ABSTRACT of

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Mealybugs (Hemiptera: Pseudococcidae) are soft bodied, sexually dimorphic, hemimetabolous insects with sucking mouthparts. There are a number of pest mealybug species in Pakistan, but citrus mealy bug, Planococcus citri and cotton mealybug, Phenacoccus solenopsis are relatively more important as they cause significant damage to fruit gardens and crop plants, respectively. P. citri is a phloem feeder and has a very broad plant host range. Loss of plant vigor and stunting are characteristic symptoms, but P. citri also reduces fruit quality and causes fruit drop leading to significant yield reductions. P. citri secretes honey dew and wax onto plant surfaces allowing for sooty mold development, and infestations can result in rejecting plants shipped for trade. Similarly, P. solenopsis is considered a highly invasive pest of agricultural and horticultural crops feeding on a wide variety of plants from an estimated 246 plant families. Cotton mealybug emerged as a serious pest in Pakistan during 2005-2006 when it caused significant losses to cotton crop. P. solenopsis feeds on all parts of plants especially on tender shoots, leaves joining the stem or along the leaf veins. Its massive reproduction on plants causes distortion, weakening, defoliation, die back and even death of susceptible plants. P. solenopsis also secretes honeydew that causes growth of sooty molds. Although genetically modified (GM) crops have proved successful in controlling chewing insects, they have generally failed to control sucking insects. One reason of this failure is considered the mode of feeding of sap sucking insects. Success of GM crops against chewing insects has highlighted the importance of biotechnology options to control sucking insects. RNA interference (RNAi) is an emerging tool for functional genomics studies and is being investigated as a practical tool for highly targeted insect control. RNAi acts at mRNA level thus impeding translation to proteins, and if vital genes are targeted, insect development can be hampered and mortality can be achieved. Here I investigated whether RNAi effects can be induced in P. citri and P. solenopsis and whether candidate genes could be identified as possible targets for RNAi-based mealybug control. RNAi effects were induced in P. citri, as demonstrated by specific target reductions of P. citri -actin, chitin synthase 1 and V-ATPase mRNAs after injection of the corresponding specific double-stranded RNA inducers. Tobacco mosaic virus (TMV) was used as a vector to express these RNAi effectors in N. benthamiana plants. It was found that P. citri exposed to recombinant TMV-infected plants showed lower fecundity and pronounced nymphal mortality. Further, these phenotypic results were confirmed by target mRNA reduction through qRT-PCR. Similarly, Potato virus X (PVX) was used as a vector to express RNAi effectors in Nicotiana tabacum against P. solenopsis chitin synthase 1 (PsCHS1), V-ATPase (PsV-ATPase) and bursicon (PsBur) as target genes. It was found that RNAi effects can be induced in P. solenopsis through feeding on N. tabacum inoculated with recombinant PVX vector with all three genes (PsCHS1, PsBur and PsV-ATPase) as was revealed by reduction in mRNA levels and phenotypic effects like physical deformities, mortality and reduced fecundity. Taken together, the data suggests that -actin, chitin synthase 1, V-ATPase and bursicon are potential targets for RNAi against P. citri and P. solenopsis, and that recombinant TMV and PVX are effective tools for evaluating candidate RNAi effectors in plants against phloem feeders.