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# ANNUAL REPORT
## 1981–82

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LEGUME POSTHARVEST TECHNOLOGY ( BANGLADESH )
BANGLADESH AGRICULTURAL RESEARCH INSTITUTE
JOYDEBPUR, DACCA, BANGLADESH.

80-0127

PROJ REPORT
213(i)

# A N N U A L  R E P O R T

1981-82

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LEGUME POSTHARVEST TECHNOLOGY (BANGLADESH)
Bangladesh Agricultural Research Institute
Joydebpur, Dacca, Bangladesh.

# Foreword

Pulses play a vital role in the dietary of the people of Bangladesh. This is due mainly to the fact that the group constitutes the major source of protein for the bulk of the population of the country. Unfortunately, the crops suffer serious postharvest losses mainly from inadequate storage and drying of grains, that have been estimated to range from 30 to 40%. Despite this, no organized research effort was undertaken in the past on the postharvest losses of pulses in Bangladesh.

Legume Postharvest Technology Project (Bangladesh) is the first of its kind on pulses in Bangladesh. An important feature of the project is that a number of disciplines such as Entomology, Plant Pathology, Agronomy, Agricultural Economics and Agricultural Engineering have been involved to implement the various postharvest studies. In this report, only the benchmark results on the pest incidence, microbial association, seed viability, socio-economic constraints to appropriate storage methods and fabrication of low-cost solar drier have been described. It is hoped that the details on the loss assessment, methods of control of losses, performance of the solar drier and their economics will be reported in the next two years of the project.

Although the project started operating from July 1981, the appointment of personnel could not be made until January, 1982. Even then, some of the scientists left the project after working only for a couple of months or so. However, the problem was largely overcome by allowing the regular scientists of the Institute to work on the project on part-time basis.

I gratefully acknowledge the generous assistance of IDRC in supporting the project. Without this assistance, it would, I am sure, not have been possible to take up this useful investigation. My sincere appreciation and thanks are due to the colleagues for their help and cooperation in compiling the results and bringing this report out.

Mohammad H. Mondal

( Mohammad H. Mondal )
Project Leader,
Legume Postharvest Technology (Bangladesh)
&
Associate Director (Res.)
BARI, Joydebpur, Dacca.

C O N T E N T S

# BASIC INFORMATION

## Financial Statement

1. Total budget provision (July 1981 to June 1984) : $ 170400.00 (Can.dollar)

2. Statements of receipts from IDRC :

| Instalment | Date deposited in local currency | Amount deposited in local currency |
|---|---|---|
| 1st | 16 June, 1981 | Tk. 2,33,049.89 |
| 2nd | 2 March, 1982 | Tk. 2,34,663.20 |
| Total : | | Tk. 4,67,713.09 |

3. Budget and expenditure for 1981-82 :

| Head of account | Budget (in Tk.) | Expenditure (in Tk.) | Balance (in Tk.) |
|---|---|---|---|
| Salaries and allowances | 1,59,554.29 | 20,476.44 | 1,39,077.85 |
| Casual labour | 46,927.73 | 12,911.95 | 34,015.78 |
| Materials for driers | 39,106.44 | 1,006.50 | 38,099.94 |
| Materials for bins | 39,106.44 | 11,092.00 | 28,014.44 |
| Expendable materials | 54,749.02 | 40,103.50 | 14,645.52 |
| Office supplies | 15,642.58 | 13,939.75 | 1,702.83 |
| Fuel | 31,285.16 | 15,761.23 | 15,523.93 |
| Per diem | 18,771.09 | 8,764.76 | 10,006.33 |
| *Books & Workshop | 15,642.58 | - | 15,642.58 |
| *Stereo Microscope | 31,285.16 | - | 31,285.16 |
| Desiccator | 15,642.58 | 12,000.00 | 3,642.58 |
| Total : | 4,67,713.07 | 1,36,056.13 | 3,31,656.94 |

*Stereo microscope already supplied and the books to be supplied by the Centre Administration.

Requirement of funds for 1982-83

| Head of account | Amount (in Tk.) |
|---|---|
| Salaries & allowances | 1,50,000.00 |
| Casual labour | 50,000.00 |
| Materials for driers | 96,000.00 |
| Materials for bins | 1,00,000.00 |
| Expendable materials | 60,000.00 |
| Office supplies | 17,000.00 |
| Fuel | 50,000.00 |
| Per diem | 21,000.00 |
| Total : | Tk.5,44,000.00 |

Training :

There is a provision for both M.S. and short-term career development training abroad. Mr. Abdus Satter, Senior Scientific Officer (Agric.Engineering) and Mr. Md. Nurul Islam, Senior Scientific Officer (Entomology) were selected for M.S. training in Agricultural Engineering and Entomology respectively. The admission of Mr. Islam and Mr. Satter is being considered by a few Universities in U.K. and India respectively.

Besides, Mr. Abdus Satter participated in the international seminar on "Food Drying" at the University of Edmonton, Canada from 6 to 9 July, 1981. On his way back to the country, he visited the Punjab Agricultural University, Ludhiana, India; Institute of Agricultural Engineering and C.E.A.E., Bhopal, India and Indian Institute of Technology, Khoragpur, India from 13 to 21 July, 1981. Mr. Kazi Benzir Alam, Senior Scientific Officer (Plant Pathology) attended the 3rd international symposium on Plant Pathology held in New Delhi, India from 14 to 18 December, 1981.

Equipment

| Name of equipment | Quantity (Provision) | Quantity received | Remarks |
|---|---|---|---|
| 1. Temperature measuring equipment with accessories | 1 | 1 | |
| 2. Moisture Meter with accessories | 2 | 1 | |
| 3. Laboratory oven | 0 | 1 | .1 oven instead of 1 moisture meter. |
| 4. Air speed meter (Anemometer) | 2 | 2 | |
| 5. R.H. equipment | 1 | 0 | Being purchased locally |
| 6. Incubator | 2 | 1 | 1 yet to be received |
| 7. Non-programmable calculator | 2 | 2 | |
| 8. Programmable calculator with accessories | 1 | 1 | |
| 9. Stereo Microscope with accessories | 1 | 1 | Funds transferred to the Centre for the purchase. |
| 10. Desiccator and desiccant | 12 | 25 | Purchased locally within the budget amount. |
| 11. Vehicle (4-wheel Toyota) | 1 | 1 | |

Books and Journals

A list of books and journals was submitted to Dr.Cordon Yaciuk, Programme Officer, Post Production System, IDRC, Canada with a request to purchase/subscribe to them for the project. We have not so far received any books and journals except 8 issues of the World Agricultural Economics and Rural Sociology Abstracts (WAERSA) for the period January to August, 1982.

Personnel

Project Leader :

Dr. Mohammad H. Mondal
Associate Director (Res.), BARI.

Investigators :

Dr. M. Ameerul Islam
Head, Entomology Division, BARI.

Dr. Hamizuddin Ahmed
Head, Plant Pathology Division, BARI

Dr. A.F.M. Maniruzzaman
Head, Agronomy Division, BARI.

Dr. S.M. Elias
Head, Agric. Economics Division, BARI.

Mr. Abdus Satter
Head-in-charge, Agric. Engg. Division, BARI.

Scientists :

Dr. Shahadat Morshed
Senior Scientific Officer (Plant Pathology)
from 23 April to 18 May, 1982.

Mr. J.C. Saha Chowdhury
Appointed as Scientific Officer (Agric.Engg.)
From 25 January, 1982.

Mr. S.M. Mahbubul Alam
Scientific Officer (Plant Physiology)
From 19 January to 6 March 1982.

Senior Scientific Officer (Entomology)-Vacant.

Technicians :

Mr. Md. Abdur Rahim Mondal
Technician (Agric.Economics)
From 9 January, 1982.

Mr. Md. Shahadat Hossain Akanda
Technician (Agric.Engineering)
From 6 January to 23 May, 1982

Mr. Abdul Gafur
Technician (Entomology)
From 23 January to 30 June, 1982.

Part-time Scientists :

Mrs. Nasima Chowdhury
Senior Scientific Officer (Plant Pathology), BARI

Mr. M.M. Hyder Ali
Scientific Officer (Plant Pathology)

Mr. Md. Serajul Islam Bhuiyan
Senior Scientific Officer (Entomology), BARI.

Miss Wahida Sultana
Scientific Officer (Physiology), BARI.

Mr. S.C. Barman
Scientific Officer (Agric.Economics), BARI.

## SCIENTIFIC INFORMATION

### Introduction

The Project started functioning from 1 July, 1981. It took about two months to complete the necessary arrangements for initiating the primary work, the loss assessment of legume seeds at the farmers' level storage. Unfortunately, by this time the storage of seeds was already completed and no arrangement could be made to go into actual action programme of the work until March, 1982 when fresh seeds were ready for storage.

Farmers of Bangladesh, with their very limited holding capacity, store their legumes for seeds in different types of containers. Hardly an effective protective measure is adopted by them except occasional sun-drying of their stored legumes. Under the existing conditions of Bangladesh, there is hardly any scope of effective sun-drying of the agricultural produces during rainy season when average R.H. remains over 90%. This condition, on the other hand, is very much congenial for the multiplication of insect pests and development of various fungi. As a result, heavy insect infestation and fungal development often occur in stored legumes at the farmers' level storage during this season rendering serious quantitative and qualitative losses of the seed legumes.

Storing of already infested seeds and sometimes seeds with high moisture content, using non-disinfected improper containers as well as space, and incapability of the farmers to procure appropriate containers and to adopt effective protective measures against insect pests and microorganisms, are the major factors responsible for spoilage of seeds in small farmers' storage. This project, therefore, aims at determining the extent of losses incurred under different methods of storage at the farmers' level and developing appropriate method(s) of storage which can be easily adopted by the farmers without much additional fund.

Five Divisions namely, Entomology, Plant Pathology, Agronomy (physiology), Agric. Economics and Agric. Engineering of Bangladesh

Agricultural Research Institute, Dacca have been involved to achieve the desired goal. The responsibility of the Division of Entomology is to draw samples from the farmers' stock and analyse those to assess losses due to insect attact, while the Division of Plant Pathology is to identify the pathogens and to determine their extent of damage. The responsibility of the Division of Agronomy is to determine the purity, moisture content as well as viability of seeds. Agric. Economics is responsible for investigating into the socio-economic problems of the farmers in adopting the improved technology whereas Agric. Engineering Division for developing appropriate technology for drying the seeds so as to maintain the desired moisture content without impairing their viability.

Materials and Methods

Investigations were made on four parameters, namely, locations (Jamalpur, Kishoregonj, Feni, Ishurdi and Jessore), type of legumes (mungbean, lentil, blackgram, khesari, gram and pea), type of containers (gunny bag, earthen pitcher, metallic drum, kerosine oil tin, bamboo-made containers) and any special measures adopted by the farmers to prevent and or minimise losses.

Selection of farmers was made on the basis of their individual method(s) of storage for each kind of pulse in the selected localities. Pulses stored in different kinds of containers were left with the selected farmers in their existing conditions of storage. Farmers were paid for about 10 kg. of each of the stored pulses on the spot so as to make the seeds available for sampling until next sowing.

Initial samples were drawn from each of the stocks at the time of storing and analysed in the laboratory to obtain the benchmark data on the quality of seeds. Subsequent samples were drawn every two months from each of the stocks of the selected localities. Same samples were analysed by the Entomologists, Pathologists and Agronomists for pests and viability.

Entomologists recorded the insect(s) associated with each of the samples and calculated the rate of infestation on the basis of the number of healthy and infested seeds, while the plant pathologists studied 200 randomly-drawn seeds from each sample through blotter method and recorded the associated fungi and their respective rates of prevalance. The agronomist, on the other hand, determined the purity of seeds in terms of their admixtures with other seeds, dirt etc., the moisture content of the seeds and tested the seeds for viability.

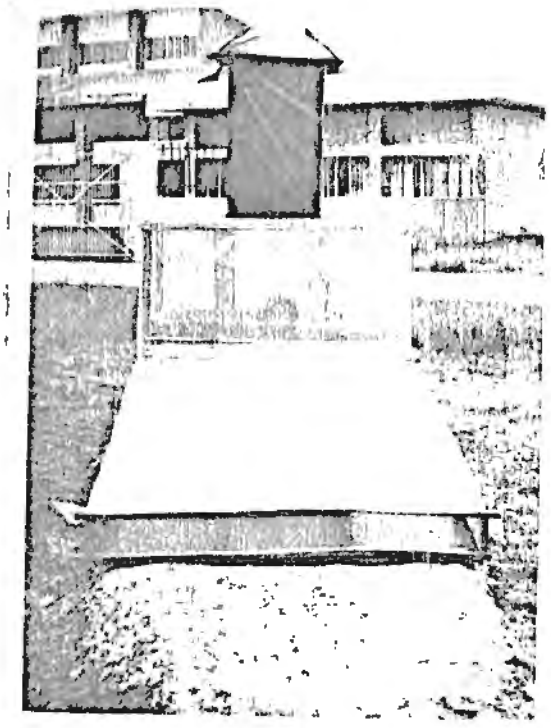
The agricultural Economist on the basis of propared questionnaire (Appendix-A) collected relevant data from the selected farmers of the aforesaid locations. The number of studied farmers was 51,50,40 and 36 at Ishurdi, Kishoregonj, Jamalpur and Feni respectively. The questionnairs was designed so as to obtain information regarding the background of the pulse growers, their present methods of processing and storing and marketing behaviour. The information incorporated in this report is on the pulse crop harvested during 1981-82 rabi season.

A solar drier with a drying capacity of about 40 kg. of seeds at a time has been designed and fabricated utilizing local materials, namely, wood, bamboo, white and black polythene sheet etc. The drier consists of three components : a. solar heat collector, b. a drying bed and c. a chimney (Fig.1) :

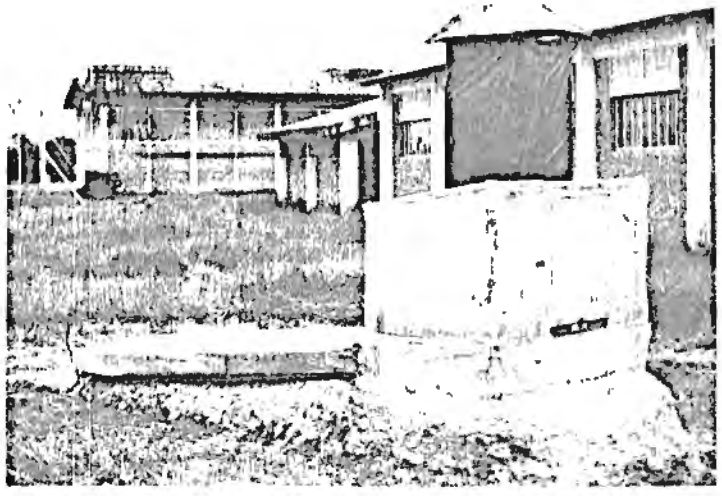
a. Solar heat collector : The upper and the bottom parts of the solar heat collector are covered with white transparent polythene sheet and black thin plastic sheet respectively. The black plastic sheet absorbs solar heat and heats ambient air in the collector which flows by way of natural convection current and dries pulses on drying bed.

b. Drying bed : The drying bed on which seeds are kept for drying consists of mesh (14 mesh). The bed holds 40 kg of seeds at a time.

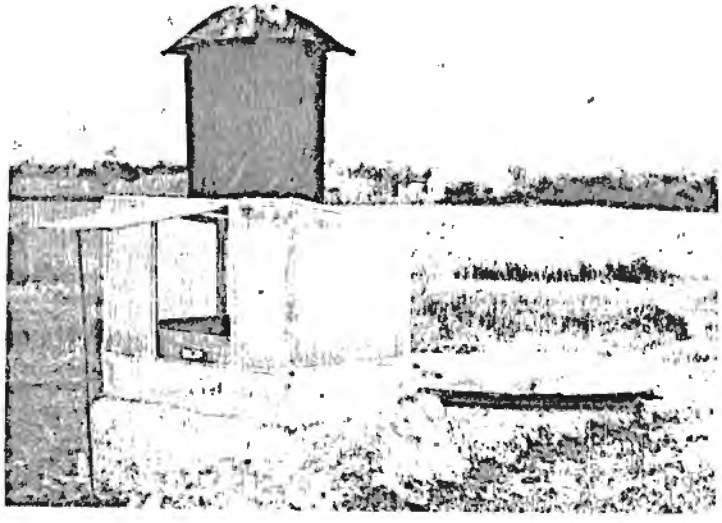
c. Chimney : After drying the seeds, hot and moist air escapes through the chimney covered with black and thin plastic which also absorbs heat and develops a higher temperature gradient and thus accelerates hot air movement through drying bed. The drier has been erected on an earth platform having a scope for placing the solar collector.



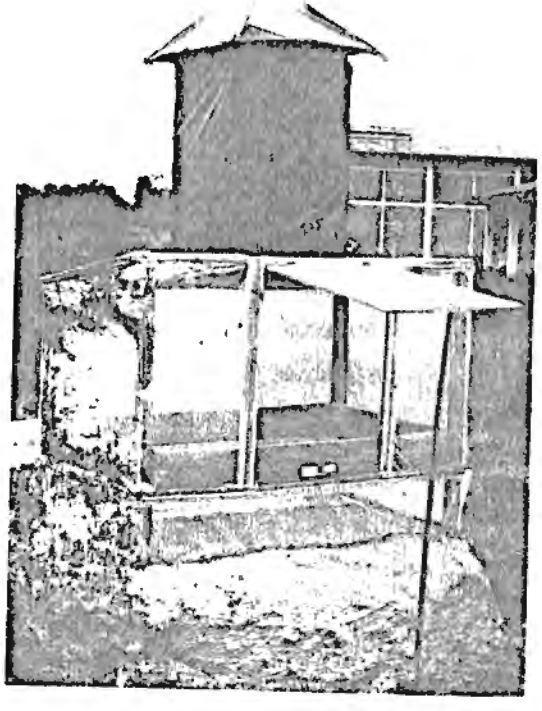
a. Front view showing air entrance and solar collector on the earthen slope.



b. Right-hand side view.



c. Left-hand side view.



d. Back side view and the chimney.

Figure 1. Different views and parts of the solar drier.

Besides the survey work, two experiments were initiated during the period under review. The experiments are still in progress and final results will be available by the end of October this year. The experiments are : (1) The effect of different methods of storage on the incidence of pulse beetles and (2) studies on the improvement made over earthen containers for better storage of pulses.

The objective of the first experiment was to identify the appropriate method(s) in terms of containers for storing pulses. Five different types of containers, namely, (1) earthen pitcher with earthen lid, (2) earthen pitcher without any lid (3) kerosine oil tin with lid, (4) kerosine oil tin without lid and (5) ordinary gunny bag constituted the treatments. Each treatment was replicated three times. Ten kg of mungbean seeds were kept in each container. The pre-storage moisture content of the seeds was measured and recorded for each treatment. The data on the insect incidence were recorded every 3 months of storage. The experiment is being carried out at Joydebpur and the last observation will be made in November, 1982.

The objective of the second experiment was to identify the exact type of improvement that should be made on the earthen containers to increase their efficiency for better storage of pulse seeds. Two kinds of pulses, namely, chickpea and lentil and earthen containers of 5 kg. capacity were used for the experiment. Five such earthen containers constituted the replications for each of the following treatments :

i. Only loose earthen lids to cover the open mouth of the container.

ii. Earthen lid sealed with mud.

iii. One inch sun-dried sand layer to cover the seeds stored in the earthen container with a loose earthen lid.

iv. Mud-cowdung smeared earthen container with sealed earthen lid by a mixture of mud and cowdung.

v. Coaltar smeared earthen containers (two coatings) having earthen lid sealed with mud.

The experiment was set up on April 5, 1982 and the data on the insect incidence will be recorded by the end of October, 1982.

Results and Discussion

1. Entomology : Insects responsible for damage of stored pulses are two species of Callosobruchus, namely (i) Callosobruchus chinensis(L.) and (ii) C. maculatus. They are commonly known as pulse beetle and belong to the family Bruchidae and order Coleoptera. The pulse beetle is a serious post causing heavy damage to the stored pulses with variable extents depending upon the type of pulses, method of storage, duration of storage, sanitary condition of the storage and any specific preventive measure taken. Farmers dry their pulse seeds after threshing and cleaning and store those in the containers that they can afford to procure. The containers usually include a. kerosine oil tin, b. gunny bag, c. earthen motka/ pitcher, d. metallic drum and e. bamboo made ''dole' etc.

As a preventive measure, occasionally they use sand, ash, dry plant leaves as a protective cover on the surface of the stored seeds in the container. Some-times, after storing seeds in the container, its open mouth is first covered by coconut husk, earthen lid or straw and then plastered with either mud or cowdung mixed mud. Occasional sun-drying during the period of storage has been reported to be quite effective in preventing storage losses, but during rainy season it is hardly possible to get favourable weather for effective sun-drying. As a result, quite often serious damage of pulses is caused by the insects during the rainy season.

In almost all cases, basic samples drawn prior to storing from five selected locations showed either no or a very low post infestation. This indicates that the farmers, in general, probably took sufficient care of their produces from harvesting to storing or the sources of infestation at the moment were absent or negligible (Table 1). However, the pulses sample, particularly those with pre-storage infestation drawn after two months of storage, showed a higher trend of infestation . Samples with no pre-storage infestations usually remained uninfested or had only very low infestation (Table 1).

The expected variability in the infestation rates with respect to various methods (different containers and any other

Table 1 : Loss assessment of pulses under different methods of storage upto June, 1982.

| Location | Pulses stored in containers | % of infestation At the time of storage | % of infestation After 2 months of storage |
|---|---|---|---|
| 1. Jamalpur | Lentil : i) Biscuit tin with lid | 0.00 | 0.00 |
| | ii) Earthen motka with mud | 0.00 | 0.00 |
| | Mungbean: i) Biscuit tin with lid | 0.40 | 10.21 |
| | ii) Kerosine oil tin with lid | 1.21 | 2.04 |
| | Mashkalai: i) Biscuit tin with lid | 0.00 | 0.00 |
| | ii) Gunny bag with polythene | 0.00 | 0.00 |
| | iii) Gunny bag | 0.00 | 0.00 |
| | iv) Insecticide drum with lid | 0.00 | 0.24 |
| 2. Kishoregonj | Lentil: i) Unsealed earthen motka | 0.02 | 1.12 |
| | ii) Steel-made sprit drum with lid | 0.00 | 0.12 |
| | iii) Gunny bag with polythen covering | 0.00 | 0.00 |
| | iv) Kerosine oil tin with lid | 0.03 | 3.21 |
| | Mashkalai : Kerosine oil tin with lid | 0.05 | 4.37 |
| | Khesari : Fertilizer gunny bag with polythene lining | 0.00 | 0.00 |
| 3. Feni | Mungbean :i) Kerosine tin without lid | 0.00 | 1.39 |
| | ii) Kerosine tin with lid | 0.19 | 1.06 |
| | Lentil : i) Earthen pitcher with mouth closed by coconut husk and plastered with cowdung | 0.01 | 2.86 |
| | ii) Paint tin with lid | 0.02 | 5.35 |
| | iii) Earthen pitcher with mouth just covered by coconut husk | 0.00 | 3.60 |
| | iv) Earthen motka | 0.24 | 0.71 |

Table-1 contd.

| Location | Pulses stored in containers | % of infestation* | |
|---|---|---|---|
| | | At the time of storage | After 2 months of storage |
| 4. Ishurdi | Mashkalai : i) Gunny bag | 4.27 | 7.51 |
| | ii) Earthen pitcher with coconut husk lid | 11.67 | 12.49 |
| | Lentil : i) 'Aury' made of bamboo, top covered with dry sand | 0.03 | 0.19 |
| | ii) Tightly packed-in gunny bag | 1.34 | 9.86 |
| | iii) Earthen container (kola) top sealed with mud | 1.35 | 5.48 |
| | iv) Drum with open top but covered by ash | 29.39 | 34.84 |
| | Khesari : i) 'Dole' made of bamboo | 1.28 | 14.68 |
| | ii) Gunny bag | 0.00 | 22.63 |
| | Gram : i) Kerosine oil tin with lid | 0.00 | 63.63 |
| | Pea : Tightly packed-in gunny bag | 0.21 | 3.97 |
| 5. Jessore | Mungbean : i) Brass pitcher with top covered with sand | 0.14 | 0.75 |
| | ii) Earthen pitcher top covered with sand | 0.00 | 5.79 |
| | Lentil : i) Tightly packed in-gunny bag | 0.39 | 4.42 |
| | ii) Kerosine oil tin without lid | 0.80 | 1.71 |
| | iii) Coconut oil drum with lid | 0.76 | 0.52 |
| | iv) Fertilizer gunny bag with polythene lining | 0.25 | 1.03 |
| | Gram : i) Coconut oil drum with lid | 0.59 | 37.66 |
| | Pea : i) Brass pitcher with sand on top | 0.35 | 0.92 |
| | ii) Kerosine oil tin with lid | 0.00 | 6.35 |
| | Khesari : i) Four-layered gunny bag | 0.24 | 1.46 |

*Average of 3 samples.

special measure(s) adopted to prevent losses) of storage could be obtained on the basis of analysis of all the samples drawn for the entire period of storage.

At the end of two months' storage at Ishurdi, gram stored in kerosineoil tin with lid suffered a loss of 63.6% while the percentage of infestation in lentil stored in drum with open top but covered with ash was 34.80%. The infestation was only 0.19% when lentil was preserved in bamboo-made "aury" with top covered by sand. Lentil and khesari samples collected from Jamalpur and Kishoregonj were free from insect attack irrespective of the containers used. All samples of other pulses from Feni, Ishurdi and Jessore were infested to a variable extent. None of the mungbean samples from any location were free from insect attack. All samples of khesari from Ishurdi and gram from Jessore were also found to be infested (Table 1).

The first observation after two months' of storage on the first experiment showed that the insect infestation in mungbean seeds stored in kerosine oil tins with lid was lowest (5.24%) as against 12.30% in gunny bags and 23.6% in earthen pitchers (Table 2). Observations on the second experiment will be taken during the first week of October.

2. Plant Pathology : The fungi and bacteria detected in pre-stored pulse samples, with their average rates of prevalence, have been presented in Tables 3,4,5,6 and 7. Many of the fungi are common on different pulses. The more prevalent fungal species were : Alternaria tenuis, Aspergillus spp., Cladosporium sp., Curvularia lunata, Fusarium semitectum and Verticillium sp. In addition to these, Alternaria raphani, Cercospora sp., Colletotrichum sp., Drechslera sorokiniana, Epicoccum sp., Fusarium oxysporum, F. moniliforme F. solani, Nigrospora sp., Pestalotia sp., Phoma sp., Stemphylium sp. and Trichothecium sp. were found to be associated with different pulse samples. But their prevalence was very low. Alternaria tenius was recorded to the extent of 67.0% on gram samples collected from Ishurdi. This could probably be due to a

Table 2 : Effect of different methods of storage on the infestation of mungbean seeds

| Treatment | % of infestation | | | Total | Average |
|---|---|---|---|---|---|
| | $R_1$ | $R_2$ | $R_3$ | | |
| GB | 3.18 | 11.60 | 22.13 | 36.91 | 12.30 |
| EMC | 23.49 | 32.77 | 14.73 | 70.99 | 23.66 |
| EM | 17.96 | 42.07 | 13.48 | 73.51 | 24.50 |
| T | 28.71 | 15.79 | 19.11 | 63.61 | 21.20 |
| TC | 8.63 | 4.93 | 2.16 | 15.72 | 5.24 |

GB = Gunny bag

T = Kerosine oil tin

TC = Kerosine oil tin with cover

EM = Earthen pitcher

EMC= Earthen pitcher with cover.

R = Replication.

Table-3 : Microbes associated with different pulses collected from Jamalpur.

| Associated microbe | % of prevalence | | |
|---|---|---|---|
| | Lentil | Kashkalai | Mungbean |
| Altemaria tenuis | 20.5 | 19.3 | 21.8 |
| A. raphanai | 1.8 | 0.0 | 0.0 |
| Aspergillus flavus | 0.0 | 1.5 | 1.3 |
| A. niger | 0.3 | 2.1 | 3.0 |
| A. spp. | 0.5 | 6.4 | 3.3 |
| Chaetomium globosum | 3.3 | 0.8 | 0.3 |
| C. indicum | 1.8 | 0.5 | 0.0 |
| C. spinosum | 0.0 | 0.5 | 0.2 |
| Colletotrichum sp. | 0.0 | 0.1 | 0.0 |
| Curvularia lunata | 2.3 | 30.5 | 8.3 |
| Drechslera sorokiniana | 1.0 | 1.0 | 0.3 |
| Epicoccum sp. | 3.3 | 0.3 | 0.0 |
| Cladosporium sp. | 22.3 | 2.6 | 10.5 |
| Fusarium moniliforme | 1.5 | 0.3 | 1.8 |
| F. semitectum | 4.0 | 0.1 | 0.8 |
| Penicillium sp. | 1.0 | 4.8 | 0.5 |
| Pestalotia sp. | 0.3 | 0.0 | 0.0 |
| Verticillium sp. | 0.0 | 0.1 | 1.5 |
| Rhizopus nigricans | 1.5 | 0.4 | 0.0 |
| Ascomycetes | 0.0 | 0.1 | 0.0 |
| Stemphylium sp. | 3.0 | 0.0 | 0.0 |
| Unknown | 2.3 | 1.1 | 0.0 |
| Bacteria | 3.3 | 0.6 | 0.0 |

Table-4 : Microbes associated with different pulses collected from Kishoregong.

| Associated microbe | % of prevalence | | |
|---|---|---|---|
| | Lentil | Khesari | Mashkalai |
| Alternaria tenuis | 14.1 | 0.5 | 5.5 |
| Aspergillus flavus | 0.3 | 1.5 | 0.0 |
| A. niger | 0.4 | 0.0 | 0.0 |
| A. spp. | 0.9 | 0.0 | 1.5 |
| Chaetomium sp. | 0.1 | 0.0 | 0.0 |
| Cladosporium sp. | 2.3 | 1.0 | 1.5 |
| Curvularia lunata | 0.6 | 0.0 | 0.0 |
| Drechslera sorokiniana | 0.4 | 0.0 | 0.0 |
| Epicoccum sp. | 1.0 | 0.0 | 0.0 |
| Fusarium moniliforme | 0.1 | 0.0 | 0.0 |
| F. oxysporum | 0.4 | 0.0 | 12.0 |
| F. solani | 0.3 | 0.0 | 10.0 |
| F. spp. | 0.5 | 1.0 | 0.0 |
| Penicillium sp. | 0.5 | 0.5 | 4.5 |
| Rhizopus nigricans | 0.3 | 0.5 | 0.0 |
| Verticillium sp. | 0.3 | 0.5 | 0.0 |
| Ascomycetes | 0.5 | 0.5 | 0.0 |
| Stemphylium sp. | 0.5 | 0.0 | 0.0 |
| Spicaria sp. | 0.1 | 0.0 | 0.0 |
| Bacteria | 0.1 | 0.5 | 0.0 |

Table-5 : Microbes associated with different pulses collected from Feni.

| Associated microbe | % of prevalence | |
|---|---|---|
| | Lentil | Mungbean |
| Alternaria tenuis | 8.3 | 4.8 |
| Aspergillus flavus | 1.4 | 0.0 |
| A. niger | 0.6 | 0.0 |
| A. spp. | 2.1 | 3.5 |
| Chaetomium sp. | 1.8 | 0.0 |
| Cladosporium sp. | 2.1 | 0.0 |
| Curvularia lunata | 1.4 | 0.0 |
| Fusarium moniliforme | 0.5 | 0.0 |
| F. oxysporum | 0.0 | 0.8 |
| F. semitectum | 0.3 | 0.0 |
| F. solani | 0.0 | 0.3 |
| F. spp. | 0.5 | 0.5 |
| Penicillium sp. | 2.4 | 0.3 |
| Phoma sp. | 0.1 | 0.0 |
| Rhizopus nigricans | 0.1 | 1.0 |
| Ascomycetes | 0.0 | 0.3 |
| Unknown/Unidentified | 0.1 | 0.0 |
| Bacteria | 0.3 | 2.0 |

Table-6 : Microbes associated with different pulses collected from Ishurdi.

| Associated microbe | % of prevalence | | | | |
|---|---|---|---|---|---|
| | Lentil | Pea | Khesari | Mashkalai | Gram |
| Alternaria tenuis | 3.7 | 1.5 | 7.3 | 7.5 | 67.0 |
| Aspergillus spp. | 6.4 | 1.5 | 5.8 | 14.0 | 4.0 |
| Cladosporium sp. | 0.3 | 0.0 | 1.0 | 0.8 | 19.0 |
| Cercospora sp. | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 |
| Curvularia lunata | 0.1 | 0.0 | 0.3 | 10.8 | 0.0 |
| Fusarium moniliforme | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| F. oxysporum | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 |
| F. semitectum | 0.4 | 0.5 | 0.8 | 1.8 | 0.0 |
| Fusarium spp. | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 |
| Phoma sp. | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Rhizopus nigricans | 0.2 | 0.0 | 0.3 | 1.0 | 4.0 |
| Stemphylium sp. | 1.7 | 0.0 | 0.0 | 0.0 | 0.0 |
| Trichothecium sp. | 0.7 | 1.5 | 0.0 | 0.0 | 1.0 |
| Verticillium sp. | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 |

Table-7 : Microbes associated with different pulses collected from Jessore.

| Associated microbe | % of prevalence | | | | |
|---|---|---|---|---|---|
| | Lentil | Gram | Mungbean | Khesari | Pea |
| Alternaria tenuis | 1.8 | 45.5 | 4.0 | 12.0 | 4.8 |
| Aspergillus spp. | 3.0 | 14.0 | 5.0 | 2.0 | 3.3 |
| Cladosporium sp. | 0.4 | 35.5 | 5.0 | 2.5 | 0.8 |
| Curvularia lunata | 0.0 | 0.0 | 2.3 | 0.0 | 0.3 |
| Fusarium dimerum | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 |
| Fusarium sp. | 0.0 | 0.5 | 0.0 | 0.0 | 0.8 |
| F. moniliforme | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 |
| F. semitectum | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 |
| F. sambusinum | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Trichothecium sp. | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Rhizopus nigricans | 0.5 | 0.0 | 1.0 | 1.5 | 0.0 |
| Verticillium sp. | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 |
| Pestalotia sp. | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 |

very high incidence of the pathogen in the pre-harvest stage of the crop. Aspergillus sp., Cladosporium sp., Fusarium oxysporum, F. semitectum and F. solani associated with mashkalai, mungbean and pea have been reported to be pathogenic on these crops. Colletotrichum sp. (0.5%) which was observed only on mushkalai from Jamalpur was also known to be pathogenic on mashkalai. Pathogenic fungi Cladosporium sp. and Fusarium semitectum were detected on pea from Jessore and Ishurdi. They were prevalent at the rate of 1.5% and 0.5% respectively. Except Alternaria tenuis, the percentages of infection due to different fungi on various pulses ranged from 0.1% to 14%. A few other unidentified fungi with very low percentages of prevalence were also recorded from the pulse samples. A few nonpathogenic unidentified bacteria were found associated with seeds as well.

About 1-15 days are required for final identification and determination of all the fungal as well as bacterial species associated with the samples of different pulses. As such, it has been possible to include only the results of laboratory analyses for the pre-storage pulse samples in the present report.

3. Agronomy (Physiology) : Samples of various pre-stored pulses drawn from the selected farmers of Jamalpur, Kishoregonj, Feni, Ishurdi and Jessore were subjected to analyses for purity, germination and moisture content. A total of 46 samples were analysed during the period under review. The results of analyses presented in Tables 8a and 8b show the benchmark data for various pulses that were subsequently stored in various containers. Actual relationship of the moisture content and viability of seeds with different methods of storage will

Table-8a : Germination, moisture content and purity (%) of pulse samples collected from Jamalpur, Kishoregonj, Feni, Ishurdi and Jessore

| Analysed for | Lentil | | | | | Mungbean | | | Mashkalai | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Jama-lpur | Kishor-egonj | Feni | Ishu-rdi | Josso-re | Jama-lpur | Feni | Jess-ore | Jamal-pur | Ishurdi |
| Germination(%) | 24.25. | 48.10 | 36.0 | 59.25 | 53.81 | 98.3 | 58.3 | 94.33 | 90.6 | 88.3 |
| Moisture content (%) | 9.46 | 10.54 | 11.97 | 11.85 | 12.42 | 9.0 | 14.2 | 7.88 | 13.19 | 11.82 |
| Inert matters (%) | 0.67 | 1.01 | 0.70 | 2.41 | 0.80 | 0.5 | 0.4 | 1.19 | 0.29 | 2.65 |
| Wood seeds (%) | 1.70 | 5.09 | 1.13 | 1.06 | 1.07 | 0.06 | 0.57 | - | - | 0.06 |
| Other crop seeds(%) | 0.83 | 0.72 | 0.18 | 2.09 | 0.58 | 0.2 | 0.03 | 3.46 | 1.05 | 0.32 |

Table-8b : Germination, moisture content and purity (%) of pulse samples collected from Kishoregonj,Ishurdi and Jessore.

| Analysed for | Khesari | | | Gram | | Pea | |
|---|---|---|---|---|---|---|---|
| | Kisho-regonj | Ishurdi | Jessore | Ishur-di | Jessore | Ishu-rdi | Jessore |
| Germination (%) | 25.6 | 28.5 | 50.0 | 49.0 | 84.0 | 40.0 | 26.5 |
| Moisture content(%) | 16.04 | 11.82 | 12.35 | 11.80 | 15.06 | 13.45 | 10.86 |
| Inert matters(%) | 0.19 | 2.85 | 1.63 | 1.28 | 0.78 | 0.62 | 0.26 |
| Weed seeds (%) | - | 0.69 | 0.77 | 0.09 | 0.01 | 3.56 | 0.03 |
| Other crop seeds(%) | - | 0.33 | 1.19 | 0.16 | - | 0.34 | 4.23 |

be determined later from the comparative study of the analysed samples to be drawn for the whole period of storage. One common feature, however, was evident from the present study. All the lentil samples except one from all locations showed poor germination. To determine the exact cause of poor germination, an investigation will be made by collecting samples starting from the harvesting stage in the next growing season. The moisture content of the seed samples varied between 9 and 16%. Contamination of the seed samples by the inert materials was found to be negligible. However, the samples of mungbean and lentil collected from Jamalpur and Kishoreganj were contaminated with weed seeds to the extent of 9% and 5% respectively.

4. Agricultural Economics : Data for the benchmark survey of pulse farmers at Ishurdi, Kishoreganj, Feni and Jamalpur were collected and tabulated. In this report, some preliminary analyses of these data have been presented.

a. Area under pulses : A total of 177 pulse farmers were interviewed. At Ishrudi, Kishoreganj, Jamalpur and Feni 51, 50, 40 and 36 farmers were interviewed respectively(Table 9). Of the farmers, 53% were small with cultivated land less than or equal to one hectare, 28% medium with cultivated land holding more than one hectare but not more than two hectares and 39% large whose land holding was more than two hectares. At Ishurdi and Jamalpur, the sample included more large farmers whereas at Kishoreganj and Feni the number of small farmers was more than the large ones.

Table-9 : Distribution of farmers according to the farm size in different survey areas.

| Farm size (ha) | Number of farmers interviewed at | | | | |
|---|---|---|---|---|---|
| | Ishurdi | Kishoregonj | Feni | Jamalpur | Total |
| Upto 1.00 | 13 | 20 | 19 | 6 | 58 |
| 1.01 - 2.00 | 9 | 16 | 16 | 9 | 50 |
| Above 2.00 | 29 | 14 | 1 | 25 | 69 |
| All sizes | 51 | 50 | 36 | 40 | 177 |

b. Area under the survey crops : Lentil, khesari, blackgram, mungbean, gram and pigeon pea were the major pulse crops in the localities under survey. However, in some areas only one crop was included in the survey while in others there were more than one crops depending upon their local importance.

The share of pulses in the total cultivated land of the farmers varied from place to place. About 32.11% of the total cultivated area of an average farmer at Ishurdi and 21% at Kishoregonj were under the survey crop, while this was only 5% at both Feni and Jamalpur (Table 10). In all places, the share of survey crop was more in small farms than in medium or large farms. The area under the survey crop with the small farmers was about 50% of their total cultivated land while it was only 30.5% in the case of large farmers at Ishurdi. The increased share of the survey crop area in small farms suggests that pulse crop occupies an important position in small farmers' farming practices. This may either be due to their special interest meeting daily food requirements or that in earning cash return.

c. Purpose of storage : Purpose of storage varied from farm to farm. At Ishurdi, 84% farmers stored pulses to meet their total or partial seed requirement and the rest stored only for their future consumption. Of the 84% farmers, 45% stored pulses only for seeds, 12% for seed and sale, while 27% for seeds, sale and consumption (Table 11). At Kishoregonj, 74% farmers stored pulses to meet the total or partial requirement of their seeds and 26% for consumption and sale. Of those who stored pulses for seeds, 32% did so exclusively for seeds and 42% for seed, consumption and sale (Table 11).

At Feni, only the mungbean farmers were interviewed since this was the major pulse in the area. Whereas 11% of these farmers did not store mungbean at all, 86% stored to meet their total or partial seed requirement and the rest for consumption only.

Table-10 : Total cultivated land and the area under the survey crop.

| Survey locality | Farm size (ha) | Total cultivated land (ha) | Area under survey crop (ha) | Percentage of total cultivated land. |
|---|---|---|---|---|
| Ishurdi | Upto- 1.00 | 0.64 | 0.32 | 50.00 |
| | 1.01- 2.00 | 1.29 | 0.42 | 32.56 |
| | Above- 2.00 | 3.64 | 1.11 | 30.49 |
| | All size | 2.46 | 0.79 | 32.11 |
| Kishoregonj | Upto - 1.00 | 0.82 | - | 37.00 |
| | 1.01 - 2.00 | 1.54 | - | 26.00 |
| | Above- 2.00 | 3.84 | - | 13.00 |
| | All size | 1.90 | - | 21.00 |
| Feni | upto - 1.00 | 0.70 | 0.06 | 9.00 |
| | 1.01 - 2.00 | 1.35 | 0.08 | 6.00 |
| | Above- 2.00 | 2.72 | 0.16 | 6.00 |
| | All size | 1.42 | 0.07 | 5.00 |
| Jamalpur | Upto - 1.00 | 0.95 | 0.12 | 13.00 |
| | 1.01 - 2.00 | 1.64 | 0.13 | 8.00 |
| | Above- 2.00 | 5.33 | 0.25 | 5.00 |
| | All Size | 3.84 | 0.21 | 5.00 |

Table-11 : Distribution of farmers storing pulses for seeds, consumption, sale etc. in different survey areas.

| Stored for | Number of farmers surveyed at * | | | |
|---|---|---|---|---|
| | Ishurdi | Kishoregonj | Feni | Jamalpur |
| Seeds | 23 (45) | 16 (32) | 6 (17) | 29 (72) |
| Future consumption | 8 (16) | 12 (24) | 1 (3) | 2 (5) |
| Future sale | - | 1 (2) | - | - |
| Seeds and future consumption | - | 9 (18) | 20 (56) | - |
| Seeds and future sale | 6 (12) | 8 (16) | 3 (8) | - |
| Seeds, future consumption and future sale | 14 (27) | 4 (8) | 2 (6) | - |
| Did not store at all | - | - | 4 (11) | 9 (23) |
| Total : | 51 (100) | 50 (100) | 36 (100) | 40 (100) |

* Figures in parenthesis indicate percentage of farmers storing seeds.

Of the latter, 17% stored pulses only for seeds, 56% for seeds and consumption, 8% for seeds and sale and the rest for seeds, consumption and sale (Table 11). At Jamalpur, farmers growing lentil, mungbean, blackgram, gram, khesari and pea were included in the survey. Of these farmers, 23% did not store any pulses at all, 72% stored their produce totally or partially for seeds and the rest for consumption only (Table 11).

d. Qunatity stored/disposed : At Ishurdi, each farmer on an average stored 67% of his total stock of lentil for deferred selling and 22% for consumption and the rest for seeds. After 1½ months of harvest, it was observed that only 40% of the total produce were stored for future consumption (10%), sale (19%) and seeds (11%) and 48% already sold and 12% consumed (Table 12). At Kishoregonj 41% of the total stock of each farmer were stored for consumption, 50% for sale and only 9% for seeds. After two months of harvest, 31% of the total produce were already sold and 14% consumed. The rest 55% were stored of which 27% for future consumption, 19% for sale and 9% for seeds (Table 12).

At Feni, each farmer stored 71% of his total produce for consumption, 21% for seeds and 8% for sale. Two months after harvest, 18% of his total produce were found to be consumed, 3% sold and the rest 79% were stored for which 53% for future consumption, 5% for sale and 21% for seeds (Table 12). At Jamalpur each farmer stored 45% pulses for consumption, 17% for seeds and 38% for sale. Two months after harvest, it was found that 16% were already consumed, 27% sold and 56% stored of which 29% for future consumption, 10% for sale and 17% for seeds (Table 12).

c. Containers for storage : The farmers used gunny bags, tins, polythene bags, bamboo basket, earthen pitchers, brass pitchers and aluminium pitchers to store their pulses. Many farmers used more than one containers for storing their pulses.

Table-12 : Average quantity (kg) of survey crops disposed for different purposes in the survey areas.

| Purposes | Quantity of produce * | | | |
|---|---|---|---|---|
| | Ishurdi | Kishoregonj | Feni | Jamalpur |
| Already consumed | 38.31 (12) | 9.80 (14) | 2.44 (18) | 11.79 (16) |
| Kept for future consumption | 33.27 (10) | 18.02 (27) | 7.31 (53) | 21.57 (29) |
| Already sold at harvest | 158.10 (48) | 21.00 (31) | 0.47 (3) | 20.06 (27) |
| Stored for future sale | 61.51 (19) | 12.58 (19) | 0.72 (5) | 7.11 (10) |
| Saved for seeds | 36.16 (11) | 6.16 (9) | 2.94 (21) | 12.57 (17) |
| Total : | 327.35 (100) | 67.56 (100) | 13.88 (100) | 73.28 (100) |

*Figures in parenthesis indicate percentage of produce disposed for different purposes.

At Ishurdi, about 43% of the farmers used earthen pitchers alone and 20% earthen pitchers and gunny bags together. Only 8% farmers stored their seeds in gunny bags and 4% in tins with lids. Polythene bags were used by only one farmer (Table 13). While gunny bags, tins with lids and earthen pitchers were used by 18% and 46% of the pulses farmers surveyed at Kishoregonj, tins with lids and earthen pitchers were used by 56% and 44% farmers at Feni. The commonly used containers at Jamalpur were gunny bags and earthen pitchers (Table 13).

It was thus found that earthen pitchers, gunny bags and tins with lids were the most common forms of containers used by the farmers for storing their pulses. Methods of storage were almost similar at all places surveyed. Drying of seeds prior to storing is a common practice everywhere. The farmers were found aware of the fact that sun-drying of seeds every month can protect the seeds from insect attack in storage.

f. Incidence of insects : About two months after harvest, 96% farmers at Kishoregonj, 39% at Ishurdi and 22% at Feni reported insect attack on their stored pulses. Only one out of 31 farmers reported such attack at Jamalpur (Table 14). At Ishurdi, 50% of the affected farmers applied malathion dust outside the container in addition to occasional sun-drying, while the rest depended on occasional sun-drying only. At Feni and Kishoregonj, all the farmers adopted sun-drying as a measure to protect their produce from insect attack.

5. Agricultural Engineering : The newly fabricated solar drier will be tested for drying pulses at BARI, Joydebpur, Dacca by the middle of September, 1982, when the rainy season will be over and sufficient sun-rays will be available for drying (Fig.1).

Table-13 : Distribution of farmers using different types of containers for storing pulses in survey areas.

| Containers used | No. of farmers surveyed at* | | | |
|---|---|---|---|---|
| | Ishurdi | Kishoregonj | Feni | Jamalpur |
| Gunny bag | 4 (8) | 9 (18) | - | 14 (45) |
| Tin with lid | 2 (4) | 9 (18) | 18 (56) | 5 (16) |
| Polythene bag | 1 (2) | 1 (2) | - | - |
| Earthen pitcher | 22 (43) | 23 (46) | 14 (44) | 12 (39) |
| Silver pitcher | - | 2 (4) | - | - |
| Dole(bamboo basket) | - | 5 (10) | - | - |
| Copper pitcher | - | 1 (2) | - | - |
| Gunny bag + tin with lid | 4 (8) | - | - | - |
| Gunny bag + earthen pitcher | 10 (20) | - | - | - |
| Gunny bag + earthen pitcher + bamboo basket | 6 (11) | - | - | - |
| Tin with lid + earthen pitcher | 2 (4) | - | - | - |
| Total : | 51 (100) | 50 (100) | 32 (100) | 31 (100) |

*Figures in parenthesis indicate percentage of types of containers used in storage.

Table-14 : Distribution of farmers affected by insect pests in different survey areas.

| Stage of attack | Number of farmers surveyed at * | | | |
|---|---|---|---|---|
| | Ishurdi | Kishoregonj | Feni | Jamalpur |
| Affected | 20 (39) | 48 (96) | 7 (22) | 1 (3) |
| Non-affected | 31 (61) | 2 (4) | 25 (78) | 30 (97) |
| Total : | 51 (100) | 50 (100) | 32 (100) | 31 (100) |

*Figures in parenthesis indicate percentage of farmers affected/non-affected.

Appendix A. A questionnaire for economic survey of the pulses growers in Bangladesh.

Identification of farmer :

Farmer's name : .....

Father's name : .....

Village : ..... Union : .....

Post Office : ..... Thana : .....

District : .....

Surveyor's name : ..... Date : .....

Part A : Farmer's background information

1. Survey Codes 1 - 3

a. District .....

b. Location ..... 4-5

.....

c. Respondent ..... 6 - 8

d. Survey year & season ..... 9 -10

2. Respondent's family

a. What is the total no. of family members who depend on respondent ? 11 12

(.....)

b. Total adult males 13 - 14

(.....)

c. Total adult females 15-16

(.....)

d. Total children under 12 years of age 17-18

(.....)

e. How many family members worked in crop cultivation this year ? 19-20

(.....)

f. How many permanently employed labours did respondent hire in last three months ? 21-22

(.....)

3. Livestock Ownership

List the no. of livestock owned by respondent now.

a. Draft animals (all bullocks, buffaloes and cows that can pull a plough) (_____) 23-24

b. Milch cows 25-26

c. Young Stock (_____) 27-28

d. Does respondent put in box if Yes=1 No =2)

- rent out draft animals ? 29

- rent in draft animals ? 30

- Share draft animals ? 31

- own goats or sheep ? 32

4. Land ownership and use

Be sure to indicate the measures (acre, decimal, ganda, katha etc) used by respondent. Convert into acres and decimals in boxes.

a. Owned land to which respondent claims a title at this time (_____) 33 - 36 (ac.) (dec)

b. Land rented in by respondent at the time of survey (_____) 37 - 40 (ac.) (dec.)

c. Homestead land used by respondent and his family. (_____) 41 - 44

d. Cultivated land under crop at this time (_____) 45 - 48 (ac.) (dec.)

e. Land rent out at this time by respondent (_____) 49 - 52 (ac.) (dec.)

f. Current fallow land owned at the time of survey (_____) 53 - 56

g. How many plots make up the respondents total holding ? (_____) 57-58

5. Cropping Intensity

a. Total cultivated land(current year) (_____) 59 - 62 (ac.) (dec.)

b. Total cropped area (current year) (_____) 63 - 66

1. Aus _____ (dec.)
2. Aman _____ "
3. Boro _____ "
4. Jute _____ "

5. Sugarcane _____(dec.)
6. Wheat _____ "
7. Potato _____ "
8. Coton _____ "
9. Vegetables _____ "
10. Pulses _____ "
i) Lentil _____ "
ii) Khesari _____ "
iii) Gram _____ "
iv) Mung _____ "
v) Mashkalai _____ "
vi) Arhar (oct.) _____ "
11. Tobacco _____ "
12. Rabi crops _____ "
13. Others _____ "

a. Name of the survey crop (_____) 67-68

b. On how many plots cultivated this season? (_____) 69-70

Total area of this crop cultivated by respondent (_____) 71 - 74 (ac.) (dec.)

d. Date of sowing of survey crop 75 - 77

Part B. Harvest & Postharvest Technology

Dist. Loc Resp. Crop.

1. Date of Harvest

a. 11 - 14
/ 1 2 3 4
month Week

b. Methods of harvest

1. Manual (Indigenous) 15
_____

2. Mechanical 17
_____

If 2, what machine ?
1. _____
2 _____
3 _____
4 _____

2. a. Date of threshing 18 - 20
/ 1 2 3 4
month week

b. Methods and power of threshers used manual/mechanical 21

Power 22
1. Manual 1
2. Bullocks 2
3. Thresher 3
4. Tractor/Powertiller 4
5. Others 5

C. No. of sunning 24
1
2
3
4
5
6
7
8
9
10

3. Crop output and disposal

a. Farmer's estimate of total farm output for this crop (_____ mds/seers) 27 - 31

b. What share of the crop already consumed? (_____ mds/seers) 33 - 37

c. What share of the crop will be consumed ? (_____) 39 - 43

d. What share of the crop sold at harvest time ? (_____ mds/seers) 45 - 50

e. What share of the crop will be sold later in the year ? (_____ mds/seers) 52 - 56

f. What share of the crop saved/will be saved to use as seed ? (_____) 58-62

g. Have you stored your crop(grain) ? Yes = 1 or No = 2, If yes. 64

h. How much have you stored ? (_____ mds/seers) 66 - 68

i. Date of storing (_____ month/week) 70-72

j. How did you store your crop ? in 74

1. Gunny bag 1
2. Airtight tin 2
3. Polythene bag 3
4. Earthen pitchers 4
5. Others(specify) 5
6. ..... 6
7. ..... 7
8. ..... 8

k. Why did you prefer these storing methods ? 76

1. 1
2 2
3 3
4 4
5 5
6 6
7 7
8 8

l. Why did you store your crop for 79

1 Seed purpose 1
2 Future consumption 2
3 Future sell 3
4 Other (specify) 4

a. Did you have any pests/ diseases attack on your crop after storing ? 12

Yes = 1
or
No = 2

If yes, after how many days of storing pest attacked your crop ? (_____) 14-15

-What are the pests & diseases ? 17

1
2
3
4
5
6
7
8

b. Did you take any measure to control the pests & diseases ? 19

Yes = 1
or
No = 2

- If yes, after how many days of pest/diseases attack, did you take the measures ? (_____) 21-22

- What are the measures did you take to control the pests/diseases ? 24

1 sunning
2 application of Heptachlore
3
4
5
6
7
8 Others (specify)

c. How many times did you apply chemicals/use sun-shine ? (_____) 26-27

d. Amount of chemicals 30-31

_____ pound/seers

e. Cost of chemicals (_____) Tk/pound/seers 34-35

Part C. Marketing and price information

( 1 - 10 )

Dist. Loc. Resp. Crop

1. a. How many times did you sell your crop ? 12

1
2
3
4
5

1st time sale 14-16

a. Date of sale

_____ / 1 2 3 4
month/week

b. To whom ? 18

1 Retailer
2 Whole seller
3 Other farmers
4 Others (specify)

c. Where ? 20

1 Home
2 Local market
3 Others (specify)

d. Amount sold
(.....) 22 - 25
mds/seers

e. Selling price
(.....) 27 - 29
Tk./md.

2nd time selling

a. Date of sale
...../ 1 2 3 4 31 - 33
month/week

b. To whom ? 35
1 Retailer
2 Whole seller
3 Other farmers
4 Others (specify)

c. Where ? 37
1 home
2 local market
3 others (specify)

d. Amount sold
(.....) 40 - 43
mds/seers

e. Selling price
(.....) 45-47
Tk/md

3rd time sale

a. Date of sale
...../ 1 2 3 4 50-52
month/week

b. To whom ? 54
1 Retailer
2 whole seller
3 other farmers
4 other (specify)

c. Where ? 56
1 home
2 local market
3 other (specify)

d. Amount sold
(.....) 58 - 61
mds/seers

e. Selling price
(.....) 63-65
Tk./md

f. Sample :
(a) size of sample
(.....) 67-69
seer