

Integrated Pest & Crop Management

Many of Missouri's Alfalfa Fields Continue to Support High Numbers of Potato Leafhoppers

By Wayne Bailey

Potato leafhoppers are about 1/8-inch in length, wedge shaped, and lime green to greenish-yellow in color. They are very mobile and quickly move sideways, jump, or fly when disturbed. This is a native insect which migrates into Missouri each spring from more southern states and Mexico. Recent numerous spring and early summer storms moving into the state from more southern locations of the US have transported high numbers of adult potato leafhoppers into the state, especially into western and northern counties. Transport of this pest often occurs when leafhoppers actively fly into approaching storms and are carried great distances by low level winds which approach 100 mph in speed. Leafhoppers are usually associated with strong thunderstorms containing hail. After a storm passes, high numbers of leafhoppers can often be found in the trail of these storms. In Missouri, potato

This year potato leafhopper adults were found in alfalfa about May 10 in central Missouri. Several flights of migrating leafhopper adults along with successful reproduction have resulted in economic infestations of this pest in most areas of Missouri. Scouting for this pest is best accomplished using a 15-inch diameter sweep net. Take 10 pendulum sweeps at five random locations in the field. If the average number of potato leafhopper adult and nymphs per sweep reach or exceed the threshold numbers listed below, treatment is justified. The economic threshold for potato leafhopper in alfalfa depends on

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Table 1. Economic Threshold for Potato Leafhopper (Adults + Nymphs) in Alfalfa

Alfalfa Stem Length - inches	Ave # PLH/Sweep (traditional variety)	Ave #PLH/Sweep (PLH Resistant Variety)
<3	0.2	0.6
6	0.5	1.5
8-10	1.0	3.0
12-14	2.0	6.0

leafhopper adults generally arrive about 5 May of each year. The arriving adults generally feed initially on several tree species before moving to alfalfa to feed and reproduce. Two to three generations of potato leafhopper are often produced with economic damage generally occurring on alfalfa following removal of first harvest. Damage is caused when both adult and nymphal (immature) leafhoppers use their piercing-sucking mouthparts to penetrate alfalfa leaflets and stems. They remove plant juices and often cause yellowing of established plants (hopper burn), stunted plant growth, and possible mortality of seedling alfalfa. Both forage quality and quantity are substantially reduced by this alfalfa pest.

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Weed of the Month: Palmer Amaranth

By Kristin Payne and Kevin Bradley

Within the pigweed family there are ten species which can be encountered in the Midwestern United States: redroot pigweed (*Amaranthus retroflexus* L.), smooth pigweed (*Amaranthus hybridus* L.), Powell amaranth (*Amaranthus powellii* S. Wats.), tumble pigweed (*Amaranthus albus* L.), prostrate pigweed (*Amaranthus blitoides* S. Wats.), spiny amaranth (*Amaranthus spinosus* L.), common waterhemp (*Amaranthus rudis* Sauer.), tall waterhemp [*Amaranthus tuberculatus* (Moq.) J.D. Sauer.], Palmer amaranth (*Amaranthus palmeri* S. Wats.) and sandhills waterhemp (*Amaranthus arenicola* I.M. Johnst.).



Figure 1. Palmer amaranth seedlings. Notice the long narrow cotyledons and first true leaves that are ovate with a notched tip.

In Missouri, the most common pigweed species encountered in corn and soybean production is common or tall waterhemp (we just generally refer to these plants as “waterhemp” because of the vast degree of hybridization that has now occurred between the two species). Redroot and smooth pigweed used to be much more common weeds before waterhemp developed into a problem in the 1980’s and 90’s, but these species can still be found sporadically in some corn and soybean fields throughout Missouri. Of the remaining pigweed species, spiny amaranth



Figure 2. Waterhemp seedling. Notice the much longer and narrower leaves of waterhemp.



Figure 3. Palmer amaranth on left and waterhemp on right.

is probably the most common; however this species is typically only found in pasture and hayfield settings. Powell amaranth, tumble pigweed, prostrate pigweed, and sandhills waterhemp are fairly rare in Missouri and only found in isolated areas. Palmer amaranth (also called palmer pigweed) is a species we thought was confined to the southernmost counties of the boot heel of Missouri but recently we have discovered sporadic infestations of palmer amaranth in corn and soybean fields in central and northwestern Missouri.

Palmer amaranth is a summer annual C4 weed that is one of the most problematic weeds of cotton and soybean production in the southern United States. Current research we are conducting in Missouri has shown that Palmer amaranth is at least twice as competitive as waterhemp, and that this species can grow 2- to 3-inches per day during the peak portions of the growing season.

Identification of Palmer amaranth is difficult in the early stages of seedling growth as many species within the pigweed family look similar. Once members of the pigweed family are mature, identification becomes less difficult. Palmer amaranth seedlings have cotyledons that are narrow and green to reddish in color. The first true leaves of palmer amaranth seedlings are ovate in shape, with few or no hairs present. Leaves often have a slightly notched tip and the leaf petioles are usually as long as or longer than the leaf blades (Figure 1). Mature Palmer amaranth plants are without hairs, with leaves that are diamond or egg-shaped in outline, and petioles that are usually longer than the leaves (Figure 3). The leaves of Palmer amaranth have a poinsettia-like leaf arrangement when viewed from above and an occasional v-shaped variegation or watermark on the upper surface of the leaf. Mature palmer amaranth can grow to more than seven feet in height.

Waterhemp, our most common pigweed species, has seedlings with leaves that are generally longer and more lance-shaped than any of the other pigweeds. Waterhemp seedlings

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the height of the alfalfa and whether the alfalfa is a potato leafhopper resistant variety or a traditional alfalfa variety. It is especially important to determine potato leafhopper numbers after removal of an alfalfa crop by harvesting. Remember that whether a field contains a traditional alfalfa variety or a PLH resistant variety, the economic threshold for alfalfa growth

3-inches or less in height is about 5 times more susceptible to potato leafhopper damage than 8 to 10-inch tall alfalfa. These data indicate that the economic threshold for newly harvested alfalfa plants is an average of 1.0 or more potato leafhoppers per 5 sweeps for a traditional variety or 1.8 leafhoppers or more for PLH resistant varieties per 5 sweeps.

Table 2. Recommended Insecticides for Potato Leafhopper Adult and Nymphs in Alfalfa

Chemical Name	Common Name	Rate of Formulated Material	Preharvest Interval
Beta-cyfluthrin Chlorpyrifos plus	*Baythroid XL	0.8 to 1.6 fl oz/acre	7 days
gamma cyhalothrin	*Cobalt	7 to 13 fl oz/acre	7-14 days
Dimethoate	Dimethoate	see specific label	10 days
Carbofuran	*Furadan 4F	1 to 2 pts/acre	14 - 28 days
Chlorpyrifos 4E	*Lorsban 4E *numerous products	1 to 2 pts/acre see specific labels	7 - 14 days 7 - 14 days
Malathion	numerous products	see specific labels	0 - 7 days
Methyl Parathion	*numerous products	see specific labels	15 days
Zeta-cypermethrin	*Mustang Max	2.24 to 4.0 fl oz/acre	3 days
Permethrin	*numerous products	see specific label	7 - 14 days
Gamma-cyhalothrin	*Proaxis	1.92 to 3.2 fl oz/acre	1 day forage 7 day hay
Carbaryl	Sevin 4F	1 qt/acre	7 days
Carbaryl	Sevin XLR Plus	1 qt/acre	7 days
Lambda-cyhalothrin	*Warrior	1.92 to 3.2 fl oz/acre	1 day forage 7 day hay
Lambda-cyhalothrin	*Numerous products	see specific labels	1 day forage 7 days hay

Read and follow all label direction, precautions, and restrictions.

*Designated a restricted use product.

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are also hairless and have a waxy or glossy appearance (Figure 2). Stems of waterhemp and Palmer amaranth are hairless, whereas redroot and smooth pigweed have hairy stems. Depending on environmental conditions, waterhemp can range from 4 inches to 10 feet in height, but generally grows to about 4 or 5 feet in height in most agronomic settings. The leaves of mature plants are elongated and narrow (lance-shaped) and, like seedlings, have a waxy or glossy appearance. Leaves are arranged alternately on

the stem and are without hairs. Stem and leaf color tend to be shades of green, but often within a population some plants will have distinctly red stems and/or leaves.

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Small Grasshoppers Numerous in Many Areas of Missouri

By Wayne Bailey

Several regions of Missouri are experiencing high numbers of small grasshoppers. Historically wet years have not favored grasshopper populations as high moisture levels tend to allow bacterial and fungal pathogens to attack developing grasshopper nymphs. This has changed in the past 5 years as grasshopper populations tend to build whether wet conditions are present or not. The economic thresholds for grasshoppers vary depending on the commodity or non-cropland area requiring insecticide applications for effective grasshopper management. In Missouri, there are approximately 100 species of grasshoppers although only 5-7 species are common in field crops. Although there

is conflicting data, most entomologist believe that smaller grasshoppers (small nymphs) are more easily controlled with insecticides than larger nymphs or adult hoppers. As with most insects, the larger the hoppers grow, the more foliage and other plant materials they consume. Damage from both nymph and adult grasshoppers is often seen as very ragged feeding wounds located on leaf edges. In severe situations, high numbers of grasshoppers can consume large amounts of vegetation and cause substantial loss of grain and forage yields. Economic threshold information is listed with each of the following commodity tables.

Table 1. Grasshoppers in Alfalfa

Comments: Control grasshoppers when they are small by applying spot treatments to hatching sites in non-cropland areas. Treatment in these areas is justified when grasshopper numbers reach or exceed 15 grasshoppers per square yard.

Common Name	Trade Name	Rate of Formulated Material per acre	Placement
esfenvalerate	*Asana XL	2.9 to 5.8 fl oz	Broadcast
zeta-cypermethrin	*Mustang Max	3.2 to 4.0 fl oz	Broadcast
carbaryl	Sevin XLR Plus	1 to 3 pt	Broadcast
lambda-cyhalothrin	*Warrior	2.56 fl oz, see dealer for rates	Broadcast

Table 2. Grasshoppers in Field Corn

Comments: Control grasshoppers when they are small by applying spot treatments to hatching sites in field borders and grass waterways. Treatment is justified in corn field when 7 or more grasshoppers per square yard are present and foliage is being severely damaged. After pollen shed, control may be necessary if grasshoppers are damaging foliage above ear zone. Dimethoate should not be applied to corn during pollen-shed.

Common Name	Trade Name	Rate of Formulated Material per acre	Placement
esfenvalerate	*Asana XL	5.8 to 9.6 fl oz	Broadcast
cyfluthrin	*Baythroid XL	2.1 to 2.8 fl oz	Broadcast
bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	Broadcast
chlorpyrifos + gamma-cyhalothrin	*Cobalt	7 to 13 fl oz	Broadcast
dimethoate	Dimethoate 4EC	1 pt	Broadcast
bifenthrin	*Fanfare 2EC	2.1 to 6.4 fl oz	Broadcast
zeta-cypermethrin + bifenthrin	*Hero	2.6 to 6.1 fl oz	Broadcast
chlorpyrifos	*Lorsban 4E	1/2 to 1 pt	Broadcast
zeta-cypermethrin	*Mustang Max	2.72 to 4.0 fl oz	Broadcast
chlorpyrifos	*Nufos 4E	1/2 to 1 pt	Broadcast
microencapsulated methyl parathion	*PennCap-M	2 to 3 pt	Broadcast
lambda-cyhalothrin	*Proaxis	2.56 to 3.84 fl oz	Broadcast
carbaryl	Sevin XLR Plus	1 to 3 pt	Broadcast
lambda-cyhalothrin	*Warrior	2.56 to 3.84 fl oz	Broadcast

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Table 3. Grasshoppers in Grass Pastures

Comments: Control grasshoppers when they are small by applying spot treatments to hatching sites or in grass pastures. Treatment in these areas is justified when grasshopper numbers reach or exceed 7 grasshoppers per square yard.

Common Name	Trade Name	Rate of Formulated Material per acre	Placement
zeta-cypermethrin	*Mustang Max	3.2 to 4.0 fl oz	Broadcast
carbaryl	Sevin XLR Plus	1 to 4 pt	Broadcast
lambda-cyhalothrin	*Warrior	2.56 to 3.84 fl oz	Broadcast

Table 4. Grasshoppers in Non-Cropland Areas

Comments: Control grasshoppers when they are small by applying spot treatments to hatching sites in non-cropland areas. Treatment in these areas is justified when grasshopper numbers reach or exceed 15 grasshoppers per square yard.

Common Name	Trade Name	Rate of Formulated Material per acre	Placement
esfenvalerate	*Asana XL	2.9 to 5.8 fl oz	Broadcast
zeta-cypermethrin	*Mustang Max	3.2 to 4.0 fl oz	Broadcast
carbaryl	Sevin XLR Plus	1 to 3 pt	Broadcast
lambda-cyhalothrin	*Warrior	2.56 fl oz, see dealer for rates	Broadcast

Table 5. Grasshoppers in Sorghum (milo)

Comments: Control grasshoppers when they are small by applying spot treatments to hatching sites in field borders and grass waterways. Treatment in field is justified when 7 or more grasshoppers per square yard are present

Common Name	Trade Name	Rate of Formulated Material per acre	Placement
cyfluthrin	*Baythroid XL	2.0 to 2.8 fl oz	Broadcast
chlorpyrifos + gamma-cyhalothrin	*Cobalt	7 to 13 fl oz	
dimethoate	Dimethoate 4EC	1/2 to 1 pt	
lambda-cyhalothrin	Karate w Zeon Tech	1.28 to 1.92 fl oz	
chlorpyrifos	*Lorsban 4E	1 to 2 pt	
zeta-cypermethrin	*Mustang Max	3.2 to 4.0 fl oz	
chlorpyrifos	*Nufos 4E	1 to 2 pt	
gamma-cyhalothrin	*Proaxis	2.56 to 3.84 fl oz	
carbaryl	Sevin XLR Plus	1 to 3 pt	
lambda-cyhalothrin	*Warrior	2.56 to 3.84 fl oz	

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Table 6. Grasshoppers in Soybean

<i>Comments: Treat when defoliation reaches 30% before bloom, 20% bloom to pod fill, or when 5% to 10% of pods are damaged.</i>			
Common Name	Trade Name	Rate of Formulated Material per acre	Placement
esfenvalerate	*Asana XL	5.8 to 9.6 fl oz	Broadcast
cyfluthrin	*Baythroid XL	2.0 to 2.8 fl oz	
bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	
chlorpyrifos + gamma-cyhalothrin	*Cobalt	7 to 13 fl oz	
dimethoate	Dimethoate 4EC	1 pt	
carbofuran	*Furadan 4F	1/4 to 1/2 pt	
carbofuran	*Furadan LFR	1/4 to 1/2 pt	
chlorpyrifos	*Lorsban 4E	1/2 to 1 pt	
zeta-cypermethrin	*Mustang Max	3.2 to 4.0 fl oz	
chlorpyrifos	*Nufos 4E	1/2 to 1 pt	
acephate	Orthene 97	1/4 to 1/2 lb	
microencapsulated methyl parathion	*PennCap-M	2 to 3 pt	
permethrin	*Pounce 3.2EC	2.0 to 4.0 fl oz	
lambda-cyhalothrin	*Proaxis	3.2 to 3.84 fl oz	
carbaryl	Sevin XLR Plus	1 to 3 pt	
lambda-cyhalothrin	*Warrior	3.2 to 3.84 fl oz	

Table 7. Grasshoppers in Wheat

<i>Comments: Treat when defoliation reaches 30% before bloom, 20% bloom to pod fill, or when 5% to 10% of pods are damaged.</i>			
Common Name	Trade Name	Rate of Formulated Material per acre	Placement
cyfluthrin	*Baythroid XL	1.8 to 2.4 fl oz	On foliage
chlorpyrifos +	*Cobalt	7 to 13 fl oz	
dimethoate	Dimethoate 4EC	3/4 pt	
carbofuran	*Furadan 4F	1/4 to 1/2 pt	
carbofuran	*Furadan LFR	1/4 to 1/2 pt	
lambda-cyhalothrin	*Karate	1.28 to 1.92 fl oz	
zeta-cypermethrin	*Mustang Max	3.2 to 4.0 fl oz	
microencapsulated methyl parathion	*PennCap-M	2 to 3 pt	
gamma-cyhalothrin	*Proaxis	2.56 to 3.84 fl oz	
carbaryl	Sevin XLR Plus	1 to 3 pt	
lambda-cyhalothrin	*Warrior	2.56 to 3.84 fl oz	
Seed Treatments			
lambda-cyhalothrin	*Proaxis	3.2 to 3.84 fl oz	
carbaryl	Sevin XLR Plus	1 to 3 pt	
lambda-cyhalothrin	*Warrior	3.2 to 3.84 fl oz	

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**Designated a restricted use product. Use is restricted to certified applicators only. Regardless of the formulation selected, read the label to determine appropriated insecticide rates, directions, precautions, and restrictions*

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Japanese Beetles (*Popillia japonica*) Continue to Cause Problems in Missouri

By Wayne Bailey

Many areas of Missouri are supporting high populations of Japanese beetle adults. Damage is occurring to many species of plants including ornamental, fruit, vegetable and field crops. Japanese beetle adults typically begin emerging in early June and continue to emerge in high numbers through the third week of July. Adult beetles feed for about a month during which time female beetles lay 40-60 eggs in the soil. These eggs hatch into white grubs within a couple of weeks and remain in the soil to feed and grow until next summer when they emerge as adult beetles. Japanese beetle adults often cause excessive damage to the 220 host plants on which they feed in the US. Although ornamental and fruit crops are most at risk, these beetles do attack corn and soybean crops in Missouri. This insect continues to disperse across Missouri with beetles being reported in areas where they have not been found in past years.

Infestations of this pest were first found in the United States near Riverton, New Jersey during 1916, following its accidental introduction in shipments of iris from its native country of Japan. During the mid 1900s infestations of this beetle in were found in the urban areas of St. Louis, Columbia, Kansas City, and Springfield, Missouri where they were probably introduced in the soil of container plants coming from infested areas of the US. About ten years ago these urban populations began to expand and disperse to the more rural areas of Missouri. This colonization of rural areas of Missouri continues today with many host plants being attacked. Once populations are established in an area, damage to field crops is common.

Japanese beetles are approximately 1/2-inch in length, metallic green in color with bronze or copper colored wing covers. A diagnostic characteristic is the presence of five white tufts of hair or bristles running down each side of the shell and

two tufts of hair located on the tail end of the insect. Without magnification, these structures are seen as twelve white dots.

Japanese beetle adults often congregate in large numbers to feed on the foliage and fruit of host plants. Beetles often begin feeding on the top of plants and move downward. They tend to select plants which emit strong odors and often feed in large groups on host plants. Tassels and silks of corn can be severely damaged by adult feeding, whereas just foliage feeding is common on soybean. Damage to soybean foliage takes on a lace-like pattern as beetles avoid leaf veins when feeding. Feeding on corn silks can disrupt pollination and result in substantial yield losses. The grub stage of this pest will feed on plant roots of both corn and soybean with most feeding occurring in late June, July and August. Damage to plant root hairs may result in poor uptake of water and nutrients or be more severe and cause reduced stands through plant mortality.

In field corn, an insecticidal treatment is justified if pollination is less than 50% complete, 3 or more beetles are present per ear, and green silks have been clipped to 1/2 inch or less from the husk. For soybean, treatment is justified if foliage feeding exceeds 30% prior to bloom and 20% from bloom through pod fill. The following insecticides are recommended for control of Japanese Beetle in field corn and soybean in Missouri.

For more information, consult Integrated Pest & Crop Management: volume 20, number 12 (<http://ppp.missouri.edu/newsletters/ipcm/archives/fullissue/v20n12.pdf>)

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Crop Injury Diagnostic Clinic

July 27-28 & July 29-30, 2010

This program is sponsored by University of Missouri College of Agriculture, Food and Natural Resources and University Outreach and Extension.

This clinic is designed to train or update agricultural professionals in management of crop health and field crop diagnostics. In addition, the Crop Injury Diagnostic Clinic will focus on hands-on training in the following areas:

- Soil, Water and Nutrient Management
- Crop Protection Issues
- Climate Change
- Soil Conservation
- Identification of Insects and Herbicide Injury
- Effect of Environmental Conditions on Disease Incidents

<http://aes.missouri.edu/bradford/events/crop-clinic.php>

Weather Data for the Week Ending July 6, 2010

By Pat Guinan

Station	County	Weekly Temperature (°F)						Monthly Precipitation (in.)		Growing Degree Days‡	
		Avg. Max.	Avg. Min.	Extreme High	Extreme Low	Mean	Departure from long term avg.	June 1- June 30	Departure from long term avg.	Accumulated Since Apr. 1	Departure from long term avg.
Corning	Atchison	84	67	88	60	76	0	4.96	+0.55	1660	+331
St. Joseph	Buchanan	83	66	86	60	74	-2	9.38	+4.66	1600	+266
Brunswick	Carroll	85	68	89	62	76	0	6.84	+1.91	1700	+329
Albany	Gentry	84	66	89	57	75	-1	7.85	+3.19	1575	+266
Auxvasse	Audrain	85	64	91	58	74	-2	6.34	+1.61	1699	+319
Vandalia	Audrain	85	64	91	57	75	-1	4.62	+0.22	1692	+348
Columbia-Bradford Research and Extension Center	Boone	85	64	92	57	74	-2	3.30	-1.07	1660	+231
Columbia-Sanborn Field	Boone	86	67	94	61	76	-1	6.64	+2.10	1824	+345
Williamsburg	Callaway	86	63	92	56	75	0	3.74	-0.62	1731	+394
Novelty	Knox	84	64	88	58	74	-1	6.43	+2.40	1549	+221
Linneus	Linn	84	65	88	57	74	-1	8.09	+3.14	1543	+254
Monroe City	Monroe	85	65	91	58	75	-1	6.12	+2.40	1642	+274
Versailles	Morgan	88	67	94	58	76	0	2.96	-1.43	1814	+341
Green Ridge	Pettis	85	66	89	60	75	-1	2.68	-2.74	1724	+333
Lamar	Barton	86	68	90	61	76	-2	3.41	-2.78	1822	+291
Cook Station	Crawford	89	60	95	50	74	-2	4.50	+0.28	1713	+219
Round Spring	Shannon	91	59	95	51	74	-2	1.82	-2.07	1738	+321
Mountain Grove	Wright	88	64	95	57	75	0	2.85	-0.93	1729	+357
Delta	Cape Girardeau	88	64	94	58	77	-2	0.74	-2.77	2029	+318
Cardwell	Dunklin	89	66	94	61	78	-2	1.51	-2.08	2258	+361
Clarkton	Dunklin	90	65	93	59	78	-2	0.45	-3.20	2189	+331
Glennonville	Dunklin	89	67	94	62	78	-2	0.03	-3.24	2203	+352
Charleston	Mississippi	90	65	96	58	78	0	0.67	-3.49	2144	+441
Portageville-Delta Center	Pemiscot	90	68	94	62	79	-1	1.27	-2.70	2283	+412
Portageville-Lee Farm	Pemiscot	90	68	95	64	79	-1	0.86	-2.93	2298	+443
Steele	Pemiscot	92	68	96	61	80	0	3.55	-0.50	2363	+483

* Complete data not available for report

‡Growing degree days are calculated by subtracting a 50 degree (Fahrenheit) base temperature from the average daily temperature. Thus, if the average temperature for the day is 75 degrees, then 25 growing degree days will have been accumulated.

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