AFRICA: BEAN PATHOLOGY

Activity 1. Characterization and distribution of *Pythium* spp causing root rots in Eastern Africa.

Introduction

In the development of management strategies for Pythium root rot, characterization of *Pythium* species associated with the disease and determination of their distribution in the region is important. Besides the information is useful as a basis for developing rapid detection and characterization techniques for *Pythium* spp pathogenic to beans. Last year we showed that there are Pythium species other than those commonly known and reported before, that are pathogenic to beans. This indicates the need to assess pathogenicity of species associated with beans to establish their potential role in the root rot problem. We therefore continued with the characterization Pythium spp, using molecular methods, carried out pathogenicity studies and developed species distribution maps for Uganda.

Methods: Last year we grouped Pythium isolates into several RFLP groups using PCR/RFLPs analysis. On the basis of the groupings we selected representative candidates for sequencing. Sequencing of PCR fragments were done using an ABI prism automated sequencer. The sequences obtained were edited and compared to known *Pythium* species from the *Pythium* database managed by Dr A. Levesque.

To determine pathogenicity of species characterized on the basis of sequencing, seed of susceptible and resistant cultivars CAL 96 and RWR 719 respectively, were planted in trays containing soil infested with each of the isolates representing new characterized species. The soil was maintained under conditions, which favour pathogen establishment and disease development. Plants were evaluated after 4 weeks using the method described above (under section 2.1.1).

Results and Discussion: Thirty isolates characterized by sequencing were grouped into 12 Pythium species **(Table 1)**, 7 of which were new additions (*Pythium zingiberum, P. indigoferae, P. paroecandrum, P. conidiophorum, P. chamaehyphon, P. graminicola, P. perrilum)* to those characterized last year giving a total of 19 species that we have so far associated with bean samples collected from areas in Kenya, Uganda, and Rwanda where root rots is a serious problem.

In pathogenicity studies we only considered isolates representing the 7 species identified. Isolates belonging to *P. ultimum* var *ultimum*, *P. spinosum, P. graminicola*, and *P. paroecandrum*, tested, caused severe root rot on susceptible bean cultivar CAL 96. However, RWR 719 remained resistant. The pathogenicity of *P. graminicola*, and *P. paroecandrum* species is a demonstration of the potential of these species in causing root rots on beans. Their importance depends on their distribution and levels of inoculum in the soil. The fact that some of the species pathogenic to beans are known pathogens of other crops (maize or sorghum) in the existing cropping system indicate the probable role of crops intercropped or grown in rotation

with beans, in contributing to the importance of root rots. Studies are being initiated to establish the role and significance of other crops in bean based system in contributing to the current status of bean root rots.

Table 1. Identification and classification of *Pythium* isolates collected from bean growing areas in Uganda, Kenya and Rwanda

Species	Number of isolates	Comments
Pythium ultimum	5	
Pythium irregulare	1	
Pythium spinosum	4	
Pythium torulosum	2	
Pythium vexans	1	
Pythium zingiberum	4	
Pythium indigoferae	4	
Pythium paroecandrum	1	
Pythium conidiophorum	3	
Pythium chamaehyphon	1	
Pythium graminicola	3	
Pythium perrilum	1	

Species distribution maps **(Figures 1a, b, c)** show that *P. ultimum* var *ultimum* is the most frequently recovered isolate in the three regions (Kabale, Kisoro and Sironko) surveyed in Uganda. This was closely followed in Kabale by *P. salpingophorum*, in Kisoro by *P. torulosum* and in Mbale & Sironko by *P. vexans*. It is significant to note that, in addition to *P. ultimum* , *P. salpingophorum*, and *P. torulosum* where shown to be pathogenic to beans as well.

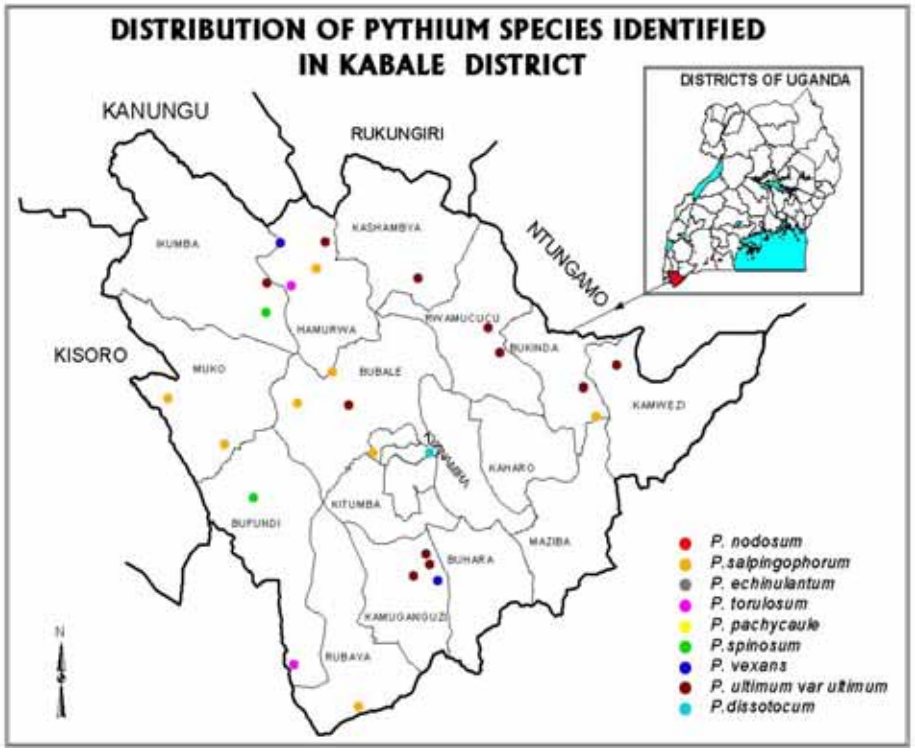

Figure 1a.

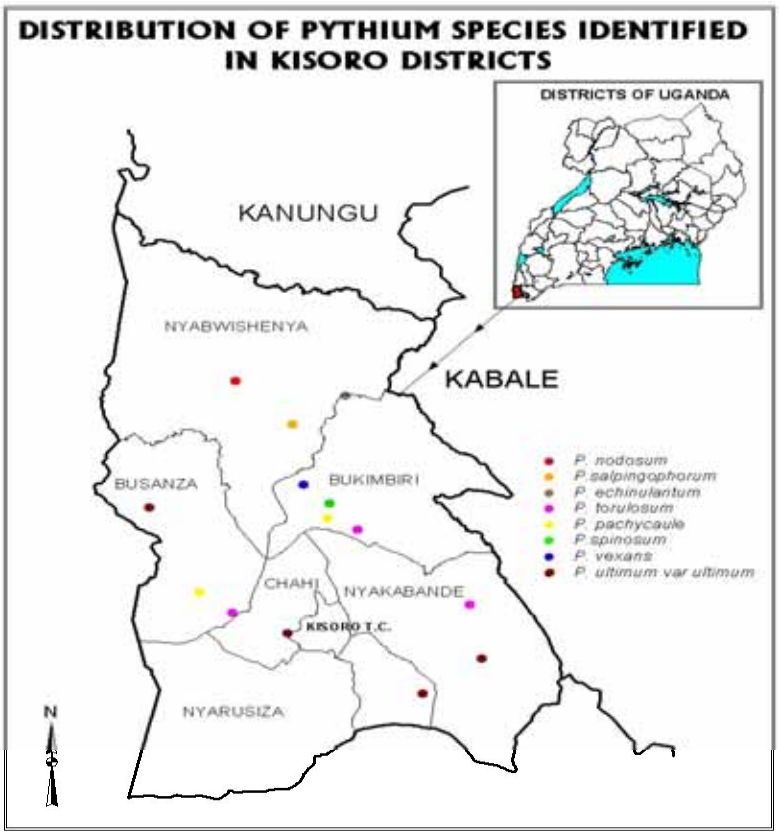

Figure 1b.

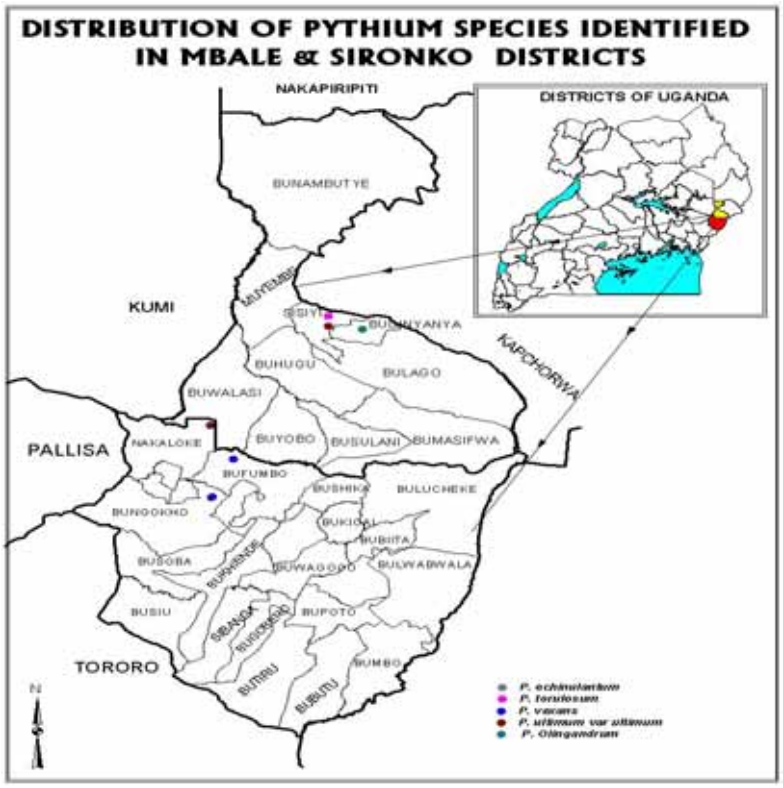

Figure 1c.

Contributors: J. Mukalazi (graduate student), R. Buruchara, S. Mayanja, G. Mahuku, F. Opio.

Collaborators: J. Carder, N. Spence, E. Adipala.

Progress towards achieving output milestones

- Characterization of thirty Pythium isolates by sequencing of IT1 region was done. Two species not considered to be pathogenic to beans were found to cause disease on beans.
- Pythium distribution maps showing relative importance of characterized species in Uganda was developed. Maps for Kenya and Rwanda will be done when characterization is complete.

Activity 2. Effect of organic amendments on bean Fusarium root rot disease and soil inoculum levels.

Introduction

Following the development of a quantification method for *F. solani* f.sp *phaseoli,* inoculum in the soil, we initiated studies last year to evaluate the effects of organic amendments on disease severity, pathogen population and plant growth. Preliminary results we obtained showed that different organic amendments have different effects on the three parameters. The objectives of the current studies were to confirm these observations and to further validate the quantification method as a basis for evaluating more IDM options.

Materials and Methods: Trials were set up both in the screenhouse and in the field in southwest Uganda. In the screenhouse, soils in wooden trays were infested with 3000 conidia of *F. s.* f. sp. *phaseoli* per gram of soil. Infested soil was then amended with farmyard or *Calliandra* green manures and left for about 2 weeks before planting K20 (susceptible) and RWR 719 (resistant) bean varieties. A similar trial was set up in the field in southwest Uganda with a history of root rot disease. In both the field and screenhouse trials, organic amendments were made at a rate of 10t/ha. Progress of root rot and soil inoculum levels were monitored at two weeks intervals.

Results and Discussion: In both the screenhouse and field trials, root rot severity was suppressed by *Calliandra* green manure, while being enhanced by farmyard manure. Similarly, the pathogen inoculum levels were highest in farmyard manure, followed by the control, and least in green manure amended soils. On the contrary, dry matter production (yield) was highest in farmyard manure amended soil. Whereas *Calliandra* green manure reduced *F. s.* f. sp. *phaseoli* inoculum levels and disease severity, farmyard manure increased both **(Figures 1a, b)**. These results confirm previous observation (CIAT, 2002). Even though farmyard manure resulted in the increase of dry matter production and grain yield, its effect on increasing inoculum is a negative contribution in the long-term management Fusarium root rot. There is therefore need to identify soil amendments or combinations that reduce soil inoculum population and disease severity but at the same time improve soil fertility and yield.

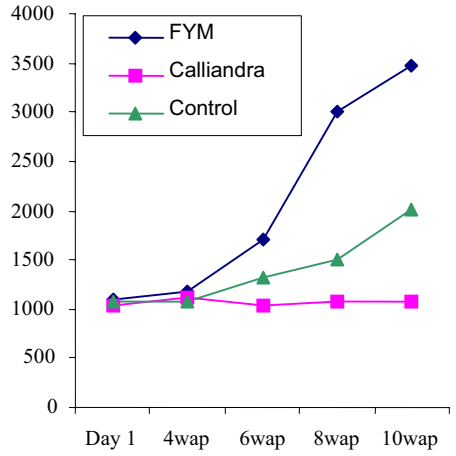

Figure 1a. Changes in soil inoculum levels of *Fusarium solani* f. sp. *phaseoli* in soils amended with farmyard manure or with *Calliandra* spp green manure, Kabale, Uganda, 2003.

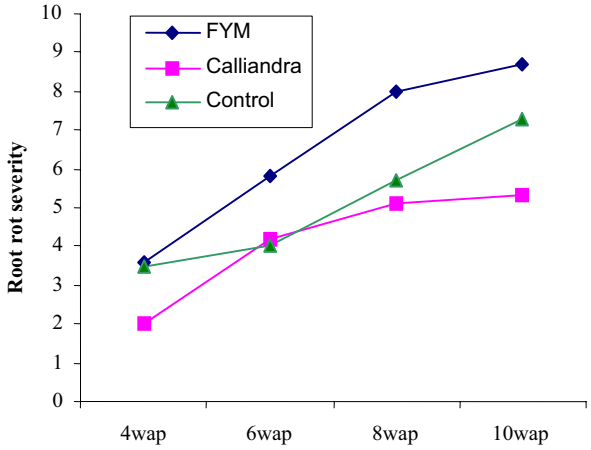

Figure 1b. Progress of Fusarium root rot disease on beans growing in soil amended with farmyard manure or with *Calliandra* spp green manure. Kabale, Uganda, 2003.

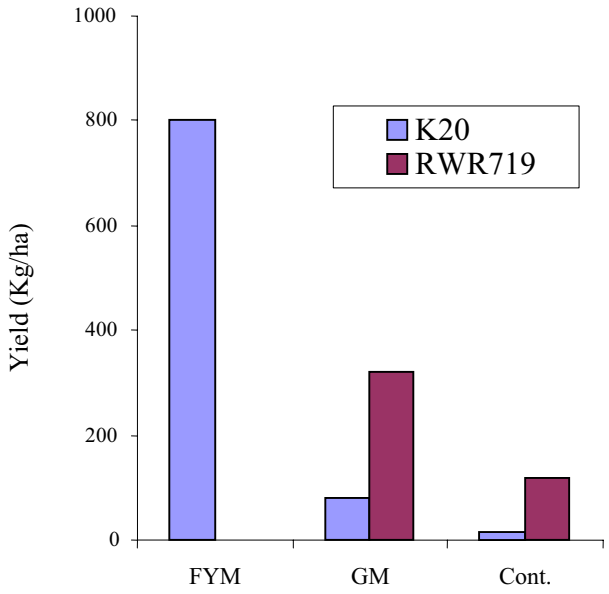

Figure 2c. Effect of organic amendments on yield of K 20 and RWR 719, susceptible and resistant bean varieties to *F. s.* f. sp. *phaseoli* respectively, Kabale, Uganda, 2003.

Contributors: G. Tusiime (graduate student), R. Buruchara, F. Opio

Collaborators: J. Carder, N. Spence, E Adipala.

Activity 3. Development and use of dilution plating method to quantify the effect of organic amendments on the inoculum levels of Pythium spp and severity of Pythium root rots.

Introduction

Population levels of soil borne pathogens influence incidence and severity of root rots. Some of the management efforts focus on reducing inoculum below economically damaging threshold levels (Buruchara and Scheidegger, 1993). Disease severity is not a good measure of the effect of management practices on soil pathogen populations because environmental factors and stage of plant growth play a critical role in disease expression and severity. There is, therefore, a need to develop a protocols to identify and quantify the effect and relative value of different management practices on inoculum levels of pathogenic *Pythium* spp. This however requires development of procedures to quantify soil inoculum. Excellent selective media exist for studying *Pythium* spp (White, 1988) and which could permit use of dilution plating in quantifying inoculum level of the fungi in the soil. The limitation of using dilution plating is that it does not distinguish between pathogenic and non-pathogenic species of *Pythium*. This study was therefore undertaken to develop a dilution-plating method in combination with molecular detection techniques to assess inoculum levels of *Pythium* spp pathogenic to beans. We hereby report studies to develop and assess the dilution plating procedure**.**

Materials and Methods: We used corn meal agar (CMA) amended with 30 mg/L of rifamycine and 75mg/L of pimaricin in 9-cm diameter petri-dishes. Soil artificially infested with Pythium ultimum var ultimum isolate (MS 41) pathogenic to beans (variety CAL 96), was used in the validation of the dilution plating procedure. Two grams of infected soil was dissolved in 100 ml of sterile distilled water in a 200 ml flask. Four soil samples from infected bean fields were also included for comparisons. Flasks were shaken on orbital shaker for 3 hours at 160 rpm. For each of the sample 0.7 ml of the suspension was evenly spread on plates (6 per sample) containing CMA and later dried in the flow isolation bench before they were covered and incubated at room temperature (20-26^{0}C) for 1-2 days.

Colonies growing on media were checked after about 20 hrs in the first day to score for the fast growing *Pythium*, and then the 2nd and 3rd day for slow ones, especially those from naturally infected field soils. The mean number of colonies per plate was relatively uniform and ranged between 5 - 8 for artificially inoculated soil, and 3 - 5 for naturally inoculated field soil. Colony forming units per gram of soil were later computed to estimate *Pythium* population in the soil as 350 - 570 and 210 – 350 cfu/gram, for artificially and naturally infected soils, respectively. Uniform colony types were observed for samples of the artificially inoculated soil, but 2 – 3 types of colonies were on plates containing samples from the naturally infected field soils suggesting occurrence of different *Pythium* species. Samples of different colonies were sub-cultured for further identification using molecular techniques. The colony types and numbers were found to be consistent for all the twelve sets tested. This method of *Pythium* quantification and detection of *Pythium* in soil was adopted for the subsequent studies on evaluation of the effects of soil amendments on *Pythium* population levels reported below.

Screenhouse trials: Seed of bean varieties CAL96 (susceptible) and RWR 719 (resistant) to Pythium root rot were sown in wooden trays containing soil that had been artificially infested with isolate MS 61 (*P. ultimum* var *ultimum*) to give pathogen concentrations of between 200 and 300 cfu.g^{-1}. Farmyard manure and *Calliandra* green manure were incorporated into the soils at rates of 10 tons/ha. Pythium populations were monitored every two weeks from the date of amendment incorporation through harvesting time using the dilution plating protocol (above). Disease progress in the two varieties was also recorded every two weeks.

Field trials: A field trial similar to the screenhouse one was set up to examine the effects of soil amendments under field conditions. Green manure from *Calliandra* spp or farmyard manure (each at 10 tons.ha^{-1}) was incorporated into randomly chosen plots. The 'control' plots received no amendments. Two weeks after the amendments had been incorporated, beans of the same two varieties (CAL 96 and RWR 719) were planted. Soil samples were collected every two weeks and Pythium populations were quantified. Disease progress in the two varieties was also recorded every two weeks

Results and Discussion: In the screenhouse where *P.ultimum* var *ultimum* was the only pathogen present our studies showed that inoculum population (in all treatments) tended to increase between the 4th and 6th week of the experiment and then declined over the remaining 10 to 8 weeks **(Table 1)**. Population numbers were also affected by the addition of organic amendments; both types causing some increase relative to the control. These relative changes in pathogen populations were mirrored by similar changes in disease severity ratings over the first 6–8 weeks but not thereafter. Farmyard manure caused a slight increase in disease in the susceptible variety. There, disease severity continued to increase throughout the duration of the experiment despite the decreases in pathogen population.

Table 1. Effect of organic amendments on population (cfu per g of soil) changes of *Pythium ultimum* var *ultimum* over a period of 14 weeks using two bean varieties (CAL96-susceptible and RWR 719-resistant), in the screnhouse, Kawanda, Uganda.

		Wks after plating							
Variety	**Soil amendment**	**Start**	**2**	**4**	**6**	**8**	**10**	**12**	**14**
CAL 96									
	Green manure	305.0	381.0	643.0	745.0	533.0	595.0	614.0	436.0
	Farmyard manure	262.0	333.0	476.0	745.0	640.0	716.0	597.0	566.0
	Control	283.0	309.0	333.0	438.0	267.0	376.0	531.0	459.0
RWR 719									
	Green manure	250.0	286.0	452.0	519.0	348.0	524.0	511.0	336.0
	Farmyard manure	309.0	405.0	571.0	1038.0	634.0	745.0	556.0	633.0
	Control	336.0	452.0	690.0	343.0	318.0	745.0	412.0	276.0
LSD (P= 0.05)		140.1	239.1	268.0	347.3*	169.6**	353.7	455.2	356.0
CV (%)		11.5	6.9	7.9	23.1	4.9	8.1	36.4	31.0

LSD: * and ** significant at 5 and <1% respectively. Values without star are not significant at 5%

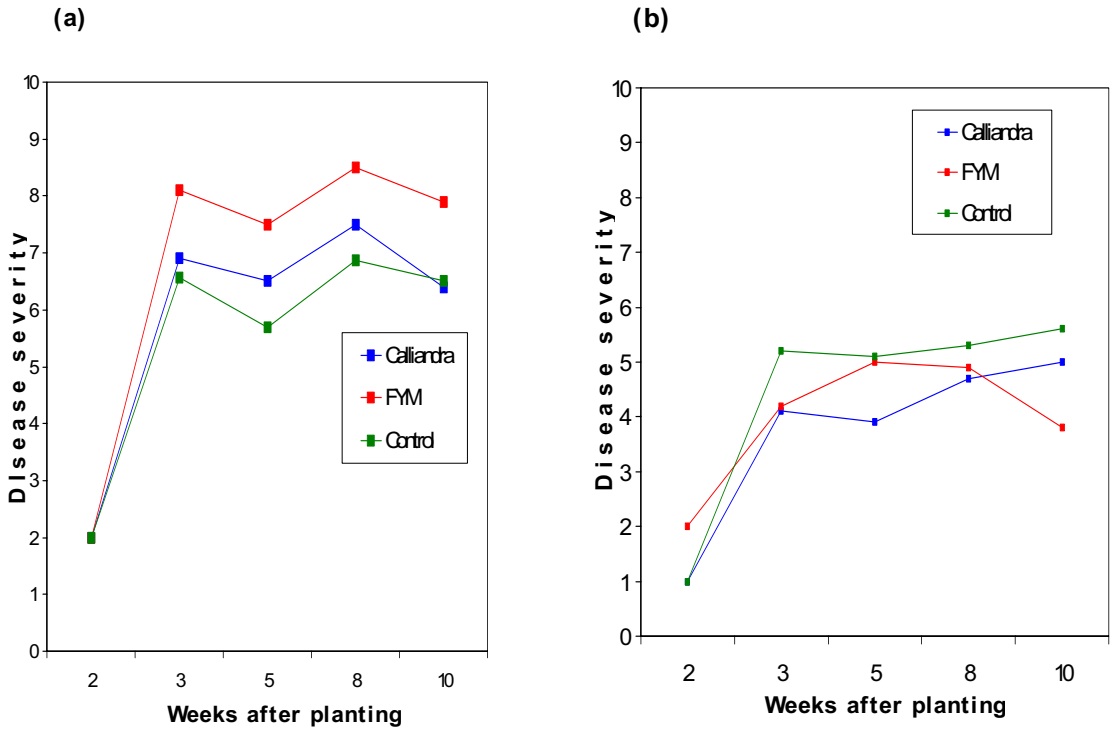

Figure 1a, b. Disease progress in the susceptible variety CAL 96 (a) and the resistant variety RWR 719 (b) and the effect of soil amendments in the screenhouse at Kawanda.

Table 2 show that population numbers of Pythium spp under field conditions was relatively lower, constant throughout the experiment and generally unaffected by the amendments. This is in contrast to the continued increase in disease severity observed **(Figure 2a, b)**. The differences seen between the screen house and field experiments may well be due to more complex interactions expected in a field situation compared to the more controlled screenhouse environment. Furthermore, only *P. ultimum* var *ultimum* was present in the screen house experiment whereas a vast range of microorganisms and Pythium spp are likely to be found in field soils. It is however not possible to correlate population of Pythium with severity as the inoculum may well have different species some of which may not be pathogenic or may be acting synergistically. Distinction of the different species isolated from field samples is underway using molecular methods. This will permit assessing the effects of organic amendments on the population of pathogenic species and also correlate the later with disease severity. The dilution plating method only enabled us to assess total Pythium population in soil. However, the method is limited if the interest is on specific (e.g. pathogenic) types. Efforts are underway to develop real time molecular-based quantitative assay for important pathogenic Pythium species.

Table 2. **Effect of organic amendments on population (cfu / g of soil) changes of *Pythium* spp over a period of 14 weeks using two bean varieties (CAL96-susceptible and RWR 719-resistant), under field condition, Kabale, Uganda.**

		Wks after plating							
Variety	**Soil amendment**	**Start**	**2**	**4**	**6**	**8**	**10**	**12**	**14**
CAL 96									
	Green manure	131.0	155.0	231.0	107.1	192.8	174.0	128.5	121.4
	Farmyard manure	107.0	107.0	226.0	95.2	109.5	138.0	126.1	176.1
	Control	124.0	155.0	181.0	126.1	102.3	150.0	147.6	119.0
RWR 719									
	Green manure	102.0	107.0	126.0	102.3	164.2	114.0	149.9	90.4
	Farmyard manure	114.0	145.0	131.0	107.1	114.2	188.0	142.8	123.8
	Control	90	143.0	143.0	90.4	142.8	164.0	145.2	107.1
LSD (P= 0.05)		79.4	97.5	11.7	57.6	76.6	105.7	45.2	67.0
CV (%)		11.3	27.2	13.0	18.3	14.0	10.2	12.4	7.3

LSD: * and ** significant at 5 and <1% respectively. Values without star are not significant at 5%

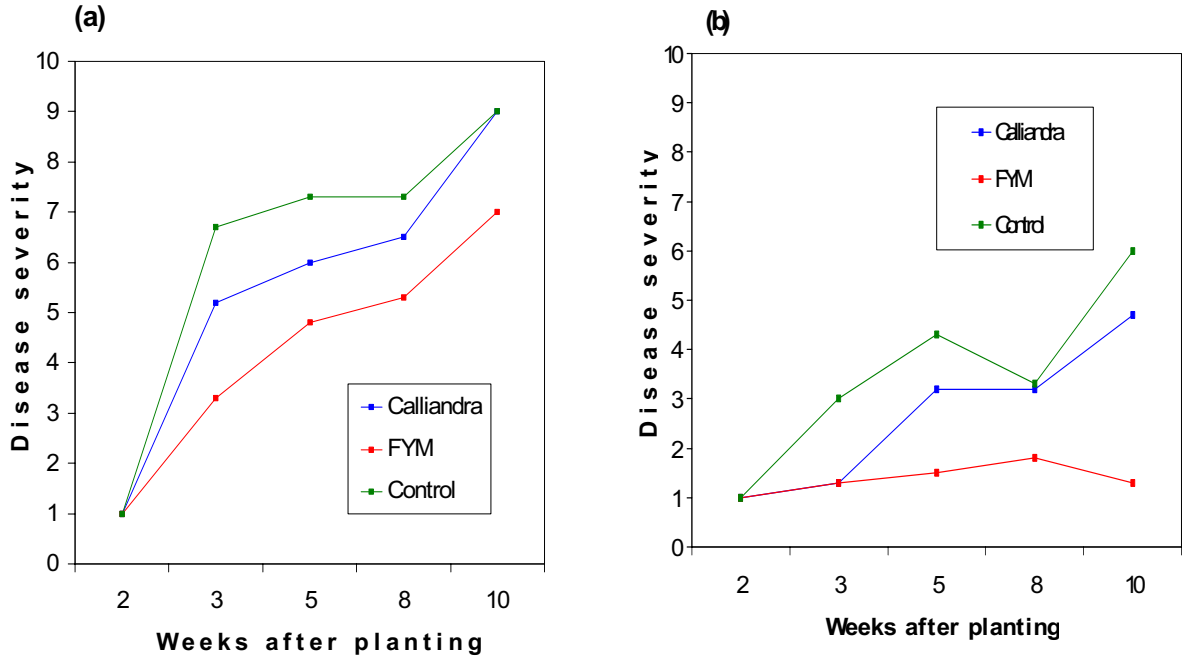

Figure 2a, b. **Disease progress in the susceptible variety CAL 96 (a) and the resistant variety RWR 719 (b) and the effect of soil amendments in the field at Kabale.**

Contributors: J. Mukalazi (graduate student), R. Buruchara, F. Opio, M. Ugen.

Collaborators: J. Carder, N. Spence, E. Adipala.

Activity 4. Scaling-up of IPM bean based technologies.

Introduction

Various traditional pest management technologies have been developed by different bean based farming communities in eastern, central and southern Africa. Some of these communities have also participated in the development of improved pest management technologies with researchers and extension agents. Most of these technologies have remained at the pilot sites where they were developed. While more technologies are being developed, dissemination approaches that combine farmer field school and participatory processes are been used at pilot sites in Kenya, Tanzania, Malawi, Rwanda and Uganda to increase awareness and adaptation of the availability of IPM technologies as well as develop capacity and skills in national research and extension service provision. Efforts are now required to scale up and scale out the approaches and processes to the wider audience.

Methods: The bean IPM project on participatory development and promotion in eastern and southern Africa, aims at scaling up and scaling out the approach developed by CIAT in northern Tanzania to Kenya, Malawi, Rwanda, Uganda and the southern highlands of Tanzania. The ECABREN and SABRN Networks have also linked their IPM subprojects to this activity and are funding the extension of project activities to Madagascar, Mozambique, Sudan and the Democratic Republic of Congo. Collaborative links have been established with National Ministries of Agriculture, NGOs and some CBOs (World Vision- WV, Adventist Development and Relief Agency -ADRA, Concern Universal- CU, Farm Africa - FA and Community Mobilisation Against Desertification- CMAD) as well as other community service providers (seed companies, religious organizations, general traders, etc.).

Participating farmer group representatives, village and district extension officers, adult education teachers, health and community leaders were trained in IPM approaches and processes (pest biology and ecology, principles of participatory approaches and community group dynamics. Farmer groups in collaboration with research and extension agents established bean seed multiplication gardens of pest tolerant genotypes (bean stem maggots and root rots) near their homesteads during the short rain season and under irrigation (September- January depending on location). The harvested seed was used to establish learning and demonstration plots as well as individual farmer fields during the long rain season (December– June depending on location). Site activities were led by farmer groups and meetings were planned and chaired by farmers. CIAT and the national researchers back stopped farmer activities and responded to farmer demands channeled through the extension service.

Results: Farmer empowerment was strengthened and scaled up at project sites in Tanzania, Kenya and Malawi. Project plans and activities in Kisii and Rachuonyo (Kenya), Hai, Lushoto and Mbeya (Tanzania) and Dedza (Malawi) were led by farmer groups (both men and women holding key positions in decision making at group, village and district levels). Farmers demanded different services depending on the location. Such services included training in various aspects including the search for market information, soil fertility and livestock management, facilitation in cross site visits, supply of farm inputs and credits, etc. Farmers have also demanded to be facilitated to disseminate their IPM message to the wider audience. It was

through this initiative that two Hai district women farmers each participated in two different regional workshops (one on science and technology in agriculture and another on bean network priority setting). Farmers groups in Hai were assisted by the district and World Vision to form and registered their association (MUVIMAHA- Muungano wa Vikundi vya Maendeleo Wilaya ya Hai, i.e. Union of Development Groups in Hai District). MUVIMAHA will facilitate members with different services including farm inputs, savings and credits, market information, etc.

Farmers in Kenya and Tanzania were facilitated by the project and other stakeholders to conduct cross site visits within their countries. New farmer groups have been formed in both countries. Representative farmers from western Kenya (Kakamega) toured project sites in southwestern Kenya (Kisii). Farmers from Arumeru and Babati districts visited Hai while farmers from Mbeya visited Mbozi district farmer groups. Five farmers from Malawi (2 men, 3 women) were facilitated by SABRIN and the project to conduct a learning, sharing and exchange visit to farmer groups in the southern highlands of Tanzania.

Additional extension materials were prepared (leaflets, posters, farmer activity reports and proceedings of project evaluation workshop). Four leaflets and two posters are in Kiswahili. The translation, editing and printing of the pest handbook was completed. New village information centres (VICs) were set up by farmer groups and community leaders in Kenya and Tanzania and were stocked with extension and other relevant materials. Other ministries (e.g. Education and Health) have supported and contributed to setting up VICs.

Contributors: E. Minja, H. Mziray, K. Ampofo, J. Ogecha, D. Kabungo and C. Madata.

Collaborators: M. Pyndji (ECABREN), R. Chirwa (SABRIN), E. Ulicky (Hai district), F. Ngulu (SARI), B. Chibambo (CU), A. Masam (WV), Y. Mbwana (ADRA), D. Ngowi (FA).

Progress towards achieving output milestones

- A bioassay method developed to quantify soil inoculum of *F. solani* f.sp *phaseoli* offers a opportunities to assess the effects of IDM options on pathogen population.
- Dilution plating method that allows quantitative measurement of total Pythium population was developed. But its utility will be enhanced if combined with fast detection procedures.
- Quantification studies of *F. solani* f.sp *phaseoli* and Pythium species show that organic amendments may have a positive effect on the crop growth and yield while having a negative influence (increase) on soil inoculum. Efforts will continue to identify management approaches that would increase plant growth but reduces pathogen populations.

Activity 5. Publications, Conferences, Workshops, Training, Students.

Refereed Journals

Wagara, I. N., Mwangómbe, A. W., Kimenju, J. W., Buruchara, R. A., Jamnadass, R. and Majiwa, P.A.O. 2003. Genetic diversity of *Phaeoisariopsis griseola* in Kenya as revealed by AFLP and group-specific primers. Submitted to Journal of Phytopathology

Conferences

1. Buruchara, R.A., Bua, B., Otsyula, R. Opio, F. and Kimani 2003. Sources of resistance in common bean (*Phaseolus vulgarism* L.) to Pythium root rot caused by *Pythium spp* in eastern and central African highlands
2. Buruchara, R. A. 2003. Integrated Disease Management In Food Legumes. Presented at the Second National Review Workshop on Food and Forage Legumes 22 – 26 September 2003, Addis Ababa, Ethiopia.
3. Macharia, R. D., P.M. Kimani, R. Buruchara and J. W. Kimenju. 2003. Breeding red mottled and red kidney bean cultivars resistant to anthracnose, angular leaf spot and tolerance to low soil fertility. Presented at the Afr. Crop Science Conference, 12-17 Oct 2003, Nairobi, Kenya.
4. Kimani, P.M., R. Buruchara, R. Otsyula, G. Rachier and R.D. Macharia. 2003. Breeding bean cultivars resistant to angular leaf spot, root rots and low soil fertility in East and central Africa. Presented at the Afr. Crop Science Conference, 12-17 Oct 2003, Nairobi, Kenya.
5. Musoni, A., Kimani, P.M., R.A. Buruchara, R.A., R.D. Narla and I. N. Wagara. 2003. Breeding marketable climbing beans resistant to angular leaf spot, Pythium root rot, anthracnose and Fusarium wilt. Presented at the Afr. Crop Science Conference, 12-17 Oct 2003, Nairobi, Kenya.
6. Wagara, I. N., A. W. Mwang'ombe, J. W. Kimenju, R. A. Buruchara and P.M. Kimani. 2003. Pathogenic variability in *Phaeoisariopsis griseola* and response of bean germplasm to different races of the pathogen. Presented at the Afr. Crop Science Conference, 12-17 Oct 2003, Nairobi, Kenya.
7. Otsyula, R., R. Buruchara, P. Rubaihayo and P. M. Kimani. 2003. Inheritance of resistance to Pythium root rots in bean genotypes (Phaseolus vulgaris L.). Presented at the Afr. Crop Science Conference, 12-17 Oct 2003, Nairobi, Kenya.
8. Mukalazi, J., Adipala, E., Buruchara, R., Carder, J., Opio, F. and Spence, N.J. Variation and identification of *Pythium* species associated with bean root rot disease in Uganda.
9. Tusiime, G., Buruchara, R., Adipala, E., Carder, J., Spence, N. and Opio, F. 2003. Variation of *Fusarium solani* from beans with root rot symptoms inferred from AFLP analysis, pathogenicity and DNA sequences.
10. Namayanja, A. R. Buruchara, P. Rubaihayo, S. Mayanja. 2003. Validating the utility of angular leaf spot resistance linked markers for marker assisted breeding in common bean. Presented at the Afr. Crop Science Conference, 12-17 Oct 2003, Nairobi, Kenya

Graduate student supervision
Completed M. Sc

Annet Namayanja – M.Sc, Makerere University, Uganda: Inheritance And Marker Assisted Selection For Angular Leaf Spot *(Phaeoisariopsis griseola*) Resistance in Common Bean" at Kawanda, Uganda.

Continuing

Geoffrey Tusiime – PhD, Plant Pathology, Makerere University, "Variation and detection of *Fusarium solani* f.sp *phaseoli* and quantification of soil inoculum in common beans".

Julius Mukalazi, PhD, Plant Pathology, Makerere University, Pathogenic variation and quantification of Pythium species of beans in Uganda".

Stephen Mayanja, MSc, Plant Pathology, Makerere University, "Characterization of pathogenic diversity of *Phaeoisariopsis griseola* in Uganda"

Reuben Otsyula, Plant Breeding, Makerere University. "study of inheritance and development of root rot (Pythium) resistant varieties using marker assisted selection in common beans"

Clare Mukakunzi, PhD Plant Pathology/Breeding University of Natal. "Breeding beans (*Phaseolus vulgaris* L.) for resistance to Fusarium root rot (*Fusarium solani f*.sp *phaseoli*) in Uganda"

Augustine Musoni, Plant Breeding, University of Nairobi: "Breeding for resistance to Fusarium wilt"

Wagara Isabel: "Molecular and virulence characterization of *Phaeoisariopsis griseola* and reaction of bean germplasm races of the ALS pathogen.

Mathias Zulu, Plant Pathology, University of Zambia. "Bean anthracnose *(colletotrichum lindemuthianum)* study and determination and distribution of races prevalent in Zambia"

Workshops and Conferences

1. Biofortification Planning Meeting, 12-18 Feb Kisumu, Kenya
2. Wider impact planning workshop, March, Kawanda, Uganda
3. Participatory Plant breeding Workshop, March 2003, Kawanda, Uganda
4. PABRA Steering Committee Meeting, 26-29 May 2003, Kabale, Uganda.
5. Good Seed Initiative Workshop, 4 - 7 June Morogoro, Tanzania.
6. ECABREN problem analysis workshop, July 2003, Naivasha, Kenya
7. ECABREN stakeholders priority setting workshop, 13- 19 July 2003, Nairobi, Kenya
8. Participatory breeding Planning Meeting, 15-16 Sep 2003, Kawanda, Uganda.
9. The Second National Review Workshop on Food and Forage Legumes, 22-26 September 2003, Addis Ababa, Ethiopia.
10. Biofortification Challenge Program-Bean Planning Meeting, 1-4 Oct, 2003, Naivasha, Kenya.
11. SABRN Steering Committee meeting, 7 –11 October 2003. Potchefstroom, South Africa.
12. African Crop Science Conference, 13-17 Oct 2003, Nairobi, Kenya.

Regional travel

1. Rwanda –March, June and September 2003.
2. Tanzania – April, June
3. Malawi – March 2003

4. Uganda, - Kabale, May, June
5. Zambia - March 2003
6. Colombia – PRGA meeting, 30 Sept –3 July 2003
7. Kenya – February, April, May, July, September.

Proposal/Concept notes developed

1. "Scaling up and scaling out bean IDPM promotion activities including pest tolerant and improved high yielding bean genotypes" and extension phase to DFID.
2. "Bean root rot disease management in Uganda" extension phase to DFID.
3. "Strengthening Research & Development for Increased and Sustainable Agricultural Productivity, Improved Food Security and Nutrition, and Income of Rural and Urban Populations in East and Central Africa" for ECABREN to USAID via ASARECA.

Project submitted and funded

Donor	Project	Duration of current funding
CIDA (Canada)	Pan-Africa Bean Research Alliance	2000-2002
HRI (from DFID)	Epidemiology of bean root rots	2000-2003
Rockefeller Foundation	Genetic Improvement of Bush and Climbing Beans	2001-2003
SDC (Switzerland)	Pan-Africa Bean Research Alliance	1998-2001 2001-2004
USAID (USA)	Eastern and Central Africa Bean Research Network	1998-2003

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Collaborators Partners:

National Programs: Democratic Republic of Congo, Ethiopia, Burundi, Rwanda, Uganda, Kenya, Tanzania, Sudan, Madagascar, Malawi, Zimbabwe, Leshoto, Mozambique, Republic of South Africa, Swaziland, Angola, Zambia.

***Universities*:** University of Nairobi, Makerere University, Moi University, Bunda College, University of Alemaya, Sokoine University, University of Zimbabwe

NGO: World Vision International -WVI (Tanzania), AfriCare - Uganda, Catholic Relief Services, Resource, ADRA-Tanzania, Farm-Africa, Adventist Development and Relief Agency – ADRA (Tanzania), Concern Universal –CU (Malawi) and Community Mobilization Against Desertification –CMAD (western Kenya). Plan International-Malawi; Pelum; Lay Volunteers International Agency and Christian Council of Tanzania,; Harvest Help, CARE International; Rural Farm Alternative Organization,- Kenya.

***CBO and Regional Institutions*:** ASARECA, Food, Agriculture and Natural Resources,

Governmental Institutions: Zonal Communication Centre (ZCC), in the Ministry of Agriculture and Fisheries, Tanzania.

***Europe Institutions*:** Horticultural Research International (HRI)(UK), NRI (UK), Agri-Food and Food Canada (Canada).

Institutional Abbreviations

AHI	African Highlands Ecoregional Programme (led by ICRAF)
ARC/GCRI	Agricultural Research Council, Grain Crops Research Institute, South Africa
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
AU	Alemaya University, Ethiopia
CARE	(International NGO in Ethiopia, Rwanda, Uganda)
CIDA	Canadian International Development Agency
CU	Concern Universal, Malawi
DARTS	Department of Agricultural Research and Technical Services, MoA, Malawi
DRD	EARO Ethiopian Agricultural Research Organization
ECABREN	Eastern and Central Africa Bean Research Network
FOFIFA	Centre National de la Recherche Appliqué au Développement Rural, Madagascar
HRI	Horticultural Research Institute (UK)
IACR	Rothamsted (UK)
ICIPE	Centre for Research in Agro-Forestry
IBFA	Ikulwe Bean Farmers Association (Uganda)
INERA	Institut National des Etudes sur la Recherche Agronomique, DR Congo
ISAR	Institut des Sciences Agronomiques du Rwanda
KARI	Kenya Agricultural Research Institute
MoA	Ministry of Agriculture
MU	Makerere University, Uganda
NARO	National Agricultural Research Organisation, Uganda
NARS	National agricultural research system
NGO	Non-governmental organization
NRI	Natural Resouces Institute (UK)
PABRA	Pan-Africa Bean Research Alliance

RF	The Rockefeller Foundation
SABRN	SADC Bean Research Network
SACCAR	Southern African Centre for Cooperation in Agricultural and Natural Resources Research and Training
SADC	Southern Africa Development Council