ZEBRA *from page 12G*

gating with city water," says O'Neill, referring to piped-in potable water. "It's not hurting the turf if you keep the chlorine residual down low." (No more than one-fourth part per million.)

"Once the chlorine hits the air it breaks down before it hits the turf," says Slattery. A drip irrigation system may require closer monitoring to protect fragile plant materials.

Zebra mussels die when left in freezing temperatures (left) or high temperatures, or the sun, say biologists. Actual experiences of landscape and golf course irrigation managers in the field attests to it.

Because zebra mussels die when deprived of water, baked in the sun or exposed to freezing temperatures, at Locust Hill the pond is drained each winter and all the pipes flushed in the spring. Dead or alive zebra mussels have to removed from sprinkler heads and other parts by dipping in a bucket of chlorinated water and using fingers to pick them out.

A chemical feed metering pump can be purchased off the shelf, and this type of system can generally be implemented for under $15,000, according to O'Neill. "It's not something that's going to break the bank."

A chlorine treatment strategy can be washed up if there are any concerns over chemicals coming in contact with sensitive wildlife or other environmental issues. Landscape managers at parks and some golf courses may find themselves faced with a public relations problem that needs to be addressed.

"It may become necessary to add really fine levels of filtration to the water sources," says Davis. A filtration system can cost from $15,000 to $30,000 on top of the initial pump station installation.

"The variables get to be so broad," Springer points out. It depends on what level of control is acceptable. It is relatively inexpensive to control the larger adult zebra mussels. For complete control of zebra mussels, a 40 micron absolute filter is needed, while a typical golf course irrigation algae screen is in the 200 to 300 micron absolute range.

The best control strategy is to take into account local conditions when battling zebra mussels. "No two sites are exactly the same," Davis warns. Zebra mussels are a formidable opponent "They breed faster than rats," Springer notes. "They're just nasty little critters."

Annual bluegrass biology and control

by Nancy D. Williams
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■ Annual bluegrass (*Poa annua* L.) is one of the most persistent and troublesome weeds of high-maintenance turfgrasses. It is well adapted to close mowing, high nitrogen fertilization, frequent irrigation and compacted soils. It is a primary invader in damaged or open areas.

Consequently, it is sometimes maintained as a monoculture (if you can't beat it, join it) but requires intensive maintenance and frequent fungicide treatments.

Annual bluegrass is generally considered a weed because it is a prolific seedhead producer; susceptible to heat, drought and many diseases; and is unsightly when mixed with other grasses.

Lifecycle—Clearly, the most important difference affecting control decisions is the difference in the lifecycle: annual (*Poa annua* ssp. *annua*) versus perennial (*Poa annua* ssp. *reptans*) subspecies.

The perennial subspecies is more difficult to control because of its ability to survive summer heat and drought (which would kill the annual subspecies) by entering a summer dormancy and resprouting when weather is more conducive to growth.

Another difference is seed dormancy. Seed of the perennial subspecies can germinate at any time of the year while seed of the annual biotype germinates in the late summer or early fall (and sometimes early spring).

Cultural control—Weed management via cultural methods requires careful planning, close observation and patience. The five steps for reducing annual bluegrass competition are:

1) Prevent or reduce compaction.

Excess moisture and traffic induce compaction and shallow rooting, conditions which favor annual bluegrass. Using lightweight mowers, reducing traffic and core cultivation will relieve compaction. Good soil structure will provide better drainage and water and air penetration, which encourages better root growth and competition in the desired species.

2) Avoid excess irrigation.

Proper irrigation alleviates excess moisture, providing better soil aeration and consequently better root growth. Less irrigation in the spring and fall may reduce annual bluegrass seed germination.

3) Avoid excess N fertilization.

Reduced nitrogen fertilization is the key to reducing annual bluegrass competition. In some situations, iron (Fe) may be used for turf "green-up" instead of higher N rates. Under certain conditions, low phosphorus rates have reduced annual bluegrass growth by reducing its ability to compete with desirable turfgrass species.

4) Mow at proper height.

Annual bluegrass can adapt to a wide variety of conditions, including mowing heights from 1/8 to 3 inches. Higher mowing heights will tend to favor the more

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CONDITIONS WHICH PROMOTE POA ANNUA SSP. AND DESIRABLE TURFGRASS SPECIES

	POA ANNUA SSP.	CREEPING BENTGRASS	KENTUCKY BLUEGRASS	PERENNIAL RYEGRASS
MOISTURE	wet	moderate	moderate	moderate
SOIL CONDITIONS	compacted	uncompacted	uncompacted	uncompacted
CORE AERATION	decreases competition relative to desirable species	increases competition relative to annual bluegrass	increases competition relative to annual bluegrass	increases competition relative to annual bluegrass
N FERTILITY	high ≥4 lbs./1000 sq. ft./yr.	moderate 2-3 lbs./1000 sq. ft./yr.	low to moderate 1-3 lbs./1000 sq. ft./yr.	high ≥ 4 lbs./1000 sq. ft./yr
MOWING HEIGHT	lower than recommended ht. for desirable species	low (5/32 to 5/8 inch)	high (2 to 3 inches)	moderate to high (½ to 2½ inches)
CLIPPING REMOVAL (POA SSP.)	decreases competition relative to desirable species	increases competition relative to annual bluegrass	generally, no effect	generally, no effect
pH	6.0—7.0	5.5—6.0	6.0—7.0	6.0—7.0

desirable turfgrasses over annual bluegrass. The key here is to select the optimum mowing height for the desirable grass.

5) Remove clippings.

Clipping removal may reduce annual bluegrass competition by reducing its seed reservoir. It may also reduce nitrogen fertility by removing that nitrogen released by the decomposition of grass clippings.

Chemical control—Plant growth regulators (PGRs) and pre- and post-emergence herbicides can be used.

PGRs provide *Poa annua* suppression, cover reduction and reduced competition to allow conversion to a more desirable turfgrass. Paclobutrazol (Scott's TGR) is the only PGR regustered in New York state for annual bluegrass suppression in creeping bentgrass. It may discolor desirable turf when applied incorrectly or at the wrong time of year. Injury can also occur when heavy rain or irrigation have moved the granules to puddles, thus concentrating the herbicide in a small area. Using the lower labeled rate at the spring application will minimize discoloration.

Pre-emergence herbicides work well on *Poa annua* ssp. *annua* but have been ineffective on *Poa annua* ssp. *reptans*. For this reason, they are rarely used for annual bluegrass control in the Northeast.

Post-emergence herbicides control seedling annual bluegrass, reduce seedhead production, suppress established plants, or provide total vegetation control.

Prograss (AgrEvo) is labeled for controlling seedling *Poa annua* in perennial ryegrass, Kentucky bluegrass and creeping bentgrass. It also can suppress established annual bluegrass. Best results have been obtained in perennial ryegrass with higher rates. Rates high enough to control established annual bluegrass in one season, however, will injure other turftrass species. In Kentucky bluegrass or creeping bentgrass, multiple applications of Prograss at 0.75 lb. AI/A or less, applied in the fall and carried out over several years has adequately suppressed annual bluegrass.

Calcium arsenate applied at high rates controls established annual bluegrass, but it is currently only registered in New York and Indiana. Disadvantages to it include: high rates necessary for control, sudden loss of poa, and long-term adverse effects on soil phosphate fertility.

Mefluidide (Embark) may be used for annual bluegrass seedhead suppression in Kentucky bluegrass, perennial ryegrass or fescue. Some discoloration of desirable turf may occur, less at lower rates.

Where annual bluegrass comprises more than 50 percent of the turf, complete renovation with glyphosate (Roundup) is often the best recourse.

Biological control—*Xanthomonas campestris* pv. *poannua* bacterium is currently being investigated as a potential biocontrol agent for *Poa annua* by Mycogen Corp.

This bacterium only kills plants when the conditions are favorable for disease development. Plant death is caused by a vascular wilt as the bacterium plugs the xylem, stopping the flow of water and nutrients. It is more effective on annual *Poa annua* species than perennial species.

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