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New Jersey Agricultural Experiment Station



Using Insecticides more Efficiently: Targeting Multiple Species with the Right Rate of the Right AI at the Right Time - Golf Course Turfgrass -

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Effective Insecticide Use

- Basics (2-10)
- Key pests/scenarios (11-63)
 - White grubs (12-27)
 - ABW (28-43)
 - Chinch bugs (44-51)
 - Billbugs (52-63)

Target principle – turf zones



Target principle

- Control agent has to be delivered to the target zone in which the pest feeds or hides.
- The target zone determines:
 a. insecticide formulation
 - b. timing of application
 - c. application technique
 - d. watering in of treatment

Target principle – soil/thatch zone

- Pre-irrigate dry soil 1 d before treatment (especially when thatchy)
- \rightarrow draws insects closer to surface
- \rightarrow improves infiltration
- Granular and liquid formulations
- Liquid: coarse spray (2 gal/1,000 ft²)
- Water in (or timely rainfall) (~0.25")

Target principle – thatch/stem zone

- Granular and liquid formulations
- Liquid: coarse spray (2 gal/1,000 ft²)
- Light post-treatment irrigation (~0.1")
- Systemics for pests inside stems
- Delay irrigation and mowing for 1-2 d

Target principle – stem/foliar zone

- Liquid: coarse spray (2 gal/1,000 ft²)
- Coincide treatments with feeding activity of pest
- Delay irrigation and mowing for 1-2 d
- Granular formulation only if compound systemic (→ post-application irrigation)

Multi Target Principle

- Correct AI at right time and rate can control more than 1 (potential) pest
- But prioritize key pest !!!
- Use to reduce labor AND 'toxicity load' for environment AND negative impacts on beneficials.

Key pests: Timing of critical stages and damage*

Pes	st	A	pr		Ma	ay	/	ļ	Ju	ne	9	,	Ju	ıly		Αι	Jg	J	Se	p	t	0	ct	
	Lv		ĺ																					
ABW	Ad																							
-	Da																							
WC	Lv																							
VVG	Da																							
	Ny																							
CB	Ad																							
-	Da																							
BCW.	Lv																							
DCVV	Da																							
S/V//V/	Lv																							
30000	Da																							
	Lv																							
BB	Ad																							
	Da																							

*Average timing for NJ

ABW = annual bluegrass weevil; WG = white grubs;

CB = chinch bug; BCW = black cutworm; BB = billbugs; SWW = sod webworms;

Ad = adults; Lv = larvae; Ny = nymphs; Da = turf damage

EcoTox Profiles - Turfgrass Insecticides (Technical Grade)

Class	Trade name	Use rate (Ib ai/a.)	Mammal. LD50 (mg/kg)	Avian, LD50 (mg/kg)	Fish, LC50 (ppm)	Bee, LC50 (µg/bee)	Water solub. (mg/L)
Carbamate	Sevin	2.0 - 8.0	550	>2,179	2		40
OP	Orthene	1.0 - 3.0	906	350	>1,000	1.2	790,000
	Dursban	1.0	97	170	8	0.6	0.4-4.8
	Dylox	5.5 - 8.2	400	>5,000	430	59.8	136,000
Pyrethroid	Talstar	0.04 - 0.11	63	2,150	<0.01	<0.1	0.1
	Тетро	0.05 - 0.1	1,070	>5,000	<0.01		2
	DeltaGard	0.03 - 0.13	96	>4,640	<0.01		2
	Scimitar	0.03 - 0.12	100	>3,950	<0.01	<0.1	0.005
Neo-	Arena	0.2 - 0.33	>5,200	>2,000	105	4	327
nico- tinoid	Merit	0.3 - 0.4	424	>4,797	>8,300	0.4	514
	Meridian	0.2 - 0.27	1,563	576	>100	<0.1	4,000
Spinosyn	Conserve	0.08 - 0.4	>5,000	>2,000	30	<0.1	235
Diacylhydraz.	Mach2	1.0 - 2.0	>5,000	>5,000	9	>100	12.3
Oxadiazine	Provaunt	0.04 - 0.24	1,000	>5,620	650	1.3	0.2
Anthr.diamide	Acelepryn	0.03 - 0.26	>5,000	2,200	>15,000	> 4	1



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- Key pests/scenarios
 - White grubs
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White grubs (Coleoptera: Scarabaeidae)

- Most widespread and destructive insect pests in cool-season and transition zones
- Primary damage: feeding on roots near soil surface (severe in hot dry weather)
- Secondary damage: vertebrate predators foraging on grubs



White grubs - Signs of infestation

VYAES

NYAES

1. Thinning, yellowing, wilting



3. Dead patches join, increase in size

VYAES

VYAES



White grubs - Signs of infestation 5. Turf easily pulled up 6. C-shaped white grubs under turf

7. Vertebrate predator foraging

Shetlar

8. Vertebrate predator damage

White grubs – Seasonal Lifecycle



JAN. FEB. MAR. AFR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.

From Shurtleff Grub pupates, then Grubs move et al 1987 Grubs feed on Grub moves up to Feeding emerges as Eggs downward in Eaa laying hatch. roots : soil Grub in winter cell. feed. ceases adult :

White grubs – Cultural control

- Good turfgrass management to increase tolerance and recuperative potential
- Irrigation and light fertilization to mask damage and improve recovery
- No resistant turfgrass cultivars known
- Endophytic fungi do not provide much resistance
- Tall fescue relatively tolerant

Preventive control

- Application before infestation is recognized, ideally around egg-hatch
- Long residual insecticides (Acelepryn, Arena, Meridian, Merit, Mach2)
- Pro: Insurance
- Contra: Often unnecessary, expensive, long term suppression of natural enemies
- → Restrict to high-risk areas (history of infestation, high adult activity, lowest tolerance for damage)

Curative control

- Application when infestation is recognized (sampling, damage) to infested areas
- Short or long residual insecticides (Arena, Dylox, Sevin)
- Pro: Cheaper, more localized negative effect on natural enemies
- Contra: Labor (sampling) or risk (damage)

→ Use in areas with higher damage tolerance



	Stage	Apr	May	June	July	Aug	Sept	Oct
	Pu							
Oriental	Ad							
hootlo	Egg							
Deelle	L1							
	L2							
	L3							
Damage	(L2) L3							
Acelepryn \$	L1-2							
Merit	L1-2							
Meridian#	L1-2							
Arena#	L1-3							
Dylox	L2-3							
Sevin	L2-3							
H.bacterio.	L2-3							
Insecticide	Target	Apr	May	June	July	Aug	Sept	Oct



	Stage	Apr	Мау	June	July	Aug	Sept	Oct
	Pu							
Japanese	Ad							
, heatla	Egg							
Declie	L1							
	L2							
	L3							
Damage	(L2) L3							
Acelepryn \$	L1-2							
Merit	L1-2							
Meridian#	L1-2							
Arena#	L1-3							
Dylox	L2-3							
Sevin	L2-3							
H.bacterio.	L2-3							
Insecticide	Target	Apr	May	June	July	Aug	Sept	Oct

	Stage	A	pr	Μ	ay	J	JN	e	Jı	ıly	Αι	Jg	Se	ept	0	ct
Asiatic	Pu															
Asialic	Ad															
garden	Egg															
beetle	L1															
	L2															
	L3															
Damage	(L2) L3															
Acelepryn \$	L1-2															
Merit	L1-2															
Meridian#	L1-2															
Arena#	L1-3															
Dylox	L2-3															
Sevin	L2-3															
H.bacterio.	L2-3															
Insecticide	Target	Α	or	Μ	ay	J	JN	e	Jı	ıly	Αι	Jg	Se	ept	0	ct

	Stage	A	pr	Μ	ay	J	JN	e	Jı	ıly	Αι	Jg	Se	ept	0	ct
Asiatic	Pu															
Asialic	Ad															
garden	Egg															
beetle	L1															
	L2															
	L3															
Damage	(L2) L3															
Acelepryn \$	L1-2															
Merit	L1-2															
Meridian#	L1-2															
Arena#	L1-3															
Dylox	L2-3															
Sevin	L2-3															
H.bacterio.	L2-3															
Insecticide	Target	Α	or	Μ	ay	J	JN	e	Jı	ıly	Αι	Jg	Se	ept	0	ct

Multi target - Key pest: White Grubs



• <u>Acelepryn</u>: WG control @ 0.1 lb ai/ac

- \rightarrow up to 0.2 lb ai/ac for early and late applications.
- →also SWW, BB, BCW control
- \rightarrow CB only suppression.
- →for ABW control: 0.16-0.26 lbs ai/ac.

Multi target - Key pest: White Grubs

Pes	st	Α	pr	N	lay	/	ļ	Ju	ne	è	Ju	ıly	1	Aı	Jg		Se	ⁱ p	t	0	ct	
	Lv			Γ	T																	
	Ad																					
	Da																					
WG	Lv																					
WG	Da																					
	Ny																					
CB	Ad																					
	Da																					
BCW	Lv						1															
	Da																					
	Lv						I															
30000	Da						[
	Lv																					
BB	Ad																					
	Da																					

• Arena: WG control @ 0.2 lb ai/ac

 \rightarrow for early & late applications vs. WG up to 0.4 lb ai/ac \rightarrow also SWW control.

 \rightarrow for BB control: 0.3-0.4 lbs ai/ac.

 \rightarrow for CB, BCW, ABW control: 0.4 lbs ai/ac.

Multi target - Key pest: White Grubs

Pes	st	Α	pr		M	ay	/	Ju	n	e	Jι	ıly		Αι	Jg		Se	•p	t	0	ct	
	Lv																					
ABW	Ad																					
	Da																					
WG	Lv			-												-						
WG	Da																					
	Ny																					
CB	Ad								i													
	Da																					
BCW	Lv								L													
DCW	Da																					
	Lv																					
30000	Da																					
	Lv																					
BB	Ad																					
	Da																					

• Merit: WG control @ 0.3 lb ai/ac

 \rightarrow up to 0.4 lb ai/ac for early and late applications. \rightarrow also BB control.

 \rightarrow CB, BCW only suppression.

Multi target - Key pest: White Grubs



• Meridian: WG control @ 0.2 lb ai/ac

 \rightarrow up to 0.27 lb ai/ac for early and late applications.

 \rightarrow also BB control.

 \rightarrow CB only suppression.



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Annual bluegrass weevil (ABW) Listronotus maculicollis (Coleoptera: Curculionidae)



Formerly classified as Hyperodes maculicollis



- Serious expanding pest of close-cut annual bluegrass
- Serious problems throughout NJ, NY, CT, PA, RI, MA, NH, VT, DE, MD.
- Also problems in parts of OH, ME, VA, ONT, QUE.

ABW







under sheath

ABW Life Cycle



Pupation in soil





1st Signs of Larval Feeding Damage (late May)

- Usually starts at edges of fairways, greens, or tees (in spring).
- Small, yellowish-brown spots
- Scattered dead spots grow together.
- Tunneled stems break off at crown.

Extensive Larval Feeding Damage (early to mid-June)

- Worst damage early to mid-June (1st gen.).
- Usually less damage in late July/early August (2nd gen.).

Phenological Indicator Plants for ABW (timing for NY metropolitan area)



*L1-3 = 1^{st} thru 3^{rd} larval stage; L4-5 = 4^{th} thru 5^{th} larval stage

From: Koppenhöfer et al. 2012

Host Plants

- Poa annua preferred for egg laying, better for larval development, and least tolerant grass.
- Creeping bentgrasses can be damaged but much less likely, much less intensive, and can recover better.
- → Keeping P. annua percentage as low possible wherever possible using cultural practices and herbicides is the best preventive control for ABW problems !!!



Insecticide Efficacy vs. ABW

DeltaGard (deltamethr.) Tempo (cyfluthrin) Talstar (bifenthrin) Scimitar (λ-cyhalothr.)

Dursban (chlorpyrifos) Dylox (trichlorfon)

Arena (clothianidin) Merit (imidacloprid)

Mach 2 (halofenozide)

Acelepryn (chlorantraniliprole) Conserve (spinosad) Provaunt (indoxacarb) Aloft (clothia.+bifen.) Allectus (imida.+bifen.)

Koppenhöfer et al. 2012

Ideal Timing of ABW Applications (Timing for NY metropolitan area)



*Ad = adult; L1-3 = 1st – 3rd larval stage; L4-5 = 4th – 5th larval stage Larvicides: Conserve, Provaunt, Dylox
*Adulticides: Pyrethroids, chlorpyrifos, Conserve, Provaunt

Koppenhöfer et al. 2012

Multi target - Key pest: ABW



<u>Acelepryn</u>: ABW control @ 0.16 lb ai/ac
→up to 0.26 lb ai/ac for early and late applications.
→also WG, SWW, BCW, BB control.
→CB only suppression.

Managing <u>resistant</u> ABW

- Chlorpyrifos less effective than pyrethroids vs. adults!!!
- Depending on degree of resistance, only effective compounds: Conserve/MatchPoint and Ference vs. larvae (≥ 80% control).
- <u>BUT</u>: Conserve/MatchPoint & Ference overuse likely to lead to resistance, too!!!
- If you see something clearly not working: stop wasting time and money on it !!!
- See ABW presentation for details.

2-year field efficacy study vs. ABW populations with different levels of pyrethroid resistance

Insecticide class	AI	Trade name	Rate (Ib ai/ac)	Targets
Pyrethroid	Bifenthrin	Talstar	0.100	Ad
Organo-	Chlorpyrifos	Dursban	1.000	Ad
phosphate	Trichlorfon	Dylox	6.000	L3-4
Spinosyn	Spinosad	Conserve	0.400	Ad, L3-4
Oxadiazine	Indoxacarb	Provaunt	0.225	Ad, L3-4
Anthranilic	Chlorantraniliprole	Acelepryn	0.156	L1-2, L3-4
diamide	Cyantraniliprole	Ference	0.156	L1-2, L3-4
Neonicotin.	Clothianidin	Arena	0.247	L1-2, L3-4



Resistance - Recommendations

- Reduce synthetic insecticide use.
- Shift control measure more towards larvae.
- RR₅₀ > 50: concentrate on larvae using Ference (L1-4), Conserve/MatchPoint (L3-5), Provaunt (L3-4) (and Dylox [L3-4]).
- RR₅₀ > 100: Ference (L1-4), Conserve/ MatchPoint (L3-4) (and Provaunt [L3-4]).
- RR₅₀ > 100: rotate with biorationals!



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Chinch bugs

Blissus spp. (Hemiptera: Heteroptera: Lygaeidae)







Adult short-winged

Adult long-winged

Nymph 3rd instar

Chinch bug - Development





Chinch bugs - Pest status & injury

 Hairy chinch bug important pest of coolseason grasses and zoysiagrass in Northeast and upper Midwest

Nymphs and adults suck juices from stems and crown and inject toxic saliva \rightarrow cloggs conductive tissues in grass stem.

Chinch bugs - Injury

- Irregular patches of wilted, yellow-brown turf
- Coalesce into larger areas of dead turf
- Damage in hot, dry periods in July/Aug. in sunny lawns w/ thick thatch w/ south. exposure
- Damage often masked by drought dormancy
- Warm, dry springs favor chinch bug buildup.



Chinch bugs – Biol./Cultural Control

- Conserve natural enemies (selective insecticide use!).
- Beauveria bassiana can control chinch bugs under moist conditions (fungicides may suppress Beauveria!).
- Irrigate during dry periods to increase tolerance (also promotes *Beauveria*).
- Control thatch.
- Overseed / renovate with endophytic grasses.



Chinch bugs - Timing & Choices (Avg. timing for NJ)

- Curative spot-treatments as needed
- Liquid or granular formulations
- ~0.1" post-treatment irrigation
- Delay deep irrigation for 1-2 d.



Chinch	Stage	Apr	Мау	June	July	Aug	Sept	Oct
bua	Nym							
bug	Ad							
Damage	N+Ad							
Arena #	N+A							
Pyrethroids	N+A							
Sevin	N+A							
Insecticide	Target	Apr	May	June	July	Aug	Sept	Oct

Multi target - Key pest: Chinch bug



• Arena: CB control @ 0.4 lb ai/ac

→ Also WG, BB, SWW, BCW, ABW control.



Effective Insecticide Use

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Billbugs *Sphenophorus* spp. (Coleoptera: Curculionidae)



Billbugs - Development



Hunting BB, uneven BB, Small BB Probably similar in NE



from Brandenburg & Villani 1995

Injury

- Young larvae feed inside grass stems, then burrow down to feed on crown.
- Older larvae feed externally on crowns, roots, and rhizomes.
- Stems break off at crown, are hollowed out or filled with sawdust-like frass.



Injury

- Initially scattered dead stems, later growing patches of dead turf
- Damage in mid/late summer, especially during extended dry periods
- Symptoms often attributed to drought, dollar spot, brown patch, other insects



Cultural control

 Endophyte-enhanced grasses more or less resistant to billbugs



- KY bluegrass varieties that are thinner leaved, aggressive creepers, and/or more heat/drought tolerant are more billbug-tolerant.
- Moderate damage can be masked by light fertilization and deep watering.

Management

- Preventive treatments vs. adults before egg-laying: spray or granules; 1/10" posttreatment irrigation; withhold deep irrigation for 1-2 days (often unnecessary).
- Preventive treatment vs. young larvae inside plants using systemics (most effective).
- Curative treatments vs. larvae in soil: spray or granules; ¼" post-treatment irrigation (timing difficult).



	Stage	\p r		N	lay	/	J	u	ne	Jı	uly	/	4ر	Jg	S	Se	p	t	0	ct
D ////	Pu																			
Billbugs	Ad																			
	Egg																			
	L1-5																			
Damage	L3-5																			
Pyrethroids	Ad																			
Merit	L1-2																			
Meridian #	L1-2																			
Arena#	L1-4																			
Acelepryn \$	L1-2																			
Sevin	L3-5																			
S.carpocap	L3-5																			
Insecticide	Target	٩pr	•	N	lay	/	J	u	ne	J	uly	/	4ι	Jg	Ś	Se	p	t	0	Ct

Multi target - Key pest: *Billbug*



• Arena: BB control @ 0.3 lb ai/ac

 \rightarrow up to 0.4 lb ai/ac for early and late applications.

 \rightarrow also BB, SWW control.

→for CB, BCW, ABW control: 0.4 lbs ai/ac.

Multi target - Key pest: Billbug



Acelepryn: BB control @ 0.1 lb ai/ac
→up to 0.2 lb ai/ac for early and late applications.
→also WG, SWW, BCW control.
→for ABW control: 0.16-0.26 lbs ai/ac.
→CB only suppression.

Multi target - Key pest: *Billbug*



• Merit: BB control @ 0.3 lb ai/ac

 \rightarrow up to 0.4 lb ai/ac for early and late applications.

 \rightarrow also WG control.

 \rightarrow CB, BCW, ABW only suppression



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