Sustainable productivity improvements in allium and solanaceous vegetable crops in Indonesia and sub-tropical Australia

Overview

Shallots and chillies are the two most important vegetable crops grown in Indonesia, particularly in Java. Garlic is mostly imported into Indonesia to satisfy a large demand.

But average crop yields are low, with less than half of the potential maximum crop growth yield being compromised. As a result, these vegetables are largely imported, particularly at peak demand periods and during poor seasonal production, such as the wet season.

Shallot crops are propagated using vegetative planting material, which, over generations, results in high virus incidence and lowered productivity. Further, lots of pests and diseases affect the productivity of shallots, resulting in an excessive and careless application of chemicals.

In chilli, pepper yellow leaf curl virus is the most serious problem, and results in very low yields, and in many farmers giving up trying to grow the plant.

The shallot and chilli systems are also typified by excessive fertiliser and pesticide application that represents an environmental and health concern.

This project will help better manage pathogen and reduce the excessive use of fertilisers and chemicals, while improving crop productivity.

<table>
<thead>
<tr>
<th>ACIAR project number</th>
<th>SMCN/2009/056</th>
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<tr>
<td>Start date and duration (years)</td>
<td>1 April 2012 – 6 Years</td>
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<tr>
<td>Location</td>
<td>Indonesia and Australia</td>
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<td>Budget</td>
<td>$1.5 million</td>
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Project leader(s) and Commissioned Organisation

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Caption: Evaluating incidence of pepper yellow leaf curl virus in chilli crops Yogyakarta, Java
Research

The project aims to:

» establish a benchmark for farmer practices and supply chain processes to determine how shallot and chilli cropping is managed

» evaluate how efficient the nutrients used in shallot and chilli crop are, and how the crops respond to them

» develop accurate diagnostics for shallot virus and fusarium pathogens

» survey key production areas (Brebes, Cirebon, Bantul and Nganjuk) for virus incidence in both shallot and chilli crops

» develop tissue culture techniques to remove virus and produce virus-free shallot plants

» screen chilli germplasm to identify resistance to pepper yellow leaf curl virus

» identify chilli germplasm with better agronomic traits and higher productivity

» import new shallot and garlic germplasm, and evaluate productivity.

Achievements

» Surveys have confirmed that Indonesian shallots have a high incidence of carlavirus and potyvirus, and garlic has also shown extremely high incidence of potyvirus, carlavirus and allexivirus.

» The project has characterised the moler disease complex in shallots, identifying three fusarium species (F. solani, F. accutatum and F. oxysporum) that cause the moler symptoms.

» Screening of chilli germplasm by the Institute of Plant Breeding, the World Vegetable Center and the Queensland Department of Agriculture and Fisheries has found six varieties with high resistance to pepper yellow leaf curl virus.

» A survey of virus diseases in chilli crops across Java has been completed, and samples have been tested for about eight viruses. This identified the whitefly-transmitted begomovirus (predominantly pepper yellow leaf curl virus) as the most common virus group.

» A shallot nutrient budgeting survey has been done, showing that farmers apply fertiliser at highly variable rates, but generally excessively. From this, researchers completed an experiment in shallot to identify the optimal nitrogen rate. This showed that although maximum yield was recorded at 280 kilograms of nitrogen per hectare, only about 60 kilograms of nitrogen per hectare was taken up by the plant. The rest was unaccounted for, which indicates considerable nutrient loss from the system.

» Garlic productivity in Queensland, Australia, has greatly increased through improving varieties, selecting better seeds, and improving agronomy, particularly nitrogen management.

Impact Story

The Indonesian and Australian teams have applied techniques to remove virus from allium germplasm, which has resulted in virus-free or low-virus plants. This is now being further refined to assess the impact of viruses on shallot yield.

Several chilli varieties have shown resistance to pepper yellow leaf curl virus, and another Queensland variety appears to react differently to infection, with delayed symptoms. This suggests a different tolerance mechanism is active, which, in combination with true resistance, could provide more durable genetic resistance. The identification of the resistant germplasm now enables a gene marker that is resistant to pepper yellow leaf curl to be developed, and subsequent selection and introgression.