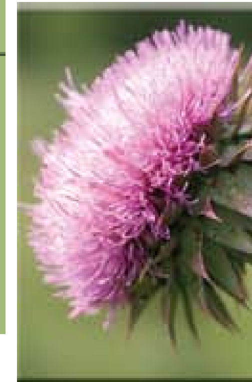
Plant Protection Programs University of Missouri

Integrated Pest & Crop Management



Nitrogen Loss: Again??!!

By Peter Scharf

It's June 15. A big weather system has just swept through Missouri last night and this morning, dropping between one and three inches of rain.

Much of the Missouri corn crop had to be re-planted due to cool and wet early-season conditions. The cool is gone, but the wet has remained. With warm soils, potential for nitrogen loss is considerably higher than it was in April, particularly on soils that don't drain well.

My rule of thumb is that corn fields that receive a foot or more of precipitation in May and June are likely to experience yield loss due to N deficiency. Over the last 60 days, most of Missouri has received 10 or more inches. That puts nearly everyone in the 'danger' category. Barton, Vernon, Bates, Nodaway, Clark, Lewis, Marion, Ralls, Cooper, New Madrid, Pemiscot, and Dunklin are counties with the highest risk levels based on rainfall totals and row crop acreage. Although I will focus on corn, milo and cotton crops are also vulnerable to yield loss when N is lost.

Figure 1. Excess rainfall can lead to nitrogen loss that can severely limit corn yield, as in this Holt County aerial photo taken August 2008.

Level of risk depends on nitrogen fertilizer management and soil properties as well as rainfall. The last two years, I've written a newsletter article with a Nitrogen Loss Scoresheet that gives some guidance as to risk levels associated with different N sources, timings, and soil textures. Here's a link to last year's version, which should still be useful this year: http://ppp.missouri.edu/newsletters/ipcm/archives/v17n10/ipmltr9.htm

Last year, nitrogen deficiency cost corn producers in Missouri and across the Midwest a pile of money. Based on aerial photos and windshield surveys in August, I estimated about 70 million bushels of potential corn production lost in Missouri, and about 460 million bushels across the corn belt. Here's a pdf file (warning, 5 Mb) about nitrogen loss and yield loss across the Midwest last year: http://plantsci.missouri.edu/nutrientmanagement/nitrogen/scharf%20N%20loss%202008.pdf

This yield loss could have been prevented using rescue applications of nitrogen fertilizer. The acreage needing rescue N last year was so great that logistics of application equipment and fertilizer delivery would have created bottlenecks. However, the biggest limitation was the mindset of producers: Being unsure about the need for additional N and the potential for yield response.

My experience with N timing experiments and rescue N applications to production fields is that full or nearly full yield can be achieved if rescue N is applied by the time the corn tassels. Limited information suggests that

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Foliage Diseases of Alfalfa

By Laura Sweets

There are at least eight leaf and stem diseases that may occur on alfalfa in Missouri. These diseases cause a variety of different types of lesions on leaflets and, in some cases, on petioles and stems as well. The symptoms for some of the foliage diseases are quite similar and might be difficult to distinguish in the field. For accurate diagnosis submitting a sample to the Plant Diagnostic Laboratory would be recommended. Most of these foliage diseases are caused by fungi which survive on infested plant tissue left in the field. And most of these leaf and stem diseases are favored by cool to moderate temperatures and wet or humid conditions. Because most of these diseases are favored by the same environmental conditions, more than one may occur in a field at the same time. When foliage diseases are severe, leaves on infected plants may yellow and drop prematurely. Foliage diseases can reduce plant vigor, reduce yields from stands and reduce the quality of harvested hay.

So far this season the majority of the samples submitted to the University of Missouri, Plant Diagnostic Laboratory have been Lepto leaf spot, although there has been one sample of spring black stem. Since most of the state has been cool and wet for much of the season it is not surprising the foliage diseases are occurring on alfalfa in Missouri.

Lepto leaf spot, caused by the fungus *Leptosphaerulina briosiana*, is usually found on young leaves but may also infect older leaves and petioles. Symptoms of Lepto leaf spot are variable. Under low light intensity spots tend to be small, pinpoint in size and grayish-black in color. Under higher light intensity spots tend to be larger in size and have a light tan center with dark margin and yellow halo. When infection is severe, leaflets will yellow and drop prematurely. Lepto leaf sport is favored by temperatures in the range of 60-80 F and long periods of high humidity.

Spring black stem, caused by the fungus *Phoma medicaginis*, begins as small, dark brown to black spots on the lower leaves, petioles and stems. These spots become irregular in shape and increase in size. Lesions may run together killing large areas of leaf tissue. Leaflets may yellow, wilt and drop prematurely. Lesions on stems may actually girdle the stem causing shoots to yellow and wilt. Spring black stem is more severe in cooler, wetter seasons.

Summer black stem, caused by the fungus *Cercospora medicaginis*, begins as small, grayish-brown lesions with irregular margins. Tissue around these lesions may turn yellow. Lesions are frequently located on or near leaflet midribs. Infected leaflets may yellow and drop prematurely. Lesions may also occur on stems. Stem lesions are usually reddish-brown to chocolate brown in color and elongate in shape. Summer black stem is favored by high relative humidity (near 100% RH) and temperatures of 80-90 F. This disease is more common after the regrowth is tall enough to shade the lower leaves.

Common leaf spot, caused by the fungus *Pseudopeziza medicaginis*, produces small, nearly circular, dark brown lesions. Common leaf spot lesions are more regular in size and shape than most of the other alfalfa leaf spot lesions. Common leaf spot lesions typically do not have yellow haloes or borders. A distinctive raised disk (fungal fruiting structure) forms in the center of mature lesions. Infected lesions may yellow and drop prematurely. Common leaf spot is favored by cool (60-75 F), wet weather.

Bacterial leaf spot starts as small water soaked spots which rapidly enlarge and merge to form irregularly shaped areas of dead leaf tissue. Lesions appear transparent and may have a narrow darker brown border. Bacterial leaf spot is favored by hot, humid weather. It is caused by the bacterial pathogen, *Xanthomonas alfalfae*.

Downy mildew begins a light grayish-green to yellow green areas on the infected leaflets. Downy mildew tends to develop first on the younger, upper leaves of a plant. Infected leaves may be curled and distorted. The disease may become systemic within plants resulting in stems that are larger in diameter than healthy stems and that are distorted at the tips. With high humidity patches of grayish-white mold growth of *Peronospora trifoliorum* may develop on the lower leaf surface of infected leaflets. Downy mildew is favored by high relative humidity (close to 100%) and temperatures of 50-65 F so it more likely to be a problem on the first cutting of alfalfa.

Rust on alfalfa begins as small, reddish-brown circular pustules on leaves and stems. These pustules break open to release masses of rusty brown spores of *Uromyces striatus*, the causal fungus. Rust is favored by high relative humidity and temperatures around 70 F. Rust is more likely to become a problem in late summer or early fall.

Anthracnose lesions are more common on alfalfa stems than leaves. Symptoms range from small irregularly shaped blackened areas on more resistant stems to large, sunken oval to diamond shaped lesions on more susceptible stems. If lesions completely girdle stems, the stems will die prematurely. The fungus causing anthracnose, *Colletotrichum trifolii*, can also cause a black to blue-black crown rot of alfalfa.

A management program for foliage diseases of alfalfa should include the following steps:

- Plant adapted varieties with resistance to diseases likely to occur in your area.
- Avoid varieties that are known to be susceptible to the foliage diseases known to occur in your area.
- Maintain good plant vigor by proper fertilization and insect control.
- Cut hay in late bud to early bloom stage before diseases become severe. (This will reduce losses and prevent infected leaflets from building up in the lower canopy of plants).

Laura Sweets
SweetsL@missouri.edu
(573) 884-7307

Early Season Soybean Diseases

By Laura Sweets

This could be an interesting year for early season soybean diseases in Missouri. Because of the erratic weather patterns, soybean planting is well behind average. However, the unusual fluctuations in both soil moisture and soil temperatures could increase the potential for Pythium seed decay and seedling blight as well as Phytophthora seedling blight. The early season soybean diseases include those that cause seed decay, seedling blights and root rots of soybean. Most of these early season soybean diseases are caused by fungi in the soil that are found wherever soybeans are grown. *Pythium*, *Phytophthora*, *Rhizoctonia* and *Fusarium* are the most common of these early season pathogens, although *Macrophomina* (charcoal rot fungus) may also cause early season seedling problems.

Soybean seedling blights have the potential to cause losses in Missouri soybean fields every year. The specific seedling blights that occur and their severity vary with the environmental conditions each season. With the changes in weather patterns this spring and soybean planting delayed in much of the state because of wet soil conditions, it is difficult to predict which, if any, seedling blights may occur or may cause significant problems this season.

Pythium and *Phytophthora* are favored by wet conditions and are more likely to be serious problems when wet conditions exist at or just after planting. *Rhizoctonia* and *Fusarium* are not as restricted by soil moistures and soil temperatures but still need some moisture to initiate infection. *Macrophomina phaseolina* grows best at temperatures between 82-95°F. Infection of seedlings with *Macrophomina* is most likely to occur if conditions of high soil temperatures and low soil moisture exist during the first two to three weeks after planting.

Symptoms of *Pythium damping-off* range from seed rot or preemergence damping-off to early postemergence damping-off. Affected tissue develops a soft, watery brown rot. Pythium damping-off is most likely to occur in cool (50-550F), wet soils.

Phytophthora can cause seed rot, preemergence damping-off and early postemergence damping-off. Initially affected tissue develops a soft, watery brown rot. Within several days the affected plant parts may dry out and shrivel up becoming dark, dry and brittle. This early stage Phytophthora is difficult to distinguish from Pythium damping-off; it may be necessary to submit a sample to the Plant Disease Clinic for an accurate diagnosis Phytophthora can also cause a seedling blight in which established seedlings turn yellow, wilt and die. Generally the entire seedling is affected and roots may be poorly developed and rotted. Phytophthora root rot is more likely to occur in heavy, wet soils, low areas or compacted areas, but it may occur in light soils or better drained areas if heavy rains occur after planting.

Rhizoctonia can cause seedling blight and root rot of soybean. Affected stands may have an uneven appearance and seedlings appear pale green in color and stunted in growth. The identifying feature of this disease is a small, reddish lesion on one side of the stem at or just below the soil line. This lesion develops into a sunken, cankered area a the point of infection. Sometimes the lesion will expand to completely girdle the stem. On severely infected seedlings, the entire hypocotyl may be discolored and shriveled into a dry, stringy or wiry stem.

Fusarium can also cause root rot of soybean. Infection is usually confined to roots and lower stems. The lower part of the taproot and the lateral root system may be discolored, deteriorated or completely destroyed. General roots show a nondescript brown discoloration and a dry, shrunken rot. Above ground portions of plants may appear off-color and stunted. Plants with severe Fusarium root rot may die prematurely.

Charcoal rot, caused by *Macrophomina phaseolina*, may be more commonly recognized as a mid to late season disease on maturing soybean plants, but it can also occur early in the season on seedlings. Infected seedlings tend to show a reddish brown discoloration from the soil line up the stem. The discolored area changes from reddish brown to dark brown to black. Foliage may appear off color or begin to dry out and turn brown. If the growing point is killed, a twin stem plant may develop. Under hot, dry conditions, infected seedlings may die. Under cooler, wetter conditions, infected seedlings may survive but carry a latent infection. Then symptoms may reappear later in the season with hot, dry weather.

Once the crop has been planted, there is little that can be done to reduce incidence or severity of soybean seedling diseases. Additional stress from poor growing conditions, herbicide injury or other factors may compound problems with soybean seedling diseases. Prior to planting it is important to consider variety selection (especially in fields with a history of Phytophthora), fungicide seed treatment, crop rotation, seedbed preparation and conditions at planting.

Laura Sweets
SweetsL@missouri.edu
(573) 884-7307

Visit our Web site at ppp.missouri.edu

Sensor-Guided Sidedressing

By Peter Scharf

It could be one of those years again. A 'sidedress' year. Last year was one of them. Sidedress treatments out-yielded preplant treatments by an average of 44 bu/acre in an experiment near Columbia.

With the recent heavy rains in Missouri, and warm soils, we could be in line for substantial losses of nitrogen fertilizer applied before planting (see other article this issue). Even pre-plant anhydrous ammonia, the most resistant to loss, has probably completely converted to nitrate by now (unless N-Serve was used) and is vulnerable. With much of Missouri's corn crop re-planted in late May, it will be July before rapid uptake begins in those fields. More losses could easily happen between now and then.

Sidedress N applications have a very low risk of being lost before uptake, but create the risk of not getting finished before the corn is too tall for tractor clearance. Availability of equipment to apply nitrogen to taller corn may be an obstacle. The yield effects of the delay are not a problem in most cases. Research in Missouri, Minnesota, Nebraska, Iowa, and Oklahoma suggests that applying N by the time the corn is four feet tall will on average give the same yield as applying all N preplant. Even when N was delayed until tasseling, average yield loss was only 10%.

In February, I reported in this newsletter that we were planning on-farm demonstrations of sensor-based sidedressing this year. So far, we have carried out demos on nine fields in Dunklin (injected solution), Barton (broadcast urea with Agrotain), and Cooper (anhydrous ammonia) Counties. One striking thing in these demonstrations is how variable the corn color has been in nearly all of these fields. It looks to me like there is wide variability in how much N the soil is supplying this year, possibly because N has been lost from some areas more than from others.

This wide variability in appearance also provided an opportunity for the cooperating producers to see how the sensors changed N rates in response to the variable corn color. It is a huge selling point when they see the rates go down while driving through dark green corn, then back up when they get into light green, stressed corn. When you see it happening, it just makes sense.

Sometimes people want to use sensors to 'top up' a crop. They don't work well for this. They're not really able to distinguish between corn that has enough N and corn that needs 30 more pounds. What they do work well for is telling whether the crop needs a little, a medium amount, or a lot. When preplant applications are kept in the neighborhood of 60 lb N/acre, they get a chance to do this. Not only have we seen that most fields this year appear to have places that need a little, a medium amount, and a lot, we have the past research to prove it. We measured the most profitable N rate all across eight fields in three regions of Missouri, and all of them had a spread of at least 150 lb N/acre from the lowest to the highest N rate needed within that field.

Carrying out field demonstrations of sensor-based sidedressing taught me how limited liquid (this includes anhydrous) application rates are. This is because with a fixed orifice, you have to quadruple pressure to double flow. Not many liquid systems can handle more than a four-fold range of pressures–too low and distribution along the boom or bar is not even, too high and a hose pops off or the pump gets damaged. So you're pretty much limited to a top rate that is twice your bottom rate. Often the crop will need a wider range than this.

There is a new innovation on the market that helps with this situation: spring-loaded nozzles. As pressure increases, springs compress and effective orifice size increases. This allows a much wider range of flow rates for the same range of pressures. SprayTarget and Greenleaf are both making and marketing this type of nozzle.

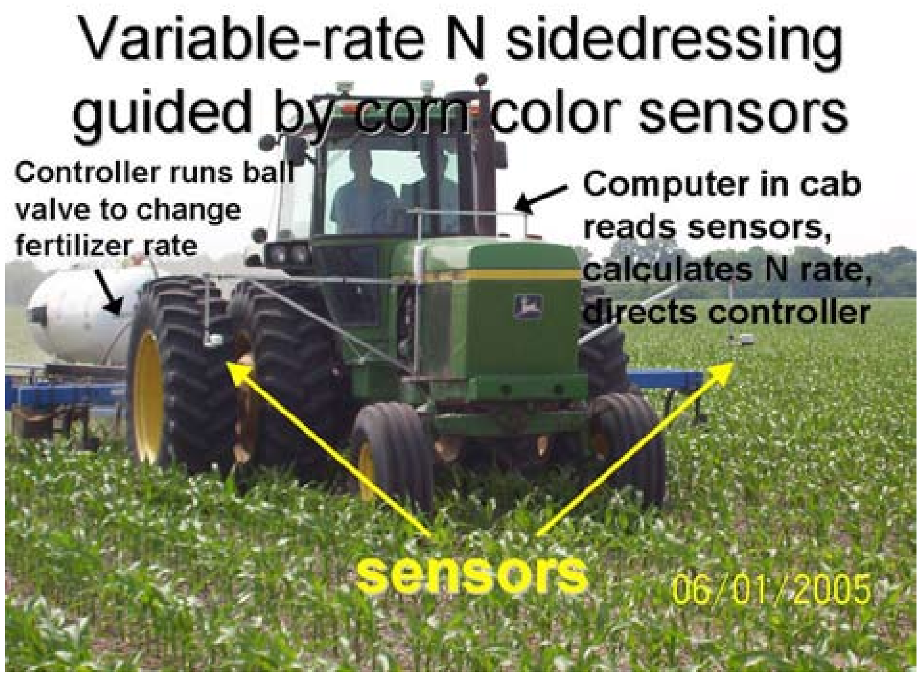

Figure 1. Crop sensors can diagnose corn N need based on color and control variable-rate sidedressing to accurately meet crop needs. Demonstration fields in 2009 have (so far) been highly variable in crop

Getting a wide range of N rates with a dry application system is generally easy, since it just relies on changing the speed of the delivery belt. There may be some issues in spinners with the pattern changing as the rate changes.

Our demos all rely on a small high-N 'reference' area. This area shows how dark green the corn can be with plenty of N for given genetics, weather, and soil. Everything

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Sensor-Guided Sidedressing *continued from page 88*

else is based off of this yardstick. In a wet year, even this area can lose so much N that it is no longer fully green at the time of sidedressing. We have not seen that so far this year, but have seen some reference areas with severe stand loss. In past years, when we've had poor reference areas (applied too late, not marked, leaf burn, atypical area of field) we've lost money with the sensors. When we've had good reference areas, we've made money.

One problem that we ran into in a bootheel demo several years ago resulted from starting the field in the evening and finishing in the morning. The value for the high-N reference was not re-checked. When we made the application rate map, there was a sharp line where N rate dropped off from evening to morning. There was a heavy dew that morning which apparently changed the sensor readings. We later confirmed this in experiments where we measured the change in sensor values as dew dried off the leaves, or as we sprayed water on the leaves. Re-checking the reading of the high-N reference area before starting to apply in the morning almost certainly would have solved this problem.

Followup research has showed that sensor readings change even when leaf wetness does not change. We are not sure why. Our current recommendation is that a high-N reference area should be measured at least every two hours while sidedressing. The Greenseeker brand of sensors, which is currently the most widely available sensor for sidedressing N, is especially changeable, possibly due to temperature sensitivity. With this sensor, we recommend checking the high-N area hourly if possible.

One approach we've come up with for re-checking the appearance of high-N corn is to apply a high rate of N crosswise to the corn rows. Then we cross this high-N strip every time we drive the length of the field. We program in its location, and our system automatically checks it every time we drive across. This will take care of any drift in sensor readings due to a rain shower, dew drying, leaf rolling or wilting, temperature effects, and so on.

Greenseeker sensors can be purchased in sets of 4 (about $18,500) or 6 (about $22,500). The 4-sensor setup is intended for applicators with narrower swaths. I'm not convinced that even four sensors are needed, much less six. The research that I've seen suggests to me that three sensors is probably the point of diminishing return, and we use three in all of our field demos. Greenseeker has recently been acquired by Trimble, which should give them some stability and product synergy. Sidedressing is a lot less work with autosteer, although my experience this year is that autosteer is not always good enough to keep the sensors directly over the corn rows.

Ag Leader is beta-testing sensors this year that were designed by Holland Scientific and plans a full release for 2010 if all goes well. They are re-designing their InSight field monitor to add the capability to receive sensor inputs and calculate N rates. This is a brand-new sensor design and in my opinion they need a better understanding of how it reacts when it moves from N-sufficient to N-stressed corn before their rate recommendations can be considered reliable. Nonetheless, my previous experience with Holland Scientific sensors is that they work well and are stable. I think the odds are good that the Ag Leader sensors will develop into an excellent product. I haven't heard anything about their pricing plans, but individual sensors of an earlier model sell for about $2500 each (including cables etc.) from Holland Scientific.

AGCO is also looking to enter the North American N sensor market with a European sensor that has been re-engineered by Toshiba. I do not know what launch timing, pricing, or bundling are planned for this product.

Interest in sensor-controlled sidedressing is growing among both producers and companies. The sidedressing aspect is an obstacle to many corn producers, but if we get more years with massive N loss like 2008, they will start to find ways to make it work. And the opportunity to diagnose and apply the correct rate is appealing to them.

Links to Powerpoint presentations about our on-farm demonstrations of sensor-based sidedressing for corn and cotton can be found at the bottom of this web page: **http://plantsci.missouri.edu/nutrientmanagement/nitrogen/rate.htm**

Peter Scharf
ScharfP@missouri.edu
(573) 882-077

Nitrogen Loss: Again??!! *continued from page 85*

even up to two weeks after tasseling, N-stressed corn will give a profitable yield response.

The question of whether more N is needed is tougher. My opinion is that aerial photos are the quickest and most accurate way to pinpoint where additional N is needed. We will be working with Agrivision to deliver a service called NVision to producers this year to acquire aerial photos and turn them into maps of estimated yield loss due to N deficiency. In fields where estimated yield loss justifies a rescue treatment, we will also provide variable-rate N application maps to correct the deficiencies. Nitrogen loss is nearly always patchy in a field, depending on where water runs and sits, and variable-rate applications handle this much better than putting the same rate over the whole field. For more information on this service, call David Hughes at (573) 682-7194 or Aubrey Martin at (660) 259-2020.

Peter Scharf
ScharfP@missouri.edu
(573) 882-077

Weather Data for the Week Ending June 16, 2009

By Pat Guinan

Station	County	Weekly Temperature (oF)						Monthly Precipitation (in.)		Growing Degree Days‡	
		Avg. Max.	Avg. Min.	Extreme High	Extreme Low	Mean	Departure from long term avg.	June 1 - June 16	Departure from long term avg.	Accumulated Since Apr. 1	Departure from long term avg.
Corning	Atchison	78	61	84	56	69	-3	4.23	+1.53	911	+91
St. Joseph	Buchanan	77	61	82	56	68	-4	3.03	+0.11	860	+22
Brunswick	Carroll	77	62	82	58	69	-3	5.39	+2.36	926	+58
Albany	Gentry	77	61	82	56	68	-4	5.82	+3.11	810	-1
Auxvasse	Audrain	79	62	83	58	70	-3	8.16	+5.57	926	+53
Vandalia	Audrain	80	62	84	56	70	-2	2.70	+0.12	907	+65
Columbia-Bradford	Boone	80	62	84	57	70	-3	5.23	+2.72	*	*
Columbia-Jefferson Farm	Boone	80	62	84	57	70	-3	5.81	+3.30	931	+12
Columbia-South Farms	Boone	79	62	83	58	70	-3	5.97	+3.46	932	+12
Williamsburg	Callaway	79	62	84	58	70	-2	6.60	+3.73	908	+63
Novelty	Knox	76	61	81	56	68	-4	5.08	+2.64	791	-43
Linneus	Linn	76	60	81	56	68	-4	4.18	+1.18	817	+10
Monroe City	Monroe	77	62	82	57	69	-4	2.33	-0.07	864	-5
Versailles	Morgan	81	62	86	59	71	-1	5.54	+3.04	995	+31
Green Ridge	Pettis	80	63	85	60	71	-1	6.24	+2.88	939	+49
Lamar	Barton	83	64	88	62	73	0	5.58	+2.08	994	-8
Cook Station	Crawford	82	62	88	59	71	-1	7.27	+5.04	916	-77
Round Spring	Shannon	84	63	88	60	72	0	5.65	+3.38	927	-3
Mountain Grove	Wright	82	62	86	58	71	0	3.06	+0.75	890	+1
Delta	Cape Girardeau	83	66	87	62	74	-2	2.92	+1.10	1096	-60
Cardwell	Dunklin	88	69	91	67	78	+1	2.69	+0.80	1263	-42
Clarkton	Dunklin	87	68	90	65	76	-1	2.61	+0.60	1195	-82
Glennonville	Dunklin	85	68	89	65	76	-1	2.32	+0.60	1209	-63
Charleston	Mississippi	85	67	89	64	75	0	2.88	+0.90	1168	+27
Portageville-Delta Center	Pemiscot	87	69	90	67	77	0	3.09	+0.94	1265	-17
Portageville-Lee Farm	Pemiscot	86	69	88	67	77	0	2.33	+0.33	1272	+4
Steele	Pemiscot	88	70	92	68	78	+1	5.49	+3.22	1314	+22

* Complete data not available for report

‡Growing degree days are calculated by subtracting a 50 degree (Fahrenheit) base temperature from the average daily temperature. Thus, if the average temperature for the day is 75 degrees, then 25 growing degree days will have been accumulated.

Weather Data provided by ***Pat Guinan***
GuinanP@missouri.edu
(573) 882-5908