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Research Application Summary

Development of a hot pepper root rot and wilt disease management strategy through genetic resistance, chemical application and proper choice of rotational crops

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Abstract

This study seeks to contribute to increased productivity of hot pepper (*Capsicum chinense*) by incorporating an integrated pest management (IPM) package for root rot/wilt disease (*Phytophthora capsici*). Pathogen host diversity will be determined to guide the use of crop rotation in managing the disease. Oomycete fungicides will be screened for effectiveness in managing *P. capsici*. Additionally, resistance introgression will be carried out with resistant donors. The contribution of the Phyto 5.2 QTL disease resistance will also be determined in order to assess its usability in resistance breeding. The study will be carried out in collaboration with pepper farmers in Kasese, Uganda.

Key words: IPM, Phyto 5.2, *Phytophthora capsici*, QTL, Scotch bonnet

Résumé

Cette étude cherche à contribuer à la plus grande productivité du poivre âcre (*Capsicum chinense*) en incorporant un ensemble intégré de gestion du parasite (IPM) pour la putréfaction de la racine/la maladie de desséchement (*Phytophthora capsici*). La diversité d'organisme infecté par le microbe pathogène sera déterminée pour guider l'utilisation de la rotation de cultures dans le contrôle de la maladie. Des fongicides d'Oomycètes seront examinés pour l'efficacité dans le contrôle de *P. capsici*. En plus, l'incorporation des gênes de résistance sera effectuée avec les donneurs résistants. La contribution de la résistance à la maladie Phyto 5.2 QTL sera également déterminée afin d'évaluer sa rentabilité dans la multiplication de résistance. L'étude sera effectuée en collaboration avec des agriculteurs de poivre à Kasese, Ouganda.

Mots clés: IPM, phyto 5.2, *Phytophthora capsici*, QTL, capot écossais

Background

Hot pepper (*Capsicum chinense*) cv. Scotch-bonnet was introduced in Uganda in the late 1990s to diversify cash crops and improve household livelihoods. This small-holder farmers' crop is mainly grown under furrow irrigation in Mubuku Irrigation and Settlement Scheme (MISS), and also under rain-fed conditions in central and some parts of mid-western Uganda. The most important hot pepper production constraint in Uganda is the root rot and wilt complex (*Phytophthora capsici*) with incidences of up to 80%. Elsewhere, the disease is managed through an integrated approach involving cultural methods such as irrigating sparingly, field drainage, crop rotation, planting pepper on raised ridges, fallowing and use of clean seed; and chemical applications (Sanogo, 2003; Gevens *et al*., 2007). However, disease resistant varieties are considered the best approach to control the disease (Sanogo, 2003). Unfortunately the commercially acceptable varieties in Uganda are not resistant to this disease, hence the need to develop resistant varieties. The above IPM components need to be evaluated under Ugandan conditions for effectiveness and feasibility. Therefore, this study has been initiated to: (i) study the host diversity of *Phytophthora capsici* in Uganda, (ii) establish the effectiveness of fungicides in managing hot pepper root rot and wilt disease, and (iii) introgress resistance to *Phytophthora capsici* in pepper.

Literature Summary

Phytophthora capsici has a wide host range, the primary hosts being Solanaceous crops and Cucurbits (Gevens *et al*., 2006) and several secondary hosts. The pathogen is favoured by water-logged conditions. Therefore water management, in addition to host resistance are key to controlling the disease (Oelke *et al*., 2003). *C. chinense* exhibits highly resistant, highly susceptible and intermediate or tolerant reactions to the pathogen. It is however established that resistance is complex and quantitatively inherited. Up to six quantitative trait loci (QTL) have been reported to contribute to *P. capsici* resistance in *C. chinense* (Thabuis *et al*., 2004). A SCAR linked to one QTL (Phyto 5.2) has been reported; its use should allow rapid selection of genotypes likely to be highly resistant to *P. capsici* (Quirin *et al*., 2005). Other QTL reported for *P. capsici* resistance include Phyto 4.1, 5.1, 6.1, 11.1 and 12.1 (Thabuis *et al*., 2003). Marker-assisted selection (MAS) for one or a few most critical QTL in combination with phenotypic analyses has been proposed as an easier way to introgress high levels of resistance to *P. capsici* in pepper (Thabuis *et al*., 2004). Phyto 5.2 QTL alone is

responsible for up to 42% of the observed resistance in pepper and is a target for use in this study.

Study Description

The study will be carried out by 2 MSc. students. Student 1 will study host diversity and fungicidal application in managing the disease. This component will begin with evaluating the pathogenicity of *P. capsici* isolates on crops usually grown in rotation with pepper. Then different oomycete fungicides will be drenched in soil at 4 application rates and the reaction of susceptible pepper evaluated for each fungicide. Student 2 will study the introgression of resistance to *P. capsici* in the commercial pepper cultivars. First, the effectiveness of different sources of resistance will be evaluated. The various hot pepper sources of Phytophthora root rot resistance will be obtained from pepper breeders and used as male parents in crosses with the Ugandan adapted but susceptible varieties. F_2 progeny will be grown in infested fields and phenotypically evaluated for resistance. The best source of resistance will be obtained. Secondly, the student will evaluate the contribution of the Phyto 5.2 QTL in controlling Phytophthora root rot and wilt disease in Scotch–bonnet. Crosses will be made between the resistant PI 159234 and the two Ugandan commercial varieties. The F_2 progeny will be artificially inoculated with a mixture of pathogen isolates. Genomic DNA will be extracted from F2 plant leaves and subjected to PCR using the Phyto 5.2 QTL SCAR specific primers. One month after transplanting, the same plants will be evaluated for root rot severity. SCAR marker and phenotypic screening generated data will be compared to determine the contribution of the Phyto 5.2 QTL in introgressing resistance to Phytophthora root rot and wilt in Scotch-bonnet. The resulting resistant lines will be kept and subsequently developed further into resistant commercial lines.

Research Application

From the study, it is expected that: the host range of *P. capsici*, reaction of *P. capsici* against different oomycete fungicides, and crop yield response to fungicide application will be determined. It is also expected that the most suitable source of *P. capsici* resistance in Uganda will be identified in addition to determining the importance of Phyto 5.2 QTL in imparting resistance to *P. capsici* in Ugandan hot pepper varieties. Finally hot pepper lines carrying *P. capsici* resistance QTL will be identified.

Recommendation

The study will use the results to design an IPM package for sustainably managing the disease in Uganda.

Acknowledgement

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