Annual Progress Report

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

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REPORTING PERIOD: 2011

ACCOMPLISHMENTS:

Potato fields across the Columbia Basin of Washington were monitored weekly to keep the potato industry updated about the size and location of important insect pest populations. The survey targeted three key insect pests: beet leafhopper (BLH), potato tuberworm (PTW) and aphid. In addition to these pests, other foliar arthropod pests (Colorado potato beetles, thrips, spider mites, and lygus bugs) and insect predators (big-eyed bugs and damsel bugs) were monitored and reported on when their numbers were significant.

Regional Survey Routes: Three survey routes covered areas in the north, west, 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 "south" route included fields in south Benton County to the Oregon border, and fields near Burbank, Kahlotus Rd., Pasco, Eltopia, Mesa, and Basin City (250 miles round trip from Pasco). Thirty-six potato fields were selected along these routes (Figure 1). Most were planted to long-season, russet cultivars under conventional management. One of the fields was certified organic. Prior to entering fields each week, the grower or field manager was contacted to learn that it was safe to work in the field.

Insect Monitoring Methods: Beet leafhoppers 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 route, either at the field edge, on a ditch bank, or at the open field corner (away from irrigation). Flights of adult male PTW moths were monitored using 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 route. Beet leafhopper and PTW moths collected on traps were counted weekly from mid April to October. Aphids were monitored by sampling potato plants, i.e. potato plants were vigorously shaken over a 4-5 quart, 8-in diameter plastic collection bucket slipped under the foliage. This method was established by Dr. Keith Pike over several years of conducting his regional aphid survey. The bucket is easy to handle and

prevents most of the insects from blowing, flying, or leaping away before they can be counted. Aphid counts were recorded on a per plant basis, and at least fifteen plants were sampled in every field. Other insects and arthropods collected in the bucket were also counted, especially thrips, Colorado potato beetles, lygus bugs, spider mites, big-eyed bugs, and damsel bugs. Fields were sampled in the same location every week. Sampling was initiated a few weeks after emergence and concluded at vine kill.

Reporting Survey Results: Results of the insect pest survey were reported to the potato industry via weekly e-mails, 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 pest management recommendations. This year, the insect population data display showed locations color-coded according to pest numbers so viewers could see at a glance where numbers were highest and lowest across the Basin. Alerts have been archived on the project website at http://www.potatoes.wsu.edu/survey/PotatoInsectSurvey.html. Reports on other pests or diseases of concern in the region were included in many of the alerts. Most alerts included updates about Dennis Johnson's late blight hotline. An alert about white mold was sent at the end of June. In August and September alerts included information about potato psyllids and zebra chip. The number of subscribers to the "potato pest alerts" increased from 190 to 260 between May and September of 2011.

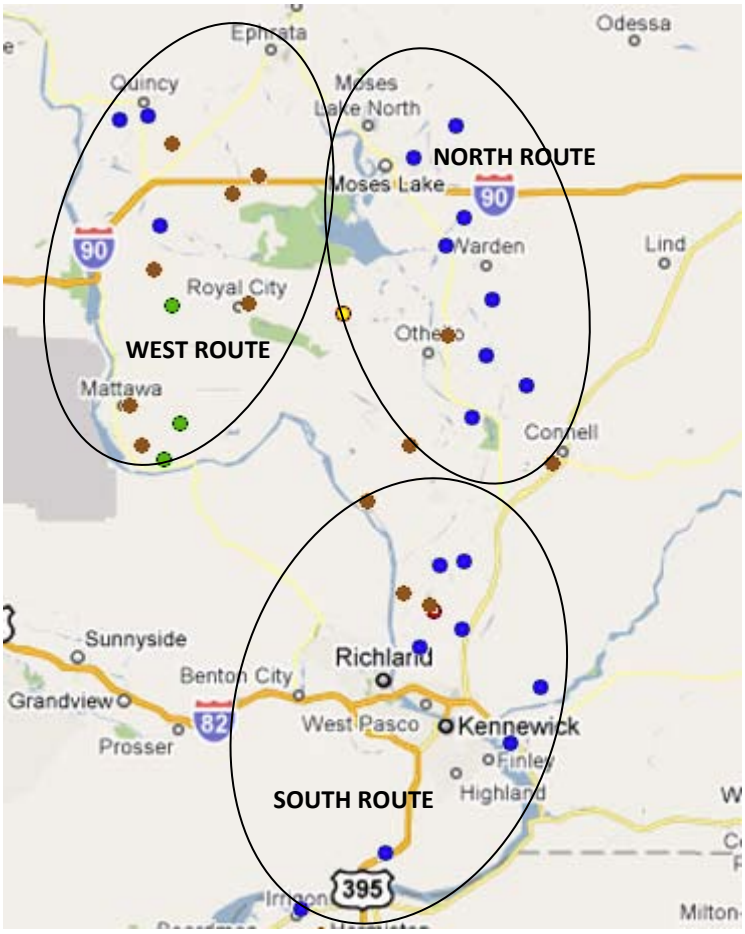


Figure 1. Survey routes and potato field locations in 2011.

RESULTS:

Beet Leafhopper

General Population Trends: We now have several years of trapping data to help us understand population trends for BLH in the Columbia Basin. Figure 2 shows the weekly BLH trap counts in 2007-2011 and the five-year average for each trapping date; these numbers are averages for the entire Columbia Basin area. Typically, BLH show up near potato fields in mid-late May. BLH numbers increase rapidly between May and June, with the largest populations occurring in late June and early July. The numbers usually drop off in August. BLH counts in 2011 were not typical. The BLH populations in 2011 were the lowest recorded for this five-year period. It probably had something to do with the cooler and wetter spring conditions, and cooler summer temperatures experienced in the Columbia Basin in 2011.

Figure 3 shows weekly BLH trap counts averaged over five-years (2007-2011) for different parts of the Basin. Mattawa is shown separately from the West Basin, because it tends to differ from other areas. The area surrounding Mattawa, WA tends to be a hot spot for BLH, and maintains the largest populations in the Basin through most of the season. Beet leafhoppers show up early in Mattawa compared to other parts of the Basin, usually in early-mid May. The largest BLH populations in Mattawa occur between May and early August, and the populations tend to remain high through that period, and then drop off. The North Basin tends to maintain the smallest populations of BLH in the Basin through most of the season. 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 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.

2011 Population Trends: Figure 4 shows the average weekly BLH trap counts for each of the routes in 2011; it illustrates the relative size of BLH populations in different parts of the Basin in 2011. The largest BLH numbers in 2011 were found on traps in the Mattawa area. The lowest counts were in the North Basin.

North Basin 2011: Figure 5 shows the average weekly BLH trap counts for the North Basin route in 2011 vs. the five-year average for the area. The average BLH catch each week in the North Basin in 2011 was much smaller than the five-year average catch each week. In 2011, average trap counts in the North Basin peaked at 2.2 BLH per card the week of June 29th. The highest number of BLH found on a card in the North Basin in 2011 was (27) the week of August 16th on a trap at the east end of the Royal Slope; this was the only trap in the North Basin that had a count greater than 25 BLH during the 2011 season. All other traps in the North Basin had extremely low peak counts of only 1-9 BLH per card.

Mattawa 2011: Figure 6 shows the average weekly BLH trap counts for the Mattawa area in 2011 vs. the five-year average for the area. Beet leafhoppers showed up in our traps in Mattawa in 2011 much later than usual. The average BLH catch each week in Mattawa in 2011 was much smaller than the five-year average catch each week. Average trap counts usually stay above 15 BLH per card in Mattawa between late May and early August, but this was not the case in 2011. In 2011 average trap counts in Mattawa peaked at only 13.5 BLH per card the week of June 23rd. The highest number of BLH found on a card in Mattawa in 2011 was (44) the week of June 9th. Peak trap counts in Mattawa in 2011 ranged from 10-44 BLH per card.

West Basin 2011: Figure 7 shows the average BLH trap counts for the West Basin route in 2011 vs. the five-year average for the area. As in other parts of the Basin, BLH were very slow to show up on traps in the West Basin in 2011. The average BLH catch each week in the West Basin for 2011 was much smaller than the five-year average counts each week. In 2011, average trap counts in the West Basin peaked at 6.7 BLH per card the week of June 23rd. The highest number of BLH trapped on a card in the West Basin in 2011 was (26) the week of June 30th on a trap on the west end of the Royal Slope; this was the only trap in the West Basin that had a count greater than 25 BLH during the season. Only four of nine traps in the West Basin had peak counts greater than 10 BLH per card for the 2011 season.

South Basin 2011: Figure 8 shows the average weekly BLH trap counts for the South Basin route in 2011 vs. the five-year average for the area. The BLH populations near potato fields in the South Basin in 2011 got off to a slow start. The BLH counts each week in the South Basin for 2011 were much smaller compared to the five-year average each week. In 2011 average trap counts in the South Basin peaked at 8.7 BLH per card the week of July 7th. The highest number of BLH trapped on a card in the South Basin in 2011 was (51) the week of August 16th on a trap near Pasco. Only one other trap in the South Basin in 2011 had a peak count greater than 25 BLH per card. Seven of the twelve traps in the South Basin had peak counts greater than 10 BLH per card for the 2011 season.

Recommendations: The BLH is the only known vector of BLTVA, a phytoplasma that causes purple top disease in potatoes. Infected plants show a range of symptoms, including leaf curling and purpling, aerial tubers, chlorosis, and early senescence. Purple top is managed by controlling BLH and thereby preventing the spread of BLTVA. In weekly survey reports potato growers were encouraged to monitor BLH populations closely from May-July. Studies by Munyaneza et. al (2008) suggest that this is the time when potato plants are most susceptible to purple top. We recommended that growers deploy their own traps to monitor BLH populations. Guidelines for setting up and monitoring traps were made available on the project website. Based on historical trapping data, we suggested that growers should be concerned when numbers collected on traps build up to 40 or more BLH per card in a week. A typical weekly catch during peak BLH activity is 100. We noted, however, that treatment thresholds based on trap counts have not been established. We also suggested that growers follow regional trapping results. The long-distance movement of BLH is poorly understood, so growers should consider the possibility of BLH moving quickly from highly infested areas to less infested areas. Other recommendations included eliminating the weed hosts of BLH in areas surrounding potato fields, planting cultivars less susceptible to purple top, and applying foliar insecticides. For more information about managing BLH, growers were encouraged to read the *IPM Guidelines for Insects and Mites in ID, OR, and WA Potatoes* and the *2011 PNW Insect Management Handbook*. Both of these publications were made available on the project website.

Figure 2. Beet Leafhopper Population Trends in the Columbia Basin of WA
Weekly Trapping Data from 2007 to 2011 vs. 5-Year Average

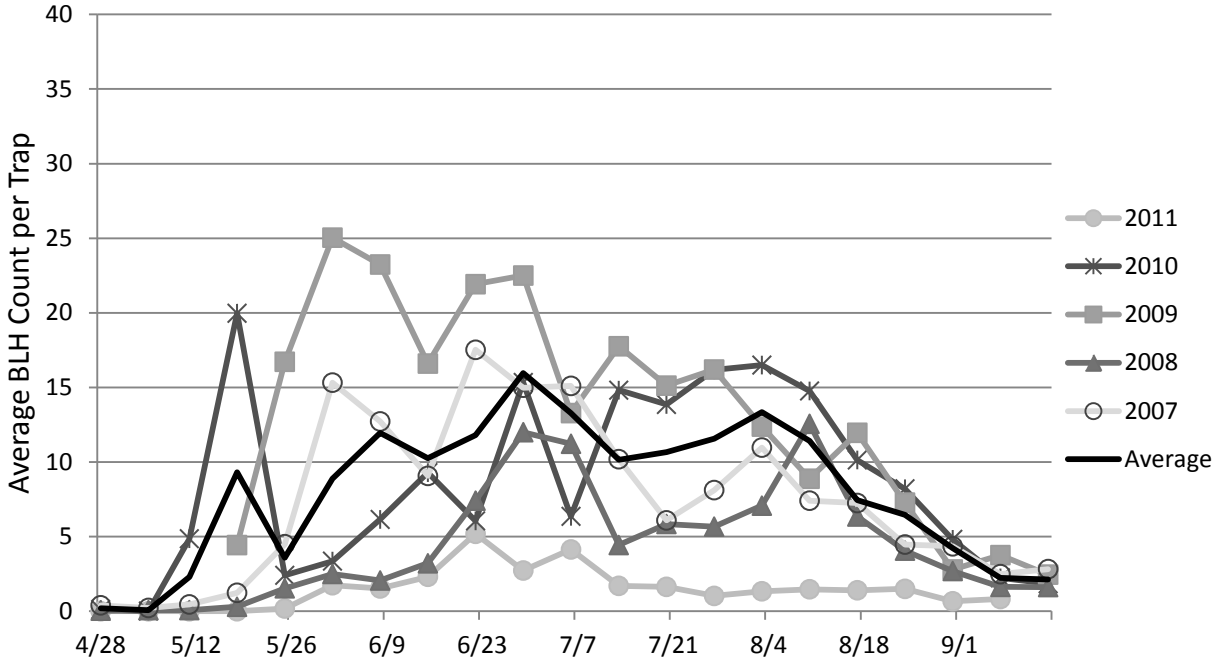


Figure 3. Beet Leafhopper Population Trends in the Columbia Basin of WA
Weekly Trapping Data: Five-year Averages 2007-2011

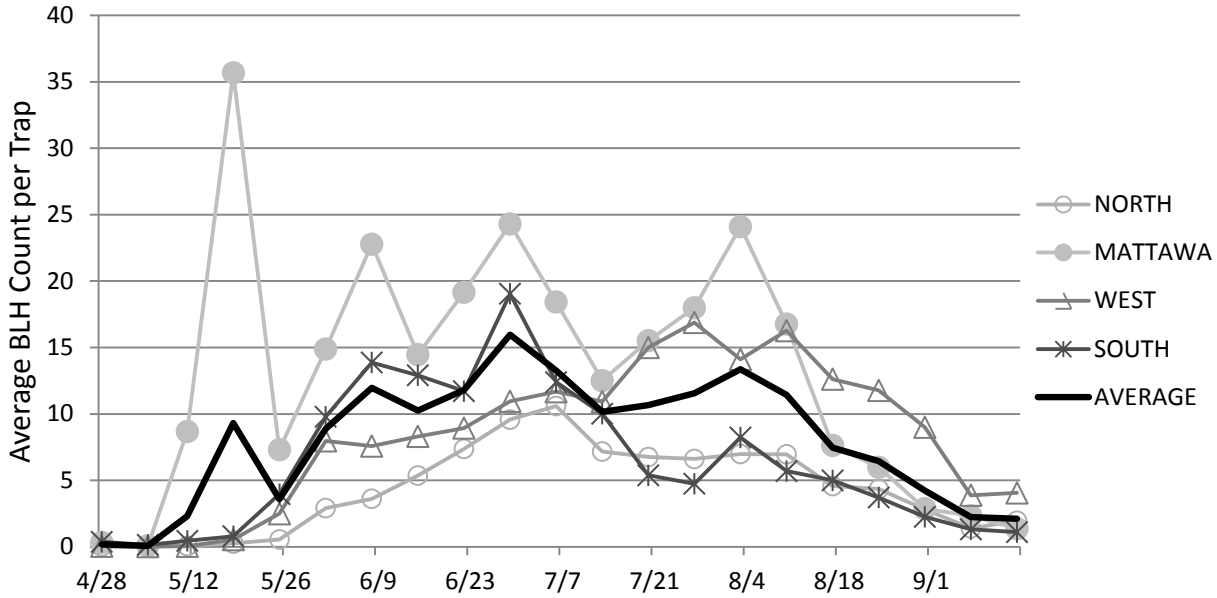


Figure 4. Beet Leafhopper Population Trends in the Columbia Basin of WA
Weekly Trapping Data: 2011

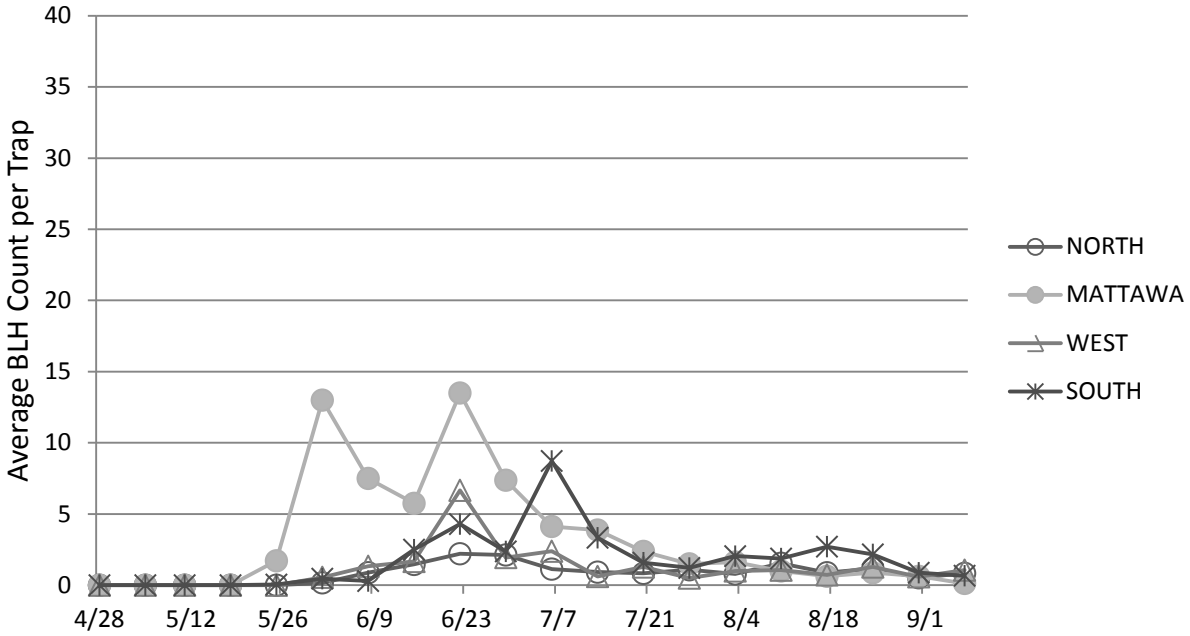


Figure 5. Beet Leafhopper Population Trends in the NORTH Basin
Weekly Trapping Data: 2011 vs. 5-Year Average

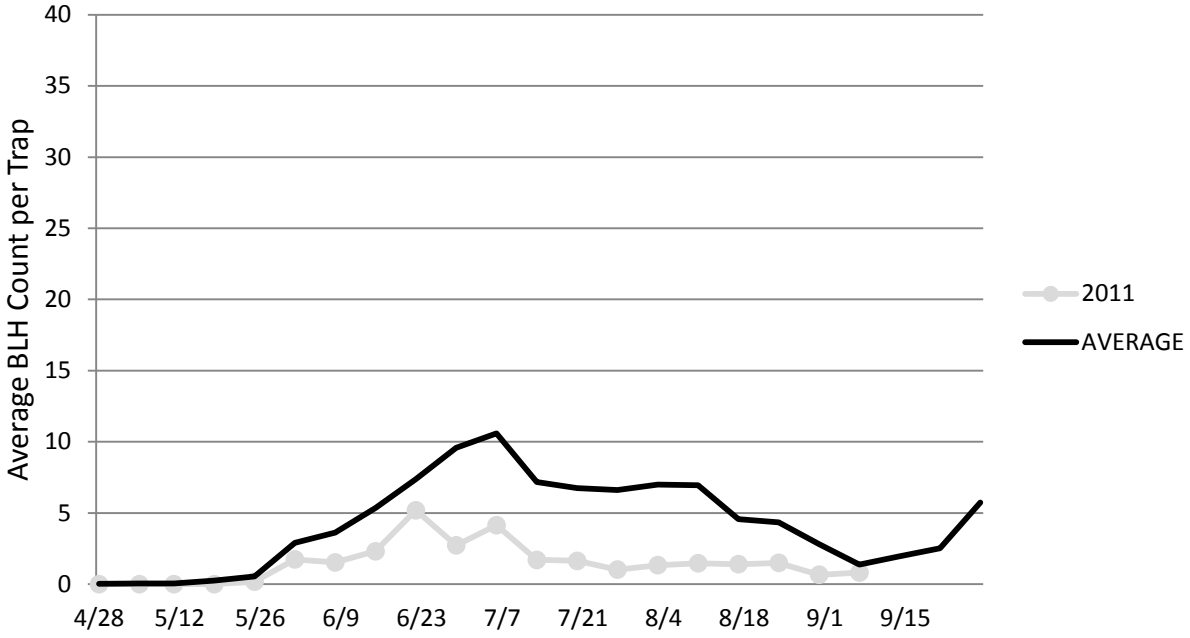


Figure 6. Beet Leafhopper Population Trends in MATTAWA, WA
Weekly Trapping Data: 2011 vs. 5-Year Average

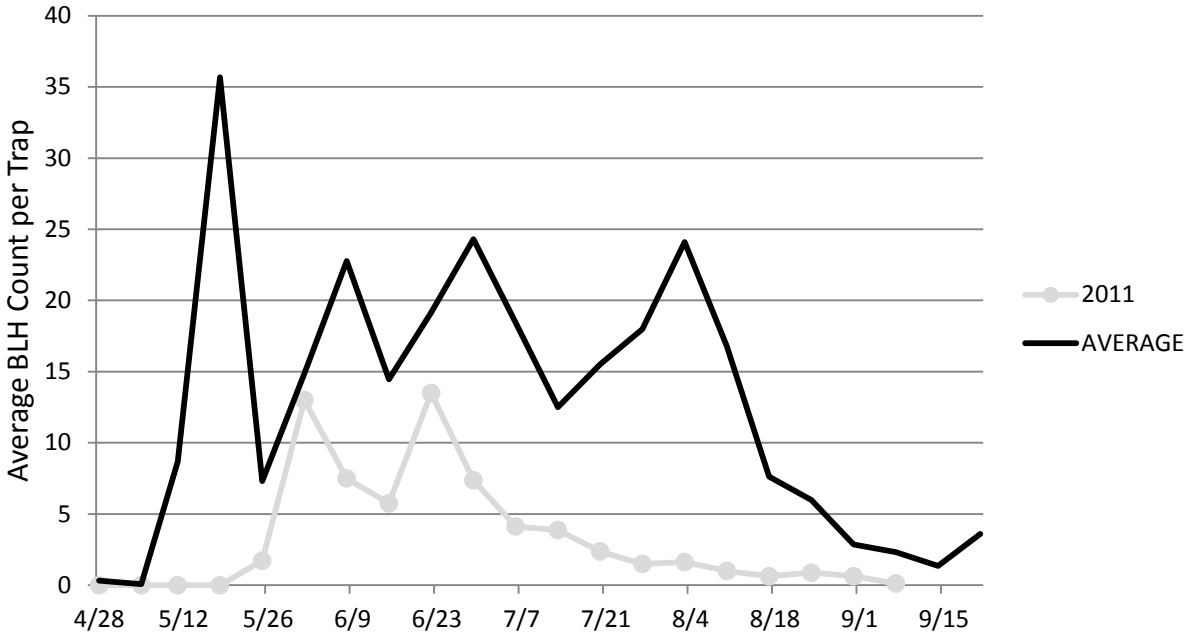


Figure 7. Beet Leafhopper Population Trends in the WEST Basin
Weekly Trapping Data: 2011 vs. 5-Year Average

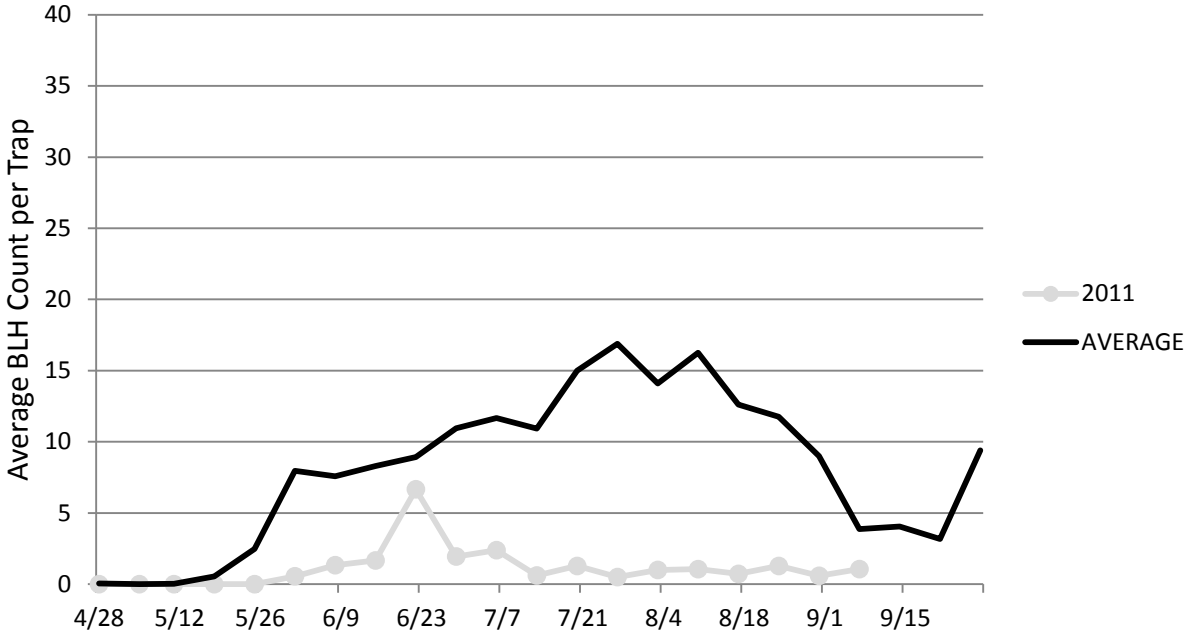
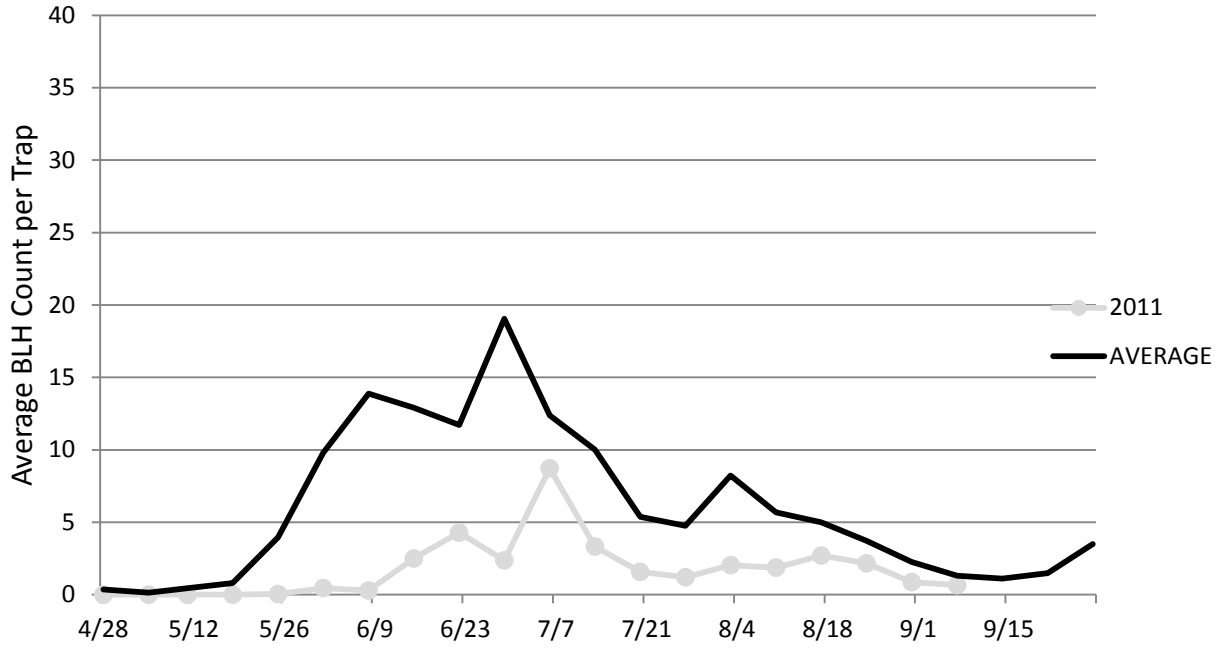


Figure 8. Beet Leafhopper Population Trends in the SOUTH Basin
Weekly Trapping Data: 2011 vs. 5-Year Average



Potato Tuberworm

General Populations Trends: Potato tuberworm (PTW) moth populations have been monitored for several years in the Columbia Basin. Figure 9 shows the weekly average PTW moth counts averaged over five-years (2007-2011) for different parts of the Basin. The graph illustrates that very few PTW moths have been collected in traps in the North Basin and West Basin over the years. The vast majority of PTW moths have been collected in the South Basin. In general, the PTW moths begin to show up in mid-late June and the numbers slowly increase between July and September. The highest PTW moth counts are usually in late September and October.

North Basin and West Basin 2011: In the North Basin, one PTW moth was found in two different traps in 2011. No moths were found in the West Basin in 2011.

South Basin 2011: Figure 10 shows the average weekly PTW moth counts for South Basin routes in 2007 to 2010 vs. the five-year average for the area. The largest moth populations recorded in the five year period were in 2008 and 2010. Moth counts in 2011 were similar to or a little lower than the average counts each week averaged over five years. In 2011, the first PTW moths began to appear mid-June. The numbers remained very low through June, but started picking up at the end of July and through August to September. Populations were very spotty in 2011. As in previous years, the majority of moths were found near the Oregon border and the city of Pasco. The most PTW moths found in a trap in the South Basin in 2011 was (39) on September 29th in a trap near the Oregon border. This trap collected the

most PTW moths over the course of the season, a total of (219). All other traps in the South Basin collected comparatively few moths over the course of the season. The second highest catch was in a trap near Pasco with (50) moths total. The South Basin traps from Eltopia to Basin City had season totals of only 0-2 moths.

Recommendations: Potato tuberworm was first recognized as an important pest of potatoes in the Columbia Basin in 2003. PTW larvae feed on tubers causing damage that renders them unmarketable. They are primarily pests of the southern Columbia Basin, but have the potential to expand their range. In our weekly survey reports, growers in areas potentially impacted by PTW were recommended to pay close attention to regional trapping data. We emphasized that growers with fields south of Connell should deploy their own pheromone traps, because infestations of PTW are highly localized, and it is risky to conclude too much from traps that may be several miles away. A guideline for setting up traps and identifying the moths was made available on the project website. Trap counts from mid-season to harvest are particularly important to watch. We indicated that pre-harvest control measures may be warranted in fields where numbers of PTW moths in pheromone traps are found to be increasing every week, especially in August-October. Unfortunately, we do not have enough information to translate counts from trapping into a risk assessment. It is clear, however, that more moths in traps equal more risk. Based on historical trapping data, PTW moth counts of 16-30 in a trap per week is in the higher range of counts and is concerning. A moth count of more than 30 in a trap in a week is very high. We mentioned that insecticide spray programs beginning 4-8 weeks before harvest have been successful in reducing PTW in potato tubers. For a list of products registered for control of PTW, growers were directed to the *2011 PNW Insect Management Handbook*. We also mentioned several cultural practices reported to reduce PTW damage, including eliminating cull piles and volunteers, maintaining soil moisture after vine kill to prevent soil cracking, minimizing the time between vine desiccation and harvest, and maintaining more than 2" of soil over tubers during the season and covering hills with 1-2" of soil after vine kill.

Figure 9. Potato Tuberworm Moth Population Trends in the Columbia Basin
Weekly Trapping Data: Five-year (2007-2011) Averages

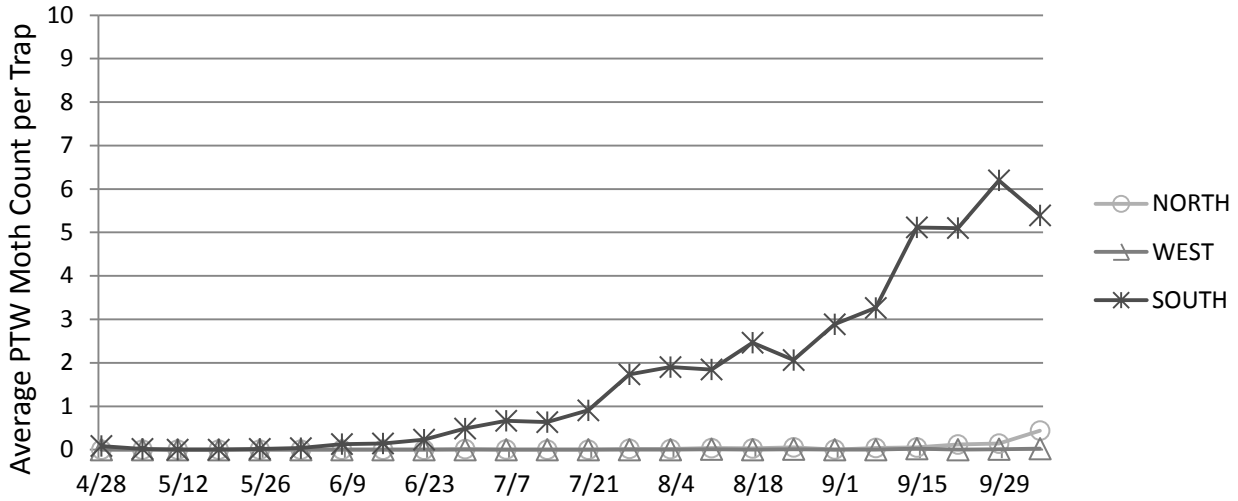
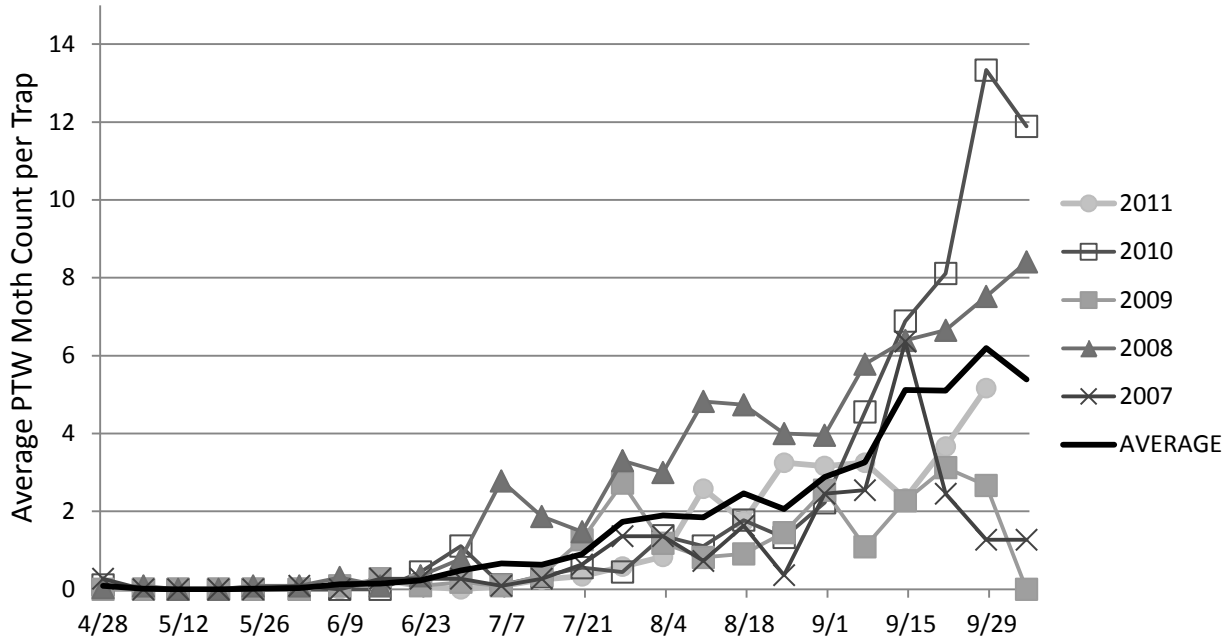


Figure 10. Potato Tuberworm Moth Population Trends in the SOUTH Basin
Weekly Trapping Data from 2007 to 2011 vs. 5-Year Average



Aphids

General Population Trends: Figure 11 shows aphid population trends in long-season potato fields in the Columbia Basin from 2007 to 2011. These data indicate that aphid infestations were larger in 2007 and 2008 compared to 2009, 2010, and 2011. In general, the aphids we find at the beginning of the season are mostly winged migratory morphs. 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. At the season end, migratory aphids usually begin to show up again in potato field samples.

2011 Populations: Figure 12 shows weekly aphid sampling data in 2011; the graph includes the average percentage of fields in which we found aphids each week, and the average number of aphids per plant in the fields that had aphids each week. Aphids were found in 30% of the fields on the first sampling date the week of June 7th. These were all winged aphids (both green peach aphids and others) and their populations were tiny, only 0.2 aphids per plant. A few wingless aphids were found in South Basin potato fields in June, but did not start to show up in North Basin and West Basin fields until early July. The week of July 14th we found aphids in 84% of the fields sampled, but the counts continued to be low, only 0.5 aphids per plant or fewer. Aphid populations did not increase much until August. By the end of August, the average number of aphids per plant in fields that had aphids was higher than 1 aphid per plant; most of these were wingless green peach aphids. Of the few fields that still had green vines by the end of September, 56% had aphids with populations averaging 3.2 aphids per plant. The largest field infestation of aphids for the 2011 season was 20.1 aphids per plant on September 26th in a field near

Mattawa. This is a small number compared to some years of the aphid survey. Potato field infestations of more than 500 aphids per plant have not been unusual for this project.

Figure 13 shows the average weekly aphid populations for each of the routes in 2011. The North Basin and West Basin maintained the smallest aphid populations through most of the season. The largest aphid populations in 2011 were in the South Basin.

North Basin 2011: In the North Basin, we found a few winged aphids in five of twelve fields the first week of sampling on June 7th. Aphid populations in the North Basin were very small and scattered through June, with only 0.02 to 0.07 aphids per plant. The number of fields with aphids increased in July, but the populations remained fairly small. Aphid populations in the North Basin decreased in August, but increased again in September and were mostly wingless. Three of twelve fields in the North Basin reached populations of 1 or more aphids per plant, but one did not occur until the end of the season and just before vine kill. The largest population of aphids in the North Basin in 2011 was 6.7 aphids per plant on September 20th in an organic field near Connell.

West Basin 2011: A couple of winged aphids were found in two of thirteen fields on the West Basin route the first week of sampling on June 7th. Aphids were found in a few more West Basin fields through June and started to pick up through July. By mid-July most of the West Basin fields had small numbers of aphids, but most were wingless green peach aphids. Aphid populations in the West Basin decreased in August, but increased again in September and were mostly wingless morphs. Three out of thirteen fields in the West Basin reached populations of 1 or more aphids per plant, but two of these were at the end of the season just prior to vine kill.

South Basin 2011: A few winged aphids were found in four of twelve fields on the South Basin route in the first week of sampling on June 7th. Aphids were found in about half of the fields sampled through most of the season. Populations were small at the beginning, but increased in mid-August. The average number of aphids per plant for South Basin fields peaked at 2.3 aphids per plant on September 1st. Six out of twelve fields in the South Basin reached populations of 1 or more aphids per plant. The largest population of aphids in the South Basin in 2011 was 7.5 aphids per plant on September 16th in a field north of Pasco.

Recommendations: Aphids are important pests because they can be abundant in potato fields and they transmit several important potato viruses, especially potato leafroll virus (PLRV) and potato virus Y (PVY). Green peach aphids are the most effective 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 cause significant yield losses, and some strains cause tuber defects. In the weekly survey reports we urged potato growers to monitor fields for aphids at least once a week. We emphasized that 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. Low tolerances have been established because even a low incidence of seed borne PVY and PLRV can spread rapidly if aphids go unchecked. Some potato growers are questioning these recommendations because there has been an extremely low incidence of seed borne PLRV in the Columbia Basin in recent years. A zero tolerance for aphids has also been in question because some of the cultivars grown in the Columbia Basin do not develop severe net necrosis symptoms in tubers infected with PLRV. It is important to keep in mind, however, that aphids spread other viruses,

especially PVY, and can cause direct injury to plants when aphid densities are high. Incidence of seed borne PVY has increased greatly in recent years. Field studies that aim to improve our understanding of the current threat posed by aphids and the viruses PLRV and PVY are currently underway.

Figure 11. Aphid Population Trends
Weekly Potato Field Sampling Data: 2007-2011

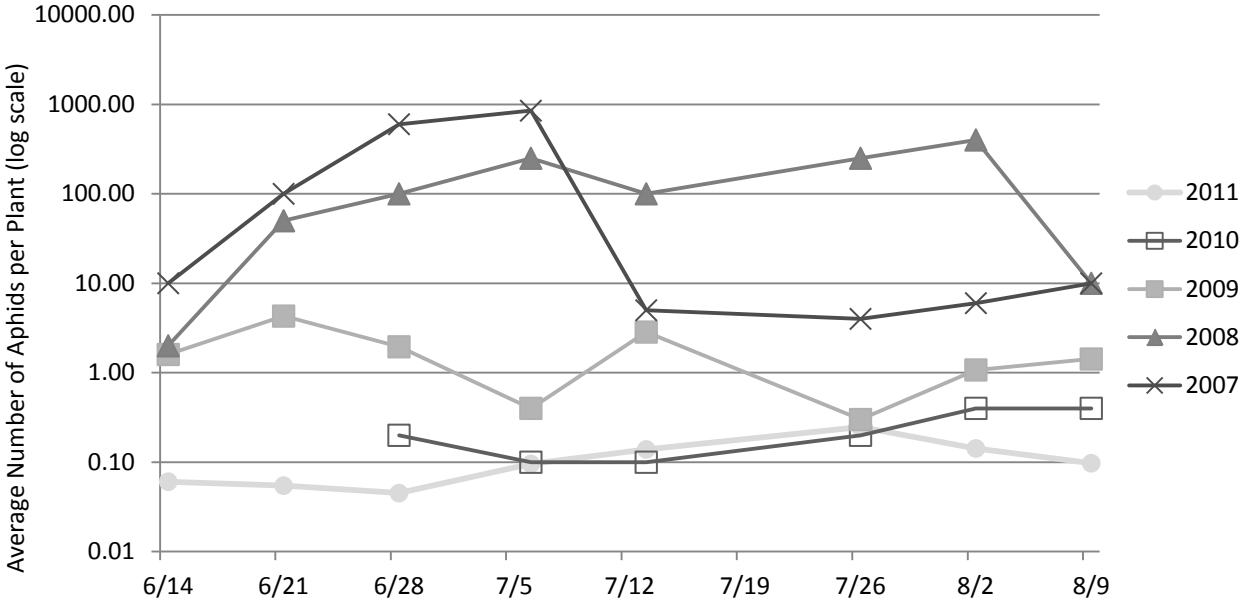


Figure 12. Aphid Population Trends
Weekly Potato Field Sampling Data: 2011

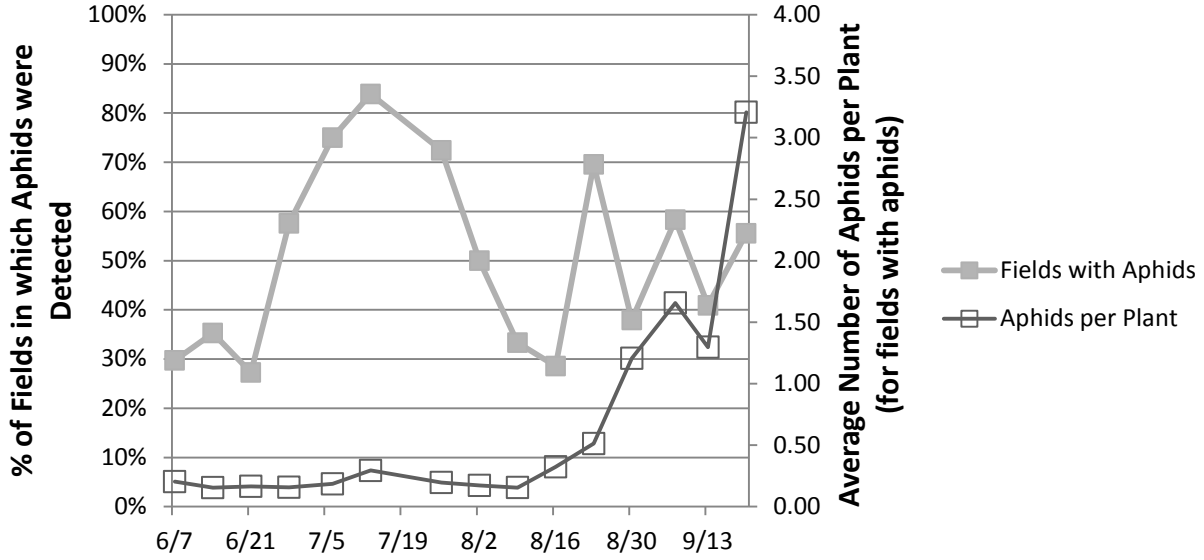
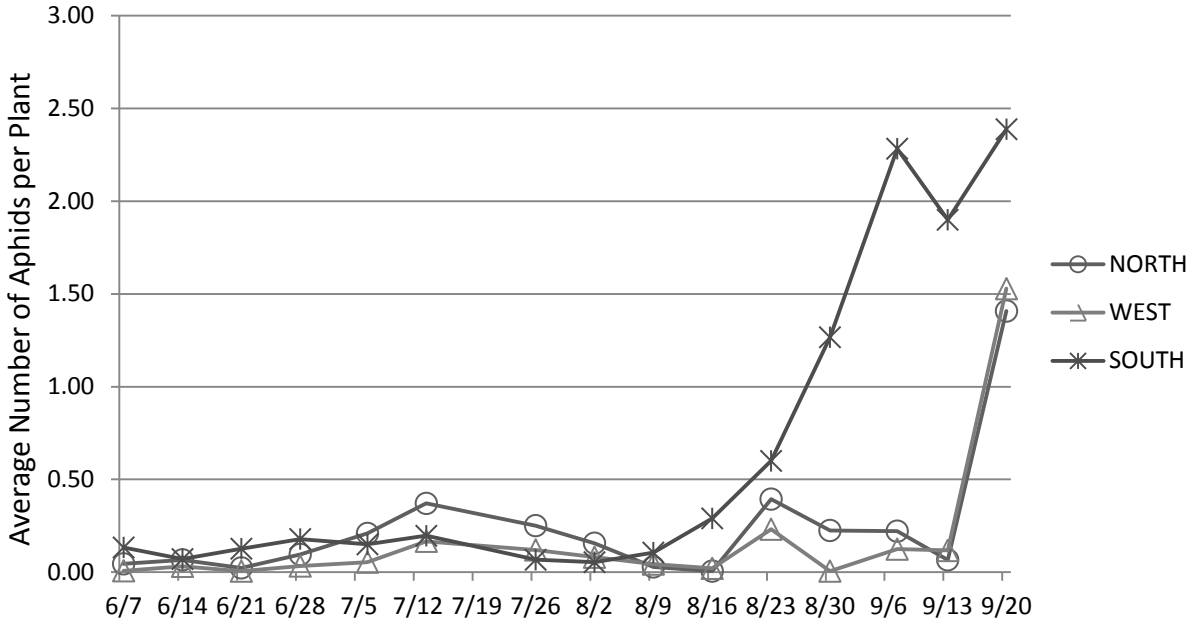


Figure 13. Aphid Population Trends in the Columbia Basin of WA
Weekly Potato Field Sampling Data: 2011



Lygus Bugs

2011 Observations and Recommendations: Lygus bug observations in potato fields peaked in July. The numbers were especially high at the end of July in the Quincy area, with counts averaging about 2.4 lygus bugs per plant. In the "potato pest alerts" we notified potato growers about our lygus bug observations, but also noted that these are not considered damaging pests of potato and chemical treatment is rarely needed.

Spider Mites

2011 Observations and Recommendations: Spider mites usually show up in some Columbia Basin potato fields by late July or early August. In the "potato pest alerts" we recommended that growers begin watching for spider mites at the end of July, but we did not actually see them in surveyed fields until mid-August. The delay in finding mites probably had something to do with the cooler summer temperatures in the Columbia Basin in 2011. Spider mites were observed in 37% of the fields we surveyed by early September. Incidence did not appear to increase after that.

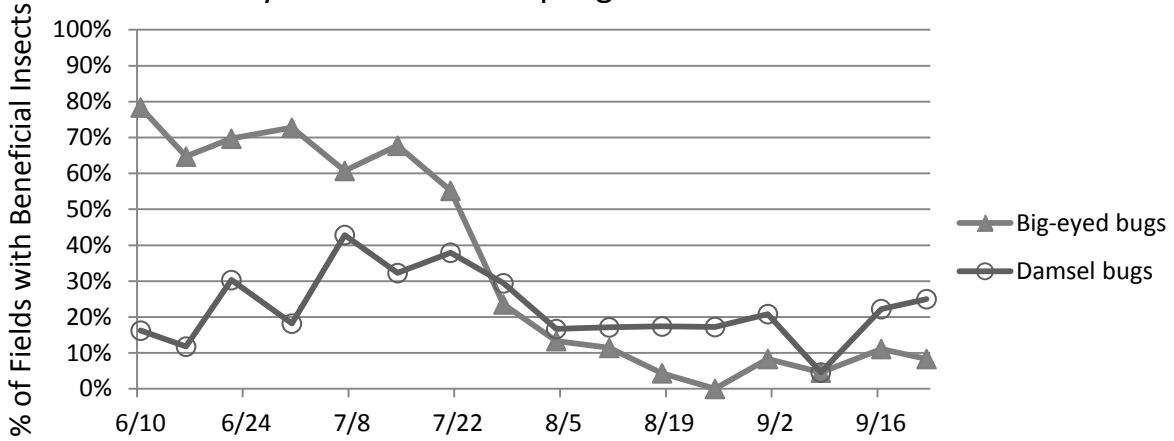
Potato Psyllids

2011 Observations and Recommendations: We did not observe potato psyllids in the fields that we surveyed in 2011, but they must have been present in at least a few of the fields. Unfortunately, the methods we used for monitoring insects were not very good for detecting psyllids; we will be working on this in 2012. At the beginning of September, we noticed "purple top" symptoms in one of the fields we were sampling in Franklin County north of Pasco. Symptomatic plants were tested and found to be infected with *Candidatus Liberibacter*, the causal agent of zebra chip disease spread by potato psyllids. In the "potato pest alert" sent on September 2nd we notified growers that several confirmed cases of zebra chip were found in the Columbia Basin, and included a report issued by Phil Hamm and Silvia Rondon with details. We recommended that growers throughout the Basin look for potato psyllids and symptoms of zebra chip. Phil Hamm's management recommendations were also provided. In the "potato pest alert" sent on October 10th we notified growers that zebra chip had been confirmed in Idaho.

Beneficial Insects

2011 Observations: The most frequently observed beneficial insects in our potato field samples were big-eyed bugs and damsel bugs. Figure 14 shows the average percentage of fields in which we observed big-eyed bugs and damsel bugs each week in 2011. Big-eyed bugs were found in 78% of potato fields that were sampled the second week of June, 2011. The percentage of fields with big-eyed bugs was about 60-70% through June and July, and then dropped rapidly at the end of July and through August. Big-eyed bugs were only observed in a few fields in September. Damsel bugs were found in 20-30% of the fields until early-July. Damsel bug observations peaked in July, when they were found in 30-40% of potato fields. After that, observations decreased again to about 20-25% of fields through September. These observations were similar to observations made in 2010. Beneficial insect observations were reported in most of the weekly "potato pest alerts".

Figure 14. Beneficial Insect Observations
Weekly Potato Field Sampling Data: 2011



PUBLICATIONS:

Wohleb, C.H., A. Jensen, and T.D. Waters. 2012. A regional sampling network for insect pests of potato in the Columbia Basin of WA. 7th International IPM Symposium. *"Submitted"*

Wohleb, C.H., A. Jensen, and T.D. Waters. 2012. Regional Survey for Insect Pests of Potato in the Columbia Basin of WA and "Potato Pest Alerts". 71st Annual Pacific Northwest Insect Management Conference. http://www.ipmnet.org/PNWIMC/2012_PNW-Conference_Proceedings%20and%20Agenda.pdf.

Wohleb, C.H., A. Jensen, and T.D. Waters. 2011. A Regional Sampling Network for Insect Pests of Potato in the Columbia Basin of WA. 95th Annual Meeting of the Potato Association of America. *Am. J. of Potato Res.*

Wohleb, C.H., A. Jensen, and T. Waters. (2011). Regional Survey for Potato Insect Pests in the Columbia Basin of Washington. Washington State Potato Commission Progress Reports for Research Conducted in 2010, pp 381-394.

PRESENTATIONS & REPORTS:

Wohleb, C.H. 2012. 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., A. Jensen, and T.D. Waters. A Regional Sampling Network for Insect Pests of Potato in the Columbia Basin of WA. 95th Annual Meeting of the Potato Association of America. Wilmington, NC, August 16, 2011.

Wohleb, C.H. Potato Insect Pest Survey for the Columbia Basin Update. WSU Potato Field Day, Othello, WA, June 23, 2011.

Wohleb, C.H. Potato Pest Alerts for the Columbia Basin. Bayer CropScience Potato Crop Protection Seminar, George, WA, June 2, 2011. *Invited Presentation.*

Wohleb, C.H. Regional Survey for Potato Insect Pests in the Columbia Basin of Washington. Washington State Potato Commission Research Review, Pasco, WA, February 15, 2011.