Groundnut Rust Disease and Plant Quarantine

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Abstract

Plant quarantine legislation and procedures for prevention of spread of groundnut rust in germplasm exchange are discussed. The recent spread of rust in the eastern hemisphere is attributed to long-distance dispersal of urediniospores by winds. There should be little or no risk of rust disease being spread through exchange of germplasm, either as seed or as vegetative material, provided it is conducted through the proper plant quarantine channels.

Résumé

Rouille de l'arachide et la réglementation phytosanitaire : *Les auteurs examinent la réglementation et les mesures phytosanitaires établies pour la prévention de la propagation de la rouille par l'intermédiaire du matériel génétique échangé. La progression récente de la rouille dans l'hémisphère Est est attribuée à la dispersion lointaine des urédospores par le vent. L'échange de matériel génétique, soit en semences soit en matériel végétal, pose peu ou pas de risque à condition de bien respecter les formalités phytosanitaires.*

The international exchange of groundnut (*Arachis hypogaea* L.) germplasm has increased rapidly in recent years. Much of this is associated with germplasm collection and distribution but there has also been an increase in the movement of seed of improved cultivars and breeding lines. The activities of ICRISAT scientists in collecting, evaluating, and distributing groundnut and wild *Arachis* species germplasm, in running international trials and supplying cooperating scientists in many countries with breeders' lines, and segregating populations, have already been outlined. In the last 8 years ICRISAT has sent groundnut seed to 73 countries and has received seed from 26 countries. This movement is necessary for the development of improved cultivars worldwide and is essential for the effective functioning of international research programs.

It is essential that the exchanges of germplasm should not result in the spread of diseases and pests. The ICRISAT Plant Quarantine Unit works in close cooperation with the Germplasm Resources Unit and the Groundnut Improvement Program of ICRISAT and the Plant Quarantine Services of the Governments of India and of other countries to ensure that this does not happen. Rust disease of groundnut caused by *Puccinia arachidis* Speg. is recognized as a destructive disease in many countries and is of considerable quarantine importance.

Distribution of Groundnut Rust

The Commonwealth Mycological Institute in 1980 published a map (Fig. 1) of the distribution of groundnut rust and listed 58 countries in which the disease was reported. This number has increased since then (Subrahmanyam and McDonald—these Proceedings). Until the 1960s rust was largely confined to South and Central America with a few isolated outbreaks in the USA, USSR, Mauritius, and the People's Republic of China. In the late 1960s and early 1970s it spread rapidly in Asia, Australasia, and Africa. As plant quarantine legislation for the disease was based on the earlier situation, the

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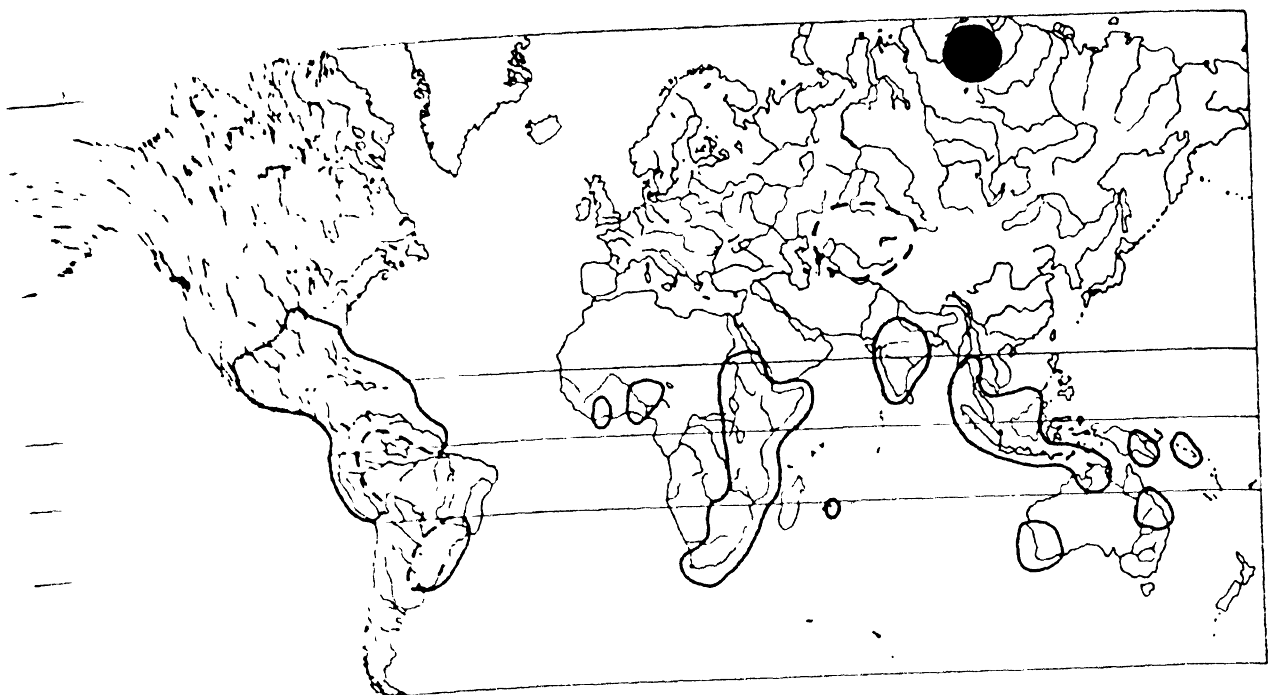

[illegible] World distribution of *P. arachidis* on groundnut.

[illegible] distribution has raised problems for [illegible] germplasm exchange.

[illegible] Quarantine Legislation [illegible] Groundnut Rust

[illegible] Government of India's Destructive [illegible] Act of 1914, corrected up to March [illegible] of groundnut seeds and seed- [illegible] North America, the West [illegible] Republic of China, and the [illegible] of the danger of import- [illegible] However, material can be [illegible] purposes subject to specific [illegible] that the seeds are treated with [illegible] prior to export, and that an [illegible] must be given on the official [illegible] stating that groundnut rust [illegible] exporting country. Israel and [illegible] requirements.

[illegible] groundnut rust has spread [illegible] In India it appeared in the [illegible] and Chohan 1971), in Mad- [illegible] and is now widespread in [illegible] et al. 1979). It is clear [illegible] procedures have not pre- [illegible] becoming established in [illegible] were not effective or, as [illegible] seems more likely, the disease was carried to India by wind and tropical storms. The legislation still stands, but in the interest of research it is permitted to move seed from countries that now have groundnut rust provided that proper precautions are taken. For seed being sent out of India by ICRISAT, a statement is required to the effect that rust is present but the seeds have been fumigated with aluminium phosphide and treated with a mixture of aldrin, Benlate®, and thiram prior to packing and dispatch. Seeds imported into India have also to be treated with appropriate protectant chemicals.

Exchange of vegetative material has been limited. It was necessary to move cuttings from some wild *Arachis* spp that do not readily set seed. These cuttings were first sent from collections in the America[s] to Reading University in the UK where they wer[e] rooted and grown under plant quarantine supervision. Cuttings were then taken from healthy plan[ts] and flown to New Delhi where they were examine[d] by Indian plant quarantine officials. Cuttings judge[d] to be healthy were then flown to Hyderabad a[nd] grown under plant quarantine supervision in [an] isolation screenhouse and plants were eventua[lly] released to Groundnut Improvement Progra[m] scientists.

This procedure, which was set up mainly to p[re]vent the spread of virus diseases, also precludes [the] possibility of rust disease being carried into country on vegetative material. There is the additional safeguard that almost all [illegible] wild *Arachis* species moved as cuttings were of Section *Arachis* and all but one are immune to rust at ICRISAT (Subrahmanyam et al. 1983).

The fact that rust is now widespread does not mean that plant quarantine in respect of this disease should be removed as there are still several groundnut growing countries where it has not yet become established. Furthermore, there is always the possibility that geographically isolated races of *Puccinia arachidis* may occur. However, the possibility of rust being spread by seed exchange should be reviewed in the light of recent studies on the biology of the pathogen, and uniform quarantine regulations and procedures should be agreed internationally.

Implication of Seed Exchange in the Spread of Groundnut Rust

Neergard (1979) and Richardson (1979) list a number of rust diseases that they consider to be seedborne, but so far there is no definite proof that *Puccinia arachidis* is seedborne in groundnut. However, a number of papers on groundnut rust contain references to *Puccinia arachidis* being seedborne and quote other papers as sources of this information. When the source papers are examined it becomes evident that there is no definite proof of the disease being seedborne and that the authors of these papers have been merely presenting their own opinions and suggestions. For instance, West (1931) in Florida, USA, in 1930 found rust on some plants of the cultivated groundnut, two wild *Arachis* species, and a hybrid between one of the wild species and the cultivated groundnut. Seed of the two species had been imported in shell from Brazil in the previous year. The disease had previously been found in Florida in 1918 and 1920 but had not become established there. Because there was no proof of rust having maintained itself in Florida from 1918 to 1930, West assumed that the 1930 outbreak was from the imported material.

More recent studies (Van Arsdel and Harrison 1972) have shown that isolated outbreaks of rust can occur in Texas and can be correlated with air movements from Mexico where rust is endemic. Another commonly quoted paper is that of Peregrine (1971) who reported the occurrence of groundnut rust in Brunei. The rust occurred on a groundnut crop grown from imported shelled seed purchased from a local store. The seeds were treated with an organo-mercury fungicide prior to sowing. The only other groundnut crop found in the locality was also infected and had been sown some 4-5 weeks later. From this data and from the knowledge that groundnuts imported into Brunei are mainly from China and Thailand, Peregrine makes the entirely unwarranted assumption that "there appears no doubt that the disease has been seed transmitted".

It is difficult to explain the very rapid spread of rust in Asia, Australasia, and Africa that took place in a period of eight years in terms of seedborne urediniospores, but easy to do so in terms of long-distance air dispersal. Indeed O'Brien (1977) quotes Pitkethley's opinion that the rust outbreak in Australia probably originated from wind-blown urediniospores.

Longevity of Rust Urediniospores and their Ability to Infect Plants from Contaminated Seed

Pods from a rust-infected crop commonly carry urediniospores that can be transferred to the seed at shelling (Subrahmanyam and McDonald 1982). Severe rust epidemics occur regularly at ICRISAT Center but uredinia (pustules) have not been observed on pegs or pods. This is not the case in Guangdong Province in the People's Republic of China where Dr. Zhou has found uredinia on pegs and on shells. This latter observation underlines the importance of moving groundnuts as seeds and not as pods.

Research at ICRISAT and in China has shown that urediniospores lose viability rapidly at high temperatures. At ICRISAT spores lost viability after being stored for 45 days at room temperature (25-30°C); in China spores only survived for 16-29 days at summer temperatures, but remained viable for 120-150 days at winter temperatures. Storing seed intended for export at a high temperature should therefore reduce the chance of viable urediniospores being moved between countries.

The question has been posed as to whether or not rust disease can develop from the sowing of seed contaminated with viable urediniospores. In trials at ICRISAT, seed of rust-susceptible cultivars dusted with viable urediniospores were sown in steam-sterilized soil in an isolation plant propagator. None of the seedlings developed rust disease. Emerged seedlings of the same cultivars had their foliage dusted with urediniospores of the same batch and all

developed rust. It would therefore appear that even if viable urediniospores could survive on seed samples through quarantine treatments and transit, they could not initiate rust in plants produced from them. The only prospect of such urediniospores initiating disease in the receiving country would be if they were moved from the imported seeds onto the foliage of susceptible groundnut plants growing in environmental conditions conducive to infection. This is considered to be unlikely to happen.

Conclusions

Most available evidence points to groundnut rust being spread by airborne urediniospores. Urediniospores rapidly lose viability at high temperatures and even at room temperatures of 25-30°C, which are common in the tropics, they will no longer be viable after 45 days. However, if stored at very low temperatures such as those used in germplasm banks, they may retain viability for many months. Most seed dressing fungicides should be effective in killing urediniospores contaminating the surfaces of groundnut seeds.

There is no evidence of rust being internally seedborne in groundnut. There should be no risk of rust disease being spread through exchange of germplasm conducted through proper plant quarantine channels. A rather more likely route for the spread of groundnut rust, and one that could have implications for plant quarantine authorities, would be through contamination of the clothes and baggage of air travellers. For the present, care should be taken to clean seeds intended for exchange and to follow the recommended quarantine procedures. For those countries that do not already have groundnut rust it may be advisable to insist upon postentry quarantine in isolation greenhouses.

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