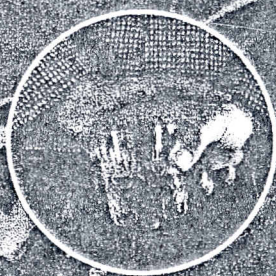
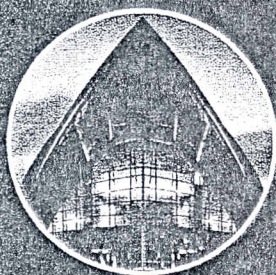


Congress Proceedings

Volume 2

15 - 18 October 2007 Scottish Exhibition & Conference Centre, Glasgow, Scotland, UK



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British Library Cataloguing in Publication Data - A catalogue record for this book is available from the British Library.

ISBN 13 978-1-901396-67-6 Set of two volumes

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Cover design by m360° Ltd, Nottingham
Printed in Great Britain by Page Bros, Norwich

The wheat curl mite, *Aceria tosichella* Keifer, and associated viruses, Wheat Streak Mosaic Virus and High Plain Virus - the risks posed to cereal crops in South America

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Aceria tosichella Keifer, an eriophyid mite known as the Wheat Curl Mite (WCM), was described from wheat in 1969. Yield losses in wheat and corn crops due to direct damage have been significant. Furthermore, the main damage caused by *A. tosichella* is indirect due to transmission of Wheat Streak Mosaic Virus (WSMV) and High Plain Virus (HPV), the causal agents of cereal diseases. WCM and WSMV are widespread and have been reported in wheat production areas around the world, while HPV is restricted to North America. The records of both WCM and WSMV in South America are recent. WSMV was first reported in 2002 infecting wheat fields in the Province of Córdoba, Argentina (Truol *et al.*, 2004). Shortly afterwards, the vector WCM was found for the first time in WSMV-infected wheat fields in the same country (Navia *et al.*, 2006). These recent reports have highlighted the potential risk posed by WCM, WSMV, and HPV to South America. It has also raised the need to conduct a Pest Risk Analysis (PRA) to identify pathways, define endangered areas and select management options to minimize the impact of these viruses in the PRA area. A PRA was conducted following FAO standards (ISPM 2 and 11). The potential for establishment was evaluated using CLIMEX and information on host availability.

The quarantine pest criteria were satisfied for WCM, WSMV, and HPV. For many years *A. tosichella* was misidentified as *Aceria tulipae* (Keifer), a pest of tulip bulbs. However, it has been showed that the eriophyid on Liliaceae was different from that on wheat and Keifer (1969) described the wheat species as *A. tosichella*.

Probability of introduction (entry and establishment) and spread

There are four main pathways: a) natural movement (wind is key for WCM; *A. tosichella* is present in Argentina, and plays the main role in WSMV and HPV spread); b) movement of vehicles and agricultural machines (winter cereal crop areas infested with WCM & WSMV in Argentina are contiguous with crop areas in Brazil and Uruguay and cross-border movement of vehicles and machines often occurs); c) trade in cereal seeds from countries where WCM, WSMV and HPV are present (this is increasing and these viruses can be transmitted through seeds at low rates ($\cong 0.05\%$) and there are indications that the vectors

WCM can survive for short periods associated with seeds and may infest new fields) and trade in potted plants contaminated with grasses infested with the mites or viruses.

The probability of WCM, WSMV and HPV establishment in South America is high, considering the availability of hosts, climatic conditions and the vector's reproductive potential. The main host of WCM is wheat, but populations can also develop on sorghum, barley, corn, oat, rye, pearl millet and more than one hundred grass species. Winter cereals are widely cultivated in the southern part of South America. The Pampa biome occupies contiguous areas in South Brazil, Argentina and Uruguay and is characterized by open areas where grasses are predominant. Several of these grasses can act as alternate hosts to WCM and WSMV. Corn and grasses can be found throughout the PRA area. WCM can survive in a wide range of temperatures (-13°C to 37°C) similar to those in the USA where populations reach high levels (Harvey *et al.*, 2002). CLIMEX analysis has indicated suitable climatic conditions for the establishment of WCM in South America, with medium (50) to high (75) ecoclimatic indexes in the main winter cereal areas. WCM has a high productive potential under favorable conditions, with a short life cycle ($\approx$ eight days) and high oviposition rate ($\approx$ 25 eggs/female) (Jeppson *et al.*, 1975).

Potential economic consequences

Yield losses in wheat crops due to WCM can reach 30% (Harvey *et al.*, 2002) and due to WCM and WSMV together have reached 100% in Poland (Jezewska, 2000). Yield losses from HPV can also be significant. Chemical control of the vector is unsatisfactory. Winter cereal crops have a high economic importance in the southern part of South America.

Conclusions

The PRA shows that WCM, WSMV and HPV have a high potential for introduction, spread and economic consequences in South America. The highest risk areas were defined as those of the southern part of South America, where WCM and WSMV have been recorded and where winter cereal crops are of major importance. Measures to minimize the risk posed by these viruses and their vectors to South America should be applied. For consignments, regulations to control the trade in cereal and grass seeds (post-entry quarantine or certification) are required as well as on the movement of vehicles/machines from infested to noninfested areas. For infested areas, reductions in infestations and spread to surrounding areas are needed. Host resistance is the most promising method to manage the viruses and their vectors. Cultural measures can help. Research should be directed to alternate hosts in the infested area and to evaluate the susceptibility of varieties to WCM, WSMV and HPV to define control strategies to prevent the spread of these viruses in the endangered areas.

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