CROP PROTECTION PROGRAMME

Safer and Better Groundnut for Southern India

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FINAL TECHNICAL REPORT

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Executive summary

Groundnut produced in Andhra Pradesh (AP) is highly prone to attack by *Aspergillus* group of soil-borne fungi that produce toxic secondary metabolites known as aflatoxins. Aflatoxins, especially B1 produced by *A. flavus* in groundnut seed is the most potent carcinogen and immuno-suppressive agent that are responsible for various illnesses in humans and animals, and result in economic losses from lowered market potential of groundnut products. Although several *Aspergillus* fungi can produce aflatoxins, *A. flavus* is the most aggressive and most commonly occurring species in groundnut. The fungus infects groundnut mostly at pre-harvest stage through the pegs after their penetration into the soil. The end-season drought stress favours further fungal invasion and aflatoxin production in seeds. In AP, groundnut is grown as a rainfed crop under subsistence farming conditions in poor soils, and end-of-season drought is common. These conditions are highly conducive for *A. flavus* infestation and toxin production. Moreover, poor awareness about the problem and insufficient skills in aflatoxin monitoring put farmers at risk through consumption of aflatoxin-contaminated groundnut. Therefore, this project was undertaken with a purpose to improve the livelihoods of the poor farmers through increased access to aflatoxin reducing technologies such as, elite high-yielding resistant varieties, use of soil amendments and biological control agents, agronomic practices and create awareness among the growers about the risks posed due to consumption of aflatoxins. Access to high yielding aflatoxin resistant cultivars will contribute to increased incomes and also makes beneficial impact on health, particularly among the poor who are most vulnerable to aflatoxicosis due to consumption of contaminated groundnuts.

- The various project activities were executed in close-collaboration with NARS and NGO partners, and framers played a decisive role in evaluating the varieties and technologies. These activities have resulted in the identification of 7 elite aflatoxin resistant groundnut varieties [ICGV 91341, 93305, 91114, 91278, 91328, 94379 and 94434], which are being adopted by the farmers in groundnut belts of Andhra Pradesh state. These varieties were evaluated on-farm in AP. The farmers are multiplying seed of these varieties and NGOs to cater their own and regional needs and this is contributing to the sustainability of seed production.
- In all the trials conducted in Anantapur district, elite varieties produced higher pod and haulm yields (23-43% increase over local variety) over the local cultivar-TMV 2. Highest pod yield of 1029 kg/ha was obtained with ICGV 94434. Aflatoxin contamination was negligible (<4.0 µg/kg) in two villages. However, in two villages toxin concentration in elite varieties were similar to that of controls [2-241 µg/kg]. Highest reduction (73%) in overall mean toxin contamination was recorded in ICGV 94379 and other varieties showed 39– 68% reduction over local controls. In six villages around Pileru area of Chittoor district, elite varieties produced higher pod and haulm yields over control (TMV 2). Highest mean pod yield (593 kg/ha) and haulm yield (1933 kg/ha) was obtained with ICGV 94379, followed by pod yield of 586 kg/ha and haulm yield of 1835 kg/ha with ICGV 91114. On average 16 – 61% increase in mean pod yield and 30 to 54% increase in mean haulm yield was recorded in all varieties evaluated. Aflatoxin concentration in kernels ranged from 0 to 869 µg/kg across the villages. Aflatoxin contamination in Pileru area was higher than the normal due to damp conditions due to prolonged monsoon leading to delay in pod drying process. Even in these conditions, 36-73% reduction in aflatoxin levels observed in elite varieties compared to local varieties. Highest (73%) mean aflatoxin reduction was observed in ICGV 91341, followed by 67% in ICGV 91114 and also 59% higher pod yield was recorded in ICGV 91114.
- On-station trials demonstrated that soil amendments with gypsum, compost and biocontrol agents either single or in combination are effective in reducing the *A. flavus* infestation and aflatoxin contamination. Data of this trial is being analyzed and results will be submitted separately.
- Our approach to combine resistance with other management practices is of major importance. In this context, aflatoxin management technologies such as compost, bio-control agents (*Trichoderma*), gypsum and their combinations showed encouraging results and using some of the management practices a 99% reduction in aflatoxin contamination was recorded in Pileru area.

Post-harvest intervention measures resulted in establishment of groundnut threshers in key groundnut growing regions in Anantapur and Pileru districts of Andhra Pradesh. This promoted early pod stripping, thereby eliminating the need for heaping of harvested groundnut – a major factor for increased aflatoxin concentration in pods. The thresher ownership was given to women and the poor farmers in Anantapur and Pileru areas, who pooled their small resources for a joint ownership of threshers and this contributed to sustainable operation of threshers.

Multi-stakeholder Expert Panel established during the project period has implemented action plans to promote awareness on aflatoxins at different levels of groundnut supply chain system. This actions has resulted in two major outcomes: (1) Establishment of aflatoxin testing facility in Anantapur district, fully funded by the state government to enable farmers to evaluate the produce for enhanced marketing; and (2) obtained subsidy on mechanical threshers for purchase by low-income groups.

Many awareness programs such as newspapers, flyers, TV programs, meetings and field demonstrations helped to increase awareness in the project area, as well as in many other regions in Asia and Africa. A BBC program on ICRISAT activities on aflatoxins is being broadcasted around the world. As secondary impact of DFID investment in this research, we can also report the establishment of ELISA detection facilities and training of appropriate staff in Malawi and Mozambique. The access to this technology has helped farmer associations to successfully export aflatoxin-free groundnut. This activity will be further transferred to other countries in Asia and Africa.

Improved varieties and low cost aflatoxin reducing technologies comprising soil amendments and mechanical threshers are providing effective solutions to reduce the *A. flavus* infestation and thereby aflatoxin contamination. The Panel that had been formed to promote aflatoxin awareness played a critical role in motivating the Government of Andhra Pradesh to pay attention to aflatoxin awareness and aflatoxin detection activities. Information dissemination thru newspapers, flyers, TV programs, meetings and field demonstrations helped to increase awareness on aflatoxins and aflatoxin-mitigating technologies in the project focus area, as well as in many other regions in Asia and Africa. A BBC program on ICRISAT activities on aflatoxins is being broadcasted around the world. As secondary impact of DFID investment in this research, we can also report the establishment of ELISA detection facilities and training of appropriate staff in Malawi and Mozambique. The access to this technology has helped farmer associations to successfully export aflatoxin-free groundnut. This activity will be further transferred to other countries in Asia and Africa. Farmers saved the seeds of improved varieties for further perpetuation and this is contributing to the sustainable seed production and further adoption of selected groundnut varieties. Groundnut threshers are providing additional income options particularly to the women groups who manage the operations. All these are positively impacting the lives of groundnut farmers leading to enhanced incomes and health, and thereby contributing to the alleviation of poverty in the rain-fed agriculture systems.

Background

Previous projects (R7809 & R8298) have shown that contaminated groundnut-based food and feed are widespread in Andhra Pradesh (AP), the largest groundnut producing state in India. These two projects have also examined groundnut-based livelihoods and markets and followed the chain of infection and contamination pre- and post-harvest. Currently, aflatoxin resistant cultivars (cvs), management practices and post-harvest mechanical threshing are being tested using participatory methods. Awareness is being promoted among farmers and NGOs. Self-help groups (SHGs) in the project villages and NGO networks have also been identified. Some of these SHGs, such as 'Rythu Mithra' are government schemes linking farmers to scientific farming methods through Agricultural Extension Officers in each village. Information flows are also being documented in the study villages. Some joint activities with project R8339 (Crop Residues) in testing residue and milk samples for aflatoxin, promoting varieties and disseminating fliers were also carried out.

From livelihood and market studies, and interactions with farmers and processors through participatory rural appraisals, it is clear that: (i) there is little or no awareness of aflatoxin or aflatoxin-reducing technologies among farmers and processors; (ii) farmers are reluctant to adopt technologies that would increase the cultivation costs or, equally important drudgery; and (iii) there is no incentive mechanism in the market to encourage the production of aflatoxin-free produce.

The project activities covered and the results are being reported herein

(i) 4000 fliers about aflatoxin and practices to reduce aflatoxin in local languages were produced and distributed at *melas* (farmer field days and fairs) and through partner NGO networks. Fliers have also been distributed through project R8339 in the involved villages. Workshops with institutional stakeholders have also been held to raise awareness in this sector. Several articles providing information about practices that will help reduce aflatoxin were published in local and national newspapers. TV programs were broadcasted before sowing time, during the crop growth and at harvest, and farmers were advised on methods to be used for higher yields and lower aflatoxin contamination.

(ii) 14 aflatoxin-resistant cvs, which are essentially cost neutral (as farmers routinely buy seed), are being tested with farmers and NGOs in two districts in AP. Presently 22 farmer-managed on-farm trials are being carried out in Anantapur and Chittoor districts, along with on-station trials. Results and responses from farmers, traders and processors have been positive so far. Timely mechanical threshing is also being promoted in one village in each district and issues of access are examined.

(iii) a Panel representing government (Commissioner for Agriculture), industry (Oil Millers Association, IOPEA etc.), exporters (APEDA), NGOs, farmers (AP Co-operative Oil Seed Growers Federation), diary and poultry industries, as well as medical and veterinary experts was formed. The objective of forming a Panel was to be able to discuss the aflatoxin problem, and constraints to aflatoxin reduction, in a wider institutional and policy context. The Panel was also tasked to identify other key stakeholders and actions needed to raise the profile of aflatoxin at all levels. The Panel met in March and November 2004 and action points were agreed. A number of initiatives have arisen from these meetings, including training and creating awareness amongst the Agriculture Department staff, developing a project proposal with IOPEA and Government of India funding, and commitment by the State Government to build an aflatoxin diagnosis laboratory. ICRISAT and STAAD have also been active in meetings and conferences on aflatoxin.

In addition, research on technologies for aflatoxin management, including biological control (*Trichoderma)*, cereal crop residues, gypsum and compost carrying bacteria were carried out. A reduction of >95% in aflatoxin contamination in JL 24 was observed when all the treatments were applied. Investigation at ICRISAT showed that a bacterial isolate used for composting has anti-fungal activity and reduced *A. flavus* population. This technology will provide better alternative to farmers as FYM can be replaced by bacteria enriched compost (e.g. from rice straw).

ELISA test developed under different DFID-funded projects at ICRISAT have attracted great attention of private sectors, national programs, and traders both in Asia and Africa. The test has been extensively used by a private company called Effem India Private Limited who were facing serious problem with maize contamination by aflatoxin and we were able to test several thousand samples. The rapid and reliable ELISA test results helped them to sort out their stock before use for animal consumption. In Africa, we are building facilities for aflatoxin detection using ELISA test. This helped farmers and exporters in Malawi to have access to reliable and cheap techniques for detection of aflatoxins. There is a major demand from many partners on use of this technology. For this reason we have organized several training courses and we received several trainees from India and other countries for training on aflatoxin detection and management technologies.

Project purpose

Benefits for poor people generated by application of new knowledge of crop protection in cereal-based Semi-Arid cropping systems

The purpose of the project is to implement the identified development opportunities or identified constraints to development.

1. Sustainable participatory processes to test and promote aflatoxin-free production technologies with farmers, NGO's and research institutes in Andhra Pradesh.
2. Panel to build networks and develop agendas to promote awareness of aflatoxins and influence policies to produce aflatoxin-free groundnut and it's products in southern India established.

Research activities

Output 1: Sustainable participatory processes to test and promote aflatoxin-free production technologies with farmers, NGO's and research institutes

Activity 1.1: Participatory testing of new cultivars and dissemination of participatory methods to NGOs and Self help groups

Activity 1.2: Test and promote new low-cost aflatoxin reducing production practices with farmers

Output 2: Panel to build networks and develop agendas to promote awareness of aflatoxins and influence policies to produce aflatoxin free groundnut and its products in southern India

Activity 2.1: Coordination of panel activities for implementation of action plans by stakeholders

Activity 2.2: Production of CD-ROM

Contribution of outputs to developmental impacts

Improved varieties produced higher pod and haulm yield in all the PVS villages both in Anantapur and Pileru areas. The performance of these varieties is very encouraging and yields are stable across the years. Improved varieties with higher pod yields will help to empower and enhance the livelihood opportunities of the women and poor farmers by increasing their incomes, as well as helping to produce groundnuts and groundnut fodder with reduced levels of aflatoxin contamination.

A) What further market studies need to be done?

The technological requirements for aflatoxin control in groundnut pre- and post-harvest management had been sufficiently fulfilled by this project. What is required now is to-

1) Study the wider dissemination effects of aflatoxin resistant groundnut varieties that were selected by farmers in this project and to assure a sustainable seed supply mechanism
2) Up-scaling of management practices to reach more farmers in AP and other states in India.
3) The larger impacts of groundnut threshers on aflatoxin control and their employment effects on poorer men and women farmers
4) Study the potential demand for value added aflatoxin free groundnuts and its products in domestic and export markets

B) How the outputs will be made available to intended users?

A twin approach was followed for dissemination of aflatoxin resistant groundnut seed and for promoting the use of mechanical threshers.

1) As a short-term measure, local NGOs and self-help groups of farmers were networked to multiply the varieties selected for which alternative strategies were worked out.

2) To support this effort, ICRISAT offered to help the farmers with supply of fresh seed of the varieties that the farmers are interested in, for the next cropping season to those farmers who are willing to pay for the seed.

3) The Department of Agriculture of Government of Andhra Pradesh had been sufficiently convinced now through the Panel activities to bring changes in its policy to incorporate aflatoxin control as a serious problem. The seed multiplication and thresher promotion activities have a good chance of being taken up as regular activities through the department's large extension network.

4) Agricultural Association of India, a private agency run by agricultural professionals offered to multiply the selected varieties on a commercial basis and ensure the seed supply of the required varieties back into the system.

C) What further stages will be needed to develop, test and establish manufacture of a product?

The immediate need is to link up farmers to export agencies in order to produce and sell aflatoxin free groundnuts for export markets in Europe and the Gulf countries where the demand for aflatoxin free groundnuts is high. Farmers need to be compensated for producing low aflatoxin groundnuts with appropriate price. This requires training the farmers and local NGOs and identifying the institutions to link up production to processing and export markets.

D) How and by whom, will the further stages be carried out and paid for?

STAAD and ICRISAT approached APEDA, an export promotion authority of Government of India for financial support to help farmers produce low aflatoxin groundnuts for export. The traders' cartels are blocking this effort, as they are reluctant to let farmers have a bigger share in the market price against the current prices offered. We are looking up for alternative funding sources for taking up a venture in this direction. Unless farmers are linked up to premium markets they will not have any incentive to take up production of aflatoxin free groundnuts.

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I confirm that the Biometric issues have been adequately addressed.

Data was analyzed appropriately.

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Output 1: Sustainable participatory processes to test and promote aflatoxin-free production technologies with farmers, NGO's and research institutes in Andhra Pradesh

Activity1.1: Participatory testing of new cultivars and dissemination of participatory methods to NGOs and Self help groups

Introduction

Aflatoxins are potent toxic chemical substances produced by *Aspergillus flavus* and *A. parasiticus* on variety of food products including groundnut. Ingestion of aflatoxin-contaminated food leads to carcinogenic effect in human and livestock and leads to liver and other cancers. Aflatoxin contamination not only affects the human and animal health but also affects the international trade. One of the possible means of reducing aflatoxin contamination of groundnut is the use of resistant cultivars. Several studies have established the presence of field resistance to seed infection by *A. flavus* in some cultivars. Resistance to pre-harvest field infection is particularly important in areas where late season drought stress is a common occurrence.

Methodology

PVS trials

This is third consecutive season for the Participatory Varietal Selection (PVS) process in Anantapur and Pileru (Chittoor) districts. During the first year, 14 varieties were evaluated through PVS approach in three districts. In the second year, the number of varieties were reduced to 7 and tested in two districts. And in the third year (2005 crop season) seven varieties were selected based on varietal performance and farmer preferences during 2004 season (which are different for two districts). For 2005 rainy season selected varieties for Anantapur include ICGV 91278, 91328, 94379, 94434 and TMV 2 (control) and the varieties for Chittoor (Pileru area) are ICGV – 91341, 93305, 94379, 94434, 91114 and TMV 2. Participatory varietal selection (PVS) program was conducted with co-ordination of local NGO's viz., Sahajeevan at Chittoor and Rural Development Trust (RDT) at Anantapur with six villages in each district. In Anantapur, three farmers in each village were selected and in Chittoor 4 farmers each in 2 villages, 3 farmers in each of the 3 villages and in BV Palli village only 1 farmer was selected. In total 36 farmers were selected (18 farmers each in Anantapur and Chittoor) for PVS trials.

The farmers were briefed about the aflatoxin contamination, its importance and about cultivation of aflatoxin tolerant varieties. The seed material was prepared and treated with Chlorpyriphos (insecticide) @6 ml/kg of seed and mancozeb (fungicide) @3 g/kg of seed against root grub and seedling diseases respectively. At Anantapur each farmer was supplied with 5 varieties and at Chittoor with 6 varieties and each variety was tested in 1000 m^2 area in all the farmer fields. Plots were prepared with the layout before sowing. Rainfall occurred during 2^{nd} fortnight of July and sowings were carried out from 17^{th} July to 30^{th} July. The plots were protected against late leaf spot by giving 2 foliar sprays with carbendazim @1g/l of water.

Crop condition

At Anantapur, frequent rains during initial stage of the crop promoted luxuriant vegetative growth, which resulted in poor pegging. This was followed by long dry-spell of 32 days during pod development stage resulting in less number and poor development of pods. The frequent rains at the time of harvest resulted in excessive *in-situ* germination at West Narasapuram and Danduvaripalli villages. In Pileru, germination was not good in the control variety (TMV 2) resulting in poor plant stand. The continuous rains during harvest resulted in severe pod losses due to *in-situ* sprouting.

Field days

One field day was conducted at Pileru at 90 days after sowing in association with local NGO Sahajeevan by involving all farmers involved in PVS trials and other farmers. During the field day, the farmers uprooted 1 m row length of all the tested varieties. The samples were kept at one place and were evaluated for their pod and haulm yield by the farmers. The farmers' performances were recorded and ranked.

Field visits and interactions

Scientists from ICRISAT, STAAD, UoR, local NGO RDT, Sahajeevan and farmers visited all village level trials at West Narasapuram, Danduvaripalli and Cherlopalli. During the visit the varieties were evaluated for their yield performance by uprooting them. Later scientists interacted with farmers about the performance of the varieties.

Harvesting and sampling

Harvesting of trial plots were initiated in the 2nd week of November and completed by the end of November. In all trials, the varieties were harvested separately and whole plot pod and haulm yields were recorded and converted into yield per hectare. Five random pod samples of 1 kg from each variety and each farmer's field were collected separately for aflatoxin estimation.

On-station trials

During 2005 rainy season, two on-station trials were conducted one each at Agricultural Research Station (ARS) Anantapur and Regional Agricultural Research Station (RARS) Tirupati, Chittoor district. All the 14 varieties along with the local control were evaluated in three replications in both the research stations. Pod, haulm yield and aflatoxin contamination was recorded in all the varieties.

Sampling for toxin analysis

The trial plots were harvested separately at maturity and allowed for field drying for 10-15 days in Anantapur and 20-30 days in Pileru area. Frequent rains at harvest and post-harvest drying stages delayed the pod drying process in both Anantapur and Pileru areas. After pod drying, from each plot 5 sub-sample weighing one kilogram each was collected. From all the sub-samples, 200 g bulk sample was taken; in the remaining 800 g, the damaged pods were sorted before they were shelled. The bulk samples were shelled and 100 g kernels were powdered out of which 20 g powder was used for aflatoxins extraction with 100 ml of 70% methanol. Aflatoxin levels were estimated by ELISA method using the methanol extract for the bulk samples. Mean of five sub-sample toxin concentration was considered for data interpretation.

Results and discussion

PVS trials at Anantapur

During the field days, the farmers evaluated and gave their rankings for the varieties in the following order ICGV 91114, 94379, 93305 at Pileru and ICGVs 94434, 94379, 91278 at Anantapur. The rankings were made based on number of pods/plant, pod size, pod filling and shell thickness.

Performance of the 4 selected groundnut varieties was better in all the 18 farmers' fields in six villages in Anantapur district and produced higher pod and haulm yields than the control (TMV 2) in all the cases. The data analysis indicated that CV (%) in all the villages ranged from 7 to 28% for both pod and haulm yields, which is a reasonably acceptable range for on-farm trials. All the four varieties produced significantly higher pod and haulm yield in Gummalagunta village. Highest pod yield of 1029 kg/ha was obtained with ICGV 94434 in Cherlopalli village. This variety produced 40-43% higher pod yield in three villages and in remaining 3 villages it produced 23-34% higher pod yield than the control. ICGV 94379 produced 26 and 40% higher pod yield in two villages. Considering the overall mean of individual varieties from six villages in Anantapur area, ICGV 94434 produced 34% higher pod yield and the remaining 3 varieties produced 15-17% higher pod yield than the control, which yielded 590 kg/ha. Similarly increase in haulm yield over the control was recorded with the improved varieties in all the 6 villages and

mean haulm yield increased by 12 to 23% across the villages in Anantapur district. The lowest pod and haulm yields were recorded at village Jalalpurum and this was due to of heavy crust formation in the soil after sowing that resulted in poor plant stand (Table 1).

It may be due to uneven distribution of rainfall during crop period. Frequent rains at initial stages of crop resulted in luxuriant vegetative growth and poor pegging. The prolonged dry spell of 32 days at critical pod development stage resulted in poor pod filling, which was followed by frequent rains at the time of harvest that resulted in *in-situ* germination and thus reduction in pod yield.

All the bulk seed samples were used for aflatoxin extraction and were analyzed by ELISA to determine the toxin concentration in the samples. Aflatoxins contamination ranged from 0.19 to 241 µg/kg across the six villages (Table 2). The toxin contamination was almost nil in two villages (Danduvaripalli and Gummalagunta) as these villages had the best condition for the crop growth, harvesting and drying conditions. Higher level of toxin contamination was observed in West Narsapurum and Cherlopalli. The CV(%) are very high because of skewed distribution of aflatoxins contamination in the groundnut kernels. At west Narsapurum, post harvest rains caused delay in the drying process of the produce and finally resulted to high level of aflatoxin contamination. ICGV 94379 showed <4.0 µg/kg in five of the six villages and it also produced 17% higher pod yield than the control TMV 2. Overall mean (6 villages pooled) of aflatoxin contamination indicated that all the four improved varieties showed reduction in aflatoxin contamination ranging 40 to 73% over the control. The highest reduction (73%) in toxin contamination was recorded with ICGV 94379. Considering the complex nature of the aflatoxin problem in groundnut, the overall mean of the six villages indicated that the improved varieties showed good tolerance to resistance for aflatoxin contamination and moreover these lines produced 15-34% higher pod and haulm yields than the local control.

PVS trials at Pileru

In Anantapur district, the trials were conducted in 3 replications in six villages, but in Chittoor district (Pileru area) due to local conditions the trials were planted in 4 replications in each of the two villages, 3 replications in each of the 3 villages and one farmer in one village. The crop failed in one field in CV Palli village due to poor management by the farmer. The performance of varieties with regard to pod and haulm yields varied among the villages (Tables 3). Pod and haulm yields ranged 226 to 1255 and 816 to 2654 kg/ha respectively across the villages. All the improved varieties produced higher pod and haulm yields than control in all the villages. Minimum pod and haulm yield was recorded in control and maximum yields were observed with ICGV 94379. In MC Palem village 4 of the 5 improved varieties produced significantly higher pod yield. Highest mean pod yield (593 kg/ha) and haulm yield (1933 kg/ha) was obtained with the variety ICGV 94379 followed by pod yield of 586 kg/ha and haulm yield of 1835 kg/ha with the variety ICGV 91114. On average, 16 – 61% increase in mean pod yield and 30 to 54% increase in mean haulm yield was recorded (Table 3).

Like Anantapur, all the bulk seed samples were used for aflatoxin estimations using ELISA. Cloudy weather with continuous rains during harvest and post-harvest periods resulted in sprouting of the kernels before crop harvest and also the pod-drying period extended up to 30 days as against 6 days in normal situation. The results of the analysis indicate that aflatoxin contamination ranged 0 to 869 µg/kg across the villages. The toxin contamination levels were negligible at BV Palli. Across the villages improved varieties showed lower level of aflatoxin contamination than the control. In general, aflatoxin contamination in Pileru area is higher than the normal situation because of the continuous rains during pre-harvest, harvest and post-harvest stages leading to sprouting in the field and delayed pod drying process. The improved varieties were developed with aflatoxin resistance mainly for pre-harvest situations. Since the improved varieties were exposed to adverse post-harvest rains, delayed pod drying, the varieties become vulnerable to aflatoxin contamination. However, even in this post-harvest adverse environmental situation there was about 36-73% reduction in overall mean aflatoxin levels in improved varieties than the control TMV 2 (Table 4). The highest 73% mean aflatoxin reduction was observed in ICGV 91341, followed by 67% in ICGV 91114 and also 59% higher pod yield was recorded in ICGV 91114.

Table 1. On-farm performance of aflatoxin resistant groundnut cultivars in six villages at Anantapur during 2005 rainy season

Variety	Pod yield (kg/ha)							Haulm yield (kg/ha)						
	West Narsapurum	Mallapurum	Jalalapurum	Cherlopalli	Dandu varipalli	Gummalagunta	**Mean**	West Narsapurum	Mallapurum	Jalalapurum	Cherlopalli	Dandu varipalli	Gummalagunta	**Mean**
ICGV 94379	803	604	427	840	504	966	**691**	1757	1839	1297	2041	1220	2449	**1767**
ICGV 94434	870	800	481	1029	601	971	**792**	1935	1870	1301	2179	1403	2465	**1859**
ICGV 91278	708	705	369	899	496	909	**681**	1720	1772	1100	2146	1135	2321	**1699**
ICGV 91328	805	699	434	759	460	909	**678**	1802	1795	1275	1940	1100	2365	**1713**
TMV 2	703	596	337	730	486	689	**590**	1638	1595	1021	1915	877	2015	**1510**
CV(%)	23	28	28	13	25	7	**13**	19	19	26	11	27	7	**10**
SEd	145	156	95	91	102	53	**112**	275	276	259	180	249	128	**235**
LSD at 5%	323	348	212	204	228	118	**231**	614	616	576	400	555	284	**487**
F value	0.75	0.69	0.60	0.05	0.70	0.002	**0.41**	0.86	0.87	0.74	0.51	0.38	0.03	**0.91**

Table 2. . On-farm performance of groundnut cultivars in six villages at Anantapur during 2005 rainy season

Variety	Aflatoxin (µg/kg)						
	West Narsapurum	Mallapurum	Jalalapurum	Cherlopalli	Dandu varipalli	Gummalagunta	**Mean**
ICGV 94379	86.27	2.86	4.06	0.82	0.54	2.73	**16.21**
ICGV 94434	12.77	52.35	4.35	80.85	0.24	3.37	**25.66**
ICGV 91278	81.70	2.29	20.92	1.50	0.67	2.11	**18.2**
ICGV 91328	120.82	25.85	1.83	61.19	0.19	1.38	**35.21**
TMV 2	241.16	12.80	19.30	78.14	0.54	3.31	**59.20**
CV(%)	127	211	143	209	129	61	**228**
SEd	113	33	12	76	0.46	1.3	**81**
LSD at 5%	260	76	27	175	1.1	3	**166**
F value	0.42	0.56	0.37	0.70	0.80	0.53	**0.60**

Table 3. On-farm performance of aflatoxin resistant groundnut cultivars in six villages in Pileru area (Chittoor) during 2005 rainy season

Variety	Pod yield (kg/ha)							Haulm yield (kg/ha)						
	Ontillu[1]	MC Palem[2]	BN Doddi[1]	MGV Palli[2]	CV Palli[3]	BV palli[4]	**Mean**	Ontillu[1]	MC Palem[2]	BN Doddi[1]	MGV Palli[2]	CV Palli[3]	BV palli[4]	**Mean**
ICGV 91341	609	511	459	372	452	912	**475**	1864	1858	1623	1500	1758	2081	**1687**
ICGV 93305	602	526	384	324	556	836	**476**	1891	1936	1410	1184	2026	1800	**1663**
ICGV 94379	793	620	528	376	609	1255	**593**	2302	2083	1724	1567	1937	2654	**1933**
ICGV 94434	587	385	352	316	493	415	**428**	1821	1675	1353	1570	1767	1252	**1623**
ICGV 91114	880	623	483	312	559	928	**586**	2243	2012	1724	1313	1760	2639	**1835**
TMV 2	520	357	354	226	365	611	**368**	1548	1438	1078	816	1483	1681	**1252**
CV (%)	32	15	28	66	13		**15**	25	14	23	41	9		**13**
SEd	149	61	83	173	54		**159**	338	211	242	443	129		**402**
LSD at 5%	313	133	174	381	138		**338**	709	460	509	976	331		**845**
F value	0.177	0.003	0.217	0.957	0.044		**0.001**	0.27	0.083	0.100	0.531	0.071		**0.178**

Note: 1=mean of 4 replications; 2 = mean of 3 replication; 3 = mean of 2 replications; 4 = one replication

Table 4. On-farm performance of groundnut cultivars in six villages in Pileru area (Chittoor) during 2005 rainy season.

Variety	Aflatoxin (µg/kg)						
	Ontillu[1]	MC Palem[2]	BN Doddi[1]	MGV Palli[2]	CV Palli[3]	BV palli[4]	**Mean**
ICGV 91341	151.00	29.45	67.24	115.00	258.42	0.37	**107**
ICGV 93305	203.64	3.19	273.16	118.29	246.60	4.68	**163**
ICGV 94379	149.95	188.74	289.83	403.56	420.53	0.59	**257**
ICGV 94434	212.83	16.58	332.07	89.29	346.41	1.13	**188**
ICGV 91114	375.62	25.58	117.09	57.78	9.55	0.38	**132**
TMV 2	868.54	168.06	369.56	452.52	5.93	0.00	**402**
CV (%)	195	218	107	85	164		**185**
SEd	451	128	183	143	352		**553**
LSD at 5%	969	285	390	324	1120		**1110**
F value	0.595	0.548	0.519	0.076	0.78		**0.982**

Note: 1=mean of 4 replications; 2 = mean of 3 replication; 3 = mean of two replications; 4 = one replication

On-station trials

All the 14 improved varieties were tested in 3 replications at Agricultural Research Station, Anantapur. The results at ARS, Anantapur revealed no significant difference among the varieties with regard to their pod and haulm yield. Highest pod yield of 1343 kg/ha was obtained with ICGV 91324 followed by 92302, 91328, 91279, 93305, TMV 2 and 91317. The poor performance of other improved varieties over TMV 2 is due to pod loss at the time of harvest due to *in situ* germination. The highest haulm yield of 2914 kg/ha was recorded with the variety 91279 followed by 93305, 91317, 91324 and 91328 (Table 5). Aflatoxin contamination in all the varieties was all most nil and this could be due lower *A. flavus* population in the soil.

Table 5. Performance of improved groundnut cultivars at ARS Anantapur during 2005 rainy season

Treatments	Pod yield (kg/ha)	Haulm (kg/ha)	Aflatoxin (µg/kg)
ICGV 91278	1147	2144	0.8
ICGV 91279	1285	2914	0.4
ICGV 91283	970	952	0.0
ICGV 91284	1115	1671	0.4
ICGV 91315	961	1931	1.1
ICGV 91317	1207	2388	0.0
ICGV 91324	1343	2316	0.0
ICGV 91328	1311	2236	0.0
ICGV 91341	920	1715	0.0
ICGV 92302	1333	1825	0.0
ICGV 93305	1274	2455	0.0
ICGV 93328	1066	1719	0.0
ICGV 94379	1180	2127	0.0
ICGV 94434	1064	1908	0.0
ICGV 91114	1122	1611	0.0
TMV 2	1206	2130	0.3
SE.m+	86.00	236	
CD (at 5%)	205	681	

The results of on-station trial at Regional Agricultural Research Station (RARS), Tirupati revealed that significant difference among the varieties with regard to pod yield in varieties ICGV 92302 followed by 91324, 94434, 91284, 91279, 93328 and the increase in the pod yield ranged from 38-96%. All most all the varieties produced higher pod yield than the control and highest pod yield was obtained with ICGV 92302. However, the overall pod yields were below the average yield may be due to uneven distribution of rainfall (Table 6). Low level of aflatoxin contamination was recorded in two varieties (91283 and ICGV 91328) and in the remaining varieties, the toxins levels were almost zero. Again the low level of aflatoxin contamination could be attributed low *A. flavus* soil population and good post-harvest management practices including quick drying of the pods.

Table 6. Performance of improved groundnut cultivars at RARS,Tirupati

Treatments	Pod yield (kg/ha)	Aflatoxin (µg/kg)
ICGV 91278	524	0.0
ICGV 91279	618	0.5
ICGV 91283	586	12.7
ICGV 91284	627	9.8
ICGV 91315	554	0.0
ICGV 91317	442	0.0
ICGV 91324	669	0.7
ICGV 91328	422	0.0
ICGV 91341	512	13.5
ICGV 92302	780	0.0
ICGV 93305	568	0.0
ICGV 93328	617	0.0
ICGV 94379	547	0.6
ICGV 94434	664	0.7
ICGV 91114	525	0.4
TMV 2	448	0.5
SE.m±	59.00	
CD (at 5%)	170.00	

1.1.1. Farmers' evaluation of aflatoxin resistant groundnut varieties and strategies for their dissemination - rainy season 2005.

Evaluation of the Participatory Variety Selection (PVS) process is being conducted with farmers immediately after harvest of rainy season crop every year since 2003. The evaluation process has been repeated in 2005 also, in order to

- Identify the most preferred varieties (farmers choices), out of the fourteen aflatoxin resistant varieties (ICG Varieties) introduced by ICRISAT.
- Work out strategies for further continuation and dissemination of the selected varieties so as to sustain in the groundnut based cropping systems.

Methodology

Selection and location of the villages:

In Anantapur and Chittoor districts, a total of six villages each were selected for the PVS process. In addition, one PVS village and three other villages were selected in Anantapur area in order to distribute a single new variety – out of the previously selected farmer preferred ICG varieties - to some of the interested farmers, other than the PVS farmers. The single variety testing process was also conducted in the six PVS trials villages in Pileru area of Chittoor district. ANGRAU with support of local partner NGOs undertook the selection process of villages and farmers.

Three farmers from each village were given five varieties of seed, which included four ICRISAT aflatoxin resistant varieties (out of the previously selected farmers choice of ICG varieties) and one local variety. These farmers were provided with required seed, chemicals for the seed treatment and fungicide, free of cost, and were constantly supervised by the scientists. These farmers are referred to as '**PVS farmers'** in the report.

Farmers who were given a single ICG variety of seed each for trying out on their own, without NGO's or ANGRAU's supervision are referred to as '**Single Variety Seed farmers'**. Along with the PVS and the single variety seed farmers, other local farmers who grow groundnut as a major crop were also asked to evaluate the varieties during the survey and are referred to as '**General farmers'** who were selected randomly from the same villages. Details of the villages selected for PVS trials and farmer categories attending the discussions on PVS evaluations are given in Tables 7 and 8 for Anantapur and Pileru respectively.

Table 7. Villages and farmers selected for on-farm PVS evaluations of groundnut varieties for 2005 rainy season in Anantapur District

No	Village	*Mandal*	Number of farmers - by category					
			PVS		General		Single variety	
			Men	Women	Men	Women	Men	Women
1	West Narsapuram	Singanamala	3	-	3	5	-	-
2	Mallapuram	Kalyana Durgam	2	1	-	-	-	-
3	Cherlapalli	Ramgiri	3	-	3	4	-	-
4	Gummalakunta	Battalapally	3	-	5	2	2	1
5	Jalalapuram	Battalapally	2	-	4	1	-	-
6	Danduvaripalli	Bukkaraya Samudram	3	-	6	3	-	-
7	Jambuladinne	Garladinne	-	-	4	-	2	-
8	Timmapuram	Guntakal	-	-	-	-	3	-
9	Bandameedapalli	Kundirpi	-	-	8	1	8	-
Total			16	1	33	16	15	1

Note: PVS denotes Farmers who participated in the trials, General includes all other groundnut growers of the village, and single variety are farmers who were give only one new variety for trial.

Table 8. Villages and farmers selected for on-farm PVS evaluations of groundnut varieties for 2005 rainy season in Pileru Mandal, Chittoor District

No	*Village*	Number of farmers - by category					
		PVS		General		Single variety	
		Men	Women	Men	Women	Men	Women
1	M.C. Palem	2	1	5	5	-	-
2	Bodinayuni Doddi	3	-	-	-	-	-
3	Mullagurivari Palli	2	-	10	-	4	1
4	Chiguruvati palli	3	-	-	-	-	-
5	Ontillu	3	-	4	-	7	-
6	Battalavari palli	1	-	-	-	-	-
Total		14	1	19	5	11	1

Note: PVS denotes farmers who participated in the trials, General includes all other groundnut growers of the village, and single variety are farmers who were give only one new variety for trial**.**

Evaluation process

Evaluation of the varieties tried out in rainy season 2005 was conducted immediately after harvest in all the PVS and single variety seed villages in the Anantapur and Pileru areas. A questionnaire was prepared to aid in conducting the discussions with the farmers during the PVS evaluation process with the main intention of

1. Eliciting farmers' preferences for the new groundnut varieties that were tried out, and
2. Trace out the possibilities for further continuation and dissemination of the varieties and the facilities available with the farmers for continued propagation of the varieties.

The survey was conducted through village wise joint group discussions consisting of PVS, single seed variety and the general farmers. Men and women participated in the discussions though women participation was comparatively less in some of the villages. A total of 92 farmers participated in the evaluation process in Anantapur, out of which 17 were PVS farmers, 16 single variety seed farmers and 49 general farmers. Overall 19 women farmers participated in the discussions. In the Pileru area, a total of 51 participants attended the discussions and of them 15 were PVS, 12 Single variety seed and 24 General farmers with only 7 women participants.

The seed and pod of all the varieties tried out this year (rainy season-2005) were displayed before the group of farmers so that they can observe and study the characteristics thoroughly before they give their preferences on the varieties. Individual opinions of all the farmers based on the most important criteria they would look for in a variety, suitability to their local soil conditions and the market requirements were noted. The PVS farmers could express their preferences based on their experiences during the on-farm trials as well as the outcome after the harvest. Though the general farmers' judgement was mostly based on the products displayed, they have also given due consideration to the PVS farmers observations and experiences during crop production.

Approach for developing dissemination strategies

An analysis of the farmers' responses during the evaluations revealed that farmer preferences for varieties in Anantapur and Pileru areas were consistent during the previous three years which shows that these varieties have withstood the tests of adaptability to local conditions over time. Having arrived at the popular and suitable varieties, working out methods for retention, continuation and dissemination of these varieties is of utmost concern now. Hence, while conducting the evaluations, the farmers were also asked about how they are going to retain and continue their preferred variety/ies. A participatory discussion was conducted in order to examine the facilities available for them to store the seed, their plan of action for continuing and multiplying the varieties. In order to get clarity on how the farmers are going to retain and sustain the varieties, a few methods of storing / retaining the seed were worked out based on suggestions from farmers so that they can go about the way that is convenient to them.

1.1.2. Promoting early mechanical threshing

During the 2003 – 04 harvesting season, it was decided to supply a groundnut thresher free of cost to the poor and marginal farmers of West Narsapur village, Anantapur District, where PVS trials were held, with the understanding that they undertake early pod stripping on a sharing basis. The thresher was provided by ANGRAU to the farmers on an experimental basis, under the aegis of Accion Fraterna/ RDT and the process was facilitated by STAAD.

The experiment was mainly conducted to ascertain whether farmers would take the benefit of low cost and easily accessible threshers for early pod stripping. Farmers were asked to pay only the operators wages and a small daily rent to cover the costs of repairs and maintenance if any. Though the thresher was provided after the main threshing season and the crop was also very meager due to extensive drought, farmers, realizing the gains of undertaking early pod stripping have requested for supply of a thresher under similar conditions, for the 2004 – 05 seasons.

With this demand in view, it was decided to introduce mechanical threshing as a post harvest technology intervention for early pod stripping in the Pileru area (Chittoor district) of the project also, where threshers are not commonly used. Ontillu village was selected for the intervention and with support from 'Sahajeevan' the NGO partner in the PVS process of the project. ANGRAU supplied the thresher free of cost while the coordination was done by STAAD. The conditions for providing the thresher were to be similar to the ones suggested for the West Narsapur village.

Social processes for increased use of threshers

Farmers in these two locations clearly expressed that the mechanical thresher was handy to facilitate early pod stripping and found the overall economics working towards their favour. Since the entire process was deliberated by the project team on a sharing concept, it was realized that access to thresher on a permanent basis has greater probability of sustaining the practice of early pod stripping than on the basis of temporary subsidized hiring during the season.

STAAD's assessments with farmers of West Narsapur and Pileru in 2005 revealed their enthusiasm with using thresher to speed up pod stripping. They are very keen to own threshers for this purpose but expressed their financial helplessness to even pool up enough resources even after a general government subsidy of 50% of the cost of small agricultural machinery for individual farmers. In order to sustain this enthusiasm and to promote the project's goal of early pod stripping, STAAD approached AP Government's Department of Agriculture (DoA) for a sanction of government subsidy for purchase of one thresher each for West Narsapur and Pileru, on a group-sharing basis, to which the DoA finally agreed. STAAD facilitated the entire process of organizing the buyers, arranging for subsidies and the final delivery of the units and their use.

STAAD managed a deal with RDT and SAHAJEEVAN (the local NGOs), in that they would negotiate with farmers to collectively pay 25% of the cost of the thresher and in which case STAAD would subsidize the balance 25% of the cost from its own development fund. This meant that, of a total cost of about Rs.60,000/- for the new thresher, govt.'s subsidy would cover Rs. 30,000 and the rest of the money would be paid by farmers and STAAD equally.

STAAD however, insisted that the thresher ownership should go to self-help groups and preferably to women groups. RDT/Accion Fraterna closed the transaction with the suppliers for the women groups of West Narasapur village by collecting the money from their members and STAAD and paying it up to the supplier. In West Narsapur village, thirty women farmers from three self-help groups joined together to buy the thresher with a contribution of Rs.500/ each. In Cherlopalli village seventy women and men from eight self-help groups formed a thresher committee to buy a thresher with a contribution of Rs. 350/ each (the price of the thresher had increased by the time the demand from Cherlopally came in). The highlight of this process was that the preamble of their memorandum of agreement has clearly indicated that the main purpose of the thresher was to avoid aflatoxin contamination by quickening the pod separation process.

The machines were formally handed over to the groups, after clearly establishing the terms for ownership and use by the members based on the contributions for purchase of the threshers. STAAD had decided to contribute for the threshers on its own since there was no allocation for this kind of transaction in the project budget and we were keen to ensure a continuum to the process initiated under the project. It was also felt the dire necessity of the poor farming community that had helped the project members undertake the research activity enthusiastically needed to be taken care of.

With the successful arrival of the thresher in West Narsapur, the experience of generating funds from poor farmers collectively for the common benefit of these farmers and the realization of the overall benefits of thresher far outweigh the disadvantages if any, RDT / Action Fraterna proposed a similar pattern of subsidy for a demand for a second unit of the thresher from the farmers of Cherlopalli village in Anantapur district. ICRISAT agreed to pay the subsidy for this third thresher. Both the threshers are already working in full swing and are being put to good use in the respective villages at the time of reporting.

The second thresher subsidized by STAAD (with ICRISAT contributing a minor share of the subsidy) is yet to be supplied due to certain logistic problems. It had become a Herculean task for STAAD to mobilize the concerned agencies for its delivery and though the delivery will take place any time now, farmers in the mean time had to forego the opportunity of early mechanical threshing of the rainy season produce of 2005-06. The main reasons for this delay was the fact that

a) There was an enormous delay on part of the local NGO (Sahajeevan) in convincing and organizing farmers to buy the thresher and collect their share of investment. Interactions with the NGO clearly proved that its social organization skills had been quite weak.

b) Due to the delay, the price of the thresher had gone up due to lapsing of the annual budgets and subsequent changes in govt. policy on pricing and subsidy component of farm machinery

c) Because of this new policy additional money was required and while the farmers could not raise any more capital STAAD had increased its contributions with ICRISAT chipping in to fill the gap in the collections.

d) This further delayed the process and the red tape in the govt. owned company slowed down the process to a snail's pace.

Method of transfer and use of thresher

Specific criteria were evolved by STAAD for ownership and use of threshers by the farmers, which were negotiated upon by the local NGOs, RDT/Accion Fraterna and Sahajeevan. These were –

- Only a group ownership is allowed.
- The thresher cost should be shared equally by farmers involved in the 'ownership group'.
- The 'thresher ownership group' should mainly consist of small and marginal (poorer) farmers where majority should be women farmers, and preferably only women.
- The 'thresher ownership group' should adhere to specific terms and conditions regarding the ownership and use of thresher, which are drawn up for this purpose and mutually agreeable to the concerned project partner and the farmers group. Local NGO will act as a watch guard for this purpose and
- The 'thresher ownership group' should agree to share information / data about thresher use with STAAD / ICRISAT even after withdrawal of project.

The entire social process was conceived and facilitated by STAAD with the support of ICRISAT and the respective local NGOs of the two study areas.

Results and discussion

The participatory varietal selection (PVS) process in the second phase of the project was commenced in the rainy season of 2003, as part of the efforts to reduce the aflatoxin contamination in groundnuts during production, storage and marketing. Initially, the process had begun with the introduction of the fourteen aflatoxin resistant groundnut varieties developed at ICRISAT, to the farmers of Anantapur, Chittoor and Mahabubnagar districts which are predominantly groundnut growing areas of Andhra Pradesh. The major purpose of the study was to arrive at the most preferred and suitable aflatoxin resistant varieties to the farmers of these regions.

Technology transfer for the on-farm trials of the varieties was facilitated by ANGRAU, University of Reading and ICRISAT. As a part of the socio-economic study of the project, STAAD had taken up the participatory evaluation process of the varieties tried out by men and women farmers of the project study areas. The whole process was carried out with the support and

active participation of the local NGOs – Rural Development Trust / Accion Fraterna (RDT / AF) in Anantapur and Sahajeevan in Pileru area of Chittoor district.

The farmers were carrying out the selection of new varieties in a participatory manner after harvest of the rainy season crop every year, since 2003, and the list of preferred varieties had precipitated down to five in number through this process. The evaluation process had been repeated in 2005 also for the rainy season groundnut crop, in order to

- Identify the most preferred variety/varieties and
- Work out strategies for further continuation and dissemination of the varieties so as to sustain them in the system

Rains being copious and more or less continuous caused more damage to the groundnut crop when compared to the drought year crop yields. *In-situ* germination of mature pods was the major damage, which affected the harvesting activity and led the farmers into a helpless situation during plenty.

Farmers' Preferences – (Please see full report in annexure 2)

Anantapur Villages

Evaluations by the PVS farmers, based on their post harvest impressions in the rainy season of 2005 showed that, in general, in the Anantapur area, ICGV 94434, ICGV 94379 and ICGV 91278 have emerged as the most preferred new varieties of groundnut.

Based on their crop management and harvesting experiences and the outcome of the harvest, majority of the PVS farmers preferred either ICGV 94434 (9) or ICGV 94379 (7) as their first choice. The reasons expressed for the preference were the good seed quality, high yield, good out turn, good fodder, high resistance to pests and diseases and ease in managing and harvesting the crop. Only two PVS farmers preferred ICGV 91328, while the rest felt that it was a low yielding variety.

Interestingly ICGV 91278 was rated first by most of the general farmers (24) while it was given second preference only by some of the PVS farmers (6). As the general farmers did not have the first hand experience of growing the crop, their judgment was mainly based on the physical attributes of the variety such as colour, size and shape of the seed and out turn. However, next to ICGV 91278, ICGV 94434 was also preferred as a first choice by many of the general farmers (18) as well, compared to ICGV 94379 which was less appealing to them due to the inconsistency in the size of the seed and low yield. A large number of the general farmers present during the survey preferred ICGV 91114, a variety that was introduced by ICRISAT a few years ago, as their second choice due to its high yielding potential. However, though the PVS farmers had a positive opinion on its characteristics, they did not give preference to ICGV 91114 as it was not aflatoxin resistant.

Table 9. Opinions of farmers on new groundnut varieties in Anantapur villages – rainy Season 2005

ICG Variety	No. of farmers		Opinions / Remarks
	PVS	SV	
94434	13	-	**Strong Points :** Good pod yield, long pods, good out turn, healthy crop with good growth, early establishment of crop, higher drought resistance, ease at harvesting, pest and disease resistant, ease in management, good fodder quality and quantity. **Weak Points :** *In-situ* germination was high. yield of 94434 was less than 94379.
94379	13	-	**Strong Points :** Good pod yield , good outturn, good size, shape and quality of the seed, healthy crop, good quality fodder, high fodder yield, pest and disease resistant. Suitable to their soil conditions, well and early established crop. **Weak Points :** Drought resistance is less compared to ICGV 94434, In-situ germination.
91278	8	9	**Strong Points :** Good quality pod, good fodder yield, good shelling %, good seed colour, good resistance to pests and diseases. **Weak Points :** Low yield compared to the other varieties, breaks while uprooting.
91328	2	7	**Strong Points :** Good pod yield, healthy crop, established early, pest and disease resistant. **Weak Points :** Very low yield.
91114	1	-	**Strong Points :** High yielding, good quality pod and seed, high resistance to drought as well as heavy rainfall conditions, resistant to pets and diseases. Note: Though PVS farmers liked the variety for its high yields and resistance to drought and heavy rainfall conditions, they did not prefer it because it is not aflatoxin resistant

Note: Pest and disease resistance of all the new ICGV varieties was reported to be exceptionally good compared to the local variety TMV2 specifically in West Narsapuram, Mallapuram and Cherlapally. In Cherlapally village the farmers said no spraying was required throughout the period.

TMV2, which was a popular local variety, has almost failed this year due to its low resistance to pests and diseases. It is very encouraging to know that all the farmers have unanimously expressed that all the ICGV varieties showed excellent resistance to pests and diseases. The single variety seed farmers expressed their liking for both 91278 and 91328, which were tried by them. They felt that the varieties performed better than local variety TMV2. Table 9 presents the variety wise preferences of different categories of farmers and specific strong and weak points of each of the varieties selected.

For all the farmers in general, the most important criteria in selecting the varieties were: yield, out turn, size and uniformity of the seed, resistance to drought, resistance to pests and diseases, ease in uprooting, foliage yield and quality, marketability. This year, due to the 30-day drought during flowering time and heavy rains at the time of harvest, in-situ germination in large tracts of groundnut cropping areas led to yield losses and hence the farmers could not respond with much clarity on each of the varietal traits.

Pileru Villages

In the Pileru area, the scenario was quite different as compared to Anantapur. Due to the heavy and untimely rains in two spells, the groundnut crop was affected very badly. As there were continuous rains during the harvest period, the crop was still in the fields, most of the seed started germinating in-situ. In spite of the bad situation, keeping in view the fact that even the

local varieties failed due to the rains, some of the PVS farmers expressed their preferences for the new varieties. As was the case of Anantapur, ICGV 94434 and ICGV 94379 were preferred as a first choice by the PVS farmers whose crop was slightly less affected compared to the others who could not express any opinion due to the complete failure of the crops. They generally preferred the red varieties better in the Pileru area. Variety wise preferences and the reasons for preference are listed in Table 10

Table 10. Opinions of farmers on new groundnut varieties in Pileru villages - rainy season 2005

ICG Variety	No. of farmers		Opinions / Remarks
	PVS	SV	
94434	5	6	**Strong Points:** High Yielding, good seed quality, good crop, good resistance to drought, pests and diseases, healthy foliage. **Weak Points :** Low oil content, *in-situ* germination, not a preferred variety.
94379	4	-	**Strong Points :** Healthy Crop, good resistance to pests and diseases, good pod filling, good seed, red color seed preferred by the Kalahasti traders. **Weak Points :** Less yield and small seed compared to 94434.
91341	1	-	**Strong Points :** Good yield, good seed, good resistance to pests and diseases, good crop, more fodder. (Yield higher than 94379). **Weak Points :** Low out-turn, Red varieties are preferred here.
91114	5	-	**Strong Points :** Tasty and spotless quality of seed, good yield, good outturn, good fodder, good resistance to drought, pests and diseases, good colour and taste of the seed.
93305	-	6	

Note: In the Pileru villages, some of them did not have any preferences due to crop failure. Two from Ontillu village did not respond at all. Those who liked this variety also did not give first preference on the basis that it is not aflatoxin resistant.

To summarize, the preferences of the farmers in both the Anantapur and Pileru areas put together can be listed as follows, in the order of their preferences –

Farmer Category	1st Pref	2nd Pref	3rd Pref
• PVS farmers	- ICGV 94434	ICGV 94379	ICGV 91278
• Single variety seed farmers	- ICGV 91278	ICGV 91328	
• General farmers	- ICGV 91278	ICGV 94434	ICGV 91114

Farmers' top preferences from the previous two years were given for on-farm trials during the 2005 rainy season. It is interesting to note that ICGV 94434 that was rated as a top choice in the 2003, by both the PVS as well as general farmers, though showed a low profile in 2004, had again emerged as the top variety in 2005.

ICGV 94379 variety, which was a top choice in rainy season 2004, is still preferred as a first choice in 2005 but only next to ICGV 94434 (Table 11). ICGV 91278 which was a preferred variety of the general farmers group in the first year, has appeared in the list of preferred varieties in the second year also and is still continuing to be the most preferred variety by the general and single variety seed farmers and as a second preference variety for the PVS farmers.

Table 11. Trends of farmers' preferences for aflatoxin resistant varieties in Anantapur and Pileru areas

Study period	Farmers' preferences			Varieties Tested in Rainy season 2005
	PVS	Single variety	General	
Rainy season 2003	94434, 91317, 91328, 93328, 91324, 92302	-	94434, 91278, 93305, 91279, 91284, 92302	**Anantapur 5 Varieties** 91278, 91328, 94379, 94434, and TMV 2
Rainy season 2004	94379, 93328, 91278, 91341, 93305, 94434, 91328	-	-	
Rainy season 2005	94434, 94379, 91278	91278, 91328	91278, 94434, 91114	**Pileru – 6 Varieties** 91341, 93305, 94379, 94434, 91114, TMV-2

This trend in the farmers' preferences does show some consistency though many factors like the weather conditions etc. seemed to vary from place to place and year to year. This could perhaps be attributed to the characteristics of the varieties like resistance to drought, pests and diseases, high yield, good out turn, etc. Overall, the farmers expressed that the ICGV varieties had better characteristics than the local varieties.

Approach for developing dissemination strategies

PVS trials and the evaluations of the varieties had been carried out consecutively for three years including rainy season of 2005. Having arrived at the final list of the popular and suitable varieties, it is extremely important to work out strategies / methods for retention, continuation and dissemination of these varieties in the larger groundnut growing areas. Discussions were held with men and women farmers at the time of evaluation regarding the ways of multiplying and sustaining the varieties that the farmers selected for future propagation after the withdrawal of project support.

Discussions were focused on the infrastructure available to store the seed and farmers opinions on how they would multiply the varieties and continue to propagate them. Based on farmers' discussions and suggestions, a list of possible strategies was arrived at and individual opinions regarding their choice of options were elicited. In addition to this, suggestions and support from the local NGOs, self-help groups and ANGRAU for seed dissemination were ascertained. The alternative strategies were -

1. Store the seed safely at home and use for sowing in the next rainy season and gradually multiply the seed.
2. In case it was not possible to store seed safely at the farmers house, then ask someone else to store the seed for them (Relative / ANGRAU / NGO)
3. Give the seed to the neighboring farmers / relatives who have irrigation facilities so that they sow the seed in *Rabi* (post rainy season), and then, by prior arrangement, get back more seed from them to sow in the next rainy season.
4. Mutually exchange the seed of their choice with other farmers so that each of them can grow the variety they like in a larger area thereby quicken the process of seed multiplication.
5. In case of a need to sell the crop for cash requirements, sell the produce to ICRISAT / ANGRAU / NGO for safekeeping and by an undertaking, buy back later for sowing in the next season.
6. Buy the preferred seed in larger quantities directly from ICRISAT / ANGRAU so as to take up cultivation in larger area, if the seed can be supplied by these institutes.

Table 12. Information on farmers' strategies for retention and continuation of new ICG varieties (Anantapur and Pileru)

No	Strategy for retention and continuation	No. of Farmers
Anantapur		
1	Store the seed safely at home and use for sowing in the next rainy season and gradually multiply the seed	23
2	Ask someone else to store the seed (Relative / ANGRAU / NGO)	1
3	Give the seed to neighbouring farmers / relatives with irrigation facility for multiplication during the summer, & get seed back for the next rainy season	4
4	Mutually exchange seed so that each of them can grow the variety they like in a larger area thereby quicken the process of seed multiplication .	2
5	Sell the produce to ICRISAT / ANGRAU / NGO for safe keeping and buy back later for sowing in the next season	-
6	Willing to buy preferred variety seed in larger quantities if supplied	40*
Pileru		
1	Store the seed safely at home and use for sowing in the next rainy season and gradually multiply the seed	2

* Total number of farmers who prefer this option includes the PVS, general and Single Variety Seed Farmers.

A majority of the farmers realized that the varieties preferred by them have the potential to give them higher yields than the traditional varieties they were growing, though they may not match the yields of the very recent releases such as the ICGV 91114 and Kadiri 6 (an ANGRAU release). They were nevertheless interested in continuing with growing, multiplying and propagating the varieties tested with them due to their high drought and pest & disease resistance (characteristic of resistance to production of aflatoxins), and also with the knowledge that they are aflatoxin resistant varieties.

Most of these farmers, the PVS as well as the single variety seed farmers, had come up with a common response that they are going to store the seed safely at their own homes, ensuring that the seed will not get mixed up with other varieties, for onward propagation from the next rainy season (Table 12). By doing this, they felt that they could multiply the seed gradually and surely, provided the rains come at the right time.

Most of the farmers in Pileru have suffered heavy losses due to heavy rains at harvesting in the rainy season 2005. In Anantapur, though the situation was better than in Pileru. Farmers expressed that the yields could have been much higher under normal conditions. Also, in some of the villages in Anantapur, the varieties were mixed up inadvertently by the labourers. All these farmers were interested in continuing the varieties of their first and second choices. Hence it would be helpful if the seeds of their choice are supplied to them in larger quantities for purchasing, so that they can try for further multiplication by themselves.

Almost all farmers however expressed dissatisfaction with the field trials in that the trial size was too small to make generalized comparisons visually. They requested that the project partners provide them much larger quantities of the seed preferred by them for production during the 2006 season and were willing to test the potential of the varieties in large scale and at their cost. They also felt that it would be worthwhile to provide larger quantities of seed so the seed could be multiplied in larger areas quickly and sustain the varieties in the system, as they were fairly convinced of the probable success of the varieties, especially taking into account the need to produce aflatoxin free groundnuts for their future sustenance and groundnut haulms for their cattle. Table 13 gives an idea about the number of farmers who are interested in acquiring groundnut seeds of the varieties of their choice in larger quantities for further trials and multiplication at their own cost.

Table 13. List of farmers who require the seed in larger quantities

No.	Variety	Village	No. of farmers
Anantapur			
1	91278	Bandla meedapalli	11
		Gummala Kunta	7
2	94434	Jambuladinne	2
		West Narsapuram	1
		Cherlapalli	1
		Gummalakunta	2
		JalalaPuram	2
		Dandhuvari palli	3
3	94379	West Narsapuram	2
		Malla Puram	2
		Cherlapalli	2
		Gummalakunta	1
4	91328	Jambuladinne	1
		Timma Puram	2
		Bandlameeda palli	1
Pileru			
1	91278	M.C. Palem	1
2	91341	M.C. Palem	2
3	94379	M.C. Palem	5
		Battalavari Palli	1
4	94434	Bodinayuni Doddi	1
		Mullagurivari Palli	5
		Chiguruvati Palli	1
		Battalavari Palli	1
		Ontillu	4

Promoting early mechanical threshing - (Please see full report in annexure 3)
Feedback from farmers since 2003 had convinced the project partners to promote mechanical threshing as a post harvest management practice so as to facilitate early pod separation and avoid prolonged stacking of the produce to prevent aflatoxin build-up. Apart from the technological advantages, the economics of thresher use clearly tilted the balance towards more gains as compared to a fewer constraints experienced by farmers with mechanical threshing (see STAAD's two reports on mechanical threshing from the previous FTR for details).

More significantly, the groundnut thresher was one technology, which turned out to be demand driven as more and more farmers started demanding for access to mechanical threshing. Hence it turned out to be an opportunity for project partners to use this intervention as a tool for promoting awareness quickly and more visibly. This resulted in a decision to provide equal and wider access of mechanical threshers to the poor and women farmers.

The process turned out to be by and large successful as two units were already delivered to the owners of the threshers in two villages (West Narsapur and Cherlopally villages). Despite the overall success of the process, hurdles were faced in Pileru due to which one unit is yet to be delivered. As the payments were already done and the file is under process its delivery ultimately is assured.

Learning experiences from thresher purchase process highlighted the fact that dissemination of technologies is contingent upon the strengths and weaknesses of the local NGOs as they are the facilitators of change at grassroots level. On the positive side, the coordination efforts of an intermediate level organization like STAAD proved to be extremely necessary to establish linkages between research on one hand and for reaping the fruits of research for the development of poor farmers on the other.

The two units are currently in operation in Anantapur area under the control of their respective 'group owners' and were reported to be operating under the terms of reference drawn up by STAAD for this purpose (Please see the annexure 4 for terms of reference). The first set of log sheets have been received by STAAD from the owners group for verification. STAAD will continue to monitor the process and will analyze the users data as soon as the threshing season is over to document the contribution of thresher to poor farmers livelihoods.

The overall benefits of the thresher ownership may be summarized thus -

1. STAAD's efforts in facilitating the process of Thresher ownership paid off in several ways. It established a social organization method that helped the women and the poor farmers in Anantapur and Pileru areas to pool their small resources for a joint ownership of thresher.
2. It has established the ways and means through which numerous owners could take turns to share the thresher for early pod stripping. Thus it helped in achieving the project objective of promoting early pod stripping and helped in sustaining the activity after the Project withdrawal from the study areas.
3. Thresher ownership created a lot of enthusiasm among the farming communities at large as it gave them an economic incentive, as at individual level it would have been impossible for them to own a thresher with their extremely limited means. As the word about thresher ownership spread, lot of farmers from other villages around the area started demanding for similar arrangements. This promoted large-scale awareness about aflatoxin problem *per se*.
4. Local NGOs' awareness and interest in combating aflatoxin problem multiplied substantially during this process.
5. It also established the ways and means through which small farmers could collectively own and take turns for sharing farm machinery and equipment that are far beyond their individual means and achieve mutual benefits.

This translates into the fact that early mechanical threshing of freshly harvested groundnut crop in 2005-06 had been promoted by the project, among the poor and marginal farmers, as a pioneering feature and with the main purpose of –

- Facilitate early threshing of groundnut crop to reduce aflatoxin contamination and
- Use this intervention to demonstrate the advantages of early pod separation and to promote dissemination of this practice to farmers at large.
- Identifying pathways to facilitating group ownership of small farm machinery by the poorer and women farmers / farmer groups,
- Establish procedures for group ownership and group sharing of the machinery and commonly share the benefits,

On-farm management of aflatoxin contamination

Output 1. Sustainable participatory processes to test and promote aflatoxin free production technologies with farmers, NGOs and research institute in Andhra Pradesh established

Activity 1.2 Test new low cost aflatoxin reducing production practices with farmers

Introduction

Several research reports indicate that cultural practices such as application of farmyard manure, gypsum, crop residues, and application of several bio-control agents such as non-toxigenic strains of *Aspergillus flavus*, *Trichoderma*, *Bacillus* and *Pseudomonas* reduce the aflatoxin contamination. Hence the components *viz*., compost, gypsum and *Trichoderma viride* alone and their combination were tested through participatory technology development (PTD) process.

Materials and methods

The trial was conducted in 10 farmers' fields at Ontillu, M.C.Palem, Mullaguruvaripalli villages at Pileru area. The following components were tested at each farmer's field by adopting plot size of 10 x 10 m^2. Compost was incorporated in the soil after field preparation, Trichoderma was applied in the soil before sowing and gypsum was applied at flowering time. The plantings were carried out during second fortnight of July using local variety-TMV 2, which is very susceptible to aflatoxin contamination.

Components

1. Application of compost @ 5 t/ha
2. Application of *Trichoderma* @ 100 kg/ha
3. Application of gypsum @ 500 kg/ha
4. Compost + *Trichoderma* + Gypsum application.
5. Farmers practice (control): At Pileru : Farmers apply neither farmyard manure nor fertilizer whereas at Anantapur farmers applied muriate of potash, urea and single super phosphate to their fields.

In Anantapur district, only *Trichoderma viride* was tested at Rekulakunta village in ten farmers' fields. The *Trichoderma*, was applied adjacent to the rows one week after germination. The plots were kept weed free and protected from insect pests and diseases. Harvesting was carried out during second week of November 2005 by uprooting the plants and were field dried. Later the pods were stripped manually and pod and haulm yields were recorded and samples were drawn for toxin estimation.

Results and discussion

The results at Anantapur indicated that there was 13% increase in pod yield in *Trichoderma* treated plots over the control plot that yielded 590 kg/ha and there was not much difference in haulm yield. However there was no aflatoxin contamination in all the 10 treated and control plots. This will be further explored to know the cultivation condition and to make a final conclusion.

At Pileru, no significant difference was observed among the treatments with regard to pod and haulm yields. Very low yields were obtained among all the treatments, which may be due to heavy and uneven distribution of rainfall that resulted in poor pegging and pod development and pod loss at the time of harvest. Bulk seed samples from all the plots were used for aflatoxin estimation using ELISA. Results on aflatoxin contamination levels in different treatment are very encouraging. Highest aflatoxin contamination 369 µg/kg was observed in untreated control plot. All the 4 treatments responded by reducing aflatoxin contamination. Reduction in aflatoxin contamination levels ranged from 79 to 99% across the treatments. Highest reduction (99%

showing only 2 µg/kg of aflatoxin) was observed in the plots where compost, *Trichoderma* and gypsum were applied together, followed by gypsum, compost and *Trichoderma* treatment applications over the control plots. Application of compost, *Trichoderma* and gypsum are known to reduce *A. flavus* seed infection and aflatoxin contamination. In the present study all the individual treatment responded well to reduce the aflatoxin contamination and combination of treatment showed the confounding effect for the reduction of aflatoxin contamination in groundnut.

Output 2: Panel to build networks and develop agendas to promote awareness of aflatoxin and influence policies to produce aflatoxin-free groundnut and it's products in southern India established.

Activity 2.1: Coordination of Panel activities for implementation of action plans by stakeholders

Approach for panel activities

Panel activities continued during the concluding phase of the project mainly through coordination and networking activities by STAAD with the support of project partners. The main approach followed for continuing the activities of the Panel had been by having closer interactions at sub Panel level and by holding meetings at the district level. The main purpose of this approach was to carry forward some of the action plans discussed during the Second Panel meeting held in 2004 rather than holding yet another large all member Panel meeting. The action points that were pursued during 2005-06 were –

- Coordinate and hold several sub Panel meetings and discussions to carry out specific actions.

The sub Panel meetings were held with –

a) Dept. of Agriculture at state level and district level in order to
   i) implement thresher subsidies for three units, (including follow-up discussions with Chittoor district authorities, officials of AP agro-industries corporation and state level authorities to ensure the delivery of a subsidized thresher to Pileru.)
   ii) incorporate aflatoxin awareness training in its extension programs and to follow-up the promise made to ICRISAT to set up an aflatoxin analysis lab in Anantapur.

b) Meetings with NIMS (Nizam's Institute of Medical Sciences) doctors to ascertain about the programs being conducted by them for promoting awareness among the medical, health and nutrition fraternity on the effects of aflatoxin contamination in the food and feed chain and to organize multi media programs to increase awareness regarding the ill effects of aflatoxin contamination on health.

c) Discussions with multi-media agencies to organize mass awareness programs across Andhra Pradesh and India.

d) Meetings with APEDA and IOPEA to promote aflatoxin-reducing technologies and to support farmers to produce low aflatoxin level groundnuts for export.

e) STAAD provided secretarial services to prepare scripts for TV mass awareness programs and coordinated with media representatives to organise the production and with the project partners to ensure their participation in the TV programs.

f) Project meeting was held in Anantapur area to promote closer interactions with farmers groups, NGOs and policy makers. District collector and several farmers' groups representatives besides several representatives of NGOs actively participated in the interactive sessions with project partners. Participation of Department of Agriculture at district level along with the local agencies gave large-scale publicity to aflatoxin problem and drew the attention of local press and media.

Results and discussion

Panel formation and developing agendas for the Panel on one hand and building networks for implementing the action plans drawn up by the Panel on the other had been an extremely process oriented affair. It turned out that converting a fewer Panel agenda points into action posed a bigger challenge to the project leave alone considering the entire agenda. One of the significant achievements of the project was facilitating the preparation of a comprehensive action plan involving multiple stakeholders requiring action at different levels of groundnut supply chain (See minutes of first and second Panel meetings in the annexures of previous FTR of the project for details). Since this had been a long drawn process sustaining the Panel activities after withdrawing the project posed another bigger challenge.

The Panel that had been formed to promote aflatoxin awareness was an informal body created out of the initiative of the project. The action plans require mutual support and cooperation from different members of the Panel to achieve the objectives set forth. There is no legal binding on

the part of the members to oblige their share of the contribution as it is purely voluntary and the actions required should emerge out of the felt necessity of the various members. Despite this complexity, project partners were able to impress upon the members that strategies to promote awareness should be built into their respective institutional mandates and also the fact that it is a mutually dependent activity.

A few action points were earmarked by the project during the concluding phase of the project for implementation involving policy makers as well as both govt. and non-government. agencies. These action points were outlined in the first section of the report. The major outcomes from these efforts are –

1) From a policy perspective, the Panel activities were instrumental in positively motivating the Government of Andhra Pradesh to pay conscious attention to aflatoxin awareness activities and aflatoxin detection activities as a part of its extension programs. It has complemented ICRISAT's efforts to influence the Government to set up an aflatoxin analysis laboratory in Anantapur (Anantapur city is the capital of Anantapur district which is the largest groundnut growing district in the world), which has been completely funded by the State Government. The state government has also, in principle, agreed to set up the labs in every mandal where groundnut is a major crop if the first lab in Anantapur turns out to be a success.

2) The social processes required to create ownership of threshers among the poorer farmers for promoting early threshing of groundnut crop was mainly possible due to the deliberations of the Panel leading to the Department of Agriculture agreeing to support the cause. This action led to farmers in Ananatapur and Pileru areas realize the benefits of early pod separation to save their crop from aflatoxin contamination.

3) Aflatoxin awareness was incorporated by the Health agencies as a part of several health awareness training programs to doctors and health workers. This came out of the initiative of a panel member who is the senior official of Nizam's Institute of Medical Sciences (NIMS), a premier government medical research institute at Hyderabad.

4) Mass awareness programs were implemented by the project partners in collaboration with NIMS as a part of health and farmers programs of the popular TV channels.

   a) A half-hour awareness program of the project partners was telecast in the local language (Telugu) state wide in Andhra Pradesh on 1st August 2005 under the health program of the government's popular TV channel (Saptagiri – a Doordarshan channel). (For script of TV show refer to annexure 5)

   b) Three short awareness messages of 5 minute duration each were telecast state wide on the agriculture section of the rural program of Saptagiri channel in Telugu, on

      i) the health implications of consuming aflatoxin contaminated groundnuts,

      ii) methods of producing aflatoxin free groundnuts and

      iii) the economic impact of producing aflatoxin contaminated groundnuts on the farm economies and farmers livelihoods.

   c) A second TV program is scheduled to be telecast Country Wide in English anytime now by the Government of India TV Channel (Doordarshan 1) in their health awareness program.

5) A project meeting was held in Anantapur in October 05 where the district level Panel members from Department of Agriculture, District level policy makers, farmers associations, traders and processors and local NGOs actively participated and agreed to raise awareness among larger farmers' communities and processors at the district level. Participation of district officials received wide publicity in the local press and drew considerable attention from the multi media agencies.

6) STAAD held several interactive sessions with APEDA (Government of India's export promotion agency), IOPEA (Indian Oilseeds Export Promotion Association) and national programs in Tirupati, Mumbai and Delhi to promote introduction of aflatoxin reducing technologies and management practices to the farmers and help them produce aflatoxin free groundnuts. The project partners managed to impress upon the fact that readymade

protocols are available for aflatoxin control and the implementing agencies have to promote their use.

As an exit strategy, ICRISAT and STAAD will continue to provide their inputs for sustaining the Panel activities. ICRISAT expressed its readiness to provide the technology back up wherever required while STAAD will continue to keep the network alive through coordination and secretarial services as post project activity. A note will be prepared by ICRSAT and STAAD enlisting the achievements of the Panel and the further action points that require future attention and will be circulated to all Panel members soon.

Activity 2.2: Production of CD-ROM

STAAD kept its communication alive with FDC, Australia to collaborate on CD-ROM production for promoting awareness and improved management practices for aflatoxin control. Though FDC had the good intentions of finishing this task, it could not mobilize sufficient resources required for filming the crop production processes in India and Indonesia. During the pre production meetings in Queensland, Australia, in May 2004, FDC had indicated its commitment to finance the Australian expertise and the costs of filming components of the project during the current aflatoxin project period. With the FDC unable to undertake the task within this project period, the CD-ROM production did not take place.

ICRISAT and STAAD therefore decided to take up CD-ROM production with a small budget by engaging local production agencies as a post project activity. This will require fewer resources as it is cheaper to produce locally in India.

ANNEXURE - I

Table I. List of farmers selected at Anantapur district for kharif 2005

S.No.	Farmer	Village
1.	K. Narappa	Danduvarialli
2.	B. Vijay Sekhar Reddy	Danduvarialli
3.	B. Bhaskar Reddy	Danduvarialli
4.	B.M. Sreenivasulu Reddy	West Narasapuram
5.	B.M. Subba Reddy	West Narasapuram
6.	P. Nallapa Reddy	West Narasapuram
7.	S. Linga Reddy	Cherlopalli
8.	P. Ramanjaneyulu	Cherlopalli
9.	K. Varadappa	Cherlopalli
10.	V. Krishna Reddy	Gummalakunta
11.	V. Narayana Reddy	Gummalakunta
12.	V. Siva Reddy	Gummalakunta
13.	P. Veera Reddy	Jalalapuram
14.	P. Rami Reddy	Jalalapuram
15.	P. Linga Reddy	Jalalapuram
16.	G. Lingamma	Mallapuram
17.	B.K. Govindarajulu	Mallapuram
18.	S. Ramanjaneyulu	Mallapuram
Management trial farmers during kharif 2005		
1.	Thirupalu	Rekulakunta
2.	Venkatanarayana	Rekulakunta
3.	Yerra nallanna	Rekulakunta
4.	Lakshminarayana	Rekulakunta
5.	Sanjeevulu	Rekulakunta
6.	Thikka Swamy	Rekulakunta
7.	Kullayappa	Rekulakunta
8.	Arun Kumar	Rekulakunta
9.	Chandra Mouli	Rekulakunta
10.	Nagaraju	Rekulakunta

Table II. List of farmers selected at Pileru, Chittoor district for kharif 2005

S.No.	Farmer	Village
1.	Y.Amarnath Naidu	M.C.Palem
2.	Y. Nagarathnamma	-do-
3.	A. Krishnaiah	-do-
4.	P. Ramesh	Bodinayunidoddi
5.	M. Narayana	-do-
6.	Subba Ramaiah	-do-
7.	P. Nurullakhan	-do-
8.	Ramachandra	Mullaguravaripalli
9.	Rahamath Peer	-do-
10.	Venkatappa	-do-
11.	Venkatesh	Chiguruvatipalli
12.	Amarnath	-do-
13.	Chalapathi	-do-
14.	Ammenuddin	Ontillu
15.	Dasthagiri Saheb	-do-
16.	Ahamed Basha	-do-
17.	S. Jaffer Khan	-do-
18.	Somasekhar Reddy	Battalavaripalli
Management trial farmers during kharif 2005		
1.	G. Saradamma	Mullaguravaripalli
2.	C. Sudhakar	-do-
3.	C. Subramanyam	-do-
4.	A. Surendra	-do-
5.	A. Krishnaiah	M.C.Palem
6.	S. Masthan	Ontillu
7.	S. Jabbar Khan	-do-
8.	S. Khadar Basha	-do-
9.	S. Riaze	-do-
10.	S. Babjohn	-do-

ANNEXURE – II

Table III. Daily weather data at Regional Agricultural Research Station, Tirupati during *Kharif* 2005

A) July 2005

Date	Temperature°C		Relative Humidity (%)		Wind velocity Kmph	Rain fall mm	Evaporation mm	Sun Shine Hours (Max.)
July 05	Max	Min	I	II				
1	35.6	27.6	56	36	11.3	0.0	1	35.6
2	37.5	26.5	60	33	10.7	0.0	2	37.5
3	3.5	28.0	54	31	15.5	0.0	3	3.5
4	37.5	27.2	57	31	14.3	0.0	4	37.5
5	35.8	27.5	49	35	16.1	0.0	5	35.8
6	36.6	27.2	53	32	11.0	0.0	6	36.6
7	36.0	27.2	55	34	20.3	0.0	7	36.0
8	35.2	28.5	57	42	14.0	0.0	8	35.2
9	34.0	26.5	52	40	11.8	0.0	9	34.0
10	37.5	27.0	54	32	14.1	0.0	10	37.5
11	37.0	26.4	55	38	12.4	0.0	11	37.0
12	37..8	27.8	49	30	11.3	0.0	12	37..8
13	37.5	27.2	59	38	10.9	0.0	13	37.5
14	34.5	27.0	60	66	9.3	0.0	14	34.5
15	35.6	24.5	77	45	6.3	9.4	15	35.6
16	33.0	24.0	79	53	6.2	1.0	16	33.0
17	32.2	24.5	72	62	4.2	1.0	17	32.2
18	35.0	24.5	65	53	6.8	1.0	18	35.0
19	37.5	26.4	65	43	5.5	0.0	19	37.5
20	34.6	22.5	92	52	6.3	130.0	20	34.6
21	34.6	25.0	70	43	8.6	1.4	21	34.6
22	32.0	26.5	64	52	14.8	0.0	22	32.0
23	31.4	26.0	70	56	10.9	0.0	23	31.4
24	30.4	23.2	68	55	13.0	8.0	24	30.4
25	32.0	23.2	67	50	15.9	0.0	25	32.0
26	31.0	25.0	78	56	16.8	0.0	26	31.0
27	33.0	23.2	70	69	11.9	2.8	27	33.0
28	34.0	24.0	60	52	11.7	5.0	28	34.0
29	34.0	26.5	62	46	15.7	0.0	29	34.0
30	34.6	25.4	61	46	15.3	0.0	30	34.6
31	35.0	26.4	56	43	15.3	0.0	31	35.0
Total						**159.6**		

B) August 2005

Date	Temperature°C		Relative Humidity		Wind velocity Kmph	Rainfall (mm)	Evaporation (mm)	Sunshine hours max
	Max	Min	1	2				
1	34.0	26.4	62	49	16.7	0	8.0	1.4
2	33.6	26.4	58	44	12.2	0	7.2	2.4
3	33.8	26.4	62	45	11.8	0	6.8	0.5
4	32.0	25.6	70	51	11.9	0	6.0	0.2
5	34.4	26.2	61	47	11.0	0	7.2	3.6
6	35.4	25.5	56	37	11.3	0	9.4	9.7
7	35.5	25.2	54	37	20.9	0	10.6	6.5
8	33.0	26.2	57	44	14.7	0	11.6	0.0
9	29.8	26.0	65	57	12.4	0	6.4	0.1
10	34.2	23.8	70	43	12.5	1.2	2.0	6.5
11	34.2	26.2	58	46	17.5	0	9.3	7.0
12	35.2	26.8	58	37	16.4	0	9.2	8.4
13	35.2	27.2	53	39	17.3	0	10.4	7.6
14	35.5	27.5	54	36	16.0	0	10.0	3.8
15	32.6	25.4	68	48	13.0	0	7.1	0.0
16	32.0	24.0	81	56	8.0	32.4	2.0	0.8
17	34.0	26.0	61	44	7.0	0	4.8	8.6
18	33.8	26.5	63	45	11.0	0	9.2	2.1
19	34.6	26.6	57	41	14.1	0	7.6	7.9
20	35.0	26.8	55	37	14.6	0	7.8	6.8
21	36.0	25.5	63	34	10.4	0	9.3	9.7
22	36.2	25.6	62	40	6.9	0	8.0	7.5
23	35.2	25.5	65	43	8.1	0	7.0	3.9
24	33.2	22.4	79	52	9.2	2.2	3.6	4.7
25	35.0	25.0	64	40	7.4	2.6	2.0	5.6
26	32.8	23.0	90	56	8.6	24.0	2.6	7.8
27	33.0	25.0	80	79	7.3	0	5.3	4.8
28	35.0	24.0	67	49	4.8	5.4	0.0	8.7
29	35.5	25.0	75	46	4.0	0	4.2	9.0
30	35.2	24.4	67	49	4.9	0	5.6	5.1
31	33.6	23.0	86	54	5.4	1.8	2.9	6.0
Total						**69.6**		

C) SEPTEMBER 2005

Date	Temperature°C		Relative Humidity		Wind velocity Kmph	Rainfall (mm)	Evaporation (mm)	Sunshine hours
	MAX	MIN	1	11				
1	34.6	23.0	72	50	7.7	0.0	4.9	6.4
2	34.2	24.0	76	56	5.0	9.4	2.0	4.2
3	33.6	23.6	81	58	5.2	4.8	1.7	4.7
4	35.6	24.6	79	49	3.0	0.0	3.5	8.1
5	34.6	24.5	80	49	4.5	2.8	2.8	8.1
6	33.2	24.5	73	60	5.3	1.4	3.3	4.9
7	27.2	23.6	87	90	5.0	10.0	1.2	0.2
8	32.6	23.5	86	65	2.0	12.4	0.6	2.5
9	33.4	24.0	86	55	6.3	0.0	3.9	3.7
10	33.0	26.0	75	59	9.4	0.0	5.8	0.0
11	32.8	24.5	75	52	7.7	7.2	0.9	3.5
12	32.2	25.0	70	55	9.0	0.0	3.6	0.8
13	33.8	24.6	70	46	6.9	0.0	4.3	1.3
14	34.0	25.4	65	46	8.6	0.0	4.3	6.9
15	33.6	24.5	65	46	8.6	0.0	6.0	4.2
16	35.8	24.5	59	42	6.4	0.0	5.4	7.7
17	35.2	25.2	5	39	9.0	0.0	8.4	8.3
18	34.0	24.8	61	44	12.4	0.0	9.1	6.6
19	30.5	26.4	60	49	19.3	0.0	9.2	0.0
20	32.0	26.8	59	47	17.9	0.0	7.0	1.3
21	35.8	23.5	63	39	11.4	0.0	7.3	8.8
22	36.2	24.5	59	36	9.2	0.0	7.5	8.1
23	36.0	25.0	69	44	7.5	3.8	2.8	9.9
24	35.8	23.2	62	40	6.0	0.0	6.7	8.5
25	33.5	23.0	78		6.1	6.8	1.0	9.3
26	35.0	23.5	60		7.1	0.0	6.0	8.3
27	32.0	23.5	60	23	7.5	0.0	6.0	3.3
28	32.6	23.0	63	57	5.2	2.8	1.8	4.4
29	30.2	23.0	80	87	6.4	0.0	0.0	0.1
30	31.6	23.0	87	67	3.9	3.8	0.0	0.7
Total						**65.0**		

D) October 2005

Date	Temperature		Relative Humidity		Wind Velocity Kmph	Rainfall (mm)	Evaporation (mm)	Sunshine hours
Oct 2005	MAX	MIN	I	II				
1-10-05	34.2	25.2	68	47	5.4	0.0	2.3	6.0
2	34.6	23.2	78	50	6.1	0.0	5.6	5.7
3	34.6	23.2	71	52	4.7	0.0	4.4	4.3
4	35.	25.0	75	45	6.4	0.0	4.7	6.2
5	34.8	24.4	77	48	7.0	3.6	2.0	7.4
6	34.8	24.0	76	43	4.0	0.0	4.2	6.8
7	34.8	25.0	76	50	5.3	0.0	5.3	7.4
8	35.4	23.8	86	40	5.7	0.0	4.5	7.4
9	34.2	22.5	73	46	7.4	0.0	5.8	5.0
10	27.0	23.8	95	73	5.5	7.6	0.6	0.0
11	26.5	23.0	90	93	4.4	6.4	0.8	0.0
12	30.0	22.5	98	69	4.3	33.2	0.0	1.5
13	26.2	22.8	96	88	4.4	38.4	1.0	1.0
14	25.2	23.4	93	76	3.8	33.4	0.0	3.6
15	32.5	25.2	82	65	2.6	0.0	2.1	5.7
16	33.0	24.2	79	62	2.9	0.0	5.2	6.9
17	32.0	23.0	77	59	4.5	0.0	1.6	6.8
18	31.0	24.4	80	96	2.9	0.0	3.3	2.1
19	30.8	22.2	90	83	2.0	37.6	0.0	5.5
20	29.0	23.5	91	86	4.3	0.0	1.8	0.3
21	31.6	23.5	95	66	2.2	1.4	0.3	3.9
22	31.0	23.5	95	77	3.6	1.6	0.7	4.9
23	30.0	23.8	95	77	4.0	20.0	0.0	4.5
24	27.0	23.2	98	95	4.2	26.0	0.0	0.4
25	25.8	23.6	96	92	1.6	5.4	0.0	0.0
26	26.6	23.2	96	87	1.2	3.0	0.0	0.0
27	24.2	22.6	93	88	6.1	31.8	0.0	0.0
28	25.2	18.6	83	79	26.4	70.4	0.0	0.0
29	30.0	23.7	79	65	17.2	0.0	1.8	5.7
30	30.8	23.4	92	68	9.0	0.0	3.7	2.7
31	30.8	23.2	93	72	2.7	1.0	0.0	4.9
Total						**320.8**		

E) November 2005

Date	Temperature		Relative Humidity		Wind Velocity Kmph	Rainfall (mm)	Evaporation (mm)	Sunshine hours
No 2005	MAX	MIN	I	II				
1-10-05	33.4	24.4	82	60	3.4	4.6	0.6	7.5
2	29.6	24	90	70	4.4	0.0	4.5	0.0
3	31.4	22	93	67	3.4	8.0	1.0	6.8
4	30.4	23.4	90	95	4.2	0.0	2.8	3.2
5	28.6	22.4	96	72	4.3	32.4	0.0	0.0
6	26	23	74	-	8.8	2.2	0.0	0.0
7	24	22	95	91	4.1	33.8	0.0	0.0
8	24	22	77	59	6.4	31.0	0.0	2.8
9	23.8	22.2	86	93	8.3	0.8	2.6	0.0
10	29.2	21.6	83	68	3.2	1.3	0.0	1.1
11	24.2	22.8	91	91	5.0	7.0	0.8	0.0
12	28.8	22.4	74	59	2.8	0.0	0.7	7.9
13	28.5	17	92	53	5.8	0.0	2.3	7.9
14	29.5	17	98	54	5.2	0.0	3.4	8.8
15	29.6	18.2	88	48	6.0	0.0	3.2	8.8
16	29.4	15.6	90	39	5.4	0.0	4.5	9.7
17	29.6	14.3	96	42	5.8	0.0	4.0	9.4
18	29.4	14	98	43	4.6	0.0	4.1	9.4
19	29	16.2	83	46	5.0	0.0	4.5	8.2
20	28	17.5	85	59	6.3	0.0	3.2	5.0
21	26	23.5	94	51	9.4	0.0	5.2	0.0
22	24.2	21.2	88	96	6.6	31.6	2.0	0.0
23	25.6	21.5	96	96	7.9	156.2	0.0	0.0
24	26.5	20.5	98	78	5.3	26.4	0.0	0.8
25	25.8	20.6	96	87	5.2	32.8	0.0	0.0
26	28	21.4	96	58	3.2	14.0	0.0	8.6
27	27.8	20.4	89	57	7.7	0.0	4.4	7.8
28	27.8	19.0	92	55	6.3	0.0	4.4	8.8
29	27.4	17.5	81	53	6.1	0.0	3.4	4.2
30	29.6	18.5	81	81	5.7	0.0	3.5	8.9
Total						**382.1**		

Table IV. Daily rainfall at Agricultural Research Station, Anantapur during 2005

a) January to July 2005

Month and Date		Rainfall (mm)	No. of rainy days
January	---	NIL	NIL
February	1	0.2	0
March	---	---	NIL
April	16	0.4	0
	26	11.2	1
	Total	**11.6**	**1**
May	4	0.6	0
	22	3.4	1
	28	7.6	1
	30	37.4	1
	31	5.2	1
	Total	**54.2**	**4**
June	4	31.0	1
	5	18.8	1
	8	3.0	1
	14	15.2	1
	29	1.4	0
	Total	**69.4**	**4**
July	6	0.4	0
	11	1.0	0
	13	0.2	0
	15	0.4	0
	16	92.6	1
	17	2.6	1
	18	7.2	1
	20	13.4	1
	21	0.8	0
	23	10.4	1
	24	4.8	1
	26	4.4	1
	Total	**138.2**	**7**

b) August to October 2005

Month and Date		Rainfall (mm)	No. of rainy days
August	2	0.8	0
	9	4.4	1
	10	6.2	1
	12	9.6	1
	16	0.4	---
	25	0.4	0
	26	1.8	0
	28	33.0	1
	29	19.0	1
	30	43.4	1
	31	17.0	1
	Total	**136.0**	**7**
September	1	1.4	0
	2	2.0	0
	3	7.4	1
	5	25.2	1
	6	35.6	1
	7	3.0	1
	8	28.2	1
	9	8.2	1
	11	1.6	0
	20	2.6	1
	21	2.8	1
	28	0.4	1
	Total	**118.4**	**8**
October	4	1.2	0
	5	2.6	1
	11	0.2	0
	12	7.4	1
	13	9.0	1
	14	15.0	1
	15	2.2	0
	16	9.4	1
	17	12.0	1
	18	3.2	1
	19	7.0	1
	20	0.4	0
	25	0.6	0
	26	0.4	0
	27	6.2	1
	28	33.6	1
	29	2.0	1
	30	8.2	1
	Total	**131.6**	**12**

c) November 2005

Month and Date		Rainfall (mm)	No. of rainy days
November	2	3.4	1
	22	3.6	1
	23	3.2	1
	24	3.0	1
	25	0.2	0
	Total	**13.4**	**4**
December	4	12.0	1

Total rainfall during crop period: 536.6 mm (July to November)
No. of rainy days during crop period : 38 days (July to November)

Table V. Dry spells of more than 14 days that occurred at ARS, Anantapur during the crop growth of *kharif* 2005

Dry spells	Period	No. of days
1.	15 June to 15 July	31
2.	13 August 27 August	15
3.	10 September to 11 October	32 days
4.	3 November to 21 November	19
5.	5 December 31 December	27

Table VI. Monthly mean rainfall at Pileru during kharif 2005

Month	Rainfall (mm)
January	7.0
February	10.9
March	5.4
April	73.6
May	63.8
June	81.4
July	135.6
August	150.8
September	105.6
October	223.8
November	214.2
December	84.2
Total	**914.2**

Table VII. Monthly mean meteorological data at Agricultural Research Station, Anantapur during 2005

Month	Temperatures °C				Rainfall (mm)		No. of rainy days		Relative humidity %				Sunshine hrs/day		Wind velocity km/ph		Evaporation mm/day	
	Maximum		Minimum						0720 hrs		1420 hrs							
	N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A
Jan.	31.1	32.6	16.8	18.5	002.0	000.0	0.2	0	81	79	41	35	9.6	8.5	6.9	7.9	7.0	7.4
Feb.	34.4	35.4	18.9	19.1	000.3	000.2	0.0	0	72	76	27	27	10.3	10.1	6.9	7.8	9.2	8.1
Mar.	38.0	38.5	22.0	23.0	001.4	000.0	0.1	0	61	63	20	23	10.4	10.2	7.2	8.3	11.6	9.3
Apr.	39.3	39.8	25.5	25.6	029.4	011.6	1.6	1	53	55	20	21	10.3	9.1	8.4	9.1	12.2	9.6
May	38.7	40.8	25.9	26.9	050.8	054.2	2.8	4	54	55	24	22	9.5	9.6	12.2	9.3	11.6	11.3
Jun.	35.9	36.7	24.6	25.3	055.8	069.4	3.8	4	63	62	31	31	7.3	7.4	16.2	16.1	9.8	8.2
Jul.	33.9	33.7	23.5	23.7	094.0	138.2	4.7	7	70	70	37	39	5.8	5.5	16.9	17.1	8.6	7.5
Aug.	32.7	33.1	22.7	22.7	113.2	136.0	5.8	7.0	74	75	44	38	5.5	5.7	14.8	15.2	7.5	7.8
Sep.	33.0	32.1	22.7	22.9	129.3	118.4	6.5	8.0	76	72	41	40	7.0	6.4	9.6	10.0	7.4	6.4
Oct.	32.0	31.9	21.5	22.4	110.4	131.6	7.0	12.0	80	75	45	41	6.8	4.5	5.3	5.3	6.3	5.8
Nov.	31.5	30.4	19.0	17.7	012.1	013.4	2.0	4.0	84	87	42	42	7.9	7.4	5.7	4.4	6.0	4.9
Dec.	30.2	30.6	16.2	16.4	005.2	012.0	0.3	1.0	87	86	41	40	8.2	8.2	6.5	4.7	5.9	5.1

N : Normal (1995 - 2004) A : Actual (2005)

Table VIII. Monthly mean soil temperatures (°C) at Agricultural Research Station, Anantapur during 2005

Month	0720 hrs						1420 hrs					
	5 cm		10cm		20cm		5cm		10cm		20cm	
	N	A	N	A	N	A	N	A	N	A	N	A
Jan.	22.6	24.0	24.1	25.0	27.1	27.5	35.7	34.6	33.1	33.5	29.3	28.6
Feb.	24.3	25.3	26.0	26.4	29.1	29.3	40.1	38.4	36.4	36.8	31.8	30.4
Mar.	27.4	28.7	28.9	29.8	32.5	32.7	44.7	42.6	39.9	40.6	34.7	34.0
Apr.	30.5	31.5	32.0	32.5	34.9	35.2	47.0	44.7	42.9	43.1	37.6	36.5
May	30.4	32.3	31.7	33.3	34.4	36.2	44.4	44.9	41.2	43.5	37.0	37.5
Jun.	28.4	29.1	29.6	30.1	32.1	33.4	38.9	38.7	37.2	38.5	34.3	34.7
July	26.9	26.7	27.9	27.7	30.0	29.7	36.0	34.4	34.7	34.2	32.1	31.2
Aug.	25.8	26.1	26.9	27.0	28.8	29.0	34.8	34.3	33.7	34.0	31.0	30.5
Sep.	26.5	25.9	27.7	26.7	29.6	28.5	37.6	34.6	36.7	34.2	32.1	30.4
Oct.	25.7	25.7	26.9	26.5	29.0	28.5	36.7	33.5	35.2	33.4	31.6	30.2
Nov.	24.3	23.1	25.5	23.9	27.9	26.3	35.5	32.5	33.8	32.1	30.3	28.1
Dec.	22.2	22.3	23.6	23.2	26.2	25.9	34.5	32.7	32.1	31.6	28.4	27.5

N : Normal (1995 - 2004); A : Actual (2005)

Table IX. Mean weekly soil temperatures (°C) at the Agricultural Research Station, Anantapur during 2005

Std. Wk no.	Period	0720 hrs						1420 hrs					
		5 cm		10 cm		20 cm		5 cm		10 cm		20 cm	
		N	A	N	A	N	A	N	A	N	A	N	A
1.	1 – 7 Jan.	22.3	23.8	23.7	24.8	26.6	27.3	34.8	33.9	31.8	32.9	28.5	28.3
2.	8 – 14	22.4	22.1	24.0	23.2	26.9	26.5	35.3	34.0	32.2	32.7	28.8	27.6
3.	15 – 21	22.5	23.7	24.0	24.7	27.3	27.3	36.5	34.8	33.3	33.6	29.4	28.4
4.	22 – 28	22.9	25.8	24.5	26.8	27.9	28.4	37.6	35.9	34.1	34.8	30.0	29.8
5.	29 – 4 Feb.	23.1	25.5	24.6	26.5	27.7	28.5	37.9	34.5	34.2	33.4	30.2	29.4
6.	5 – 11	24.2	23.8	25.7	24.9	28.9	28.2	39.2	37.2	35.3	35.9	31.1	29.6
7.	12 – 18	23.8	24.5	25.7	25.7	29.1	28.9	40.1	38.7	36.1	36.8	31.5	30.1
8.	19 – 25	25.2	27.1	26.7	28.2	29.8	30.5	41.6	40.2	37.2	38.3	32.3	31.6
9.	26 – 4 Mar	25.6	25.9	27.1	27.0	30.7	31.1	42.5	41.6	38.0	39.1	32.9	32.3
10.	5 – 11	28.3	29.2	27.8	30.2	31.5	32.1	43.5	41.5	39.2	39.8	34.0	33.0
11.	12 – 18	27.2	28.6	28.8	29.7	32.3	32.9	45.0	42.6	40.2	40.6	34.5	34.3
12.	19 – 25	28.3	28.9	29.6	30.0	33.2	33.0	45.7	43.2	40.9	41.3	35.6	34.4
13.	26 – 1 Apr.	29.2	30.5	30.7	31.5	33.8	33.9	46.0	43.7	41.6	41.8	36.1	35.0
14.	2 – 8	29.3	30.8	30.9	31.9	34.2	34.3	46.3	43.1	42.1	41.5	36.9	35.5
15.	9 – 15	30.6	33.0	32.1	34.1	34.9	35.6	47.0	45.5	43.0	43.7	37.4	36.9
16.	16 – 22	31.1	31.2	32.6	32.3	35.4	35.4	47.7	45.1	43.4	43.5	38.1	36.6
17.	23 – 29	31.2	30.7	32.7	31.8	35.3	35.4	47.1	45.3	43.3	43.8	38.3	36.8
18.	30 – 6 May	31.3	31.8	32.8	32.9	35.5	35.7	46.2	43.8	42.7	42.5	38.3	36.8
19.	7 – 13	30.3	33.6	31.3	34.7	34.0	36.3	44.7	45.9	41.4	44.1	36.7	37.6
20.	14 – 20	30.1	33.3	31.5	34.3	34.0	37.3	43.2	47.6	40.7	45.6	36.5	38.7
21.	21 – 27	30.3	33.0	31.7	34.1	34.3	37.0	41.4	45.9	41.3	44.5	36.7	38.2
22.	28 – 3 Jun	29.2	27.8	31.4	28.8	34.2	33.2	44.2	39.8	41.2	39.7	36.8	34.9
23.	4 – 10	28.7	28.6	29.9	29.6	32.6	33.1	40.3	37.8	38.2	38.0	34.9	34.4
24.	11 – 17	28.3	29.7	29.4	30.7	31.9	33.2	38.5	40.8	37.0	40.5	34.2	34.7
25.	18 – 24	28.1	29.9	29.3	30.8	31.5	33.8	37.3	38.8	36.0	38.5	33.5	35.0
26.	25 – 1 Jul	27.9	28.7	29.2	29.7	31.3	33.6	38.3	35.9	36.3	35.7	33.4	34.6

N : Normal (1995 - 2004); A : Actual (2005)

Table contd…..

Std. Wk no.	Period	0720 hrs						1420 hrs					
		5 cm		10 cm		20 cm		5 cm		10 cm		20 cm	
		N	A	N	A	N	A	N	A	N	A	N	A
27.	2 – 8 July	27.1	28.2	28.4	29.2	30.6	31.0	37.0	36.0	35.6	35.7	32.8	32.5
28.	9 – 15	26.4	28.2	27.4	29.2	29.8	31.1	35.6	37.1	34.7	36.6	31.9	32.7
29.	16 – 22	26.6	26.3	27.8	27.3	29.8	29.9	35.9	34.1	34.7	34.7	31.9	31.5
30.	23 – 29	26.9	24.1	28.0	25.0	30.0	26.7	35.6	30.1	34.2	30.5	31.8	28.1
31.	30 – 5	26.2	26.3	27.4	27.1	29.5	28.6	35.9	33.0	34.6	32.7	31.7	30.0
32.	6 – 12	25.3	24.9	26.4	25.8	28.4	27.9	33.4	32.5	32.3	32.4	30.4	29.3
33.	13 – 19	25.9	25.6	26.9	26.5	28.6	28.4	34.7	33.3	33.5	33.1	31.0	29.8
34.	20 – 26	25.6	27.2	26.7	28.2	28.2	30.0	34.6	37.0	33.4	36.2	30.7	31.9
35.	27 – 2 Sept.	26.5	26.2	27.5	27.3	29.5	29.7	36.3	36.0	34.8	35.8	31.7	31.3
36.	3 – 9	26.3	25.8	27.3	26.5	29.4	28.2	36.2	32.4	34.7	32.5	31.6	29.8
37.	10 – 16	26.8	25.1	27.7	25.8	29.8	27.7	37.3	33.4	35.6	33.0	32.2	29.4
38.	17 – 23	26.4	25.2	27.6	26.2	29.9	27.8	38.0	33.7	36.3	33.1	32.6	29.7
39.	24 – 30	26.5	27.5	27.7	28.5	29.7	30.3	37.8	38.4	36.3	37.6	32.6	32.5
40.	1 – 7 Oct	26.0	27.8	27.1	28.8	29.4	30.7	37.7	38.6	36.1	37.6	32.3	32.8
41.	8 – 14	26.0	26.6	27.2	27.6	29.2	29.8	36.8	34.4	35.5	34.2	31.8	31.6
42.	15 – 21	25.8	24.7	26.9	25.4	28.9	27.5	36.0	33.1	34.7	33.3	31.4	29.5
43.	22 – 28	25.5	25.1	26.7	25.6	29.1	27.6	37.0	30.9	35.1	31.1	31.5	28.9
44.	29 – 4 Nov	24.8	23.2	26.0	23.9	28.1	25.4	35.7	29.6	34.3	29.7	30.8	26.7
45.	5 – 11	25.0	24.4	26.1	25.2	28.2	27.1	36.5	32.8	34.9	33.1	31.1	29.0
46.	12 – 18	24.5	22.7	25.8	23.7	27.9	26.9	35.4	34.8	34.0	33.8	30.6	29.2
47.	19 – 25	23.9	23.1	25.2	23.9	27.6	26.0	34.4	29.7	33.0	29.4	29.8	27.2
48.	26 – 2 Dec	23.1	21.3	24.5	22.3	26.7	25.2	35.2	33.6	33.1	32.4	29.6	27.3
49.	3 – 9	22.7	21.7	24.0	22.5	26.3	25.5	34.3	31.9	32.2	31.1	28.9	27.2
50.	10 – 16	22.3	23.0	23.4	23.8	26.1	26.1	33.2	32.7	31.3	31.6	28.0	27.5
51.	17 – 23	21.6	23.2	22.9	24.0	25.6	26.2	34.5	32.7	31.9	31.6	28.0	27.7
52.	24 – 31	22.4	21.6	23.7	22.7	26.1	26.0	34.8	32.9	32.0	31.7	28.4	27.4

N : Normal (1995 - 2004)
A : Actual (2005)

Table X. Weekly mean meteorological data at the Agricultural Research Station, Anantapur during the year 2005

S.No.	Period	Temperatures (°C)				Rainfall (mm)		No. of rainy days		Relative humidity (%)				Sunshine (hrs/day)		Wind velocity (kmph)		Evaporation (mm/day)	
		Maximum		Minimum						0720 hrs		1420 hrs							
		N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A
1.	1 – 7 Jan.	30.1	31.8	16.5	18.3	0.1	0.0	0.1	0	82	81	37	38	9.2	8.1	7.1	9.0	6.0	7.2
2.	8 – 14	30.5	32.2	16.7	15.4	0.1	0.0	0.0	0	78	87	38	35	9.2	9.6	7.2	5.6	6.6	7.2
3.	15 – 21	31.5	32.5	17.3	18.1	1.2	0.0	0.1	0	80	79	34	34	9.1	9.5	6.9	7.7	7.3	7.7
4.	22 – 28	32.7	33.8	16.8	21.0	0.0	0.0	0.0	0	78	71	31	32	9.1	9.0	6.2	8.9	7.9	7.8
5.	29 – 4 Feb.	32.5	31.5	17.3	20.5	0.0	0.2	0.0	0	76	78	30	38	9.2	6.1	7.3	8.7	8.0	6.3
6.	5 – 11	33.7	33.9	18.7	17.5	0.1	0.0	0.0	0	74	83	29	30	9.3	10.0	7.5	9.8	8.9	7.6
7.	12 – 18	34.2	37.1	18.6	17.9	0.0	0.0	0.0	0	72	76	27	24	10.3	10.6	7.1	5.8	9.0	9.2
8.	19 – 25	35.6	37.0	19.7	20.6	0.0	0.0	0.0	0	69	71	25	25	9.5	10.3	6.4	7.2	9.8	8.5
9.	26 – 4 Mar	36.4	37.6	19.7	19.5	0.0	0.0	0.0	0	68	73	24	24	10.5	10.7	7.1	8.4	10.4	8.7
10.	5 – 11	37.2	37.1	20.6	23.5	0.0	0.0	0.0	0	66	61	22	2	10.3	9.6	6.8	10.2	10.8	8.4
11.	12 – 18	38.0	38.2	22.2	22.8	0.0	0.0	0.0	0	61	63	19	24	10.3	10.4	7.1	7.5	11.6	9.1
12.	19 – 25	39.2	39.7	23.6	23.0	1.2	0.0	0.1	0	57	63	19	21	10.4	10.8	7.6	8.6	12.0	10.0
13.	26 – 1 Apr.	39.1	40.2	24.8	25.4	0.8	0.0	0.1	0	55	55	19	20	10.3	9.7	7.7	6.4	12.1	10.1
14.	2 – 8	38.9	38.3	24.5	24.7	5.5	0.0	0.3	0	54	56	21	24	9.9	8.2	8.5	11.4	11.7	8.6
15.	9 – 15	39.7	39.9	25.3	26.7	5.3	0.0	0.5	0	53	51	20	20	9.6	9.2	8.2	8.9	12.2	9.6
16.	16 – 22	39.8	40.8	25.9	25.0	6.6	0.4	0.5	0	53	59	20	19	10.1	9.2	8.2	8.9	12.0	10.0
17.	23 – 29	39.7	40.0	25.9	25.6	11.2	11.2	0.3	1	53	56	21	21	9.6	9.4	8.9	7.9	12.1	9.9
18.	30 – 6 May	39.8	39.8	26.3	26.5	9.3	0.6	0.7	0	53	53	22	23	9.9	9.5	10.0	8.9	12.1	9.8
19.	7 – 13	38.5	41.0	25.8	27.9	15.6	0.0	0.5	0	54	49	24	20	8.5	10.0	11.0	12.4	11.5	10.8
20.	14 – 20	38.6	43.1	26.2	27.3	11.5	0.0	0.5	0	54	53	23	17	8.4	11.1	13.2	10.9	11.5	13.1
21.	21 – 27	39.0	42.0	26.1	27.8	12.7	3.4	0.6	1	54	54	24	22	9.2	9.9	13.1	5.2	11.9	12.9
22.	28 – 3 Jun	38.6	36.9	26.0	24.8	4.0	50.2	0.7	3	57	68	25	29	8.9	7.7	12.5	11.2	11.4	9.1
23.	4 – 10	36.5	37.2	25.4	24.8	31.1	52.8	1.3	3	61	62	31	30	7.8	8.6	13.3	11.8	9.7	8.5
24.	11 – 17	36.0	37.6	24.7	25.2	14.0	15.2	1.1	1	65	61	38	28	5.7	9.9	16.0	14.5	8.9	8.7
25.	18 – 24	35.2	36.4	24.7	25.4	3.3	0.0	0.6	0	65	62	35	32	6.7	7.0	18.8	18.7	9.5	7.8
26.	25 – 1 Jul	35.2	35.3	24.6	25.5	6.0	1.4	0.7	0	67	62	34	34	6.6	3.9	17.8	20.9	9.6	7.5

Table contd…..

S.No.	Period	Temperatures (°C)				Rainfall (mm)		No. of rainy days		Relative humidity (%)				Sunshine (hrs/day)		Wind velocity (kmph)		Evaporation (mm/day)	
		Maximum		Minimum						0720 hrs		1420 hrs							
		N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A
27.	2 – 8 Jul	34.3	35.5	24.3	24.8	14.9	0.4	1.4	0	69	64	38	34	6.0	6.9	16.8	21.9	9.2	8.0
28.	9 – 15	33.4	34.7	23.8	24.0	31.1	1.6	2.0	0	71	70	39	35	5.5	4.6	16.5	15.2	8.3	8.1
29.	16 – 22	33.7	33.5	23.9	23.1	12.9	116.6	0.4	4	70	72	40	40	5.6	7.4	17.9	9.3	8.2	7.2
30.	23 – 29	33.6	30.9	23.7	22.8	33.5	19.6	0.9	3	70	76	40	46	5.0	2.8	18.0	20.0	8.5	6.2
31.	30 – 5 Aug	33.2	32.6	23.5	23.8	28.7	0.8	1.3	0	73	72	41	41	5.5	4.4	15.	21.9	8.5	8.3
32.	6 – 12	32.5	32.8	23.2	22.3	20.9	20.2	1.4	3	76	77	44	39	5.0	4.8	16.5	17.0	8.0	7.9
33.	13 – 19	32.8	32.8	23.4	23.0	15.0	0.4	1.0	0	75	74	42	39	5.5	5.4	15.8	17.2	7.8	7.5
34.	20 – 26	32.4	33.8	23.1	22.8	38.8	2.2	1.5	0	75	73	43	35	7.0	6.4	14.5	12.6	7.3	8.2
35.	27 – 2 Sept.	33.0	33.1	23.0	22.2	13.0	115.8	1.1	4	73	78	40	38	5.8	7.7	14.5	6.5	8.4	6.8
36.	3 – 9	33.0	31.9	23.0	22.7	33.3	107.6	1.2	6	75	73	41	43	7.0	5.8	12.7	5.4	7.5	5.6
37.	10 – 16	33.0	31.3	23.1	23.1	28.4	1.6	1.2	0	75	71	40	42	7.1	5.4	10.6	13.5	7.7	6.1
38.	17 – 23	33.1	31.4	23.0	22.5	23.8	5.4	1.3	2	76	74	42	43	7.1	6.4	8.9	15.1	7.8	6.6
39.	24 – 30	32.7	33.8	22.7	23.0	41.6	0.4	2.3	0	75	70	43	33	7.0	7.0	6.6	7.3	7.6	7.3
40.	1 – 7 Oct	32.6	34.9	22.3	23.5	26.6	3.8	2.0	1	78	70	43	31	7.3	6.8	6.2	5.1	7.8	8.1
41.	8 – 14	32.1	32.7	22.1	22.6	31.8	31.6	1.6	3	79	73	44	40	6.4	4.8	5.8	5.5	6.6	6.5
42.	15 – 21	31.6	31.8	21.9	21.9	38.7	34.2	1.8	4	81	78	47	39	6.8	5.7	5.8	4.5	6.3	5.3
43.	22 – 28	32.2	31.0	20.8	21.8	11.6	40.8	0.9	2	81	79	43	47	7.0	3.6	4.8	4.5	5.7	4.7
44.	29 – 4 Nov	31.4	28.3	20.3	20.8	3.8	24.6	1.0	3	83	82	45	48	7.0	2.6	5.6	5.1	6.9	3.7
45.	5 – 11	31.8	31.2	19.9	19.4	4.5	0.0	0.6	0	80	86	42	40	7.9	7.6	5.7	4.2	6.0	5.2
46.	12 – 18	31.4	31.4	18.6	14.8	0.4	0.0	0.4	0	84	92	43	37	8.1	9.8	6.8	3.7	6.2	5.5
47.	19 – 25	30.7	28.9	18.8	18.2	4.0	10.0	0.5	3	83	85	40	50	7.5	5.1	5.9	5.8	5.9	4.3
48.	26 – 2 Dec	31.0	30.4	17.5	16.4	1.3	0.0	0.2	0	86	89	43	41	8.4	8.2	5.8	4.8	5.6	5.1
49.	3 – 9	30.2	30.0	16.4	17.6	2.5	12.0	0.2	1	86	85	42	43	8.1	6.5	6.3	5.3	5.9	4.3
50.	10 – 16	29.8	30.2	16.6	17.2	1.2	0.0	0.1	0	86	87	42	42	7.6	7.6	6.3	5.0	5.5	4.8
51.	17 – 23	30.4	31.0	15.9	16.8	1.2	0.0	0.1	0	85	85	39	37	8.7	8.5	6.6	3.9	5.9	5.2
52.	24 – 31	30.5	30.7	17.5	14.3	0.1	0.0	0.0	0	81	89	39	39	8.5	9.7	7.0	4.7	6.3	5.6

N : Normal (1995 - 2004) A : Actual (2005)

ANNEXURE 3

Participatory Varietal Selection of Improved Aflatoxin Resistant Groundnut Varieties in South India and Strategies for Future Adoption.

- Rainy Season 2005

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Introduction

The participatory varietal selection (PVS) process was commenced in the rainy season of 2003, in the second phase of the project, as part of the efforts to reduce the aflatoxin contamination in groundnuts during production, storage and marketing. Initially, the process has begun with the introduction of the fourteen aflatoxin resistant groundnut varieties developed at ICRISAT, to the farmers of Anantapur, Chittoor and Mahabubnagar districts which are predominantly groundnut growing areas of Andhra Pradesh. The major purpose of the study was to arrive at the most preferred and suitable aflatoxin resistant varieties to the farmers of these regions.

Technology transfer for the on-farm trials of the varieties was facilitated by ANGRAU, University of Reading and ICRISAT. The socio-economic aspects of introducing aflatoxin reducing technologies and the evaluation process of the varieties tried out under the project were undertaken up by STAAD. The whole process has been carried out with the support and active participation of the local NGOs – Rural Development Trust (RDT) / Action fraterna (AF) in Anantapur and Sahajeevan in Pileru area of Chittoor district.

Evaluation of the Participatory Variety Selection (PVS) process is being conducted with farmers immediately after harvest of rainy season crop every year since 2003. The evaluation process has been repeated in 2005 also, in order to

- Identify the most preferred varieties (farmers choices), out of the fourteen aflatoxin resistant varieties (ICG Varieties) introduced by ICRISAT.
- Work out strategies for further continuation and dissemination of the selected varieties so as to sustain in the groundnut based cropping systems.

Rains being copious and more or less continuous caused more damage to the groundnut crop this year as compared to the drought year crop. In-situ germination of mature pods was the major damage that affected the harvesting activity and led the farmers into a helpless situation during plenty.

Selection and location of the villages:

A total of six villages each were selected in Anantapur and Pileru area of Chittoor districts for the PVS process. In addition, one PVS village and three other villages were selected in Anantapur area in order to distribute a single new variety – out of the previously selected farmer preferred ICG varieties - to some of the interested farmers, other than the PVS farmers. The single variety testing process was also conducted in the six PVS trials villages in Pileru area of Chittoor district. ANGRAU with support of local partner NGOs undertook the selection process of villages and farmers. All these villages are within 75 and 110 kms radius from the district head quarters in Anantapur and within 20 kms radius from mandal head quarters in Pileru, (refer Tables i. and ii.).

Methodology

PVS process - **Categories of farmers**

In the first year, the PVS process was started with 3 villages each in the districts of Anantapur, Chittoor and Mahabubnagar. The test varieties were given for on-farm trials to three farmers in each village. During the PVS trials for second year, the villages have been increased to six in

the districts of Anantapur and Chittoor while Mahabubnagar has been dropped out. During the third year i.e. rainy season 2005 also, six villages were selected from each of the two districts. General farmers who grow groundnut crop for their livelihood were also involved in the discussion to find out their preferences during the evaluation process.

Three farmers from each village were given five varieties of seed, which included four ICRISAT aflatoxin resistant varieties (out of the previously selected farmers choice of ICG varieties) and one local variety. These farmers were provided with required seed, chemicals for the seed treatment and fungicide, free of cost, and were constantly supervised by the scientists. These farmers are referred to as '**PVS farmers'** in the report.

Farmers who were given a single ICG variety of seed each for trying out on their own, without NGO's or ANGRAU's supervision are referred to as '**Single Variety Seed farmers'**. Along with the PVS and the Single variety seed farmers, other local farmers who grow groundnut as a major crop were also asked to evaluate the varieties during the survey and are referred to as '**General farmers'** who were selected randomly from the same villages. Details of the villages selected for PVS trials and farmer categories attending the discussions on PVS evaluations are given in Tables i and ii for Anantapur and Pileru respectively.

Evaluation Process:

Evaluation of the varieties tried out in rainy season 2005 was conducted immediately after harvest in all the PVS and single variety seed villages in the Anantapur and Pileru areas. A questionnaire was prepared to aid in conducting the discussions with the farmers during the PVS evaluation process with the main intention of

1. Eliciting farmers' preferences for the new groundnut varieties that were tried out, and
2. Trace out the possibilities for further continuation and dissemination of the varieties and the facilities available with the farmers for continued propagation of the varieties.

The study was conducted through village wise joint group discussions consisting of PVS, single variety seed and the general farmers. Men and women participated in the discussions, though women's participation was comparatively less in some of the villages. A total of 82 farmers participated in the evaluation process in Anantapur, out of which 17 were PVS farmers, 16 single variety seed farmers and 49 general farmers. In all 19 women farmers participated in the discussions. In the Pileru area a total of 51 participants attended the discussions and of them 15 were PVS, 12 Single variety seed and 24 General farmers with only 7 women participants (Tables i. and ii.).

The seed and pod of all the varieties tried out this year (rainy season-2005) were displayed before the group of farmers so that they can observe and study the characteristics thoroughly before they give their preferences on the varieties. Individual opinions of all the farmers based on the most important criteria they would look for in a variety, suitability to their local soil conditions and the market requirements were noted. The PVS farmers could express their preferences based on their experiences during the on-farm trials as well as the outcome after the harvest. Though the general farmers' judgment was mostly based on the products displayed, they have also given due consideration to the PVS farmers observations and experiences during crop production.

PVS farmers' preferences:

Anantapur Villages

Evaluations by the PVS farmers, based on their post harvest impressions in the rainy season of 2005 showed that, in general, in the Anantapur area, ICGV 94434, ICGV 94379 and ICGV 91278 have emerged as the most preferred new varieties of groundnut.

Based on their crop management and harvesting experiences and the outcome of the harvest, majority of the PVS farmers preferred either ICGV 94434 (9) or ICGV 94379 (7) as their first choice. The reasons expressed for the preference were the good seed quality, high yield, good

out turn, good fodder, high resistance to pests and diseases and ease in managing and harvesting the crop. Only two PVS farmers preferred ICGV 91328, while the rest felt that it was a low yielding variety.

Interestingly ICGV 91278 was rated first by most of the general farmers (24) while it was given second preference only by some of the PVS farmers (6). As the general farmers did not have the first hand experience of growing the crop, their judgement was mainly based on the physical attributes of the variety such as colour, size and shape of the seed and out turn. However, next to ICGV 91278, ICGV 94434 was also preferred as a first choice by many of the general farmers (18) as well, compared to ICGV 94379 which was less appealing to them due to the inconsistency in the size of the seed and low yield. A large number of the general farmers present during the survey preferred ICGV 91114, an ICRISAT variety that was introduced few years ago, (independent of this project), as their second choice due to its high yielding potential. The PVS farmers under this project, however, though having a positive opinion on it's characteristics, have not preferred ICGV 91114 as it was not aflatoxin resistant.

TMV2 which was a popular local variety has almost failed this year due to it's low resistance to pests and diseases. It is very encouraging to know that all the farmers have unanimously expressed that all the ICGV varieties showed excellent resistance to pests and diseases. The single variety seed farmers expressed their liking for both 91278 and 91328, which were tried by them. They felt that the varieties performed better than local variety TMV2. Tables iii. and iv. present the variety wise preferences of different categories of farmers and specific strong and weak points of each of the varieties selected.

Here, out of the eighteen farmers who were given the new varieties for on-farm trials, 17 participated in the evaluation process. Only one could not respond due to personal constraints. Most of the farmers had preference for two varieties (15) and few showed preference for the third variety also. Only two farmers had single choice. The main reasons expressed for the preferences were good yield, good out turn, good size and shape of the seed, oil content, resistance to the pests and diseases, resistance to the drought conditions, ease in managing the crop, uprooting, foliage yield and quality, market acceptability and price etc., Most of them expressed that yield and outturn were more important irrespective of the colour of seed.

A total of 49 general farmers who grew groundnut for their livelihood were present at the group discussion. Though these farmers were not given the new varieties for trying out, it was thought that their judgment of the varieties based on their experience in growing groundnut would be of great value in identifying the most preferred and suitable variety for the people in the study region. On the whole most of the general farmers gave first preference for ICGV 91278 (23) and ICGV 94434 (17). Eight of them expressed liking for the Kadiri 6 variety compared to the ICG varieties and only one showed interest in ICGV 94379. For most of the general farmers, the second preference was for ICGV 91114 (20) which is a variety given by ICRISAT few years ago, followed by ICGV 94434 and 91328. It is interesting to note that only one farmer preferred TMV2. The reasons expressed for not preferring TMV2, apart from yields and out-turn, included the fact that growth of fungus was very high due to which pods and leaves were falling apart.

Though the general farmers could not explicitly discuss about the management aspects of the crops individually, as a group they expressed their liking for the varieties and reasons for the preference, which were mostly the physical attributes such as the colour, size and shape of the seed and the out-turn (shelling percentage of groundnut kernel weight versus gross pod weight).

Opinions of Single variety seed farmers of Anantapur

Spare seed of ICGV 91278 has been given as a single variety to 13 farmers in the Anantapur villages and out of them 8 were present for the discussion. All of them expressed satisfaction and willingness to continue with the variety. They expressed that it was better than the local variety TMV2. Of the 9 farmers who were given ICGV 91328 as single variety, 7 were present for the evaluation. They said that the size of the seed was good in ICGV 91328 variety but the yield was little less than ICGV 91278. As these farmers were not supported technically by either the project scientists or the NGO personnel in supervising these farmers' fields during

production, it was difficult to get responses from them on all the aspects of the varietal characteristics.

Most of these farmers in general were growing TMV-2, Kadiri-6, JL-24, Polachi, and other such varieties in the previous years. They were unaware of the aflatoxin contamination in the groundnut crop and the ill effects of it when consumed by the humans as well as animals. Only in villages where the new varieties were given in the previous rainy season, some of them showed awareness regarding this aspect. When informed of the aflatoxin problem by the survey team and then questioned about their decision on the varieties they would like to prefer cultivating, all the farmers present for the discussions agreed that it was better to grow the aflatoxin resistant varieties.

For all the farmers in general, the most important criteria in selecting the varieties were, yield, out turn, size and uniformity of the seed, resistance to drought, resistance to pests and diseases, ease in uprooting, foliage yield and quality, marketability. This year, due to the 30-day drought during flowering time and heavy rains at the time of harvest, in-situ germination in large tracts of groundnut cropping areas led to yield losses and hence the farmers could not respond with much clarity on each of the varietal traits. Farmers also expressed that increasing the frequency of visits by qualified personnel for monitoring of the crop would be of great help.

Pileru Villages

In the Pileru area, the scenario was quite different as compared to Anantapur. Due to the heavy and untimely rains in two spells, the groundnut crop was affected very badly. As there were continuous rains during the harvest period, the crop was still in the fields, most of the seed started germinating in-situ. In spite of the bad situation, keeping in view the fact that even the local varieties failed due to the rains, a few the PVS farmers expressed that the new varieties have good potential for high yields and so would prefer to continue growing the varieties.

Eighteen PVS farmers were given the new varieties to try out and 15 of them were present during the evaluation process. Here also, similar to Anantapur, ICGV 94434 and ICGV 94379 were preferred as a first choice by the PVS farmers whose crop was slightly less affected compared to the others who could not express any opinion due to the complete failure of the crops. Only one farmer preferred ICGV 91341 and the rest did not show interest as the yield was less and they preferred the red varieties better in the Pileru area. Here, ICG varieties 94434, 93305 and 91328 were given as single variety to some of the farmers but they were not in a position to talk about the varieties due to the failure of all the crops (Refer Tables v.& vi.)

STAAD encouraged farmers to discuss on the benefits of growing aflatoxin resistant varieties in general even though the farmers faced problems at the time of harvest due to heavy rains. This was mainly done to get the farmer's overall impression on the performance of the varieties during the crop season. Four of them liked the ICGV 94434 first and three of them liked the ICGV 94379 first. In M.C. Palem, none of them preferred ICGV 94434 saying that oil content is less in this variety, and germination of the seed while in the pod itself is more due to soakage in heavy rains. ICGV 91114 was liked by some of them but was given the second choice only based on the fact that it was not aflatoxin resistant.

One PVS farmer however expressed that all the varieties tested were good and have yielded well in his field but due to the heavy rains immediately after the harvest and while the harvested crop was still in the field, the entire crop was spoilt. Even the foliage got rotten and so cannot be used for fodder purpose. While some of the general farmers did show isolated preference for ICGV 94379, 94434, 91341, 91114 and 91278 and expressed interest in buying the seed if given, most of them could not give preference for any variety. However, the PVS farmers whose crops were not a failure, expressed their willingness to retain and grow the seed in the next season, provided the seed is in good condition in spite of getting soaked in the rains.

Consistency in Farmers' Preferences

To summarize, the preferences of the farmers in both the Anantapur and Pileru areas put together can be listed as follows, in the order of their preferences –

Farmer Category	1st Pref	2nd Pref	3rd Pref
• PVS farmers	- ICGV 94434	ICGV 94379	ICGV 91278
• Single variety seed farmers	- ICGV 91278	ICGV 91328	
• General farmers	- ICGV 91278	ICGV 94434	ICGV 91114

Farmers' top preferences from the previous two years were given for on-farm trials during the 2005 rainy season. It is interesting to note that ICGV 94434 that was rated as a top choice in the 2003, by both the PVS as well as general farmers, though showed a low profile in 2004, had again emerged as the top variety in 2005.

ICGV 94379, which was a top choice in rainy season 2004, is still preferred as a first choice in 2005 but next to ICGV 94434. ICGV 91278 which was a preferred variety of the general farmers group in the first year, has appeared in the list of preferred varieties in the second year also and is still continuing to be the most preferred variety by the general and single variety seed farmers and as a second preference variety for the PVS farmers. (Refer to Table vii)

This trend in the farmers' preferences does show some consistency though many factors like the weather conditions etc. seemed to vary from place to place and year to year. This could perhaps be attributed to the characteristics of the varieties like resistance to drought, pests and diseases, high yield, good out turn, etc. It is interesting to note that the two top varieties chosen in the current season are the red coloured seed varieties. This year's results show that the farmers give more importance to the yield, outturn, size of the seed and ease in management compared to the color of the seed. Overall, the farmers expressed that the ICGV varieties had better characteristics than the local varieties.

Exit Strategies:

PVS trials and the evaluations of the varieties had been carried out consecutively for three years including rainy season of 2005. After a thorough analysis of the evaluations, when the preferences of the two areas i.e. Anantapur and Pileru area were put together and the consistency of the varieties in the three years was considered, ICGV 94434 has come out as the top choice followed by ICGV 94379 and ICGV 91278. ICGV 91328 showed a low profile in the PVS farmers' evaluations though the single variety seed farmers who have tried this variety singly have expressed that it is better than the local varieties.

Having arrived at the final list of the popular and suitable varieties, it is extremely important to work out strategies / methods for retention, continuation and dissemination of these varieties in the larger groundnut growing areas. Participatory discussions were held with men and women farmers at the time of evaluation regarding the ways of multiplying and sustaining the varieties that the farmers selected for future propagation after the withdrawal of project support.

Discussions also focused on the facilities and infrastructure available to store the seed and their plan of action for continuing and multiplying the varieties. Based on farmers' discussions and suggestions, a list of possible strategies was arrived at and individual opinions regarding their choice of options were elicited to get a clear picture on how the farmers are going to retain and sustain the varieties through the most convenient method available to them. In addition to this, suggestions and support from the local NGOs, self-help groups and ANGRAU for seed dissemination were ascertained. The alternative strategies arrived at are -

1. Store the seed safely at home and use for sowing in the next rainy season and gradually multiply the seed.
2. In case it was not possible to store the seed safely at the farmer's house, then ask someone else to store the seed for them (Relative / ANGRAU / NGO)

3. Give the seed to the neighbouring farmers/relatives who have irrigation facilities so that they sow the seed for *Rabi*, and then after the harvest, the PVS farmers can get back more seed from them to sow in the next rainy season
4. Mutually exchange the seed of their choice with other farmers so that each of them can grow the variety they like in a larger area thereby quicken the process of seed multiplication.
5. In case of a need to sell the produce to ICRISAT / ANGRAU / NGO for safekeeping and by an undertaking, buy back later for sowing in the next season.
6. Buy the preferred seed in larger quantities from ICRISAT / ANGRAU so as to take up cultivation in larger area, if these institutes can supply the seed.

A majority of the farmers realized that the varieties preferred by them have the potential to give them higher yields than the traditional varieties they were growing, though they may not match the yields of the very recent releases such as the ICGV 91114 & Kadiri 6 (an ANGRAU release). They were nevertheless interested in continuing with growing, multiplying and propagating the varieties tested due to their high drought, pest and disease resistance (characteristic of resistance to production of aflatoxins), and also with the knowledge that they are aflatoxin resistant varieties.

Most of the farmers, the PVS as well as the single variety farmers have come up with a common response that they are going to store the seed safely without mixing with other varieties in their own house and sow for the next rainy season. By doing this, they can multiply the seed gradually provided the rains come at the right time. Only one farmer in the West Narsapuram said that he did not have proper facilities to store the seed and he wanted either ANGRAU or RDT/AF to store the seed for him till the next sowing season. Some of them expressed their willingness to share the seed with their relatives for the Rabi, so that they can get more seed from them for the next rainy season. In Mallapuram, they are willing to give the seed to their neighbouring farmers who have irrigation facilities for sowing in Rabi, and take the seed back from them after harvest, to sow in the next rainy season. In Gummalakunta, two farmers who were brothers wanted to mutually exchange two varieties so that each of them could grow one preferred variety in a larger area to get more produce. (refer Table viii.)

Farmers in Pileru have suffered heavy losses due to the bad timing of heavy rains in two spells in the rainy season 2005. In Anantapur, though the scene was better than Pileru, they also feel that the yields could have been more in normal conditions. Also, in some of the villages in Anantapur, the varieties were mixed up inadvertently by the labourers. All these farmers are interested in continuing the varieties of their first and second choices.

Almost all farmers however expressed that the trial sizes given to them very small to make generalized comparisons visually. They requested that the project partners provide them much larger quantities of the seed preferred by them for production during the 2006 season and were willing to test the potential of the varieties in large scale and at their cost. They also felt that it would be worthwhile to provide larger quantities of seed so the seed could be multiplied in larger areas quickly and sustain the varieties in the system, as they were fairly convinced of the probable success of the varieties, especially taking into account the need to produce aflatoxin free groundnuts for their future sustenance and groundnut haulms for their cattle. Table ix. gives an idea about the number of farmers who are interested in acquiring groundnut seeds of the varieties of their choice in larger quantities for further trials and multiplication at their own cost in the two study areas.

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Table i. Villages & Farmers selected for on-farm PVS evaluations of groundnut varieties rainy season 2005 – Anantapur Dist

S. No.	Name of the		Distance from Anantapur in Kms	No. of farmers						
	Village	Mandal		PVS		General		Single variety		Total
				Men	Women	Men	Women	Men	Women	
1	West Narsapuram	Singanamala	30	3	-	3	5	-	-	**11**
2	Mallapuram	Kalyana Durgam	60	2	1	-	-	-	-	**3**
3	Cherlapalli	Ramgiri	56	3	-	3	4	-	-	**10**
4	Gummalakunta	Battalapally	30	3	-	5	2	2	1	**13**
5	Jalalapuram	Battalapally		2	-	4	1	-	-	**7**
6	Danduvaripalli	Bukkaraya samudram	30	3	-	6	3	-	-	**12**
7	Jambuladinne	Garladinne	35	-	-	4	-	2	-	**6**
8	Timmapuram	Guntakal	75	-	-	-	-	3	-	**3**
9	Bandameedapalli	Kundirpi	110	-	-	8	1	8	-	**17**
TOTAL				**16**	**1**	**33**	**16**	**15**	**1**	**82**

Table ii. Villages & Farmers selected for on-farm PVS evaluations of groundnut varieties - rainy season 2005 – Pileru Mandal, Chittoor Dist

S. No.	Name of the Village	Distance from Pileru in Kms	No. of farmers						Total
			PVS		General		Single variety		
			Men	Women	Men	Women	Men	Women	
1	M.C. Palem	30	2	1	5	5	-	-	**13**
2	Bodinayunidoddi	22	3	-	-	-	-	-	**3**
3	Mullagurivaripalli	23	2	-	10	-	4	1	**17**
4	Chiguruvatialli	25	3	-	-	-	-	-	**3**
5	Ontillu	20	3	-	4	-	7	-	**14**
6	Battalavaripalli	10	1	-	-	-	-	-	**1**
	TOTAL		**14**	**1**	**19**	**5**	**11**	**1**	**51**

Table iii. Opinions of Single Variety Seed Farmers on the new varieties of Groundnut in Anantapur villages - Rainy season 2005

Variety	Name of the Village	No. of farmers	Reasons for the preference/ remarks
ICGV 91278	Gummallakunta	3	**Strong Points :** Good pod and fodder yield, good shelling percentage, good colour of the seed, good resistance to pests and diseases. Note : Farmers at Bandameedapalli expressed that the variety is better than TMV2 in terms of yield and resistance to pests and diseases.
	Jambuladinne	1	
	Bandameedapalli	5	
	TOTAL	9	
ICGV 91328	Jambuladinne	1	**Strong Points :** Good yield, better than TMV2, good pest resistance but less than ICGV 91341, seed size is quite good, healthy crop, suitable to their soils. **Weak Points :** Jambuladinne – Farmers here felt that the pod filling was not good and the seed quality was also not good due to drought and untimely heavy rains.
	Timmapuram	2 – 1st preference 1 – 2nd preference	
	Bandameedapalli	3	
	TOTAL	7	
ICGV 91341	Timmapuram	1	**Strong Points :** Height of the plant was good providing good fodder, drought and pest resistant. Yield better than TMV2. **Weak Points :** Out turn was not good and insitu germination was observed. *Note: This variety was given only at Timmapuram.*

Table iv. Opinions of PVS farmers on the new varieties of Groundnut in Anantapur villages - Rainy season 2005

Variety	Name of the village	No. of farmers as per order of preference			Opinions / Remarks
		1st	2nd	3rd	
ICGV 94434	West Narsapuram	1	-	-	**Strong Points:** Good pod yield, long pods, good out turn, healthy crop with good growth, early establishment of the crop, high drought resistance, ease at harvesting, ease in uprooting, pest and disease resistant, ease in management, good fodder quality and quantity. **Weak Points:** West Narsapuram - Very high in-situ germination was observed in this village hence preferred by only one farmer. Mallapuram – In general, yield this year is not as expected in all the crops due to the absence of rain at the time of flowering, but yield of ICGV 94434 is less than ICGV 94379 hence preferred by only one farmer that too as second choice. Cherlopalli - Two of the three PVS farmers expressed that yields of ICGV 94379 were better than ICGV 94434 in their fields.
	Mallapuram	-	1	-	
	Cherlopalli	1	-	2	
	Gummallakunta	2	-	1	
	Jalalapuram	2	-	-	
	Dandhuvaripalli	3	-	-	
Total		9	1	3	
ICGV 94379	West Narsapuram	2	1	-	**Strong Points:** Good pod yield, good outturn, good size, shape and quality of the seed, healthy crop, good quality fodder, high fodder yield, high resistance to pest and disease. Suitable to their soil conditions, well and early established crop, easy to manage **Weak Points:** West Narsapuram - One farmer said that drought resistance is less compared to ICGV 94434. Dandhuvaripalli – Farmers in this village did not prefer this variety at all as there was lot of insitu germination. Jalalapuram – Crop could not be harvested due to in-situ germination in this village. Farmers also expressed that red variety is not preferred in the market.
	Mallapuram	2	1	-	
	Cherlopalli	2	1	-	
	Gummallakunta	1	-	2	
	Jalalapuram	-	1	-	
	Dandhuvaripalli	-	-	-	
Total		7	4	2	
ICGV 91278	West Narsapuram	-	-	1	**Strong Points:** Good pod and fodder yield, good shelling percentage, good colour of the seed, good resistance to pests and diseases. **Weak Points:** West Narsapuram, Cherlopalli and Jalalapuram: Farmers here felt that the yield of this variety was less compared to the other varieties, hence did not prefer at all. Dandhuvaripalli: Farmers here expressed that the crop is good but breaks while uprooting which in turn results in employing more labour for getting the land ready for the next sowing.
	Mallapuram	1	-	-	
	Cherlopalli	-	-	-	
	Gummallakunta	-	3	-	
	Jalalapuram	-	-	-	
	Dandhuvaripalli	-	3	-	
Total		1	6	1	
ICGV 91328	West Narsapuram	-	-	-	**Strong Points:** Cherlopalli: Only in this village the PVS farmers gave second preference for this variety and said that pod yield was good, healthy crop, established early, and was pest and disease resistant. **Weak Points:** Except for Cherlopalli, in all the villages this variety was not preferred at all due to its low yield.
	Mallapuram	-	-	-	
	Cherlopalli	-	2	-	
	Gummallakunta	-	-	-	
	Jalalapuram	-	-	-	
	Dandhuvaripalli	-	-	-	
Total		-	2	-	
ICGV 91114 *	West Narsapuram	-	1	-	**Strong Points:** High yielding, good quality pod and seed, high resistance to drought as well as heavy raining conditions, resistant to pets and diseases. *Note: Though PVS farmers liked the variety and felt that this is high yielding and resistant to drought as well as heavy raining conditions, they were inclined to prefer aflatoxin resistant varieties as compared to marginally higher yielding varieties like ICGV 91114.*
	Mallapuram	-	-	-	
	Cherlopalli	-	-	-	
	Gummallakunta	-	-	-	
	Jalalapuram	-	-	-	
	Dandhuvaripalli	-	-	-	
Total		-	1	-	
TMV2	West Narsapuram	-	-	-	**Strong Points:** Good colour of the seed, good taste, and good drought resistance. **Weak Points:** PVS farmers in all the villages felt that the yield and outturn has completely failed this year and the variety is not pest and disease resistant.
	Mallapuram		1		
	Cherlopalli	-	-	-	
	Gummallakunta	-	-	-	
	Jalalapuram	-	-	-	
	Dandhuvaripalli	-	-	-	
Total		-	1	-	

Note: *Pest and disease resistance of all the new ICGV varieties was reported to be exceptionally good compared to the local varieties, especially In West Narsapuram, Mallapuram and Cherlopally villages. In Cherlopally village the farmers said no spraying was required throughout the period.*

***** *ICGV 91114 – an ICRISAT variety is now very popular in Anantapur. Farmers have often referred the performance of the trial varieties to its performance and hence the variety is included in the table for comparisons sake even though this not a test variety. ICGV 91114 is however under trial in Pileru area under this project.*

Table v. Opinions of PVS farmers on the New varieties of Groundnut in Pileru villages – Rainy season 2005

Variety	Name of the village	No. of farmers as per order of preference			Opinions / Remarks
		1st	2nd	3rd	
ICGV 94434	M.C. Palem	-	-	-	**Strong Points :** Better yield than local varieties, good seed, good crop, good resistance to drought, pests and diseases, healthy foliage. **Weak Points :** M.C.Palem **–** Farmers here expressed that oil content is less in this variety, and germination of the seed while in the pod itself was more due to soakage in heavy rains. Hence they did not prefer this variety.
	Bodinayuni Doddi	1	-	-	
	Mullagurivaripalli	1	-	-	
	Chiguruvatipalli	1	-	-	
	Ontillu	1	-	-	
	Battalavari palli	-	1	-	
	TOTAL	**4**	**1**	**-**	
ICGV 94379	M.C. Palem	2	-	1	**Strong Points :** Healthy produce, no pests and diseases, good pod filling, good seed, red color seed preferred by the Kalahasti traders. **Weak Points :** Less yield and small seed compared to ICGV 94434. Hence, except for M.C. Palem and Battalavaripalli, this variety was not preferred in the other villages. Note: Six of the PVS farmers in these villages did not show preference to any variety as all of them failed due to heavy rains. Two from Ontillu village did not respond at all.
	Bodinayuni Doddi	-	-	-	
	Mullagurivaripalli	-	-	-	
	Chiguruvatipalli	-	-	-	
	Ontillu	-	-	-	
	Battalavari palli	1	-	-	
	TOTAL	**3**	**-**	**1**	
ICGV 91341	M.C. Palem	-	1	-	**Strong Points :** Good yield, good seed, no diseases, good crop, more fodder. One farmer in M.C. Palem, said that yield was more than ICGV 94379. **Weak Points :** It was preferred by only one farmer from M.C.Palem. All the rest did not show preference from the Pileru villages . They expressed that the outturn was less and prefer red varieties better.
	Bodinayuni Doddi	-	-	-	
	Mullagurivaripalli	-	-	-	
	Chiguruvatipalli	-	-	-	
	Ontillu	-	-	-	
	Battalavari palli	-	-	-	
	TOTAL	**-**	**1**	**-**	
ICGV 91114	M.C. Palem	-	1	-	**Strong Points :** Tasty and spotless quality of seed, good yield, good outturn, good fodder, good resistance to drought, pests and diseases, good colour and taste of the seed, more oil content. *Note: In the Pileru villages, some of them did not have any preferences due to crop failure. Those who liked this variety also did not give first preference on the basis that it is not aflatoxin resistant.*
	Bodinayuni Doddi	-	1	-	
	Mullagurivaripalli	1	1	-	
	Chiguruvatipalli	-	1	-	
	Ontillu	-	-	-	
	Battalavari palli	-	-	-	
	TOTAL	**1**	**4**	**-**	
ICGV 93305	TOTAL	**-**	**-**	**-**	None of the PVS Farmers preferred this variety as the variety completely failed due to heavy rains when compared to the performance of the other trial varieties.

Table vi. Opinions of Single variety seed farmers of Pileru villages – Rainy season 2005

Name of the Village	Name & no. of variety	No. of farmers Preferring	Remarks
Mullagurivaripalli	ICGV 94434	4	Due to the heavy rains at wrong time, all the crops have failed. For all these farmers, it was a great disappointment this year, because all their expenditure and efforts had gone waste. They expressed that the varieties may be good but they are not in a position to express any opinion as all of them have failed.
	ICGV 93305	1	
Ontillu	ICGV 94434	2	
	ICGV 93305	4	
	ICGV 91328	1	
M.C.Palem	ICGV 93305	1	

Table vii. Trend of farmers' preferences in the three years' PVS evaluations

Period of the study	Farmers' preferences			Tested Varieties in Rainy season 2005
	PVS	General	Single variety	
Rainy season 2003	ICG varieties 94434, 91317, 91328, 93328, 91324, 92302	ICG varieties 94434, 91278, 93305, 91279, 91284, 92302	-	ICG varieties 94434, 94379, 91278, 91328, 93305, 91114 and TMV2
Rainy season 2004	ICG varieties 94379, 93328, 91278, 91341, 93305, 94434, 91328	-	-	
Rainy season 2005	ICG varieties 94434,94379, 91278	ICG varieties 91278, 94434, 91114	ICG varieties 91278, 91328	

Table viii. Information on farmers' strategies for retention and continuation of the new ICG varieties (Anantapur and Pileru)

S. No.	Strategy for retention and continuation	Name of the village	No. of Farmers	
			PVS	SVS
Anantapur				
1	Store the seed safely at home and use for sowing in the next rainy season and gradually multiply the seed	West Narsapuram	2	-
		Mallapuram	3	-
		Cherlopalli	3	-
		Gummallakunta	1	1
		Jalalapuram	1	-
		Dandhuvaripalli	3	-
		Jambuladinne	-	-
		Timmapuram	-	3
		Bandameedapalli	-	6
		Total	13	10
2	Ask someone else to store the seed.(Relative /ANGRAU /NGO)	West Narsapuram	1	-
3	Give the seed to the neighbouring farmers/relatives who have irrigation facilities so that they sow the seed for Rabi, and then after the harvest, the PVS farmers can get back more seed from them to sow in the next rainy season	Mallapuram	3	-
		Cherlopalli	1	-
		Total	4	10
4	Mutually exchange the seed of their choice so that each of them can grow the variety they like in a larger area thereby quicken the process of seed multiplication.	Gummallakunta	2	-
5	Sell the produce to ICRISAT/ANGRAU/NGO for safe keeping and buy back later for sowing in the next season	-	-	-
6	Willing to buy the seed in larger quantities so as to take up cultivation in larger area if the varieties they prefer are provided by ICRISAT/ANGRAU	West Narsapuram	3	
		Mallapuram	2	
		Cherlopalli	3	
		Gummallakunta	10	
		Jalalapuram	2	
		Dandhuvaripalli	3	
		Jambuladinne	3	
		Timmapuram	2	
		Bandameedapalli	12	
		TOTAL	40*	
Pileru				
1	Store the seed safely at home and use for sowing in the next rainy season and gradually multiply the seed	All villages	8	
6	Willing to buy the seed in larger quantities so as to take up cultivation in larger area if the varieties they prefer are provided by ICRISAT/ANGRAU	M.C. Palem	9	
		Bodinayuni Doddi	1	
		Mullagurivaripalli	5	
		Chiguruvatipalli	1	
		Ontillu	4	
		Battalavari palli	2	
		TOTAL	30 *	

* *- The total for this option includes the PVS, general and single variety seed farmers*

Table ix. Variety wise farmer demand for larger quantities of Seed for further trials

No.	Variety No.	Anantapur		Pileru Area		Total Farmers
		Name of the Village	No of farmers	Name of the Village	No of farmers	
1	**91278**	Bandlameedapalli	**11**	M.C. Palem	**1**	**19**
		Gummalakunta	**7**	-	**-**	
2	**94434**	Jambuladinne	**2**	Bodinayuni Doddi	**1**	**23**
		West Narsapuram	**1**	Chiguruvati Palli	**1**	
		Cherlopalli	**1**	Battalavaripalli	**1**	
		Gummalakunta	**2**	Mullagurivaripalli Palli	**5**	
		Jalalapuram	**2**	Ontillu	**4**	
		Dandhuvaripalli	**3**	-	**-**	
3	**94379**	West Narsapuram	**2**	M.C. Palem	**5**	**13**
		Mallapuram	**2**	Battalavaripalli	**1**	
		Cherlopalli	**2**	-	**-**	
		Gummalakunta	**1**	-	**-**	
4	**91328**	Jambuladinne	**1**	-	**-**	**4**
		Timmapuram	**2**	-	**-**	
		Bandlameedapalli	**1**	-	**-**	
5	**91341**	-	**-**	M.C. Palem	**3**	**3**
Total farmers in Anantapur district			**40**	Total farmers in Pileru	**22**	**62**

Annexure 4

COMMUNITY OWNERSHIP OF GROUNDNUT THRESHERS FOR EARLY THRESHING – THE SOCIAL PROCESSES AND STRATEGIES.

Rama Devi Kolli and T. Harischandra Prasad – STAAD.

Introduction

Groundnut growers of Anantapur and Pileru (Chittoor district) areas of Andhra Pradesh are habituated to the conventional threshing operations, which involve manual separation of the groundnut pods from the plants. This process is labour intensive and time consuming. Due to the high demand for the labour in the peak season and difficulty in getting paid help soon after harvesting and in order to save on the high labour costs during this period, farmers stack the crop in their backyard after the primary field drying and take up the threshing (pod separation) at a convenient and feasible time.

This stacking up of the crop though facilitates the poor farmers to take up the threshing activity at a convenient time and at affordable price, provides conducive environment for the growth and spread of aflatoxins, especially if the initial field drying is not done properly. In this context, mechanical thresher is thought of as an ideal technological solution to speed up the pod stripping operations and help contain aflatoxin. Though the mechanical threshers are being used in some of the villages in Anantapur, they are inaccessible and unaffordable to the poor farmers. During the peak harvest season threshers are not easily available even to those who can afford them inevitably forcing the farmers to stack the groundnut crop.

Providing easy accessibility of threshers at affordable prices and making them available to the poorer farmers at harvest time can help reduce aflatoxin in the groundnut crop and fodder to a large extent. It also helps these farmers save on the cost of threshing the crop while they can realize better incomes by selling their crop early in the season. Realizing this dire need for the thresher at an affordable price, and based on an experiment conducted through the aflatoxin control project STAAD had come up with the program of providing subsidized mechanical threshers to poor farmers self help groups in order to help them harvest cleaner crops early, easily at lower costs and gain higher incomes.

Background

Mechanical threshers were introduced free of cost in the 2003-04 harvesting season in West Narsapuram village where the PVS on-farm trials were already initiated. This was done on an experimental basis to ascertain whether the farmers would take the benefit of low cost and easily accessible threshers for early pod stripping and to see how they would react to the idea of using the technology on a sharing basis.

Farmers were asked to pay for the cost of diesel consumed, operators' wages and a small daily rent to cover the costs of repairs and maintenance if any. While there were hurdles to the supply and use of thresher during that season, only a few farmers could actually use the thresher. Realizing the gains accruing from such an arrangement and the fact that the crop could be sent to market early, farmers of West Narsapur requested for the supply of a thresher under similar conditions in 2004-05 seasons also. With this demand in view, mechanical threshing as a post harvest technology was introduced in West Narsapur and by way of introduction in Chittoor area in Ontillu village of Pileru mandal also.

After the experiment, STAAD's assessments with farmers of West Narsapur and Pileru in the harvesting season 2004-05 revealed their enthusiasm for using threshers to speed up the threshing operations. Farmers in these two locations clearly expressed that the mechanical thresher was handy to facilitate early pod stripping and found the overall economics working towards their favour. Since the entire process was deliberated by the project team on a sharing concept, it was realized that access to thresher on a permanent basis has greater probability of sustaining the practice of early pod stripping than on the basis of temporary subsidized hiring during the season.

Upon a suggestion by STAAD, farmers expressed keenness to possess a thresher on a community ownership basis. However, the farmers were not in a position to pool up the required Rs. 58,000/- (about USD 1250.00). STAAD had intervened and managed to get an approval for a 50% subsidy on the cost of thresher from the small agricultural machinery subsidy scheme of the AP government's Department of Agriculture (DoA), through the deliberation of the panel and requested support from 'RDT/Accion Fraterna' and 'Sahajeevan' (the local NGOs) to negotiate with farmers of Anantapur and Pileru respectively.

STAAD offered a further subsidy of 25% of the cost of the thresher from its own development funds and the balance was to be collected from the farmers. STAAD had decided to contribute for the threshers on its own since there was no allocation for this kind of transaction in the project budget but were keen to ensure a continuum to the process initiated under the project. It was also felt that the necessity of the poor farming community that had helped the project members undertake the research activity enthusiastically needed to be taken care of.

It was therefore finally possible for the poor farmers of West Narsapuram village to buy their own mechanical thresher. Pileru farmers were not in a position to raise even this small amount but were determined not to let the opportunity go by.

The Social Process - Facilitating an Ownership

STAAD insisted that the thresher ownership should go to self-help groups and preferably to women groups. RDT/Accion Fraterna closed the transaction with the suppliers for the women self help groups of West Narasapur village by collecting the money from their members and STAAD and paying it up to the supplier. In West Narsapur village, thirty women and men farmers from three self-help groups joined together to buy the thresher with a contribution of Rs.500/ each. The machine was formally handed over to the West Narsapuram Thresher Committee on the 29th Oct 2005 under the auspices of all the project partners and under the organization of RDT/AF, after clearly establishing the terms for ownership and use by the members based on the contributions for purchase of the threshers.

Subsidizing the threshers has helped the poor farmers of these areas to pool their small and limited resources for a joint ownership of thresher and also established the ways and means through which these numerous owners would make use of the thresher for early pod stripping on turns. For providing clarity on the ownership and use of the thresher by the farmers, specific criteria were evolved by STAAD, which were negotiated upon by the local NGOs, RDT/Accion Fraterna and Sahajeevan. These were –

- Only a group ownership is allowed.
- Farmers share of the cost of thresher should be shared equally by farmers of the 'thresher ownership group'.
- The 'thresher ownership group' should mainly consist of small and marginal (poorer) farmers where majority should be women farmers, and preferably only women.
- The 'thresher ownership group' should adhere to specific terms and conditions regarding the ownership and use of thresher which are drawn up for this purpose and mutually agreeable to the concerned project partner and the farmers group. Local NGO will act as a watch guard for this purpose and
- The 'thresher ownership group' should agree to share information / data about thresher use with STAAD / ICRISAT even after withdrawal of project.

The entire social process was conceived and facilitated by STAAD with the support of ICRISAT and the respective local NGOs of the two study areas.

Impact of ownership

With the successful arrival of the thresher in West Narsapur, the experience of generating funds from poor farmers collectively for the common benefit of these farmers was realized. Farmers have also realized that the overall benefits of thresher far outweigh the disadvantages if any,

With this success, RDT / Accion Fraterna proposed a similar pattern of subsidy based on the demand for a second unit of the thresher from the farmers of Cherlopalli village in Ananthapur district. ICRISAT agreed to pay the subsidy for this thresher. Both the threshers are already working in full swing and are being put to good use in the respective villages at the time of reporting.

West Narsapur

Thresher ownership created a lot of enthusiasm among the farming communities at large as it gave them an economic incentive, as at individual level it would have been impossible for them to own a thresher with their extremely limited means. The prolonged stacking of the crop after harvesting was avoided due to the timely arrival of the thresher in the West Narsapur and Cherlopally. The details are as follows:

In West Narsapur, the thresher was put to operations by early November 2005. Thirty members (14women and 16 men farmers) from three self-help groups had paid the ownership contribution of Rs.500 each. The owner members of the thresher at the West Narsapur met on 5th Nov 2005 in order to discuss the mode of use of the thresher. It was agreed that

- the thresher should be allotted on a lottery basis.
- the hire charges for members of the committee would be Rs. 400 per day and for outsiders it would be Rs. 500 per day, as against the general rates of Rs. 700 per day.
- Outsiders would be given access to the thresher only after all the members have finished their pod stripping.
- After the expenses were deducted from the income of the thresher, the profit would be distributed between the three groups as per their respective contributions.

The thresher was operated for 31 days during the current harvesting season, starting from 8th Nov to 17th Nov 2005. Of the 31 days, the thresher was given to other farmers in the village for 5 days and the remaining days it was used by the members. Out of a total of 30 owner members only 14 could use the thresher for separation of groundnut pods from their own crops due the extensive damage to the crop through in-situ germination. (Please find enclosed thresher committee log extracts)

A total income of Rs. 13,050/- was derived from its' use and the expenditure was Rs. 4,058/-. The profit as on 17th Nov 2005 was Rs.3,464 per group and as each group consists of 10 members, amount per person would be Rs. 346. In effect, the farmers had already realized over 62% of their capital investment in the thresher with just 31 days of operations. Had the weather conditions been normal and if the yields were good their entire investment could have been recovered in the current season itself.

The group ownership of thresher in West Narsapur has not only helped all the members to carry out pod separation very early giving a break to the prolonged stacking of the harvested groundnut plants which causes the aflatoxin contamination but also can enhance their incomes through revenues generated from hiring out the machine once the total investment on the thresher is recovered. Devoid of thresher, the activity would have continued for a longer period and hence saving in time were also clearly observed.

Cherlopalli

In Cherlopalli village seventy women and men farmers from eight self-help groups formed a thresher committee to buy a thresher with a contribution of Rs. 350/ each (the price of the thresher had increased by the time the demand from Cherlopally came in). The highlight of this process was that the preamble of their memorandum of agreement has clearly indicated that the main purpose of the thresher was to avoid aflatoxin contamination by quickening the pod separation process.

The machine was received on the 28th Dec 2005 and started operating on New Years' eve. It was right on time for harvest, as Cherlopally had received rains much later than in West Narsapuram. Members of the thresher committee had decided that there would be one leader

from each of the eight groups, and all the hiring activities will be done under the supervision of these leaders. It was decided that

- The operator of the machine be paid Rs.50 per day.
- Hiring charges would be at the rate of Rs.30/- per bag (40 Kg. pod).
- Diesel expenses would be borne by the thresher committee.
- The thresher would be sent on a first come first basis.
- Priority would be given to the poor farmers first, and then the urgency.
- The collected money would be kept with two leaders and after the harvesting season is over the profits would be distributed among the members after deducting all the expenditures.

The threshing operations were still continuing at the time of this report and the accounts till date are as follows

- The thresher was operated for 9 days and 387 bags of groundnut pods were threshed.
- Income derived was Rs.11,610 for 387 bags at the rate of Rs.30 per bag.
- The total expenditure was Rs. 5,435, and
- The profit after deducting the expenditure from the income was Rs 6,175

It seems that the Cherlopally farmers will be recovering their entire contributions for the purchase of the thresher this season itself. They had totally contributed Rs. 21,800/- towards their share of the cost of the machine. Even if they run the machine foe 31 days like their compatriots in West Narsapuram, pro-rata they would be earning a total of Rs. 21,270/-. (Please find enclosed thresher committee log extracts)

Since the members are many and the hiring is on the per bag basis, the process of recovery of the rentals requires close monitoring unlike in West Narsapur where the days rent is paid in advance. It is expected that as the process gets streamlined, the benefits would be more. The major advantage however, is the fact that prolonged stacking of harvested crop was avoided and farmers could save their crops from pest disease damage during stacking.

Pileru

The process turned out to be by and large successful as the owners in two villages (West Narsapur and Cherlopally villages) are enjoying the benefits of the mechanical threshing. Despite the overall success of the process, hurdles were faced in Pileru due to which one unit is yet to be delivered.

The second thresher subsidized by STAAD for Pileru (with ICRISAT contributing a minor share of the subsidy) is yet to be supplied due to certain logistic problems. It had become a Herculean task for STAAD to mobilize the concerned agencies for its delivery and though the delivery will take place any time now, farmers in the mean time had to forego the opportunity of early mechanical threshing of the rainy season produce of 2005-06. The main reasons for this delay was the fact that

- There was an enormous delay on part of the local NGO (Sahajeevan) in convincing and organizing farmers to buy the thresher and collect their share of investment. Interactions with the NGO clearly proved that its social organization skills had been quite weak.
- Due to the delay, the price of the thresher had gone up due to lapsing of the annual budgets and subsequent changes in govt. policy on pricing and subsidy component of farm machinery, and
- Because of this new policy additional money was required and while the farmers could not raise any more capital STAAD had increased its contributions with ICRISAT chipping in to fill the gap in the collections.
- This further delayed the process and the red tape in the govt. owned company slowed down the process to a snail's pace.

However, as the payments were already done and the file is under process delivery of the thresher is ultimately assured.

Benefits

Apart from the technological advantages, the economics of thresher use clearly tilted the balance towards more gains as compared to a fewer constraints experienced by farmers with mechanical threshing (see STAAD's two reports on mechanical threshing from the previous FTR for details).

STAAD's efforts in facilitating the process of Thresher ownership paid off in several ways. The overall benefits of the thresher ownership may be summarized thus -

- It established a social organization method that helped the women and the poor farmers in Anantapur and Pileru areas to pool their small resources for a joint ownership of thresher.
- It helped in achieving the project objective of promoting early pod stripping and helped in sustaining the activity after the Project withdraws from the study areas.
- Thresher ownership created a lot of enthusiasm among the farming communities at large as it gave them an economic incentive, as at individual level it would have been impossible for them to own a thresher with their extremely limited means. As the word about thresher ownership spread, lot of farmers from other villages around the area started demanding for similar arrangements.
- This promoted large-scale awareness about aflatoxin problem per se and generated awareness on and interest in combating aflatoxin problem multiplied substantially among the local NGOs.
- It also established the ways and means through which small farmers could collectively own and take turns at sharing farm machinery and equipment that are far beyond their individual means and achieve mutual benefits.

This translates into the fact that early mechanical threshing of freshly harvested groundnut crop in 2005-06 had been promoted by the project, among the poor and marginal farmers, as a pioneering feature and with the main purpose of –

- Facilitate early threshing of groundnut crop to reduce aflatoxin contamination, and
- Use this intervention to demonstrate the advantages of early pod separation and to promote dissemination of this practice to farmers at large.
- Identifying pathways to facilitating group ownership of small farm machinery by the poorer and women farmers / farmer groups,
- Establish procedures for group ownership and group sharing of the machinery and commonly share the benefits.

Learning experiences

Learning experiences from thresher purchase process highlighted the fact that dissemination of technologies is contingent upon the strengths and weaknesses of the local NGOs as they are the facilitators of change at grassroots level. On the positive side, the coordination efforts of an intermediate level organization like STAAD proved to be extremely necessary to establish linkages between research on one hand and for reaping the fruits of research for the development of poor farmers on the other.

Collective ownership of groundnut pod threshers by the poorer farmers with extremely limited means promoted large scale awareness about aflatoxin problem per se among the farmers and local NGOs' and substantially increased their interest in combating the aflatoxin problem. STAAD's efforts in facilitating the process established a social organization method of collective use of farm machinery, helped empowering and enhancing the livelihood opportunities of the women and poor farmers by increasing their incomes and help produce and consume groundnuts and groundnut fodder with reduced levels of aflatoxin content. The project's objective of promoting early pod stripping is also sustained after the Project withdraws.

STAAD will continue to monitor the process and will analyze the users data as soon as the threshing season is over to document the contribution of thresher to poor farmers livelihoods.

From a development perspective, 'owning of a groundnut thresher' for farming communities meant empowering themselves with a productive asset. Since the owners of the threshers

provided during this project are small farmers with limited means, without the project support they would not have been able to get access to thresher at all. Particularly this was the case with women farmers as they could get equal access to a thresher while being given an incentive to pool their resources together with small individual contributions to buy the asset.

Thus the post harvest intervention strategies followed in Anantapur and Pileru areas not only helped the poor farmers to have access to new technologies in equal terms along with the rich farmers but also empowered them to have access to a capital asset. The thresher ownership has considerably enhanced the livelihood opportunities of the poor as the positive economics of thresher operation helped in increasing their income from this activity while helping them produce and consume groundnuts and groundnut fodder with reduced levels of aflatoxin content.

Annexure 5

Group Ownership and Management of Groundnut Thresher

Preamble

Farmers in Anantapur district were encouraged to use mechanical threshers to facilitate early separation of groundnut pods from the plants (threshing operation) as one of the post-harvest technology interventions for reducing aflatoxin contamination in groundnuts as part of the recommendations of the DFID supported project for 'control of aflatoxin contamination in groundnut in Southern India - raising awareness and transferring and disseminating technologies to reduce aflatoxin'.

The main rationale behind this intervention was to encourage farmers to undertake pod stripping immediately after the primary field drying. The intervention was planned as against the farmers' current practice of stacking up the crop after the primary field drying and taking up the threshing operation at a convenient time later on. This stacking of crop (haulm & pods together) is believed to be a possible cause for increasing the chances of aflatoxin contamination. This may be especially true if the pods are not properly dried during the primary field drying process, leading to moisture build up (in the stack) which is conducive to the growth and spread of aflatoxin. It is also expected that if threshers are made available to the farmers in sufficient numbers and at affordable prices, they will be able to save substantially on labor costs and time and have a clean crop on hand that may fetch higher prices.

Farmers of Anantapur stack the groundnut crop in their backyards or at threshing grounds immediately after field drying and undertake pod separation at a later date mainly as a means of avoiding the high labour charges that prevail during the harvest season (demand for labor during the very short harvesting season is high and time is limited due to non availability of sufficient soil moisture for extended periods). Even in areas where mechanical threshing for pod separation is an established process, farmers nevertheless are apt to stack their produce awaiting access to threshers or simply because the poor, small and marginal farmers cannot afford the cost of hiring the threshers based on the local charges being levied by the thresher owners. Availability of threshers during the peak-harvesting season is also a big limiting factor.

In order to reduce the levels of aflatoxin contamination in groundnuts, project partners (ICRISAT, ANGRAU, STAAD and University of Reading - UK) had provided mechanical threshing facility to the farmers of the study villages at subsidized costs, thereby encouraging farmers into early pod stripping. It was decided to provide mechanical threshers to the farmers in one or two villages of Anantapur district initially and preferably in those villages where threshing is done manually and under conditions of prolonged stacking. It was further decided that the threshers would be introduced through a participatory approach and only after farmers confirmed their willingness to experiment with early pod stripping.

A Thresher belonging to ANGRAU was supplied free of hire charges and under the condition that farmers use the threshers on a participatory basis and that the willing farmers bear the required expenditure for diesel and labour plus pay an amount of Rs. 150/- as deposit for expenses to be incurred towards operator cost, minor repairs and other incidentals.

Some of the important terms developed by and agreed to by the farmer representatives of the village including members of the men and women farmer groups, the watershed groups and the village development groups are that

- A Thresher Organization Committee is to be formed in a participatory manner wherein gender participation, special skills and other responsibilities of the members were considered.
- The roles of the different members were discussed and agreed upon and accordingly, the responsibilities of different members of the committee as well as RDT/AF were also decided.
- ANGRAU was to dispatch the thresher to the village at its cost and the villagers would return it to their office at their cost.
- No hire charges would be levied.

- An amount of Rs. 150/- would be collected from the farmers per days usage as deposit for expenses to be incurred towards operator cost, minor repairs and other incidentals.
- The entire responsibility of handling the machines and organizing the activity of rotating the machine among the farmers was to be entrusted to this committee.
- Any funds left with the committee after the threshing operations are completed and the thresher returned to ANGRAU would be allocated to the village common fund and handed over to the existing Village Development Committee.

The results of the experiment were so successful that STAAD (the research partner in the project) has decided to add an additional 25% subsidy to the 50% subsidy given by the AP State Government on the cost of thresher if farmer groups were willing to collect the balance 25% and promise to use the thresher on similar grounds as that used during the research activity. The difference being that the thresher would now be the asset of the participating groups.

With over-whelming response from women farmers, under the aegis of RDT/Accion Fraterna, STAAD had paid an amount of Rs. 14,300/- to the Agriculture Dept while the FOUR Women groups of West Narsapur Village, Garladinne Mandal, Anantapur Dist have collected a similar amount of Rs. 14,300/- from about 30 members in all (at the rate of Rs. 500/- per member) and paid to the department. The balance 50 % of the predetermined price of Rs. 57,200/- being subsidized by the Government, a thresher was handed over to the farmer on whose name the thresher was booked by the Government. The thresher was inaugurated on 29th Oct 2005 under the auspices of all the project partners and under the organization of RDT/Accion Fraterna.

In order to ensure that the thresher is properly used by the members of the participating women groups and to track the utility of the thresher and the replicability of such action the participation members from among the four women groups have entered into the following agreement for use of the 'common fund thresher' and monitoring of the utility of the thresher by STAAD.
Agreement:

- Joint Ownership – A thresher owners association needs to be formed - Thresher committee has to be formed (from among the owner members and advisors from RDT/Accion Fraterna) which
- The Thresher committee will manage the entire operations, safekeeping, maintenance and accounts of the thresher, as per the decisions taken in the general body meetings of the owners group.
- The AGM should meet before and after every threshing season where the economics, operations and finances pertaining to the thresher are discussed and decided by the members.
- The person on whose name the allocation is made by the government has no authority to deal with the thresher in any manner whatsoever.
- STAAD and RDT/AF should be allowed to monitor the utility and patterns of use of the thresher by the members.
- List of owners to be recorded and kept as permanent record in the registers.
- Only in case of complete inutility of the thresher, should the thresher be considered for sale and that too after ascertaining majority opinion of the participating members and approval and joint directions of STAAD and RDT/AF.
- Methods of allocation of thresher by the members and other operating conditions should be arrived at mutually and under the aegis of RDT/Accion Fraterna.
- Methods of allocation and cost of utilization of thresher by other poor, small and marginal farmers of West Narsapur village and the operating conditions should be arrived at mutually and under the aegis of RDT/Accion Fraterna.
- Methods of allocation and cost of utilization of thresher by other farmers of West Narsapur village and the operating conditions should also be arrived at.
- Methods of allocation and cost of utilization of thresher by other poor, small and marginal farmers of neighbouring villages and the operating conditions should also be arrived at.

Annexure 6

TV SHOW on Awareness and Technology Dissemination by Aflatoxin Panel			
No	**Suggested Questions (To be asked by moderator during Show)**		**Probable Answers by panel discussants**
1	What is aflatoxin?	F	Technically: Aflatoxins are secondary metabolites produced by ubiquitously occurring *Aspergillus* group of fungi. Generally speaking aflatoxins are toxic chemicals released by certain types of fungus that have adverse effects on human and animal health if consumed for prolonged periods.
2	What are the crops that are affected by this aflatoxin contamination?	Y	Crops and commodities that have high risk of aflatoxin contamination are Groundnuts, Maize, Cottonseed, dried Coconut (Copra), parboiled rice. Pepper and chillies have moderate risk while wheat, soyabean and sunflower have low risk of contamination
3	What are the effects of aflatoxin consumption on the human body?	R	It can cause both acute poisoning, when it is present in large quantities in the groundnut preparations and chronic poisoning, through prolonged consumption. Acute poisoning is rapidly fatal. In chronic poisoning, It specifically damages the liver and produces cancer in all animal species as well as humans. Hepatitis B and C virus infections can potentiate the liver damage produced by aflatoxin.
4	How does it enter the human body?	R	It can enter the human body through the food we consume
5	In what type of foods can we find this aflatoxin in India?	R	Specifically through foods that are contaminated by the fungus, *Aspergillus*, that has infected ground nuts and ground nut oil, poultry and meat from animals that have been fed the groundnut powder or cake. It can also be found in milk from animals as well as in human breast milk
6	When & how (field conditions) does it infect the groundnut crop?	Y	Aflatoxin forming fungus is usually present in the soil and air. The ideal conditions for the fungus to attack the plant during its growth period are • When there is a drought period at the end of the cropping season • Use of susceptible cultivars • Leftover pods and infected plant material in soil from previous crop • High soil temperature - 28 - 32°C mean – in pod zone • cracks in the pods while in soil, Insect damage by termites, nematodes and pod borers • Death of plant caused by disease at pod maturity stage
7	Apart from health are there any other reasons why we should be controlling aflatoxins in groundnuts?	H	Indian groundnuts are in great demand in Europe as confectionery and chocolate-coated nuts. Due to introduction of stringent Sanitary and phytosanitary standards and very low aflatoxin content specifications our exports of hand picked groundnuts (HPG) have drastically reduced since the last 10 years. Consequently farmers are not able to command good price even for high-grade groundnuts. So as a country we must be recognized as low aflatoxin content groundnut producing country or else we will permanently lose the international market even to small countries like Malawi in Africa where the farmers are quickly changing over.
8	How serious is this aflatoxin problem with respect to groundnut crop	F	Aflatoxin contamination in groundnut crop is the most serious and widespread problem. The crop habitat and growing conditions, especially in developing countries

			like India, favor high contamination. It is single major reason for declining export potential of developing countries and health hazard. Kernel is susceptible to toxin Small pods attached to plant are very susceptible and toxin is accumulated in the kernel, which enters into food chain: for instance, kernels are consumed by humans and also fed to cattle and poultry birds. which again enter the human food chain through milk and eggs. Dried plants after harvest and groundnut cake are an important cattle and poultry bird feed.
9	What are prevailing conditions under which farmers are producing groundnuts that is causing aflatoxin contamination?	H	Drought High temperatures (not too high as the toxin production will decrease) Susceptible variety seeds Improper weeding Drought at the end of season; High rainfall during the harvest Labour shortage during harvesting season leading to Delay harvest and Improper drying Necessity for stacking of crop before pod separation Prolonged period of stacking before pod separation leading to pest infestation
10	How can we control the problem? Are there any solutions for farmers and how can these be implemented	F	ICRISAT has been working to develop global and regional remedies to manage aflatoxins in groundnut. -Resistant cultivars were developed, cultivation of which can reduce the aflatoxin contamination -Pre-harvest cultural practices involving application of various soil amendments (gypsum, farmyard manure), planting density, avoid water stress etc., have been developed. -Recently bio-control agents that can reduce toxin contamination were identified and are being tested at advanced stages. -Post-harvest cultural practices involving simple techniques such as harvesting at right maturity, drying, and threshing. Recently Govt. of AP is providing subsidies to obtain mechanical groundnut threshers, which reduces the pod damage and helps undertake early pod separation, which is critical for reducing aflatoxins. -We are working with various agencies and farmers in the target regions – i.e., Anantapur and Chittoor. Although several options are available, we developed specific-packages for particular regions (depending on the farmers socio-economic condition and ecological situations). This is leading to widespread adoption among farmers. However, a lot more is required to be done in disseminating this information / technologies.
11	Is it possible for the farmers to change their practices?	H	A majority of the practices suggested are well within the means of the farmers and do cost anything more. In fact some of the suggested practices will bring in savings to the farmers – threshers for example – if farmers can procure threshers through their SHGs – they can save Rs 250 to 500 on the harvesting costs alone.
12	What success have you had with crop management and cultivation methods in reducing the problem?	F	Up to 90% reduction was achieved in the most endemic areas. This is by following simple and cost-affective methods, which is within the farmers control. Several farmers have adopted the management

			practices. But this process can be up scaled and can gain momentum, if farmers see an incentive in producing toxin-free groundnut. This is most essential.
13	What will be the Economic risks for farmers and to the country?	H	It is only a matter of time before India comes up with S & PS standards equal to the world standards. Aflatoxin is at the top of the list. Recently we have seen chilies and chilly products being rejected in the European market. More than 14 consignments of groundnuts have been returned last year. This is bad news for the country. We lose the highly remunerative European markets and also get a bad name in the international market. Consequently farmers do not get higher rates for good quality produce also. The new WTO order will be very detrimental to our country if this type of low quality production goes on. We have to change our attitude towards crop production parameters immediately. The risks we are now taking are very big?
14	What are the cost implications for farmers if they wish to adopt these technical interventions?	F	Adoption of resistant cultivars and subtle changes in crop management practices does not add costs to the existing costs or practices. Certain soil amendments, such as gypsum and farmyard manure are cheap and are already known and available to farmers. Bio-control agents, although is cheap, but large-scale production needs to be reinforced. Mechanical threshers are expensive. But we have found very encouraging results with the experiments we conducted on community-based approach to purchase of mechanical threshers. This way, the per capita costs will be minimal and affordable for farmers and collective ownership ensures equal usage. The govt. of AP subsidies, help reduce the costs. To summarize, it is not really the cost that hinders farmers from adopting, but lack of incentive for putting extra effort in producing toxin-free quality seeds. This is the area to look into in future!
15	Is it possible to restrict aflatoxin from entering our bodies if we feed the contaminated crop to animals first and then eat their meat /eggs or drink milk.	R	No, it is not possible to restrict the level of aflatoxin through feeding the contaminated crop to the animal first. It will ultimately enter the human system, whatever the route.
16	Are there any specific areas and regions where aflatoxins are a major problem?	F	The problem is widespread in rain fed crops in semi-arid and arid zones in India. For instance Anantapur is a hotspot. We found that this is most rampant in groundnut crops grown by marginal farmers Having said that, aflatoxins can occur in other areas, especially when there is end-of-season moisture stress or when soil pest incidence is high. There is no real exception, but hotspots are those specified earlier.
17	How do you convince farmers to change their farming methods?	H	We have been working with the farmers since the last three years on this aflatoxin problem and we now know that farmers are willing to orient themselves to producing crops to international standards. However, they cannot afford additional input costs and also require additional remuneration for their extra efforts. Since it is evident that adopting new technologies do not

			necessarily involve additional costs with a possibility of getting higher yields and better prices, farmers have willingly come forward to adopt the new methods. It is only a matter of time and large-scale efforts by all involved when we will be seeing our farmers produce crops to international standards.
18	You said aflatoxin is invisible - then how does one find out if there is aflatoxin in the groundnuts that are sold in the market - At what points should a crop be tested for aflatoxins	F	Indeed they are invisible. 20 infected seed in one billion is the high-end limit for safe-consumption. Although number is minuscule, that is enough for damage. Pinpointing those contaminated seed visible is not possible. Of courser in extreme infections, seeds will be black or dark colored and shriveled, which can be readily detected visibly. The most reliable means to detect them is by doing specific laboratory tests. Several methods are available, but ELISA is the most cheapest and convenient test for developing nations. ICRISAT has developed cheapest ELISA kit for aflatoxin analysis. This is being used by many govt. agencies and we are aiding them in setting up the testing facilities. After crop harvest groundnut seeds are used for estimating the toxin. It is done randomly, but by methodological, sampling procedures, which gives an indication of toxin level in particular lot of produce. If it is within safe limits it is suitable for exports. Accreditation labs will provide certificates – which is essential for export to certain countries.
19	What suggestions do you have for the farmers if aflatoxin growth is to be controlled after harvest	Y	We have identified about a dozen steps that will not require any additional cost to the farmers, which can help reduce aflatoxin content after harvest is done. **(SHOW SLIDE)** If farmers can procure Threshers, dryers, tarpaulins, etc through the available government subsidies and on community / group basis they can benefit further at a very small costs.
20	What are the international standards, and how are these standards affecting Indian farmers, traders and exporters?	F	Various countries have set of different standards. UAS standard is 20 parts per billion (ppb). However they allow upto 50 parts per billion if the product is meant for beaf and pork industry. EU standard is 4 ppb and Japan is most stringent, as they do not accept contaminated samples (0 ppb) Aflatoxins are the major bottleneck for exporters. This has seriously affected the countries exports to other countries. Due to lack of awareness quite often products go up to ports and are rejected at that level.
21	What will be the impact of the sanitary and phytosanitary conditions and levels of aflatoxin content to the Indian farmers?	H	The benefits are two fold. 1. If we adopt these S & PS standards like in most other poor and developing countries we will have international recognition and our crops will be accepted internationally without any complaints which will get us higher returns, and second 2. Apart from those who can afford expensive foods, even the common man – the farmer himself and his family too - can eat quality food like any other person in the developed countries which incidentally is a basic requirement of the modern polluted world.
22	What is the likely cost of testing groundnuts for aflatoxin before the crop can be marketed	F	This depends on the sample size. At an average each sample cost 100 to 1000 Rs depending on the processing method and time.
23	Do you have any cheaper techniques and what could be the costs?		ICRISAT has the world's cheapest test; one cannot get cheaper than this.

24	Do you think that other people such exporters can also benefit from this ELISA technology?		Yes. They are one of the primary stakeholders, if not they become one. It is this technology that provides them to "pass" the produce for export.
25	Is it true that European countries accept only HPLC testing procedures for importing groundnuts? ?		ELISA is an AOAC accepted method, and is accepted by all countries including EU. However, in some cases importing countries can demand for HPCL data also.
26	If we could control the aflatoxin problem how much could that improve the yield and the economic well being of farmers?	H	The cultivation methods used for Controlling aflatoxin content need not necessarily increase yields immediately, but inputs such as FYM, gypsum etc create a base for sustainable higher outputs by increasing soil quality. But the main benefits are 1. Better pricing 2. Greater demand for their products – immediate sale 3. Improved human and animal health leading to higher productivity and reduced expenditure on health, which indirectly contributes extensively to farmer well being.
27	Are there any other solutions with no cost or low cost technologies?	Y	Yes. A majority of the components of the alternative methods suggested by us are either 'low' cost are 'no' additional cost technologies which farmers can easily adopt without any additional burden.
28	Indian markets do not recognize aflatoxins. If the issue of aflatoxin contamination is highlighted extensively don't you think that the traders may take advantage of the situation and deceive the farmers?	H	The situation is quite sensitive. In order to avoid being outsmarted by the traders, farmers have to take the lead in producing aflatoxin free groundnuts and offer to those traders who have specific demand for the produce. Because the oil industry which consumes more than 80% of the countries groundnut produce is not in a position to export groundnut oil and is consequently not quality conscious, there is a good lead time for farmers to take advantage of the situation and lead the process of producing crops to international standards, and save themselves from the clutches of the traders.
29	What are your suggestions to farmers who have irrigation facilities and financial strengths for producing aflatoxin free groundnuts?	Y	With Irrigation, aflatoxin can be reduced drastically. So, in regions such as Ánantapur, farmers should go in for aflatoxin free groundnut production under international standards of S & PS conditions, through which they can earn much higher profits than compared to crops like paddy. Excess irrigation at the end of cropping season also increases aflatoxin. Therefore careful irrigation is needed This way they will not only be making better use of the scare water resources, they will be contributing extensively to exports from our country and earn a good reputation to the country as a producer of quality crops.
30	What is the interest of your partners and the Panel for Aflatoxin Control in solving the problem?	F	Our interest is to help poor farmers grow quality and toxin-free crops. It contributes to their health and income. This process automatically enhances the export potential of the crop. Through our partners we are promoting various aflatoxin-mitigating technologies to regional farmers. Our panel is working to impart awareness among various sectors so that this problem can be tackled effectively.

Note: F-Farid Waliyar, Y- Y.Reddy, R- Raghunatha Rao, H-Harishchandra Prasad,

Slide for Question no. 19

1. At harvest, avoid mechanical damage to the pod by inserting the blade or plow below the pod zone.
2. Dry the harvested produce for 3-5 days using the inverted wind row drying method
3. Dry the produce until the pod moisture is below 8%.
4. Strip or thresh the pod immediately after drying. Avoid stacking.
5. When using mechanical threshers, use appropriate sieves based on pod size so that immature pods are blown off.
6. Remove mechanical and insect damaged pods.
7. Separate the fully mature large pods (to be used for raw consumption) from the remaining produce (used for oil extraction)
8. Do not mix the gleaned pod with the main produce.
9. If necessary, dry the stripped/ threshed pod once again to maintain seed moisture below 8%.
10. Stack the pod-filled gunny bags on a wooden plank and store them in well-aerated, waterproof storage.
11. Prevent insect damage to the pod in storage.
12. Remove all immature pods attached to the haulms.