Pathology

Aflatoxin Contamination of Groundnuts in Mozambique

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Contamination of groundnut (*Arachis hypogaea L.*) with aflatoxins, the secondary toxic metabolites produced by fungi of the *Aspergillus flavus* Link ex Fries group, is a serious quality problem (Mehan et al. 1991). The fungi invade groundnut seeds before harvest, during postharvest drying/curing, and during storage. Preharvest aflatoxin contamination is important during the pod development under drought conditions while postharvest contamination is significant under wet and humid conditions (Mehan 1987).

Mozambique is the largest producer of groundnut in southern Africa. The crop is grown almost throughout the country, with the largest concentration in Nampula Province in the northern region. Groundnut plays an important role both as a food and cash crop for smallholder farmers in the country. It is an important component of rural diet and provides supplementary cash income to women farmers in Mozambique. The crop is grown and managed mostly by resource-poor farmers, especially women.

Aflatoxin contamination is a serious quality problem in Nampula Province. Loss of international and regional markets is attributed to poor quality of nuts due to aflatoxin contamination. South African companies, which are the major contacts for the international export market for Mozambique, discontinued buying groundnuts from Nampula because of high levels of aflatoxin contamination (G A de Wit, South African Peanut Co., PO Box 172, Pretoria 0020, personal communication). Hence, there is a need for systematic evaluation of the incidence and extent of aflatoxin contamination at the farm level and at buying points and warehouses. This information will permit the identification of appropriate methods of management suitable to smallholder fanners, traders, and exporters.

This paper reports the incidence of fungal infection and levels of aflatoxin contamination in groundnut samples collected from farmers at lifting and after drying/curing, and from traders at buying points.

Soil and climate characteristics and groundnut cultivation

Groundnut-producing areas in Nampula are predominantly deep, sandy soils. Soils in the western part, in Malema and Ribawe districts, are heavier and consist of light textured, brownish-red clay loams and sandy clay loams. Nampula falls in one of the agroclimatic regions with high rainfall (700-800 mm annum^{-1}), but it is unevenly distributed. The highest rainfall usually occurs from mid-November to early April. Severe dry spells are usually experienced from mid-December to late January. Warm winters and hot summers with temperatures rising above 30°C are experienced. Groundnut sowing proceeds from late-November to mid-January and harvesting begins in mid-April. Both short-duration (110 days) and long-duration (140 days) varieties are grown.

Groundnut sampling and analysis

Thirty-four groundnut samples were collected from farmers at the time of lifting in 10 districts, and 30 samples after drying/curing in five districts in Nampula Province. Ten samples were also collected from traders at two different buying points. In each case, approximately 200 g of pods were collected, dried in paper bags, and the samples were sent to South Africa for mycological examination and aflatoxin analysis.

Seeds were examined at the Oil and Protein Seed Centre, Potchefstroom, South Africa, and the percentage of moldy seed was determined. Each seed sample (50 g) was analyzed for the occurrence of aflatoxins at the Quality Assurance Laboratory, Perishable Products Exports Control Board, PO Box 40863, Arcadia 0007, South Africa.

Results

The percentage of seed with visible mold growth and the levels of aflatoxin contamination (ug kg^{-1}) in groundnut samples are presented in Table 1. Of 34 samples collected at lifting, 13 were contaminated with aflatoxins and eight recorded aflatoxin levels in excess of 30 ug kg^{-1}. Samples from Mecubury, Muabassa, Nampula, Nacaroa,

and Malema were free of aflatoxins. Fifteen samples showed visible mold growth, but were free of aflatoxins. Two samples from Erati had heavy mold growth but were free of aflatoxins. Samples from Mugovola and Murrupuia showed the highest levels of aflatoxin contamination (620 to 1320 ug kg^{-1}). Out of 30 samples collected from farmers after drying/curing, 10 recorded the presence of aflatoxins and four had in excess of 30 ug kg^{-1}. Two samples from Amendo, and one each from Mugovola and Erati, showed very high levels of aflatoxin contamination. Several samples from Erati were highly moldy (mean 25.1%) but with little or no aflatoxin contamination. Of 10 samples collected from traders, only two showed aflatoxin contamination. All the samples collected from Nakala had very severe mold growth (mean 54%), but only two contained aflatoxins (Table 1). The high incidence of mold growth and the low levels of aflatoxin content in some samples are probably due to high temperatures during pod development and drying/curing phases.

Four samples collected from farmers at lifting and from traders at buying points were also examined to determine the aflatoxin composition (B1, B2, G1, and G2) and the results are presented in Table 2. Aflatoxin G1 was predominant in samples collected at lifting and aflatoxin B1 in samples collected from traders. Predominance of aflatoxin G1 in samples collected at harvest suggests that A. parasiticus is probably the major colonizer (Klich and Pitt 1988, van Wyk 1998).

Conclusions

The results of this study show that aflatoxin contamination is a serious problem in Nampula Province and the contamination occurs in both preharvest and postharvest phases. Some of the locations showed extremely high levels of aflatoxin content (2740 ug kg^{-1}) and the produce is unfit both for human and animal consumption. Further investigations are required to understand the factors

Table 1. Percentage of moldy seed and aflatoxin content in groundnut samples collected from farmers' fields at lifting (10 locations), after drying/curing (five locations), and from traders at buying points (two locations) in Nampula Province, Mozambique, during the 1997/98 crop season.

	No. of samples	Moldy seed (%)[1]		Aflatoxin content (ug kg^{-1})	
Location	tested	Range	Mean	Range	Mean
Samples collected at lifting					
Mugovola	7	0-19	5.0	0-620	167.9
Mecubury	3	1-7	4.7	0	0
Muabassa	1	4	4.0	0	0
Erati	4	0-19	9.3	0-24	5.9
Muecate	4	0-15	4.8	0-97	24.3
Murrupuia	5	3-13	7.6	0-1320	750.8
Nampula	2	1-4	2.5	0	0
Ribawe	2	0-4	2.0	0-2	0.8
Nacaroa	5	0-4	2.2	0	0
Maletna	1	0	0	0	0
Samples collected after drying/curing					
Amendo	8	0-8	4.1	0-2740	362.2
Mugovola	6	1-4	1.8	0-1382	230.7
Mecubury	1	4	4	0	0
Erati	9	6-48	25.1	0-167	20.5
Murrupuia	6	4-10	7.0	0	0
Samples collected from buying points					
Mugovola	5	0-6	2.4	0	0
Nakala	5	32-64	54.0	0-31	10.9

1. Percentage of seeds showing visible moldiness due to infection by A.flavus and Macrophomina phaseolina (Tassi) Ooid.

Table 2. Aflatoxin composition in four groundnut samples collected from farmers at lifting and in two samples collected from traders at buying points in Nampula Province, Mozambique, in 1998.

Sample	Aflatoxin content (ug kg^{-1})				Total aflatoxin (ug kg^{-1})
	B1	B2	G1	G2	
At lifting					
1	1041	63	1126	510	2740.1
2	54	8	90	3	154.6
3	476	142	652	112	1381.5
4	55	21	55	36	166.9
At buying point					
1	20	2	2	0	23.4
2	22	5	4	1	31.0

contributing to aflatoxin contamination. Drought and temperature stress during the pod development and damage to pods by soil pests and diseases (preharvest phase), and the practices of lifting, drying/curing, and storage (postharvest phase) need to be critically examined before interventions are suggested to farmers, traders, processors, and exporters. Experience gained in other countries on the management of aflatoxin contamination should be utilized to educate farmers and other stakeholders in Mozambique.

References

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Response of Spanish Groundnuts to Stem and Pod Rots Caused by *Sclerotium rolfsii* Sacc.

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Stem and pod rots, caused by *Sclerotium rolfsii* Sacc. are a major constraint to production in most of the groundnut-growing areas in India (Mehan et al. 1995a). Various cultural, chemical, and biocontrol practices have been recommended for control of these diseases, but individually they are not effective. Hence, integrated disease management incorporating different approaches has been suggested for effective control (Sherwood et al. 1995). Host-plant resistance is an important component of such an approach. But there is no information about the reaction to this disease of Spanish bunch cultivars currently grown in India. Screening for resistance in the field is complicated by the nonuniform spatial distribution of sclerotial inoculum, and as a result consistent and reliable data are difficult to obtain.

In the present study, 10 Spanish bunch cultivars along with already known resistant (ICGV 87165 and ICGV 86590) and susceptible (TMV 2) controls (Mehan et al. 1995b) were evaluated in 3.38 m^2 plots with four replications in a randomized block design by artificial inoculation over two seasons. The recommended package of practices for groundnut cultivation was adopted. Harvesting was done according to the maturity of different entries.

S. rolfsii was isolated from diseased groundnut plants grown in Vertisols. Sand-corn meal medium (Abeygunawardena and Wood 1957) was used to prepare the culture of *S. rolfsii.* Inoculum containing mycelia and sclerotia along with corn meal and sand was applied to the soil surface around the base of groundnut plants at approximately 125 g per 2.5 m in row, 50-60 days after sowing. Sorghum stubble (3-4 cm pieces) was scattered along the rows to enhance the fungal growth. After two weeks the inoculation was repeated. Plants showing symptoms of stem rot, pod rot, or both stem and pod rots were counted at harvest and the incidence was expressed as a percentage of the total number of plants in each plot. The data was subjected to AMOVA in each season and over seasons using pooled analysis. Genotypes exhibited significant variation in both the seasons and pooled analysis revealed significant genotype x season interactions.