

METHODOLOGY

*“When planning for a year, plant food crops. When planning for a decade, plant trees.
When planning for generations, train and educate people”*

Pulses are considered as a primary source of dietary protein. With continuously increasing Indian demographics, pulses have become more and more expensive and getting beyond the reach of larger part of the population; paradoxically to the fact that India being the largest pulses producer and consumer in the world (Agricultural Situation in India, 2012). While the production of pulses is seasonal in nature, consumption of the same is throughout the year; hence, safe and sound storage practice is important to maintain pulses quality and quantity. It is estimated that 5 - 10% of the world's production of food grains is damaged by insects during storage (Kumar and Gupta 2011) which can be avoided by following safe storage methods. Sustained physical losses and deterioration of the quality are a major threat to national food security. Although use of synthetic insecticides may help in reducing pulses damage during storage, it is proven that they pose serious health hazard and threat to the safety of the human beings, animals and environment.

Indigenous practices play a vital role in preventing storage losses that occurs due to varied factors such as improper storage temperature, inappropriate handling of pulses, mites, insect and pest attack, fungal attack and other biological factors which may cause uncertainty in pulses availability. The extent of the damage varies with storage conditions and methods adopted. It is important to bring back the use of botanicals during pulses storage in order to ensure food safety and security. Since there is need for safe storage techniques and the use of botanicals during pulses storage, the study **“Effect of different botanicals on the keeping quality of selected pulses”** was designed to assess household storage practices of pulses and to promote as well as to persuade safe storage techniques and the use of botanicals during pulses storage in order to improve the quality of food, reduce the

use of synthetic insecticides, and improve the health status of the family members, thereby improving food security and economy. The study was conducted in the following phases:

Phase I

A. Survey

- i) Household Survey
- ii) Market Survey

Phase II

- B. Trial on using different botanicals on the keeping quality of selected pulses

Phase III

- C. Conducting training programme on the use of different botanicals during pulses storage

Phase IV

- D. Evaluation of the impact of the training programme conducted.

The schematic representation of the research design is presented in Figure 1 and 2.

Phase I

A. SURVEY

Survey is a method for collecting and analyzing data, obtained from large number of cases representing a specific population. Survey is a process of collecting data from existing population units with no particular control over factors that may affect population characteristics of the study where the method helps to gather data from a relatively large number of cases at a particular time (Gupta, 2008). As the topic of the study required information on pattern of pulses consumption, purchasing behaviour of consumers, storage methods of pulses and its accompanying problems, a household survey and market survey were conducted.

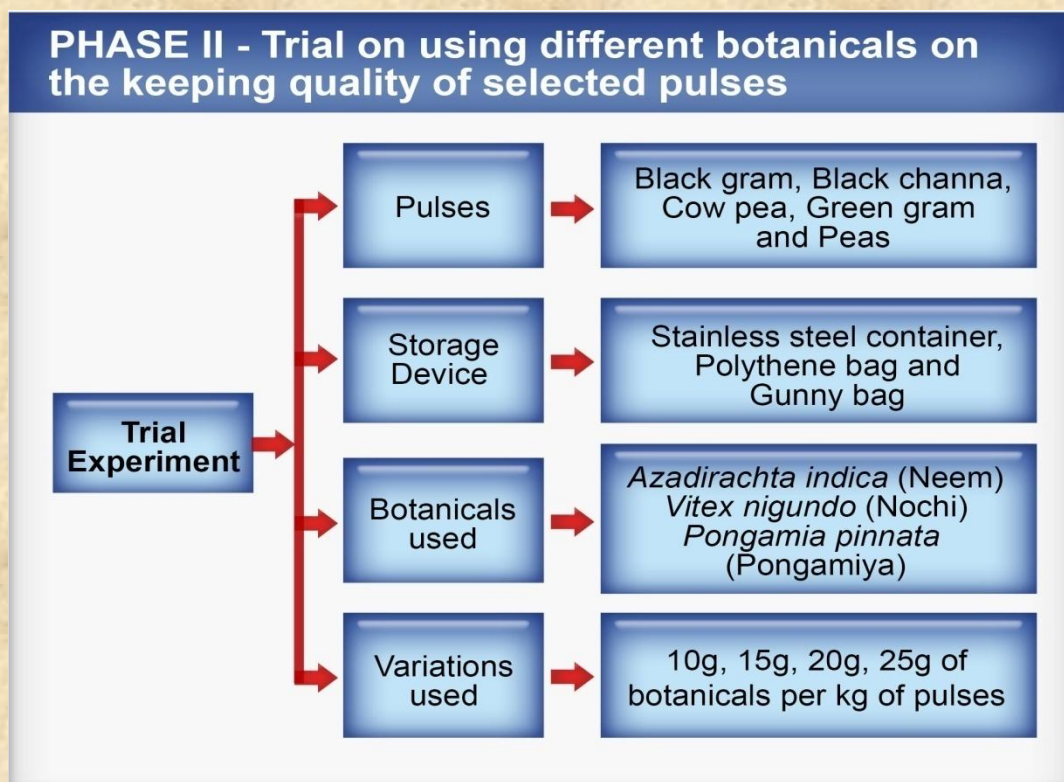
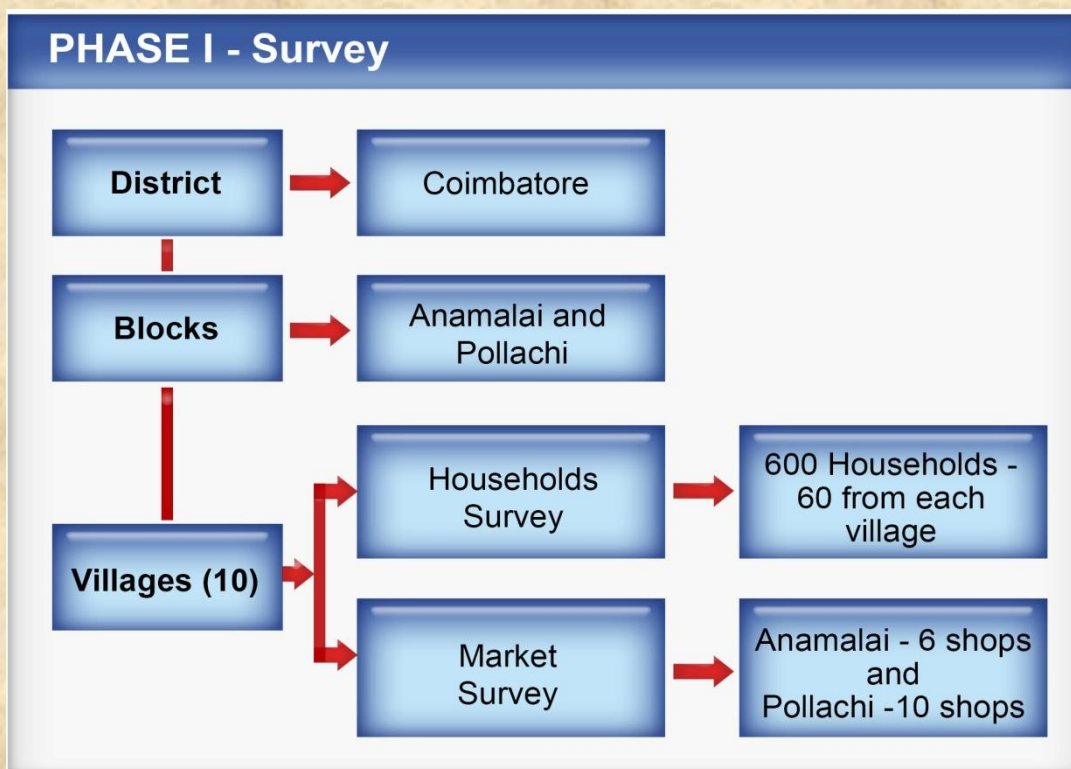


Figure 1
Schematic Representation of the Research Design (Phase I and II)

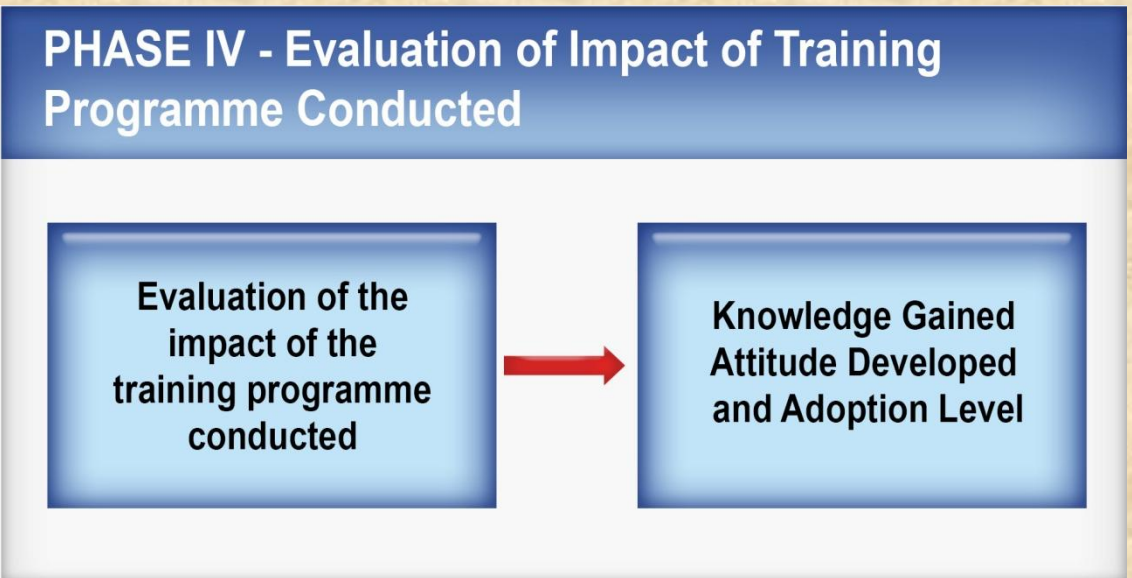
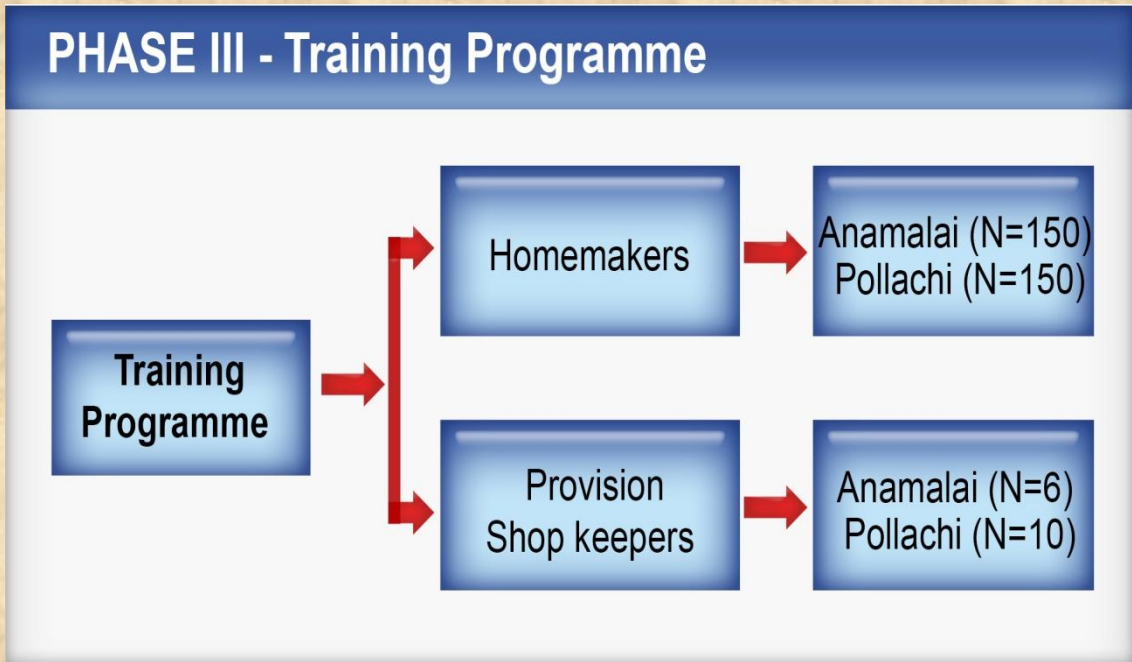


Figure 2

Schematic Representation of the Research Design (Phase III and IV)

i) Household Survey

Kothari (2007) points out that household surveys are concerned with conditions or relationships that exist, opinions that are held, processes that are going on, effects that are evident or trends that are developing. To understand the storage practices, problems faced during storage and methods to overcome the problems, household survey was conducted. The household survey consists of the following steps:

1. Selection of area
2. Selection of samples
3. Conduct of survey
4. Analysis and interpretation of the data collected

1. Selection of Area

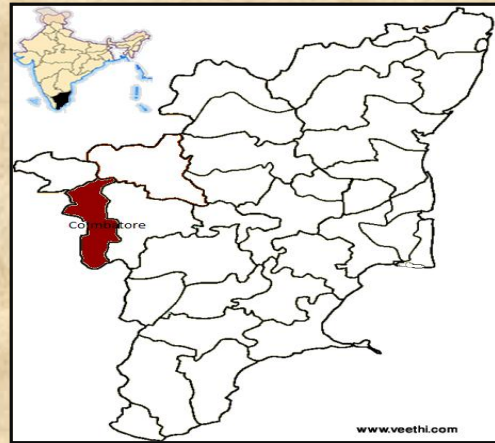
The study was conducted in Coimbatore District of Tamil Nadu State, India. Two blocks, namely, Anamalai and Pollachi blocks (Figure 3) were selected as the study area through simple random sampling method. Gupta (2007) states that simple random sampling is a randomly selected sample from a larger sample or population, giving all the individuals in the sample an equal chance to be chosen. Five villages each from Anamalai and Pollachi block were also randomly selected for the study. The list of selected villages is given in Appendix I.

2. Selection of Sample

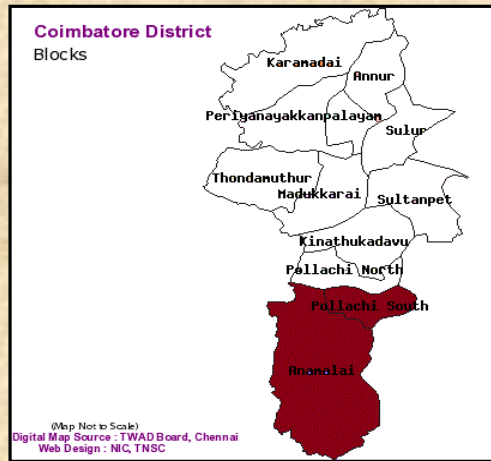
The success of any study depends on the careful selection of the sample. A sample is a portion of the total population that is considered for the study and analysis (Chandan,2008).The choice of the sample must be decided based on factors such as nature of the study, size of universe, size of the sample, degree of precision desired and availability of resources. For the household survey, covering more than fifty percent of the village population was considered and hence 60 households from each of the ten chosen villages which constituted a total of 600 households were selected by using simple random sampling technique.



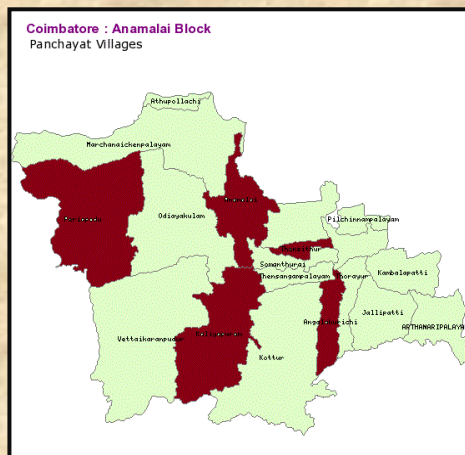
State -Tamil Nadu



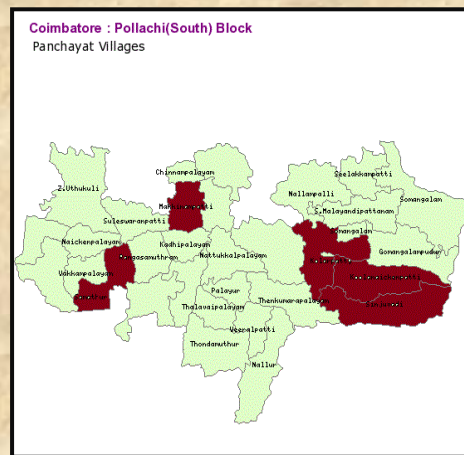
District - Coimbatore



Blocks - Anamalai and Pollachi



Anamalai



Pollachi

■ Villages selected

Figure 3
Locale of the Study

3. Conduct of Survey

Survey is concerned with describing, recording, analyzing and interpreting conditions that either exists or existed. Survey is a systematic method of gathering information from a sample of entities for the purpose of constructing quantitative descriptors of the attributes of a large population of which the entities are members, opines Groves (2011). This part of the study included:

- a. Selection of method
- b. Selection of tool
- c. Collection of data

a. Selection of method

To collect first hand information related to socio-economic profile of the selected households, quantum of pulses stored, period of storage, damage of pulses noticed during storage and control measures adopted to reduce damage, a direct personal contact with respondents is essential.

Khan (2009) opines that personal interview is a well established method of data collection in which respondents are given opportunity to freely express their problems, views, opinions, comments etc. Interview helps to establish close personal contacts between the interviewer and interviewee and by its means detailed knowledge about intimate and personal aspects of the individual can be ascertained. Owing to its suitability, direct personal interview method was selected to collect the required information.

b. Selection of tool

Gupta (2005) opines that schedule is the name usually applied to a set of questions which are asked and filled in a face to face situation with the other person. The schedule contains all the questions which would extract complete information from respondent (Agarwal, 2006). To collect details related to this study, it was necessary to include in the schedule, questions relating to socio-economic profile, storage practices adopted, problems encountered during storage and measures undertaken to solve the problems. A schedule was carefully drawn to elicit the required information from the selected sample.

According to Kothari (2007), pilot study is considered advisable to do some field observation through which the researcher may undertake some sort of preliminary survey or pilot survey. Hence, a pilot study was done by administering the schedule to 50 households. Based on the experience in pre-testing, the schedule was modified to avoid ambiguity and complexity. Open ended questions were also included in the schedule to get detailed information from the respondents. The schedule thus finalized is presented in Appendix II.

c. Collection of data

Collection of data refers to a purposive gathering of information relevant to the subject matter of the study from the units under investigation (Gupta 2001). Reddy, (2009), suggest information has to be collected from individuals directly or indirectly. With the help of the finalized schedule, the survey was carried out. The homemakers were contacted personally one at a time at their convenience. Rapport was developed and they were explained about the objective of the study. Confidence was thus instilled in the respondents. Then the required information was elicited using the schedule and recorded side by side.

4. Analysis and Interpretation of the Data

Paneerselvan (2005) suggested that data are the basic input in any decision making process. The processing of data gives statistics of importance of the study. The data thus obtained was tabulated, analysed and presented in Chapter IV.

ii) Market Survey

A market survey is a tool used to gather information about existing or potential customers in a certain market or population (www.ehow.com). This part of the study comprised of market survey in provision stores. This survey was conducted among shop keepers to analyze the pulses consumption pattern of consumers through the existing market trend which paved way for a clear understanding of the pulses storage and consumption pattern. The initial pulses quality and storage practices adopted in the market are the main factor causing the pulses damage during storage

in households. So as to understand the extent of damage through insect, pest and other biological agents in the market itself is important. This survey included;

- a. Selection of Locale and Sample.
- b. Conduct of the Study.

a. Selection of Locale and Sample

For the market survey, covering all the provision stores in the adopted villages were considered and hence six provision stores from Anamalai block and 10 provision stores from Pollachi block were chosen for the study. These stores were selected to understand the availability, selling pattern and storage practices of pulses, and consumer preference for pulses. Selection was also based on the point of sale experience, ease in accessibility and willingness to participate.

b. Conduct of the Study

The investigator contacted the shop owners and explained the purpose of the study. A good rapport was established with the respondents and the questions were asked informally adopting personal interview method and the relevant information was gathered for the study. According to Thakur (2006) interview is the oral version of questionnaire or schedule in which the subject supplies the needed information in a face to face relation. Gupta (2008) as well reflects that personal interview is an effective informal, verbal and non-verbal conversation, initiating for a specific purpose and focused on certain planned content areas, this method was chosen to decipher the required information from the dealers. Conduct of household survey and market survey are depicted in Plate 4.

The tool chosen for the market survey was an interview schedule. It includes questions on frequency of purchasing pulses, quantum of pulses procured and sold per month and problems faced during storage of pulses. The schedule thus prepared was administered on the dealers to comprehend the information needed by the investigator. The schedule thus finalized is presented in Appendix III. The findings of the study are presented under Chapter IV.

Household Survey



Market Survey



Plate 4

Conduct of survey

Phase II

B. Trial on using different botanicals on the keeping quality of selected pulses

Various botanicals can be used for the protection of the food grains from damage during storage and is an effective alternative to chemical insecticides. Use of chemicals is indeed expensive, not easily available and cause ill effects as well, whereas botanicals are readily available to farmers and free of cost, environmental friendly and safe to handle. Khatun *et al.*, (2010) also concluded in his study that the use of different plant parts and their derivatives appeared as an effective alternative to the use of poisonous chemical insecticides for controlling various insects and pests during storage.

The experiment was conducted with the following aspects:

1. Selection of pulses for storage
2. Selection of storage devices
3. Selection of botanicals
4. Preparation of botanicals
5. Conduct of the experiment
6. Assessing the keeping quality of selected stored pulses

1. Selection of pulses for storage

It was understood from the household survey that 80 per cent of the homemakers stored pulses for a period of six months for their family consumption and for forthcoming sowing season. The preliminary survey data revealed that the majority of the households consumed pulses liberally. The pulses commonly stored and consumed by the selected households were black gram (*Vigna mungo*), black channa (*Cicer arietinum*), cowpea (*Vigna unguiculata*), green gram (*Vigna radiate*), and pea (*Pisum sativum*). Hence these pulses were selected for the storage experiments (Plate 5).



Black Gram



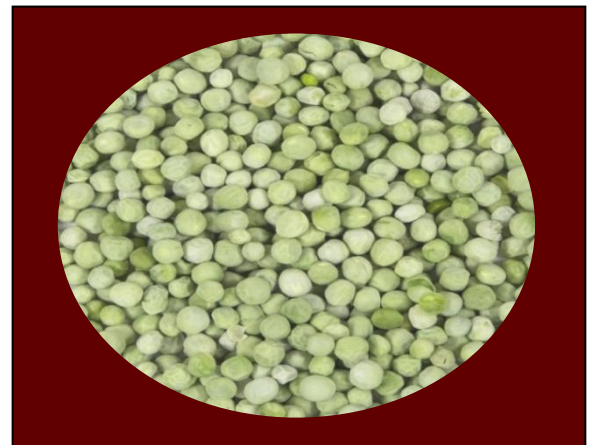
Black Channa



Cowpea



Green Gram



Peas

Plate 5

Pulses Selected for Storage Experiment

2. Selection of storage devices

The household survey revealed that majority of the homemakers stored pulses in stainless steel container for household purpose. It is a common practice to store dry grains in air tight stainless steel container since it restricts the insect breeding. Market survey revealed that bulk quantities of pulses were stored in gunny bags and polythene bags. Hence, stainless steel container, gunny bag and polythene bag were selected as the storage devices for conduct of the experiments (Plate 6).

3. Selection of botanicals

Experimental studies conducted by Devkumar (2005), Purohit (2006), Mariappan & Srimathi (2009) and Rajashekar *et al.*, (2012) on pest repellent qualities of botanicals revealed that leaves of *Azadirachta indica* (Neem), *Vitex nigundo* (Nochi) and *Pongamia pinnata* (Pongamia) are effective against wide range of insects and pests. These trees are widely grown in the selected area and their leaves often go on waste. These leaves are a treasure and also a boon to the households to overcome the problems of pulses damage during storage. The ubiquitous presence, eco-friendly and renewable nature of its produce, makes it an ideal choice for its use during storage of pulses.

With this background, the uses of different botanicals during storage of pulses were found essential. Hence *Azadirachta indica* (Neem), *Vitex nigundo* (Nochi) and *Pongamia pinnata* (Pongamiya) were selected for the trial experiment (Plate 6).

4. Preparation of botanicals

According to Feng and Isman (1995) insect resistance is likely to develop with crude forms like powders and mixtures. If plant materials are readily available, it will be easy for farmers to prepare the pulverized form as this is the simplest and cheapest method for preparing botanicals (Paul *et al.*, 2009). Therefore the leaves of the selected botanicals were collected from the selected villages. The collected leaves were dried under ambient room temperature (27°C to 34°C), powdered separately using blender and sieved through a mesh to get fine leaf powder. Eco-friendly cloth material was procured from the market since these materials allow the free air circulation and thus will have effect of botanicals on to the pulses.

Storage Devices



Gunny bag



Polythene bag



Stainless steel container

Botanicals



Azadirachta indica (Neem)



Vitex nigundo (Nochi)



Pongamia pinnata (Pongamiya)

Plate 6

Storage Devices and Botanicals Selected for the Experiment

Small packets using thin non-woven eco-friendly material (cloth) were prepared and different quantity each of *Azadirachta indica* (Neem), *Vitex nigundo* (Nochi) and *Pongamia pinnata* (Pongamiya) powder were weighed accurately and transferred to these packets (Plate 7).

5. Varied proportion of botanicals for storage

The organic organization HDRA has validated the proportion of neem leaf powder to be added to the stored grain as 1 or 2 kg for 100 kg of grains. The same was given in another study conducted by Tamil Nadu Agricultural University. They also stated that Neem leaf powder, Nochi leaf powder, Turmeric powder, Sweet Flag (Vasambu) Rhizome powder have been found to be effective against storage pests at 10g/kg (http://agritech.tnau.ac.in/agriculture/agri_index.html). Thus, the selected three botanicals such as *Azadirachta indica* (neem), *Vitex nigundo* (nochi) and *Pongamia pinnata* (pongamiya) were added in five different proportions namely 10g, 15g, 20g, 25g to 1 kg of all the selected pulses stored for a period of six months in order to finalize the optimum quantity of botanicals required for safe storage. A control sample for each pulse was also stored in the selected three different storage devices without using the selected botanicals.

6. Conduct of the trial experiment

The trial experiment was conducted under controlled conditions like avoiding unnecessary opening of the storage device, maintaining hygienic method during inspection, maintaining moisture level and avoiding cross contamination. One kg of each pulse stored with eco-friendly non-woven bags containing three different *Azadirachta indica* (Neem), *Vitex nigundo* (Nochi) and *Pongamia pinnata* (Pongamiya) botanical leaf powders with four variations in quantity were placed in air tight stainless steel container, small gunny and polythene bags for a period of six months. A control for each pulse was also stored in three different storage devices. Thus a total of 60 stainless steel containers, 60 gunny bags and 60 polythene bags were used for the study to store the five different pulses with the experimental botanicals in addition to the control groups.



Collection of botanical leaves



Cleaning and processing



Drying



Powdering



Packing

Plate 7

Preparation of Botanicals for Storage

Coding is an interpretive technique that both organizes the data and provides a means to introduce the interpretations of it into certain quantitative methods. Most coding requires the analyst to read the data and demarcate segments within it. Each segment is labeled with a code usually a word or short phrase that suggests how the associated data segments inform the research objectives (Khan, 2009). Hence coding was used for the experiment. The coding information is given below:

1. SS –Stainless steel container, GB – Gunny bag, PB – Polythene Bag.
2. X_{10} , X_{15} , X_{20} , X_{25} - Variations in proportion of Botanicals

7. Analysis of Keeping Quality of Selected Pulses

According to Food Corporation of India publication (2012) the quality of food grains (Cereals and Pulses) stored should be assessed in terms of percentage of moisture, weevilization, germination percentage and organoleptic qualities. Therefore, the study was focused on the quality analysis of stored pulses following the guidelines of Food Corporation of India.

i. Moisture Content

The moisture content of pulses varies during prolonged period of storage because of the atmospheric changes (Deshpande and Singh, 2001). Therefore the moisture content of stored pulses was analyzed once in a month for six period storage periods. For analysis, the pulses were collected from different sections of the container (top, bottom, middle and side). Digital Moisture Meter was used to measure the percentage of moisture content of stored pulses. Analysis of Variance (single factor analysis - completely randomized design) was performed using AGRSS - Agricultural Research Statistical Software to assess the moisture content of the selected pulses stored for six months in three different storage devices. Room temperature was measured using a sensitive thermometer during the storage period. Relative humidity during the study period was obtained from Agro Climate Research Centre, Tamil Nadu Agricultural University, Coimbatore.

ii. Weevilization Percentage

For assessing the weevilization percentage, 1 kg of pulses were collected and kept separately to avoid spillage. From this, a sub- sample of 100 g was taken and

spread in a tray. All the insect infected and damaged pulses were separated from the sample, counted and weighed and the percentage of weevilization and percentage weight of loss was calculated using rapid loss assessment techniques (Golob *et al.*, 1996).

Weight loss was calculated using:

$$\text{Percentage of weight loss} = \frac{(UNd) - (DNU)}{U(Nd+Nu)} \times 100$$

Where: U - Weight of undamaged pulses
 Nu - Number of undamaged pulses
 D - Weight of damaged pulses
 Nd - Number of damaged pulses

The percentage of weevilization was calculated using:

$$\text{Percentage of weevilization} = \frac{Nd}{(Nu+Nd)} \times 100$$

This was repeated every month during the storage period. On the basis of this data, the percentage of infestation in the stored pulses was determined. Analysis of Variance (single factor analysis - completely randomized design) was performed using AGRASS - Agricultural Research Statistical Software to assess the weevilization percentage of the selected pulses stored for six months in three different storage devices.

iii. Germination Percentage

The germination test was conducted by using sand medium method in plastic tub. 10 g of black gram, black channa, cowpea, green gram and pea were used for the test. The germination percentage was calculated at the fifth day of green gram, black gram, cowpea and seventh day of peas and black channa. This was done during initial and final period of storage. The number of normal seedling was counted and expressed as percentage of germination. Analysis of Variance (single factor analysis - completely randomized design) was performed using AGRASS - Agricultural Research Statistical Software to assess the germination percentage of the selected pulses stored for six months in three different storage devices.

iv. Organoleptic Quality

In order to find out the organoleptic qualities of the stored pulses, black gram vadai, black channa sundal, cowpea gravy, green gram sundal and peas sundal were prepared using the stored pulses as part of the daily menu and the organoleptic qualities such as appearance, texture, colour, flavour and taste were assessed by the homemakers using a score card. This was done in the initial and final period. Plate 8 depicts the analysis of moisture, weevilization, germination and organoleptic qualities.

Phase III

C. Conducting training programme on use of different botanicals during pulses storage

*“Feed a man for a day and you feed him for a day
Teach a man how to feed and you feed him for the life”*

Based on the household survey and experiment, it was found necessary to arrange a training programme to convey the benefits of using botanical leaves in storage of pulses and safe storage techniques to avoid damages due to insects, pests and fungus. Although surveys have identified that people believe botanicals are cheaper, easily available and safer than conventional insecticides. It is also evident that a lack of understanding prevents their widespread uptake.

Training provides knowledge and develops skills required for adoption of the techniques and builds up desirable scientific attitude. Training and awareness generation aim at finding a solution for an immediate problem facing by the society (Saravanavel, 2004). After instilling the awareness, the ways and means of its adoption were informed through a training programme. The training programme focused on aspects which needed special attention such as benefits of consuming pulses, need for preventing pulses damage, safe storage techniques, problems in pulses storage and methods to overcome these problems.

The steps included in conducting the training programme were,

1. Selection of sample
2. Formulation of training curriculum
3. Organization of the training programme
4. Follow up of the training



Moisture content



Weevilization percentage



Germination percentage



11.



Organoleptic quality



Plate 8

Assessing the Keeping Quality of Selected Pulses

1. Selection of sample

A sample is part of the whole, selecting in such a manner as to be representing the whole, opine Pal and Sarkar (2006) and Chandan (2008). Half the sample of household survey i.e. 300 households, 30 from each village were selected for the training programme through simple random sampling technique. Willingness of the homemakers, leadership ability, interest in learning new techniques and attitude to spread the message learnt was also considered in the selection process.

2. Formulation of training curriculum

The problems in storage as revealed from the household and market survey and the efficiency of selected botanicals to prevent insect and pest attack proven by the experiment conducted in the laboratory over a period of six months, a training curriculum was formulated. The major thrust areas dealt in the training programme is given in Table I.

TABLE I
COURSE CONTENT OF THE TRAINING PROGRAMME

S.No	Topic	Method/Audio-Visual Aids Used
1	Pulses - importance of pulses in daily diet, production status of pulses in India	Lectures by subject experts and booklets
2	Storage of pulses, importance of storage, storage methods and devices, safe moisture level of pulses, importance of sun drying, safe storage techniques	Lectures using slide shows, and booklets
3	Factors responsible for storage losses, types of losses - quality and quantity loss, measures to control losses, existing storage practices and their modifications, type of pulse damage and deterioration in storage	Lectures, group discussion using booklets and charts
4	Common storage pests - Fungi, insects (primary, secondary and tertiary pests) rodents, preparation of pulses for storage, preparation of storage container, preventive measures against insects and moulds – before storage and during storage, safe and simple methods adopted to control insects and pests	Lectures with group discussions
5	List of botanicals in preventing pulses damage due to insects and pests, role of botanicals in stored pulses, preparation of botanical leaf packets using eco-friendly non-woven materials, practical methods of its application.	Lectures cum demonstration, slide shows and booklets

3. Organization of the training programme

Realizing the importance of training programme in minimizing pulses losses during storage, a training programme was organized. Training was given for a period of five days in each of the selected villages. It was given during the leisure time of the homemakers and shop keepers for around 90 minutes every day. They were asked to assemble in a common place and purpose of the training was explained to them. Totally three hundred homemakers and sixteen shop keepers participated in the training programme from the selected villages of both the blocks. The purpose of the study and the training programme was explained to them and their co-operation was sought for the success of the programme. The tools used for the training programme were special lectures, participatory discussion, and field demonstration by using charts, posters, booklets, power point ICT tools. The content of the message conveyed through the above tools are detailed below.

i. Special lectures

Lectures were designed to make the trainees aware of the need for storage of pulses, problems during storage, health problems of chemicals in storage, safe storage techniques, importance of botanicals, medicinal and insecticidal properties of selected botanicals, pulses losses due to moisture, temperature, insects and mites, nature of damage and prevent measures through use of *Azadirachta indica* (Neem), *Vitex nigundo* (Nochi) and *Pongamia pinnata* (Pongamia) leaves (Plate 9).

ii. Participatory discussions

Discussion was held with the target group on all topics mentioned in the training schedule with the support of audio-visual aids. The infested and sound pulses bought by the trainees from their villages were displayed and discussions were centered on causes for infestation, preventive measures, and storage practices using *Azadirachta indica* (Neem), *Vitex nigundo* (Nochi) and *Pongamia pinnata* (Pongamia) leaves (Plate 10).

iii. Demonstration

Lecture cum demonstration was used to show the use of botanicals during storage of pulses. Discussions were held on the prevention of insect attack in stored pulses. Posters and charts were also used as visual aids for better interaction among participants on minimizing storage losses (Plate 11 and 12).



Plate 9
Lecture Method



Plate 10

Discussion and Demonstration Method

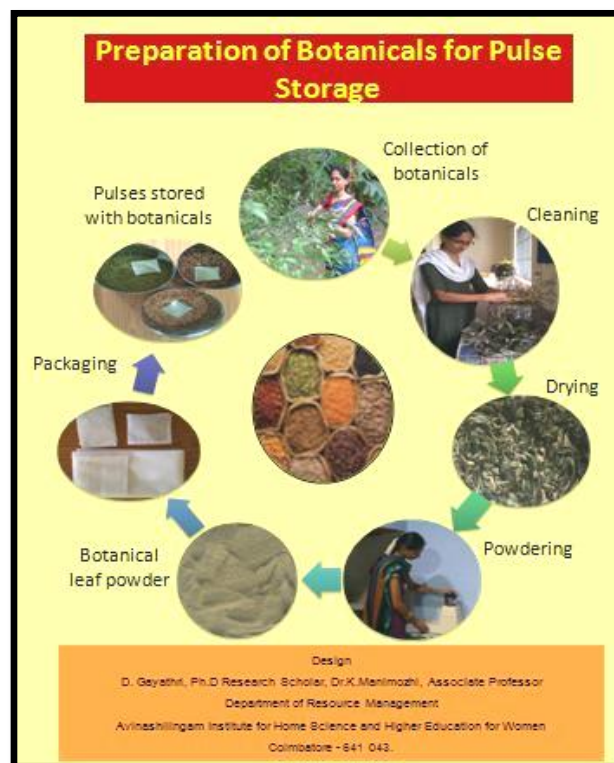
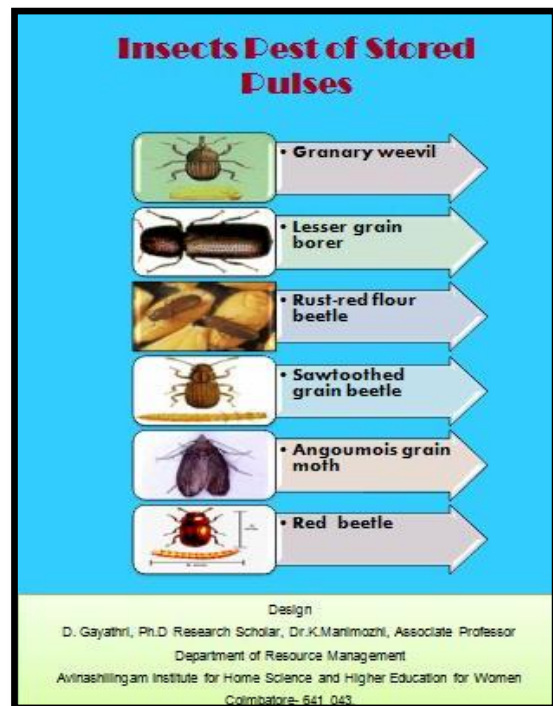
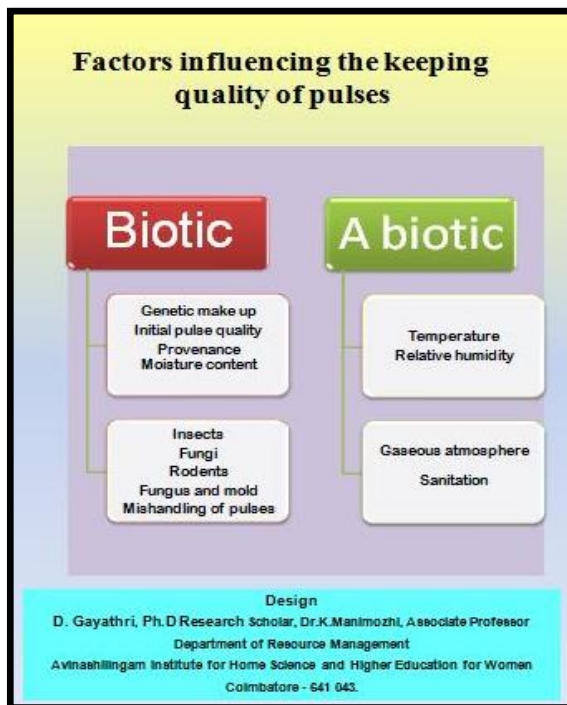


Plate 11

Posters Used during the Training Programme

VARIOUS BOTANICALS USED AGAINST STORED GRAIN PESTS

Azadirachta indica (Neem)

Vitex negundo (Nochi)

Pongamiya pinnata (Pongamiya)

Annona squamosa (Custard apple)

Punicum Granatum (Pomegranate)

Psidium guajava (Guava)

Design
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Advantages of Using Botanicals during Storage of Pulses

Botanicals are available at free of cost and very effective against insects, pests and diseases.

Botanicals are easy to prepare and use, and is environmentally safe and not harmful to man and animals

It is not harmful to the environment also and safe to handle too.

Removal of these powders from pulses before consumption is not essential.

Botanicals does not usually affect beneficial insects, for example those that eat crop pests.

Design
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FACTORS DETERMINING THE KEEPING QUALITY OF PULSES

Moisture Content
For every decrease of 1% pulse moisture content, the life of the pulses doubles. This rule is applicable between moisture content of 5-14%.

Temperature
For every decrease of 5°C in storage temperature, the life of the pulses doubles. This rule applies between 0°C to 50°C.

Relative Humidity
There is progressive increase in insect multiplication up to 70 percent relative humidity, Beyond this, mould formation sets in and complicates the situation.

Design
D. Gayathri, Ph.D Research Scholar, Dr.K.Manimozhi, Associate Professor
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STORAGE LOSSES

- Insects and pests cause loss in weight of the stored grains by feeding.
- Direct losses occur when the disappearance of a pulses is caused by leakage or consumption by pests, whereas indirect losses occur when a reduction in quality leads to the consumer's refusal to purchase
- Deterioration through fungus growth and rotting
- Loss in quality through biting damage, insect and rodent excrement and fungus growth

Design
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Plate 12

Charts Used during the Training Programme

iv. Meeting

Meeting was conducted on various aspects like pulses production, need for storage, prevention of pulses losses and use of botanicals in storage (Plate 13). Pamphlets, booklets and posters can go a long way to explain a process of making botanical leaf packets for storage or to show examples of different kinds of storage problems. Specially prepared pamphlets, booklets and posters were also distributed during discussion (Plate 14). A model of pamphlet and booklets distributed is given in Appendix IV.

v. Slide shows

The slide shows were used to depict the safe storage practices of pulses, environment and health benefits of using botanicals in storage.

Thus, the trainees' knowledge was enriched with the use of audio-visual aids and they were encouraged to observe and adopt the method of using botanicals during storage of pulses, so as to prevent pulses losses in storage.

Phase IV

D. Evaluation of the impact of the training programme conducted

It was felt important to evaluate the training programme in order to know whether the objectives formulated before the actual conduct of the training were fulfilled or not and to ascertain the knowledge gained by the trainees as well as to improve the quality and content of the training programme in future. Evaluation may be defined as a systematic process of determining merits in which educational objectives are attained by pupils (Khanzods, 2009). The impact of the training programme was assessed in order to find out the effectiveness of the training programme. It would also reflect how far the trainees have understood about the safe storage techniques and the use of botanicals in pulses storage and how far they have been motivated to adopt the concept. The impact of the training programme was evaluated in terms of following aspects

1. Formulation of evaluation schedule
2. Conduct of evaluation
3. Analysis and presentation of data



Plate 13
Conduct of Meeting



Plate 14
Distribution of Booklets and Pamphlet

1. Formulation of evaluation schedule

a. Knowledge gained

Knowledge plays an important role in decision-making and adoption process. The knowledge gained from the training programme by the selected homemakers and shop keepers were assessed using an evaluation schedule and direct observation of the adoption practices. Observation is a systematic viewing, coupled with consideration of the seen phenomena (Cauvery, 2008). Hence an interview schedule was prepared to assess the trainees' knowledge on various storage aspects.

The aspects highlighted in the schedule were: main causes of pulses spoilage, precautions to be undertaken before, during and after storage and advantages of the use of botanicals during pulses storage. The schedule presented in Appendix V used to find out the knowledge gained through the training programme on the use of botanicals during pulses storage. The knowledge score before and after training programme were recorded using the schedule. Chi-square test and Paired t-test were performed using SPSS version 16.0 (Statistical Package for the Social Sciences) to test the significance between the two sets of exposures and to find out the association between levels of knowledge and socio-demographic characteristics of the respondents.

b. Attitudes Developed

An Attitude scale was developed based on Likert's Summated Rating Scale technique to obtain the right reflection of homemakers' and shop keepers' attitude towards the use of botanicals during pulses storage. Each item in the scale was provided with five response categories. They were strongly favourable, favourable, neutral, unfavourable and strongly unfavourable with scores 5, 4, 3, 2 and 1 (Appendix VI). Based on the responses obtained against each items, total attitude scores were calculated. Chi - square test and Paired t-test were done using SPSS version 16.0 (statistical package for the social sciences) to find out any significant differences with regard to the attitude before and after training programme and to find out the relationship between attitude and socio-demographic variables.

c. Adoption Practices

Impact of training programme on the use of selected botanicals during pulses storage was assessed through the adoption level of homemakers and shop keepers. An adoption scale was developed and assessed before and after training programme (Appendix VII). Paired t- test and Chi square test were done by using SPSS version 16.0 (statistical package for the social sciences). The quantity of pulses conserved by the households and shop keepers through adopting safe storage techniques and the use of different botanicals during storage of pulses was estimated. The use of botanicals during pulses storage was also observed through frequent visits and indirect questions. The results of the study are presented in Chapter IV Results and Discussion.

d. Categorization of Level of Knowledge, Attitude and Adoption Score

The levels of knowledge, attitude and adoption of the trainees were categorized as low, moderate and high level based on the statistical measures as described in Table II.

TABLE II
CATEGORIZATION OF LEVELS OF KNOWLEDGE, ATTITUDE AND ADOPTION OF THE TRAINEES

Low	less than (Mean – SD)
Moderate	between (Mean - SD) and (Mean + SD)
High	greater than (Mean + SD)

Those who obtained a score above (mean + SD) is considered as high level, and those who obtained a score below (mean – SD) is considered as low level and those score was in between (mean - SD) and (mean + SD) is categorized as moderate level.

2. Conduct of Evaluation

The impact of the training programme was assessed after a period of six months. In addition to that evaluation was also done through direct observation of the knowledge put into practice by the trainees. The quantity and quality of pulses

conserved through the use of botanicals in storage was assessed by using the quantification formula which was arrived based on the experience of the homemakers.

3. Analysis and Presentation of Data

According to Mohan and Elangovan (2007), analysis of data involves a number of closely related operation that are performed with the purpose of summarizing the collected data and organizing them in such a manner that will yield answers to the research questions. The data collected through interview and observation were tabulated, analyzed and discussed under Chapter IV.

Statistical Software and Tools Used for the Analysis

Software used

- SPSS (Statistical Package for Social Sciences) version 16.0
- AGRESS (Agricultural Research Statistical Software)

Tools used

- Percentage analysis
- Average analysis
- Chi-square test
- Paired t-test
- ANOVA – Completely Randomized Design

“Like rain water harvesting, safe storage practices of using botanicals should become a movement in revolution”