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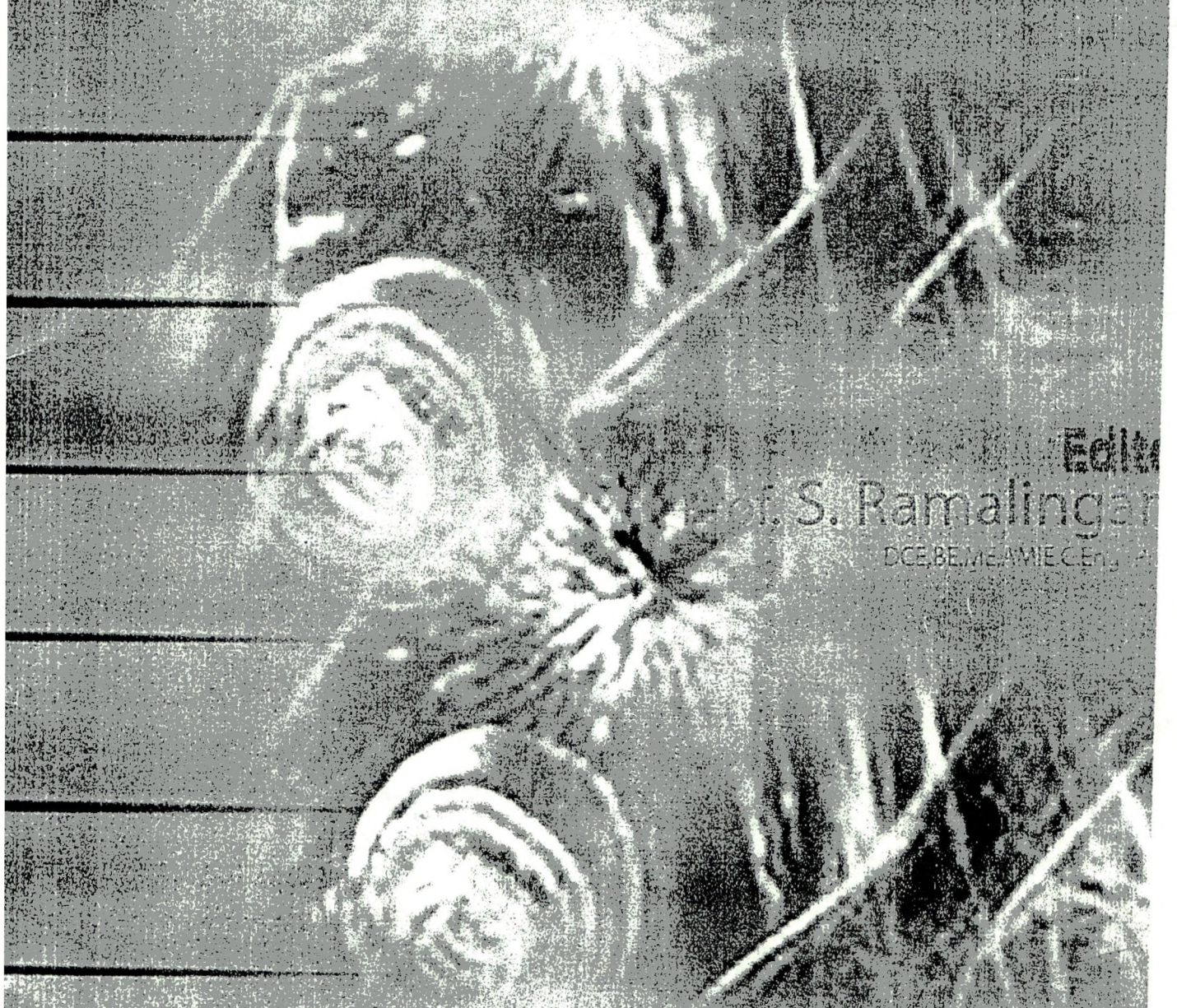

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EFFECT OF SELECTED BOTANICALS TO PREVENT LOSSES IN STORED PULSES

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Introduction

Pulses are considered as a primary source of protein. It is often referred as "poor man's meat", have a prominent place in the daily diet because of being a rich source of vegetable proteins.

Storing pulses for longer period of time has always been a problem for homemakers and farmers as the stored pulses are found to be most often infested with insects and pests. Storage is associated with a range of hazards. Insect damage, mould spoilage, pest infestations and fungal attack are the main problems encountered during storage of pulses.

The quality and quantity of pulses can be maintained only through proper storage. The quality of pulses has a direct effect on the health of the consumers. At present, there is a worldwide shortage of all pulses and it is absolutely necessary to produce to the maximum and preserve every grain that is produced to make it available to reach the ultimate consumers.

Safe storage is necessary to prevent spoilage, increase usability and durability, and also to add to monetary reasons. There is evidence of botanicals used in ancient civilization and the same have also been credited with healing power for increasing storage life. Botanicals are considered as one of the safer alternatives to chemical insecticides as they are reservoirs of secondary compounds produced by selected botanicals that could be used for pest control purposes.

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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. This study is an attempt to prevent losses in stored pulses through introduction of locally available botanical leaf powders.

Materials and Method

The experiment was conducted with the following aspects:

1. Selection of pulses for storage

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.

2. Selection of storage devices

Stainless steel container, gunny bag and polythene bag were selected as the storage devices for conduct of the experiments

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 indiça* (Neem), *Vitex nigundo* (Nochi) and *Pongamia pinnata* (Pongamiya) were selected for the trial experiment.

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.

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.

5. Varied proportion of botanicals for storage

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 require 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.

7. Analysis of Keeping Quality of Selected Pulses

The quality analysis focused in terms of percentage of moisture, weevilization, germination percentage and organoleptic of the selected stored pulses

i. Moisture Content

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.

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. 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.

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.

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.

Results and Discussion

The findings are discussed under following headings

1. Effect of botanicals on the moisture content of selected pulses at the end of sixth month

Moisture is the key to the safe storage of pulses. The amount of moisture in the pulses is the most important factor influencing pulses viability during storage. Generally if moisture content of the pulses increases, storage life decreases. If pulses are kept at high moisture content then loss could be very rapid due to mould growth. (http://www.fao.org/docrep/x5738e/x5738e0e.htm").

Details on moisture content percentage of the selected stored pulses in the initial period and at the 6th month of storage period are presented in Table I. Results observed from all the three storage devices (stainless steel container, polythene bag and gunny bag) was also given for comparison.

The initial germination was hundred per cent in all the selected pulses. Even though the germination was hundred percent in all the selected pulses, black channa and peas showed germination only on the 7th day of seedling while the other pulses namely black gram, green gram and cowpea showed germination on the 5th day of seedling. Only 50 per cent of germination was observed in control group pulses at the sixth month of storage period. The experimental group pulses showed higher germination percentage when compared to control group pulses. The reason for lower germination rate in the control group pulses might be attributed to the fact that they are more infested and likely to affect germination unlike the experimental group pulses which were stored with botanicals. According to Ipsitaet *et al.*, (2013) Infestation causes reduced seed germination, increase in moisture and decrease protein contents etc. resulting in total quality loss. Quality losses affect the economic value of the food grains fetching low prices to farmers. The botanicals even at the rate of 10 grams proved to show higher germination percentage in all varieties of pulses when compared to control group pulses.

1. Average organoleptic quality of the prepared dishes stored with botanicals

The organoleptic qualities of the recipes prepared out of experimental (at four variations of botanical leaves and proportions) and control group pulses were found to be excellent during its initial storage period. At the end of the storage period (6th month), the organoleptic qualities of the recipes such as black channa sundal, green gram sundal and peas sundal were rated fair in control group while rated as good and very good among the pulses stored in three different botanicals with four variations. The reason for fair rated organoleptic quality of recipes of control group pulses might be attributed to damages caused due to insect and pest when compared to pulses stored with botanicals. Similar results were also observed in pulses stored in gunny and polythene bags.

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TABLE III

EFFECT OF BOTANICALS ON THE GERMINATION PERCENTAGE OF SELECTED PULSES AT THE END OF SIXTH MONTH

Pulses		Initial	*Azadirachta indica* (Neem)				*Vitex nigundo* (Nochi)				*Pongamia pinnata* (Pongamiya)				Control
			10g	15g	20g	25g	10g	15g	20g	25g	10g	15g	20g	25g	
Black Gram	SS	100	96	96	97	98	92	93	94	95	91	90	91	93	58
	PB	100	93	93	95	96	90	92	94	95	90	91	92	92	55
	GB	100	90	90	91	91	88	76	89	90	85	85	88	89	52
Black Channa	SS	100	93	95	94	95	91	91	90	90	88	90	92	92	51
	PB	100	84	85	87	88	80	81	84	85	81	82	84	84	45
	GB	100	82	82	84	85	78	80	81	82	78	79	82	82	44
Cowpea	SS	100	98	99	98	99	95	96	98	98	94	95	95	96	55
	PB	100	87	87	89	89	83	84	86	87	84	85	87	88	55
	GB	100	86	87	89	89	82	84	86	86	83	84	87	87	52
Green Gram	SS	100	96	98	98	99	95	95	96	97	93	94	95	95	64
	PB	100	88	90	91	92	85	88	90	90	86	88	89	89	62
	GB	100	85	86	88	89	83	85	86	87	84	86	86	88	60
Peas	SS	100	82	84	84	86	78	80	82	82	78	79	82	81	50
	PB	100	80	83	84	84	78	79	81	81	75	78	80	80	48
	GB	100	78	79	80	83	76	78	79	80	74	76	78	78	45

SS – Stainless steel container PB – Polythene bag GB – Gunny bag

On the basis of the trial experiment, among the four variations - 10, 15, 20, 25 g/kg of *Azadirachta indica* (neem), *Vitex nigundo* (nochi) and *Pongamia pinnata* (pongamiya) leaf powders, 20 and 25 g/kg of these botanical leaf powders proved to be more or less similar in terms of their efficiency to maintain moisture level.

The data from the above table on the analysis of moisture content revealed that 25g/kg of *Azadirachta indica* (neem) leaf powder had high moisture control in black gram, green gram and black channa compared to other botanicals. With regard to cowpea and peas, *Vitex nigundo* (nochi) leaf powder in proportion of 25g/kg showed effective control of moisture.

The safe level of moisture content for pulses recommended by FCI was 12-15 percent. Black gram, black channa and green gram maintained safe moisture level upto 6 months in all the selected botanicals with all the variations. With regards to pea and cowpea, the moisture level was safe upto three months stored with different botanicals.

It was also noted that the initial moisture content of 12.6 in black gram increased to 16.5 in the control group, i.e. an 4 per cent increase in moisture was noticed while the same increased to 13.9, 14.1 and 14.3 per cent in black gram stored with neem, nochi and pongamiya respectively i.e. about 1 per cent (1.43%) increase in the pulses stored in air tight stainless steel container was noticed. The risk of weevilization generally increases with increase in moisture content, thus was also evident from the experiment on weevilization and hence the botanicals proved to be efficient in controlling occurrence and damage caused by insects and pests.

It was observed from the experiment that, among all the pulses of control group, the increase in moisture content was approximately 1 per cent every month and hence there are chances for 2 fold reduction in keeping quality every month according to the proven rule (Hayma, 2003). The same trend was observed in gunny and polythene bag. The experiment on moisture content revealed that botanicals could play a significant role in minimizing storage losses due to insect and pest attack. It is scientifically proven that for every decrease of 1% moisture content the life of the pulses doubles as applicable to pulses and seeds with moisture content between of 5-14% (http://agritech.tnau.ac.in).

1. Effect of botanicals on the weevilization percentage of selected pulses at the end of sixth month

Details on weevilization percentage of the selected stored pulses in the initial period and at the end of sixth month of storage period are presented in Table III. Data obtained from all the three storage devices (stainless steel container, polythene bag and gunny bag) is also given for comparison.

TABLE I

EFFECT OF BOTANICALS ON THE MOISTURE CONTENT OF SELECTED PULSES AT THE END OF SIXTH MONTH

Pulses		Initial	Experimental Group												Control Group
			Azadirachta indica (Neem)				*Vitex nigundo* (Nochi)				*Pongamia pinnata* (Pongamiya)				
			Botanical Variations												
			10g	15g	20g	25g	10g	15g	20g	25g	10g	15g	20g	25g	
Black Gram	SS	12.6	14.2	14.0	13.9	13.9	14.5	14.2	14.1	14.1	14.6	14.5	14.3	14.3	16.5
	PB	12.6	14.2	14.1	13.9	13.9	14.6	14.3	14.3	14.3	14.7	14.6	14.4	14.4	16.7
	GB	12.6	14.2	14.2	13.9	13.9	14.5	14.3	14.3	14.4	14.7	14.6	14.5	14.5	16.8
Black Channa	SS	11.0	12.7	12.6	12.4	12.4	13.0	12.9	12.6	12.6	13.2	13.0	12.7	12.7	13.5
	PB	11.0	12.6	12.5	12.5	12.4	13.0	12.9	12.7	12.7	13.1	13.1	12.8	12.8	13.7
	GB	11.0	12.8	12.7	12.7	12.6	13.0	12.9	12.8	12.8	13.1	13.0	12.9	12.9	14.2
Cowpea	SS	13.8	16.1	16.0	15.7	15.7	15.9	15.7	15.5	15.5	16.2	16.1	15.9	15.8	16.9
	PB	13.8	16.2	16.0	15.8	15.8	15.9	15.7	15.6	15.6	16.3	16.2	15.9	15.9	17.2
	GB	13.8	16.2	16.0	15.9	15.9	15.9	15.8	15.7	15.7	16.3	16.2	16.0	16.0	17.4
Green Gram	SS	11.2	13.6	13.5	13.3	13.3	13.9	13.8	13.5	13.5	14.1	14.0	13.6	13.6	14.5
	PB	11.2	13.6	13.5	13.3	13.3	14.0	13.8	13.6	13.5	14.1	14.0	13.6	13.6	14.8
	GB	11.2	13.6	13.5	13.4	13.4	14.0	13.8	13.6	13.6	14.1	13.9	13.7	13.6	14.8
Peas	SS	13.6	15.7	15.6	15.3	15.3	15.5	15.3	15.1	15.1	15.8	15.7	15.4	15.4	16.5
	PB	13.6	15.4	15.3	15.2	15.2	15.3	15.2	15.1	15.1	15.5	15.4	15.3	15.3	16.8
	GB	13.6	15.7	15.6	15.4	15.3	15.5	15.4	15.2	15.2	15.8	15.7	15.5	15.5	16.8

SS – Stainless steel container PB – Polythene bag GB – Gunny bag

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TABLE II

EFFECT OF BOTANICALS ON THE WEEVILIZATION PERCENTAGE OF SELECTED PULSES AT THE END OF SIXTH MONTH

Pulses		Initial	*Azadirachta indica* (Neem)				*Vitex nigundo* (Nochi)				*Pongamia pinnata* (Pongamiya)				Control
			10g	15g	20g	25g	10g	15g	20g	25g	10g	15g	20g	25g	
Black Gram	SS	Nil	3.3	3.0	2.8	2.7	4.0	3.8	3.2	3.2	4.2	3.9	3.5	3.5	14.8
	PB	Nil	3.4	3.1	2.8	2.8	4.1	3.8	3.5	3.4	4.2	3.8	3.7	3.7	15.6
	GB	Nil	3.4	3.2	2.8	2.8	4.2	3.9	3.5	3.5	4.2	3.8	3.8	3.8	15.8
Black Channa	SS	Nil	3.0	2.9	2.2	2.2	3.4	3.3	3.0	3.0	3.5	3.4	3.2	3.2	10.5
	PB	Nil	3.1	3.0	2.2	2.2	3.5	3.5	3.1	3.1	3.6	3.5	3.3	3.2	11.2
	GB	Nil	3.1	3.0	2.5	2.4	3.6	3.5	3.2	3.2	3.7	3.5	3.3	3.3	11.5
Cowpea	SS	Nil	2.8	2.7	2.5	2.5	3.0	2.9	2.8	2.8	3.1	3.0	2.9	2.8	11.4
	PB	Nil	2.9	2.8	2.6	2.6	3.1	3.0	2.9	2.8	3.2	3.1	2.9	2.9	12.5
	GB	Nil	3.0	2.9	2.6	2.6	3.1	3.0	2.9	2.9	3.2	3.1	3.0	3.0	12.8
Green Gram	SS	Nil	3.6	3.3	3.0	3.0	3.8	3.7	3.4	3.4	3.9	3.6	3.5	3.4	18.7
	PB	Nil	3.7	3.4	3.1	3.1	3.8	3.8	3.5	3.4	3.9	3.7	3.5	3.5	18.8
	GB	Nil	3.6	3.4	3.2	3.2	3.8	3.7	3.5	3.5	3.9	3.8	3.6	3.6	18.9
Peas	SS	Nil	2.6	2.5	2.2	2.2	2.8	2.6	2.4	2.4	2.9	2.8	2.5	2.4	9.8
	PB	Nil	2.6	2.6	2.2	2.2	2.8	2.7	2.4	2.5	2.9	2.9	2.5	2.5	10.2
	GB	Nil	2.7	2.6	2.3	2.2	2.9	2.8	2.5	2.5	3.0	2.9	2.6	2.6	10.5

SS – Stainless steel container PB – Polythene bag GB – Gunny bag

The Bureau of Indian Standards (BIS) has marked the maximum level of weevilization in pulses as three per cent. Black channa, cowpea and peas stored with botanicals maintained the standard for weevilization upto six months. With regard to black gram and green gram stored with botanicals among all the variations maintained the standard recommended by BIS mark upto five months. But control group pulses maintained standard BIS indicated by only for 2 months. The same trend was observed in gunny and polythene bag as well.

At the end of the 6th month, the weevilization was less (2.7%) in Black gram stored with neem leaf powder followed by nochi (3.2%) and pongamiya (3.5%). The similar trend was observed in all other selected pulses. Irrespective of the storage devices used, weevilization was efficiently controlled in pulses stored with neem followed by nochi and pongamiya leaf powders. It was also observed from the experiment that, as storage time increased, the weevilization percentage also slightly increased concurrently.

It was also noted that among the four variations - 10,15,20,25 g/kg of *Azadirachta indica* (neem), *Vitex nigundo* (nochi) and *Pongamia pinnata* (pongamiya) leaf powders, 20 and 25 g/kg of these botanical leaf powders proved to be efficient on moisture control and weevilization control for 1 kg of pulses. Dubey *et al.*, 2008 also reported in their study that increased concentration of botanical leaf powders will help to improve the insecticidal property to control food grain losses during storage.

1. Effect of botanicals on germi nation percentage of selected pulses at the end of sixth month

Details on germination percentage of the selected stored pulses in the initial period and at the end of sixth month of storage period are presented in Table V. Changes observed in all the three storage devices (stainless steel container, polythene bag and gunny bag) are also given for comparison.