

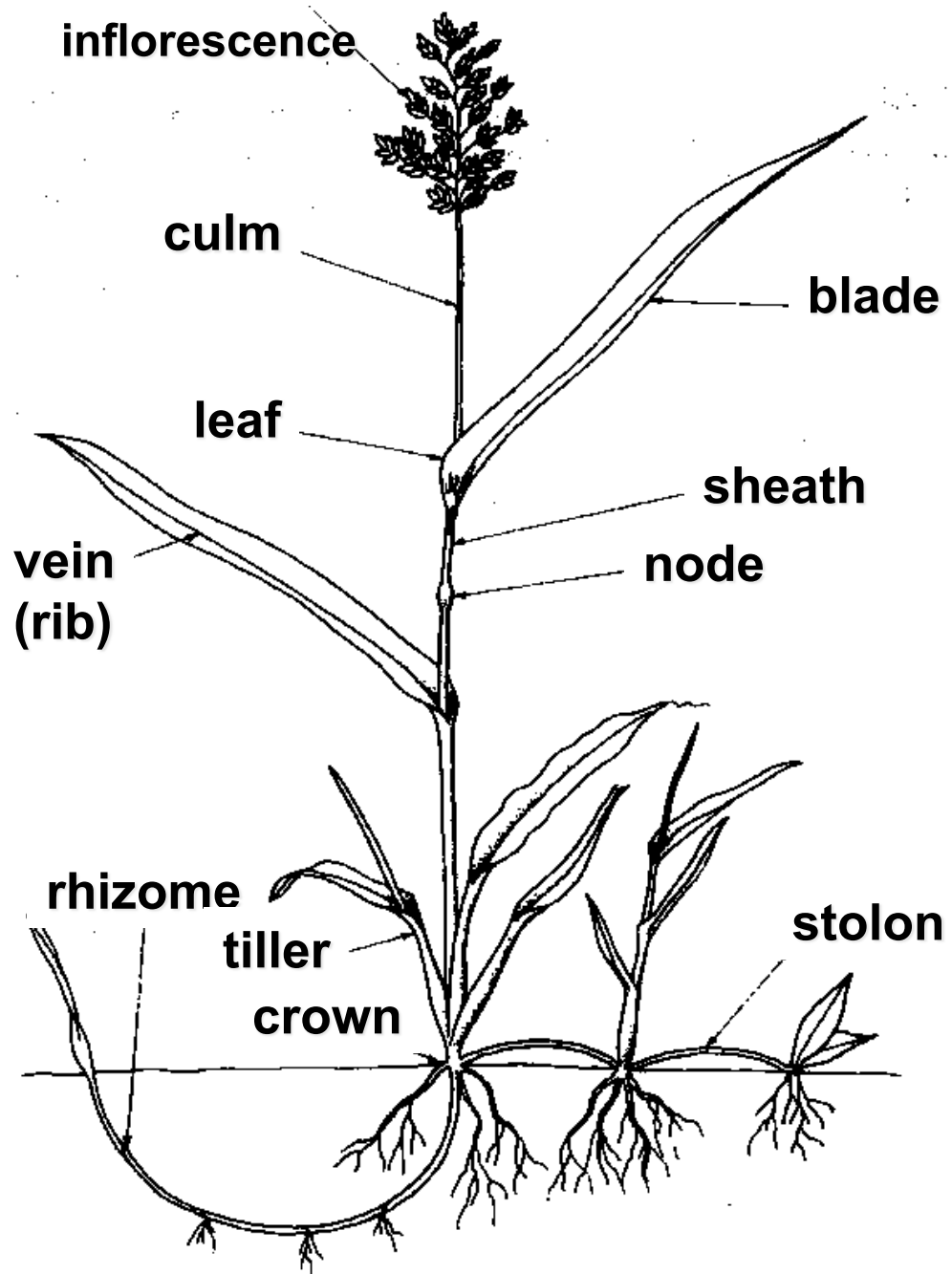
Assessing and Recovering from Winter-kill of Bermudagrass in Oklahoma

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- Frequently saturated soils, heavy snows, extended periods of ice/snow cover and colder temperatures contributed to increased winter-kill of bermudagrass seen in spring 2010.



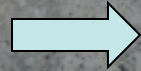
Understanding of the anatomy of a warm-season grass plant and how it grows can be helpful in understanding winter-kill and regrowth potential



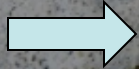
Terms

- Stolon – above ground horizontal creeping stem or runner of bermudagrass, buffalograss, zoysiagrass, centipedegrass and St. Augustinegrass.
- Rhizome – below ground horizontal stem of bermudagrass or zoysiagrass.

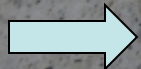
Vertical aerial shoots



Stolon of bermuda



**Rhizome
of
bermuda**



Stolon of buffalo

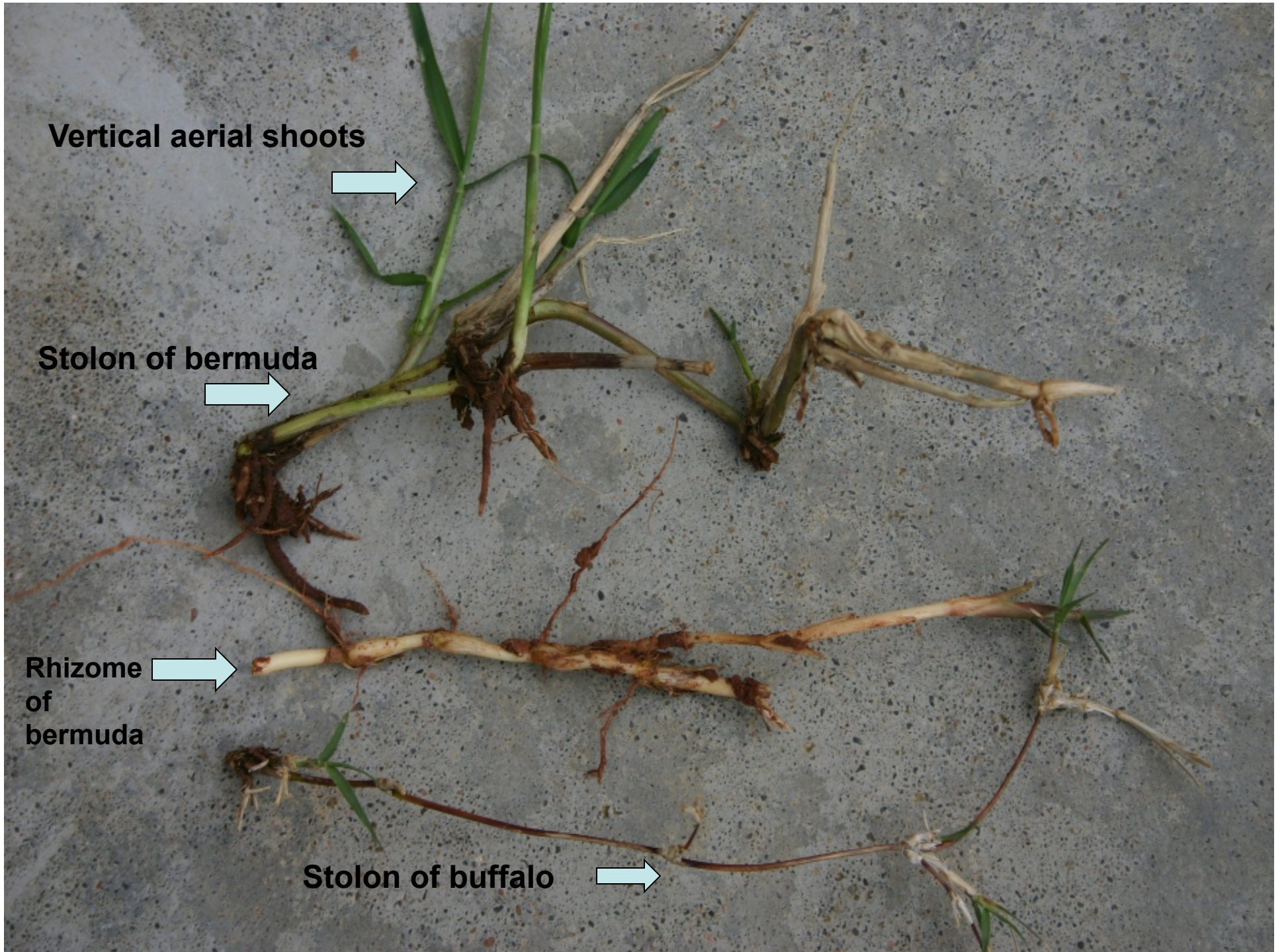
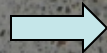
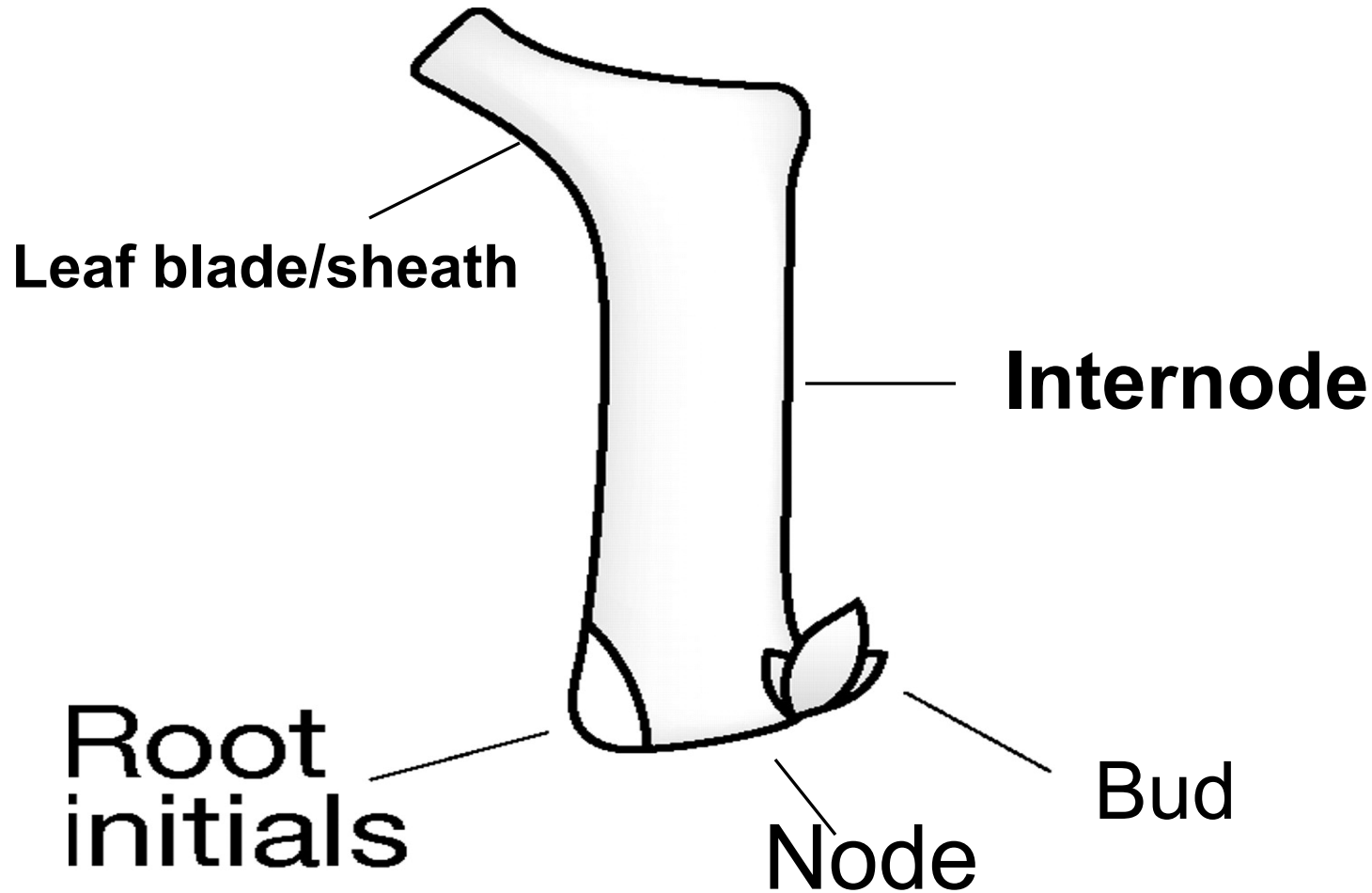


Diagram of a Barley grass phytomer. The basic building block of the grass plant.

(Image courtesy of B. P. Forester and others, *Annals of Botany* 2007 100(4):725-733)

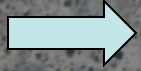


The Phytomer

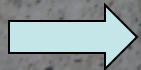
- It's the basic building block of the grass plant used over and over again.
- A phytomer consists of a node, internode, lateral bud, root initials and leaf.
- The dormant lateral bud is located at the node and opposite the side from which the leaf arises.
- The dormant lateral bud has the capacity to become a new shoot, and thus, regenerate the stand in bermuda, buffalograss, centipede, St. Augustinegrass and Zoysiagrass species.

Orange arrows indicate the location of nodes. There is a lateral bud at each node.

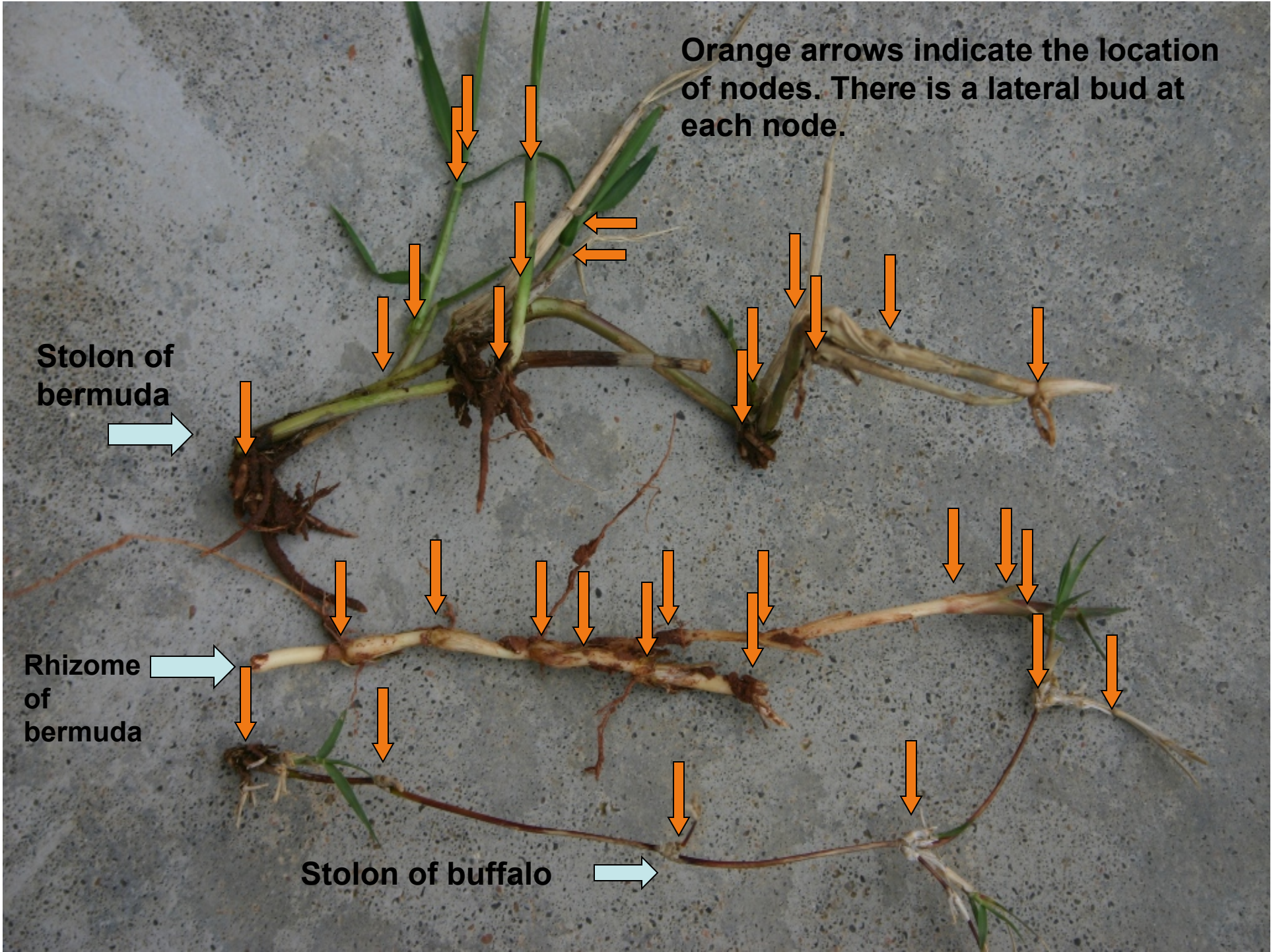
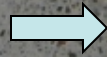
Stolon of bermuda



Rhizome of bermuda



Stolon of buffalo



What is winter-kill?

- Winter-kill – part or all of a grass plant or turfgrass stand dies during the winter.
- It's a relative term.
- Bermudagrass, centipede, buffalograss and St. Augustinegrass suffer varying degrees of winter kill in Oklahoma each year.
- During a mild winter, only a few nodes/internode segments will winter-kill on the aerial vertical shoots of bermudagrass.
- In a severe winter or when several unfavorable factors predispose the grass to death during the winter, the vertical aerial shoots may be killed several nodes farther down than in mild winters.



Most bermudagrasses in the Stillwater area had high levels, near 100% kill of vertical aerial and stolon shoots during the winter of 2009/2010. The difference in regeneration vs non-regeneration of the stand depended on the survival of lateral buds on vertical shoots in the soil or on shallow or deep rhizomes

Winter-kill in 2009/2010

- During the winter of 2009/2010, substantially more node/internode segments of warm-season grasses were killed during the winter.
- Substantial areas of bermudagrass died during the winter and will need to be grown back in by intensive management.
- This may include resprigging, plugging, sodding or seeding to speed up the process.

Winter-kill

- Any number of physical, chemical, biological or abiotic factors can interact with either a short very cold temperature event or a less cold longer term event to increase the severity of winter-kill. These factors can either pre-dispose the grass in advance or work together with the low temperature event to increase severity of damage.

Areas Most Susceptible to Winter-kill

- North facing slopes
- Heavily shaded areas
- Poorly drained areas
- Areas planted with poorly adapted cultivars
- Areas trafficked during winter
- Areas of substantial soil compaction
- Areas with deficient levels of soil potassium (K)
- High spots, especially if sandy

Bermudagrass Winter Hardiness

- More Susceptible to Winter-kill (alphabetical order)
 - Arizona Common
 - Celebration
 - Kansas Improved
 - Mohawk
 - Princess 77
 - Sahara (NuMex Sahara)
 - Sunturf
 - Tifdwarf
 - Tifgreen
 - Tifway 419
 - Transcontinental

Bermudagrass Winter Hardiness

- Less Susceptible to Winter-kill (alphabetical order)
 - Some types sold as U-3
 - Guymon
 - Midfield
 - Midlawn
 - Patriot
 - Riviera
 - TifSport
 - Wrangler
 - Yukon

North



- Winter-kill is often more severe on north-facing slopes. In many years, green-up is simply delayed on north facing slopes due to less incoming sunlight, and slower soil heating.

- Low cutting height, traffic, soil compaction and shade interacted to pre-dispose this bermudagrass tee box to winter-kill.



North



Tifway winter-killed in what perhaps was the freeze/thaw zone over several days. Perhaps the area in the center was protected by snow cover.



Truckster drove over slush pile, traffic triggered mechanical/freeze injury to bermudagrass. A single event.



Traffic on path interacted with snow/ice to cause winter-kill



In winter, can you tell if the aerial shoots, stolons and rhizomes are alive or dead?



Canopy Brushing Technique

- Performed in winter to provide a relative estimate of rejuvenation potential of the warm-season grass stand.
- Looking for survival of aerial stems and stolons
- Use heavy leather glove to protect hand
- Defoliate small sample areas 6 inch to 12 inch diameter of leaf blades and leaf sheaths
- Sample multiple suspect areas, your assessment is only as good as your sampling technique
- Assess for the density of living aerial shoots showing green, red, purple or white internode segments
- Nodes are too small to see with the naked eye, internodes are not. There is one node for each internode and one lateral bud for each node.
- The effect of upcoming cold events are not assessed, only the affect of past events
- Must have some time elapsed for decay of tissue to occur from “acute” damaging event to when brushing technique is performed in order to see symptoms (dead tissue)

Firm, Green, White, Red or Purple internodes are Good!
Soft, mushy, brown or only straw tan internodes are Bad News!



- Example: Jan 25, 2010 canopy brushing reveals high number of green aerial shoots in Bowie Buffalograss



Canopy brushing and close examination revealed no surviving vertical aerial shoots or stolons in the area of common bermudagrass. If little to no survival of aerial shoots is found, wash soil from plug and look for live white rhizomes



- **Plug of common bermuda extracted, look for live, firm white rhizomes. Washing soil from the plug can be helpful.**



- **Several large, firm, white rhizomes have survived (see Arrows). This stand had delayed greenup due to loss of aerial shoots to winter-kill but regenerated rapidly from the rhizomes**



Window Sill Method of Assessing Damage During Winter

In the winter, prior to green up, take a plug, no smaller than 3 inches in diameter by 3 inches deep and place in a dish on a warm (70F or above), sunny window sill. Keep soil moist. Watch for regrowth and sources (origin of the shoots) over next 3 to 4 weeks.



**Green shoots in
spring arise of lateral
buds that were
dormant on at nodes
on phytomers that
survived the winter**

So, is it “dead” or just “dormant?”

- As of this time of this workshop (May 5, 2010), if you are in Oklahoma and have not seen green shoots arising from the large areas of tan brown bermudagrass, you are not likely to see many new shoots in these areas coming from the so called “dormant turf”.
- Areas that appear completely “dead” or “dormant” are most likely completely dead or very little material will remain viable to generate aerial shoots. These areas should be renovated.



It's dead in this case.



No live aerial shoots, stolons or rhizomes present

Heavy traffic and compaction likely pre-disposed this sports field to winter-kill



Double ring infiltrometer can be used to measure saturated infiltration rate of water into the soil surface. Opinion: Infiltration rates should be a minimum of 2 inches per hour or greater.





Although dead, the grass in this plug had responded to aeration the previous year as evidenced by roots in the aerification holes.





**Lack of surviving nodes/
lateral buds on either aerial
shoots, stolons or rhizomes.
This grass is toast!**



In an area of less traffic just a few feet away, 100% live green cover. Note rhizomes.



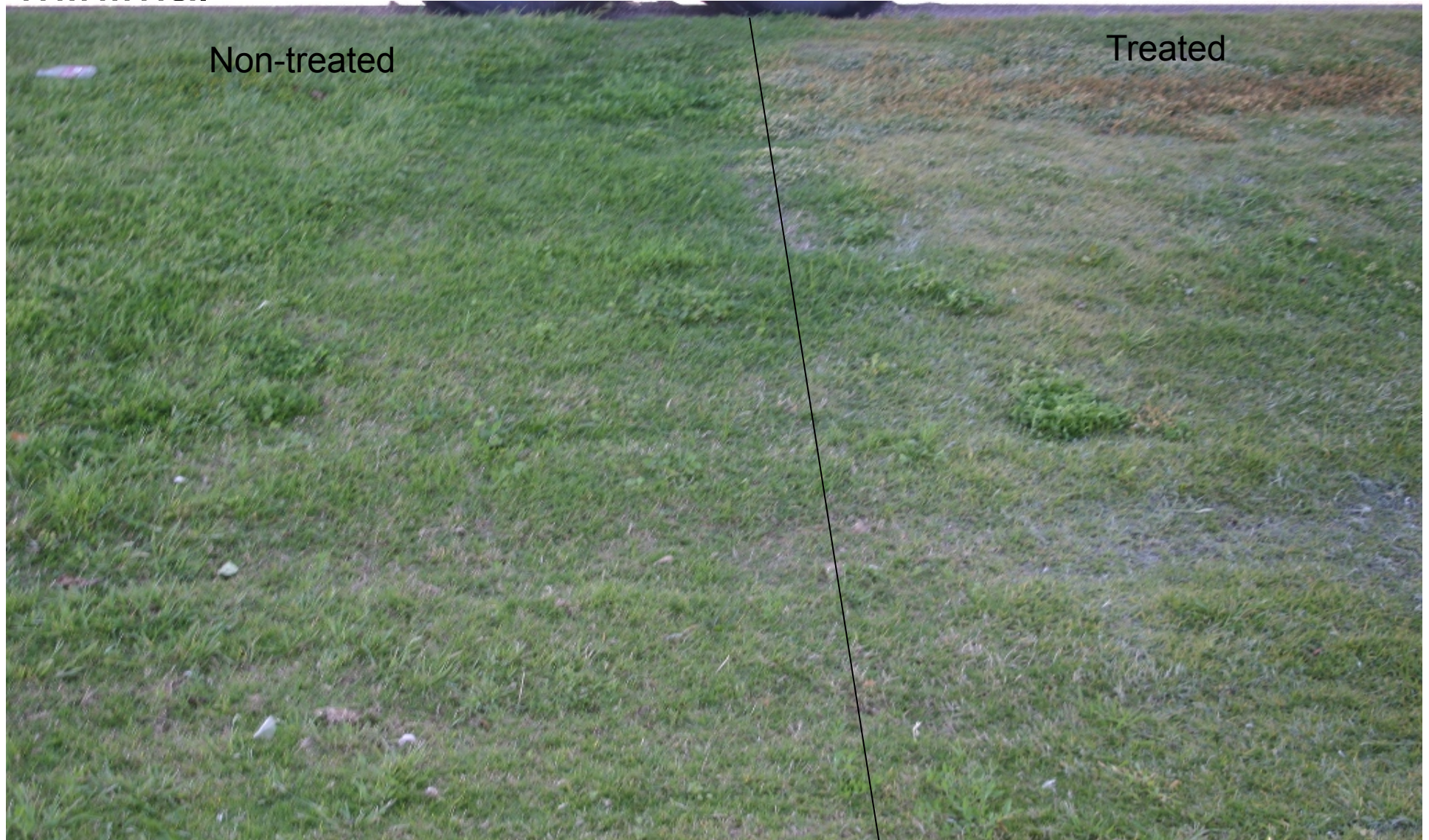
Are these beetle emergence holes or merely birds keying off of tan turf and hoping to find food? Examine them.



Nutsedge emerging where bermudagrass was winter-killed.



Bermudagrass may be more sensitive to herbicides during greenup or when plant energy reserves are minimal



Yellowing and dull-green appearance to bermudagrass sprayed with standard 2,4-D; MCPP, dicamba and MSMA during greenup.



Multiple Problems here in spring 2009: several common bermudagrass varieties present, differences in resistance to *Bipolaris* leaf spot, winter-kill on the right

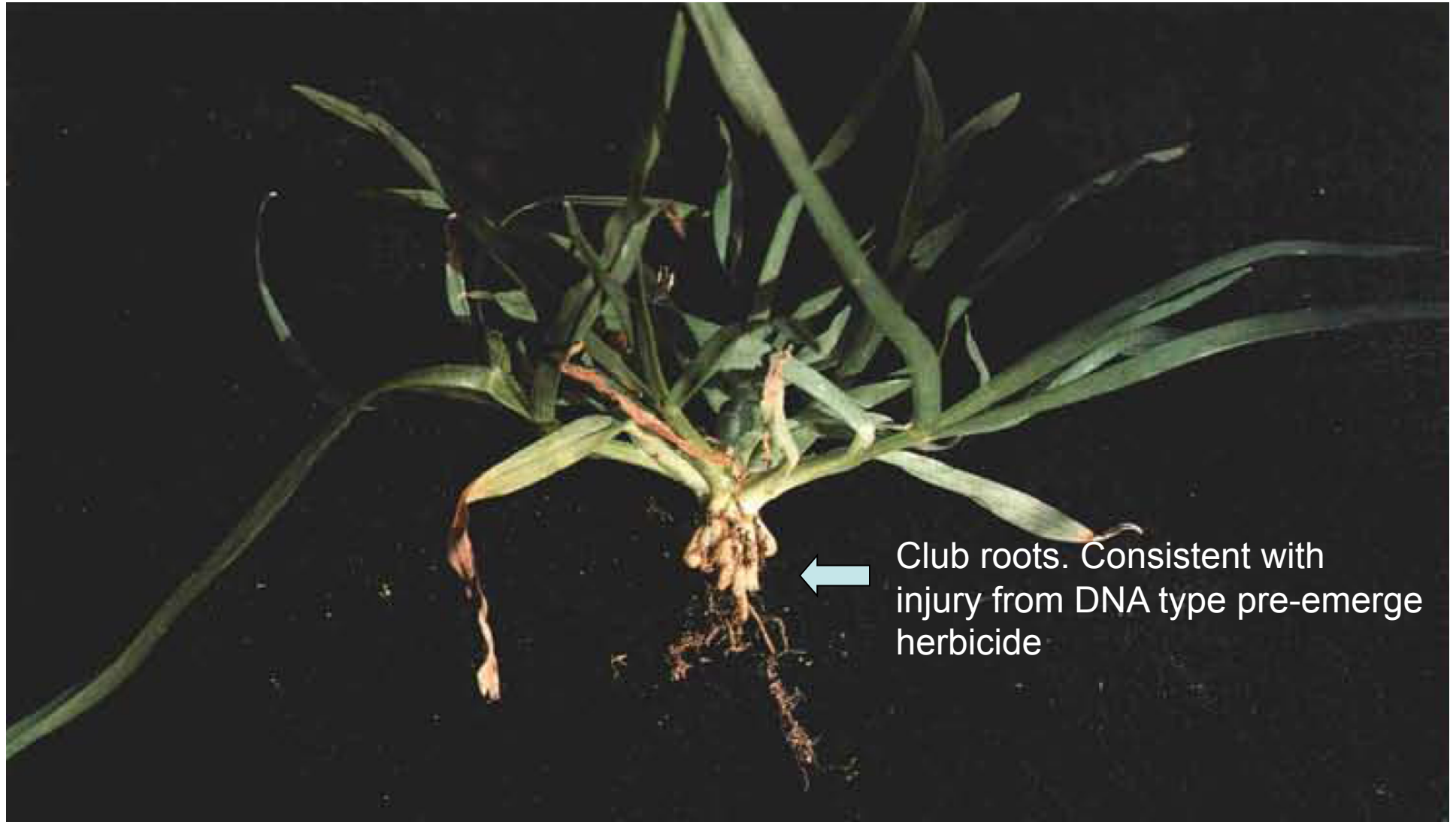


Bipolaris leaf spot and crown rot disease on common bermudagrass



Most Pre-emergent Herbicides Affect Root Cell Division and Thus Plant Health.

Photocredit: Frank Rossi. 1992. To Pre or not to Pre- Summer Annual Weed Control Strategies. USGA Greens Section Record. Sept/Oct pp 15-17.



Root inhibition on bermudagrass stolon



Crabgrass

- Crabgrass germination begins at surface temperatures of 58 to 60 F consistently and moist at the surface.
- South and west facing slopes with thin turf canopy and heavy seed supply are first areas to germinate



Pre-emergent herbicides

- Major Pre-emergent Herbicides for Crabgrass/ Goosegrass Control in bermudagrass turf
 - Barricade (prodiamine), Dimension (dithiopyr), Pendulum (Pendimethalin), Surflan (oryzalin)
 - All of these can inhibit root generation from stolons and slow recovery from winter-kill or from new sprigging. Lower label rates are less injurious than maximum label rates.
 - All are inhibitory to bermudagrass seed germination for a certain period of time. See the labels for the reseeding interval. Perform a test seeding (bioassay) as an added precaution to check for herbicide residue in the soil.

Ronstar (oxadiazon)

Not for residential lawns

- Ronstar 50 WP or 2G or on fertilizer carrier
- Labeled for use on newly sprigged bermudagrass
- Controls or suppresses several summer annual grasses and some broadleaves from seed.
- Generally not injurious to bermudagrass roots or stolons at labeled rates. Injurious to bermudagrass establishment from seed.
- Typically looking at 2 lbs ai/A with second application of 1 or 2 lbs ai/A if stand remains thin
- If greenup and grow in is suitable, second application of split program could proceed with other pre-emergent herbicides.
- WP formulation should be applied to dormant turf, granular can be used on green turf. Some Superintendents have used WP on green turf followed by rapid irrigation and have minimized phytotoxicity

Post-emergent Crabgrass Program

- MSMA 6 lb ai/Gallon product
- Typically used at 1 fl oz/1,000 sq. ft. for post-crabgrass control, repeat applications allowed.
- Reasonable tolerance of recently sprigged bermudagrass and bermudagrass recovering from winter injury.

Post-emergent Crabgrass Program

- Drive 75DF (1 lb product/A application) and Drive XLR8 (64 fl oz/A application) – active ingredient quinclorac.
- +/- methylated seed oil at 1.5 pts/acre
- Sequential applications allowed, 1.5 lb ai/A limit per year on Drive products.
- Can be used on recently sprigged or seeded bermudagrass. Some phytotoxicity effect on bermudagrass can occur.

Bermudagrass Re-establishment

- Resprigging:
 - 120 to 400 bu/A for high quality areas
 - No-till slit sprigging if possible
- Resodding:
 - Don't lay sod on recently pre-emergent treated soil, till soil first, properly prepare soil
- Seeding:
 - Generally 0.8 to 1 lb of pure live seed per 1,000 sq. ft. or about 2 lbs of coated seed per 1,000 sq. ft.
 - Beware of existing pre-emergent herbicides in soil
 - Ideally seed should be placed at about 1/16 inch deep

Bermudagrass Fertility

- For non-putting green areas of high quality turf.
- Optimize soil pH, P and K based on soil test results.
- Consider about 1 lb of N per 1,000 sq. ft. for highly damaged areas where there is at least some material to recover. Apply in April, May and June until 100% cover is achieved.
- Reduce N to holding pattern of 0.5 to 0.75 lbs of N per 1,000 sq. ft. per growing month for color and density unless additional heavy growth is needed.
- Last N application no later than Sept 15 for southern and central Oklahoma, Sept 1 for northern counties

Mowing heights going into fall

- Increasing mowing height may be expected to assist in increase resistance to stress during winter by altering shoot to root ratios.
- Increasing mowing height generally results in increased loading of rhizomes reserves and increases canopy insulation of crowns during the winter.

Questions?