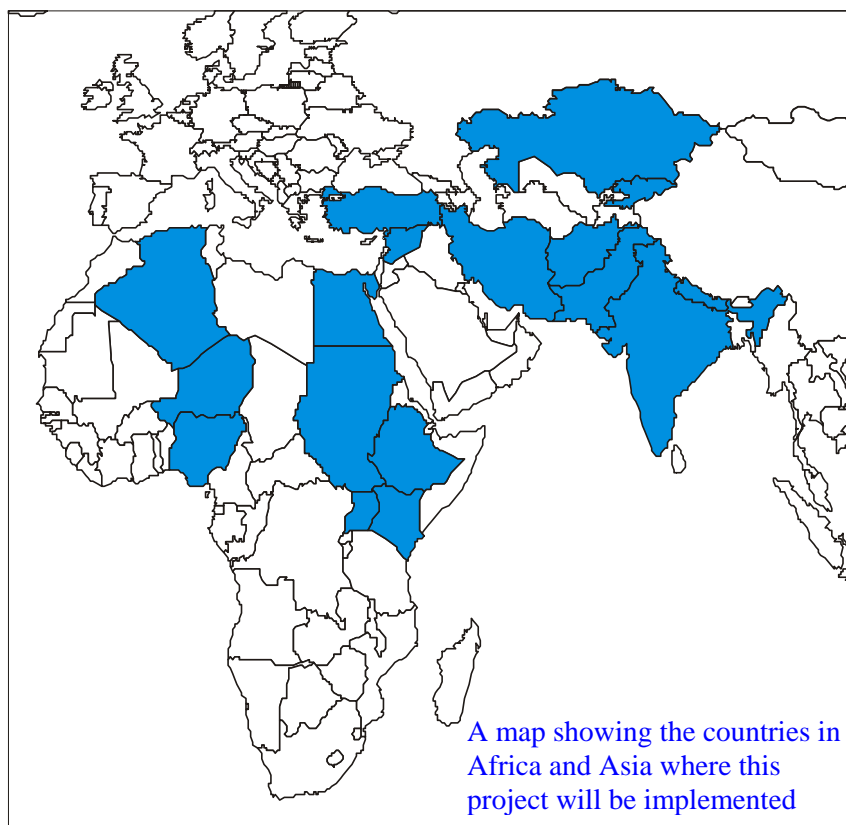


BETTER LIVES FROM HEALTHY SOILS: INTEGRATED PEST MANAGEMENT IN SOILS OF CEREAL AND LEGUME CROPPING SYSTEMS IN THE DRY, SEMI-ARID AND SUB-HUMID AREAS



IARC PARTNERS

ICARDA - *International Center for Agricultural Research in the Dry Areas*

CIMMYT - *Centro Internacional de Mejoramiento de Maíz y Trigo*

ICRISAT - *International Crops Research Institute for the Semi-Arid Tropics*

IITA - *International Institute for Tropical Agriculture*

CABI - *Center for Agriculture and Biosciences International*

TSBF/CIAT – *The Tropical Soil Biology and Fertility Institute / Centro Internacional de Agricultura Tropical*

COORDINATING CENTER:

ICARDA - *International Center for Agricultural Research in the Dry Areas*

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

The majority of farmers in dry, semi-arid and sub-humid regions in Asia and Africa are resource-poor and risk avoidance, not maximized productivity is their main worry. The majority of cereal/legume cropping systems in these regions is characterized by low rainfall, terminal drought stress and cereal monoculture. Land and water resources are limited and any increase in output will have to come from better use of available resources. The challenge is to develop more resilient and sustainable productive cropping systems without disrupting the traditional practices that are in harmony with their environment.

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 in soil-borne pests. Since plant health is intimately linked to soil health, managing the soil in ways that conserve and enhance a fully functional 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 regulate decomposition of organic matter and toxic compounds, and thereby 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 attack the cereal/legume cropping system in the dry, semi-arid and sub-humid areas:

Nematodes	Wheat ground beetle
Root rots	Ground pearls
Fungal wilts	Root aphids
Parasitic weeds	Bean stem maggot
White grubs	Root worms



To the right a lentil field with chlorotic plants because of heavy soil infestation with Sitona weevil. Subset, Sitona larvae feeding on a lentil root nodules



A lentil field heavily infested with the parasitic weed *Orobanche crenata*



A chickpea field with a high incidence of chickpea wilt in Syria. Subset, vascular discoloration in the chickpea stem due to invasion with the wilt pathogen



Typical white head formation caused by crown rot and browning/pinking of the basal stems of winter wheat (left). A cereal field in Turkey showing several patches with typical crown rot symptoms (right), with subset showing spores of the crown rot pathogen *Fusarium pseudograminearum*



Bean seedlings damaged by the bean stem maggot, with the subset showing damage on the tap root



Winter wheat (Bezostva) grown in naturally nematode-infested soil

The above-mentioned pests often cause serious crop losses, but precise loss data is not available for most countries. Available information suggest that chickpea wilt causes an annual loss of around 10% in India and Spain and 40% in Tunisia. Likewise, lentil wilt is reported to cause similar losses, and can lead to complete crop failure in growing seasons characterized by warm-dry spring and hot summer. Root rots and nematodes are a major limiting factor in cereals production. In Turkey, these diseases are reported to reduce winter cereals yield by 25% in several production areas. Bean stem maggot is the crop's most important insect pest in Africa. Sitona weevil feeding on lentil nodules is reported to cause 10-15% losses in Sitona-infested soils. Similar yield loss levels are caused by nematodes and root rots in cereal crops.

AN URGENT NEED FOR SAFE MANAGEMENT SYSTEMS

Today there is a global need for safe systems for pest management. This sub-project does just that, by offering sustainable solutions to improve soil health and consequently crop health. This is accomplished by focusing on biologically-based means of preventing and managing pests, such as host resistance, biological pest control using natural enemies and cultural practices. Pesticides are used only when other approaches fail to manage the soil-borne pests. Such an approach will lead to reductions in production costs and in contamination by toxic chemicals of the environment and food and will safeguard the health of land users.

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 for use by technicians. 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 use of participatory research strategies using simple on-farm techniques. This sub-project aims to highlight for farmers, limits of the

present techniques used in the management of the soils of the cereal/legume production system, and to provide tools to measure soil health and management solutions to overcome soil limitations.



A female farmers field school in Egypt



A male farmers field school in Iran

WHAT CAN BE ACCOMPLISHED

It is expected that the project will achieve the following objectives over a five-year period:

- a. Establish an international network on soil biota, fertility and plant health.
- b. Characterize soil-based constraints for the cereal/legume production systems.
- c. Improve the understanding of the dynamics of crops, soil biota and soil fertility interactions.
- 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 six IARCs (ICARDA, CIMMYT, ICRISAT, IITA, CABI and CIAT/TSBF) and NARS institutions of eight countries in Africa (Algeria, Egypt, Ethiopia, Kenya, Niger, Nigeria, Sudan, Uganda), and nine countries in Asia (Afghanistan, India, Iran, Kazakhstan, Kyrgyzstan, Nepal, Pakistan, Syria, Turkey), and six advanced institutions from Australia, Canada, Denmark, Germany, Spain and the United Kingdom. A holistic approach will be followed through a multidisciplinary team including entomologists, nematologists, pathologists, soil and weed scientists, agronomists, physiologists, breeders, extension workers and socio-economists.

ESTIMATED BUDGET

The estimated budget for the project for a five years period is 1.9 million US dollars, and will be implemented in two phases. The estimated cost for the first phase (2 years) is 0.76 million US dollars, and for the second phase (3 years) is 1.14 million US dollars.