9	13.8	13.8	14.2	14.1	13.9	13.9
Nochi	12.6	12.6	12.6	12.6	13.1	13.0	12.7	12.7	13.5	13.4	13.1	13.1	13.8	13.7	13.6	13.6	14.2	14.1	13.9	13.9	14.6	14.3	14.3	14.3
Pongamiya	12.6	12.6	12.6	12.6	13.4	13.4	13.1	13.1	13.6	13.5	13.4	13.4	13.9	13.8	13.7	13.6	14.2	14.2	14.1	14.1	14.7	14.6	14.4	14.4
Control	12.6				13.6				14.2				14.8				15.5				16.7			
Black Channa	**Initial -11.0**																							
Neem	11.0	11.0	11.0	11.0	11.4	11.3	11.3	11.3	11.6	11.6	11.5	11.4	11.9	11.8	11.7	11.7	12.4	12.3	12.3	12.2	12.6	12.5	12.5	12.4
Nochi	11.0	11.0	11.0	11.0	11.6	11.5	11.3	11.4	11.8	11.7	11.6	11.6	12.3	12.0	11.9	11.9	12.7	12.6	12.5	12.5	13.0	12.9	12.7	12.7
Pongamiya	11.0	11.0	11.0	11.0	11.6	11.4	11.4	11.4	11.9	11.8	11.7	11.7	12.3	12.2	12.1	12.1	12.8	12.7	12.6	12.6	13.1	13.1	12.8	12.8
Control	11.0				11.7				12.2				12.5				12.9				13.7			
Cow Pea	**Initial – 13.8**																							
Neem	13.8	13.8	13.8	13.8	14.2	14.1	14.0	14.0	14.5	14.3	14.2	14.2	14.9	14.8	14.7	14.7	15.5	15.4	15.3	15.3	16.2	16.0	15.8	15.8
Nochi	13.8	13.8	13.8	13.8	14.1	14.0	13.9	13.9	14.4	14.3	14.1	14.1	14.7	14.5	14.5	14.4	15.4	15.3	15.2	15.2	15.9	15.7	15.6	15.5
Pongamiya	13.8	13.8	13.8	13.8	14.2	14.1	14.1	14.1	14.6	14.5	14.3	14.4	15.1	15.0	14.9	14.9	15.7	15.5	15.4	15.4	16.3	16.2	15.9	15.9
Control	13.8				14.5				15.2				15.6				16.3				17.2			

Effect of botanicals on moisture content of the selected pulses stored in polythene bags

Name of the pulse	VARIATIONS (in gms)																							
	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25
	1st month				2nd month				3rd month				4th month				5th month				6th month			
Green Gram	**Initial -11.2**																							
Neem	11.2	11.2	11.2	11.2	11.4	11.3	11.2	11.2	11.8	11.7	11.5	11.5	12.7	12.5	12.4	12.4	13.1	13.0	13.0	13.1	13.6	13.5	13.3	13.3
Nochi	11.2	11.2	11.2	11.2	11.5	11.3	11.4	11.4	12.1	12.0	11.7	11.7	12.9	12.7	12.6	12.5	13.3	13.2	13.2	13.2	14.0	13.8	13.6	13.5
Pongamiya	11.2	11.2	11.2	11.2	11.5	11.4	11.5	11.4	12.2	12.1	11.8	11.8	13.0	12.8	12.7	12.7	13.4	13.4	13.3	13.3	14.1	14.0	13.6	13.6
Control	11.2				11.8				12.6				13.5				13.7				14.8			
Peas	**Initial – 13.6**																							
Neem	13.6	13.6	13.6	13.6	13.9	13.9	13.8	13.8	14.2	14.0	13.9	13.9	14.8	14.6	14.3	14.3	15.4	15.3	14.9	14.8	15.4	15.3	15.2	15.2
Nochi	13.6	13.6	13.6	13.6	13.7	13.7	13.7	13.6	14.1	14.0	13.8	13.8	14.7	14.5	14.3	14.2	15.3	15.2	14.8	14.8	15.3	15.2	15.2	15.1
Pongamiya	13.6	13.6	13.6	13.6	13.9	13.9	13.9	13.9	14.4	14.3	14.1	14.1	14.9	14.8	14.5	14.5	15.5	15.3	15.1	15.1	15.5	15.4	15.3	15.3
Control	13.6				14.2				15.0				15.3				16.0				16.8			

Effect of botanicals on moisture content of the selected pulses stored in gunny bags

Name of the pulse	VARIATIONS (in gms)																							
	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25
	1st month				2nd month				3rd month				4th month				5th month				6th month			
Black gram	**Initial – 12.6**																							
Neem	12.6	12.6	12.6	12.6	13.0	12.9	12.8	12.7	13.4	13.3	13.0	13.0	13.6	13.5	13.4	13.4	14.1	13.9	13.9	13.8	14.2	14.2	13.9	13.9
Nochi	12.6	12.6	12.6	12.6	13.1	13.0	12.9	12.9	13.5	13.4	13.2	13.2	13.8	13.7	13.6	13.6	14.2	14.1	14.0	14.0	14.5	14.3	14.3	14.4
Pongamiya	12.6	12.6	12.6	12.6	13.5	13.4	13.2	13.1	13.6	13.5	13.4	13.4	13.9	13.8	13.7	13.7	14.3	14.2	14.2	14.2	14.7	14.6	14.5	14.5
Control	12.6				13.6				14.5				14.9				15.6				16.8			
Black Channa	**Initial -11.0**																							
Neem	11.0	11.0	11.0	11.0	11.4	11.4	11.3	11.3	11.6	11.6	11.5	11.5	11.9	11.9	11.8	11.8	12.4	12.4	12.3	12.3	12.8	12.7	12.7	12.6
Nochi	11.0	11.0	11.0	11.0	11.6	11.5	11.4	11.4	11.8	11.8	11.7	11.6	12.3	12.2	12.1	12.0	12.7	12.6	12.6	12.5	13.0	12.9	12.8	12.8
Pongamiya	11.0	11.0	11.0	11.0	11.6	11.6	11.5	11.5	11.9	11.9	11.8	11.8	12.4	12.3	12.2	12.2	12.8	12.8	12.7	12.7	13.1	13.0	12.9	12.9
Control	11.0				11.8				12.2				12.7				13.3				14.2			
Cow Pea	**Initial – 13.8**																							
Neem	13.8	13.8	13.8	13.8	14.2	14.2	14.1	14.0	14.5	14.4	14.2	14.2	14.9	14.8	14.7	14.7	15.6	15.5	15.4	15.4	16.2	16.0	15.9	15.9
Nochi	13.8	13.8	13.8	13.8	14.2	14.1	14.0	13.9	14.4	14.2	14.1	14.1	14.7	14.5	14.5	14.5	15.4	15.4	15.2	15.2	15.9	15.8	15.7	15.6
Pongamiya	13.8	13.8	13.8	13.8	14.3	14.2	14.2	14.1	14.6	14.5	14.4	14.4	15.1	15.1	14.9	14.9	15.7	15.6	15.5	15.4	16.3	16.2	16.0	16.0
Control	13.8				14.5				15.3				15.6				16.5				17.4			

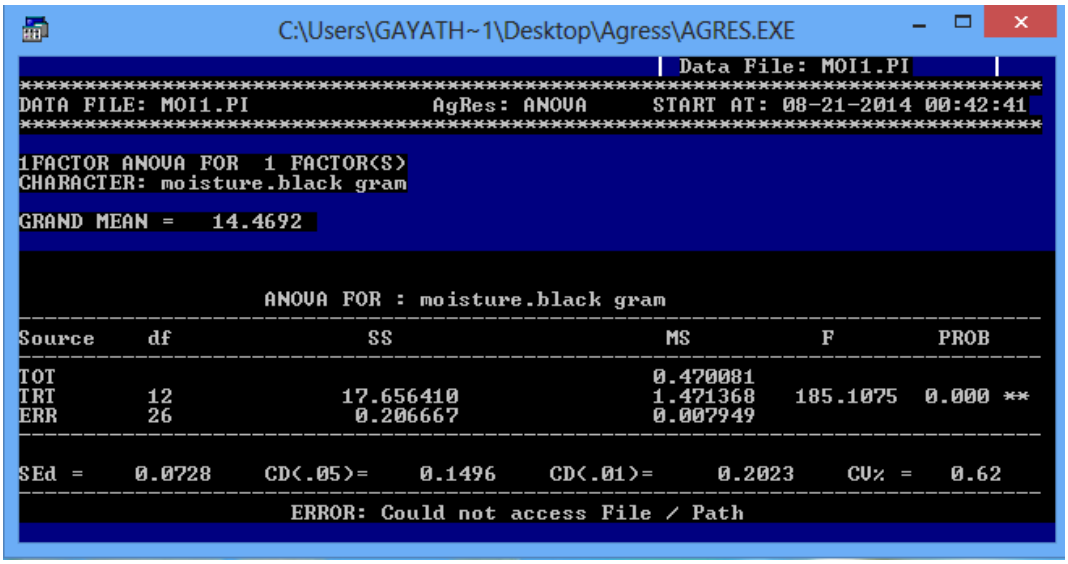
Effect of botanicals on moisture content of the selected pulses stored in gunny bags

Name of the pulse	VARIATIONS (in gms)																							
	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25
	1st month				2nd month				3rd month				4th month				5th month				6th month			
Green Gram	**Initial -11.2**																							
Neem	11.2	11.2	11.2	11.2	11.4	11.4	11.3	11.3	11.8	11.7	11.6	11.5	12.7	12.6	12.5	12.4	13.2	13.2	13.1	13.1	13.6	13.5	13.4	13.4
Nochi	11.2	11.2	11.2	11.2	11.6	11.5	11.4	11.4	12.1	12.1	11.7	11.7	12.9	12.7	12.5	12.5	13.3	13.2	13.2	13.2	14.0	13.8	13.6	13.6
Pongamiya	11.2	11.2	11.2	11.2	11.6	11.5	11.5	11.5	12.2	12.1	11.8	11.8	13.0	12.9	12.8	12.8	13.4	13.4	13.4	13.3	14.1	13.9	13.7	13.6
Control	11.2				11.8				12.6				13.5				13.7				14.8			
Peas	**Initial – 13.6**																							
Neem	13.6	13.6	13.6	13.6	13.9	13.9	13.8	13.8	14.2	14.1	14.0	13.9	14.8	14.5	14.4	14.4	15.3	15.3	14.9	14.8	15.7	15.6	15.4	15.3
Nochi	13.6	13.6	13.6	13.6	13.7	13.7	13.7	13.7	14.1	14.0	13.9	13.8	14.7	14.5	14.3	14.3	15.3	15.2	14.8	14.8	15.5	15.4	15.3	15.2
Pongamiya	13.6	13.6	13.6	13.6	13.9	13.9	13.9	13.9	14.4	14.3	14.2	14.1	14.9	14.8	14.5	14.5	15.5	15.3	15.1	15.1	15.8	15.7	15.5	15.5
Control	13.6				14.2				15.0				15.3				16.0				16.8			

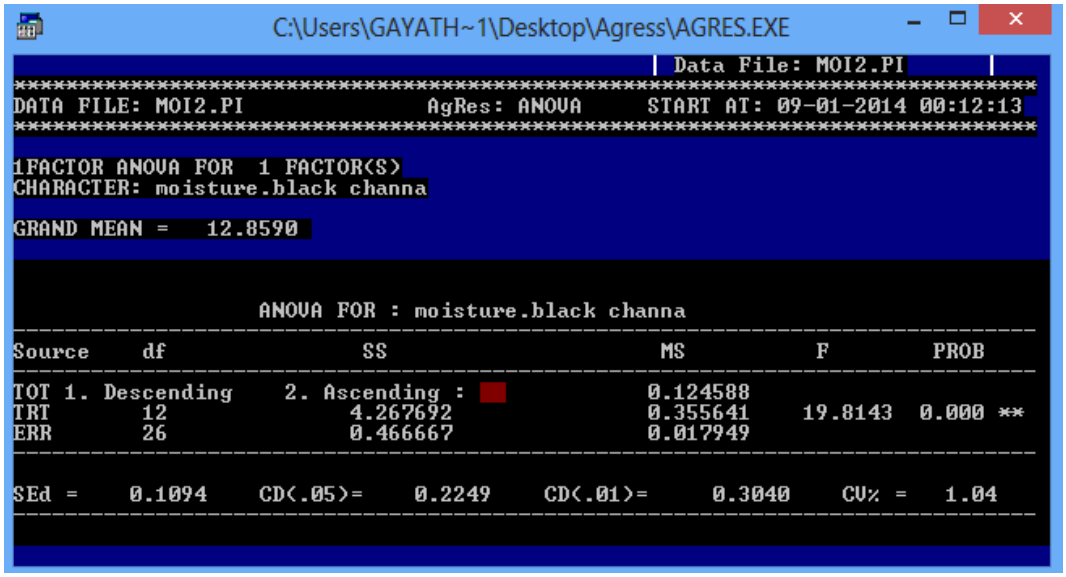
APPENDIX – IX

Moisture Content

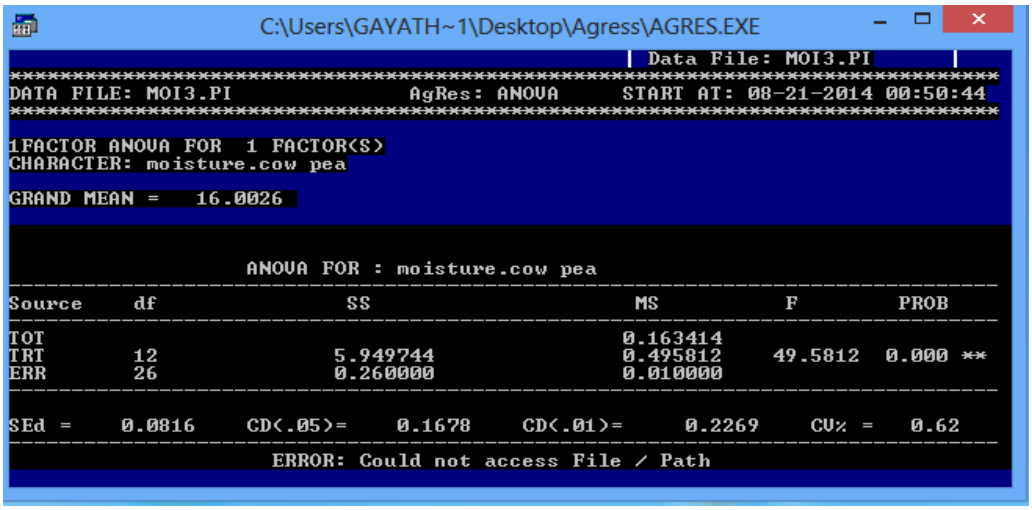
Single Factor ANOVA – Completely Randomized Design



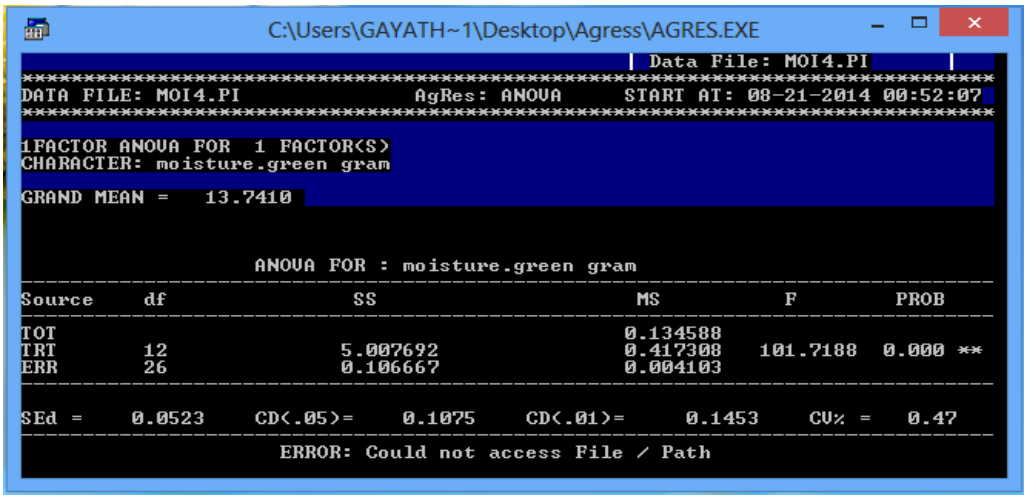
Black Gram



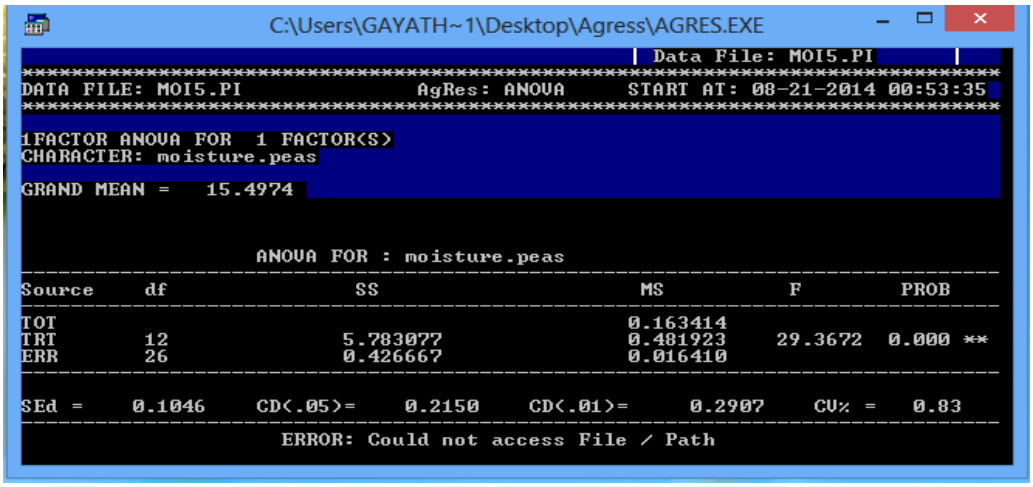
Black Channa



Cowpea



Green Gram



Peas

APPENDIX X

Effect of different botanicals on weevilization percentage of the selected pulses stored in stainless steel container

Name of the pulses	VARIATIONS (in gms)																							
	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25
	1st month				2nd month				3rd month				4th month				5th month				6th month			
Black Gram																								
Neem	-	-	-	-	0.1	-	-	-	0.4	0.4	0.3	0.3	1.5	1.3	1.0	0.8	2.4	2.2	1.8	1.7	3.3	3.0	2.8	2.7
Nochi	-	-	-	-	0.2	0.2	0.1	0.1	0.6	0.5	0.4	0.4	1.8	1.6	1.3	1.0	3.4	2.7	2.4	2.4	4.0	3.8	3.2	3.2
Pongamiya	-	-	-	-	0.3	0.2	0.2	0.1	0.8	0.7	0.5	0.5	1.8	1.7	1.4	1.2	3.5	3.2	2.7	2.8	4.2	3.9	3.5	3.5
Control	-				1.8				3.7				6.9				9.4				14.8			
Black Channa																								
Neem	-	-	-	-	-	-	-	-	0.2	0.1	-	-	0.9	0.6	0.4	0.4	1.2	1.5	0.8	0.9	3.0	2.9	2.2	2.2
Nochi	-	-	-	-	0.2	0.1	-	-	0.8	0.7	0.3	0.3	1.2	1.0	0.8	0.7	2.0	1.8	1.2	1.2	3.4	3.3	3.0	3.0
Pongamiya	-	-	-	-	0.2	0.3	0.1	-	0.8	0.9	0.4	0.3	1.4	1.2	0.8	0.8	2.3	2.0	1.5	1.4	3.5	3.4	3.2	3.2
Control	-				1.7				3.4				5.2				7.2				10.5			
Cow Pea																								
Neem	-	-	-	-	0.2	0.3	-	-	1.0	1.1	0.8	0.8	1.4	1.3	1.0	0.9	2.0	1.8	1.5	1.5	2.8	2.7	2.5	2.5
Nochi	-	-	-	-	0.2	0.2	0.2	0.1	1.5	1.4	1.0	1.1	1.6	1.3	1.2	1.2	2.4	2.2	1.8	1.9	3.0	2.9	2.8	2.8
Pongamiya	-	-	-	-	0.3	0.2	0.2	0.2	1.8	1.5	1.2	1.2	1.7	1.5	1.3	1.3	2.7	2.5	2.0	2.0	3.1	3.0	2.9	2.8
Control	-				2.1				3.8				6.5				8.3				11.4			
Green Gram																								
Neem	-	-	-	-	0.2	0.2	0.1	0.1	1.2	1.0	0.7	0.7	2.0	1.8	1.5	1.5	2.4	2.0	1.9	1.8	3.6	3.3	3.0	3.0
Nochi	-	-	-	-	0.3	0.2	0.1	0.2	1.5	1.3	0.9	0.9	2.2	2.0	1.8	1.8	2.6	2.3	2.2	2.0	3.8	3.7	3.4	3.4
Pongamiya	-	-	-	-	0.3	0.3	0.2	0.2	1.6	1.5	1.0	1.0	2.3	2.0	1.8	1.9	2.5	2.2	2.1	2.1	3.9	3.6	3.5	3.4
Control	-				2.9				5.8				9.5				14.6				18.7			
Peas																								
Neem	-	-	-	-	-	-	-	-	0.1	-	-	-	1.6	1.5	1.2	1.2	2.1	2.0	1.8	1.8	2.6	2.5	2.2	2.2
Nochi	-	-	-	-	0.1	-	-	-	0.4	0.2	0.1	0.1	1.9	1.8	1.4	1.5	2.5	2.4	2.0	2.0	2.8	2.6	2.4	2.4
Pongamiya	-	-	-	-	0.1	0.1	-	-	0.4	0.2	0.2	0.1	2.0	1.8	1.5	1.5	2.6	2.5	2.2	2.1	2.9	2.8	2.5	2.4
Control	-				1.3				3.2				5.7				7.2				9.8			

Effect of different botanicals on weevilization percentage of the selected pulses stored in polythene bags

Name of the pulses	VARIATIONS (in gms)																							
	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25
	1st month				2nd month				3rd month				4th month				5th month				6th month			
Black Gram																								
Neem	-	-	-	-	0.1	-	-	-	0.6	0.5	0.4	0.4	1.5	1.4	0.9	0.9	2.5	2.3	1.7	1.7	3.4	3.1	2.8	2.8
Nochi	-	-	-	-	0.2	0.2	0.1	0.1	0.7	0.6	0.5	0.5	1.8	1.7	1.3	1.2	3.5	2.9	2.5	2.5	4.1	3.8	3.5	3.4
Pongamiya	-	-	-	-	0.3	0.2	0.2	0.1	0.9	0.8	0.5	0.6	1.9	1.8	1.5	1.4	3.4	3.1	2.8	2.8	4.2	3.8	3.7	3.7
Control	-				2.0				4.2				7.3				9.8				15.6			
Black Channa																								
Neem	-	-	-	-	0.2	0.2	-	-	0.4	0.2	0.1	0.1	1.2	1.0	0.7	0.7	1.5	1.4	0.9	0.9	3.1	3.0	2.2	2.2
Nochi	-	-	-	-	0.3	0.2	0.1	0.1	0.9	0.8	0.5	0.5	1.5	1.3	1.0	0.9	1.9	1.8	1.4	1.3	3.5	3.5	3.1	3.1
Pongamiya	-	-	-	-	0.3	0.3	0.2	0.1	1.0	0.9	0.5	0.6	1.6	1.3	1.0	1.0	2.0	1.9	1.5	1.5	3.6	3.5	3.3	3.2
Control	-				1.7				3.5				5.5				7.9				11.2			
Cow Pea																								
Neem	-	-	-	-	0.3	0.3	0.1	0.1	1.3	1.2	0.9	0.8	1.5	1.2	1.0	1.0	2.1	1.9	1.5	1.5	2.9	2.8	2.6	2.6
Nochi	-	-	-	-	0.4	0.3	0.2	0.2	1.6	1.5	1.2	1.2	1.7	1.5	1.2	1.2	2.5	2.3	1.9	2.0	3.1	3.0	2.9	2.8
Pongamiya	-	-	-	-	0.5	0.3	0.3	0.2	1.8	1.5	1.3	1.3	1.8	1.5	1.3	1.3	2.7	2.6	2.0	2.0	3.2	3.1	2.9	2.9
Control	-				2.1				3.9				6.8				8.5				12.5			
Green Gram																								
Neem	-	-	-	-	0.3	0.2	0.1	0.1	1.3	1.2	0.9	0.9	2.1	2.0	1.7	1.6	2.6	2.5	2.2	2.2	3.7	3.4	3.1	3.1
Nochi	-	-	-	-	0.3	0.3	0.2	0.2	1.6	1.4	1.0	1.0	2.4	2.2	1.9	1.9	2.8	2.7	2.4	2.3	3.8	3.8	3.5	3.4
Pongamiya	-	-	-	-	0.4	0.3	0.2	0.2	1.6	1.5	1.1	1.1	2.4	2.3	2.1	2.1	2.9	2.8	2.5	2.4	3.9	3.7	3.5	3.5
Control	-				2.9				5.9				9.8				14.8				18.8			
Peas																								
Neem	-	-	-	-	0.1	-	-	-	0.3	0.2	0.1	0.1	1.6	1.6	1.2	1.2	2.2	2.0	1.8	1.8	2.6	2.6	2.2	2.2
Nochi	-	-	-	-	0.2	0.2	0.1	0.1	0.5	0.4	0.1	0.2	2.1	2.0	1.5	1.5	2.6	2.5	2.2	2.2	2.8	2.7	2.4	2.5
Pongamiya	-	-	-	-	0.2	0.2	0.1	0.1	0.7	0.5	0.2	0.2	2.2	1.9	1.6	1.6	2.8	2.6	2.3	2.3	2.9	2.9	2.5	2.5
Control	-				1.5				3.5				5.9				7.5				10.2			

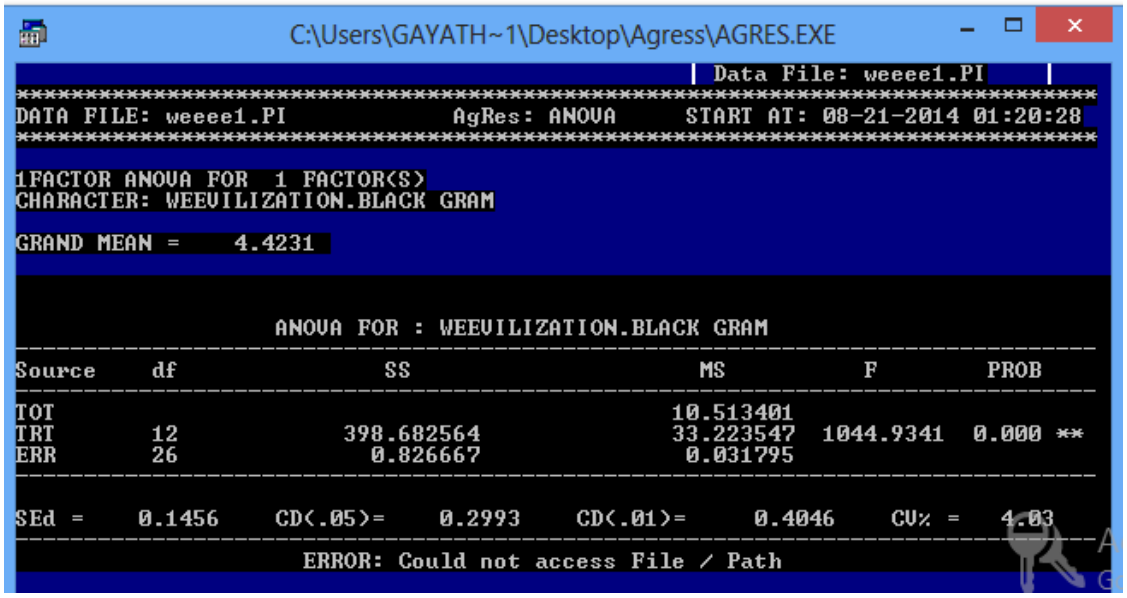
Effect of different botanicals on weevilization percentage of the selected pulses stored in gunny bags

Name of the pulses	VARIATIONS (in gms)																							
	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25
	1st month				2nd month				3rd month				4th month				5th month				6th month			
Black Gram																								
Neem	-	-	-	-	0.2	0.1	0.1	0.1	0.6	0.6	0.5	0.4	1.5	1.5	1.0	1.0	2.5	2.4	1.7	1.7	3.4	3.2	2.8	2.8
Nochi	-	-	-	-	0.3	0.2	0.1	0.1	0.8	0.6	0.5	0.5	1.9	1.8	1.3	1.3	3.5	3.0	2.6	2.5	4.2	3.9	3.5	3.5
Pongamiya	-	-	-	-	0.3	0.3	0.2	0.2	1.0	0.8	0.6	0.6	2.0	1.9	1.5	1.5	3.6	3.4	2.9	2.9	4.2	3.8	3.8	3.8
Control	**-**				**2.2**				**4.4**				**7.5**				**10.0**				**15.8**			
Black Channa																								
Neem	-	-	-	-	0.2	0.2	0.1	0.1	0.4	0.3	0.2	0.2	1.3	1.1	0.8	0.8	1.6	1.5	1.2	1.2	3.1	3.0	2.5	2.4
Nochi	-	-	-	-	0.3	0.3	0.2	0.1	1.0	0.9	0.6	0.6	1.5	1.4	1.0	1.0	2.0	1.9	1.4	1.4	3.6	3.5	3.2	3.2
Pongamiya	-	-	-	-	0.4	0.3	0.2	0.2	1.1	0.9	0.6	0.7	1.6	1.5	1.1	1.1	2.2	2.1	1.6	1.6	3.7	3.5	3.3	3.3
Control	**-**				**1.8**				**3.5**				**5.6**				**8.2**				**11.5**			
Cow Pea																								
Neem	-	-	-	-	0.3	0.2	0.2	0.1	1.2	1.2	0.9	0.9	1.6	1.4	1.2	1.2	2.2	2.0	1.7	1.7	3.0	2.9	2.6	2.6
Nochi	-	-	-	-	0.5	0.4	0.2	0.2	1.6	1.6	1.3	1.3	1.7	1.5	1.3	1.3	2.5	2.4	2.0	2.0	3.1	3.0	2.9	2.9
Pongamiya	-	-	-	-	0.5	0.4	0.2	0.3	1.8	1.6	1.4	1.4	1.8	1.6	1.4	1.4	2.6	2.6	2.1	2.1	3.2	3.1	3.0	3.0
Control	**-**				**2.3**				**4.1**				**6.9**				**8.5**				**12.8**			
Green Gram																								
Neem	-	-	-	-	0.3	0.3	0.1	0.1	1.3	1.3	0.9	0.9	2.2	2.1	1.7	1.7	2.5	2.5	2.3	2.2	3.6	3.4	3.2	3.2
Nochi	-	-	-	-	0.4	0.3	0.3	0.2	1.5	1.4	1.1	1.0	2.4	2.3	1.9	1.9	2.8	2.7	2.4	2.4	3.8	3.7	3.5	3.5
Pongamiya	-	-	-	-	0.5	0.4	0.3	0.3	1.6	1.5	1.2	1.2	2.5	2.4	2.1	2.0	2.8	2.8	2.5	2.5	3.9	3.8	3.6	3.6
Control	**-**				**2.9**				**6.2**				**10.3**				**14.9**				**18.9**			
Peas																								
Neem	-	-	-	-	0.2	0.1	0.1	0.1	0.4	0.3	0.2	0.1	1.6	1.5	1.2	1.2	2.2	2.1	1.9	1.8	2.7	2.6	2.3	2.2
Nochi	-	-	-	-	0.2	0.2	0.1	0.1	0.5	0.4	0.2	0.2	2.2	2.1	1.7	1.6	2.6	2.5	2.3	2.3	2.9	2.8	2.5	2.5
Pongamiya	-	-	-	-	0.3	0.2	0.2	0.1	0.6	0.5	0.3	0.3	2.4	2.0	1.7	1.7	2.8	2.7	2.4	2.4	3.0	2.9	2.6	2.6
Control	**-**				**1.5**				**3.6**				**6.0**				**7.8**				**10.5**			

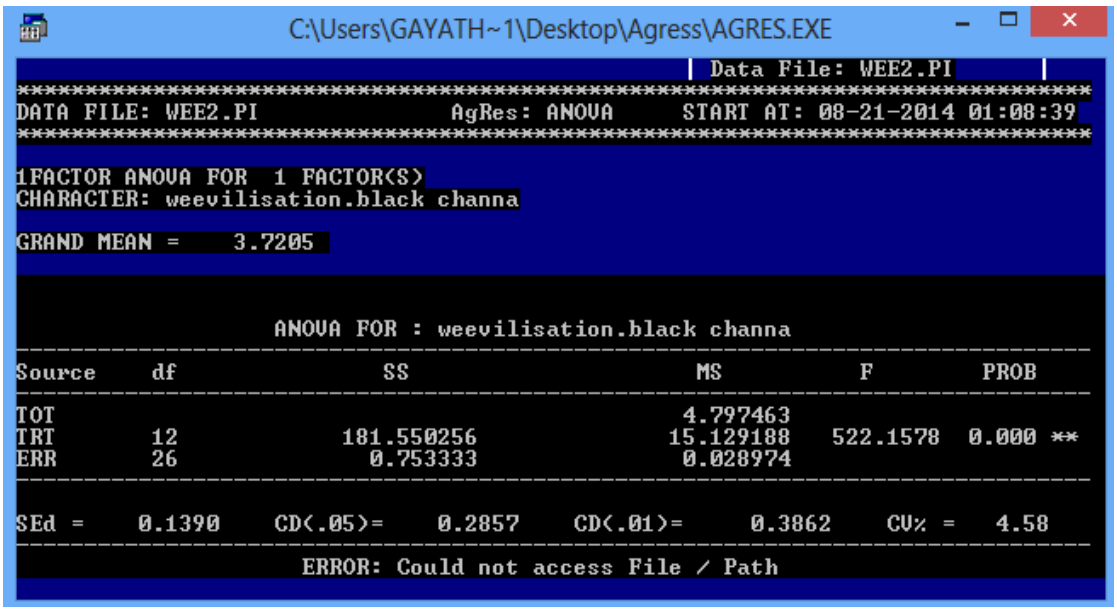
APPENDIX – XI

Weevilization Percentage

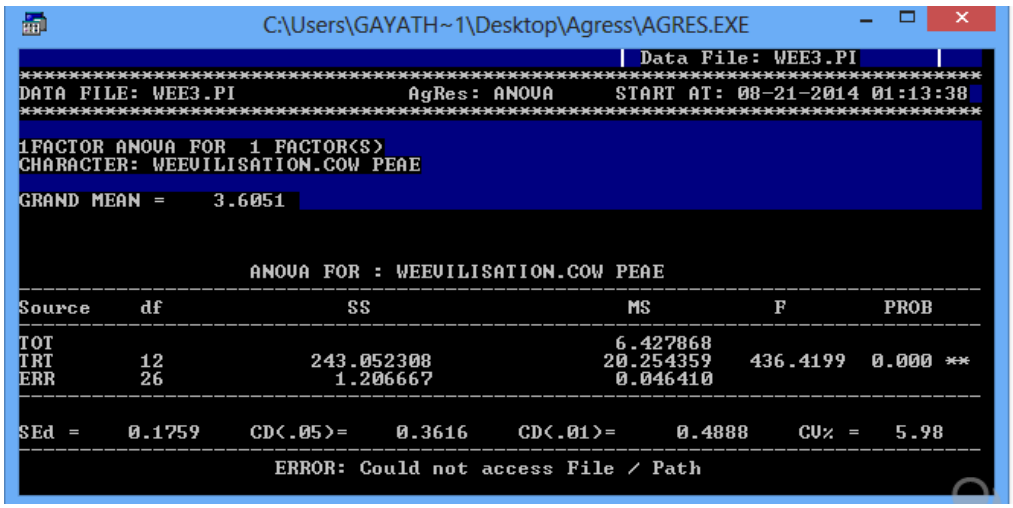
Single Factor ANOVA – Completely Randomized Design



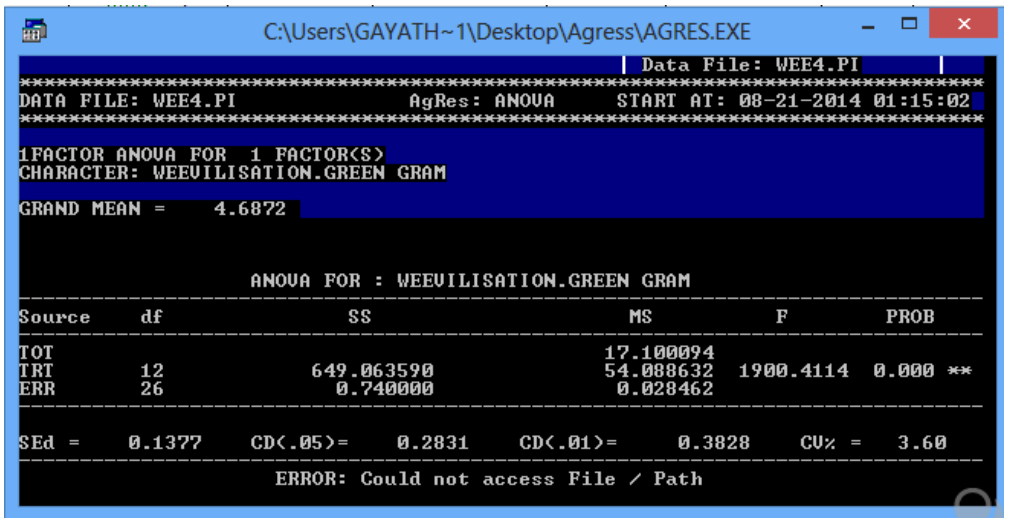
Black Gram



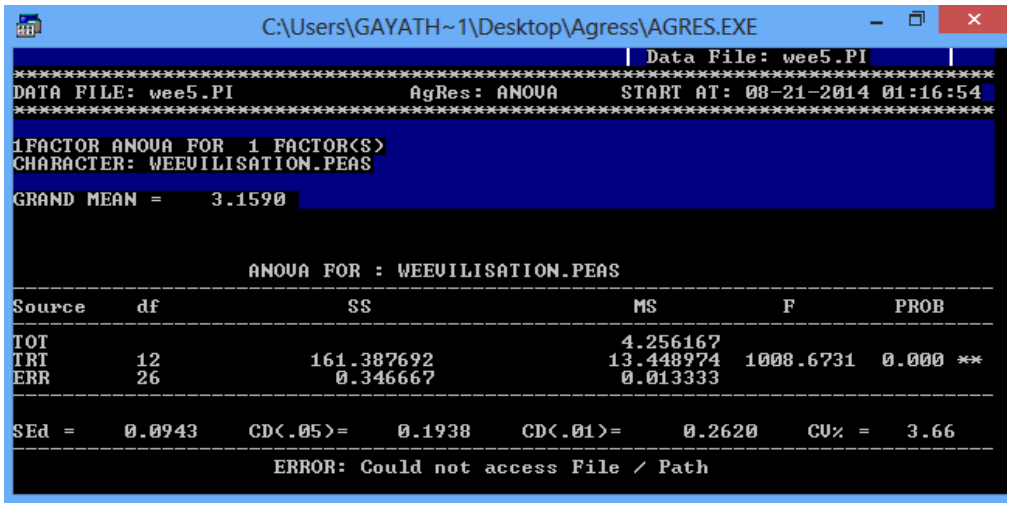
Black Channa



Cowpea



Green Gram



Peas

APPENDIX – XII

Effect of botanicals on germination percentage of the selected pulse stored in stainless steel container

Name of the pulse	VARIATIONS (in gms)							
	10	15	20	25	10	15	20	25
	Initial				Final			
Black gram								
Neem	100	100	100	100	96	96	97	98
Nochi	100	100	100	100	92	93	94	95
Pongamiya	100	100	100	100	91	90	91	93
Control	100				58			
Black Channa								
Neem	100	100	100	100	93	95	94	95
Nochi	100	100	100	100	91	91	90	90
Pongamiya	100	100	100	100	88	90	92	92
Control	100				51			
Cow Pea								
Neem	100	100	100	100	98	99	98	99
Nochi	100	100	100	100	95	96	98	98
Pongamiya	100	100	100	100	94	95	95	96
Control	100				55			
Green Gram								
Neem	100	100	100	100	96	98	98	99
Nochi	100	100	100	100	95	95	96	97
Pongamiya	100	100	100	100	93	94	95	95
Control	100				64			
Peas								
Neem	100	100	100	100	82	84	84	86
Nochi	100	100	100	100	78	80	82	82
Pongamiya	100	100	100	100	78	79	82	81
Control	100				50			

Effect of botanicals on germination percentage of the selected pulse stored in polythene bags

Name of the pulse	VARIATIONS (in gms)							
	10	15	20	25	10	15	20	25
	Initial				Final			
Black gram								
Neem	100	100	100	100	93	93	95	96
Nochi	100	100	100	100	90	92	94	95
Pongamiya	100	100	100	100	90	91	92	92
Control	100				55			
Black Channa								
Neem	100	100	100	100	84	85	87	88
Nochi	100	100	100	100	80	81	84	85
Pongamiya	100	100	100	100	81	82	84	84
Control	100				45			
Cow Pea								
Neem	100	100	100	100	87	87	89	89
Nochi	100	100	100	100	83	84	86	87
Pongamiya	100	100	100	100	84	85	87	88
Control	100				55			
Green Gram								
Neem	100	100	100	100	88	90	91	92
Nochi	100	100	100	100	85	88	90	90
Pongamiya	100	100	100	100	86	88	89	89
Control	100				62			
Peas								
Neem	100	100	100	100	80	83	84	84
Nochi	100	100	100	100	78	79	81	81
Pongamiya	100	100	100	100	75	78	80	80
Control	100				48			

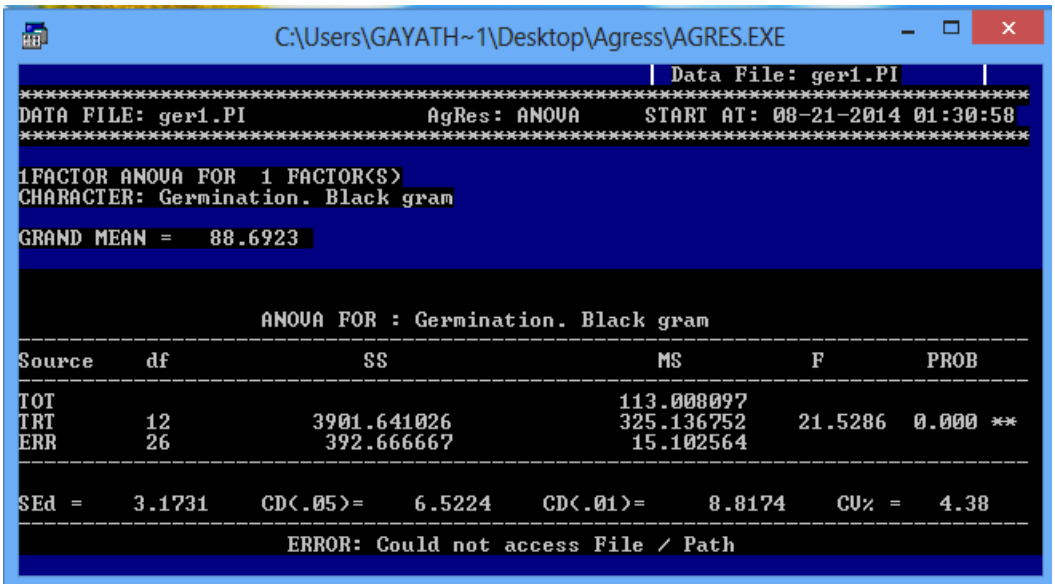
Effect of botanicals on germination percentage of the selected pulse stored in gunny bags

Name of the pulse	Variations (in gms)							
	10	15	20	25	10	15	20	25
	Initial				Final			
Black gram								
Neem	100	100	100	100	90	90	91	91
Nochi	100	100	100	100	88	76	89	90
Pongamiya	100	100	100	100	85	85	88	89
Control	100				52			
Black Channa								
Neem	100	100	100	100	82	82	84	85
Nochi	100	100	100	100	78	80	81	82
Pongamiya	100	100	100	100	78	79	82	82
Control	100				44			
Cow Pea								
Neem	100	100	100	100	86	87	89	89
Nochi	100	100	100	100	82	84	86	86
Pongamiya	100	100	100	100	83	84	87	87
Control	100				52			
Green Gram								
Neem	100	100	100	100	85	86	88	89
Nochi	100	100	100	100	83	85	86	87
Pongamiya	100	100	100	100	84	86	86	88
Control	100				60			
Peas								
Neem	100	100	100	100	78	79	80	83
Nochi	100	100	100	100	76	78	79	80
Pongamiya	100	100	100	100	74	76	78	78
Control	100				45			

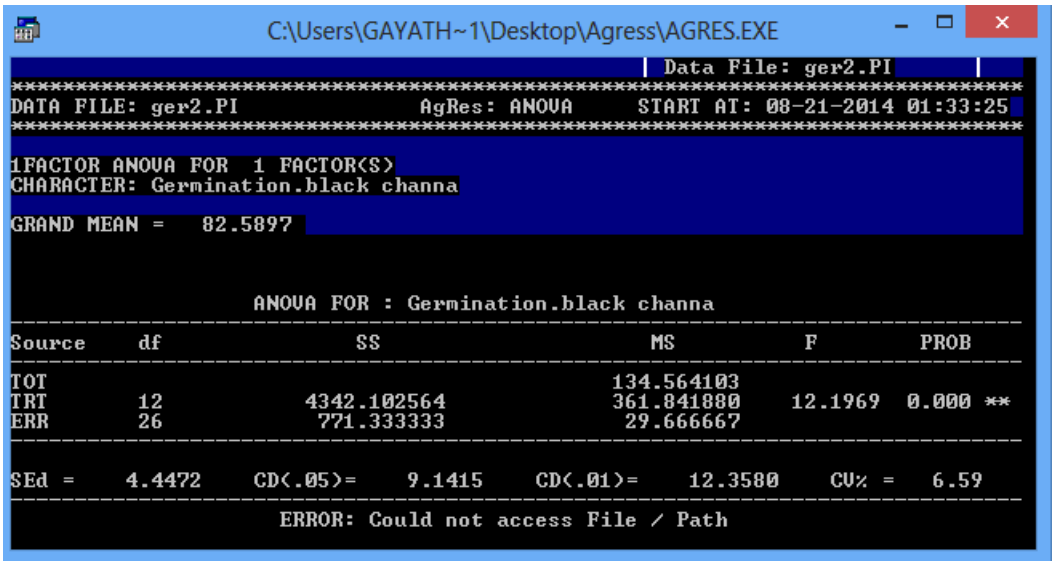
APPENDIX – XIII

Germination Percentage

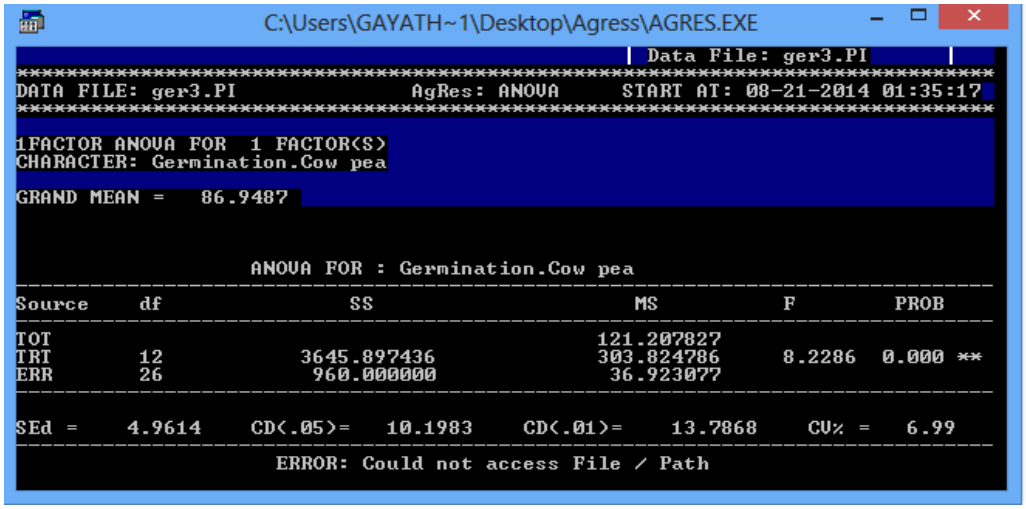
Single Factor ANOVA – Completely Randomized Design



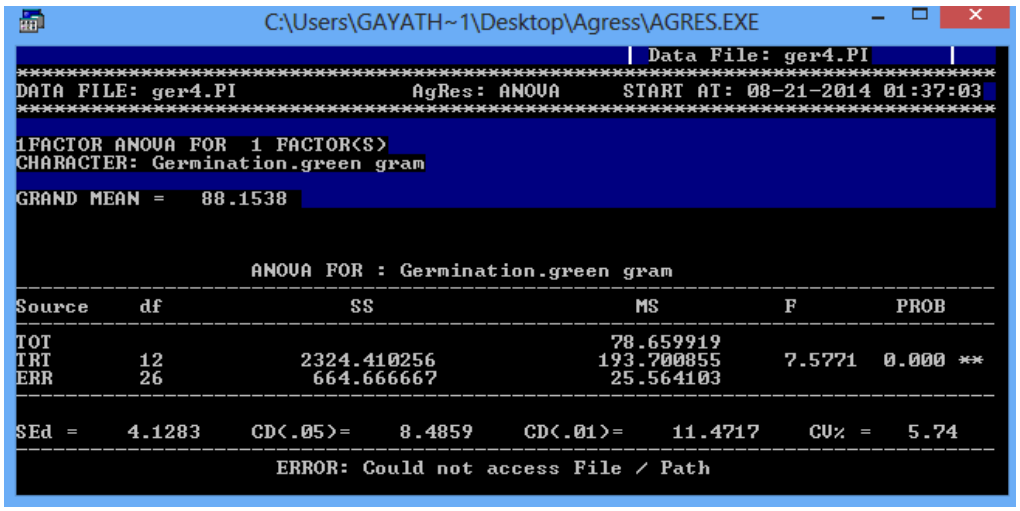
Black Gram



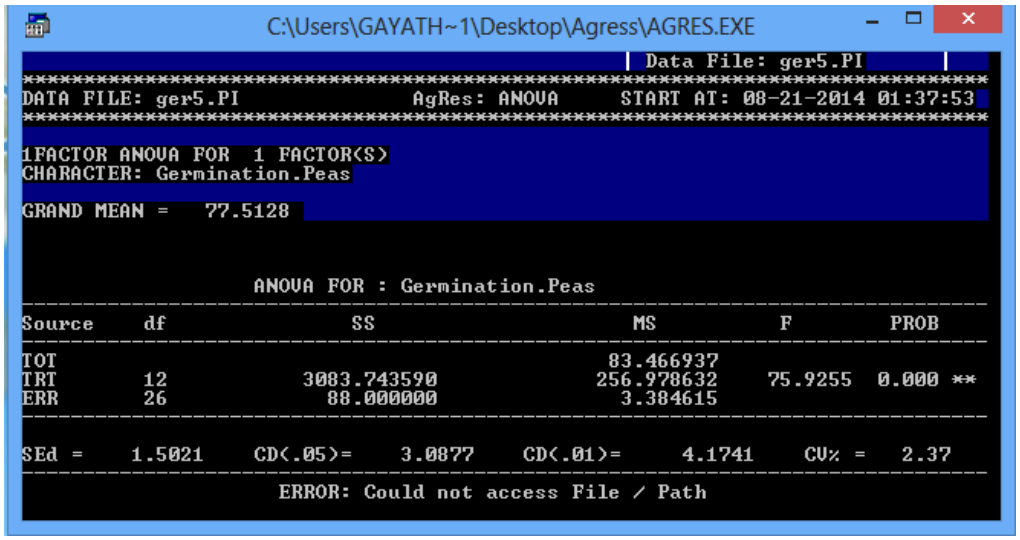
Black Channa



Cowpea



Green Gram



Peas

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- Gayathri.D., and Manimozhi,K., (2011), “Sustainable Livelihood through Organic Farming”, Proceedings of the Seventh All India Conference of KAAS (Vol-III), Pp. 7-10, ISBN No – 978-81-909710-0-3.

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- Manimozhi.K., and Gayathri.D., (2011), “Organic Agricultural for Agricultural Sustainability”, Vignanachudar, September, Pp. 46 – 50.

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- Manimozhi.K., and Gayathri.D., (2012), “Food Grain Storage and Practices”, Vignanachudar, March, Pp. 6-8.