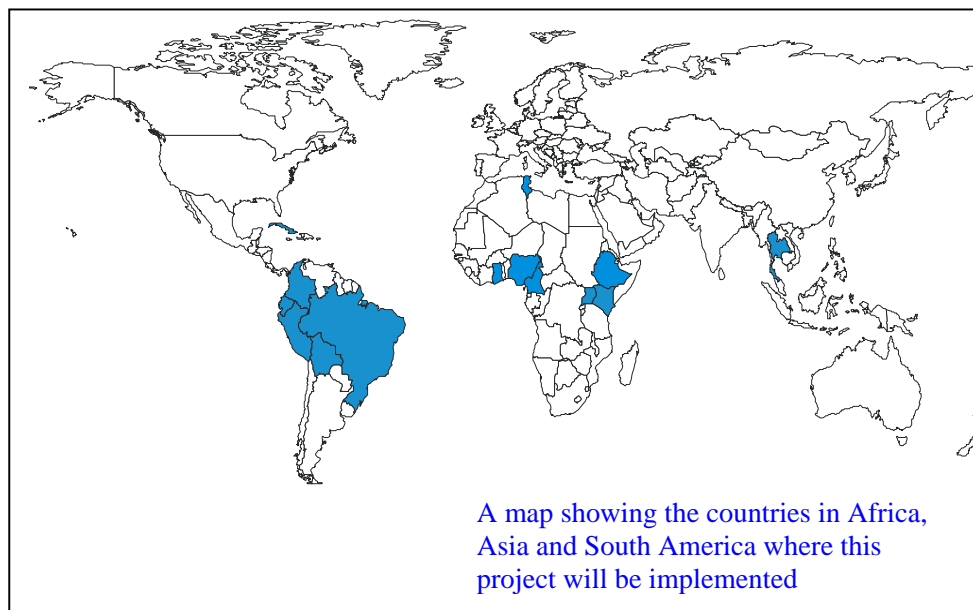


BETTER LIVES FROM HEALTHY SOILS: INTEGRATED PEST MANAGEMENT IN SOILS OF ROOT AND TUBER (CASSAVA, POTATO, SWEET POTATO, YAM) CROPPING SYSTEMS IN THE TROPICS AND SUB-TROPICS



IARC PARTNERS

CIP - International Potato Center

CIAT - Centro Internacional de Agricultura Tropical

ICRAF - World Agroforestry Centre

IITA - International Institute for Tropical Agriculture

CABI - Center for Agriculture and Biosciences International

COORDINATING CENTER:

CIP - International Potato Center

Systemwide Program on Integrated Pest Management (SP-IPM)

A CGIAR global effort to improve livelihood of poor farmers by reducing crop losses and producing more food in a sustainable way

INTRODUCTION

Root and tuber crops are important staple food crops of small-scale farmers in developing countries in a wide range of land use systems and agro-ecological zones spreading from tropical low to tropical highlands. Having a high yield potential, low yields are often common and mostly attributed to low soil fertility and pest attack. Traditional farming systems in the tropics rely on extended periods of fallow between cultivation periods to restore and maintain soil fertility and to control soil-borne pests and weeds. However, demographic growth and consequently the intensification of land use leads to reduced fallow periods, which are therefore unable to fulfill their desired functions. Mineral fertilizer can provide the required inputs but are often beyond the financial reach of small-scale and resource-poor farming households. Also, in low input systems the use of pesticides is often too costly for farmers but with exceptions especially in potato production where the use of highly toxic pesticides has often become a routine. Soil fertility, soil microorganism activity and the build-up of soil-borne pests, including weeds are strongly related to each other. Therefore, an interdisciplinary research approach is required to develop sustainable land use systems, which address all soil related issues of crop management.

SOIL HEALTH AND PLANT HEALTH

There is a strong relationship between soil fertility and plant health, in the sense of plants ability to resist pests' attack. Poor land management and declining soil fertility often result in a negative feedback cycle characterized in part by an increase of soil-borne pests. Since plant health is intimately linked to soil health, managing the soil in ways that conserve and enhance the soil biota can improve crop yields and quality. A diverse soil community will not only help reduce losses due to soil-borne pests, but also speed up decomposition of organic matter and toxic compounds, and improve nutrient cycling and soil structure.

HIDDEN ENEMIES

A number of pests often attack plants from below the soil surface. The following are the major pests, which occur in root and tuber cropping systems in sub-humid and humid areas:

Nematodes	Weevils
Root rots	Millipedes
Fungal wilts	Cutworms and white grubs
Bacterial wilt	Root aphids



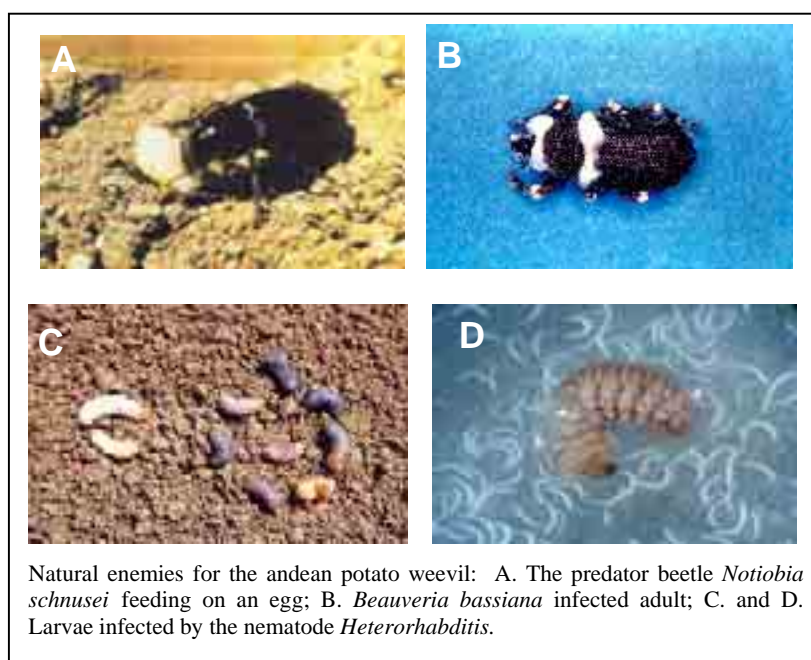
Estimates for the losses caused by the various pests and diseases of root and tuber crops can be either found as percentage of field infestation, percentage of production loss or as monetary benefits from effective control. In highly infested areas losses can be total and annual losses due to BW (*Ralstonia solanacearum*) are estimated at one billion US\$. In Bolivia, common scab/stem canker (*Streptomyces scabies*) caused in certain areas a disease incidence of up to 40% with yield losses averaging between 12 and 20%. For 31% of tuber infestation caused by the Andean potato weevil (*Premnotrypes* spp.) a monetary loss of US\$ 276/ha was calculated for southern Peru. In Ecuador, 7.5 to 21.3% of the total production costs in potato are spent to control the Andean potato weevil. With regard to the sweetpotato weevil (*Cylas* spp.) problem in Africa for Uganda losses of up to 73% have been reported. Cutworms (*Agrotis* sp.) have caused feeding damage on potato tubers of up to 20%. Serious losses due to white grubs (*Phyllophaga* spp.) of 30% occurred in cassava in Colombia and of up to 60% in potato production in Colombia, India and Nicaragua.

Spread and inoculum build-up of soil-borne pests are naturally controlled by soil biota, e.g., by predators feeding directly on different developmental stages of weevils or by entomopathogens causing diseases and death of pests.

AN URGENT NEED FOR SAFE MANAGEMENT SYSTEMS

If safer alternatives for the management of pests and diseases can be found through the development of client-oriented crop management strategies, a major contribution

can be made to improve food security with less impact of pesticides on agricultural and natural ecosystems in resource-poor countries. CIP scientists and its partners anticipate a widespread impact through the adoption of integrated crop management technologies on a global basis in different agro-ecological zones. The sub-project follows a systematic and fully ecological-based approach of crop management contributing to sustainable crop production and promoting plant health *via* soil health.



LINKING SCIENCE TO PRACTICE

Through research activities, this sub-project will develop a better understanding of the soil ecosystem and identify tools that can improve its management. Some of these tools require specialized knowledge and equipment and can only be used by scientists. However, in order to link science to practice it is essential to also develop simple indicators of soil quality and health that can be used by farmers. The best way of achieving this is by the testing simple on-farm techniques through participatory research approaches. This sub-project aims to highlight for farmers, limits of the present techniques used in the management of the soils of root and tuber production systems, and provide tools to measure soil health and management solutions to overcome soil limitations to create more productive root and tuber cropping systems.

WHAT CAN BE ACCOMPLISHED?

It is expected that the project will achieve the following objectives in a five years period:

- a. Establish an international network on soil biota, fertility and plant health.
- b. Characterize soil-based constraints for root and tuber production systems.
- c. Improve the understanding of the dynamics of soil biota and interactions of soil fertility with plant health.
- d. Identify and evaluate management components for soil-borne pests.
- e. Identify and validate integrated pest and soil fertility management practices.
- f. Enhance farmers' capacity in soil management through knowledge development and exchange.

A GLOBAL EFFORT

Achievements of this sub-project will be through scientists from five ARCs (CIP, CIAT, IITA, CABI, ICRAF) and NARS institutions of seven countries in Africa (Cameroon, Ghana, Ethiopia, Kenya, Nigeria, Tunisia, Uganda), one country in Asia (Thailand), and six in South America (Cuba, Bolivia, Brazil, Colombia, Ecuador and Peru) and advanced institutions from Germany, the United Kingdom, USA and New Zealand. A holistic approach will be followed through a multidisciplinary team including entomologists, nematologists, pathologists, soil and weed scientists, agronomists, socio-economists, extension workers and farmers.

ESTIMATED BUDGET

The estimated budget for the project for a five years period is 1.93 million US dollars, and will be implemented in two phases. The estimated cost for the first phase (2 years) is 0.77 million US dollars, and for the second phase (3 years) is 1.15 million US dollars.