Annual Progress Report

TITLE: Regional Survey for Insect Pests of Potato in the Columbia Basin of Washington

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REPORTING PERIOD: 2012

ACCOMPLISHMENTS:

Commercial potato fields across the Columbia Basin of Washington were monitored weekly to determine the size, location, and distribution of important insect populations in the region. The survey targeted four key insect pests: beet leafhoppers (BLH), aphids, potato tuberworm (PTW), and potato psyllids. In addition to these pests, other foliar arthropod pests (thrips, lygus bugs, and spider mites) and insect predators (big-eyed bugs, damsel bugs, and minute pirate bugs) were monitored and reported on when numbers were significant. Information from the survey provided early warning to potato growers when pests had been detected in the region.

Regional Survey Routes: Four survey routes covered areas in the north, west, central, and south Columbia Basin of Washington. The "north" route included fields near Moses Lake, Warden, Othello, and Connell (200 miles round trip from Ephrata). The "west" route included fields near Ephrata, Royal City, Mattawa, George, and Quincy (200 miles round trip from Ephrata). The "central" route included fields near the Kahlotus Rd., Pasco, Eltopia, Mesa, Connell, and Basin City (150 miles round trip from Pasco). The "south" route included fields near Paterson and Plymouth (150 miles round trip from Pasco). Thirty-nine potato fields were selected along these routes (Figure 1). Most of the fields were planted to long-season, russet cultivars under conventional management. One field was certified organic. Prior to entering the fields each week, the grower or field manager was contacted to learn if it would be safe to work in the field.

Beet Leafhopper, Potato Tuberworm, and Potato Psyllid Trapping: As in previous seasons of the survey, BLH were monitored using yellow sticky cards (5.25 x 3.75 inches) mounted on small stakes about 3 inches above the soil surface. Two cards were located near each potato field on the survey routes, either at the field edge, on a ditch bank, or at the open field corner (away from irrigation). BLH traps were collected weekly, from April to October. Potato tuberworm were monitored by trapping adult male moths using the same set up as in prior seasons of the survey. The traps consisted of Trece delta traps with pheromone lures on sticky liners. The traps were hung from PVC pipe stands that suspended them about 12 inches from the ground. One trap was placed near each potato field on the survey routes. Pheromone lures were provided by Dr. Peter Landoldt. The lures were replaced every three weeks. The

traps for PTW were collected weekly, from April to October. Traps for monitoring potato psyllids were yellow sticky cards (5.25 x 3.75 inches) mounted on lathe, located inside the field about 10 feet from the edge, and placed just above the plant canopy. One trap for potato psyllids was placed inside each potato field on the survey routes. Potato psyllid traps were collected weekly, from early July to vine kill. Potato psyllids found on traps were sent to Dr. Joseph Munyaneza to determine if they were infected with the bacterium, *Candidatus* Liberibacter, causal agent of zebra chip.

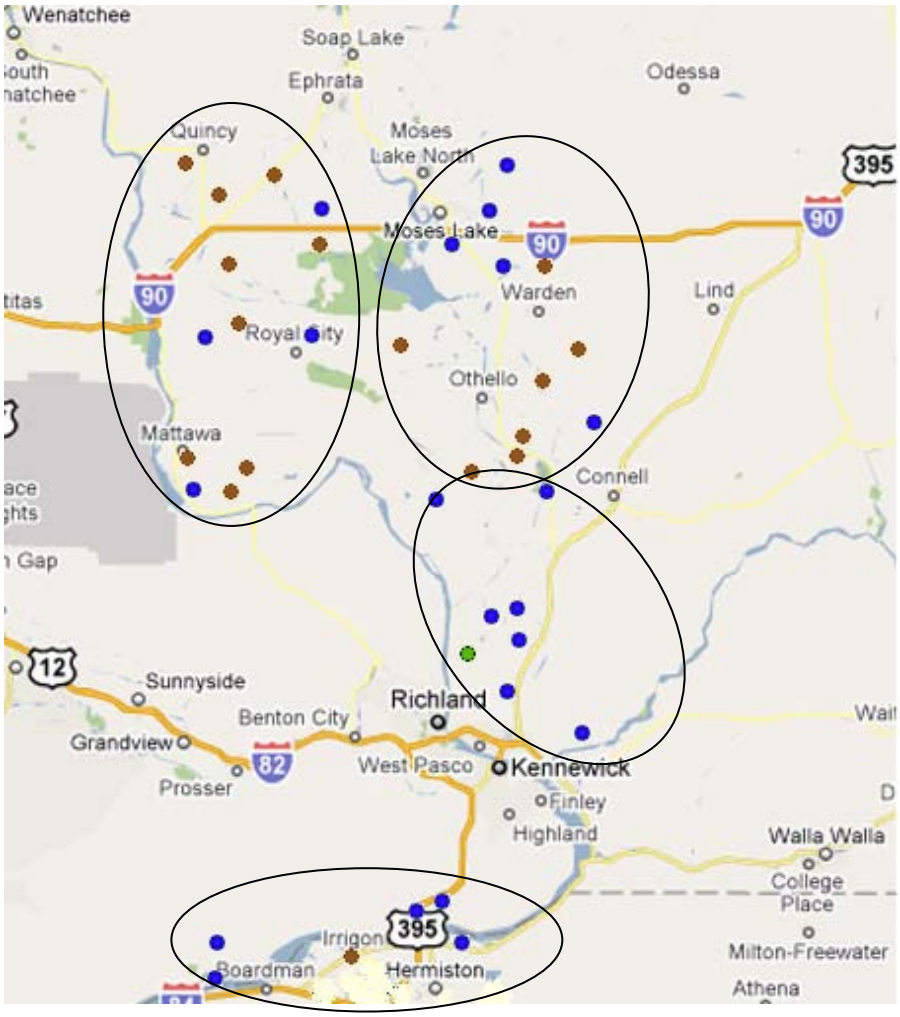


Figure 1. Map showing survey routes and locations of thirty-nine potato fields monitored in 2012.

Aphid Sampling: Aphids were monitored by sampling potato plants, using the same method established by Dr. Keith Pike in his regional aphid surveys; potato plants were vigorously shaken over a 4-5 quart, 8-in diameter collection bucket. Fifteen or more plants were sampled in each field, and aphid counts were recorded on a per plant basis. Other insects and arthropods collected in the bucket were also noted, in particular Colorado potato beetles, lygus bugs, thrips, caterpillars, spider mites, and a number of

beneficial insects. Fields were sampled in the same location each week. Sampling was initiated a few weeks after emergence and concluded at vine kill.

Potato Psyllid Sampling: In addition to trapping with sticky cards, potato psyllids were monitored by sampling potato plants in sentinel plots. This strategy for monitoring potato psyllids has been used by Dr. Joseph Munyaneza for several years, and appears to be a reliable way to detect psyllids. Sentinel plots were established by the project personnel at three strategic locations, near Paterson, Pasco, and Othello (Note that three more sentinel plots were maintained, by Dr. Joseph Munyaneza in Prosser and Moxee, and by Dr. Silvia Rondon near Hermiston). Each sentinel plot consisted of a small block of potato plants (approximately one-tenth acre) surrounded by bare ground, which were maintained without insecticides. The plots were sampled weekly using a gas-powered leaf vacuum to collect insects on plants in the outer two rows of the plot. Additionally, two yellow sticky cards were placed in each sentinel plot and changed regularly. These sampling methods were intended to detect adult psyllids. In addition, 100 leaves were collected from the sentinel plots each week and examined for potato psyllid adults, eggs, and nymphs. Sampling began shortly after emergence and continued until the end of the season. Sentinel plots located near commercial potato fields were treated after nymphs and eggs were detected, and were monitored afterwards to determine the efficacy of insecticides applied. Potato psyllids found in the plots were sent to Dr. Joseph Munyaneza to determine if they were infected with the bacterium, *Candidatus* Liberibacter, causal agent of zebra chip.

Reporting Survey Results: Results of the insect pest survey were reported to the potato industry via weekly emails, a.k.a. "potato pest alerts". The alerts summarized weekly survey results and included web links to connect subscribers to further information, including maps to show insect counts at each location, graphs of insect population trends, and recommendations for the management of pests and beneficial insects. Reports on additional pests and diseases of concern for potatoes were also included in the alerts, especially Dr. Dennis Johnson's late blight hotline information. Alerts and other information were archived on the project website at http://www.potatoes.wsu.edu/survey/PotatoInsectSurvey.html.

RESULTS:

Beet Leafhopper

General Population Trends: Another year of beet leafhopper (BLH) trapping data is helping us understand population trends for this insect in the Columbia Basin. Figure 2 shows weekly average BLH trap counts in the years from 2007 to 2012, and compares them to the 6-year average; these data are averages for the entire trapping network. The 6-year average explains the general population trend for BLH in the Columbia Basin. Typically, the traps begin to pick up small numbers of BLH in mid-late May. BLH numbers increase rapidly between May and June, with peak populations occurring in late June and early July. The numbers usually begin to drop off in August, with very few BLH in September. However, there is a lot of variability in the development and size of BLH populations each year. BLH counts over the past two seasons (2011-2012) have been the smallest on record for six seasons. The peak population in 2012 was almost ten times smaller than that of 2009, which was the year with the largest counts in the 6-year period.

Populations Trends in Different Areas in the Basin: Several seasons of trapping data indicates that some areas in the Columbia Basin tend to develop larger BLH populations than others. Figure 3 shows weekly average BLH trap counts for different areas in the Columbia Basin; these data are 6-year averages for each area. Mattawa is shown separately from the West Basin, because it tends to be a hot spot for BLH and usually maintains the largest populations of BLH through most of the season. Beet leafhoppers show up earlier in Mattawa compared to other areas of the Basin, usually early-mid May. The largest BLH populations in Mattawa occur anytime between May and early August, and the numbers tend to remain high through that period, and then drop off. The North Basin tends to maintain some of the smallest populations of BLH in the Basin through most of the potato growing season. The traps on the eastern edge of the North Basin (east Moses Lake, Warden, and east Othello) usually record the fewest BLH each year. On the other hand, the western edge of the North Basin (east Royal Slope) usually has rather large numbers of BLH. Beet leafhoppers usually show up in the North Basin between late May and early June, which is a little later than other parts of the Basin. The largest populations in the North Basin usually occur in early July. In the Central/South Basin, BLH numbers tend to peak early, around late June, and then drop off for most of the remainder of the season. In the West Basin, BLH populations tend to build more gradually, peak around late July or early August, and then drop off.

Population Trends for 2012: The BLH season in 2012 got off to a very slow start (Fig. 2); it was not until May 26th that the first BLH of the season was found on a sticky card near the Oregon border. This was about four weeks later than usual. As previously mentioned, BLH counts in 2012 were much smaller than in most previous seasons (Fig. 2). Figure 4 shows weekly average BLH trap counts for different areas in the Columbia Basin in 2012. This graph suggests that the North Basin had the largest numbers of BLH in 2012. A close investigation of the trapping data, indicates that there was one trap site on the western edge of the North Basin route (east Royal Slope) that had significantly larger numbers of BLH compared to anywhere else in the Columbia Basin in 2012. This site had a peak count of 110 BLH per card, and accumulated 417 BLH over the season. The second largest peak count was 18 BLH per card on traps southwest of Ephrata and near Pasco, which accumulated totals of 76 BLH and 66 BLH over the season.

North Basin 2012: Figure 5 shows the average weekly BLH trap counts for the North Basin in 2012 vs. the 6-year average for the area. Beet leafhoppers in the North Basin were late to show up compared to previous seasons, and the peak population was smaller in 2012 compared to most seasons. In 2012, average trap counts in the North Basin peaked at 6.2 BLH per card the week of August 7th. As mentioned above, the largest number of BLH found on a card in the North Basin was (110) the week of August 7th on a trap at the east end of the Royal Slope; this was the only trap location in the North Basin that had a count greater than 10 BLH per card during the 2012 season. All other traps in the North Basin had very low peak counts of only 1-10 BLH per card.

Mattawa 2012: Figure 6 shows the average weekly BLH trap counts for the Mattawa area in 2012 vs. the 5-year average for Mattawa (we did not trap BLH in Mattawa in 2009). Mattawa was not a "hot spot" for BLH in 2012. The average trap counts in Mattawa peaked at 2.1 BLH per card the week of July 12th, which was about thirteen times smaller than the typical average peak population for the Mattawa area. The largest number of BLH found on a card in Mattawa in 2012 was (6) the week of July 7th. All other traps in the Mattawa area had similar counts, peaking at 3-6 BLH per card.

West Basin 2012: Figure 7 shows the average weekly BLH trap counts for the West Basin in 2012 vs. the 6-year average for the area. As in other parts of the Basin, BLH were delayed and their numbers were few on traps in the West Basin in 2012. The average trap counts in the West Basin peaked at 3.3 BLH per card the week of August 16th. The largest number of BLH trapped on a card in the West Basin in 2012 was (18) the week of August 20th on a trap southwest of Ephrata. Other traps in the West Basin had peak counts of 1-13 BLH per card in 2012.

Central/South Basin 2012: Figure 8 shows the average weekly BLH trap counts for the Central/South Basin in 2012 vs. the 6-year average for the area. Again, the counts were very low compared to most other seasons. In 2012, the average trap counts in the Central/South Basin peaked at 1.4 BLH per card the week of August 16th. The largest number of BLH trapped on a card in the West Basin in 2012 was (18) the week of June 21st on a trap north of Pasco. Other traps in the Central/South Basin had peak counts of 1-16 BLH per card in 2012.

Recommendations: Beet leafhopper counts were reported in the "potato pest alerts" most weeks during the season. The alerts sent in June included timely information about monitoring BLH and some recommendations for management. This information was also archived on the website. The following information was provided and recommendations were made…

"Beet leafhoppers are important pests because they transmit BLTVA, a phytoplasma that causes purple top disease in potatoes. In the Columbia Basin the first spring generation of BLH usually migrates towards potato fields in late May and early June, with a peak flight in late June. Yellow sticky traps placed near potato fields are one way to monitor BLH. Information about setting up traps and identifying BLH can be found in the article, "*Beet Leafhopper Monitoring with Yellow Sticky Cards*" by Dr. Andy Jensen. Treatment thresholds based on BLH numbers on traps have not been established, but we know that the risk of infection increases as BLH populations become large. If the numbers on traps build up to 40 or more BLH per week, then it is probably time to be concerned. A typical weekly catch during peak BLH activity is 100. Eliminating weed hosts (wild mustards, Russian thistle, kochia) in areas surrounding potato fields is a cultural management approach for BLH. Potato growers may also select cultivars that are less susceptible to purple top (Ranger, Umatilla, and Norkotah are considered highly susceptible; Russet Burbank is susceptible; and Alturas and Shepody are moderately susceptible). A number of insecticides are labeled for use on potatoes to control leafhoppers. There is new research to suggest that systemic at-planting insecticides, especially those with longer residual activity applied at the maximum allowed rate, provide adequate early season control of BLH. Results may vary depending on the product used, application rate, soil and environmental conditions, and insect pressure. Foliar insecticides may also be used to control BLH. These are usually applied in May, June, and sometimes July. Insecticides with long residual activity (10-14 days) are preferred. If you apply a non-systemic insecticide, it may be necessary to shorten the application interval during periods of rapid plant growth to ensure adequate plant coverage. Remember to always read and follow instructions on the pesticide label. For more information about managing BLH, read the *IPM Guidelines for Insects and Mites in ID, OR, and WA Potatoes* and the *2012 PNW Insect Management Handbook*."

Figure 2: Beet Leafhopper Population Trends in the Columbia Basin of WA
Weekly Trapping Data from 2007 to 2012 vs. 6-Year Average

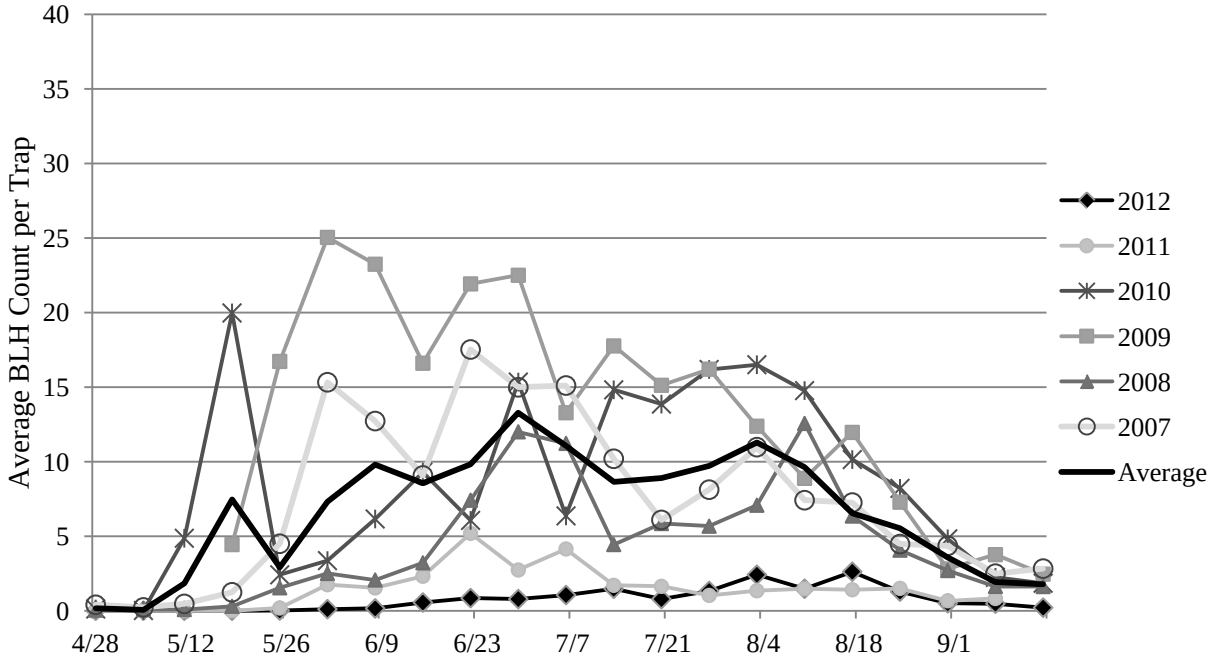


Figure 3. Beet Leafhopper Population Trends in the Columbia Basin of WA
Weekly Trapping Data from Different Areas in the Basin: 6-year Averages

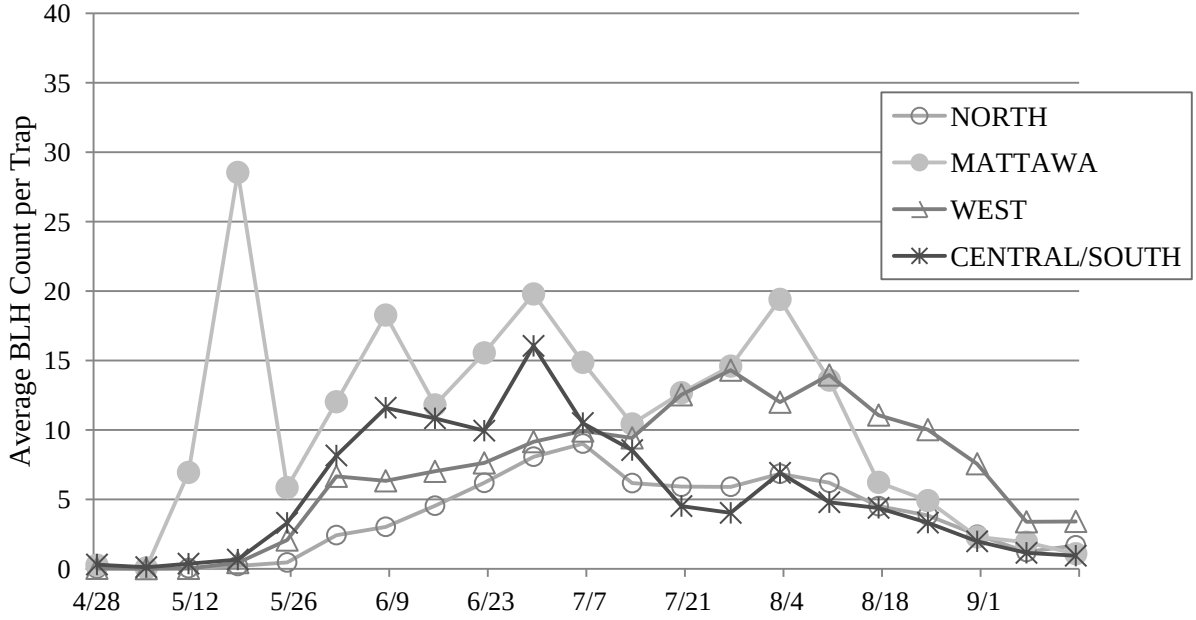


Figure 4. Beet Leafhopper Population Trends in the Columbia Basin of WA
Weekly Trapping Data from Different Areas in the Basin: 2012

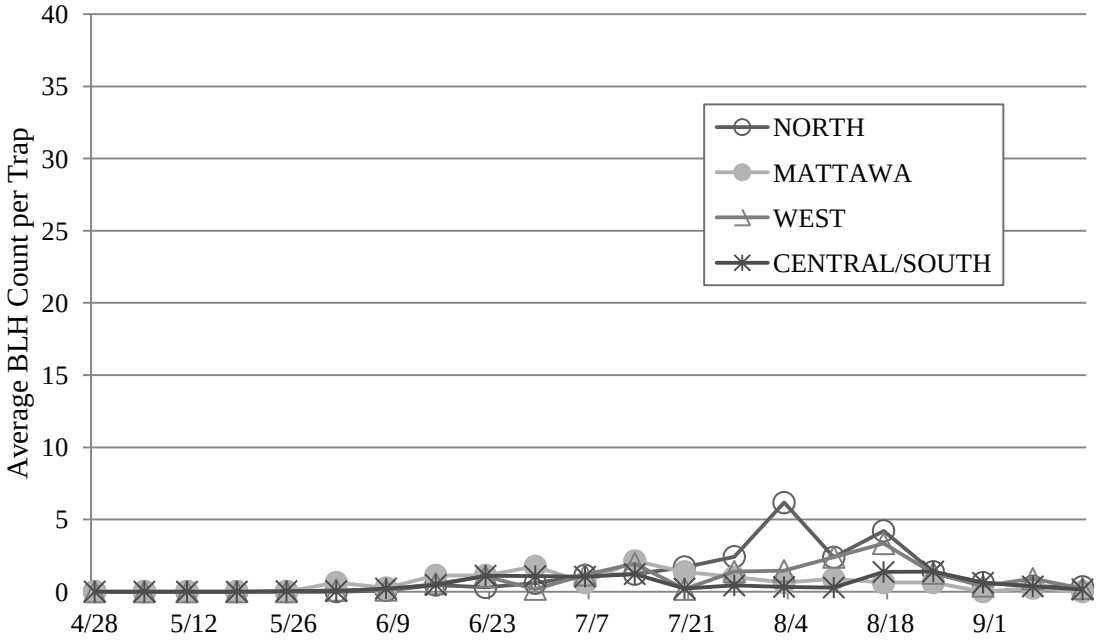


Figure 5. Beet Leafhopper Population Trends in the NORTH Basin
Weekly Trapping Data: 2012 vs. 6-Year Average

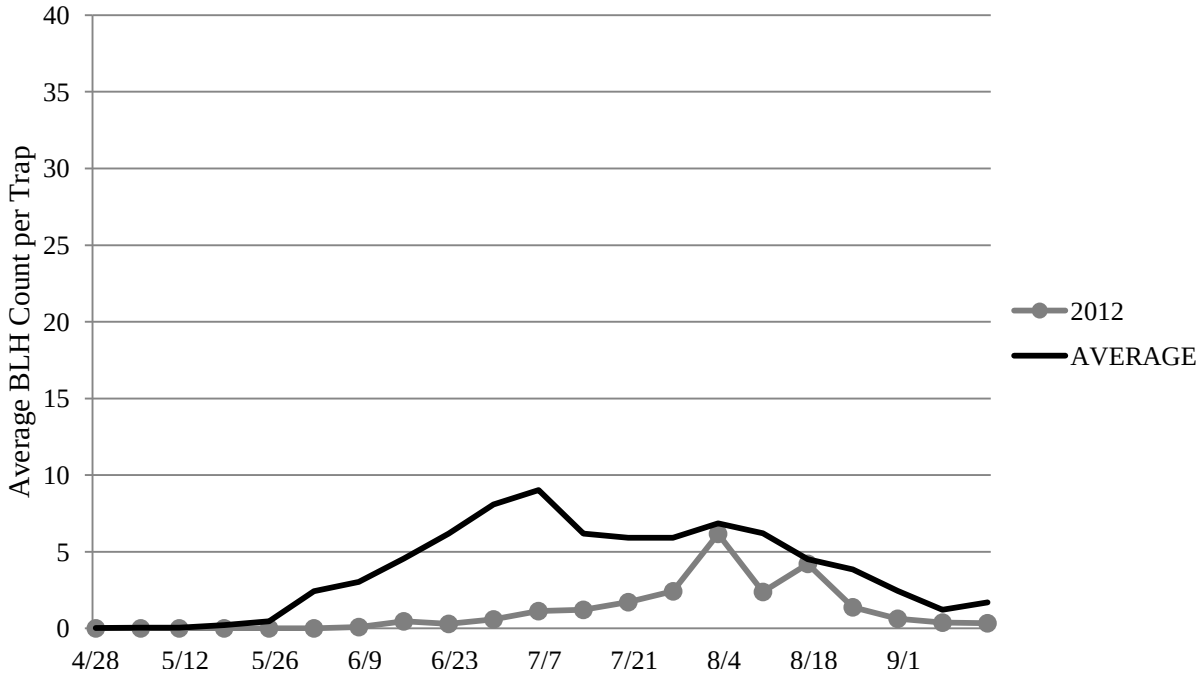


Figure 6. Beet Leafhopper Population Trends in MATTAWA, WA
Weekly Trapping Data: 2012 vs. 5-Year Average

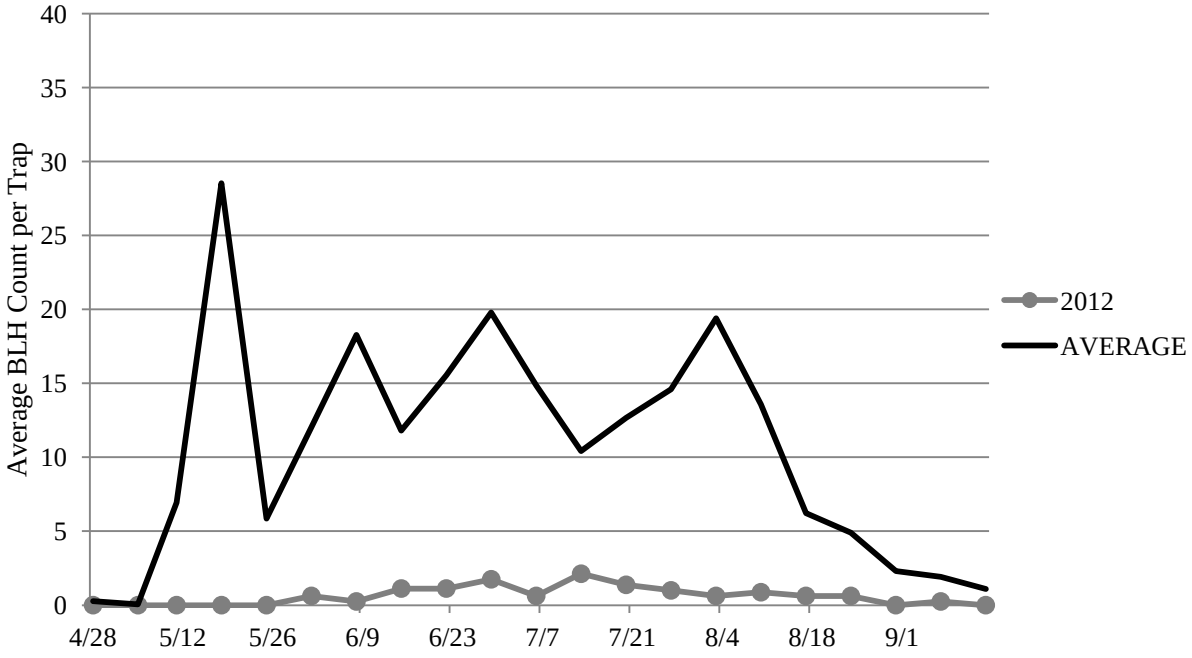


Figure 7. Beet Leafhopper Population Trends in the WEST Basin
Weekly Trapping Data: 2012 vs. 6-Year Average

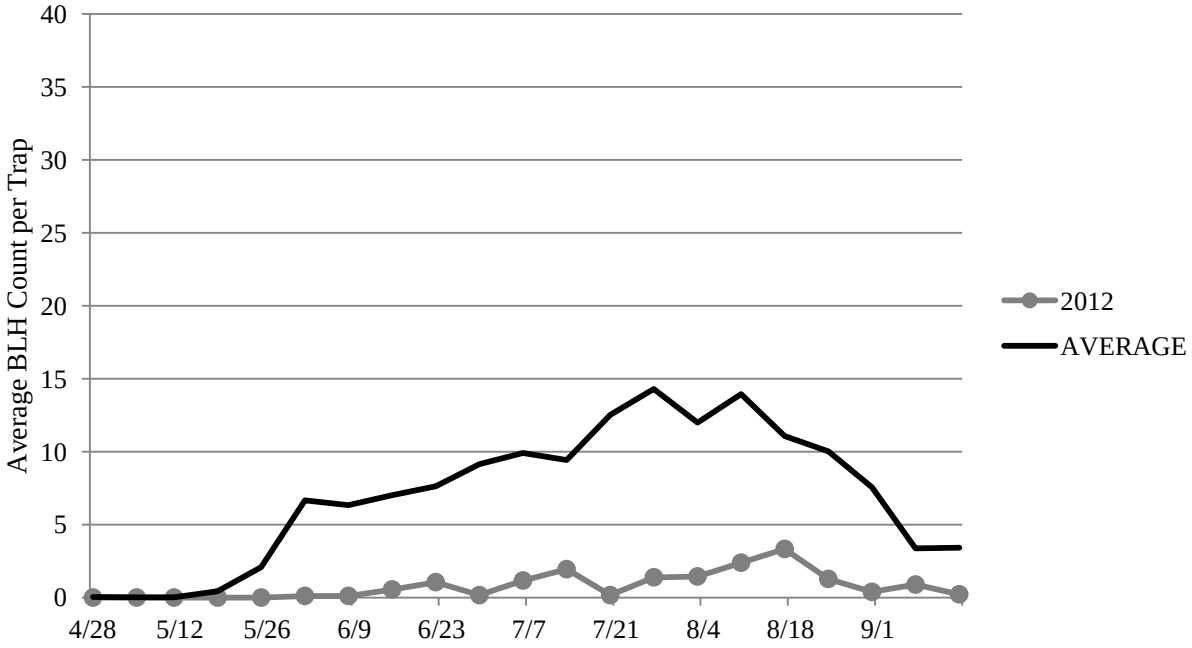
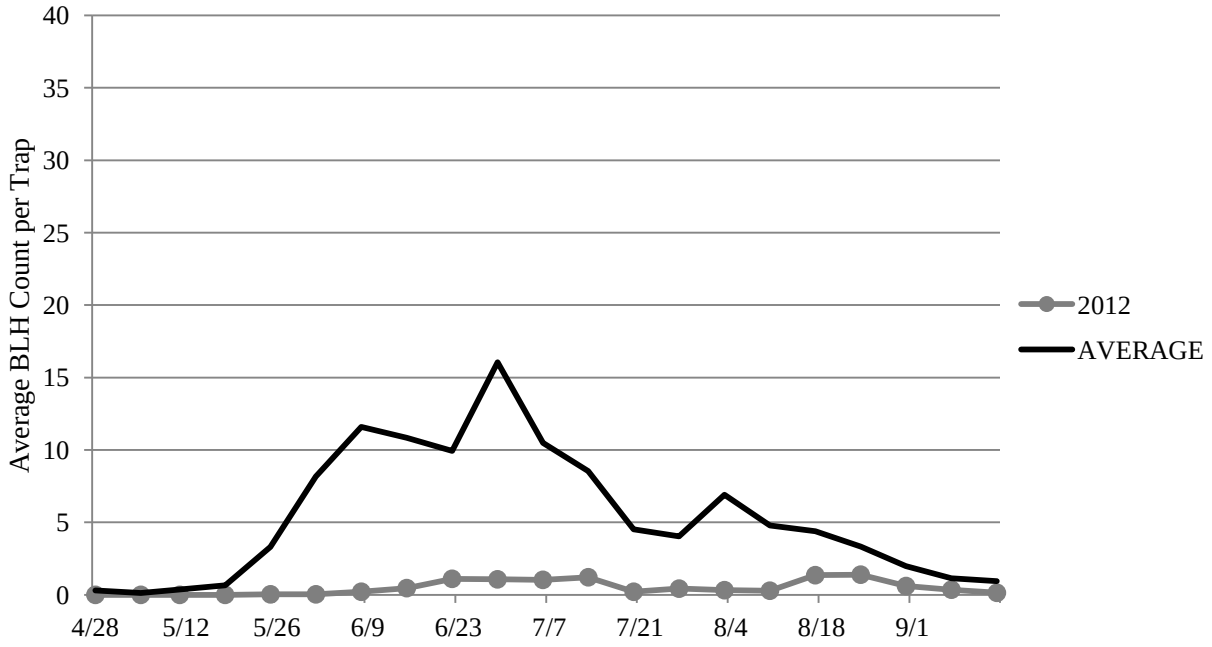


Figure 8. Beet Leafhopper Population Trends in the CENTRAL/SOUTH Basin
Weekly Trapping Data: 2012 vs. 6-Year Average



Potato Tuberworm

Population Trends in Different Areas in the Basin: Potato tuberworm (PTW) populations have been monitored for several years in the Columbia Basin using pheromone traps to attract adult male moths. Figure 9 shows weekly average PTW moth trap counts for different areas in the Columbia Basin; these data are 6-year averages for each area. The graph clearly shows that PTW populations vary greatly in different parts of the Basin; the vast majority of PTW moths are collected in the Central/South Basin, and very few in the North Basin or West Basin. Moreover, the PTW moth trapping network in Northeastern Oregon usually has even larger weekly average trap counts, compared to the Central/South routes in the Columbia Basin of WA.

General Population Trends: Figure 10 shows the average weekly PTW moth counts for the Central and South Basin routes from 2007-2012, and compares them to the 6-year average. Typically, the PTW moths begin to show up in traps in mid-late June and the numbers slowly increase between July and September. The largest PTW moth counts are usually in late September and early October.

North Basin 2012: The first PTW moth caught in the North Basin in 2012 was on July 3rd on a trap east of Othello. Over the season, PTW moths were found in traps at eight of twelve sites in the North Basin, but the counts were always quite small. The most PTW found in a trap in the North Basin was (4) on October 2nd north of Connell. This trap collected (8) moths over the course of the season. The other traps with PTW moths in the North Basin collected only 1-4 moths total for the season.

West Basin (including Mattawa) 2012: In the West Basin, PTW moth were detected at only three out of thirteen traps sites all season; two were traps near Mattawa, and one was a trap near Royal City. These traps only collected 1-2 PTW moths total for the season.

Central/South Basin 2012: An unusually large number of PTW moths were collected the first week of trapping (on March 28th) in the Central/South Basin in 2012 (Fig. 10). They were found in eight of fourteen traps and counts were 1-8 moths per trap. After that, the counts decreased and did not begin to build up again until July. Moth counts increased from July to September. All traps on the Central and South Basin routes caught PTW moths over the course of the season, but some caught a lot more than others. The most PTW moths found in a trap in the South Basin in 2012 was (54) on September 20th in a trap near Paterson. This trap collected the most PTW moths over the course of the season, a total of (290). Other traps in the Central/South Basin collected 2-75 PTW moths total for the season. There was a lot of variability in trap counts, and infestations were highly localized. The traps nearest Pasco and Paterson collected the most PTW moths. By contrast, the traps near Connell and Basin City collected only (2) and (3) moths total for the season.

Recommendations: Potato tuberworm moth counts were reported in the "potato pest alerts" each week. The alerts sent in late July and August included more detailed guidance about monitoring and managing PTW. Growers were also alerted (mid-August and thereafter) that some tuber damage caused by PTW feeding had been reported in fields being harvested near Pasco and Eltopia. The following information was provided…

"Potato tuberworm (PTW) was first recognized as an important pest of potatoes in the southern Columbia Basin in 2003. PTW larvae feed on tubers causing damage that renders them unmarketable. Potato growers with fields south of Connell, WA are recommended to pay close attention to regional trapping data, and should deploy pheromone traps. Infestations of PTW are highly localized, and it is risky to conclude too much from traps that may be several miles away. Information about setting up traps and identifying PTW moths can be found in the article, "*Tuberworm Monitoring with Pheromone Traps*" by Dr. Andy Jensen. Trap counts from mid-season to harvest are particularly important to watch. The more moths you find in the traps, the more tuberworm larvae you are likely to find in the field feeding on plants and tubers. Pre-harvest control measures may be warranted in fields where PTW moths in pheromone traps are found to be increasing every week, especially in August-September. Cultural methods reported to reduce PTW damage include 1) eliminate cull piles and volunteers to reduce overwintering stages of PTW; 2) maintain soil moisture after vine kill to prevent soil cracking; 3) minimize the time between vine desiccation and harvest; and 4) ensure that tubers have more than 2" of soil covering them in the hill. Insecticide applications beginning 4-8 weeks before harvest have been shown to reduce PTW in tubers. For more information about managing PTW, study the *2012 IPM Guidelines for Insects and Mites in ID, OR, and WA Potatoes* and the *2012 PNW Insect Management Handbook*."

Figure 9. Potato Tuberworm Population Trends in the Columbia Basin
Weekly Trapping Data from Different Areas of the Basin: 6-Year Averages

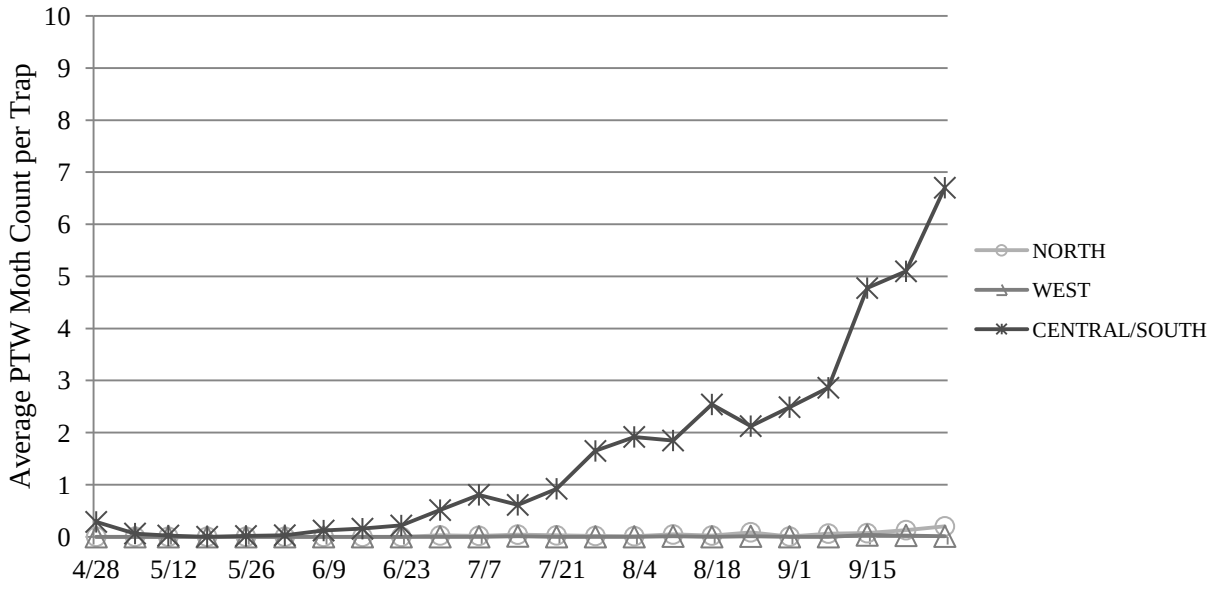
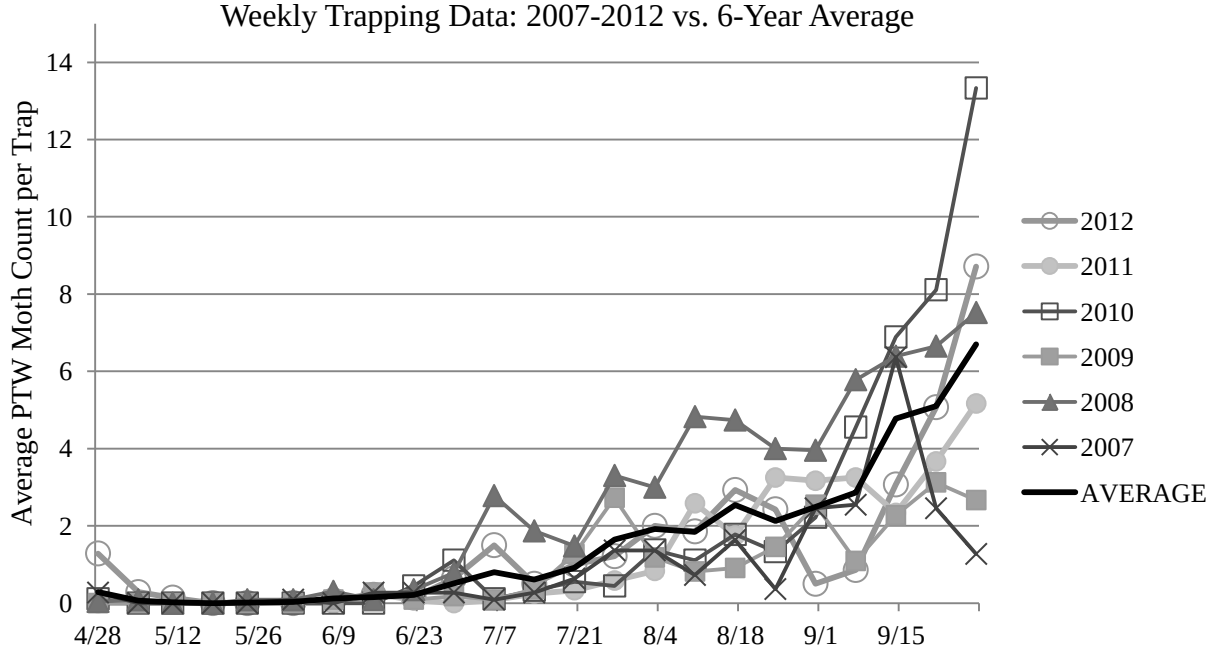


Figure 10. Potato Tuberworm Moth Population Trends in the
CENTRAL/SOUTH Columbia Basin
Weekly Trapping Data: 2007-2012 vs. 6-Year Average



Aphids

General Population Trends: Aphid population trends in long-season potato fields in the Columbia Basin in the years from 2004 to 2012 are presented in Figure 11. It shows the weekly average number of aphids per plant each season (the data are in logarithmic scale because the values range widely). For the past four seasons (2009-2012) aphid counts have been smaller compared to prior seasons (2004-2008). This probably reflects the recent, widespread adoption by potato growers of systemic neonicotinoid insecticides applied at planting. We have often observed that large infestations of aphids are more common in fields in which aphids are managed with an in-season foliar insecticide program alone, i.e. without the application of a systemic insecticide at planting.

In general, the aphids we find at the beginning of the season are primarily winged, migratory morphs of several species. We start to find more wingless, colonizing aphids and fewer migratory aphids as the season progresses. By July-August, most of the aphids are wingless, and most of them are green peach aphids (GPA). At the season end, we start to see migratory aphids again in samples from potato fields.

Population Trends for 2012: Figure 12 shows weekly aphid sampling data recorded in 2012; the graph shows both the average percentage of fields in which aphids were detected each week, and the average number of aphids per plant in those fields. Aphids were found in 12% of the fields we monitored on the first sampling date the week of June 7th. All but one of these were winged aphids (GPA and others) and their numbers were few, only 0.1 aphids per plant. A few wingless aphids were found in potato fields on the Central and South Basin routes in June, but did not start to show up in North Basin and West Basin fields until early July. The week of July 8th we found aphids in 85% of the fields sampled, but the counts continued to be small, only 0.25 aphids per plant. Most of the aphids found in early July were winged and of various species, and only a small number of these were wingless GPA. After that, the numbers of fields with aphids declined until the end of July. In August and September the numbers of fields with aphids increased again, and the size of the populations in these fields increased as wingless aphids multiplied. Of the fields that were still growing at the end of September, 81% had aphids and the populations in these fields averaged 7.1 aphids per plant. The largest field infestation of aphids in 2012 was 30.0 aphids per plant on September 18th in a field on the east end of the Royal Slope. In 2012, ten of the thirty-nine fields (26%) we monitored for aphids exceeded populations of 1 or more aphids per plant, but most did not get there until very late in the growing season.

Population Trends in Different Areas in the Basin: Figure 13 shows the average weekly aphid populations for each of the routes in 2012. There did not appear to be any areas in the Columbia Basin that were more or less prone to have aphids. All routes had similar population trends for aphids in general.

Recommendations: Aphid counts were reported in all of the "potato pest alerts" in June and thereafter. The following recommendations were made…

"Aphids are important pests because they transmit several important potato viruses, especially potato leafroll virus (PLRV) and potato virus Y (PVY). Green peach aphids are the most important vector of PLRV, which has caused substantial yield and tuber quality losses in the Columbia Basin. PLRV causes net necrosis in some cultivars, an unacceptable tuber defect in processing potatoes. PVY

can also result in significant yield losses, and some strains cause tuber defects. Potato growers should monitor fields for aphids at least once a week, because early recognition and control of aphids is the best tactic in limiting spread of potato viruses. Current recommendations are to treat long-season storage potatoes as soon as wingless aphids are detected to prevent spread of PLRV. Low tolerances have been established because even a low incidence of seed borne PLRV can spread rapidly if aphids go unchecked. You can find more information about aphids and the viruses they spread in the *2012 IPM Guidelines for Insects and Mites in ID, OR, and WA Potatoes*."

Figure 11. Aphid Population Trends
Weekly Potato Field Sampling Data: 2004-2012

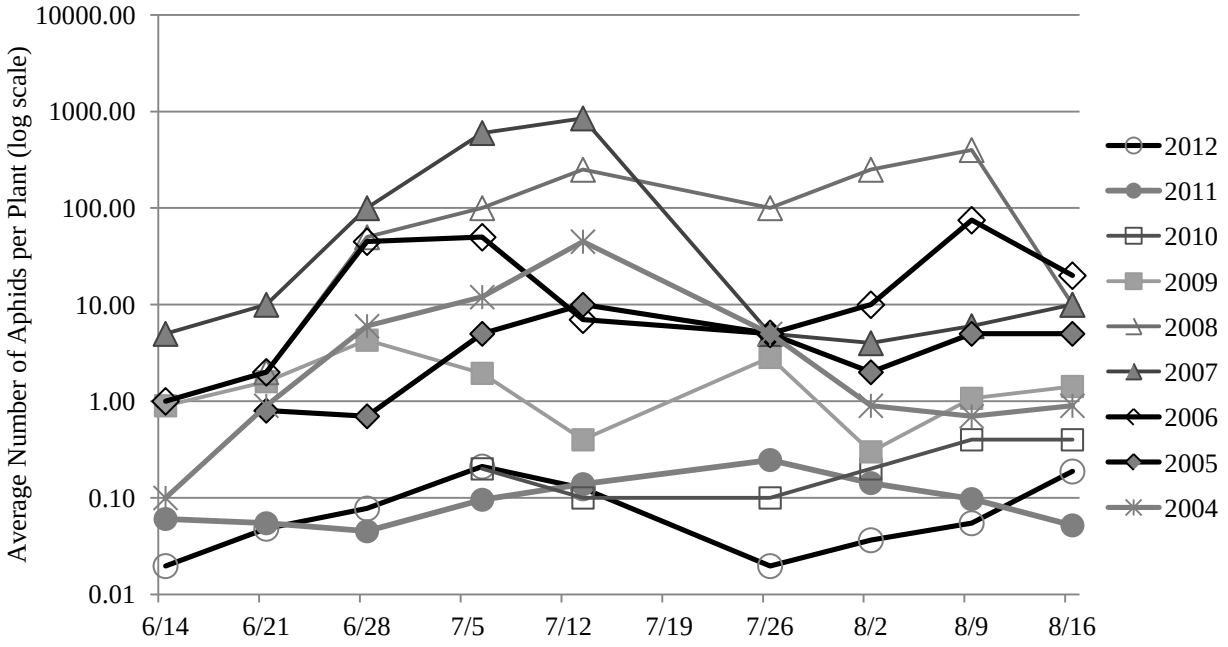


Figure 12. Aphid Population Trends
Weekly Potato Field Sampling Data: 2012

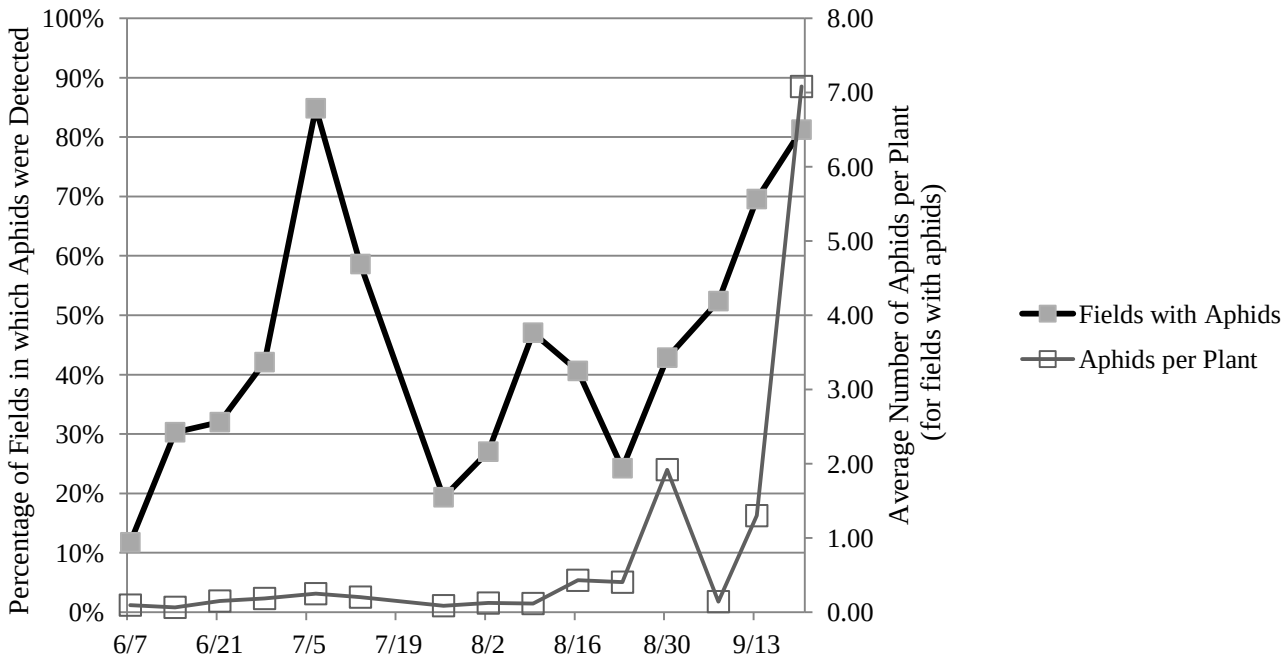
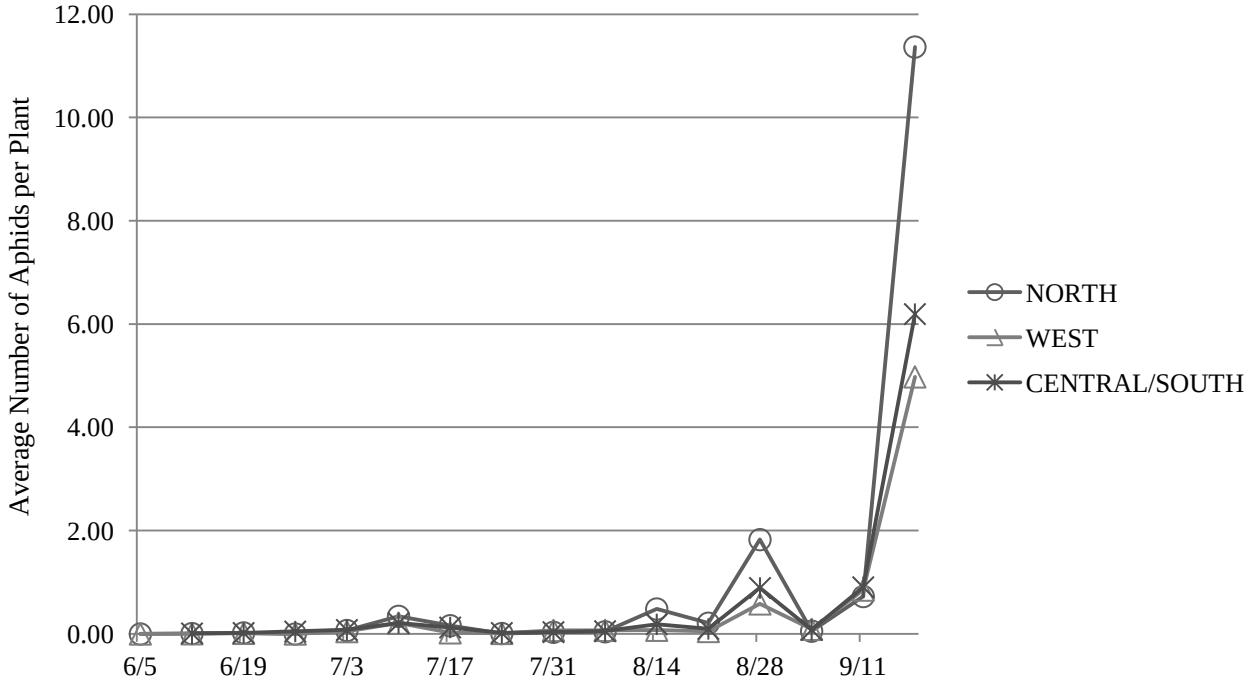


Figure 13. Aphid Population Trends in the Columbia Basin of WA
Weekly Potato Field Sampling Data: 2012



Potato Psyllids

Sentinel Plots: Monitoring of the sentinel plots at Paterson, Pasco, and Othello started the first week of June. On June 26th, one adult potato psyllid was collected in the Paterson plot using a leaf vacuum. The following week, two adult potato psyllids were collected in the Pasco plot using a leaf vacuum. Adult potato psyllids were not detected in the Othello sentinel plot until August 28th. Nymphs were first detected in the Paterson plot on July 20th, in the Pasco plot on August 3rd, and in the Othello plot on September 4th. All of the potato psyllids collected in the sentinel plots tested negative for the bacterium, *Candidatus* Liberibacter (Lso).

Figures 14a and 14b show potato psyllid sampling data in the Paterson and Pasco sentinel plots in 2012; the graphs show both adult and nymph sampling data, and they are shown in the same scale. The insecticide, abamectin (AgriMek), was applied to the sentinel plot in Paterson shortly after nymphs were detected. It was vine killed on August 28th. Insecticides were not applied to the sentinel plot in Pasco, which was more isolated from commercial fields. This allowed for an interesting comparison of potato psyllid infested plots with and without insecticide treatment. Potato psyllid populations did not increase much following the insecticide application in the Paterson sentinel plot. However, in the Pasco plot the potato psyllid population increased rapidly once nymphs were first detected and left to develop unchecked by insecticides. We conclude that the single application of abamectin was well-timed and very effective at controlling the potato psyllids in the sentinel plot.

Yellow Sticky Cards: Yellow sticky cards were deployed in the thirty-nine surveyed fields beginning the first week of July. Over the course of the season, only seven of the thirty-nine trapping sites collected any potato psyllids; three of these trap sites were close to the Oregon border near the towns of Plymouth and Paterson, two trap sites were west of Royal City, and one trap site was near Mattawa. Each of these sites collected only 1-3 adult potato psyllids over the season. In total, there were only (12) potato psyllids collected on the hundreds of cards that were deployed during the season.

Potato Psyllid Timeline: The following is a rough timeline for some of the more notable potato psyllid collections on potatoes in the Pacific Northwest. These were reported and made public by personnel operating trapping networks in ID, OR, and WA. It is an incomplete list and intended only to highlight some of the first reports of potato psyllid in various areas.

- 6/11/12 — 1 adult, not specified, near Irrigon, OR, crop advisor, negative Lso
- 6/12/12 — 2 adult, vacuum, Prosser Sentinel Plot, J. Munyaneza, negative Lso
  (J. Munyaneza and crew continued finding psyllids each week thereafter.)
- 6/13/12 — 1 adult, sticky card, near Hermiston, OR, crop advisor, negative Lso
- 6/19/12 — 2 adult, sticky cards, near Twin Falls, ID, E. Wenninger, positive for Lso
  (E. Wenninger and crew continued to find psyllids in this area of central ID thereafter, but none were found in southeast or southwest ID in 2012.)
- 6/26/12 — 1 adult, vacuum, Paterson Sentinel Plot, T. Waters, negative Lso
  (T. Waters and crew continued finding psyllids thereafter, but numbers were small, especially following treatment with insecticide. Many more potato psyllids were found by crop advisors monitoring fields in this area).

- 7/2/12 1 adult, vacuum, Moxee Sentinel Plot, J. Munyaneza, negative Lso (J. Munyaneza and crew continued finding psyllids each week thereafter.)
- 7/3/12 2 adult, vacuum, Pasco Sentinel Plot, T. Waters, negative Lso (T. Waters and crew continued finding psyllids thereafter, with increasing numbers each week.)
- 7/6/12 17 adult, vacuum, OSU HAREC Trap Network of 7 fields, S. Rondon, negative Lso (S. Rondon and crew continued finding psyllids on some of the fields on her routes each week thereafter.)
- 7/10/12 1 adult, sticky card, near Royal City, C. Wohleb, negative Lso
- 7/17/12 1 ZC plant, observed, near Kimberly, ID, E. Wenninger, positive for Lso
- 7/24/12 2 ZC plants, observed, near Hermison, OR, S. Rondon, positive for Lso
- 7/24/12 adults, vacuum, near Hermiston, OR, S. Rondon, positive for Lso
- 8/16/12 1 adult, sticky card, NE of Pasco, C. Wohleb, no Lso
- 8/20/12 1 adult, sticky card, near Mattawa, C. Wohleb, no Lso
- 8/28/12 4 adults, vacuum, Othello Sentinel Plot, C. Wohleb, no Lso.

Recommendations: Information about potato psyllids and sampling results for potato psyllids were provided every week in the "potato pest alerts". We also made a best effort to provide management recommendations to growers, but it continues to be difficult to accurately assess the risk of damage to crops throughout the Columbia Basin. The following information was provided in an alert on September 21st, and is similar to information provided through the season…

"Potato psyllids are important pests mostly because they can transmit a bacterium (*Candidatus* Liberibacter *solanacearum*) to potatoes that causes zebra chip disease (ZC). This disease reduces both yield and tuber quality and has lead to serious economic losses in some regions. ZC was first detected in potato fields in the Columbia Basin in 2011, and it has occurred again in 2012. Yellow sticky cards are recommended for detecting psyllid migration into an area. The cards should be placed inside the field, near the field edge, and just above the canopy level. It is best to have five or more yellow sticky cards around the field. Another method for sampling adult psyllids is to use an inverted leaf blower with a mesh net secured to the end of the cylinder. This method is better for detecting low population densities than the sticky cards. Operate the machine (in vacuum mode) above the potato plants for at least 5 minutes, 5-10 feet from the edge of the field, and then carefully remove the net from the end of the cylinder. It helps to transfer the insects from the net to a plastic bag that you can seal, and then look for the tiny winged adults. If you place the bag in the freezer for a while, you can slow the buzzing insects down which will make it easier to scan the bag. Other life stages of the psyllid may be found by collecting several leaves (mid-plant) from the outer rows of the field, and then scanning the underside (with a hand-lens) for the tiny nymphs and eggs. It is also recommended to scout for psyllids in cull piles and volunteer potatoes."

"This week, we found one potato psyllid on each of three sticky cards in commercial potato fields located in the area north of the WA/OR border. These are three of the sites we have been monitoring since early July using yellow sticky cards. The aim has been to see where potato psyllids might appear across the Basin this season. We have found potato psyllids on sticky cards at 7 of 39 locations so far (west and east of Paterson, east of Pasco, near Mattawa, and two sites on the Royal Slope). Psyllids have also been collected in sentinel plots near Othello, Yakima, Prosser, Pasco, and Paterson. Additionally, Silvia Rondon and her team at OSU have been finding psyllids in areas surrounding Hermiston. This indicates that psyllids are widely distributed across the Basin. However, it

appears that the largest populations of psyllids are in the southernmost parts of the Basin; i.e. potato growing areas south of the Tri-Cities. This observation is based mostly on information shared with us from growers. A very low percentage of psyllids collected in the Basin have been reported to carry the bacterium that causes zebra chip, but it is enough to cause great concern because 1) only a fraction of the total population is being collected and tested, which makes it difficult to assess infection levels; 2) it does not take a lot of infected psyllids to spread the disease; and 3) the potential losses from zebra chip are great. When a psyllid picks up the bacterium it carries it for life, and even passes it on to its offspring. Moreover, it only takes a few hours to transmit the bacterium to potato plants. Many potato growers in the region are applying foliar insecticides on a regular schedule to control potato psyllids that may be migrating into their fields. Potato harvesting is underway, so psyllids in these fields will be moving to nearby potato fields that are still actively growing. A number of insecticides are registered for use on potatoes that have activity against psyllids. For more information about psyllids, including insect identification, monitoring, and control recommendations, read *Biology and Management of Potato Psyllid in Pacific Northwest Potatoes* and *Potato Psyllid Vector of Zebra Chip Disease in the Pacific Northwest.* Always read and follow label instructions. And continue to scout for potato psyllids and plants with zebra chip, so you know which products and application timings are working well, or not working so well."

Figure 14a. Potato Psyllid Population Trends
Paterson Sentinel Plot: 2012 Sampling Data

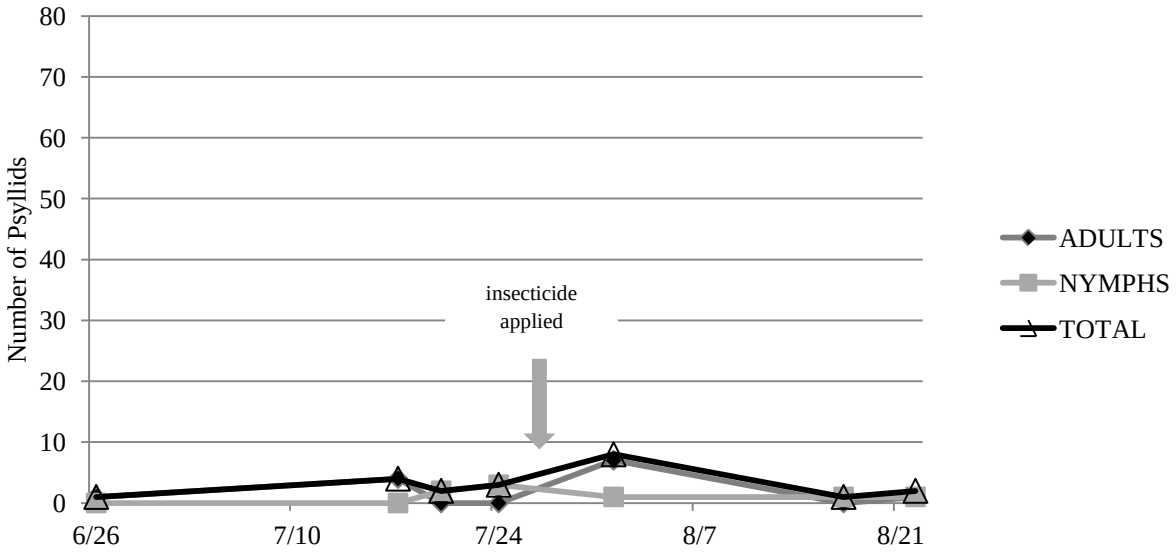
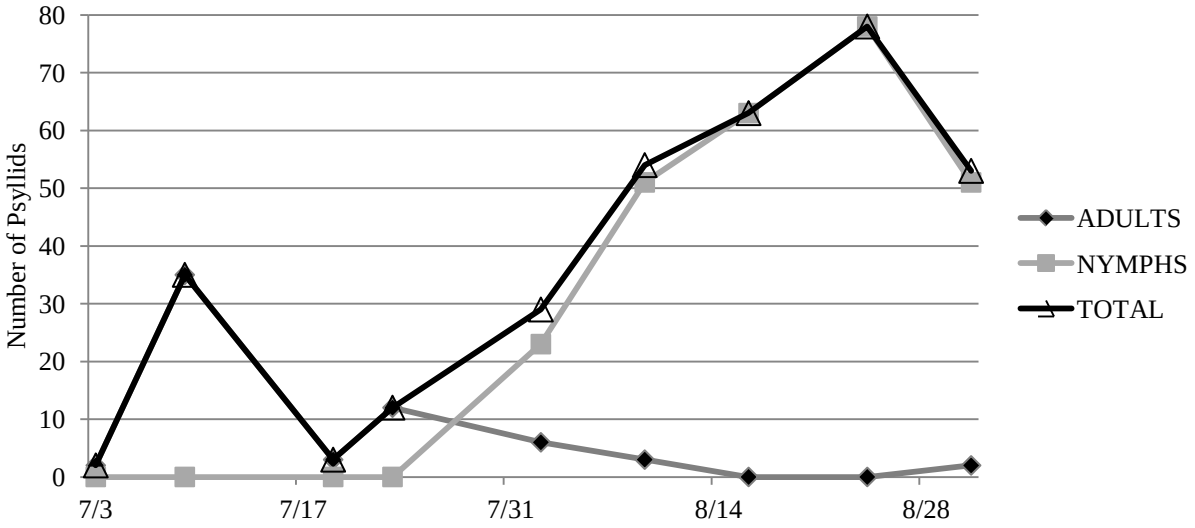


Figure 14b. Potato Psyllid Population Trends
Pasco Sentinel Plot: 2012 Sampling Data



Spider Mites

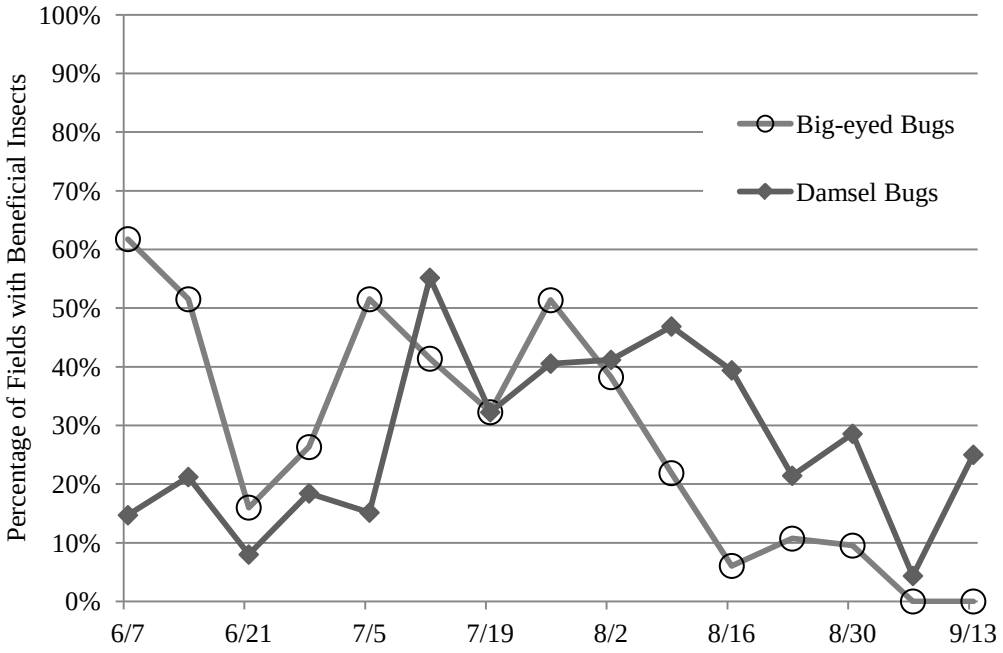
Observations and Recommendations: Two-spotted spider mites usually begin to be noted in Columbia Basin potato fields at the end of July or early August. In 2012, we first observed spider mites in samples collected on our sampling routes the first week of August. Spider mites were observed in 15% of the fields we sampled in early and mid August, and in 30% of the fields at the end of August. Information about spider mites and management recommendations were provided in "potato pest alerts" sent from mid July to mid September. The following recommendations were made…

"Sampling for mites requires close visual inspection because they are tiny and difficult to see. It helps to shake plants over white paper and then look for the tiny moving dots. Mite populations increase rapidly and the damage they cause can go unnoticed, so it is important to scout often. If you plan to apply a miticide, apply it early because none of the registered miticide products provide full control once populations reach outbreak levels. A well-timed miticide application is made when mite populations reach 2 mites per leaf, which is close to the detection limit for the pest. Include a surfactant to improve coverage. In most cases, a single, well-timed application will control mites. Mite outbreaks have been associated with 1) use of non-selective insecticides, like pyrethroids, that reduce natural enemy populations; 2) close proximity to mite harboring crops like corn, alfalfa, hops, and mint; 3) close proximity to dusty roads; and 4) hot, dry weather. More information is available in the publications *2012 IPM Guidelines for Insects and Mites in ID, OR, and WA Potatoes* and the *2012 PNW Insect Management Handbook*."

Beneficial Insects

Observations and Recommendations: The most frequently observed beneficial insects in our potato fields samples were big-eyed bugs and damsel bugs. Figure 15 shows the average percentage of fields in which we observed these beneficial insects in 2012. Big-eyed bugs are usually observed in a larger percentage of the potato fields we sample through June and July, and then in fewer fields as the season progresses. This was basically the pattern for big-eyed bugs in 2012, except that they were not found in many fields in late June. They are usually distributed in potato fields throughout the Columbia Basin. Damsel bugs are not usually seen in many potato fields until the beginning of July, and are seen in more fields through July and August than in other months of the season. This pattern was observed in 2012. Damsel bugs were observed in all areas of the Columbia Basin, but they were particularly prevalent in fields on the West Basin route. Big eyed bugs were observed in fewer fields in 2012 than in 2011, but damsel bugs were observed in more fields in 2012. These two beneficial insects are usually found in the range of 0.05 to 0.2 insects per plant, except in organic fields where the numbers are usually 0.05 to 0.3 insects per plant. Other beneficial insects observed in samples collected in potato fields were minute pirate bugs, ladybird beetles, and lacewings. Spiders are also very common. Information about beneficial insects was reported in many of the "potato pest alerts" during the season.

Figure 15. Beneficial Insect Observations
Weekly Potato Field Sampling Data: 2012



PUBLICATIONS:

Rondon, S., A. Schreiber, A. Jensen, P. Hamm, J. Munyaneza, P. Nolte, N. Olson, E. Wenninger, D. Henne, C. Wohleb, and T. Waters. 2012. Potato Psyllid Vector of Zebra Chip Disease in the Pacific Northwest. PNW Extension Publication 633. http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/30058/pnw633.pdf.

PRESENTATIONS & REPORTS:

Wohleb, C.H. A regional sampling network for insect pests of potato in the Columbia Basin of WA. 97th Annual Meeting and Professional Improvement Conference of the NACAA. Charleston, SC. July 16, 2012. *Poster Presentation.*

Wohleb, C.H. Methods for Monitoring Potato Psyllids and Other Insect Pests in the Columbia Basin. WSU Potato Field Day, Othello, WA, June 28, 2012. *Presented for the Potato Cultural Practices Concurrent Field Tour I and repeated for the Potato Pest Management Concurrent Field Tour II.*

Wohleb, C.H. A regional sampling network for insect pests of potato in the Columbia Basin of WA. 7th International Integrated Pest Management Symposium. Memphis, TN. March 27, 2012. *Poster Presentation*.

Wohleb, C.H. Regional Survey for Insect Pests of Potato in the Columbia Basin of WA and "Potato Pest Alerts". 71st Annual Pacific Northwest Insect Management Conference. Portland, OR. January 9, 2012.

Wohleb, C.H. 2010-present. "Potato Pest Alerts" list serve. Weekly pest and disease alerts e-mailed from April-October to 330 subscribers.