



Bean root rot: getting the upper hand

New tools have enabled researchers to identify the leading causes of root rot in African bean crops. Armed with this knowledge, they have developed a set of simple management measures that can make the difference between success and total loss.



Above: The common bean is especially important to women, who grow it as an important source of protein and precious cash for their households. In one local language, the word for beans is 'a woman's crop.'
Photo: S. Mann

Beans are one of Africa's key crops. The common bean (*Phaseolus vulgaris*) is the second most important source of dietary protein and the third most important source of calories for the people of eastern and southern Africa.

Over the past ten years, however, common bean yields in parts of Africa have dropped by as much

as 50 percent. The reasons for this include low soil fertility, insect pests and diseases and, most important of all, root rots caused by fungi. Today there is new hope for farmers, who can fight fungi using a combination of control measures. This *Pocket Guide* summarizes the solutions.



Common beans, common problems

Populations are growing in Africa, creating a rise in the demand for staple foods such as beans. And while the common bean is important to people of all income levels, bean crops are particularly valuable to the poor, who find it difficult to include animal protein in their diets. Common beans are widely grown by smallholder farmers—women in particular—to feed their families, and any excess is sold on the market for vital cash.

Yet as cropping intensity grows to keep up with demand, deadly diseases—such as root rot, the most serious disease attacking bean crops—are also multiplying. Because this disease attacks at a very early stage of plant development, the farmer often has no chance to harvest any of the crop—not even the leaves. For a family that depends on beans for their protein, this can be disastrous.

Root rots can be caused either by one fungus, or by a combination of fungi that are carried in the soil. They can act either alone, or as a complex. When farmers grow beans one season after another in the same field, disease populations build up and soil fertility drops, resulting in weaker plants and, at the same time, a better breeding ground for fungi.

While farmers recognize the signs of disease, they do not always associate the leaf symptoms (which they refer to as a 'rain disease') with root rot (a 'soil disease'). They also confuse the symptoms and effects of root rot with those caused by other diseases or pests, such as the bean stem maggot. All of this makes it difficult for them to take appropriate control measures.



Above: This field shows the tell-tale signs of chlorosis: a yellowing of the leaves that indicates that below the ground, roots are rotting due to fungi, preventing plants from taking up the nutrients they need. **Photo: N. Spence**



Above: This plant's roots display symptoms of root rot, one of the most serious threats to food security among poor, smallholder families in southern and eastern Africa. **Photo: N. Spence**

Not one but many solutions

The fungi that cause root rot depend on a variety of factors to survive and grow. In much the same way, control of this deadly disease involves several steps.

Detection and identification of the fungi

The first step in combating root rot is to work out, in a given location, just which of the many known fungi are causing the problem. Using modern techniques, researchers have developed fast, reliable tools that allow them to analyze soil samples and diagnose which fungi are present, as well as how they interact among themselves and with other pests and diseases. Modern tools can also tell researchers the amount of fungi present in the soil. This, in turn, helps them to decide which management measures will produce the best results.

Developing resistant or tolerant varieties

Once scientists know just what fungi are causing the problem, they can develop or select varieties with resistance to these pathogens. Farmers repeatedly name resistance as their preferred control strategy, and have also been active partners in testing and selecting a range of varieties with improved tolerance or resistance to root rots. The use of these varieties, in combination with other control measures, gives good results.

Unfortunately, because many of the resistant varieties are smaller than traditional ones, or have darker seeds, they are often rejected by farmers.

Control of this deadly disease **involves several steps**



Above: Trials have helped researchers develop resistant varieties and work out the best ways to manage bean crops to avoid devastating root rot disease.
Photo: N. Spence



Not one but many solutions *cont.*

Women, nonetheless, have found that these beans are not only high-yielding, but also tasty. They have got round their 'negative' characteristics by roasting them and then grinding them into flour before mixing them into foods. This has the added advantage of allowing the bean flour to be stored for longer periods of time than fresh beans. It also means that cooking times are shorter.

Spotting the hosts

Beans are grown together with many other crops. This means that once the fungi causing root rot have been identified, it is important to work out which other plants they can infect. Sorghum, millets and peas can be hosts of root rot, even if they do not show symptoms. Not planting bean crops in the same fields as host plants can help to reduce the build-up of fungi in the soil, and thereby the spread of the disease.



Above: A typical intercropped field where bean is grown with maize and peas. Peas can be root rot hosts, even if they don't show any symptoms.

Photo: N. Spence

Soil management

Rotation is an important management tactic. Because mixed cropping is common among smallholders in Africa, it is relatively easy for farmers to control the growth of fungi by ensuring that bean crops—or other host crops—are not planted in the same field in successive seasons.

Fertilizers

The use of green manure or farmyard manure helps to improve yields. In the first place, this increases the strength of the plant, and thus its ability to offer resistance to fungi. Also, by increasing soil health, fertilizers reduce the build-up of fungi in the soil. However, while farmyard manure is the most effective and easy to come by, it is not clear what effect it has on the populations of fungi in the soil.

Bean mixtures

Many farmers 'take out insurance' against bean root rot by growing mixtures that include many varieties. While some of the beans in these mixtures may be susceptible to the fungi that cause root rot disease, others will be tolerant or resistant. As a result, farmers know that they will not lose an entire crop to bean root rot. At the same time, mixtures provide variety in families' diets.

Raised beds

Planting on mounds or ridges can also help to control the spread of bean root rot. This is a traditional farmer practice in Africa, although many farmers do not associate its use with the control of the disease.

Bio-control agents

A common soil fungus known as *Mortierella* (isolate MS10) has proved to reduce disease

severity by as much as 100 percent without damaging bean crops. *Mortierella* minimizes the impact of the root-rot fungi on infected plants by improving root development. This allows the plant to absorb more nutrients and grow strong enough to defend itself against the fungi.

Gaining and spreading knowledge

The farmers surveyed said they preferred to learn about root rot in their fields; they were also eager to help spread the word to other farmers. This is why a farmer field school approach is particularly effective in communicating these integrated control measures.



Above: In field schools, farmers express their preferences and help to select varieties, while gaining valuable knowledge—for instance, how to identify root rot and its causes, and how to control it using integrated management techniques. They can then share their knowledge with their neighbours. **Photo:** N. Spence

Planting on mounds or ridges can also help to **control the spread of bean root rot**



Not one but many solutions *cont.*

Community-based seed production

The next step is the development of community-based seed production systems. This type of grass-roots local enterprise can help to make disease-free, resistant or tolerant seed widely available. It can also generate important income for producer communities and improve the lives of local farmers.



Above: Tackling bean root rot means more beans and more income. Photo: E. Minja, Centro Internacional de Agricultura Tropical (CIAT)



Above: Bean roots affected by root rot.
Photo: N. Spence

Tools, guidelines and contacts

If you want to find out more, please contact the **RIU Programme**, NR International, Park House, Bradbourne Lane, Aylesford, Kent, UK, ME20 6SN, riuinfo@nrint.co.uk.

Other resources

In all cases, please copy emails to RIU Information (riuinfo@nrint.co.uk).

For manuals on the identification and quantification of the fungi (*Fusarium solani* f. sp. and *Pythium* species), contact Dr. Nicola Spence, Central Science Laboratory, Sand Hutton, York, YO41 1LZ, UK, n.spence@csli.gov.uk

For extension guides and other materials, contact Dr. Robin Buruchara, Centro International de Agricultura Tropical (CIAT) and Kawanda Agricultural Research Institute (KARI), P.O. Box 6247 Kampala, Uganda, r.buruchara@cgiar.org.

Or, visit the CIAT website, <http://www.ciat.cgiar.org>

Further contacts:

Dr Fino Opio and Dr. Michael Ugen
Namulonge Agricultural and Animal Research Unit (NAARI)
National Agricultural Research Organisation (NARO)
P.O. Box 7084, Kampala, Uganda

About this series

Research into Use *Pocket Guides* showcase new technologies that have been tried and tested, and have proven successful in the field. They were produced to demonstrate the importance of high-quality scientific communication.

This *Pocket Guide* was developed from research funded by the UK Department for International Development (DFID), Crop Protection Programme (Projects R7568, R8316 and R8478). The views expressed are not necessarily those of DFID.

RIU is managed by Natural Resources International Ltd., in partnership with Nkoola Institutional Development Associates Ltd. (NIDA) and Michael Flint and Performance Assessment Resource Centre. RIU is funded by DFID.

www.researchintouse.com

The *Pocket Guide* series was developed, written, designed and printed for RIU by SCRIPTORIA (www.scriptoria.co.uk).



Tackling bean root rot means **more beans and more income**

