Leafhopper Population Dynamics in the South Columbia Basin

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Introduction

A serious epidemic of purple top disease of potato occurred in the Columbia Basin of Washington and Oregon in 2002 growing season and caused very significant losses to potato fields from Boardman and Hermiston in the south to Moses Lake in the north. There were also indications of reduced tuber quality resulting from diseased plants. The same disease was observed in 2003 growing season, especially in organic potato fields. In addition, similar disease outbreaks have recently been observed in several vegetable crops grown in the area, including dry beans. Symptoms in affected potato plants include a rolling upward of the top leaves with reddish or purplish discoloration, moderate proliferation of buds, shortened internodes, swollen nodes, aerial tubers, and early plant decline. These symptoms resemble very much those of purple top caused by psyllid damage or phytoplasma infection, and in some cases to those caused by potato leafroll virus (PLRV). Early investigation of the cause(s) of the disease indicated that leafhopper transmitted phytoplasmas may have played a significant role in this disease epidemic.

In response to this disease outbreak, the Washington State Potato Commission (WSPC) put together a multi-disciplinary team, mainly made of entomologists and plant pathologists, to work on various aspects of the problem including disease symptoms, causal agent(s) identification, insect(s) vectoring the disease, disease epidemiology, and disease management. This research team includes Andy Jensen (WSPC, Moses Lake, WA), Pete Thomas and Jim Crosslin (USDA-ARS, Prosser, WA), Joseph Munyaneza (USDA-ARS, Wapato, WA), Keith Pike (Washington State University, Prosser, WA), Hanu Pappu (Washington State University, Pullman, WA), Phil Hamm (Oregon State University, Hermiston, OR), and Alan Schreiber (Agriculture Development Group, Inc., Eltopia, WA). Also, the laboratory of Ing-Ming Lee (USDA-ARS, Beltsville, MD) helped in the identification of pathogens involved in this potato disease.

During 2003, samples of diseased potato plants were collected from potato fields in various locations of the Columbia Basin and sent to the USDA-ARS laboratories at Prosser and Beltsville for phytoplasma testing using the polymerase chain reaction (PCR). Results from Ing-Ming Lee and Jim Crosslin analyses indicated that all phytoplasmas detected from the diseased plants belong to the clover proliferation group (16SrVI), subgroup A (16SrVI-A) phytoplasmas. This subgroup currently consists of three members: clover proliferation (CP), potato witches'-broom (PWB), and vinca virescence (VR), a strain of beet leafhopper transmitted virescence agent (BLTVA) phytoplasmas. The 16S rDNA sequence analysis indicated that the detected phytoplasmas were most closely related to VR with 99.7% gene sequence homology compared to 99.2% with CP and PWB. Also, Ing-Ming Lee pointed out that the phytoplasmas detected in infected potatoes were nearly identical (99.8%) to phytoplasma strains associated with dry bean phyllody disease which recently occurred in the Columbia Basin.

Insects vectoring this disease have not conclusively been identified. However, all indications point to leafhoppers. Although the beet leafhopper (*Circulifer tenellus*) is the prime suspect, several other leafhopper species are potential vectors, including *Macrosteles* spp. and *Ceratagallia* spp. The main objective of the present study was to identify and determine the occurrence, composition, and the abundance of leafhopper species found in and near commercial

potato fields in the south Columbia Basin. This information is essential to establish which and when leafhoppers move to the potato fields and for how long they stay in the potatoes and will help growers make good management decisions to limit spread of this disease in potatoes.

Leafhopper Monitoring and Sampling

In 2003, leafhopper monitoring and sampling were conducted from early spring to late fall at several locations throughout the south Columbia Basin potato growing area of Washington and Oregon using yellow sticky traps and sweep nets. Several potato growers were involved and sampling locations included Boardman and Hermiston/Umatilla area in Oregon and Alderdale, Paterson, McNary area, Pasco (K2H Farms), Wallula, and Moxee in Washington. Most of these sites were located in and/or near commercial potato fields that were affected by the disease in 2002 and along the hills overlooking the Columbia River and Yakima River. This region has previously been identified as one of the breeding grounds for leafhoppers in the Pacific Northwest, especially the beet leafhopper. Also, some of the crops in the vicinity of potatoes were regularly sampled to determine which kinds of leafhoppers they host and to determine if they constitute potential source of disease vectors. Yellow sticky traps were used to detect leafhopper movement from their overwintering and spring host plants to potatoes, and sweep net samples were used to estimate the leafhopper population density. Samples were taken weekly and brought to the laboratory at the USDA-ARS in Wapato where leafhoppers were sorted out, identified, and counted. Andy Jensen helped with leafhopper species identification.

Results

Several leafhopper species were found during the sampling and included *Circulifer tenellus*, *Macrosteles* spp., *Ceratagallia* spp., *Dikraneura* spp., *Exitianus exitiosus*, *Ballana* spp., *Colladonus* spp., *Amblysellus* spp., *Paraphlepsius* spp., *Balclutha* spp., *Latalus* spp., *Empoasca* spp., and *Erythroneura* spp. Species identification of several of these leafhoppers has not conclusively been made yet and further identification is planned. The population dynamics of the different leafhopper species at each sampled location is indicated in Figures 1-12 using sweep sample data. Leafhopper species composition was almost the same in all sampled locations. Most of the leafhopper species found in weeds and crops near potatoes were also present within potato fields. Although leafhoppers were observed in weeds near potato fields early spring, most leafhopper species seem to invade potatoes early summer. *Circulifer tenellus* and *Ceratagallia* spp. were very abundant and predominant in most of the sampled locations; *Macrosteles* spp. were also present but less abundant.

Conclusion

Information on insects vectoring this purple top disease of potato and their population dynamics is key to appropriately manage this disease in potatoes. Leafhoppers are easy to control and most registered foliar insecticides are effective in providing good control. However, leafhopper monitoring and sampling is crucial for timely insecticide applications and effective management of leafhopper transmitted diseases such as this potato purple top.

Figure 1. Paterson 2003 - Weeds

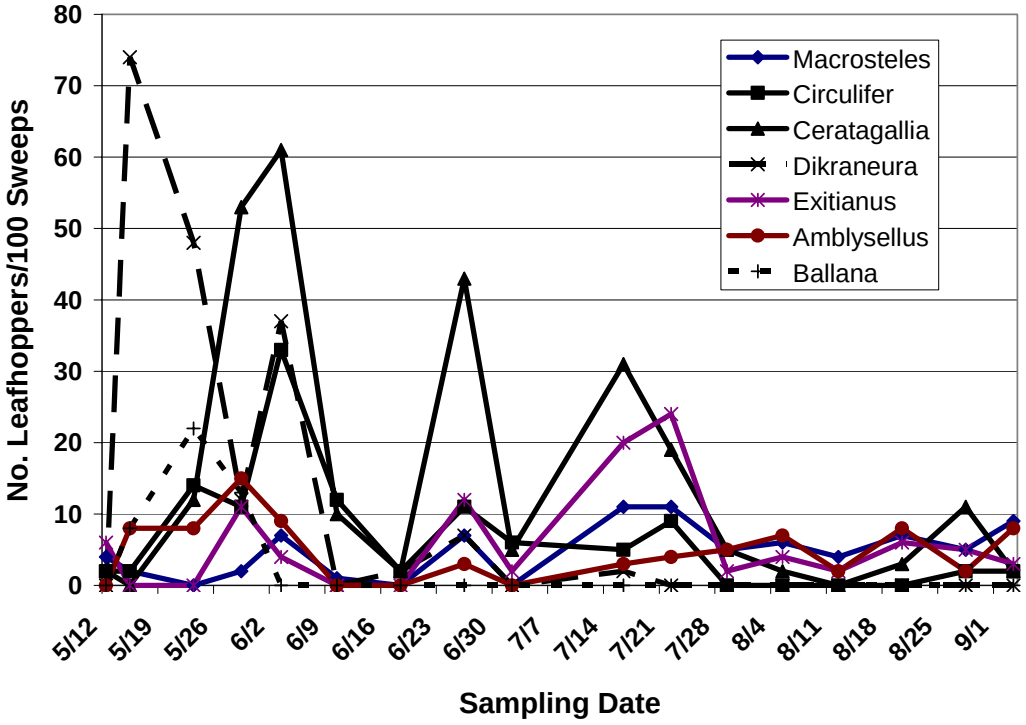

Figure 2. Paterson 2003 - Potatoes

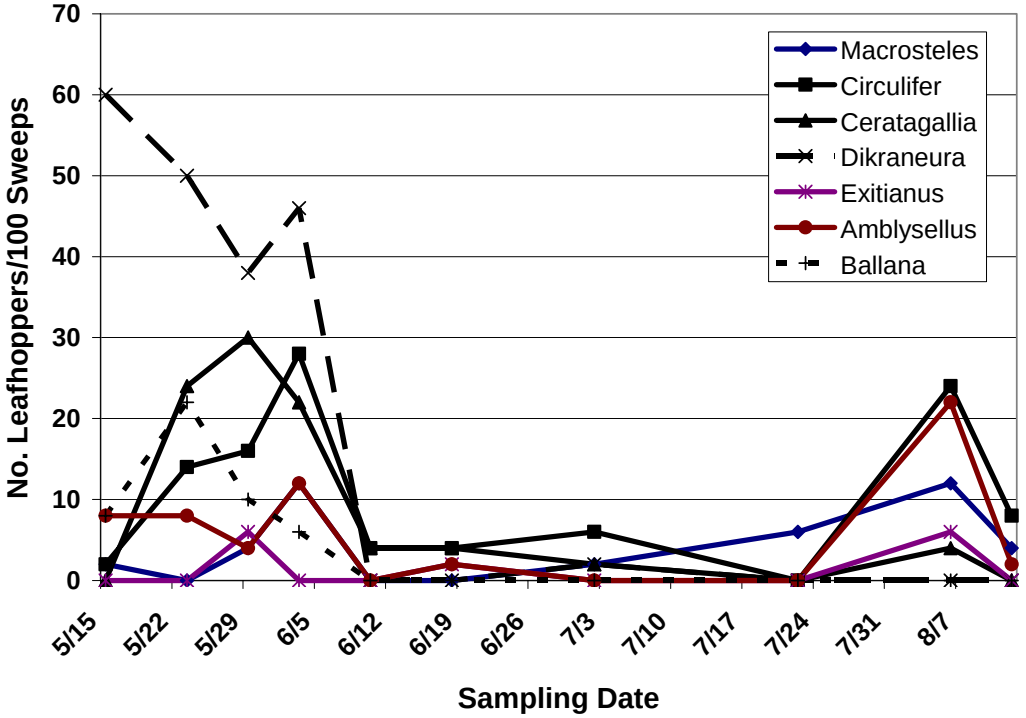

Figure 3. Moxee 2003 - Weeds

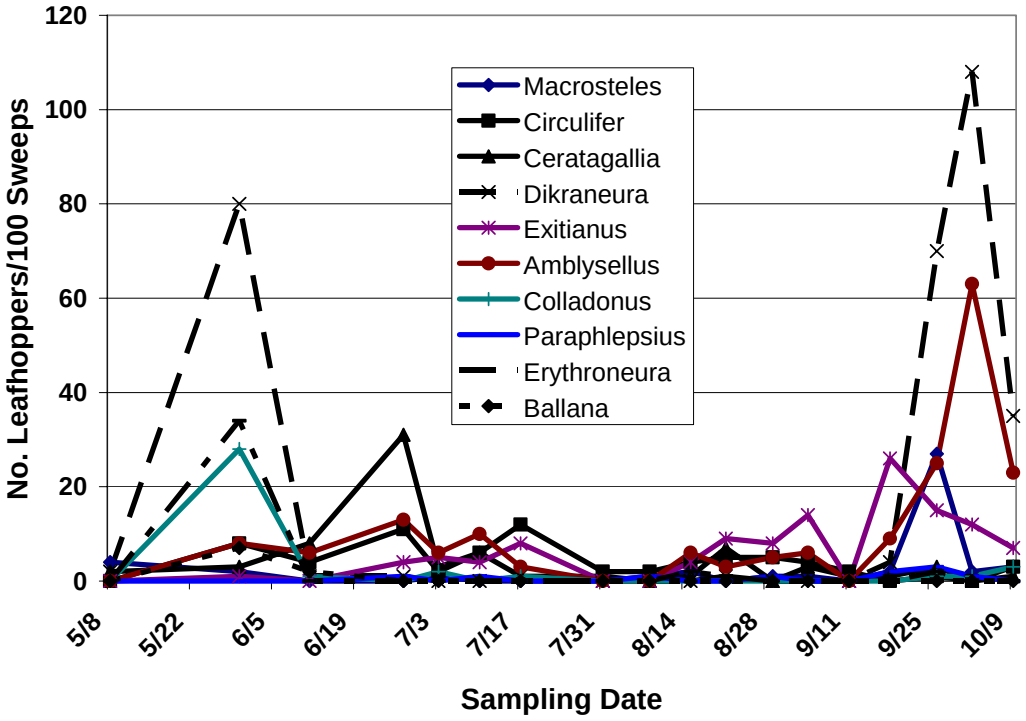

Figure 4. Moxee 2003 - Potatoes

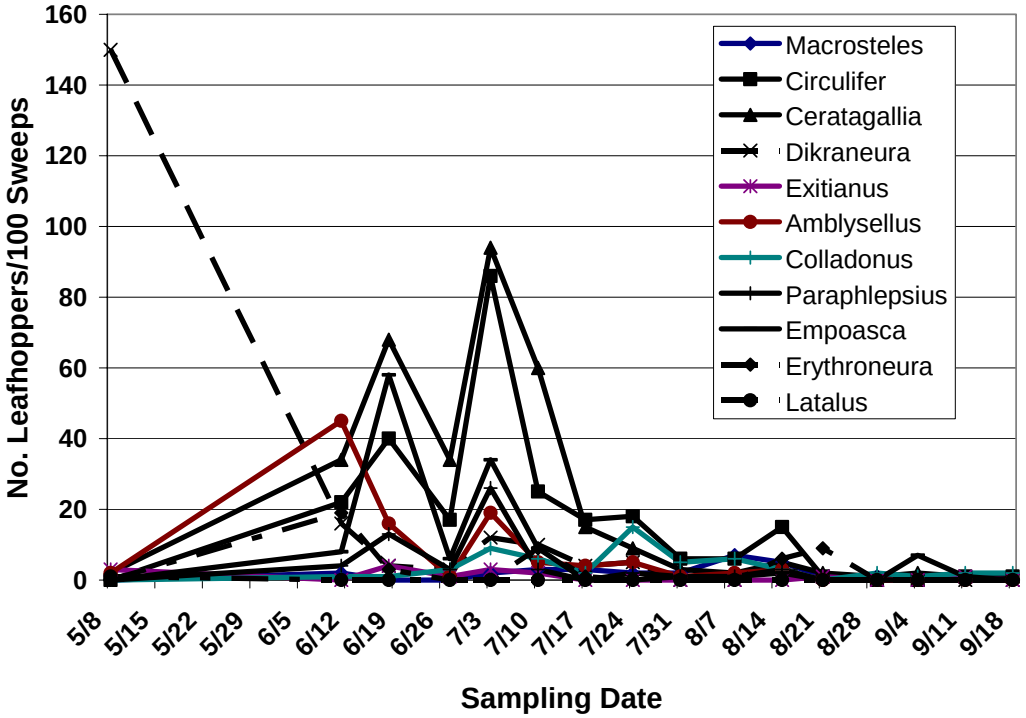

Figure 5. Alderdale 2003- Weeds

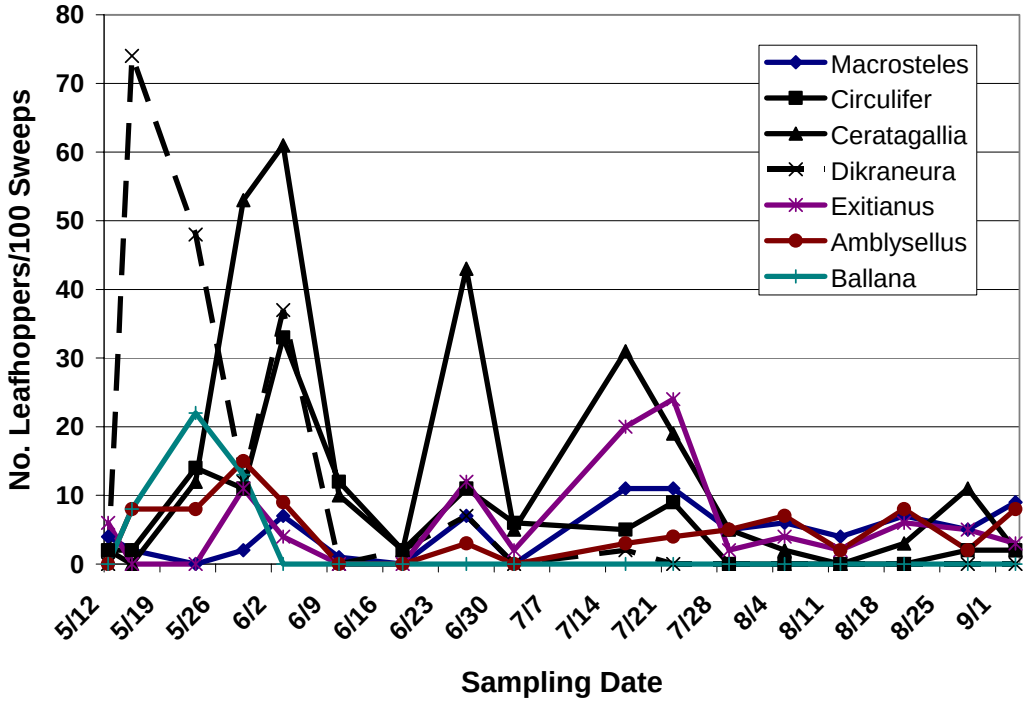

Figure 6. Alderdale 2003 - Carrots

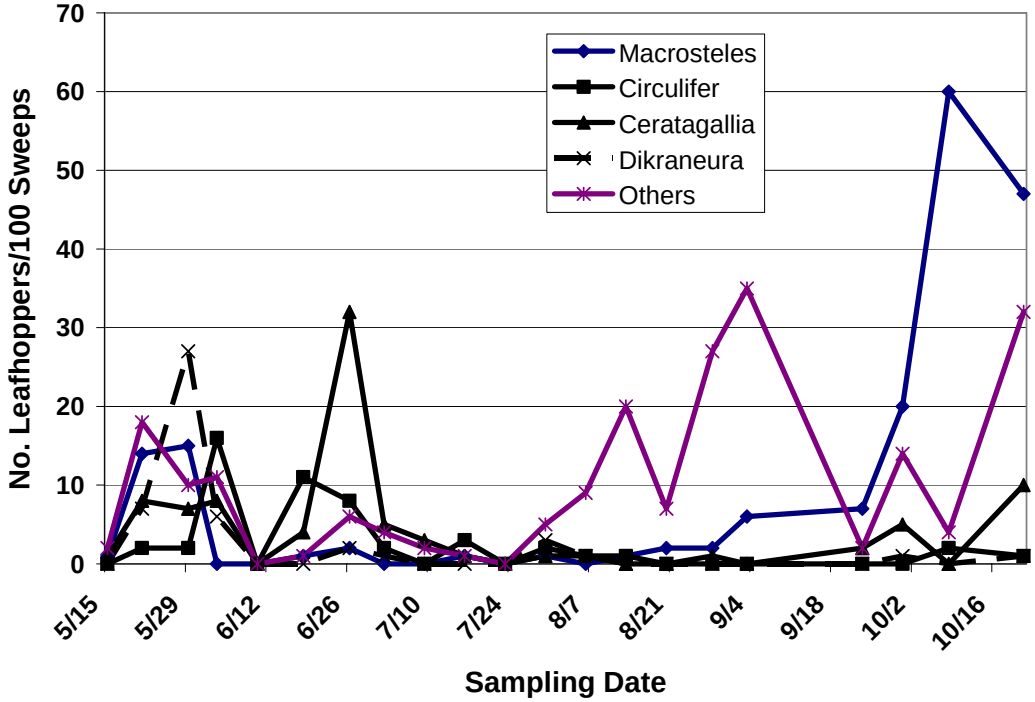

Figure 7. Hermiston 2003 - Weeds

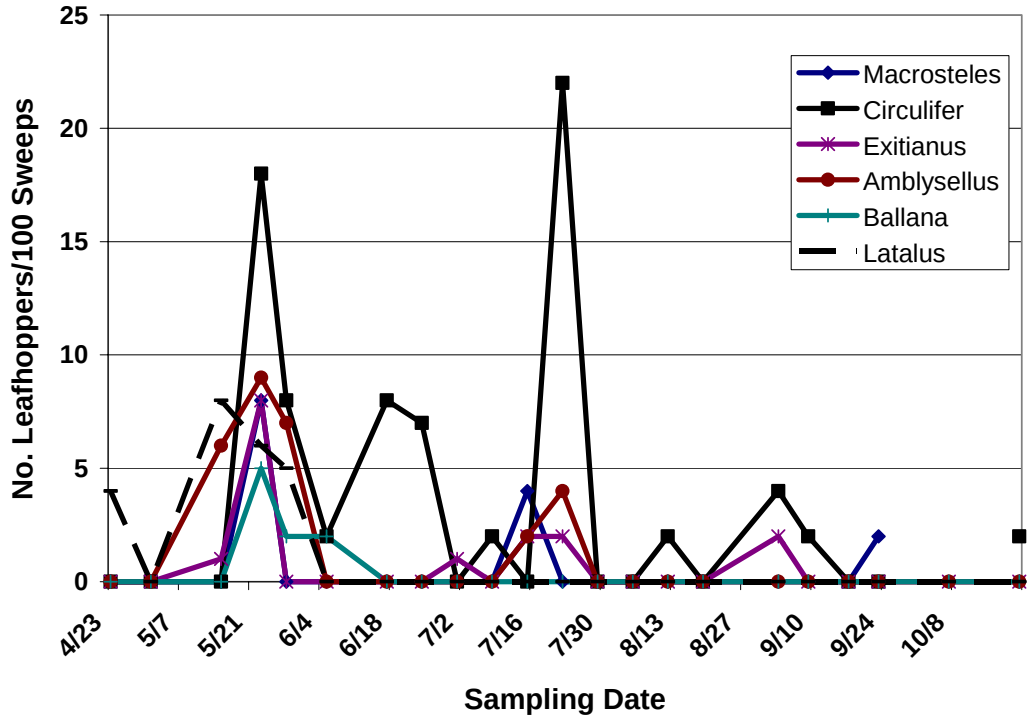

Figure 8. Hermiston 2003 - Alfalfa

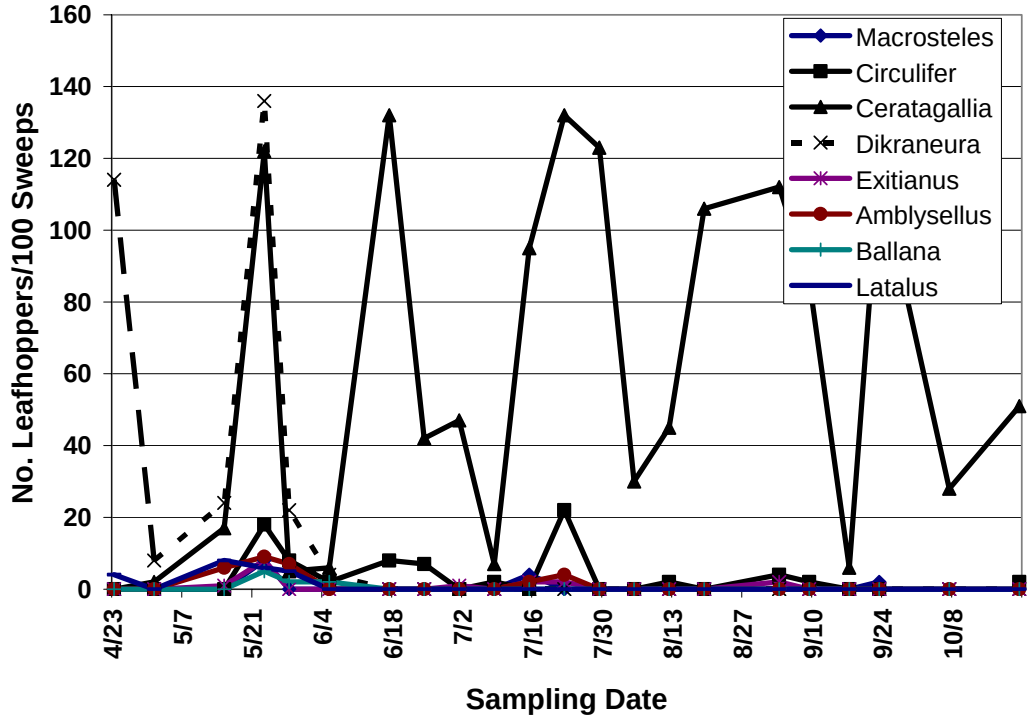

Figure 9. Boardman 2003 - Weeds/Alfalfa

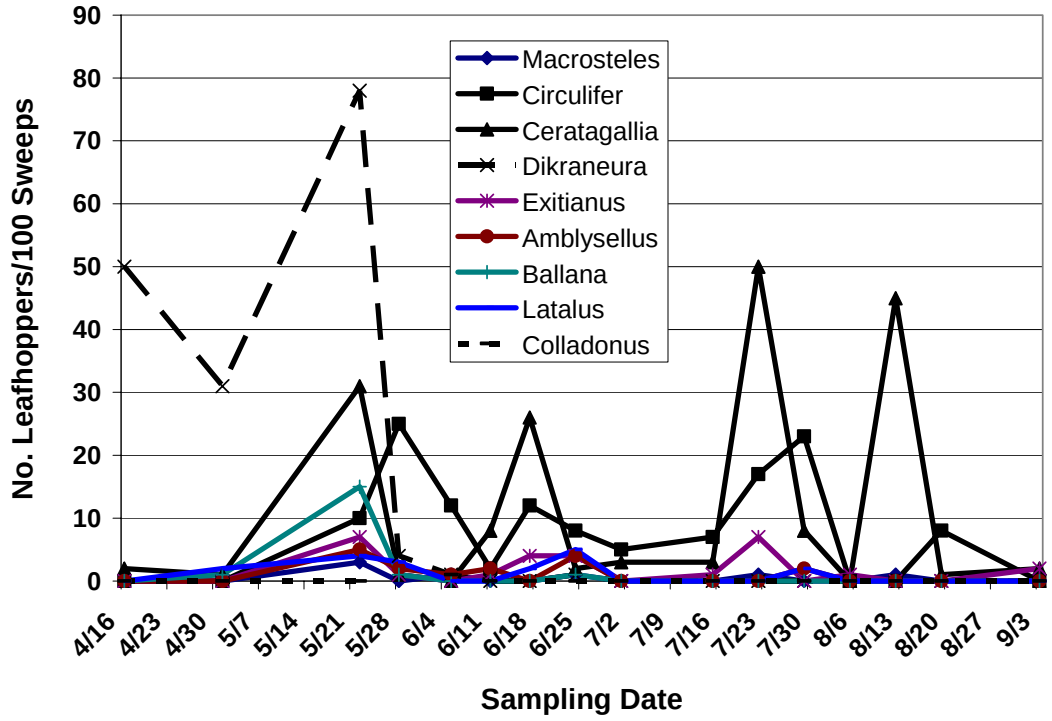

Figure 10. McNary Farms 2003 - Weeds

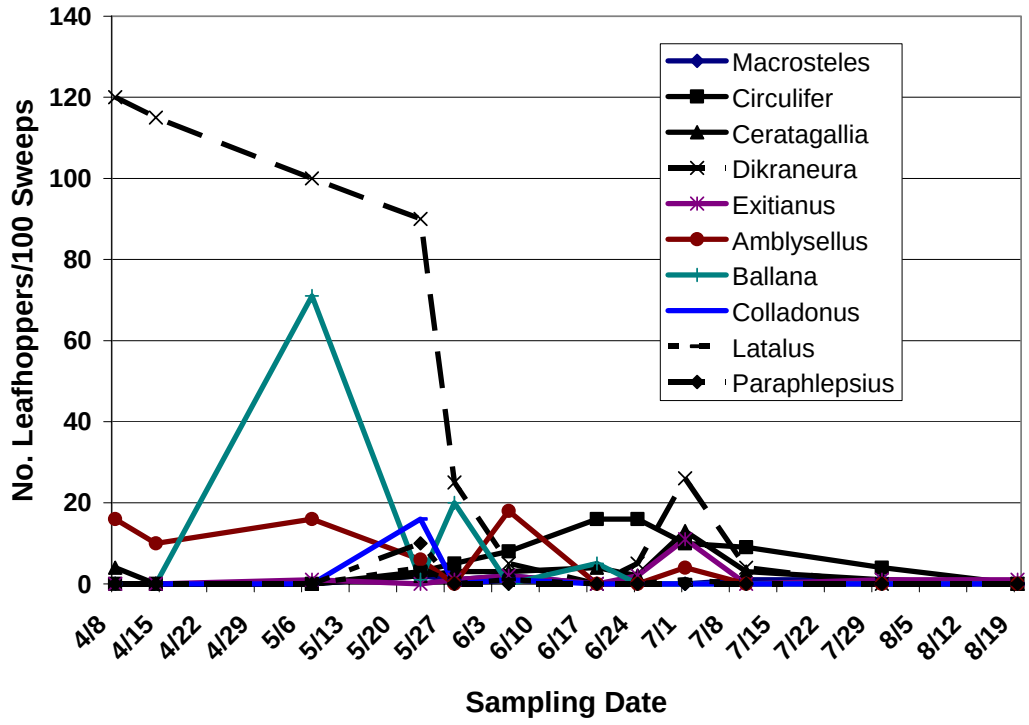

Figure 11. Pasco (K2H Farm) 2003 - Weeds/Wheat/Potatoes

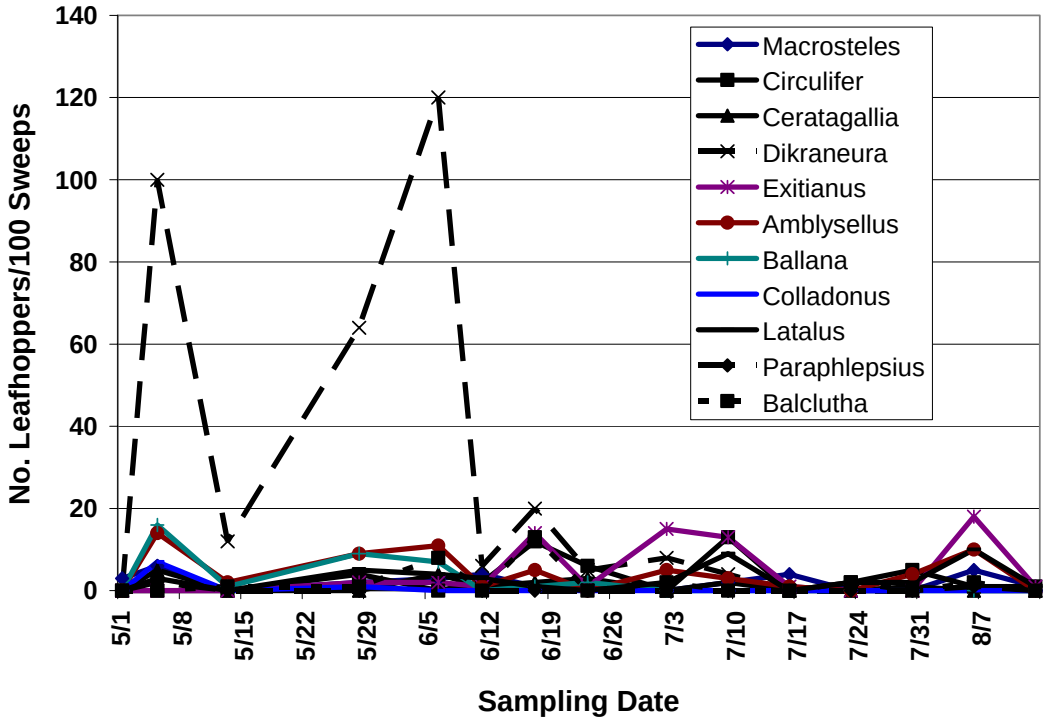

Figure 12. Wallula 2003 - Weeds/Alfalfa