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Research Application Summary

Host plant resistance for management of quarantine fruit pests of hot pepper in Uganda

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Abstract

Hot pepper (*Capsicum frutescens*) dominates the world spice trade and is an important cash crop for small scale farmers in developing countries. However, its production and productivity remain low and this is attributed to lack of improved varieties, poor seed systems, insect pests, diseases and drought. Fruit flies and the False coddling moth (FCM) are quarantine pests and cause substantial losses in the hot pepper venture. Farmers in effort to protect their produce mostly rely on pesticides and this increases the likelihood of rejection of export produce at the international market. Pests can cost effectively be managed by exploiting host plant resistance. The study identified hot pepper genotypes with sources of resistance to fruit pests and morphological fruit traits associated with resistance to the pests. Genotypes CAP0408-12, UG2-WE0402-16, UG2-WE0511-22, UG2-WE0307-14 and UG-WE02-1014 showed resistance to both fruit pests. Fruit size (weight, width and length) significantly and positively correlated with pest infestation. The chemical basis of resistance of these resistant hot pepper genotypes should be determined in order to breed for resistant varieties.

Key words: False coddling moth, fruit flies, fruit weight, fruit width, resistance, Uganda

Résumé

Le piment (*Capsicum frutescens*) domine le commerce mondial des épices et, est une importante culture de rente pour les petits agriculteurs des pays en développement. Cependant, sa production et sa productivité restent faibles et cela est attribué au manque de variétés améliorées, aux systèmes de semences médiocres, aux pestes, aux maladies et à la sécheresse. Les mouches des fruits et la fausse carpocapse (FCM) sont des pestes en quarantaine et causent des pertes substantielles dans l'aventure du piment. Les agriculteurs dans l'effort de protéger leurs produits dépendent principalement des pesticides, ce qui augmente la probabilité de rejet des produits d'exportation sur le marché international. Les pestes peuvent être gérées de manière rentable en exploitant la résistance des plantes

hôtes. L'étude a identifié des génotypes de piments avec des sources de résistance aux pestes des fruits et des caractères morphologiques des fruits associés à la résistance aux pestes. Les génotypes CAP0408-12, UG2-WE0402-16, UG2-WE0511-22, UG2-WE0307-14 et UG-WE02-1014 ont montré une résistance aux deux pestes des fruits. La taille des fruits (poids, largeur et longueur) était corrélée significativement et positivement avec l'infestation par des pestes. La base chimique de la résistance de ces génotypes de piments résistants devrait être déterminée afin de faire la sélection pour des variétés résistantes.

Mots clés: Fausse carpocapse, mouches des fruits, poids des fruits, largeur des fruits, résistance, Ouganda

Introduction

Hot pepper (*Capsicum frutescens*) dominates the world spice trade (Lin *et al.,* 2013) with the world production area estimated at 3.7 million ha (FAOSTAT, 2018). It is an important cash crop for small scale farmers in developing countries (Lin *et al.,* 2013). In Uganda, it is highly valued and produced majorly for export (Karungi *et al.,* 2011). Hot pepper has the potential to improve the livelihoods of small scale farmers by alleviating poverty (Buyinza and Mugagga, 2010) and is one of the non-traditional export crops diversifying exports in Uganda (Jaimovich and Kamuganga, 2011). However, its production and productivity remains low (Karungi *et al.,* 2013) and this is attributed to lack of improved varieties, poor seed systems, insect pests, diseases and drought (ADC/IDEA, 2001; Horton, 2008; Buyinza and Mugagga, 2010). Fruit damaging pests such as fruit flies, boll worms and the false coddling moth (FCM) are economically important since they cause profound direct yield losses (Djieto-Lordon *et al.,* 2014; Muzira *et al.,* 2015).

Fruit flies and the FCM are quarantine pests with stringent restrictive regulations imposed by importing countries (Barnes *et al.,* 2015; Roberts *et al.,* 2015). Fruit flies can cause yield losses of more than 37% (Muzira, 2015) while a loss of about 67% was registered in 2014 due to the FCM (UBOS, 2017). Farmers in effort to protect their produce, resort to use pesticides though in most cases inappropriately (Karungi *et al.,* 2013). This increases the likelihood of rejection of export produce at the international market due to the failure to meet acceptable maximum pesticide residue levels in export produce (UIA, 2009). Pests can cost effectively be managed by exploiting host plant resistance (Mundt, 2014) which can also easily be used with other management practices. The main objective of this study was to improve the competitiveness of Ugandan hot pepper exports on the international market by developing recommendations for utilization of host plant resistance against quarantine fruit pests. To achieve this, studies were conducted to: a) identify hot pepper genotypes with sources of resistance to fruit pests and b) identify morphological fruit traits associated with resistance to the pests.

Experimental design. Fifty-one hot pepper genotypes were screened for resistance against fruit pests under field conditions at Makerere University Research Institute Kabanyolo (MAURIK) in 2016 and 2017 using a complete randomized block design with three replicates consisting of a single row for each of the genotypes. Each row comprised 10 plants spaced at 45cm and 80cm between rows.

Data collection. Ripe fruits were harvested four consecutive times for two seasons and grouped per genotype. The fruits were inspected and graded into marketable and non-marketable fruits. The non-marketable fruits were further inspected for oviposition marks, and rotting and these were considered damaged. The damaged fruits were opened to reveal presence of internal damage and larvae. The fruits that had fruit fly larvae were considered infested (Rossetto *et al.,* 2006), and expressed as a percentage of damaged fruits. level of FCM infestation was calculated as a percentage of fruits with frass and or FCM larva to the damaged fruits. Average fruit weight, length, width, fruit wall thickness and penetration force were measured from 30 fruits per genotype.

Results

All the test genotypes were susceptible to fruit flies (P<.001) though at varying levels. Fruit fly infestation ranged from 0-46.3% and genotypes CAP0408-12 and UG2-WE0402-16 showed substantial resistance to fruit fly infestation. Furthermore, the number of fruit fly larva per fruit varied significantly among genotypes at P<.001 in both seasons and genotypes RHA-T305-07 and NSR0105-01 had the highest mean number of larva per fruit. Fruit infestation by the FCM was generally low in both seasons but was significant in season A at P<.001. Only one genotype, OHA-T305-09 was infested in season B.

There were significant positive relationships between fruit fly infestation and fruit weight, width, length and penetration force. Fruits traits, i.e., weight, fruit width and length on the other hand significantly correlated with FCM infestation. This implies that fruit morphological traits associated with resistance to fruit pests of hot pepper are weight, width and length. Large sized fruits are more prone to fruit pest infestation as compared to smaller fruits.

Discussion

According to Diatta *et al.* (2013) and Love *et al.* (2014), varieties within the same species are preferred and utilized differently by fruit pests. This could be due to the chemical bases and morphological fruit traits such as size and colour that vary among genotypes. Fruit traits such as size and fruit wall thickness have been reported to influence pest infestation (Aluja and Mangan, 2008; Gogi *et al.,* 2010). This is in line with the result of this study. Overall, genotypes CAP0408-12, UG2-WE0402-16, UG2-WE0511-22, UG2-WE0307-14 and UG-WE02-1014 performed better than the others in terms of resistance to the pests and breeders can follow up with inheritance studies.

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