Whitefringed Beetle in New Mexico Alfalfa

Revised by Carol Sutherland, Amanda Skidmore, Leonard Lauriault, Mark Marsalis, and Jane Pierce[1]

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Figure 1. **A two-year-old stand of alfalfa destroyed because of root feeding by whitefringed beetle larvae. Note the sparse stand of alfalfa plants and abundant growth of weeds and grasses. The previous stand was also in this condition two years after planting (photo by Leonard Lauriault, August 2008).**

HISTORY

New Mexico alfalfa growers may wonder why some of their established or recently planted fields are patchy with sparse stands and poor yields, despite their best corrective efforts (Figure 1). The answer may be root feeding by whitefringed beetle larvae [Coleoptera, Curculionidae, *Naupactus* spp. (formerly *Graphognathus* spp.)] (Figures 2A and 2B). Initially discovered in New Mexico in Lea County in the 1980s, confirmed infestations of these difficult-to-detect invasive pests have now been found in alfalfa fields in Bernalillo, Chaves, Curry, De Baca, Doña Ana, Eddy, Quay, Roosevelt, Socorro, Torrance, and Valencia Counties. Infestations in New Mexico and elsewhere are probably more widespread than presently recognized because the insect is so difficult to detect. In the Northern Hemisphere, whitefringed beetle is adapted to a wide range of latitudes, from 42°N (Colorado/Wyoming border) to 12°N (Panama) (EPPO, 2020).

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[1]Respectively, former Extension Entomologist, Department of Extension Plant Sciences/former State Entomologist, New Mexico Department of Agriculture; former Extension Integrated Pest Management Specialist, Department of Extension Plant Sciences/Agricultural Science Center at Los Lunas; Forage Crop Management Scientist, Department of Plant and Environmental Sciences/Rex E. Kirksey Agricultural Science Center at Tucumcari; Extension Forage Specialist, Department of Extension Plant Sciences/Agricultural Science Center at Los Lunas; and Extension Entomologist, Department of Extension Plant Sciences/Agricultural Science Center at Artesia, New Mexico State University.

Figures 2A and 2B. **Typical external scarring and tunneling on alfalfa roots (A) by whitefringed beetle grubs (B) [photos by Carol Sutherland (2A) and Mark Marsalis (2B)].**

Whitefringed beetle is a native of southern South America, but is a relative of alfalfa weevil [*Hypera postica* (Gyllenhal) and *H. brunnipennis* (Boheman), strains of which are found throughout the U.S.], alfalfa snout beetle (*Otiorhynchus ligustici*, found only in New York and neighboring Canada), and clover root curculio [*Sitona hispidulus* (F.), found throughout the U.S.]. First detected in the southeastern U.S. in the mid-1930s, whitefringed beetle is associated with

Figure 3. **Adult whitefringed beetle (actual length about 1/2 inch), so named because of the white markings on the edges of the gray-striped wing covers. Also note the elbowed antennae and the short, broad snout (photo by Pest and Diseases Image Library, Bugwood.org).**

over 385 host plant species, including some that are economic crops and woody plants and weeds in New Mexico (Table 1; Barnes and DeBarro, 2009).

DESCRIPTION AND BIOLOGY

Whitefringed beetle, like all beetles, undergoes complete metamorphosis, with four stages of development (egg, larva, pupa, and adult). Viewed from the side, the 1/2-inch-long gray-striped adult has a white fringe on the outer edges of its wing covers, from which the name is derived. These beetles are a type of weevil and have a head that is elongated into a short, broad snout featuring a pair of elbowed antennae (Figure 3). Viewed from above, the body is broadest across the bases of the wings and tapered somewhat on either end. Adults live above ground, hide in plant debris, and feed by cutting small notches in the leaf margins of various plants. The flightless adults are transported accidentally from one location to another on hay or other plant material, equipment, trailers, vehicles, building or landscaping materials, fence posts, or other materials stored in or near the field—whatever the beetles decide to crawl onto, into, or under for shelter. Flood irrigation may force the beetles to leave crop fields and take temporary refuge around homes, other buildings, or field margins. Over the course of its adult life, a whitefringed beetle may also travel 1/4 to 3/4 of a mile in pursuit of host plants and places to lay eggs (Metcalf and Metcalf, 1993).

Table 1. Whitefringed Beetle Host Plant Species Prominent in New Mexico		
Plant	**Species**	**Crop Type**
Alfalfa	*Medicago sativa*	Forage
Beans	*Phaseolus* spp.	Field crop; vegetable
Blackberry	*Rubus* spp.	Fruit
Carelessweed	*Amaranthus palmeri*	Weed
Clover	*Trifolium* spp.	Cover crop; forage
Corn	*Zea mays*	Field crop
Cotton	*Gossypium* spp.	Field crop
Cowpea	*Vigna unguiculata*	Cover crop; forage
Curly dock	*Rumex crispus*	Weed
Dahlia	*Dahlia* spp.	Landscape flower
Grape	*Vitis* spp.	Fruit-bearing vine (young woody plants)
Lettuce	*Lactuca sativa*	Vegetable
Mustard	*Brassica* spp. *Sinapis* spp.	Vegetable; weed
Oat	*Avena sativa*	Field crop; forage
Okra	*Abelmoschus esculentus*	Vegetable
Peach	*Prunus persica*	Fruit tree (young woody plants)
Peanut	*Arachis hypogaea*	Field crop
Pecan	*Carya illinoinensis*	Nut tree (young woody plants)
Peppers	*Capsicum* spp.	Vegetable
Potato	*Solanum tuberosum*	Vegetable
Ragweed	*Ambrosia* spp.	Weed
Strawberry	*Fragaria × ananassa*	Fruit
Willow	*Salix* spp.	Deciduous tree (young woody plants)
Additionally, whitefringed beetle will survive on parts of dead plants in the soil.		
Source: Barnes and De Barro (2009).		

A single insect can infest an entire field over time because all whitefringed beetles are highly fertile females; no males have been found outside of the beetle's South American range, and are only rarely found there (Barnes and DeBarro, 2009; Bragard et al., 2020). Fertile eggs are produced asexually (without fertilization) through a process called parthenogenesis, giving this invasive species a reproductive edge (Rodriguero et al., 2019). Each female begins producing eggs within five days of emerging as an adult (Bragard et al., 2020), and produces 600 to 700 eggs or more over an average adult lifespan of two to five months. Multiple egg masses of up to 60 eggs each are laid indiscriminately on or just below the soil surface, on living or dead plant material, or on miscellaneous items parked or stored in or near the infested field. Egg masses are camouflaged by a gelatinous coating that likely conserves moisture and helps them adhere to their substrate (Barnes and DeBarro, 2009; Bragard et al., 2020). Larvae hatch within 10 to 11 days in summer or up to 100 days or more in cooler weather. Newly hatched larvae can survive up to 100 days without eating (Gough and Brown, 1991) and complete their development underground, feeding on and inside roots, tubers, underground stems, rhizomes, pods (e.g., peanut pods), and other belowground plant parts through seven larval instar stages that can take up to two years (Barnes and DeBarro, 2009). The plump, legless larvae are pale pink to off-white grubs up to 1/2 inch long with brown heads, and can most often be found within the top 12 inches of soil (Figure 4). After overwintering in the soil, pupation typically occurs from late April through late July, usually 2 to 8 inches deep in the soil. However, some pupae may be found as deep as 18 inches (Barnes and DeBarro, 2009). Adults emerge from the soil in April through October, peaking in July (Bragard et al., 2020). One generation per year is the norm where they were first detected in the southeastern U.S.

DETECTION

September and October are good times to look for adults in alfalfa, particularly after fields have been cut. Scan or rake short stubble and hay debris while looking for these gray-striped beetles; use a hay fork to turn windrows where beetles may hide by day, being careful to watch for rattlesnakes. These beetles are very wary and will fake death when disturbed, which, along with their color and size (Figure 3), makes them easy to overlook.

For fields with some regrowth, look for spots in the field where alfalfa plants are obviously thinning and weeds are increasing (Figure 1). Good times to observe aboveground symptoms, such as stunted plants and yellowing of leaves, are after initial green-up in the spring and prior to the first cutting. These symp-

Figure 4. **Whitefringed beetle larva. Note the well-developed, slightly darker brown head capsule on the right; the chewing jaws; the multi-segmented, ivory-colored body; and the absence of legs (photo by Edward L. Barnard, Florida Department of Agriculture and Consumer Services, Bugwood.org).**

toms can usually be seen while standing in a truck bed and looking over the field. Otherwise, when the soil is soft enough to dig at least 12 inches deep, carefully dig some alfalfa plants—roots and all—from the edge of the thinning area. Insert the shovel straight down 12 inches, leveraging the shovel, soil, and roots out in one motion without scarring or breaking the root. A tarp or large piece of window screen makes a good surface for separating damaged roots and larvae from the soil. Affected alfalfa roots can have external chew marks as well as tunnels and holes where the larvae chewed their way in or out. Some larvae may still be inside the root; 20 or more larvae have emerged when roots were kept moderately cool and out of the sun in a plastic food storage bag. Grubs of other beetles, such as green June beetle, also feed on alfalfa roots and may be found in a sample. However, green June beetle and other scarab beetle larvae always have three pairs of well-developed, easy-to-see jointed legs just behind their heads, while whitefringed beetle larvae are always legless (Figure 4).

SAMPLE PRESERVATION AND SUBMISSION

Submit a sample of grubs live or preserved in 70% or greater rubbing alcohol to your County Extension Agent for identification. Submerging the insects in boiling water before putting them in alcohol will preserve their colors better for identification. If grubs are not submitted for identification, dispose of the sample so that no living grubs can escape.

CONTROL STRATEGIES

Since the 1930s, producers have tried a variety of strategies to control invasive whitefringed beetles. Once established, the pests can be managed but not eliminated from a farm. An integrated pest management (IPM) approach can be the most successful way to manage these pests using prevention and monitoring in combination with cultural, mechanical, biological, and chemical controls to suppress pests while also limiting environmental and health risks (Bennett, 2017). Maintaining detailed production records for each field, regularly monitoring plant vigor and trends in pest populations, judiciously using certain labeled insecticides (for the adult stage), and rotating crops in infested fields remain the most effective short- and long-term tools for managing whitefringed beetle.

Prevention and Monitoring

Remember, over time some adult beetles are likely to wander or be transported to other fields, non-crop areas, or home landscapes where they may shelter temporarily or become established. These individuals will be the reservoir for reinfestation of the original field and can also be sources for new field infestations. Pest scouting routines, field treatments (if appropriately labeled), and crop rotations should be planned and executed for the entire property, not just the originally infested field.

Cultural Control Options

Crop rotation (a form of cultural control) is a reasonably effective strategy to integrate into a whole-farm whitefringed beetle management plan. Alfalfa is a perennial with a fairly thick taproot in mature plants. Select a series of interim annual crops with thin, fibrous roots, such as grasses, that can deprive whitefringed beetle larvae of optimal microhabitats as well as a continuous diet of a perennial crop. Note, however, that some grass crops have been found to support whitefringed beetle (Table 1). If alfalfa is rotated to a new location on the farm, try to place it as far from the infested field as possible to reduce the ability of adults to reach the new field. If it is not possible to distance the fields, a 10- to 12-foot ditch with well-packed sides can help reduce adult spread between fields. Burning the ditches periodically throughout the season to kill weeds and destroy harborage materials can also help suppress adult movement (Allen et al., 2015). Alternate crops may have insecticides labeled for whitefringed beetle control. Replant alfalfa several years later, and monitor the field for performance and pest problems.

Table 2. Insect Pest Larvae Known to Be Infected by Entomopathogenic (Beneficial) Nematodes		
Ants (queen)	Cucumber beetles	Mole crickets
Armyworms	Cutworms	Onion maggots
Artichoke plum moths	Fall armyworms	Pill worms
Asparagus beetles	Fire ants	Pine weevils
Bad nematodes	Flea beetles	Poplar clear wig borers
Bagworms	Fleas	Raspberry crown borers
Berry root weevils	Flies	Root aphids
Bill bugs	Fruit flies	Root weevils
Black cutworms	Fungus gnats	Scarabs
Black vine weevils	Gall midges	Sclarids
Borers	Girdlers	Shore flies
Cabbage maggots	Grape root borers	Sod webworms
Carpenter worms	Grubs	Squash vine borers
Carrot weevils	Gypsy moths	Subterranean termites
Chafers	Humpbacked flies	Strawberry root weevils
Chinch bugs	Hylobius weevils	Sugarcane stalk borers
Citrus weevils	Japanese beetles	Sweet potato borers
Codling moths	June bugs	Termites (queen)
Cockroaches	Large pine weevils	Thrips
Colorado potato beetles	Lawn grubs	Wireworm aphids
Corn borers	Leaf miners	Wireworms
Corn earworms	Leather jackets	Wood borers
Corn rootworms	Masked chafers	Wooly aphids
Cotton bollworms	Mint borers	Wooly aphids
Crane flies		
Source: Nature's Good Guys (n.d.)		

Biological Control Options

Recently published research by NMSU has found that two species of beneficial entomopathogenic (insect-infecting) nematodes (*Steinernema feltiae* Filipjev and *Heterorhabditis bacteriophora* Poinar) can be introduced into New Mexico with persistence comparable to that in New York for control of alfalfa snout beetle (Lauriault et al., 2020). These nematodes are also known to infect whitefringed beetle (Barnes and De Barro, 2009). Native populations of these nematodes have been found in higher-precipitation areas of Oklahoma without irrigation (Risser et al., 2016), but they likely will not survive in unirrigated areas of New Mexico and were not found to be previously present (Lauriault et al., 2020).

In many cases, it might not be possible to salvage alfalfa stands already damaged by whitefringed beetles; however, field reclamation might be feasible using entomopathogenic nematodes in irrigated fields in semiarid regions for future alfalfa establishment after a reasonable rotation period to avoid allelopathy (Lauriault et al., 2009, 2020). Entomopathogenic nematodes could also be applied to protect new fields before economic loss occurs (Long et al., 2000). The nematodes can be applied to a field either through a ground spray rig or overhead irrigation. Even when pest larval populations are low, nematodes will maintain low populations, then increase rapidly as host insect populations increase. They might spread on the hooves of grazing animals, but that was not observed with winter grazing by horses in a New Mexico study (Lauriault et al., 2020).

Most commercially available nematodes have poor persistence due to laboratory rearing procedures (Long et al., 2000) and require continued applications to achieve pest control. However, strains tested in New Mexico were isolated from agricultural fields in New York, and rearing procedures were used to retain genes for persistence for multiple years (phased infectivity) and across crop rotations (Lauriault et al., 2020). Consequently, the degree of success of entomopathogenic nematodes for biological control of whitefringed beetle and similar pests might be enhanced by collecting native entomopathogenic nematodes from local, soil-based sources for nematode production in living hosts in a laboratory for immediate distribution to other fields. This would be beneficial because the spread of whitefringed beetle is likely not preventable (Lauriault et al., 2020), and because whitefringed beetle host plant species include many weeds and economic crops (Barnes and De Barro, 2009) in New Mexico (Table 1). Additionally, there are many other crop pests with similar larval root feeding behavior that these entomopathogenic nematodes can control (Table 2).

Table 3. Examples of Currently Registered (2020) Insecticides for Treatment of Adult (Only) Whitefringed Beetles in New Mexico Alfalfa*			
Product	**Company**	**Percent**	**Chemical name**
Helena Lambda	Helena Agri-Enterprises, LLC	22.8	lambda-Cyhalothrin (128897)
Warrior II with Zeon Technology	Syngenta Crop Protection, LLC	22.8	lambda-Cyhalothrin (128897)
Lamcap II	Syngenta Crop Protection, LLC	22.8	lambda-Cyhalothrin (128897)
Grizzly Too	Winfield Solutions, LLC	22.8	lambda-Cyhalothrin (128897)
Province II Insecticide	Tenkoz, Inc.	22.8	lambda-Cyhalothrin (128897)
Nufarm Lambda-Cyhalothrin 1 EC	Nufarm Americas, Inc.	13	lambda-Cyhalothrin (128897)
Roundhouse 1 EC	Loveland Products, Inc.	13.1	lambda-Cyhalothrin (128897)
Silencer	Makhteshim-Agan of North America, Inc.	12.7	lambda-Cyhalothrin (128897)
Willowood Lambda 1EC	Willowood, LLC	12.7	lambda-Cyhalothrin (128897)
Paradigm VC	Winfield Solutions, LLC	12.7	lambda-Cyhalothrin (128897)
Cyhella Insecticide	Arxada, LLC	23.8	lambda-Cyhalothrin (128897)
Lambda-Cy EC Insecticide – RUP	UPL NA	11.4	lambda-Cyhalothrin (128897)
Lunge Insecticide	UPL NA	23.15	lambda-Cyhalothrin (128897)
Lambdastar Insecticide	FarmHannong America, Inc.	13.1	lambda-Cyhalothrin (128897)
Lambdastar 1 CS	FarmHannong America, Inc.	12	lambda-Cyhalothrin (128897)
Lambdastar Plus	FarmHannong America, Inc.	23.28	lambda-Cyhalothrin (128897)
Kendo Insecticide	HELM Agro US, Inc.	13.1	lambda-Cyhalothrin (128897)
Kendo 22.8 CS	HELM Agro US, Inc.	22.8	lambda-Cyhalothrin (128897)
Lambda CY AG	Winfield Solutions, LLC	11.4	lambda-Cyhalothrin (128897)
Lambda Select	Select Source	13	lambda-Cyhalothrin (128897)
Willowood Lambda – CY 1EC	Willowood, LLC	13.1	lambda-Cyhalothrin (128897)
Ravage 2.0	Innvictis Crop Care LLC	23.6	lambda-Cyhalothrin (128897)
Ravage	Innvictis Crop Care LLC	13.1	lambda-Cyhalothrin (128897)
Serpent 1 EC	Atticus, LLC	13.1	lambda-Cyhalothrin (128897)
Baythroid XL	Bayer CropScience LP	12.7	beta-Cyfluthrin (118831)
Sultrus	Helena Agri-Enterprises, LLC	12.86	beta-Cyfluthrin (118831)
Hero EW Insecticide	FMC Corporation	9.72	Bifenthrin (128825)
		3.24	Zeta-Cypermethrin (129064)
Bifenture EC Agricultural Insecticide	UPL NA	25.1	Bifenthrin (128825)
Mustang Insecticide	FMC Corporation	17.1	Zeta-Cypermethrin (129064)
Mustang MAXX Insecticide	FMC Corporation	9.15	Zeta-Cypermethrin (129064)
Declare Insecticide	FMC Corporation	14.4	gamma-Cyhalothrin (128807)
Proaxis Insecticide	FMC Corporation	5.9	gamma-Cyhalothrin (128807)
Fastac EC Insecticide	BASF Corporation	10.9	alpha cypermethrin (209600)
Fastac CS Insecticide	BASF Corporation	9.88	alpha cypermethrin (209600)
Imidan 70-W (WSB)	Gowan Company	70	Phosmet (59201)
Tombstone	Loveland Products, Inc.	24.74	Cyfluthrin (128831)
Tombstone Helios Insecticide	Loveland Products, Inc.	25	Cyfluthrin (128831)
* All products are "Restricted Use." Pesticide labels change frequently; read all pesticide labels carefully.			

Chemical Control Options

Currently, chemical controls are limited, and only certain products are labeled for control of white-fringed beetles (adults only) in alfalfa in New Mexico (Table 3). All of these products are “Restricted Use” and require a current Pesticide Applicator License to purchase or use. These products also are highly toxic to pollinators and natural enemies, so they should be used with care, and not during the blooming period.

Additional precautions can be taken by spraying when it is not windy and/or spraying at dusk when fewer pollinators are active and when there will be some time for the product to degrade overnight. **No products are labeled for control of whitefringed beetle larvae in alfalfa.** Read the labels for these products carefully for additional restrictions on applications.

All products listed in Table 3, except Phosmet, are Mode of Action Classification Category 3 (www.irac-online.org) for Insecticide Resistance Management. As defined by the Insecticide Resistance Action Committee (www.irac-online.org), insecticide resistance is “a heritable change in the sensitivity of a pest population that is reflected in the repeated failure of a product to achieve the expected level of control when used according to the label recommendation for that pest species.” Currently, it is unknown whether or how quickly whitefringed beetles will develop resistance to Category 3 insecticides. Ideally, applicators should rotate insecticide products with different modes of action (i.e., the ways these products affect the physiology of an organism at a biochemical level) to reduce the selection pressure on pest populations, thereby slowing down the development of insecticide resistance. (See https://www.youtube.com/watch?v=pS7pxpTwMoQ&t=8s for more information about preventing insecticide resistance.)

CONCLUSIONS

The best option for controlling whitefringed beetle is to implement a holistic management strategy using a number of IPM techniques—a combination of cultural, biological, and chemical controls—to help suppress populations and reduce their risk of spreading. Additionally, implement a careful monitoring plan, and take preventive steps to protect fields from becoming infested.

For more information about alfalfa management, contact your County Cooperative Extension Service office (https://aces.nmsu.edu/county/), or visit the NMSU Cooperative Extension Service publications website at https://forages.nmsu.edu/resources.html or https://pubs.nmsu.edu/.

REFERENCES

Allen, G., P. Walker, N. Davie, P. Horne, and S. Johnson. 2015. *Improving management of white-fringed weevils in potatoes—Final report*. Sydney: Horticulture Innovation Australia Limited.

Barnes, T., and J. De Barro. 2009. Improving pest management in the Australian lucerne industry—A review of management of white fringed weevil, small lucerne weevil, and broad-back weevil [Publication 09/172]. Kingston, ACT: Australian Government Rural Industries Research and Development Corporation.

Bennett, A. 2017. Integrated pest management (IPM) for home gardeners [Circular 655]. Las Cruces: New Mexico State University Cooperative Extension Service. https://pubs.nmsu.edu/_circulars/CR655.pdf

Bragard, B., K. Dehnen-Schmutz, F. Di Serio, P. Gonthier, M-A. Jacques, J.A.J. Miret, A.J. Justesen, C.S. Magnusson, P. Milonas, J.A. Navas-Cortes, S. Parnell, R. Potting, P.L. Reignault, H-H. Thulke, W. Van der Werf, A.V. Civera, J. Yuen, L. Zappalà, E. Czwienczek, F. Streissl, and A. MacLeod. 2020. Pest categorisation of *Naupactus leucoloma*. *EFSA Journal*, 18, 6104. doi:10.2903/j.efsa.2020.6104

EPPO. 2020. *Naupactus leucoloma* (GRAGLE). Paris: European and Mediterranean Plant Protection Organization. https://gd.eppo.int/taxon/GRAGLE/distribution

Gough, N., and J. Brown. 1991. Development of larvae of the whitefringed weevil, *Graphognathus leucoloma* (Coleoptera: Curculionidae), in northern Queensland. *Bulletin of Entomological Research*, 81, 385–393. doi:10.1017/S0007485300031941

Lauriault, L.M., F.E. Contreras-Govea, and M.A. Marsalis. 2009. Assessing alfalfa stands after winter injury, freeze damage, or any time renovation is considered in New Mexico [Circular 644]. Las Cruces: New Mexico State University Cooperative Extension Service. https://pubs.nmsu.edu/_circulars/CR644.pdf

Lauriault, L.M., E.J. Shields, A.M. Testa, and R.P. Porter. 2020. Persistence of select introduced entomopathogenic nematodes in the US Southwest as potential biological control for whitefringed beetle in alfalfa. *Southwestern Entomologist*, 45, 41–50.

Long, S.J., P.N. Richardson, and J.S. Fenlon. 2000. Influence of temperature on the infectivity of entomopathogenic nematodes (*Steinernema* and *Heterorhabditis* spp.) to larvae and pupae of the vine weevil *Otiorhynchus sulcatus* (Coleoptera: Curculionidae). *Nematology*, 2, 309–317.

Metcalf, R.L., and R.A. Metcalf. 1993. *Destructive and useful insects*, 5th ed. London: McGraw-Hill.

Nature's Good Guys. n.d. Beneficial nematodes triple blend Hb+Sc+Sf [Product packaging]. Medford, OR: Author.

Risser, K., C. Greenwood, N. Walker, M. Payton, and J. Talley. 2016. Prevalence and diversity of entomopathogenic nematodes spanning a mean annual precipitation gradient in pastureland in Oklahoma. *Southwestern Entomologist*, 41, 933–944.

Rodriguero, M.S., N.V. Guzman, A.A. Lanteri, and V.A. Confalonieri. 2019. The effect of reproductive system on invasiveness: Lessons from South American weevils. *Florida Entomologist*, 102, 495–500.

The pesticide recommendations in this publication are provided only as a guide. The authors and New Mexico State University assume no liability resulting from their use. Please be aware that pesticide labels and registration can change at any time; by law, it is the applicator's responsibility to use pesticides ONLY according to the directions on the current label. Use pesticides selectively and carefully and follow recommended procedures for the safe storage and disposal of surplus pesticides and containers.

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Carol A. Sutherland is a retired Extension Entomologist at New Mexico State University and also retired State Entomologist for the New Mexico Department of Agriculture. In late 2022, Dr. Joanie King replaced Dr. Sutherland. Dr. King is an Extension/research entomologist in the Department of Extension Plant Sciences at NMSU.

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