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AN ANALYSIS OF THE LOSS OF SEED QUALITY  
AT THE WAREHOUSE OF NASIR POOR

CONDUCTED FOR:

DEVELOPMENT ALTERNATIVES, INC.

ON THE BEHALF OF THE

AFGHANISTAN AGRICULTURAL SECTOR SUPPORT PROJECT

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## PAKISTAN SEED PROBLEM

Seed production is a highly technical, management-intensive undertaking. It is the collective responsibility of each person and organization to maintain the quality of the seed after it is harvested, and until the farmer plants it.

After reviewing all the documents it must be concluded that several errors were made during the process of producing, procuring, storing and shipping the seed. In large part it is the fault of a system set up by USAID in which a procurement agent (RONCO) is acting on the behalf of a distributor (DAI). As a result there is no direct contact between the producer (CARGILL), the distributor, and the end user of the seed, (the FARMER).

Given the enormity of the problem and the total time that has elapsed, a very limited number of documents were presented by DAI. Several of the participants involved could have directly influenced the quality of seed. As a result, a different method will have to be used to address the questions surrounding the apparent drop in seed quality.

The first section of the paper is a Chronology of Events developed from the documents supplied by DAI. This will establish what actually happened between March 1990, and March 1991.

The second section presents the responsibilities and basic procedures that should be followed when dealing with seed. This will allow the various participants to review their actions against what should have been done.

The topics covered are not complete, and are not meant to be a definitive study on seed handling. They do point out how any one of the parties involved in this incident could have prevented the problem from getting out of hand.

The topics covered are:

- Responsibilities for Providing Quality Seed;
- Procedures to Insure Quality;
- Warehouse and Storage Management;
- Bagging of Seed;
- Seed Fumigation;
- Germination Tests;
- Seed Sampling Procedures.

The third section deals with those actions taken by CARGILL, RONCO, and DAI from the time the seed was delivered to Nasir Poor, and certain questions that should have been addressed.

A final section presents the conclusions of International Development Services, Ltd. staff based on the documentation presented to it by DAI, discussions with seed chemical experts, review of technical data, and based on the firm's own experience.

The conclusions made are the findings solely of International Development Services, Ltd.

## PAKISTAN SEED GERMINATION STUDY

### CHRONOLOGY OF EVENTS IN 1990

1. March: DAI asks RONCO to secure 1000 mt of wheat seed for use by ASSP.
2. March: RONCO contacts Cargill Seed Co. to provide 1000 mt of wheat seed for variety Pirsabak (85); Cargill is only able to provide Pak (81).
- 3 July: DAI takes delivery of 100 mt of variety Pak (81) at its warehouse in Peshawar.
4. July: DAI takes delivery of 200 mt of variety Pak (81) at its warehouse in Quetta.
5. July(?): Germination test on seed delivered to Quetta registered "over 85%".
6. Sept 12: DAI takes delivery on 500 mt of Pak (81) at its warehouse at Nasir Poor (NP).
7. Sept 12: Physical inspection of seed delivered to NP by Mssr. Noori, Hawes, Wais, and Rann; two species of grain beetles found on the outside of the bags. Labels inside bags state the seed is treated with Vitavax.
8. Sept 17: First germination samples taken [by Mr. Sofi(?), no identification of lots]
9. Sept 18: Memo to Dr. Richard L. Smith (COP/DAI) reporting insect problem and recommended action to be taken.
10. Sept 24: Germination results are 84% and 87% for samples taken on Sept 17th. [Handwritten note asks Mr. Sofi to repeat tests. No data presented on the repeat tests.]
11. Oct ?-14: Seed fumigated at Peshawar warehouse (Nasir Poor?)
12. Oct 16: Mr. Church and Ms. Tietjen file an update report to Mr. Lewis, Chief ARD at USAID.
13. Oct 22: Seed samples taken for germination test [assume from Nasir Poor]; no identification as to location or lot number, only labelled as "new seed" and "old seed".
14. Oct 30: Germination results from 22 Oct. indicate "new seed" averaged 86%, while "old seed" averages 83%.

15. Nov 28/29 Memos to Dr. Richard L. Smith (COP/DAI) from Mssr. Noori and Haws, and Mr. Hassan (in Darha Nur) concerning complaints of low field germination of Pak (81) wheat seed. (Memo from Mr. Salimanzai in Darah Nur dated Dec 1, confirms problem).
16. Nov 29: Samples taken of seed from Darah Nur, and Nasir Poor
17. Dec 9: Germination results from Nov 29;  
  
Average of three tests from both sets of seeds;  
Darah Nur = 18%, Nasir Poor 34.5%.  
  
However tremendous and contradictory differences are reported.
18. Dec 18: Germination results from Pakistan Dept of Ag. results:  
  

Lab No. 157; "27-7-90"	= 85%
158; Darah Nur	= 90%
159; Nasir Poor	= 38%
19. Dec 9-19: Germination results from Mr. Sofi, Dept. of Agronomy  
  

Darah Nur	= 82%
Nasir Poor	= 14%

He observes that seed seems to be from different sources.
20. Dec 20: Germination results from Cereal Crops Research Institute, no source of seed indicated.  
  

Seed unwashed (with Vitavax)	= 3.3%
Seed Washed (no Vitavax)	= 9.3%
21. Late Dec: Unsigned report giving update on whole seed problem.
22. Dec 31: Seed samples taken from Nasir Poor warehouse by Cargill, for germination test (by Ferag, Dadullah, and Sayar?)

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23. Jan 1: Dr. A.R. Khan of Cargill Pakistan Seeds, Ltd. sends memo to Mr. I.A. Akhtar of RONCO in Islamabad. He mentions the sub-standard conditions of the warehouse, and recommends the use of Phostoxin for fumigation.
24. Jan 2: Memo from Mssr. Noori and Haskell to Mr. Akhtar of RONCO reviewing the situation and outlining some of their conclusions.
25. Jan 7: Memo from Mr. Noori to Mr. Akhtar protesting the way Dr. A.R. Khan reported the way the seed was handled.
26. Jan 8: Germination results of three samples taken by Cargill;  
(test by Ferag, Dadullah, and Sayar)
- |           |   |       |
|-----------|---|-------|
| Sample 1. | = | 30.5% |
| Sample 2. | = | 9.0%  |
| Sample 3. | = | 11.0% |
| Average   | = | 16.3% |
27. Jan 31: Memo to Dr. R.L. Smith (COP/DAI) from Mr. Noori discussing contacts with Cargill and securing samples of seed from Afghanistan.
28. Feb 13: Memo to Mr. K. Parvez of Ronco, from Dr. A.R. Khan in which he details who and how the fumigation was conducted. He includes the results of the samples taken on Dec. 31. (test conducted by Cargill staff)
- |              |   |     |
|--------------|---|-----|
| Sample No. 1 | = | 65% |
| Sample No. 2 | = | 73% |
| Sample No. 3 | = | 61% |
29. Feb 25: Memo from Mr. I.R. Akhtar (RONCO) to Dr. R.L. Smith (COP/DAI) another summary of the situation in which RONCO finally states that Cargill supplied seed of the required quality and standard[s].
30. Feb 27: Memo from Dr. R.L. Smith (COP/DAI) to Mssr. G. Lewis and P. Church (USAID) in which he refutes some of the claims made by both RONCO and Cargill.

31. March 5: Memo to Dr. R.L. Smith (COP/DAI) from Mr. I.R. Akhtar (RONCO) in which he raises questions to be answered before they (RONCO) pursue any action against Cargill.
32. March 5+: Memo to Mr. Gary Lewis (USAID Project Officer) from Dr. Richard L. Smith (COP/DAI) reviewing the situation.

## RESPONSIBILITIES FOR PROVIDING QUALITY SEED

### I. Producer

A conscientious seed producer wants to insure that their product is of the highest standard possible. Seed production is a labor and management intensive activity and requires tremendous attention to details. Poor seed is immediately apparent to farmers and once the reputation of the seed producer is compromised, it is hard to regain the confidence of the agricultural sector.

The way to maintain high quality is to constantly check the quality of the seed at each step. Field production records should be kept on each operation. These will include planting records, field maps, agronomic schedules, and harvest information.

When the seed is harvested, it is delivered to a conditioning plant. Here the seed is cleaned, sized or graded, and perhaps treated with specific chemicals such as fungicides or insecticides. Records must be kept on the germination of the seed as it comes from the field along with its moisture content, and the percentage of off-grade material.

Once the seed is conditioned and bagged, it is the responsibility of the producer to store it in a manner that will maintain the quality of the seed until it is delivered to the agent or distributor. Before each shipment of seed, each lot is inspected and reference germination samples are taken.

### II. Procurement Agent

A procurement agent is used when special attention must be taken to insure that the needs of the distributor are met. The procurement agent's first responsibility is to insure that quality seed is available for the distributor.

Normally, a distributor works directly with the producer. This entails an inspection of the producer's facilities, records, and the seed (either in the field or the warehouse).

The procurement agent has to assume the responsibility of purchasing the best quality seed possible and delivering it to the distributor without any loss in quality. Until the distributor is satisfied with the quality of the seed the responsibility lies with the producer and procurement agent.

### III. Distributor

The distributor has to deliver good seed to its clients, usually the farmer. If the seed is not of good quality, the distributor's reputation is damaged in the same way as the producer's.

The distributor has to have confidence in the producer and the procurement agent. However, the distributor must assure itself that the seed delivered is the same quality as ordered. It must assume the responsibility of inspecting and sampling the seed at the moment of delivery.

The distributor must provide clean facilities to receive and store the seed before delivery to the growers.

Finally, the distributor must continually inspect and test the seed in storage. Before any seed leaves the warehouse it should have a germination test conducted, and a physical examination of each lot to insure it is pest-free.

PROCEDURES TO INSURE THAT QUALITY SEED IS PURCHASED THROUGH  
A PROCUREMENT AGENT, OR DIRECTLY FROM THE PRODUCER

I. Distributor/Producer Relationship

- A. The distributor must know who the producer will be, and to establish the type, amount, price, and the quality of seed to be delivered.
- B. The distributor must have access to all production and inspection records relative to the seed it will purchase.
- C. The distributor must have the right to refuse any seed not meeting the stated specifications.
- D. Final payment for seed is made upon satisfaction that the seed delivered to the distribution point meets the defined specifications.

II. Producer's Responsibilities

- A. To produce seed to the minimum specifications of the customer and deliver it on schedule in good condition.
- B. To maintain field operation records and inspection data.
- C. Allow the client to see their contracted seed production fields.
- D. Harvest, handle, and condition the seed so as to maintain its quality up to the time and place of delivery.
- E. Provide technical advice to the client (upon request) on how to best handle, store, transport, and use the seed.

III. Procurement Agent's Responsibilities

- A. To be assured that the seed asked for by the client (distributor) is available and/or contracted by the producer.
- B. Inspect the production fields, conditioning plants, and warehouses of the producer.
- C. To inspect all production, inspection, conditioning and warehouse records relative to the seed being purchased for the distributor.

- D. Insure that the quality standards agreed upon by the distributor and producer have been met BEFORE the seed is delivered.

#### IV. Distributor's Responsibilities

- A. Inspect the documentation on the contracted seed BEFORE delivery to the distribution/storage point.
- B. Provide a clean, and pest-free storage environment available to receive the seed.
- C. Have a competent company employee present while the seed is being unloaded.
- D. Inspect every bag (or other container) of seed to insure that:
  - 1. Every bag is labelled correctly
  - 2. There are no damaged bags
  - 3. There are no pests present (rodents, insects)
- E. Take representative samples of the seed shipment to insure that germination, purity, and cleanliness standards have been met by the producer and distributor.

## WAREHOUSE AND STORAGE MANAGEMENT

The single most important factor for insuring pest-free seed is maintaining a clean storage area. A warehouse must be cleaned and fumigated BEFORE seed is stored in it. If there is seed already stored in a warehouse, it should be fumigated before new seed is brought into the same area.

Warehouse inspection and sampling is a constant activity and the responsibility of the seed producer, supplier, and distributor's staff. Inspection of the seed should be conducted almost daily, and sampling should be carried out at regular intervals. If the storage facility is sealed and adequately ventilated, and/or cooled, germination tests should be carried out at least every two months. If the storage facility is not secure, or environmental conditions are irregular, tests should be carried out every month.

Rodent attacks and insect infestation are two of the worst problems in seed storage. In the case of rodents, they usually invade the storage space, rather than accompany the seed into the warehouse at delivery. Rodents are best controlled by using poison baits, and by regular fumigation with chemicals. Traps are normally inadequate to the task.

Insects on the other hand often accompany the seed into the warehouse. Insect eggs and larvae can be on the surface of, or inside, the seed at the time of harvest. They may attack the seed while it is being stored for conditioning, or during the conditioning itself. They may also attack the seed after it is conditioned and before it is delivered to the distributor. Even the use of chemical treatments will not guarantee insect-free seed.

Regular inspections of every lot of seed, particularly in the interior of the stack will alert staff to the presence of insects. By the time the staff see insects on the surface of the bags, significant damage will have already occurred inside the bag. Normally it is the adult form of the insect that is visible outside the bag, while the larval form has already destroyed the seed. For this reason, it is imperative that fumigation begin as soon as the insect problem is identified.

## BAGGING OF SEED

An important factor concerning the potential of insect infestation is the type of bags used to store the seed. Seed should never be handled as if it is grain. Seed should always be placed in bags of multi-layered paper, or heavy plastic. Regardless of which material is available, only new and clean bags should be used.

Open-weave bags (such as jute) should never be used. There is no way to protect the seed from insects with this type of material.

## SEED FUMIGATION

The use of methyl bromide was clearly the wrong choice of chemicals. All professional contacts in the USA (including the DOW representatives), recommended against the use of it for seed fumigation.

Methyl bromide is a dangerous poisonous gas which is colorless and odorless, and is used to fumigate closed spaces, commodities, and for soil fumigation. The normal method for the application of methyl bromide gas is with pressurized cylinders and using electronic devices to monitor gas concentrations.

If the memo from Church and Tietjen is correct, methyl bromide in the formulation DOWFUME MC<sup>2</sup> in canisters was used to fumigate the seed. It is impossible to regulate the concentration of methyl bromide gas when using canisters. It seems that the methyl bromide gas was used at Nasir Poor without any sort of regulation or monitoring devices.

Without being able to monitor the concentration, and rate, of gas permeation into the stacks of seed, it would be impossible to know how effective the gas was in killing the insects. Methyl bromide in high concentrations and for excessive periods of time would kill the seed germ just as effectively as the insects.

DOW Chemical company officials stated that they no longer make DOWFUME in the USA. It may be that it is still formulated in Pakistan, but if not, the chemical may have been out of date.

Phostoxin, (Aluminum phosphide) is the preferred chemical to use as a fumigant against storage insects in stored seed, vegetables, fruits, and nuts. Dr. Khan of Cargil (in January 1991) recommended using Phostoxin as a seed fumigant "in the future" at its "recommended dose with an exposure period of three days".

While this advice is correct, it should have been given to RONCO and DAI in July. It was irresponsible of Cargill to contract out the fumigation of the seed, and then not to monitor the operation.

## THE GERMINATION TESTS

It is apparent from the contradictory data from the several germination tests, that there was no uniformity in either sampling techniques or germination procedures.

In the absence of any data from Cargill, there is no way of knowing what the original germination percentage was for the seed shipments. Subsequent tests are so erratic that no conclusions can be drawn to what the actual germination percentage was on any of the seed in the Nasir Poor warehouse.

Standard sampling procedures were not followed. For a volume of 500 mt of seed, more than three (3) samples at a time are needed to get an adequate representation of the condition of the seed. A minimum of 50 samples should have been taken from all parts of the warehouse immediately after the fumigation was completed. In this way it might have been possible to detect how different parts of the seed in the warehouse were effected by the methyl bromide.

It is felt that each of the parties mentioned in the documents, conducted their respective germination reports using different selection and measurement criteria. For this reason the following section is presented to show how sampling should be carried out at each step.

## SEED SAMPLING PROCEDURES

Sampling procedures for germination tests will vary with the type of seed to be tested and with the germination procedures carried out. However, certain techniques should be used to insure uniformity between samples, and to provide backup samples for duplication of tests.

### A. Field Sampling:

Field samples are taken just before, or at the time of harvest. This sample is used to establish the "base line" of the seed quality. It may be taken in the field from which the seed is harvested. However this is laborious and is not usually representative of the whole field. It is a useful procedure when it is suspected that a portion of a (or whole) field has some particular problem that would warrant harvesting it separately. It is given a unique identification number, and an explanation why it is to be handled differently. Tests for germination, moisture content, and purity will be run on the samples.

B. Harvest Sample:

At the time of harvest, and usually in the truck or at the seed conditioning facility, a random sample is taken for testing. The sample is labelled with the date, the production field or location, and it is assigned a unique LOT NUMBER. This number will be used to identify the seed through out the conditioning procedure. Tests for germination, moisture content, and purity will be run on the sample.

C. Storage Sampling:

Most seed quality problems occur after harvest, and before conditioning. Too often, bulk storage is necessary during the harvest season since the seed is being harvested faster than it can be conditioned and sent to the warehouses. The seed is handled as "grain" and often it is destroyed by storing it in bags, bins, or under covers with a high moisture content and without air circulation. The seed should be constantly aerated by turning it or by using forced air circulation. Measurements are taken to monitor the temperature and to insure that it does not rise so high as to kill the germ. Before the seed is sent to the conditioning plant, its moisture content and germination percentage should be measured. Seed which has suffered any deterioration in quality should be set aside and handled as a separate lot.

D: Conditioning Sample:

As the seed is being conditioned (cleaned, sized, treated and bagged), a random and representative sample is taken of the whole LOT. EACH SACK OF SEED must have a label containing; the Lot Number, the harvest date, conditioning location, the date and percentage of the germination test, purity, inert material, and the amount of seed in the bag.

Normally, a reserve or reference sample of the seed is maintained in cold storage. This sample can be used to confirm the quality of the seed at the time it left the conditioning plant or the warehouse. These samples are usually kept until the seed has been planted by the grower and there is satisfaction with its performance. In the event of a claim against the company, a duplicate set of quality tests are re-run by the producer and an outside agency.

E. Warehouse Sampling:

As the seed is received, it is stored in separate LOTS of 10 to 20 tons. The LOT identification is maintained as a physical unit while in the warehouse. That is, seed should not be moved randomly around the warehouse, or bags of seed mixed between lots.

When a new shipment of seed is received, a sample for germination and purity tests must be taken immediately. These tests results are then checked against the supplier's data and the information on bag labels. If any discrepancies are found, the receiver should notify the shipper and the producer.

Samples should be taken from each lot in the following manner:

1. A grain probe is inserted into the bag and a few grams of seed placed in a bucket.
2. Bags throughout the LOT are sampled, including those in the interior of the stack.
3. Once a bag is sampled, it should be tagged so that it is not re-sampled at a future date.
4. All the seed from the several bags is mixed thoroughly in the bucket.
5. Two (2) 500 gram samples are made up from the composite seed and labelled. One sample is stored and becomes the "reference sample". The other sample is used for the germination and purity tests.
6. If the results are different than the data supplied by the producer, then a duplicate set of tests should be conducted by an outside agency.

Once the distributor has taken delivery of the seed and is satisfied with its quality, the responsibility to maintain that quality is no longer that of the producer or supplier.

A conscientious distributor will take a final germination sample of any seed before delivering it to the client. This sample is handled in the same way as the initial sample taken upon receiving the seed. That is, a duplicate is taken and one sample is held in storage in case there is a customer complaint about the field germination results.

F: Laboratory Procedures:

Each sample is kept separate and usually two or three replicate tests are made. Each test is labelled so as to identify the lot from which the sample was taken.

The seed is NOT CLEANED OR SORTED, nor are only good seeds selected for the test. The sample is a random one and if there are damaged seeds, or infested seed, they have to be tested as if they are good.

AFTER the germination is complete and the results analyzed, then the reasons for poor or non-germination are discussed.

## CARGILL'S ACTIVITIES AND RESPONSIBILITIES

Cargill is an internationally renowned seed company and grain marketer. As such, they undertook the production of the wheat seed in question, Variety PAK (81).

Since there were no background contract documents provided regarding the amount and quality of seed ordered by DAI, it must be assumed that RONCO made all the arrangements for securing, or contracting the production of, the seed. RONCO should have had a person inspect the production fields, conditioning plants, and storage facilities of Cargill, before and during the production of the seed. (At the same time, Cargill should have offered technical advice to both RONCO and DAI in March 1990, and not waited until January 1, 1991 to extend this offer.)

In the absence of any field, conditioning plant, or warehouse data from Cargill regarding the seed in question, it must be assumed that RONCO never asked for it, or Cargill never volunteered it. In the absence of any germination tests in particular, there is no way to establish what the quality of the seed was when it left Cargill's conditioning plant. The same applies to the lack of any statement from Cargill certifying that the seed was free of any insect infestation.

Data of this type should have been presented by Cargill at the first moment there was any question as to the quality of the seed delivered to DAI's warehouse. The sole personal intervention by Cargill was a single visit to Nasir Poor by Dr. A. Rahman Khan in December of 1990, a full six months after the problem was first raised.

## RONCO'S ACTIVITIES AND RESPONSIBILITIES

RONCO has a procurement contract with USAID to provide commodities to the DAI Afghanistan Agricultural Sector Support Project (AASSP). Since they assumed the responsibility to procure the seed from Cargill on the behalf of DAI, they should have been the first to seek a resolution to the problem. In fact they should have been present at the time the seed was loaded on to the trucks at the Cargill facility and during the unloading at the Nasir Poor warehouse in Peshawar.

At each step of the process, RONCO should have inspected the seed to insure that it was of the quality needed for the AASSP. From the documentation presented, it appears that RONCO was negligent in this regard.

Because of the producer/procurement/distributor arrangement, communications between the parties was apparently slow. If DAI and USAID staff saw insects on the outside of the seed as early as September 12th 1990, (regardless of their source), it is incredible that the fumigation was not completed until October

14th, 1990. Since neither Cargill nor RONCO actually carried out the fumigation, both claimed it was someone else's fault if it was incorrectly executed.

On February 2, 1991 Mr. I. Akhtar of RONCO in Islamabad, wrote a memo to USAID, saying that Cargill had arranged for, and paid the seed fumigation costs. He further states that the seed tested in December 1990, had an average germination percentage of 66%. Further he asserts that, "Cargill supplied the wheat seed of the required quality and standard." This statement is misleading since it would imply that RONCO either had data to support a germination percentage above 90% at the time of delivery, or that RONCO altered their germination requirements after the seed had been fumigated.

If DAI and USAID staff reported the insects on the day of delivery, then it is unlikely that they could have come from any other source than the seed from Cargill. Also, if Cargill arranged for and paid for the fumigation of the seed, it would imply they accepted the responsibility for the infestation. Further, the germination tests (conducted by Cargill themselves and nearly six months later) were substantially lower than Cargill's guarantee of germination of ..."no less than 90%.

It appears that RONCO did not have the technical capacity to insure that quality seed was delivered to DAI, nor did it have the ability to secure or monitor the fumigation services for the seed. As a result methyl bromide, rather than other, and more suitable chemicals was used.

#### DAI's ACTIVITIES AND RESPONSIBILITIES

Based upon the documents supplied by DAI, at least the following actions were taken by DAI in ordering, and taking delivery of the wheat seed needed for the Afghanistan Agricultural Support Project.

DAI relied on an outside procurement agent (RONCO) to purchase the wheat seed without stipulating minimal quality standards. In July, 100 mt of wheat seed was delivered to the Nasir Poor warehouse apparently with an insect infestation (per a memo written in December 1990). DAI took receipt of the seed without any back-up documentation on production procedures, or quality assurance.

DAI took receipt of an additional 500 mt of wheat seed on September 12, at Nasir Poor. DAI staff were present and noted the presence of two species of beetles. DAI should never have taken delivery of the seed in September (or in July) if it had insects on it.

Noori and Haws reported the insect problem to Dr. Smith on September 18, and recommended that Ronco should undertake an investigation of problem. For whatever reason, it took almost one month to get the seed "fumigated". To some degree DAI staff were negligent by delaying, even for one day, the initiation of treatment of the insect problem.

It is not known (from the documents) how DAI kept the seed lots "old and new" separated during the time it was held in Nasir Poor and then shipped to Darah Nur. (In fact it is not clear just exactly what constituted old and new seed. This could mean the seed delivered in July (old) and then in September (new), or different lots of seed during September and October.)

DAI had RONCO handle the insect problem but in fact RONCO relied on Cargill to locate the fumigation company. It is unclear from the documentation just what role DAI had in the fumigation.

## CONCLUSION

The administrative organization of the Afghanistan Agricultural Sector Support Project has lead to a series of actions that resulted in the delivery of poor quality seed to the farmers in Afghanistan. With the introduction of several participants, and without a clear line of responsibility, it is difficult to say exactly at what point, and what action resulted in the sudden loss of seed quality.

There were several questions raised in the documentation which are not part of the issue. These include:

1. The condition of the warehouse at Nasir Poor at the time of the September 12th delivery,
2. Previous seed treatment with Vitafax, which is a fungicide,
3. Alternative chemicals that could have been used for insect fumigation
4. Seed quality at Quetta

The real issues are:

1. Was the seed delivered to Nasir Poor with an existing insect infestation?
2. What was the germination of the seed at the time it arrived at the Nasir Poor warehouse?
3. Was the seed correctly fumigated?
4. What was the germination of the seed after the fumigation?

### SEED DELIVERY ON SEPTEMBER 12, 1990

Apparently the seed delivered to Nasir Poor on September 12th, was infested with at least two different species of insects. There was no record of any insects being in the warehouse prior to the July seed shipment. Even if there were insects in the warehouse at the time of delivery, they could not have attacked the seed that quickly in any event.

If the seed was infested with insects when it arrived at the warehouse, Cargill is responsible for supplying substandard seed.

If the seed was purchased by RONCO without inspecting it, then they too were responsible for delivering substandard seed to DAI and should accept that responsibility.

While DAI was not responsible for the quality of the seed, they should have refused to accept, or pay for it when they discovered the insects on September 12th.

#### FUMIGATION OF THE WAREHOUSE

By accepting the responsibility to treat the seed against the insects, Cargill should have monitored the fumigation. They allowed an outside agency to treat the seed with methyl bromide which is designed to fumigate storage areas. It is a chemical which can kill all forms of life, including seed.

Apparently the methyl bromide was not uniformly applied and as a result, the seed was affected differently in various parts of the warehouse, or between different lots of seed.

Subsequent sampling of the seed, and the germination results, probably indicate that some portions of the seed was not as severely affected by the methyl bromide as others.

#### GERMINATION TEST PROCEDURES AND RESULTS

It is apparent from the erratic germination results, that there was no systematic sampling or germination procedures used by the various agencies, companies, and institutions in Pakistan.

The procedures used to sample the 500 mt of seed in the Nasir Poor warehouse, were an inadequate measurement of the variability of the seed. By only sampling a few bags at irregular intervals, erratic and inconsistent readings were obtained at every laboratory.

There is no way to draw a definitive conclusion as to what the effect of the fumigation was on the germination of the seed.

## SUMMARY

In order for Cargill to prove their case that the seed met their own germination standards of "not less than 90%" they should have presented germination results to RONCO and DAI at the time of delivery. The presentation of germination test results from samples taken in December 1990 are little use. Even these tests results showed an average of only 66%.

There were several witnesses present at the warehouse on September 12th to testify that the seed arrived with insects on the outside of the bags. Cargill and RONCO should have travelled immediately to Nasir Poor to confirm this. Cargill should have presented documentation to RONCO and DAI stating the purity and cleanliness of the seed.

DAI should have stopped the unloading of the seed, and refused to take delivery, as soon as the insects were discovered.

Cargill and RONCO must provide proof that the Fumigation Agency acted on their own volition to use methyl bromide as a seed fumigant. Obviously Cargill officials knew that Phostoxin is the preferred chemical to treat seed but did not share that information with RONCO or DAI until December 1990.