Highlights
CIAT in Africa

N°.2 January 2003

Integrated management strategies or bean root rots in Africa

Over the last decade incidence and severity of bean root rots have increased markedly in the Great Lakes Region of central Africa, some areas in western Kenya and southwest Uganda, resulting in a general decline in bean production.

Root rots are caused by a complex of fungal pathogens, resident in the soil and includes species of *Pythium*, *Fusarium solani* f sp *phaseoli, Rhizoctonia solani* and *Sclerotium rolfsii*. On the basis of spatial distribution, damage and effect on yield, *Pythium* and *Fusarium* species are more important particularly, under high (soil moisture) rainfall and low temperatures, which favour disease development. Symptoms associated with the diseases are yellowing or / and wilting of se occurring two to four weeks after emergence. Surviving plants appea stunted, and often with little or no (Fig.1).

Fig. 1: Root rot symptoms in the field

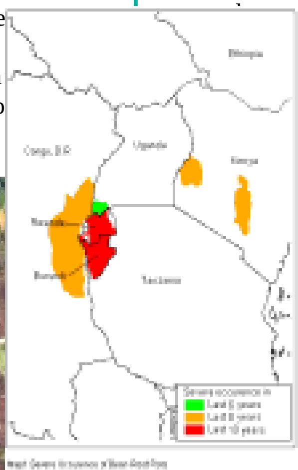
Diseases associated with intensification of agriculture

Bean root rots are among diseases and pests associated with intensification of agriculture. In the highlands of East and Central Africa, declining household land area due to increasing human population, has led to increased use of soil resources, thus reducing crop rotation, fallow periods resulting in the use of inappropriate crop and soil management practices. Besides, there is little use of organic and inorganic sources of fertility, leading to a decline in soil fertility, nutrient depletion and land degradation. The effects of the above scenario are:

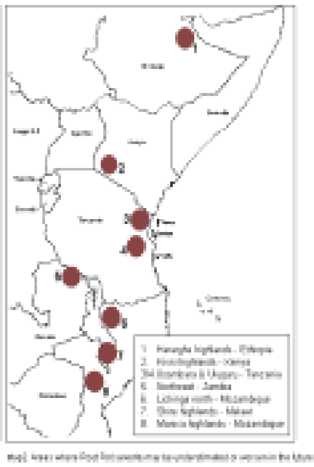
- Imbalance between beneficial and disease causing organisms in the soil, resulting in the increase in (inoculum) levels of the latter.
- Ability of plants to take up nutrients is greatly impaired due to root damage or/and reduced soil nutrients.
- Plant tolerance to root rots is reduced leading to frequent and higher yield losses.

Root rot prediction map

Based on human population density, intensity of bean production and soil nutrient characteristics, we have developed a prediction model (RR = 3.382 + 0.000654 * PD + 0.0605 * INT + 0.191 PASOIL) for root rots. On the basis of the model, root rots are either under-estimated or expected to become severe in ... below.



Map 1: Severe occurence of bean root rots



Map 2: Areas where root rot severerity may be under-estimated or worsen in the future

Development of management technologies

Root rots are problems not amenable to traditional commodity programme approach but where integrated disease management (IDM) using a combination of compatible, appropriate and complementary methods is considered an effective management strategy. Being a knowledge-intensive and farmer based management approach, strong farmer participation is encouraged and used in the

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development and evaluation of IDM technologies based on genetic and cultural options.

Use of resistant, adapted and acceptable cultivars is an effective management option for disease control particularly for small-scale farmers. In the identification of genetic options, evaluations of over 4000 diverse germplasm materials, has resulted in only very few (less than 2.5 %) resistant entries emphasizing the limitation of relying only on resistant varieties in managing such a complex problem.

Entries that have shown potential and are now grown by farmers in Kenya, Rwanda and Uganda include MLB-49-89A, RWR 719, SCAM-80-CM/15, MLB-40-89A, and RWR 1092. The first three (Fig.2) are widely adopted and have had a major impact in Western Kenya where bean production had virtually stopped due to root rots.

Improved, resistant, climbing-bean varieties include G 2333 (Umubano), G 865 (Vininkingi), Flora de Mayo and Puebla. Efforts are continuing to identify more sources of resistance with application of biotechnology tools to introduce resistance into diverse and major market classes in the region.

A regional nursery (70 entries) is available offering regional partners genetic options that may be used directly or for improving commercial susceptible varieties.

Fig.2: Three resistant bean varieties adopted in Western Kenya

Participatory variety selection

In developing genetic options, we advocate and use participatory variety selection methods and techniques (pioneered by CIAT and its collaborators in the Great Lakes Region) that enhance farmer participation in variety selection and for eliciting preferences among varieties. Involvement of farmers in the identification and selection of germplasm has shown several advantages; it takes into account farmer's criteria, indigenous knowledge and preferences and results in faster identification of superior varieties and rapid adoption. In W. Kenya this approach led to farmers selecting a now widely adopted black seeded variety (KK15), which would not have been considered under conventional selection process.

Cultural options

Certain cultural practices influence severity of root rots and can be used as short-term measures and as complementary components in integrated management of these diseases.

Some create unfavourable condition for pathogen development and survival, leading to reduction in inoculum levels, or in promoting plant growth and vigour such that the plant becomes tolerant to infection despite the presence of the pathogens. Use of certain organic amendments such as green manures or farmyard manures have been shown to reduce severity of root rots and promote plant growth and vigour.

Ideal and preferred measures are those which result in a gradual decline in inoculum concentration coupled with an increase in soil fertility. This improves plant tolerance while reducing incidence and severity of root rots (Fig. 3).

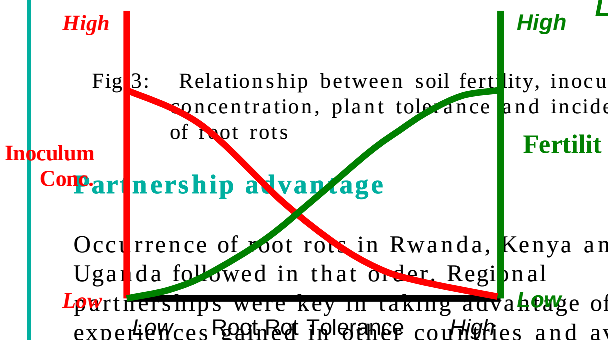

Fig 3: Relationship between soil fertility, inoculum concentration, plant tolerance and incidence of root rots

Partnership advantage

Occurrence of root rots in Rwanda, Kenya and Uganda followed in that order. Regional partnerships were key in taking advantage of experiences gained in other countries and avoid duplication or competition. CIAT's regional mandate, and its participation as a partner in all three countries, facilitated collaboration between and within partner institutions. For example, results from Rwanda were directly evaluated in on-farm trials in western Kenya and south-western Uganda, enabling those countries to economize by omitting the usual on-station stage and arriving at faster adoption (Fig 2).

Conclusion

Our experience show that soil and crop based technologies complement each other and contribute positively in the management of bean root rots. This underscores the importance and the need to integrate disease and nutrient management approaches in addressing the problem, and together with participatory approaches are key in developing sustainable management technologies.