Japanese beetle grubs feed on turfgrass roots, causing considerable damage.

kurstaki—available as Dipel, Javelin, Steward; all trademarks—is used to control caterpillars in turf and ornamentals, as well as in fruit and vegetable production. *Bt. var. israeliensis* is used to control mosquito populations in aquatic settings, and to control fungus gnats in greenhouses. A newly-discovered strain, *Bt. var. japonensis*—of the strain *buibui*—looks to hold some promise for white grub control.

Entomopathogenic nematodes, which cause diseases in insects, can be applied to turf with standard hydraulic sprayers. These nematodes, available as Vector, BioSafe and others, can move short distances in search of their intended victims. The nematodes are sensitive to cool or cold temperatures, and are sensitive to desiccation, so applications must be watered in immediately.

Some perennial ryegrasses and fescues contain endopytes-fungi growing inside the plants—which provide a level of resistance to certain kinds or insects such as chinch bugs, greenbugs, webworms, cutworms or billbugs. These cultivars also tend to be more drought tolerant. So in areas where these insects have been a problem, consider renovating the areas using endophytic grasses.

One chemical product consideration is speed of efficacy, or how quickly the product works. Proxol, Dylox and Triumph begin to affect target insects within a day or two after applications, while others, such as Oftanol and Merit, may take two or three weeks before target insects begin to die.

If an application is made when most of the target insects are very small and there is a chance that some of the eggs have not yet hatched, you should use one of the slower-acting but longer-lasting materials, such as Oftanol or Merit. If an application is made when most of the target insects are already quite large and feeding actively, you probably should use one of the faster-acting ma-

Insects and their treatment

White grubs: Feed on roots of turfgrasses. Turf looks like it is in drought stress.

Cultural control: provide adequate moisture to root zone. Do not mow too low.

Biological control: *Bacillus thuringiensis var. japonensis* strain *buibui* (may be available in 1996. *Heterorhabditis bacteriophora,* certain strains (entomopathogenic nematode).

Chemical: Use products which penetrate thatch well (Dylox, Proxol, Triumph) in areas with more than 0.25 inches of thatch. Merit works very well but must be applied before most of the population is in the middle-sized grub stage. Water any material in as soon after application as possible to improve contact with grubs.

Chinch bugs: Suck plant juices from stems. Usually most severe or noticeable in sandy soils or sunny areas. Usually most active in summer months.

Cultural control: reduce thatch. Avoid drought stress. Use endophytic grasses.

Biological control: Watch for big-eyed bugs, which are natural predators resembling chinchbugs.

Chemical control: Many turf insecticides are labelled and effective. Consider using products that will remain in thatch (e.g. Dursban). Apply in late spring or early summer, if sampling documents need.

Billbugs: youngest larvae feed inside stems. Larger larvae feed near crown of plant and on roots. Areas turn yellow or brown and die. Perhaps the most misdiagnosed turf insect problem in the Northeast.

Cultural controls: Use endophytic grasses.

Biological controls: *Steinernema carpocapsae* (available as Vector, BioSafe and others); an entomopathogenic nematode; water in immediately after application.

Chemical control: Most applications are directed toward adults as they begin to lay eggs, often May or June. Timing of application appears to be critical, and the application window is only two weeks in some areas.

Webworms, cutworms: Caterpillars hide in thatch during the day and feed at night on tender tissue.

May thin or kill patches of turf. Several species, often several generations per year.

Cultural control: reduce thatch, avoid drought stress and use endophytic grasses.

Biological control: *Steinernema carpocapsae* (available as Vector, BioSafe and others); an entomopathogenic nematode. *Bacillus thuringiensis var kurstaki,* available as Dipel, Javelin, Steward and others.

Chemical: many turf insecticides are labelled and effective. consider using materials which remain in the thatch (e.g. Dursban) or some of the relatively new pyrethroids. Treat as late in the day as possible. □

Chinch bug damage is most severe in sandy soils or sunny areas.

terials, such as Proxol, Dylox or Triumph.

Some materials, such as Dursban, are tied up in the organic material in the thatch, and are less likely to penetrate the thatch and reach the rootzone. Such materials are usually very effective against some of the surface feeding insects (cutworms, webworms, chinch bugs), but are not as effective against root insects (white grubs) when used in areas where there is measurable thatch.

Some materials such as Proxol or Dylox are quite soluble in water and move through the thatch quite readily. These materials are good choices for control of white grubs and other soil insects because they can penetrate the thatch, but may be less well-suited to control surface feeders.

Some insecticide applications should be watered in immediately after application, often to help move the material through the thatch toward the rootzone and to draw the target insects up into the thatch. Other applications should not be watered in or should receive only small amounts of water to move the material off the blades and into the upper thatch. Some materials (for example, Proxol, Dylox, Orthene, Triumph) break down very rapidly when the water pH is greater than 8.0 alkaline.

Most field trials seem to indicate there is no consistent or measurable difference between formulations of the same material. In other words, if a turf manager decides to use "chemical x," the sprayable formulation and the granular formulation should provide the same level of control.

New materials

Several insecticides have been available to the turf market for only a year or two, and turf managers are still experimenting with their use.

Merit has proven to be very effective, particularly on several species of white grubs. However, as with any insecticide, you should resist the temptation to rely on Merit alone, but include that material as one of several in the arsenal.

Several synthetic pyrethroids, such as Tempo and Talstar, have received turf registrations in the past couple of years and appear to be quite effective against a range of surface insects.

Another compound which has been tested in university settings for several years and appears to be nearing registration is *halofenozide* (referred to as RH-0345 in most trials). This compound is an insect growth regulator which prevents the target insect from molting from one immature stage to the next. It is relatively specific to certain kinds or insects and has a very low level of toxicity to other organisms such as people, birds, fish or other vertebrates. It looks promising against several species of white grubs. The compound may not be registered in 1996, but should be registered in 1997 and will be a welcome, environmentally-favorable compound for turf insect control programs.

The keys to successful insect control are: (1) identifying the pest insect; (2)determining when the insect will be in its most vulnerable stage for control; and (3) choosing an insecticide which is best suited for the conditions. There are many insecticides on the market, so check with your local cooperative extension specialist and determine which ones are recommended in your area. □

—The author is an associate professor of entomology at the University of Massachusetts in Amherst.

PARTIAL LIST OF INSECTICIDES AND TARGET PESTS

	billbugs	chinch bugs	cutworms	mites	webworms	white grubs
acephate (Orthene)[1]		x	x		x	
bendiocarb (Turcam)	x	x			x	x
bifenthrin (Talstar)	x	x	x	x	x	
carbaryl (Sevin)	x	x	x		x	x
chlorpyrifos (Dursban)	x	x	x	x	x	x
cyfluthrin (Tempo)	x	x	x		x	
diazinon[2]	x	x	x	x	x	x
ethoprop (Mocap)[3]	x	x	x		x	x
fluvalinate (Mavrik)		x	x	x	x	
fonofos (Crusade, Mainstay)	x	x	x		x	x
imidacloprid (Merit)	x					x
isazofos (Triumph)[4]	x	x	x	x	x	x
isofenphos (Oftanol)	x	x			x	x
trichlorfon (Proxol, Dylox)[5]			x		x	x

1—sensitive to high water pH
2—not for use on golf courses or sod farms
3—see label restrictions
4—not for use in sandy soils
5—sensitive to high water pH

For all products, note that state regulations vary and information may not be completely accurate. Always check the label to confirm that the pest you wish to control is indeed on the label. Mention of a product does not imply endorsement by the author.

Extreme heat compounds insect problems

We can't control the weather, but an understanding of its effects on pests and their control can be useful.

by R.L. BRANDENBURG, Ph.D./N.C. State University

In the southern United States, the early part of the summer of 1995 was unusually cool and wet.

In July the water was shut off and the thermostat climbed higher. The change in the weather was associated with drought stress on turfgrass, increased disease incidence, and some unusual insect problems.

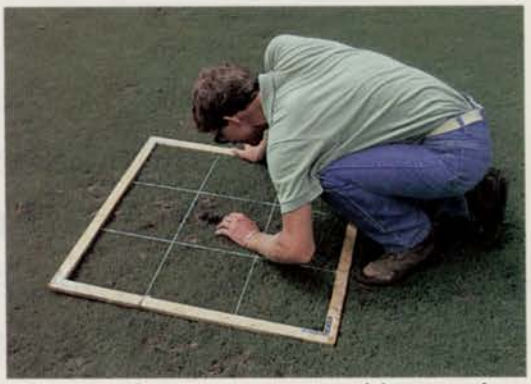
Why would a sudden change of weather create unusual insect problems? The answer goes beyond insects being cold-blooded and controlled by temperature.

Some insects simply survive better on stressed turf. At other times, certain insects will become a problem because the unusual weather patterns may allow them to escape their natural controls. Hot and dry weather favors chinch bugs because a fungal disease that often keeps them in check doesn't perform well under those conditions.

During 1995, the Southeast saw its share of chinch bugs late in the season due to the hot, dry conditions. However, the wet conditions earlier in the summer slowed their early-season build-up and prevented any early summer problems.

The number of white grubs observed in many areas this past fall was below normal, probably due to the fact that the soil was dry in many areas during the time the beetles were laying eggs. The dry soil was detrimental to egg survival and consequently resulted in fewer grubs.

Other weather relationships may be beneficial for some pests. Cool, wet springs may lead to more cutworm problems throughout the summer. Unusually hot, dry conditions may result in more armyworms in the turfgrass as other food sources are depleted. This alerts us to potential pest outbreaks, but does not replace the need for turf monitoring and scouting.



Adverse weather means you must track insect numbers.

How to calculate degree-days

1) Record the maximum and minimum temperature for the day.
2) Add the two numbers.
3) Divide by 2 for an "average temperature."
4) Subtract 50°F (insect development threshold temperature).
5) The sum is the number of degree-days for that day.

A negative number is not used since it means no development occurred. If the minimum temperature for a day was 60°F, and the temperature was 80°F, then the average would be 70°F (80+60=140÷2=70).

Subtracting the 50°F threshold would yield 20. This is the number of degree-days recorded for that day.

SOURCE: DR. BRANDENBURG

Insect forecasting

The term "degree-days" is often mentioned in association with weather and insects. Degree-days are simply an accounting tool for recording how warm it has been. Most living organisms have a threshold—or minimum temperature—during which time development is possible. For insects, a common threshold is 50°F. Temperatures below this ususally mean development does not take place. Insect development is more rapid as the temperature climbs above 50°F.

Developmental models have cumulative degree-day targets that indicate when an important event is likely. For example, if mole cricket eggs are expected to hatch at 2,000 degree-days—and it usually occurs around June 17 in Raleigh, N.C.—we base our prediction on that model. Should we have

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Heat stress makes diagnosis more difficult.

PRODUCTS FOR CONTROL OF WARM-SEASON INSECT PESTS

Southern chinch bug: bendiocarb (Turcam); ethoprop (Mocap); cyfluthrin (Tempo); permethrin (Astro); diazinon; chlorpyrifos (Dursban); isofenphos (Oftanol); isazofos (Triumph); fonofos (Crusade); lambda-cyhalothrin (Scimitar); acephate (Orthene); fluvalinate (Mavrik)
Timing: apply as needed during hot, summer months. Thorough coverage is critical. Irrigate immediately after application of granules. Avoid over-fertilizing.

Leafhopper/ two-lined spittlebugs: acephate (Orthene); bendiocarb (Turcam); chlorpyrifos (Dursban); diazinon; carbaryl (Sevin); isazofos (Triumph); fluvalinate (Mavrik).
Timing: begin monitoring and treat damaging populations in early summer.

Cutworms, armyworms: azadirachtin (Turplex); lambda-cyhalothrin (Scimitar); acephate (Orthene); carbaryl (Sevin); diazinon; isofenphos (Oftanol); chlorpyrifos (Dursban); fluvalinate (Mavrik).
Timing: Monitoring and treatment may be necessary in early spring through late fall.

Mole crickets: chlorpyrifos (Dursban bait); propoxur (Baygon bait); carbaryl (Sevin bait); bendiocarb (Turcam); chlorpyrifos (Dursban); isofenphos (Oftanol); fonofos (Crusade); acephate (Orthene); ethoprop (Mocap); fluvalinate (Mavrik); entomogenous nematodes (Vector MC and others).
Timing: Use soap flushes to monitor egg hatch. Treat emerging nymphs in early summer.

White grubs: bendiocarb (Turcam); diazinon; chlorpyrifos (Dursban); acephate (Orthene); isazofos (Triumph); amdro; avermectihn B (Affirm bait); fenoxycarb (Award bait).
Timing: treat small grubs in late summer and fall for best control.

Ground pearls: No known effective chemical controls. Follow proper turf man agement practices and irrigation.

Not all trade names are mentioned, and the ones listed are used as examples. No endorsement of products is intended nor does omission of any products imply criticism.

SOURCE: DR. BRANDENBURG

1,900 degree-days by June 1, and accumulate about 30 additional degree days thereafter, then we can estimate that egg hatch will occur earlier than June 17. With this information in hand, we know when to begin soap flushes to verify egg hatching.

Once hatching has been verified, we can begin timely and effective control measures.

Similar intuitive methods of insect pest forecasting are used in many states. Their value depends on the accuracy and completeness of the environmental information collected, and how specific the information is to the location of interest. Using a base of 50°F, we see our first Japanese beetle adults in North Carolina at about 1100 degree-days, which is the same for Ohio or New York. Only the time of year that target is reached is different for different states.

The effectiveness of various control measures can be dramatically affected by the weather.

Cool weather may render the insects less active and the insecticides less effective. Rainy weather can reduce the effectiveness of insecticides applied for control of foliar pests. However, the hot, dry conditions we had during 1995 often have the greatest impact on control efficacy. The management of soil pests such as grubs and mole crickets is adversely affected in a number of ways. The hot, dry soil surface may cause insecticides to bind to organic matter or to vaporize. Either way, less insecticide is available to the target site.

Control of soil insects requires that the insecticide be moved down into the soil. The longer the insecticide is on a hot, dry surface, the more likely it is to be degraded by sunlight.

Irrigation

Moisture from rainfall or man-made irrigation systems is made even more important by the negative consequences of hot, dry weather. Additionally, hot, dry weather often moves the insects deeper into the soil, and therefore more difficult to control. Many turfgrass managers irrigate

A - White grub populations and the efficacy of control can be affected by weather.

B - Natural enemies, such as this beetle larva dining on a caterpillar pupa—can be affected by weather.

C - The hot, dry weather of North Carolina caused sporadic outbreaks of sod webworms, as the moths laid eggs in drought prone areas.

sites before treatment. By thoroughly soaking the soil—two to three days in advance for white grubs and one day for mole crickets—two important functions are accomplished. First, the irrigation will cause the insects to move closer to the soil surface and be more susceptible to the control measure. This pre-irrigation also reduces the insecticide binding in the organic matter near the surface. The post-application irrigation is still required immediately after treatment.

Biological materials, such as entomogenous nematodes are just as susceptible (if not more so) to hot, dry conditions as conventional synthetic insecticides.

A good scouting program and attention to detail while applying insecticides can help you manage insect pests through adverse weather conditions. **LM**

TURFGRASS PEST CONTROL CALENDAR

When to scout for insects and mites

Pests	I*	P**	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ants	II	A			S or Gr									
Armyworms and cutworms	III	A					S							
Bees and wasps	II	A						S						
Billbugs	III	D,E,F				S or Gr								
Chinch bugs	III	B						S						
White grubs	I	A			S or Gr					S or Gr				
Green June beetles	I	A				S					S			
Ground pearls	III	A						M						
Leafhoppers and spittlebugs	II	A						S						
Mole crickets	I	G,H			S or Gr					Ba				
Sod webworm	III	C,D,E,G						S or Gr						

*Degree of importance as pest: I= Important pest, frequent occurrence; II= Usually present, but generally not a pest; III= Occasional pest, treat when detected.

**Preferred grass species: A= Centipedegrass, fescue, and many other grasses; B= Saint Augustinegrass; C= Fescue; D= Bluegrass; E= Bermudagrass; F= Zoysiagrass; G= Bentgrass; H= Bahiagrass.

S= Sprays; Gr= Granules; Ba= Baits; M= Maintain the turf in healthy condition, irrigate.

Plants that say: 'Keep Off the Grass'

Strategically placed barrier plants look better than barbed wire.

by RUSSELL BALGE, Ph.D./

Western Maryland Research & Education Center

When Tiny Tim, the neighborhood kids, or thoughtless adults begin to tip-toe or traipse through the tulips, it's time to think about selecting plants for their benefit as barriers rather than their beauty.

Often, these barrier plants are barbed or thorned, are grown to a pedestrian-traffic-inhibiting height and planted in a wide enough bed to give people pause.

A large corner lot with a broad expanse of lawn is an open invitation to pedestrians taking and establishing well-worn short cuts. Plants must be at least knee high to deter pedestrians. If the perimeter of a corner is planted with barrier plants, pedestrians are more likely to use the sidewalk. Here are some other guidelines:

1) Do not rely solely on pruning to keep barrier plants in check. Plants with thorns do not invite close inspection. Instead of tall plants that will need to be bludgeoned, butchered and beaten into a smaller, submissive size, plant groundcovers, shrubs and trees that will quickly mature to roughly the height and spread that you need.

2) Place barrier plants on the outside of any conventional fence when using as a second line of defense or privacy around a swimming pool. Select compact shrubs to reduce the number of twigs that might poke through the fence. Avoid plants with dry, prickly leaves that might impale feet.

3) Lay down a landscape fabric before installing any plants if you are planting a large area. This will reduce the need to venture into thorns for weeding.

4) Install trickle or pop-up irrigation for barrier plants, if possible, or channel run-off from a nearby watering system.

5) Safety equipment: sturdy gloves, a long-sleeved shirt, thick full-length pants, barbecue tongs, salad tongs.

6) Shred clippings before composting prickly prunings or using them as a mulch.

PHOTO COURTESY HOLDEN ARBORETUM

The paleleaf barberry grows two feet tall—a perfect height for sticking wayward human knees and shins.

7) Use barrier plants to burglarproof your house. Most burglars are amateurs, seeking an easy target, so anything you can do to discourage them is to your advantage.

8) Avoid plants that can grow high enough to obstruct windows, or wide enough to crowd doors or sidewalks. Select plants that do not need frequent heavy pruning, and which have a slow growth rate. Leave at least one window free of thorny plants as a possible escape route in the event of an emergency. Leave space between the shrubbery and the foundation to allow air circulation.

9) Don't plant prickly or thorny plants around children's play areas or outdoor eating areas.

10) In general, the pricklier and thornier the plant, the better.

—The author is a regional specialist in commercial horticulture at the Western Maryland Research and Education Center, and a professor at the University of Maryland. This article was condensed from "Free State Nursery News," where it originally appeared.

LANDSCAPE PLANTS TO CONSIDER AS BARRIER PLANTS

BOTANICAL NAME	COMMON NAME	EVERGREEN / DECIDUOUS	HEIGHT	USDA ZONE
Agave americana	**century plant**	E	6″	6
Aralia elata	**Japanese angelica tree**	D	45′	3
Berberis beaniana	**Beran's barberry**	D	8′	6
Berberis buxifolia nana	**dwarf Magellan barberry**	E	18″	5
Berberis candidula	**paleleaf barberry**	E	2′	5
Berberis x chenaultii	**Chenault barberry**	E	4′	5
Berberis circumserrata	**cutleaf barberry**	D	6′	5
Berberis cocinna	**dainty barberry**	E/D	3′	6
Berberis darwinii	**Darwin barberry**	E	10′	7
Berberis gagnepainii	**black barberry**	E	6′	5
Berberis gilgiana	**wildfire barberry**	D	6′	5
Berberis juliana	**wintergreen barberry**	E	6′	5
Berberis koreana	**Korean barberry**	D	6′	5
Berberis x mertorensis	**Mentor barberry**	D/E	7′	5
Berberis potaninii	**longspine barberry**	D	8′	7
Berberis x stenophylla	**Rosemary barberry**	E	9′	5
Berberis thunbergii	**Japanese barberry**	D	18′-7′	4
Berberis triancanthophora	**threespine barberry**	E	4′	5
Berberis verruculosa	**warty barberry**	E	4′	5
Celastrus flagellaris	**Korean bittersweet**	D	24′ (vine)	4
Chaenomeles japonica var. *alpina*	**Japanese quince**	D	3′	4
Chaenomeles speciosa	**flowering quince**	D	6′	4
Crategus phaenopyrum	**Washington hawthorn**	D	30′	4
Elaeagnus angustifolius	**Russian olive**	D	20′	2
Elaeagnus pungens	**thorny elaeagnus**	E	12′	7
Elaeagnus umbellatus	**autumn elaeagnus**	D	12′	3
Halimodendron halodendron	**salt tree**	D	6′	2
Hippophae rhamnoides	**sea bucthorn**	D	30′	3
Ilex cornuta	**Chinese holly**	E	18″-10′	7
Juniperus chinensis	**Chinese juniper**	E	18″-20′	4
Juniperus horizontalis	**creeping juniper**	E	6″-18″	2
Lyciun halimifolium	**Oregon grape holly**	E	2′-6′	5
Opuntia basilaris	**beavertail prickly pear cactus**	E	4′	5
Paliurus spina-christi	**Christ thorn**	D	18′	7
Poncirus trifoliata	**hardy orange**	D	35′	5
Prinsepia sinensis	**cherry prinsepia**	D	10′	4
Pyracantha atalantiodes	**Gibbs forethorn**	E/D	18′	6
Pyracantha coccinea	**scarlet firethorn**	E/D	18″-6′	6
Pyracantha crenulata rogersiana	**Rogers firethorn**	E	10′	7
Rhamnus cathartica	**common buckhorn**	D	18′	2
Robinia hispida	**rose acacia**	D	3′	5
Rosa rugosa	**sea tomato rose**	D	3′-6′	2
Rosa spp.	**many names**	D	3′-6′	2-5
Smilax rotundifolia	**common greenbrier or horsebrier**	D	30′	4
Sophora davidii	**vetch sophora**	D	7′	5

SOURCE: DR. BALGE

Pesticides on the shelf:

Our national government seems to be devoting almost all its energy to positioning for the 1996 Presidential election. That leaves little time to attend to issues that might affect the green industry.

by RON HALL/Senior Editor

So far in 1996, the environment—including pesticides—is not one of Washington D.C.'s burning issues. The green industry is even less of a topic.

The Capital crowd is concerning itself...well, mostly with itself. An impending Presidential election tends to do that.

Phil Forgarty, left, Crowley Lawn Service, and Bill Hoopes, Barefoot Grass, leave Old Executive Office Building during PLCAA's 1996 legislative visits.

"The environment is not a first-tier issue," says Mary Bernhart, environmental policy manager for the U.S. Chamber of Commerce.

"It's not something that will make or break an election. No one candidate is going to lose because of his or her stand on environmental issues," says Bernhart. "And Presidential politics kicked in very, very early."

Presidential politicking may, in fact, keep Congress from modernizing FIFRA by year's end, although Allen James remains "guardedly optimistic" it won't.

James, headquartered in Washington D.C., is executive director of Responsible Industry for a Sound Environment (RISE). FIFRA is the Federal Insecticide, Fungicide and Rodenticide Act that governs the use of all pesticides in the country.

"It's been 10 years since FIFRA was overhauled, and more than 10 years since it was overhauled in a big way," says James.

Delaney Clause blues

Especially worrisome to industry is the so-called Delaney Clause which is included in FIFRA. The Delaney Clause says no product will be registered or sold that has been linked—even by a single test—to causing cancer.

It's been in effect since 1958, but today's sophisticated testing and detection capabilities would—assuming Delaney is enforced—disqualify almost all chemical products.

"There is a greater recognition that the Delaney Clause is outdated scientifically and that it needs reform," says a staff member for Senator Richard Lugar (R-Ind.), chairman of the Senate Agriculture Committee.

RISE wants the Delaney Clause revoked. Many others, both on and off Capitol Hill, feel the same way.

"The big obstacle is that Presidential politics are soon going to take the place of all other politics," says James.

Political tug of war

As part of the bigger picture in the Capital, political action escalated last fall when Pres. Bill Clinton and the Republican majority in Congress locked horns over the Republicans' balanced budget proposal.

But the stakes involve more than dollars, says Congressman John Linder (R-Ga.).

"Any two of us can sit down in the next 30 minutes and solve this problem. This is not about money, it's about control," says Rep. Linder.

The impasse between the President and Republicans has, in fact, accomplished something unprecedented: it shut down federal offices twice this past winter, and threatened a third shutdown this spring.

It also put a funding squeeze on the U.S. EPA. The Republicans authored a $1 billion reduction (10 percent) from EPA's actual 1995 budget in the face of the President's request for a $1.7 billion increase.

Rep. John Linder (R-Ga.) says budget stalemate is really a tug-of-war for power.

Re-registration process slows

The smaller budget is causing EPA to slow pesticide re-registration just

cont. on page 32