



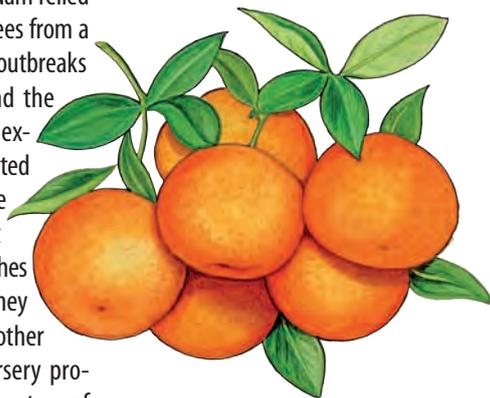
*To feed a growing world population, we have no option but to intensify crop production. But farmers face unprecedented constraints. In order to grow, agriculture must learn to save.*

# Plant protection: approaches that save and grow

Pesticides kill pests, but also pests' natural enemies, and their overuse can harm farmers, consumers and the environment. The first line of defence is a healthy agro-ecosystem.

## Ecosystem approach to citrus diseases

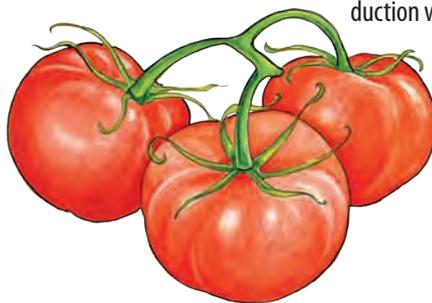
Traditionally, growers in China and Viet Nam relied on manipulating ants to defend citrus trees from a wide range of insect pests. Recent pest outbreaks on citrus in Australia, Eritrea, Israel and the United States of America have followed excessive insecticide spraying, which disrupted naturally occurring biocontrol. While Huanglongbing disease (HLB) has not been resolved, several ecosystem approaches have slowed the impact of infection. They include certification programmes for mother trees and geographical isolation of nursery production, which is conducted in secure insect proof screen houses. In commercial plantations, insect vectors are controlled using chemical insecticides and, where applicable, biocontrol or intercropping with repellent plants such as guava. Infected trees are removed to reduce HLB inoculum sources.



oranges

## Control of viral diseases in tomatoes

Over the past 10 to 15 years, epidemics of viral diseases associated with high populations of whiteflies have plagued tomato production in West Africa, severely reducing yields. In some cases, tomato growing is no longer economically viable. A multipartner international public-private research collaboration helped establish in Mali an IPM programme which included an area-wide campaign to eliminate infected host plants, followed by planting of high-yielding early maturing varieties and extensive sanitation efforts that removed and destroyed tomato and pepper plants after harvest. The programme evaluated early maturing disease-tolerant varieties, and used monthly monitoring of whitefly populations and virus incidence to assess the impact of control practices. Recent tomato production was the highest in 15 years.

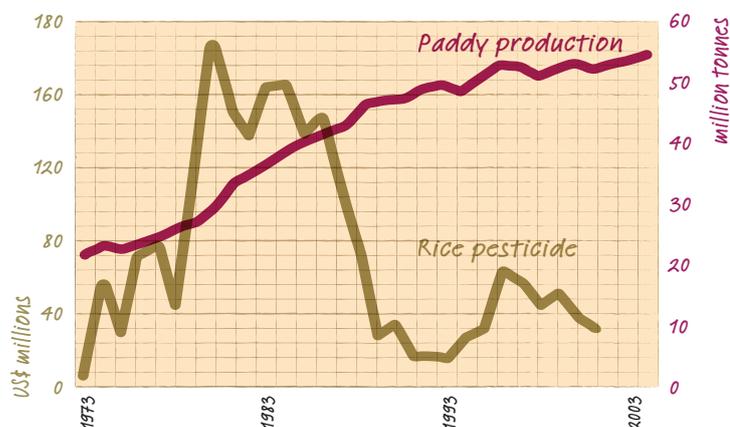


tomatoes

## Reduced insecticide use in rice

Most tropical rice crops require no insecticide use under intensification. Yields have increased from 3 tonnes per ha to 6 tonnes through the use of improved varieties, fertilizer and irrigation. Indonesia drastically reduced spending on pesticide in rice production between 1988 and 2005. However, in the past five years, the availability of low-cost pesticides, and shrinking support for farmers' education and field-based ecological research, have led to renewed high levels of use of pesticides and large-scale pest outbreaks, particularly in Southeast Asia.

Changes in rice production and spending on pesticides in Indonesia



## Natural enemies of cotton pests

Cotton systems have a diverse natural enemy fauna, consisting of general predators that keep sucking pests, such as white flies and leaf hoppers, under adequate natural control. Cotton's tolerance for these pests changes during the crop cycle and treatment thresholds vary according to crop stage and the extent of natural enemy presence. The mosaic of crops near cotton plays an important role in IPM systems, because neighbouring crops – such as melons, and tomatoes – can serve as sources of pests or, as in the case of fodder crops such as alfalfa, of natural enemies. In addition, effective host plant resistance conferred by transgenic Bt cotton has reduced insecticide use significantly.

## Recommendations

The examples above suggest various tactics that can be employed to counter or avoid plant pests in intensified production systems:

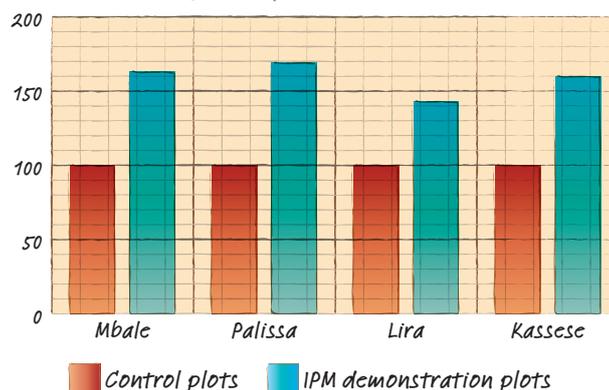
- Insect pests.** It is important to conserve predators, parasitoids and beneficial pathogens to avoid secondary pest release, manage crop nutrient levels to reduce insect reproduction, deploy resistant varieties and make selective use of insecticides.
- Plant diseases.** Organize seed systems that can deliver clean planting material, and deploy varieties with durable pest resistance. Use of clean irrigation water will help ensure that pathogens are not spread, while crop rotations will help suppress pathogens and support soil and root health. Farmers need to manage antagonists of plant pests to enhance biological control.
- Weeds.** Management of weeds requires selective and timely manual weed control, crop rotation, cover crops, minimum tillage, intercropping and fertility management, including organic amendments. Herbicides should be used for targeted, selective control and managed so as to avoid the evolution of herbicide resistance.

## Biocontrol of cassava pests

In Latin America, the centre of origin of the cassava, pest insects are normally kept under good natural population regulation. However, pests cause heavy damage when inappropriately treated with insecticides or when the crop and its pests are moved to another region, such as Africa or Asia, where effective natural enemies are absent. A biocontrol initiative led by IITA successfully brought under control the cassava green mite and the cassava mealybug throughout most of sub-Saharan Africa. This control was provided by natural enemies from Latin America, which were widely established in Africa in the 1980s and are now being introduced to Asia.



Impact of IPM and improved agronomic practices on seed cotton production, in four districts of eastern Uganda (percent)



Adapted from *Save and grow* (FAO, 2011), a policymaker's guide to the sustainable intensification of smallholder crop production. *Save and grow* can be purchased from: [fao@earthprint.co.uk](mailto:fao@earthprint.co.uk) or through the FAO online catalogue: [www.fao.org/icalog/inter-e.htm](http://www.fao.org/icalog/inter-e.htm)



Plant Production and Protection Division  
Food and Agriculture Organization of the United Nations  
Viale delle Terme di Caracalla  
00153 Rome, Italy  
[www.fao.org/ag/agp](http://www.fao.org/ag/agp) ♦ [agp@fao.org](mailto:agp@fao.org)