Groundnut is of undeniable nutritional importance in the Sahel countries, where few crops have as many nutritional or financial advantages. However, it is susceptible to aflatoxin, a highly toxic substance produced by the fungus Aspergillus flavus. Infection is favoured by water stress towards the end of the cycle, and African regions regularly hit by drought, such as Senegal, Niger and Mali, are thus at particular risk. This brings serious health risks, such as liver cancer, as local populations may consume large quantities of contaminated products. Moreover, with the tightening of European health regulations, the export value of groundnut has dropped considerably, which means a financial risk for the countries concerned. To reverse this trend, it is vital to prevent contamination in the field and at every stage of marketing.

However, until now, varietal breeding programmes have failed to develop groundnut cultivars that are aflatoxin resistant and at the same time have high agronomic potential. In an attempt to find a solution, researchers are studying how the plant's resistance mechanisms work in the event of drought. To this end, a European project entitled "New tools for groundnut aflatoxin control in Sahel Africa", headed by CIRAD, has just been completed. In particular, it enabled the development of methodologies for improving varietal screening and growing groundnut under rainfed conditions, to reduce aflatoxin contamination both in the field and postharvest.

Groundnut seed ripening rate: a key criterion

Two reference varieties were chosen for study: a cultivar that gives average yields under drought conditions but has good aflatoxin resistance, and another that is higher-yielding but more susceptible to the fungus. Both varieties are widely distributed in Senegal and a large part of sub-Saharan Africa. The approach taken consisted in studying them under different environmental conditions: under water stress, in the field, in glasshouses, etc. The researchers studied the varieties on an agronomic and physiological, and also biochemical and molecular, level.

One of the main results of the project concerned seed ripening rate: this is a key criterion in groundnut tolerance of aflatoxin contamination. Short-cycle varieties that produce small
seeds that ripen quickly are more resistant. Moreover, water stress towards the end of the cycle disrupts the lipid metabolism of the susceptible cultivar more than that of the resistant cultivar. Fatty acid composition differs depending on whether or not the variety is aflatoxin-resistant, and the fatty acid metabolism can thus be assumed to be another parameter linked to groundnut resistance mechanisms prior to harvest.

With a view to groundnut varietal improvement, five genes of interest in terms of aflatoxin resistance were identified, cloned and studied. For most of them, this was the first time they had been sequenced and studied in groundnut. Some are involved in the lipid metabolism. The results suggest that groundnut has cell protection mechanisms to limit damage due to the dry season. Moreover, once water is available again, the crop has repair mechanisms. A study of expression of these five genes showed that they were all regulated by the water deficit. Moreover, transgenesis techniques are available for groundnut that could be used to integrate them into the varieties to be improved.

**Good agricultural practice to prevent contamination**

Furthermore, varieties with improved drought resistance have been developed from an aflatoxin-resistant parent and are currently being disseminated within the production zone. Various studies of good practices that may control contamination before and after harvest have been conducted in conjunction with farmers. They revealed a change in product degradation as it makes its way along the production chain. As a result, the researchers opted to set up a contamination risk analysis system, based on the “from farm to fork” concept, at every stage of the production chain, from production to marketing. In particular, the system concerns the choice of variety, treating crop storage facilities against infestation and the effect of using quicklime or manure to control infestation.

The results of this work are already being applied through an operation to develop a quality groundnut production chain in Senegal. The approach taken is participatory and based on analysing market demand (local industry, the export market, etc). One of the aims is to implement a system of fair contracts between producers’ organizations and the private sector, so as to optimize market value. The operation is being led by CIRAD, in partnership with the main Senegalese producers’ organization (ASPRODEB), with European Union funding.

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