

Dec. 10, 2015

## Final Report on ODA/OAN Grant: Host range of Azalea lace bug

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**Problem:** The Azalea lace bug (AzLB), *Stephanitis pyrioides*, is an emerging pest in the Northwest of ericaceous plants. Its feeding causes whitening or yellow spotting of leaves.

### 1) Evaluate the host range of AzLB on untested species significant to Oregon's nursery industry.

**Methods:** Using protocols developed for preliminary host plant species suitability by Oregon Department of Agriculture (ODA), potted nursery stock of species to be evaluated will be placed in enclosures with colonies of AzLB maintained on a plant of a known preferred host. A host will be deemed "suitable" for AzLB only if oviposition and subsequent completion of development occurs on it. Mere feeding damage will not be considered sufficient for determining that a species is truly a host, although it will be noted as indicating vulnerability.

**Results:** In 3 sets of host plant trials, 26 species of nursery stock were exposed to AzLB colonies. Feeding damage was observed on 16 species of Ericaceae, and immature AzLB were observed on 12 of these.

- Chlorotic spotting/faeculum observed (feeding):

*Andromeda polifolia* 'Blue Ice'  
*Epigaea repens* (Eastern N.A. native)  
*Kalmia latifolia* 'Red Bud' (Eastern N.A. native)  
*Rhododendron benhallii* (= *Menziesia ciliicalyx*)

- Early instars observed (reproduction):

*Chamaedaphne calycutata* (Eastern N.A. native)  
*Daboecia cantabrica* 'Atropurpurea'  
*Kalmiopsis leachianum* 'Le Piniec' (OR native)  
*Kalmiopsis leachianum* 'Umpqua form' (OR native)  
*xPhylliopsis hillieri* 'Pinocchio'  
*Pieris japonica* 'Mountain Fire'  
*Rhododendron* ("Ledum") *groenlandicum* (OR native)  
*Rhododendron macrosepalum* 'Linearifolium'  
*Vaccinium corymbosum* 'Chandler' (Eastern N.A. native)  
*Vaccinium macrocarpon* (Eastern N.A. native)  
*Vaccinium ovatum* (OR native)  
*Vaccinium uliginosum* (OR native)



- No AzLB damage observed:

*Arbutus unedo* 'Compacta'  
*Arctostaphylos glandulosa* (OR native)  
*Arctostaphylos hispidula* (OR native)  
*Arctostaphylos uva-ursi* 'Massachusetts' (OR native)  
*Enkianthus campanulatus*  
*Leucothoe davisiae* (OR native)  
*Leucothoe fontanesiana* 'Scarletta' (Eastern N.A. native)  
*Pieris floribunda* (Eastern N.A. native)  
*Umbellularia californica* (Lauraceae) (OR native)  
*Vaccinium parviflorum* (OR native)

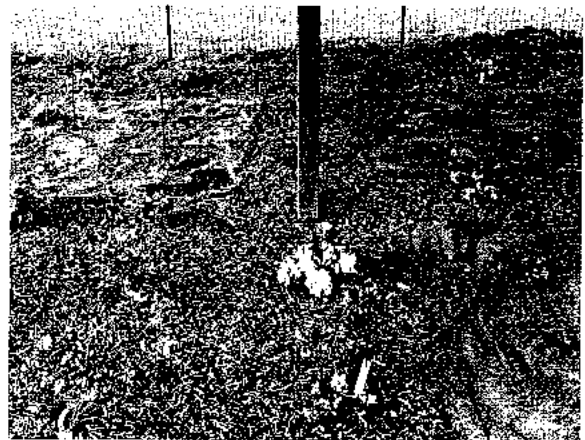
In addition a "common garden" planting was established consisting of quadrants of 4 test plants each of commercial high-bush blueberry (*Vaccinium corymbosum* 'Blueray'), commercial cranberry (*V. macrocarpon* 'Stevens'), and *Kalmiopsis* ('Bovees' seedling' and 'Le Piniec') each surrounded by 8 evergreen azalea cultivars (24 cultivars total).

At the corners of the planting are seedlings of other plants of interest too large to be included in free-choice trial cages: Pacific madrone (*Arbutus menziesii*), cotoneaster (*Cotoneaster apiculatus* 'Cranberry'), commercial hazelnut (*Corylus avellana* 'Yamhill'), and commercial mahaleb cherry (*Prunus mahaleb* 'North Star'), each with an evergreen azalea cultivar at its base.

In May 2015 when AzLB immatures were first observed in Salem, the common garden azaleas were inoculated with 40 3rd -4th instar AzLB nymphs each (1120 AzLB immatures total).

As of mid-September, AzLB damage has been observed only on *Kalmiopsis leachiana* 'Bovees Seedling'. In addition to AzLB the garden has a heavy infestation of the introduced pest azalea leafminer (*Caloptilia azaleella*, Gracillariidae). Coccinellid beetles and spiders have been observed on the azaleas.

**Objective 2. Survey for the predatory mirid and native natural enemies while monitoring and surveying for AzLB in urban, periurban, and wild landscapes.**



**Methods: ODA** - Populations of AzLB in heavily infested areas, such as the Portland metro area and Salem, were sampled at peak abundance for the presence of the mirid or other natural enemies. Transects were sampled from heavily infested areas through periurban and wild landscapes for damage by AzLB on cultivated and native hosts. Any AzLB populations in those areas were also sampled for introduced and native natural enemies.

**Methods: USDA** – Eight locations in the Mid-Willamette Valley were sampled 1-2 times per month from May to October. Natural enemies were observed on the leaf samples taken back to the laboratory, and in shake samples of infested plant material. Also, leaf samples with intact eggs were reared for 5 weeks to later determine if egg parasitism occurred and collect any emerging parasitoids.

**Results: ODA:** To facilitate discrimination between AzLB and native *Stephanitis rhododendri* when no adults are present, in spring and summer 2015 all instars of both species from the colonies maintained in the ODA greenhouse were imaged to determine diagnostic differences in early instars. Several “first” AzLB finds occurred in Multnomah Co, Hood River Co., and Douglas Co. ODA found no specific AzLB natural enemies either from transect samplings, heavy infestation samplings, or in our common garden.

Stops at Multnomah Falls, Bonneville Dam, Cascade Locks, Hood River, The Dalles.

AzLB collected

Bonneville hatchery, Multnomah Co.

ex: evergreen azalea

S. Hood River, Hood River Co. COUNTY RECORD

ex: evergreen azalea 'Rosebud', lepidote rhododendron 'Dora Amateis' (nursery)

2) I-5 South from Eugene to Roseburg, 29 IX 2015

Stops at Cottage Grove, Sutherlin, Rice Hill, Roseburg.

AzLB collected

S. Roseburg, Douglas Co. COUNTY RECORD

ex: evergreen azalea 'Hino White' (nursery)

**USDA survey:** AzLB and associated insects were monitored on infested rhododendrons and azaleas in eight locations in the Mid-Willamette Valley from May to October. Spiders were found most often, followed by ladybeetles (*Coccinella septempunctata*). AzLB eggs were collected, reared and inspected regularly; no signs of egg parasitism were observed.

*Outcome: The predatory mirid (Stethoconus) or parasitic wasp that are important in the Eastern US do not appear to be present in Oregon, therefore future biocontrol efforts should focus on other natural enemies currently in range and augmentative releases of predators or pathogens (additional objective added at end).*

**3) Test the susceptibility of various azalea and rhododendron cultivars to AzLB.**

Methods: Natural infestation was followed on ~450 cultivars of rhododendrons in a commercial nursery and private collection (unsprayed). About 350 cultivars were infested, including several commonly sold cultivars such as March Madness and Anna Rose Whitney.

Out of 428 cultivars examined, 75 cultivars have not yet shown signs of natural infestation by AzLB in the field (Table 1). Notably, a number of these cultivars have indumentum, and four of the indumentum-bearing cultivars were confirmed to be unsuitable to AzLB in the laboratory (in bold\*). An absence of infestation does not imply resistance, but rather these cultivars should be investigated further for susceptibility. Specimens from the garden were located in an unsprayed area with high AzLB populations, and therefore infestation likelihood was considered high. Single plants in the specimen garden were checked unless otherwise specified.

**Table 1. Cultivars that have not shown infestation**

	Name	Characteristics	Habit	Plants checked	Repeated checks
R.	Arborcum		garden		repeat
	Atlanticum		garden		no
R.	Austrinum Moonbeam		garden		no
R.	Balfourianum	light Indumentum	garden		repeat
R.	Beanianum	Indumentum	garden		repeat
	Bloom-a-thon Lavender Azalea		pot	one bed	repeat
	Bloom-a-thon White Azalea		pot	one bed	repeat
	Bureavii Lem Form	Indumentum, Glossy	garden		repeat
	Burovii	Indumentum	garden		repeat
R.	Calophytum		garden		repeat
	Caroline		garden		repeat
R.	Cecorum		garden		repeat
	Chlorops x Campylocarpum x Yak	Indumentum	garden		repeat
	Clarke's #7363	Indumentum	garden		repeat
R.	Crimson Piippin	Indumentum, Tomentum	garden	multiple	repeat
R.	Degronianum Metlernichii	light Indumentum	garden		repeat
R.	Degronianum Yakushimanum	Indumentum	garden	multiple	repeat
	Double Besse		pot	one bed	repeat
	Endre Osto		garden		repeat
	Etta Burrows	Indumentum, Tomentum	garden	multiple	repeat
R.	Fred Peste	Indumentum	garden		repeat
	Impedium	Small leaves, odor	pot	multiple	repeat
	Irnowii	Indumentum	garden		no
	Jonathan Shaw		garden		no
	<b>Laramie*</b>	Indumentum	garden		repeat
	Machmann's Diadem x Unique x Irroratum x Polka dot	Tomentum	garden		no
R.	<b>Makinoi*</b>	Indumentum	garden		repeat

	Matador	light Indumentum	garden		no
	Mergeratum		garden		no
R.	Metternichi var. Kyomaruense	Indumentum	garden		repeat
R.	Metternichii var. Kyomame	Indumentum	garden		repeat
	Mikkeli		pot	one bed	repeat
	Morgehrot x Rubicon x Anna's Riplet	Tomentum	garden		repeat
	Naselle x Bambi x Proteoides	Tomentum	garden		no
	Noyo Dream		garden		no
R.	Occidentale Stagecoach Cream		garden		no
	Patrick's		garden		repeat
	Percly Menoides		garden		repeat
	Perfume/Patrick		garden		repeat
	Planting Memories	Indumentum	garden		repeat
	Polar Bear		garden		repeat
	Polarnacht		pot	one bed	repeat
	Ponticum Variegatum		pot	multiple	repeat
R.	Pseudochrysanthum Exbury	Tomentum	garden		repeat
	Purple Passion		pot	one bed	repeat
R.	Racemosum		garden		repeat
	Red Eye		garden		repeat
	Ruby Heart		garden		no
	Saluene	Hairy	garden		no
	Seaview Sunset		garden		no
	September Song x (Bambi x Proteoides x (Yellow saucer x Anna's Riplet)		garden		no
R.	Serrulatum		garden	multiple	repeat
R.	Smirnowii	Indumentum	garden		repeat
R.	Smirnowii White	Indumentum	garden		repeat
R.	Strigillosum	Hairy	garden		repeat
	Sugar Puff		pot	one bed	repeat
	Thor	Indumentum	garden		repeat
	Trocadero		pot	one bed	repeat
	Unknown Pink/Dark Eye red	Glossy	garden		no
	Viscosam Rosata		garden		no
R.	Viscosum		garden		repeat
R.	Viscosum Aemulans		garden		no
R.	Volunteer Seedling/Ruby Heart	Indumentum	garden		no
R.	Yak Koichiro Wada	Indumentum	garden		repeat
	Yak Mist Maiden	Indumentum	garden		repeat
R.	Yak Pachysanthum*	Indumentum	garden		repeat
	Yak Warpaint		garden		no

	Yak x Arborium	Indumentum	garden		repeat
	Yak x Bureauvii*	Indumentum	garden	multiple	repeat
	Yak x Pretty Place		garden		no
	Yak x Strigilosum	Indumentum	garden	multiple	repeat
R.	Yak, Yaku angle	Indumentum	garden		repeat
	Yaku sunrise x (Bambi x proteoides) x Amuas Ripletdwark		garden		repeat
	Yaku sunrise x Edwin Weber x Bambi x Proteoides #16	Indumentum	garden		repeat
R.	Yakushima Dwarf Layer	Indumentum	garden		repeat

Next, 353 cultivars out of 428 showed signs of natural infestation by AzLB (Table 2). Infestation level is described if the cultivar had indumentum or other specific characteristics. Low infestation is with <5% leaves damaged upon close inspection, medium infestation is with 5-25% of leaves with visible damage, and high infestation is with 25-100% leaves with discoloration.

**Table 2. Cultivars observed to have AzLB damage in the field**

	Name	Characteristics	Infestation	Habit
	(Yak x Norman Gill) x (Yellow Saucer x Anna S Riplet Dwarf			garden
	1000 Butterflies			garden
	Aberconway 1			garden
	Aberconway x David x Crest			garden
	Aberreconway II			garden
R.	Albamense			garden
	Alice Spring	Indumentum	Low	garden
	Allison Johnstone			garden
	Anah Kruscke			garden
	Anna Rose Whitney			pot, garden
	April Rose			garden
R.	Arborescens			garden
R.	Arborescens Layer	Glossy	Low	garden
	Arborescens Sweet Azalea			garden
R.	Arboreum Connamomeum	Indumentum	Low	garden
	Arboreum Hybrid			garden
R.	Augustinii			garden
	Augustinii Bergeii Bump			garden
R.	Augustinii Blue			garden
	Augustinii Bump B/W Cross			garden
R.	Augustinii Charmanthum Blue Cloud			garden
	Augustinii Chasman Willad grey			garden

R.	Augustinii Chasmanthum			garden
	Augustinii Copera	Indumentum	High	garden
R.	Augustinii Crater Lake			garden
	Augustinii Dark			garden
	Augustinii Exbury			garden
R.	Augustinii Lacamas Blue			garden
R.	Augustinii Senora Meidon			garden
R.	Augustinii St. Trudy			garden
R.	Augustinii Vilmoranium Blue			garden
	Augustinii White			garden
R.	Auriculatum	light Indumentum, Sticky	Med	garden
R.	Austrinum			garden
	Avalanche			garden
	Azalea GA Karen			pot
	Azalea GA Rosebud			pot
	Azalea Letuem			garden
	Azalea White Rosebud			garden
	Barto			garden
	Barto/Macrophyllum White			garden
R.	Basilicum			garden
	Belle Heller			garden
	Belleaus Toy	light Indumentum	Low	garden
	Bessie Balcom			garden
	Best Purple			garden
	Biscuit Colored Daydream			garden
	Black Eye			garden
R.	Black Magic			garden
	Blaney's Blue			garden
	Bloom-a-thon Pink			pot
	Blue Baron			garden
	Blue Cloud			garden
	Blue Diamond			garden
	Blue Jay			garden
	Blue Peter			garden
R.	Bob Bovee			garden
	Bob's Blues			garden
	Borde Hill			garden
	Bow Bells			garden
	Bronze Wing			garden
R.	Brown Eyes			garden
	Buzzer Beater			pot
R.	Cacasicum x Fred Rose			garden

	Candi			garden
	Captain Jack	light Indumentum	High	garden
R.	Cardiobasis			garden
	Carmen			garden
	Cary Ann			garden
	Cataw Grandiforum			pot
	Catawbiense Forma Insularis	Leathery	Low	garden
	Cawtawbiense Boursalt			garden
R.	Chaetomallum			garden
	Charmont			garden
	Chasman William Gay			garden
	Chasmanthum			garden
	Cherry Cheesecake			pot
	China			garden
	Chlorops			garden
	Chlorops x Yak x Skipper			garden
	Christmas Cheer			garden
R.	Ciliatum			garden
R.	Cinnabarinum var. Pearly Glow			garden
R.	Cinnabarinum Xanthocodon			garden
R.	Cinnabarum Xanthocodon Purpurellum			garden
R.	Cipinense			garden
	Circus			garden
	Clark's Mardis Gras	Indumentum, Tomentum	Low	garden
	Clipense			garden
	Corona x Yak			garden
	Creole Bell			garden
	Crest			garden
	Crimson Pippin's Sister x (Ernest Inman x Edwin O. Weber)			garden
	Cuneatum			garden
	Cunningham's White			pot, garden
	Dan's Early Purple			garden
	Daphiodes			pot, garden
R.	Daphnoides			garden
R.	Dauricum Alba			garden
	David x Crest			garden
R.	Davidsonianum			garden
R.	Diaprepes			garden
	Dido x Williamsianum			garden
	Dora Amateis			garden
	Dr. Stocker x self			garden
	Dreamland			pot



R.	Dreodoxa var. Fargisii			garden
	Edith Bosley			pot
	Electra Mel Reeves			garden
	Electra's Son			garden
	Elliott's Red Whallop			garden
	Elisabeth Hobbie			garden
	Elizabeth R. Shum Picnic	light Indumentum	High	garden
	Elvira			pot
	English Roseum			pot
	Evening Glow			garden
	Everything nice			garden
R.	Exbermia			garden
	Exury Azalea	Indumentum, Tomentum	Low	garden
	Falvidur x Lady Roseberry	Glossy	High	garden
	Fastuosum Flore Pleno			garden
	Firestorm			pot
R.	Fortunei Pink Chiffon			garden
	Fred Hamilton			garden
	Friday			garden
	Furnivall's Daughter			garden
	Gall's Crimson			garden
	Garten-Direktor Gloker			garden
	George Delight			garden
	Ginny Gee			garden
	Gold Mour			garden
	Golden Gate			garden
	Goldstrike			garden
	Gomer Waterer			pot, garden
	Grace Seabrook			garden
	Grand Slam			garden
	Green Eye			garden
	Greenland			pot
	Guy Nearing	Tomentum	Med	garden
	Haaga			pot
	Hachmanns Diadem x Yellow Saucer x Anna's Riplet			garden
	Hachmanns Polaris x Yellow saucer x Anna's Riplet Dwarf			garden
	Hackmans Polaris			garden
	Halfdan			garden
	Halfdan Lem			garden
R.	Hanceanum Nanum			garden
	Hardi JZ ER's Beauty Azalea			garden
	Heart's Delight			garden

	Helikki			pot
	Helsinki University			pot
	Henry's Red			pot
R.	Hensley Anum			garden
	Holy Moses			garden
R.	Hookeri			garden
	Hoopla			pot
	Hoppy			garden
	Horizon Lakeside			garden
	Hotel			pot, garden
	Huskymania			pot
R.	Hyperthrum	light Indumentum, Glossy	Low	garden
	Ignatius Sergeant			pot
	Ilam Violet			garden
R.	Irroratum			garden
	Isabel Pierce			garden
	Jan Dekins			garden
	Jean Marie de Montague			pot, garden
	Jock			garden
	Johnsteanum	Hairy	High	garden
	Jumbo			garden
	Karen Triplett			garden
	Karin			garden
R.	Keiskei Yaku Fairy			garden
	Kevin	Indumentum	Low	garden
	Kilmanjaro			garden
	Kiusianum var Shp			garden
	Kiusilaum Album			garden
	Kristin			garden
	Lacanas Blue			garden
	Lady Clementine Hotford			garden
	Last Chance	light Indumentum	High	garden
R.	Ledum			garden
	Ledum Glanoulosum			garden
	Lee's Dark Purple			pot
	Lemon Tart			garden
R.	Lems 121			garden
	Lem's Cameo			garden
	Lems Oregon Sunset			garden
	Len's Monarch			garden
	Leo			garden
	Leonna			garden

R.	Leutiem			garden
	Lissabon			garden
	Little Beth			garden
	Lodauric x R. Hemsley Anum			garden
	Loderi King George			garden
	Loder's White			garden
	Looking Glass			pot
	Lord Roberts			pot
	Lucky Strike			garden
	Lucy Lou	Hairy	Med	garden
R.	Lutescens FCC			garden
R.	Lutescens FCC Layer			garden
R.	Luteum			garden
R.	Macabeanum			garden
R.	Macrophyllum			garden
R.	Macrophyllum L. Lum			garden
	Madan Fr. J. Chauvin			garden
R.	Malamute			garden
	March Madness			pot
	Mark EET A's Prince			garden
	Markeeta's Prize			garden
	Marley Hedges			garden
	Maryke			garden
R.	Maximum Fetlerhoffs Ivory Bump	light Indumentum	Low	garden
R.	Maximum White/Bump			garden
	McGuire Hybrid	Glossy	Var.	garden
	Medusa	light Indumentum	Low	garden
	Mid Summer			garden
	Midnight Mystigame			garden
	Miss Portland			garden
R.	Morii			garden
	Moser's Maroon			garden
	Mount Everest			garden
	Mrs. 4 De La Mere x Purple Splendor			garden
	Mrs. Betty Robertson			garden
	Mrs. Charles Pearson			garden
	Mrs. EC Sterling			garden
	Mrs. G W Leak			garden
	Mrs. P.D. Williams x Lacteum			garden
	Mrs. W.C. Slocock			garden
	Mucronulatum			garden
	Nakaharai			garden
	Naomi Astarte			garden

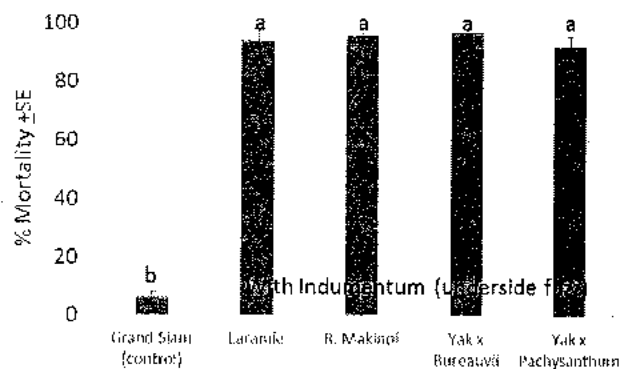
	Naselle x (Lem's cameo x Recurvoides)	light Indumentum	Med	garden
	Nelda Peach			garden
	Nightwatch			garden
	Normandy			pot
	Nova Zembla			pot
R.	Oblonfolium			garden
R.	Occidentale			garden
	Occidentale Olivever			garden
R.	Occidentales S M 29			garden
	Ocean Lake			garden
	Odee Wright			garden
	Olive			garden
	OR Tricanthum			garden
R.	Orbiculare			garden
R.	Oreotrepes			garden
R.	Oreotrepes exbury			garden
	Ostbo's Low Yellow			garden
	Paprika Spiced			garden
	Peppermint Stick			garden
	Perfume			garden
	Peter Faulk	light Indumentum	Low	garden
	Phyllis Kern			garden
	Phyllis Kor			garden
	Pink Pearl			garden
	PJM			pot, garden
	Point Defiance			garden
	Popeye No. 2			garden
R.	Praevernum			garden
	President Roosevelt			pot, garden
	Primula Sibddii "Pink Spray"			garden
	Princess Elizabeth x Elizabeth			garden
	Puget Sound			garden
	Purple Elegans			garden
	Purple Gem			pot
	Queen of Waaldheim			garden
	Rac Roc Rose	Small leaves	Low	pot
R.	Rainbow			garden
	Ramapo	Small leaves	Low	pot
	Razzle Dazzle			garden
	Red Walloper			garden
R.	Ririei			garden
	Rockett			pot
	Roseum elegans			pot

	RSF #77-787			garden
	Rubicon	light Indumentum	High	garden
	Ruby Bowman			garden
R.	Rukizon			garden
R.	Russatum			garden
R.	Sapphire			garden
	Sarita Loder			garden
	Sausalito			garden
	Scarlet Wonder Dwarf			pot
R.	Schlippenbachii			garden
	Scintillation			garden
	Searsiae			garden
	Seedling JE 30 x Avalanche			garden
	September Song			pot
	Serotinum x Skipper			garden
	Seta			garden
	Shamrock			garden
	Skipper			garden
	Slam Dunk			pot
R.	Smithii Clarks	Indumentum	Low	garden
	Smokey			garden
	Sneezy			pot
	Solent Queen			garden
R.	Soulei			garden
	Soulei hybrid			garden
	Spatter			garden
	Spatter Paint			garden
	Special White	Leathery	Med	garden
	Spring Glory			garden
	St. Tudy			garden
	Star Sapphire			garden
	Star Trek			garden
	Starfish			garden
	Sugar Pink			garden
	Sunset Bay			garden
	Sunspray			garden
R.	Sutchuenense	Indumentum	Low	garden
	Tahitian Dawn			garden
	Taurus			pot, garden
	Tempest Sister			garden
R.	Thomsonii			garden
	Tortoise Shell Orange			garden
	Town Court			garden

	Trail Blazer			garden
R.	Tricanthum	Indumentum	High	garden
	Trilby			pot
	Trube Waterer			garden
	Unique			garden
	Unnamed Rothschild Yellow			garden
R.	Uvarifolium			garden
	Vanness Sensation			garden
R.	Vaseyi Pink Shell Azalea			garden
R.	Vernicosum			garden
	Vibrant Violet			garden
R.	Vicosum Davis Layer			garden
	Virginia Richards			pot, garden
	Voleit			garden
	Voleit Cornubia			garden
R.	Vulcan			pot, garden
	Vulcan's Bells			garden
R.	Wallachii			garden
	Wardir			garden
	Warlock			garden
	William Falconer Layer			garden
	Wind River			garden
	Windbean			garden
	Winsome	light Indumentum	Low	garden
	Wizard			garden
	Wonjar's Purple			pot
	Yak Hybrid	Indumentum	Low	garden
	Yak x Norman Gill			garden
	Yaku Dreamland			pot
	Yaku Percy Wiesman			pot
	Yaku Princess			pot
	Yellow Petticoat			pot
	Yellow Rolls Royce			garden

In a no-choice laboratory assay, AzLB were found to die within a week when given rhododendrons with indumentum (see figure).

*Outcome: Many rhododendron cultivars are susceptible to AzLB. Some cultivars*



with indumentum may be resistant, as AzLB cannot feed from them.

**Other) Test the effect of *Metarhizium* spray to kill adult AzLB.** Adult AzLB were sprayed with a commercial formulation of *Metarhizium* (Met 52 EC), or water control in a Potter spray tower. Adults died at a marginally higher rate with *Metarhizium* (line graph), and 78% that died had sporulated confirming infection. High levels of mortality were also observed in the water control. *Outcome: While AzLB are susceptible to Metarhizium sprays, water spray also lead to high mortality and should be investigated further as a control method.*

