Plant & Soil Sciences
Jan. 14, 2010 • Vol. 3 Issue 1
Extension Newsletter

In this issue ...

•Cosmetic wheat freeze injury

•Becoming a certified turfgrass grower

•New Pete's Sheet for 2010

•New Fact Sheet

•Upcoming events you do not want to miss

Plant & Soil Science Extension

368 Ag Hall
Stillwater, OK 74078
Phone: 405-744-6130
Fax: 405-744-0354

Wheat freeze injury, mostly cosmetic

By Jeff Edwards

The recent record low temperatures and high winds have many Oklahoma wheat growers, especially those with late-sown wheat, wondering how well their wheat crop weathered the storm. After looking at a few fields in central Oklahoma and speaking with area agronomists, I am comfortable in saying that most Oklahoma wheat fields survived the cold snap with only cosmetic damage. Large wheat is showing the most visual injury symptoms with upper leaves almost completely desiccated as shown below.

Many large wheat fields in central Oklahoma, like the one picture above, were only cosmetically injured by the recent cold snap.

Smaller wheat, such as that in the two pictures below, does not look as bad as larger wheat at first glance. However on a percentage leaf area basis, small wheat lost more leaf area due to cold injury than larger wheat. The primary issue with late-sown wheat, though, remains the lack of sufficient tillering. We will need adequate moisture and temperatures above 50 F to encourage these plants to produce a few tillers before jointing in early March. There is still plenty of time for adequate tillering to occur, but conditions will need to be much more favorable for wheat growth than those of the past few weeks.

Small wheat in central Oklahoma received less cosmetic injury, but lost more leaf area overall.

Unfortunately, it appears that most of the snow was blown away from wheat fields and this moisture was not moved into the soil profile. It is likely that temperatures were cold enough for long enough to reduce the amount of leaf rust spores present in fields. Hopefully, new spores will not be blown in over the coming months. Right now wheat farmers need to continue to focus on scouting for insects and accurately assessing topdress nitrogen requirements.

Jeff Edwards can be reached at jeff.edwards@okstate.edu.

Becoming a certified turfgrass grower

By Roger Osburn

Turfgrass certification is the process required to produce high quality pedigreed turf and is open to all who wish to participate. Certified turf is a limited generation production system. Foundation seed or sprigs produce registered sod, registered seed or sprigs produces certified sod and certified sod is sold to the consumer. There is no class beyond certified. In some varieties, there may be no registered class.

There are several basic requirements to become a certified sod producer.

1. **Start clean.** All planting and harvesting equipment and storage facilities must be clean to prevent contamination from other crops, varieties or weeds.

2. **Plant eligible seed or sprigs and retain proof of eligibility.** Foundation or registered seed or sprigs must be planted for the crop to be eligible for certification. If you are going to produce registered sod you will need to purchase foundation seed or sprigs. If you are going to produce certified sod you will need to purchase registered seed or sprigs or in some cases foundation seed or sprigs.

3. **Eligible Ground.** The ground on which you want to establish certified turfgrass must be inspected prior to planting, as there are no exceptions. The field must have been found to be free of noxious weeds or other strains of the same species. And, must not have been tilled or otherwise molested prior to inspection.

4. **Field Inspection Application.** Contact OCIA office for an application for field inspection and submit it by the appropriate deadline. This will start the paperwork process to complete sod certification.

5. **Prepare your field for inspection by OCIA.** This involves roguing any contaminants, such as off-type plants and controlling any weeds that might be present. Isolation also needs to be determined at this time. With turf, there must be 10 feet between a certified sod field and other non-certified fields.

6. **Field inspections.** The inspector will contact you prior to making the inspection to make you aware that he will be in the area and confirm that your field is ready for inspection. After inspection is complete, you will receive a copy of the field inspection report.

If you are interested in becoming a certified turfgrass grower, please contact the Oklahoma Crop Improvement Association at 2902, West Sixth Ave., Stillwater, OK 74074-1555.

Specific crop standards and other information at available from the OCIA office or at *www.okcrop.com.*

Roger Osburn can be reached at roger.osburn@okstate.edu.

Turfgrass Certification Fees

Annual Applicant Fee (per applicant) - $1000.00
Inspection Fee - $20 per acre up to 20 acres, then $10 per acre over 20
Late Fee - Round-trip milageat IRS rate or $50 (whichever is greater)
Tags - 10 cents per tag, minimum order of 10 bags

Subscription Information

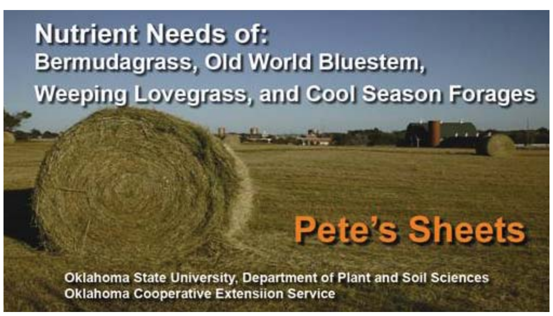
To receive an electronic copy of the OSU PASS Extension Newsletter, contact Janelle Malone at janelle.malone@okstate.edu. Please include "PASS Newsletter Subscription" and your name in the subject line.

New Pete's Sheet for 2010

By Brian Arnall

We are unveiling the newest Pete's Sheet that is ready for distribution. The *Nutrient Needs of: Bermudagrass, Old World Bluestem, Weeping Lovegrass, and Cool Season Forages Pete's Sheet* is set up just like the previous Wheat and Corn Pete's Sheets. These cards are designed to help you in making fertilizer decisions. The cards have the nitrogen, phosphorus and potassium requirement for each crop or forage identified on the cover- The optimum pH range for each crop can also be found in this resource.

If you would like copies of any of our Pete's Sheets, please e-mail or call me with your request. The cards will be sent out free of charge. A maximum of 100 of each of the cards per request will be sent. All Pete's Sheets are folded in half to equal the size of the average business card.



Pete's Sheets are great resources to have easily accessible. Pictured above, is an example of the newest Pete's Sheet for 2010.

To see all of the Pete's Sheet available check out *www. NPK.okstate.edu/petesheets/index.htm.* In addition, if you would like to see different topic covered on a Pete's Sheet, please contact Brian Arnall with your suggestions.

Brain Arnall can be reached at b.arnall@okstate.edu.

New herbicide Fact Sheet published

By Joe Armstrong

Herbicide resistant weeds, such as pigweed in soybeans and peanuts, ryegrass in wheat and year-round problematic marestail, are an increasingly important concern in nearly all of Oklahoma's agricultural crops. Rotating crops and herbicides are the most effective method for preventing or delaying the development of herbicide resistance. However when rotating herbicides, it is important to rotate herbicide active ingredients and use multiple herbicide modes of action.

To help in the process of designing an effective and diverse chemical weed control program, I put together a new Fact Sheet called "*Herbicide How-To: Understanding Herbicide Mode of Action*," (PSS-2778, included with at the end of this newsletter). This Fact Sheet includes a brief description of the different modes of action and a list of commonly used herbicides, in addition to their respective mode of action.

Remember, reducing dependency on a single herbicide mode of action is the first step towards pro-active management of herbicide resistant weeds.

Joe Armstrong can be reached at joe.armstrong@okstate.edu.

Upcoming Events

2010 Oklahoma Soybean Expo

Jan. 27, 2010 *Oklahoma State University*
Stillwater, Okla.
(More details to follow.)

2010 Northwest Oklahoma Grain Sorghum Educational Program Series

Feb. 1, 2010 *Midwest Crop Services Building, Gate, Okla. - 12 p.m.*
Fairgrounds, Fairview, Okla. - 6 p.m.
Feb. 2, 2010 *Marland Community Center, Marland, Okla. - 7:30 a.m.*
Fairgrounds, Alva, Okla. - 1:30 p.m.
Feb. 3, 2010 *Fairgrounds, Guthrie, Okla. - 7 a.m.*
Hoover Building, Enid, Okla. - 1 p.m.
Feb. 4, 2010 *Kay Electric Coop, Blackwell, Okla. - 9 a.m.*
Fairgrounds, Cherokee, Okla. - 1 p.m.
Medford City Offices, Medford, Okla. - 6:30 p.m.

2010 No-till Oklahoma Meeting

Feb. 8-9, 2010 *National Center for Employee Development*
Norman, Okla.
(See registration attached.)

Herbicide How-to:

Understanding Herbicide Mode of Action

Joe Armstrong
Extension Weeds Specialist

The large number of herbicide options—new products, old products with new names, new formulations of old products, premixes, and generics—can make weed control a difficult and confusing task. In addition to knowing the crops in which a herbicide can be used, the weeds it will control, the appropriate rate, and any necessary adjuvants to include, it is also important to know and understand the herbicide's mode of action to design a successful weed management program.

What is "Mode of Action?"

The mode of action is the way in which the herbicide controls susceptible plants. It usually describes the biological process or enzyme in the plant that the herbicide interrupts, affecting normal plant growth and development. In other cases, the mode of action may be a general description of the injury symptoms seen on susceptible plants. In Oklahoma crop production, 11 different herbicide modes of action are commonly used, and each is unique in the way it controls susceptible plants. Some herbicide modes of action comprise several chemical families that vary slightly in their chemical composition, but control susceptible plants in the same way and cause similar injury symptoms.

Herbicides can also be classified by their "site of action," or the specific biochemical site that is affected by the herbicide. The site of action is a more precise description of the herbicide's activity; however, the terms "site of action" and "mode of action" are often used interchangeably to describe different groups of herbicides.

Why is it Important to Know the Mode of Action?

Knowing and understanding each herbicide's mode of action is an important step in selecting the proper herbicide for each crop, diagnosing herbicide injury, and designing a successful weed management program for your production system. Over-reliance on a single herbicide active ingredient or mode of action places heavy selection pressure on a weed population and may eventually select for resistant individuals. Over time, the resistant individuals will multiply and become the dominant weeds in the field, resulting in herbicides that are no longer effective for weed control. Simply rotating herbicide active ingredients is not enough to prevent the development of herbicide-resistant weeds. Rotating herbicide modes of action, along with other weed control methods, is necessary to prevent or delay herbicide-resistant weeds. Always read each product's label to determine the mode of action and best management practices for herbicide-resistant weeds.

Many weeds have developed "cross resistance" and are resistant to multiple herbicides within a single mode of action. Most waterhemp populations in Oklahoma, for example, are cross-resistant to both Scepter (chemical family: imidazolinone) and Classic (chemical family: sulfonylurea). Both of these herbicides are ALS inhibitors, but belong to different chemical families within the same mode of action. Therefore, it is important to not only rotate herbicide active ingredients but also to rotate modes of action to prevent herbicide-resistance weed populations from developing. One of the most effective ways to rotate herbicide modes of action is through crop rotation.

Weeds that have developed "multiple resistance" are resistant to herbicides from two or more modes of action. At this time, there are no weeds in Oklahoma that have been confirmed as resistant to multiple herbicide modes of action; however, instances of weeds with multiple resistance can be found in neighboring states. ALS-resistant, PPO-resistant, and glyphosate-resistant populations of waterhemp have been confirmed in Kansas. As well, Italian ryegrass populations in Arkansas have been confirmed to be resistant to both ALS- and ACCase inhibitor herbicides.

How can I Determine the Herbicide's Mode of Action?

Information regarding each product's mode of action can sometimes be found on the front of the herbicide label. Often, the herbicide is described as being a member of a particular numbered group. These numbers refer to a specific mode of action and were developed to consistently organize herbicides based on their mode of action. For example, "Group 1" herbicides are ACCase inhibitors and "Group 2" herbicides are ALS inhibitors. Some herbicides will list the mode of action somewhere in the general instructions or product description in the label. In other situations, products may not mention the mode of action anywhere in the label. If you are unsure of the herbicide's mode of action, contact your local county extension educator for clarification.

What are the Different Modes of Action? What are their Characteristics?

The following is a short description of the 11 most commonly used herbicide modes of action in Oklahoma crop

(Continued on page 4)

ACCase Inhibitors

Group	*Chemical family*	*Trade names*	*Active ingredient*
1	Arloxyphenoxypropionate “FOPs”	Assure II	quizalofop
		Hoelon[r]	diclofop
		Fusilade	fluazifop
		Puma	fenoxaprop
1	Cyclohexanedione “DIMs”	Select, Select Max, others	clethodim
		Poast, Poast Plus	sethoxydim
1	Phenylpyrazoline “DENs”	Axial XL	pinoxaden

ALS Inhibitors

Group	*Chemical family*	*Trade names*	*Active ingredient*
2	Imidazolinone “IMIs”	Beyond, Raptor	imazamox
		Cadre	imazapic
		Pursuit	imazethapyr
		Scepter	imazaquin
2	Sulfonylurea “SUs”	Accent	nicosulfuron
		Ally	metsulfuron
		Amber	triasulfuron
		Autumn	iodosulfuron
		Beacon	primisulfuron
		Classic	chloriumuron
		Express	tribenuron
		Glean	chlorsulfuron
		Harmony	thifensulfuron
		Maverick	sulfosulfuron
		Option	foramsulfuron
		Osprey	mesosulfuron
		Peak	prosulfuron
		Permit	halosulfuron
		Resolve	rimsulfuron
2	Triazolopyrimidine	FirstRate	cloransulam-methyl
		PowerFlex	pyroxsulam
		Python	flumetsulam
		Strongarm	diclosulam
2	Pyrimidinyl(thio)benzoate	Staple	pyrithiobac
2	Sulfonylaminocarbonyltriazolinones	Everest	flucarbazone
		Olympus	propoxycarbazone

Root Growth Inhibitors

Group	*Chemical family*	*Trade names*	*Active ingredient*
3	Dinitroaniline	Treflan, others	trifluralin
		Prowl, others	pendimethalin
		Sonalan	ethafluralin

Growth Regulators

Group	*Chemical family*	*Trade names*	*Active ingredient*
4	Phenoxy-carboxylic acid	many	2,4-D
		Butyrac, others	2,4-DB
			MCPA
4	Benzoic acid	Banvel, Clarity, Status, others	dicamba
4	Pyridine carboxylic acid	Stinger	clopyralid
		Starane	fluroxypyr
		Tordon[r], Grazon[r]	picloram
4	Quinoline carboxylic acid	Paramount	quinclorac

Photosynthesis Inhibitors (Photosystem II)

Group	*Chemical family*	*Trade names*	*Active ingredient*
5	Triazine	Aatrex[r], atrazine[r], others	atrazine
		Princep	simazine
		Caparol	prometryn
5	Triazinone	Sencor	metribuzin
		Velpar	hexazinone
5	Uracil	Sinbar	terbacil
6	Nitrile	Buctril, others	bromoxynil
6	Benzothiadiazinone	Basagran	bentazon
7	Urea	Linex, Lorox	linuron
		Karmex	diuron

Shoot Growth Inhibitors

Group	*Chemical family*	*Trade names*	*Active ingredient*
8	Lipid synthesis inhibitor, thiocarbamate	Eptam	EPTC
15	Chloroacetamide	Dual, Cinch, others	metolachlor
		Intrro[r], Micro-Tech[r]	alachlor
		Harness[r], Degree[r], Surpass[r], others	acetochlor
		Outlook	dimethenamid-P
15	Oxyacetamide	Define	flufenacet

Aromatic Amino Acid Synthesis Inhibitors

Group	*Chemical family*	*Trade names*	*Active ingredient*
9	Glycine	Roundup, Touchdown, others	glyphosate

Glutamine Synthesis Inhibitors

Group	*Chemical family*	*Trade names*	*Active ingredient*
10	Phosphonic acid	Ignite, Liberty	glufosinate

Pigment Synthesis Inhibitors

Group	*Chemical family*	*Trade names*	*Active ingredient*
12	Pyridazinone	Zorial Rapid 80	norflurazon
13	Isoxazolidinone	Command	clomazone
27	Triketone	Callisto	mesotrione
		Laudis	tembotrione
		Impact	topramezone
27	Isoxazole	Balance[r]	isoxaflutole

PPO Inhibitors

Group	*Chemical family*	*Trade names*	*Active ingredient*
14	Diphenylether	Blazer	acifluorfen
		Reflex, Flexstar	fomesafen
		Cobra	lactofen
		Goal	oxyfluorfen
14	N-phenylphthalimide	Valor	flumioxazin
		Resource	flumiclorac
14	Thiadiazole	Cadet	fluthiacet
14	Triazolinone	Aim	carfentrazone
		Spartan, Authority	sulfentrazone

Photosynthesis Inhibitors (Photosystem I)

Group	*Chemical family*	*Trade names*	*Active ingredient*
22	Bipyridilium	Gramoxone Inteon[r], others	paraquat
		Reglone, others	diquat

[r] Restricted use pesticide.

production. The list of herbicides in the accompanying table (found on the inside pages) is not exhaustive and does not account for herbicide premixes that contain two or more active ingredients. If you have questions regarding mode of action, consult the individual product label and support literature from the manufacturer or contact your county agricultural Extension educator for more information.

ACCase Inhibitors (Group 1)

Inhibitors of the ACCase enzyme in plants are used strictly for grass control. As a result, they are used primarily in broadleaf crops or fallow situations, but there are also some products labeled for use in grass crops to control specific grass weeds. These herbicides are commonly referred to by the nicknames of their chemical families, "FOPs," "DIMs," and "DENs."

ALS Inhibitors (Branched-Chain Amino Acid Inhibitors) (Group 2)

ALS inhibitors, or branched-chain amino acid inhibitors, comprise the largest mode of action and include at least one herbicide used in nearly every crop produced in Oklahoma. Many herbicides in this mode of action fall into two chemical families: imidazolinones (or "IMIs") or sulfonylureas (or "SUs"), but there are three other chemical families within the ALS inhibitors. Cross resistance, or herbicide-resistance to multiple chemical families within a single mode of action, is common with ALS inhibitors.

Root Growth Inhibitors (Group 3)

Herbicides in this mode of action inhibit cell division, which stops roots from extending and are distinctive because of the yellow color of their formulations. They are applied preplant incorporated or preemergence in a wide range of agronomic crops, vegetables, turf, and ornamentals for control of grasses and small-seeded broadleaf weeds.

Growth Regulators (Group 4)

This mode of action, also known as synthetic auxins, includes many commonly used plant hormone-type herbicides in wheat, corn, sorghum, and pasture settings. These herbicides are generally selective for broadleaf control in grass crops; however, there are some uses for preplant and in-season weed control in broadleaf crops.

Photosynthesis Inhibitors—Photosystem II (Groups 5, 6, and 7)

These herbicides inhibit Photosystem II, part of the photosynthesis pathway, and are used in a variety of crops for control of grass and broadleaf weeds. Because of their extensive use for several decades, some weeds have developed resistance to these herbicides, particularly atrazine and metribuzin.

Shoot Growth Inhibitors (Groups 8 and 15)

Herbicides in this mode of action are soil-applied herbicides and control weeds that have not emerged from the soil surface. These herbicides generally control grass weeds and small-seeded broadleaf weeds.

Aromatic Amino Acid Inhibitors (Group 9)

The only herbicide included in this mode of action is glyphosate. There are many generic glyphosate and glyphosate-containing products available. Depending on the product, glyphosate can be formulated as ammonium, diammonium, dimethylammonium, isopropylamine, and/or potassium salts. Despite the different salt formulations available, it is important to know that the type of salt formulation does not affect weed control, but rather it indicates the way a particular glyphosate product is formulated. Glyphosate is a generally a non-selective herbicide and will severely injure or kill any living plant tissue that it comes in contact with. However, it can be used selectively in glyphosate-resistant crops, including corn, soybean, cotton, and canola. Like the ALS inhibitors, glyphosate controls susceptible plants by inhibiting amino acid synthesis; however, glyphosate and ALS inhibitors control susceptible plants in completely different ways and should not be considered to be the same mode of action.

Glutamine Synthesis Inhibitors (Group 10)

The only herbicide included in this mode of action is glufosinate. Glufosinate can be used as a non-selective burndown treatment or as an over-the-top postemergence application in Liberty Link® crops (glufosinate resistant).

Pigment Synthesis Inhibitors (Groups 12, 13, 27)

These herbicides are also called "bleachers" because of the characteristic white plant tissue that develops in susceptible plants after application. Several of the pigment synthesis inhibitors (mesotrione, isoxaflutole) are also referred to as HPPD-inhibitors, based on their site of action.

PPO Inhibitors (Groups 14)

PPO inhibitors may also be referred to as cell membrane disruptors and are usually "burner"-type herbicides. Some PPO-inhibitors can be applied preemergence, but most are used for postemergence weed control.

Photosynthesis Inhibitors—Photosystem I (Group 22)

Photosystem I inhibitors include paraquat and diquat and are used for non-selective weed control and crop desiccation prior to harvest. These herbicides are also referred to as "cell membrane disruptors" because of their contact activity.

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Robert E. Whitson, Director of Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma. This publication is printed and issued by Oklahoma State University as authorized by the Vice President, Dean, and Director of the Division of Agricultural Sciences and Natural Resources and has been prepared and distributed at a cost of $1.35 per copy. 1209 GH