

Mid-Atlantic Regional Agronomist Quarterly Newsletter

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To subscribe or unsubscribe, please send your request to the editor at <u>rtaylor@udel.edu</u> Comments, suggestions, and articles will be much appreciated and should be submitted at your earliest convenience or at least two weeks before the following dates: February 28, May 30, August 30, and November 30. The editor would like to acknowledge the kindness of Mr. Todd White who has granted us permission to use his scenic photographs seen on the front cover page. Please go to <u>www.scenicbuckscounty.com</u> to view more photographs.

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A Summary of a Series of Irrigation Sessions Presented in Rockingham County, Virginia

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Cooperative Extension, Rockingham County, held a series of irrigation sessions recently. Dr. Ron Heiniger, NCSU presented. Following is a link to his presentations (Irrigation Part 1— Principles and Irrigation Part 2—Scheduling), a link to a presentation by James Adkins, UD (Irrigation 101), and a collection of other papers related to irrigation in Virginia and the mid-Atlantic: <u>http://offices.ext.vt.edu/rockingham/programs/anr/Crops/irrigation.html</u>

During the series of irrigation sessions, Dr. Heiniger made some key points that are presented below. Dr. Heiniger's paper "Sensors and Monitors for Measuring Soil Moisture" is highly recommended, as an overview of the tools that are available. Again, the paper is available from the link provided above.

To sum up the soil moisture sensing info, the options are:

• Tensiometers - \$100 - \$120. Available at Gempler's and others.

• Electrical resistance/gypsum blocks - \$300 + . These allow you to log data electronically and/or wirelessly direct to a phone or computer. Dr. Heiniger recommended this route. A complete weather station can be purchased, set up and broadcast on the internet or at least to your house or phone. Extension is in the process of setting up similar stations in Augusta and Rockingham Counties. Here is one example (soil moisture sensors not yet installed): www.weatherlink.com/user/vcerockingham1

Also available at Gempler's and others.

• TDR Probes - \$2,000-\$3,000 + . These sensors allow readings at multiple depths on the same device, which can be easily moved around for monitoring, and broadcast wirelessly. Available from Dynamax (www.dynamax.com).

Irrigation Key Points from Ron Heiniger Presentations

- 1. Utilize a check book, to maintain adequate soil moisture; **the rate of rainfall** + **irrigation must meet or exceed evapotranspiration** (evaporation from the soil surface + transpiration from leaves) to avoid crop stress.
- 2. Do not monitor upper soil depth; top inch is very dynamic. **Monitor fifteen inches or deeper** (depending on rooting depth). See enclosure for soil moisture monitoring information.
- 3. We must know our soil type and depth to know soil water holding capacity. Soil type, along with water holding capacity, is listed in the soil survey.

- 4. As we increase plant population, water demand also increases (0.05"/day for every increase of 5,000 plants/acre.)
- 5. Corn uses very little water until around V6 (6 leaves and leaf collars visible), when water use increases dramatically.
- 6. The number one problem with irrigation systems is that we are not leading in, or providing water ahead of peak demand. We must have adequate soil water *before* V10-V12 (10-12 leaves & leaf collars visible).
- 7. Corn planted at 30,000 plants/acre will use up to 0.35" per day at peak need. This **peak need occurs the week before through the week after tasselling.**
- 8. The most *critical time* that water is needed are days 5, 6 & 7 after R1 (silk emergence).
- 9. The second most critical time is R2 (blister) R6 (black layer)-plants use 0.1 0.25" of water/day.
- 10. A very rough fertigation program is described below. Studies have shown that irrigation water through traveling guns and even pivots is applied non-uniformly, therefore fertigation may not be uniform.
 - i. 50 # at planting (via starter band and/or manure)
 - ii. 50 # at V6 sidedress via fertigation, sprayer/spreader or could be eliminated with past organic source (manure or legumes) (V6: 6 leaves AND leaf collars visible)
 - iii. 30 # at V10 through fertigation (V10: 10 leaves AND leaf collars visible)
 - iv. 30 # 1 week before tassel (about V15: 15 leaves AND leaf collars visible)
 - v. 50 # at tassel (VT)

Total N Application: 210 Pounds total (based on 210 bushels per acre)



V6 corn plant. The first six leaves are fully emerged, evident by their exposed leaf collars. Count only these leaves with exposed collars for growth staging.

Inset photo shows only leaves with exposed collars. Photos courtesy Mississippi State Extension and Corn, Beans, Pigs and Kids blog.

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Impact of Flooded and Saturated Soil Conditions on Field Crops

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Across the state, most areas have been experiencing an intense period of very high rainfall with another line of storms moving through New Castle County as I write this article. We've had a number of growers asking about the possible impact of the heavy rain and saturated soil conditions on their crops.

Let's take a look at the corn crop first. Roaming the state yesterday, I saw corn that ranged from just a few leaves and less than six inches tall to corn as much as chest high. Young corn which is less than stage V6 (six fully visible leaf collars) is most susceptible to submergence injury as well as to the numerous diseases such as seedling blight, common smut, and crazy top that become greater risks during periods of flooding.

Dr. Bob Nielsen at Purdue University has written a comprehensive review of the effects of flooding on young corn and the document is available at the following web address: www.agry.purdue.edu/ext/corn/news/timeless/pondingyoungcorn.html. According to Dr. Nielsen, young corn can tolerate flooding up to about 4 days, with greater survivability when temperatures are cool. When temperatures are above the mid-60's F, corn tolerance decreases to less than 2 days of submergence. Usually within a few days to a week, you can cut open plants and gain an idea of whether they are still alive or not. One of the major reasons for stand loss is the depletion of soil oxygen levels which can fall to negligible after 48 hours of flooding. Sustained submergence leads to considerable stand loss, leaving growers to consider their options for replanting. Unfortunately, replanting this late in the growing season often will not be profitable to growers and alternatives should be considered.

Another factor that can affect corn that survives is the loss of soil nitrogen (N). Between emergence and the V6 growth stage about 5% of the N that the crop takes up will be obtained by the corn plant but from V8 to silking as much as 60% of the crop's N will have been taken up and stored. Flooding can lead to denitrification which is the loss of the nitrate form of N from the soil as the anaerobic soil bacteria use that compound as an electron acceptor to metabolize energy and grow. These bacteria are active primarily when soil oxygen levels are very low, there's organic matter available to the bacteria, and nitrate-N is present in the soil. The bacteria convert the nitrate to nitrogen gas (N₂), nitrous oxide (N₂O), or nitric oxide (NO) all of which are gases and are easily and quickly lost from the soil to the atmosphere. Where manure has been applied, there could be enough mineralization to supply the crop's N needs later in the summer; but where commercial fertilizer has been applied and enough time has passed for that N to be converted to the nitrate form, soil N levels might not be adequate to carry corn through the growing season. Areas of corn that survived saturated soil conditions should be watched carefully over the next couple of weeks for typical N deficiency symptoms (yellowing of the lower or older leaves usually forming an inverted V shape on the leaf). Photo 1 shows an example of the inverted V-shape and the yellow to orange color characteristically seen.



Photo 1 showing the inverted-V shaped symptom of N deficiency on field corn. The point of the V is nearest the corn stalk and the symptom can range from a pale yellow to almost orange but as the color depends the center of the leaf begins to die or turn necrotic. (Photo by R. Taylor).

While observing the corn in the northern part of Delaware and southern New Jersey, the impact of denitrification is readily visible (Photo 2). Many fields are showing typical N chlorosis symptoms indicating that most if not all of the soil available N has been loss. In some cases, the economic loss of N was minimal as the growers applied only small amounts of N as starter. However in some cases the amount of N was much greater and was applied to allow greater flexibility in the timing of sidedress N. In other cases not only was commercial fertilizer as urea ammonium nitrate solution (UAN) applied but past efforts at building soil organic matter had been expected to add to the timing buffer. The unusual weather pattern of 2013, cold followed by cold and wet, followed by dry and hot, and then this last period of moderate temperatures and heavy rainfall, lead to slow mineralization but complete denitrification of any soil N that had been mineralized and nitrified. The difficulty now will be getting on these wet fields with sidedress N before too much damage is done to the yield potential of the corn crop.



Photo 2 showing the impact of denitrification on corn in Delaware. This corn field received 50 lbs N/acre and in addition has a soil organic matter content of greater than 4%. Normal expectations are that the crop would be a deep green color by this time of year and require minimal sidedressed N application. (Photo by R. Taylor).

If you do find you need to replace some of the N lost by denitrification, remember to have your nutrient management consultant make adjustments to your nutrient management plan and write out the justification for the additional N fertilizer. Also take note that the use of a manure source does not mean that the same situation will not occur in fields fertilized with manure. If the mineralization process is about completed, the manure's organic N could have been completely converted to nitrate N and lost via denitrification. Consult your nutrient management consultant or Extension county ag agent for more information.

Other field crops that are at risk are soybeans and small grains. In some areas, small grains have lodged from the heavy rainfall and high winds. I've seen this especially in New Castle County and this will slow harvest when the crop and fields dry out enough to permit us to proceed with the small grain harvest. A major risk with winter wheat for some of the fields I've observed is that the crop is so flattened that many plants will be unable to properly photosynthesize and this will reduce the yield potential in these fields. Many seed heads are showing damage from either frost or scab already, so shading and the problem of picking up the crop during combining will add to the yield reduction we can expect.

Soybeans can be injured by flooding conditions or by prolonged saturated soil conditions although they can survive underwater for a week or more under ideal conditions. When I worked in Louisiana, Dr. Jim Griffin and I conducted tests to see how long soybeans could be flooded without impacting yield potential. We noted a number of factors that affected how well a soybean crop tolerated flooding. The most important factors that determine the fate of flooded soybean fields were: 1) duration of the flooding, 2) temperature during the flood, 3) rate of

drying after the flooding event, and 4) growth stage of the crop during the flood. Other researchers have found these same factors are important in determining whether yield losses occur.

From our research and that of others, we can generally state that yield losses are seldom noted in fields flooded for 48 hours or less. Four days or more of flooding stresses the crop, delays growth, causes the loss of some N fixing nodules, and causes the plants to be shorter with fewer nodes. Flooding for 6 days or more can depress yields significantly, while flooding for a week or more may result in significant (or entire) losses of stand. One paper that I read about was by Scott et al. 1989 and these researchers found that losses on heavy soils (clay soils) that were flooded were 1.8 bushels per acre per day when soybean plants were at the V4 growth stage but for a silt loam soil this loss was only 0.8 bushels per acre per day. Losses when the soybean crop was at the reproductive stage were considerably higher for both soil types.

As a final note to this article, I would like to encourage anyone who feels that they need to put equipment on either planted fields or fields that have yet to be planted to think about the potential for damage to these fields. Just yesterday as we drove by one unplanted field, I made a comment how it was foolish to be out planting soybeans in the field with as wet as the soil was. An hour later as we drove back to town past the same field, my statement proved to be prophetic as the tractor and planter were mired in mud down to the axils and unlikely to be rescued until the field dries out. Please keep in mind your basic agronomy principles that say that soil should not be worked and cannot adequately support equipment when it's too wet, especially when the moisture content is above field capacity.

Denitrification and Corn Fertilizer Programs

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As a follow-up article to my article above, I thought I should review what I'm seeing a lot of in northern Delaware and southern New Jersey.

When you look at many of the fields of corn in the northern part of Delaware and southern New Jersey, the impact of denitrification is readily visible (Photo 1-6). Many fields are showing typical N chlorosis symptoms that indicate that most if not all of the soil available nitrate-N has been loss as N_2 , NO or N_2O gas. In some cases, the economic loss of N was minimal as the growers applied only small amounts of N as starter. However in other cases the amount of applied N was much greater and done to allow greater flexibility in the timing of sidedress N. In other cases, not only was commercial fertilizer as urea ammonium nitrate solution (UAN) applied but past efforts at building soil organic matter had been expected to add to the timing buffer via the effect of soil organic matter mineralization. In still other cases where growers were successful in planting corn early, sidedressed N application could have taken place before the last period of heavy rain.



Photos by R. Taylor).

The unusual weather pattern of 2013, cold followed by cold and wet, followed by dry and hot, and then this last period of moderate temperatures and heavy rainfall, led to slow mineralization of soil organic matter but complete denitrification of any soil N that had been mineralized and nitrified. In addition in those fields that had been sidedressed with UAN early, a substantial portion of the urea and ammonium that had been nitrified to nitrate-N could have been loss to denitrification. The difficulty now will be getting on these wet fields with either sidedress N or additional N before the lack of N lowers the corn's yield potential.

At this point in the growing season, we all probably wish for a crystal ball to tell us how much N remains in the soil, what the weather will be like for the rest of the growing season, how best to get N on our crops, and a host of other questions. Unfortunately, that type of crystal ball just doesn't exist and the answers will likely vary from field to field. Each grower or consultant will need to evaluate the individual fields and try to make the best guess possible as to what needs to be done to produce the maximum economic return from each field. As a guide, you should keep in mind that N is a mobile element. What this means is that the plant will cannibalize the N from the older, lower leaves first and send that to either the growing point or later after silking and pollination to the grain that is being filled. The severity of N deficiency can to some degree be estimate by how many corn leaves on a plant are showing N deficiency symptoms. The more leaves affected the greater the severity.

Another question often asked is how much of the required N is taken up by the crop by a particular growth stage. An Iowa State Extension Special Report No. 48, "How a Corn Plant Develops", by Ritchie, Hanway, and Benson indicates that by tassel emergence to silking about 60 to 70% of the uptake of N has occurred with two thirds of the 60% taking place between V10/V12 and tassel emergence (R1). For potassium (K), about 90% of K uptake is completed by R1 with almost all of that occurring between V6 and R1. Phosphorus, on the other hand, has a steady and almost linear uptake that is not complete until after R5 (dent stage).

Again from a nutrient management viewpoint, you need to consult with you nutrient management plan writer to be sure your plan is modified for this year's unusual weather. In addition to the proposed changes in your N management plan, be sure your plan writer includes the justification for the additional N you may need to apply to corn this year.

After the Flood: How much damage? What to Do?

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During the week ending on June 9, some parts of Virginia received 6 to 10 inches of rainfall (see map to the side). Plus, more may be on the way.

This heavy rainfall has resulted in saturated soils and in some cases, flooding. The field below is a Soybean Research Verification Field in Dinwiddie County that I've been scouting. The photo was taken after a hard rain on Friday, June 7. It's difficult to know the long-term effect of flooding on soybean fields. Research is limited, but we do know that the fate of flooded fields will largely depend on 1) the development stage during which the flood took place; 2) the duration of the flood; 3) the temperature during and right after the flood; and 4) the drying rate after the flood.

Basically a flooded field depletes the roots of oxygen (O_2) , causing photosynthesis to slow. After several days without O_2 , the plant may turn yellow, grown very slowly, and



possibly die. Other indirect effects of flooding can include reduced nitrogen-fixing bacteria (but they will recover), nutrient imbalances, and increased disease pressure.

Effects on Germination & Emergence

The most damaging effects of flooding on un-emerged soybean occur when the duration of the flood is greater than 24 hours and/or when the soil temperature is low. In controlled research conducted during the late 1990's, researchers examined the effect of flood duration, soil temperature, and time after seed imbibition that the flood occurred. They found that saturated conditions decreased germination by 15 to 43 percentage points when averaged over temperatures of 59° or 77° F (germination was 62% in the non-flooded control, averaged over temperature treatments). When flooding lasted only 1 to 12 hours, germination was only decreased by an average of 15 percentage points, regardless of when the seed began imbibing water. Even after 48 hours of saturated conditions, germination was only reduced by 20 percentage points if the flooding occurred one day after the seed imbibed water. But, if the flooding occurred 2 or 3 days after the seed imbibed water, then the germination was lowered 33 or 43 percentage points, respectively. Therefore, the farther along the seed was in the germination process, the more susceptible they were to flood damage. Lower temperatures during the germination process increased the damage. At 59°F, germination was lowered by 21 to 25 percentage points, regardless of the duration of the flood. But at 77^oF, germination was only lowered by this amount if the flood lasted 48 hours. The researchers suggested that damage to the seed under brief flooding was primarily physical (e.g., seed membrane damage), but damage with longer flood duration was physiological (e.g., ethanol toxicity, O₂ deprivation, CO₂ build up).

Flooding can also result in soil crusting. This will be worse in tilled fields that are low in organic matter and surface residue. Unless the crust is broken with a rotary hoe or similar implement, the emerging seedling, already stressed by the flood, will have an even more difficult time emerging and growing.

There is also an increased chance of seedling disease, but this is less of a problem at this time of the year with warm soil temperatures. Poor stands will be the biggest issue. To determine whether or not re-planting will be beneficial, refer to Virginia Soybean Update Vol. 13, No. 3 (June 2012).

Flooding after Emergence

Soybean can generally tolerate up to 2 days of flooding. But if the saturated soil conditions persist for more than 2 days, significant yield reductions may occur. The amount of yield reduction will vary with development stage, duration of the flood, the type of flood (stream overflow vs. low land depressional), temperature during the flood, the drying rate after the flood, and the overall environmental conditions after the flood.

In general, the following comments can be made. Flooding in the reproductive stages causes more damage than in the vegetative stages. Yield is reduced more with longer flooding duration and with a slower drying rate of the field (e.g., a well-drained sandy soil will recover faster than a poorly-drained or heavier textured soil). Higher temperatures after the flood will lead to greater yield losses. This is because the recovering plant will deplete its stored energy at a faster rate. In addition, high soil temperatures will result in greater microbial respiration, which lead to greater depletion of oxygen. The best conditions for a recovering soybean crop are cool, cloudy days and cool, clear nights.

In a Arkansas study conducted on two poorly drained soils with slow permeability (Sharkey clay and Crowley silt loam), researchers found that yield decreased by 1.8 and 2.3 bushels per acre per day of flooding on the Sharkey clay when soybean were flooded from 2 to 14 days at the V4 stage (4 trifoliate leaves on the main stem) and R2 (full flower) stages, respectively. On the Crowley silt loam soil, yield was reduced 0.8 and 1.5 bushels per day of flooding at V4 and R2, respectively. It's worth noting that this research did not have an un-flooded control treatment; therefore, the 2-day period of flooding was considered the control. This research clearly showed that duration of the flood greatly impacts yield. In addition, flooding during reproductive stages caused more yield loss that if the flooding occurred at vegetative stage. Eight varieties were tested, but variety did not affect the flooding response. Other researchers have however indicated that certain varieties exhibit greater flooding tolerance.

Another study in Louisiana evaluated 7 days of waterlogging on V2, V3, V7, R1, R3, R5, R6, and R6.3 stage soybean under greenhouse conditions. The V stages represent the number of trifoliate leaves on the main stem and the R stages represent beginning flower, beginning pod, beginning seed, full seed, and the temporal midpoint of seed filing. In summary, the early vegetative stage (V2) and the early reproductive stages (R1, R3, and R5) were most sensitive to waterlogging.

Although some research has been conducted, estimating the yield loss due to flooding is nearly impossible because we don't know what the conditions will be like afterwards. The best gauge may be ones past experience with fields that have flooded.



Fortunately, some of these experiences have been documented. An example is research conducted in Ohio in 1998, where researchers monitored several fields that flooded during that year. They reported a 20% reduction in soybean yield in one field and a complete loss in another field that was flooded for 3 days during the V2-V3 stage. The field with the complete loss was due to thick sediment coating the plants and not allowing any recovery. However, flooding for 3 days in two other fields caused no yield loss and

flooding actually increased yield in a fifth field. In the field where yield was increased, sediments covered the plants but a light rain soon after the flooding washed the sediment off. In addition, greater residual soil moisture associated with the flooded area when a late-season drought occurred was probably responsible for the greater yield. After 6 days of flooding, yield losses ranged from 0% at two sites to about 60% at a third site and over 90% at another site. At one of the sites with no yield loss, the subsoil had a high sand content, which enable the root zone to quickly return to aerated conditions.

In another study, researchers found that flood irrigation for greater than 2 days reduced soybean yield by 20% as compared to a 1-day flood treatment.

What to Do After the Flood

While it may seem that there is little to do to help a flooded crop, it is very important that we minimize any other stress on the crop that can prevent recovery. First, try to stay off of the field. Wet fields compact easily. Compaction will further stress the crop and slow its recovery. Make sure that the field is dry enough before taking equipment back on it.

Evaluate the stand. If a stand reduction occurred, determine if it's worthwhile to replant. Remember that after mid-June, every day delay in planting will cost you about ½ of a bushel in yield. The plants that remain are still higher yielding than seed that can now be planted, even if the stand has been substantially reduced.

Stress such as herbicide injury can slow the crop down further. Still, weeds need controlling. But you may want to select herbicides (usually as tank-mix partners to glyphosate) that don't cause a significant amount of burning.

Cultivation is an option to conventionally tilled fields to help aerate the soil. However, cultivating a wet soil can do more damage than good by causing additional compaction, which in turn would further stress the crop.

You may also want to dig a few roots and inspect for adequate nodulation. Make sure the nodules are pink. I see little that can be done, but knowing that the nodules are still working may

give you peace of mind. And while you're doing that, split some stems and roots to check for any disease. If suspected, send in to one of our Plant Disease Clinics to be further evaluated.

Finally, some will want to apply some type of foliar fertilizer to the crop to "kick-start" it back to health. But, I see little advantage of this. Remember that the real problem is lack of O_2 to the roots and CO_2 buildup in the soil; only after the roots begin to receive O_2 will the recovery process start.

Hopefully you haven't experienced severe flooding (> 24 hours). But if so, be patient and evaluate the field. Then make good decisions on how to handle it.

It's Time to Increase Seeding Rates

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Soybean yield potential declines with delayed planting date. During the first two weeks of June, this decline is barely noticeable. After mid-June, expect yield to decline about $\frac{1}{2}$ bushel per acre per day.

Soybean planted after mid-June will not always develop enough leaf area to capture 90-95% of the available sunlight by early pod development (R3). Only if four layers of leaves are formed by this time will yield not be affected. Of course the growing season makes a difference. Last year in many parts of Virginia, even the latest-planted soybean were able to produce enough leaf area. But, on average, June- or July-planted soybean are unable to do so. Therefore it's important to take actions to minimize this decline.

First, plant as soon as possible. With the recent rains, soil moisture should not be a problem. Even if the soil is dry on top, I suggest to go ahead and plant. You may have to plant a little deeper to hit moisture (don't plant much deeper than 1.5 inches), but planting depth is not as big of an issue with double-cropped as with full-season soybean.

Second, narrow your row spacing. Narrow rows will produce more leaf area and canopy over faster.

Finally, increase your seeding rates gradually as time goes on. I'm suggesting the following plant populations in 2013:

- June 2-8 120,000 plants/acre
- June 9-15 140,000 plants/acre
- June 16-21 160,000 plants/acre
- June 23-29 180,000 plants/acre
- June 30-July 5 200,000 plants/acre
- After July 5 220,000 plants/acre

See the seeding rate chart below to determine the seeds per foot of row needed to obtain a certain number of plants per acre. Note that these seeding rates assume 80% emergence. For different emergence assumptions, divide your desired plant population by the percent emergence that you expect.

In addition to planting date, I've found that more productive soils will tolerate lower seeding rates, and less productive soils need higher seeding rates; a more productive soil will produce more leaf area than a less productive soil over the same time period.

Table 1. Soybean seeding rates based on 80% emergence at various row spacings to achieve the desired plant population depending on planting date.

	<u> </u>		Ŭ					
Row	Early	-June Planting	Date	Late-June/Early July Planting Dat				
Width	120,000	140,000	160,000	180,000 200,000		220,000		
(Seed per foot of row assuming 80% emergence)								
20	5.7	6.7	7.7	8.6	9.6	10.5		
18	5.2	6.0	6.9	7.7	8.6	9.5		
15	4.3	5.0	5.7	6.5	7.2	7.9		
10	2.9	3.3	3.8	4.3	4.8	5.3		
7.5	2.2	2.5	2.9	3.2	3.6	3.9		
As planting is delayed increase the seeding rate								

As planting is delayed, increase the seeding rate.

Use lower seeding rates on more productive soils.

Calculation: Desired Plant Pop. \div (43,560 sq. ft./acre \div row width in feet) \div % emergence Example: = 180,000 \div (43,560 \div (15 \div 12)) \div 0.80 = 6.5 seed per foot of row

Kudzu Bugs Now Found Infesting Soybean Fields in Virginia

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The kudzu bug situation has very quickly become a real problem for Virginia soybean producers. We are getting reports of infestations in the South Boston area and one from near Yale in Sussex County. I am quite sure that there are more infested fields. The image sent to me from the Yale field showed at least a dozen KB adults on a single plant. WHAT IS THE THRESHOLD and WHEN SHOULD YOU TREAT??? The treatment threshold for full grown R-stage plants has not changed (see below), but I have new information on thresholds for seedling/vegetative stage plants. Based on an experiment in GA, they (and others) are recommending treating at V2-V3 stage at an average of 5 bugs (adults and/or nymphs) per plant.



The threshold increases to 10 bugs per plant for plants from 1-2 feet tall. The established threshold of one nymph per sweep (one swoosh of the net) should be used for plants above 2 feet tall. Plants should be sampled at least 50 feet from the edge of the field. The reason for this is that the adults have an extended migration period (6-8 weeks) and colonize field edges first. If you sample the edges, chances are you will make a spray decision too soon before the migration is over. They stress that these thresholds are PRELIMINARY and will absolutely change as we get more information.



Here is a cautionary tale provided by Dr. Reisig at NCSU. A NC grower noticed kudzu bugs on the edge of his April-planted beans in May 2012. They had not yet infested the interior portions of the field. He opted to spray. He then had to spray again in June, as the adults remigrated into the field. Additionally, sprays don't kill eggs, so these hatched into nymphs. The grower then had to spray a 3rd time in June, as spider mites were flared in the field from the lack of beneficial insects. We want to avoid these costly situations while still preserving our yield.

The article above is one that I released in the weekly Virginia Ag Pest Advisory on May 30. I suggest that you keep up with our weekly updates as the insect pest situation is rapidly changing. You can keep up with soybean and other crop pest management issues on the Virginia Ag Pest Advisory web page: <u>http://www.sripmc.org/Virginia/</u>. For additional information, I suggest the following website: <u>http://www.kudzubug.org/</u>. On this website, you can see a distribution map, identification and control information, images, and videos. The photos in this article are taken from that website.

Pasture Associated Laminitis: Be Aware of the Risks

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Introduction: What is Laminitis?

Laminitis is an important health concern, especially during spring months when horses are given access to or are turned out on pasture. Laminitis is an inflammation of the laminae in the hooves, which is the tissue connecting the coffin bone with the hoof wall. When the laminae become inflamed, depending on the severity of the case, the coffin bone can rotate downwards. Complete downward rotation of the coffin bone is known as "founder." Even if the case of laminitis is not so severe as to cause rotation of the coffin bone, it may lead to lameness and other hoof health issues. Signs of laminitis in horses include, but are not limited to, a bounding digital pulse, "treading" where the horse is constantly shifting its weight between the left and right front foot, and reluctance to move especially on turns.

Pasture associated laminitis can be prevented by implementing pasture management strategies and the condition, if caught early, is somewhat treatable. Unfortunately, once a horse has had severe inflammation of the laminae, the damage is never completely reversed and that horse will be more likely to develop the disease in the future.



Figure 1. Source: http://www.thehorse.com/images/content/hoof_anatomy.html

What Causes Pasture Associated Laminitis?

When horses consume excessive amounts of sugars and starch, these carbohydrates pass though the small intestine (where they are normally digested with the help of enzymes) and spill over into the hindgut where they are rapidly fermented. Horses do not possess enzymes capable of breaking down fructans so they pass through to the hindgut where they are also rapidly fermented by resident microflora. Rapid fermentation of carbohydrates in the hindgut results in the proliferation of lactic acid producing amylolytic and saccharolytic bacteria. This may result in reduced hindgut pH, which in addition to hindgut acidosis, may lead to a cascade of events culminating in compromised blood flow (and thereby reduced nutrient supply) to the foot resulting in laminitis.

Laminitis is also associated with insulin resistance in equines, whereby the uptake of circulating glucose by tissue cells normally potentiated *via* insulin is reduced, leading to impoverished glucose supply to cells (or its metabolism within them), including those of the foot. Insulin resistance is often seen in very fat horses and ponies, and may be exacerbated by high intakes of sugars and or starch. While research has shown both digestive and metabolic forms of laminitis, the exact nutritional and physiological mechanisms are not completely understood. In either case, there is a clear link between the high levels of sugars in spring grasses and the resulting laminitis.

Management Solutions

The following are a few management tips that may help reduce the risk of pasture laminitis in horses.

- 1. When the time comes to reintroduce horses to pasture in the spring, do so gradually. By turning a horse out for small increments of time (15-30 minutes at first) and gradually working them up to full day turn out, they will be able to acclimate to the change in nutrients and will be less likely to experience grass founder.
- 2. If a horse is pre-disposed to laminitis (from previous occurrences or equine metabolic disease), then it may be a good idea to turn them out in the early morning or at night, especially during the spring months. One study found that sugar content is highest in the

grass in the early evening and that it decreases to its lowest point in the early morning. This pattern was most prominent in April when compared to data from other months.³

- 3. Be sure to graze grass that is at an appropriate height. Overgrazing can result in horses eating the re-growth of the pasture. The new growth of grass usually has higher sugar content. On the other hand, if the grass stand in a pasture is overgrown or too mature, a horse may consume seed heads, which can also have high sugar levels.
- 4. Graze a horse with a muzzle on in order to reduce the amount of grass it is able to eat while allowing for exercise.
- 5. Hot, dry summer weather often causes cool-season grass pastures to slow growth and enter a period of dormancy. For example, Kentucky bluegrass almost always goes dormant sometime in the summer but when cooler and often wetter weather occurs in the early fall, cool-season grasses begin growth again. The increase in sugar and starch content of the pasture during fall regrowth will put susceptible horses at greater risk for pasture-based laminitis.

If a horse is pre-disposed to laminitis, for instance due to genetics (breed) or obesity, there are further steps that may need to be taken in order to reduce the possibility that the horse will experience laminitis. A webinar by Dr. Bridgett McIntosh, available through My Horse University, has several tips on managing a horse that may be more likely to develop laminitis.³

Conclusions

Pasture associated laminitis can be a serious problem and it is more commonly seen when pastures are lush and horses are transitioning back to grazing pasture after being inside or housed in a sacrifice lot and maintained primarily on hay. Some horses are especially sensitive to the sugar levels in lush pastures while others may not have a problem making the transition. It is important for owners to be aware of the management strategies that may help prevent laminitis, and to consult with their veterinarian concerning diagnosis and treatment of laminitis.

Article reviewed by: Bridgett McIntosh, Assistant Professor and Horse Extension Specialist, University of Tennessee

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Good Hay Storage is a Key Component in the Economics of Extending the Grazing Season

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A key component to extending the grazing season is having a good hay storage system. It may seem backwards to discuss hay storage when the goal is to extend the grazing season. However, here is a scenario that I often see: For example, a farmer who normally feeds hay from December 15 through April 15 (let's estimate 121 bales for 121 days) makes the decision to try to extend their grazing season using stockpiled fescue. He fertilizes all his fescue fields in early August and he experiences abundant fall rain. He strip grazes the stockpiled fescue to get maximum utilization. By the end of the winter he only needed to feed hay for 50 days (which means he has 71 bales remaining that he can carry over until the next year). The problem is that this farmer has all his hay stored on the ground with no cover. This surplus hay will likely continue to deteriorate until the next winter.

Likely the most difficult thing to estimate is the dry matter and quality losses from different storage systems. The table shown below contains data of storage losses from a few different storage systems.

Table 2. Dry matter and digestibility losses in large round hay bales during various storage methods over a sevenmonth period.

Dry Matter Loss (%)									
Study	Ground Stored	Elevated on Pallets	Elevated on Pallets and Covered with a Tarp	Covered with a Tarp Only	Barn Stored				
Ely (1984)	65	38	14	_	4				
Collins et al. (1987)	50	32	14	_	4				
Hoveland et al. (1997)	30	—	—	10	0				

From: Extension Publication 442-760. Planning for a Farm Storage Building. S. Gay and R. Grisso. http://pubs.ext.vt.edu/442/442-760/442-760 pdf.pdf.

Let's go back to our farm scenario above. This farmer has 71 bales of hay sitting on their farm in April that will likely continue deteriorating for an additional eight months (April to December) prior to feeding. Based on data from the table above he will have likely lost at least half of this hay to decomposition. On the other hand, if these 70 bales were preserved in a good storage system (such as a barn) the farmer would realize some new management options:

- Bale less hay the following summer (which should reduce grazing pressure on some fields).
- Bale the same amount of hay but sell some surplus hay.
- Bale the same amount of hay but be better prepared for a drought.
- Apply less fertilizer to reduce input costs.
- Purchase less hay the following year.

The University of Wisconsin has a "Hay Storage Calculator" (the link is shown below) to estimate the cost of using different storage systems. This calculator compares six different storage scenarios. The user can easily adjust estimated dry matter losses, storage time, labor requirements, building costs, etc. Feel free to try out this calculator or email us and we can put together some estimates together.

Calculator link http://www.uwex.edu/ces/crops/uwforage/storage.htm

Pasture and Hay Fertilization before Summer's Heat

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Although the weather this spring has not been kind to our state's hay producers and has even been limiting to a degree for those pasturing animals due to the colder than normal and often wetter than average spring, it is time to consider your forage's need for early summer fertilizer. For the hay producers, this will need to wait until the first or second, for those lucky few who managed to cut hay before the wet June weather began, hay crop is removed. For those that did manage to cut hay in mid- to late-spring and now have plenty of moisture in both the top and subsoil, an early summer fertilizer application should be next on your agenda.

Let's start with the product that will almost always give you the biggest bang (profit) for the dollars you spend on it. That is agricultural limestone when used to adjust your pH to the ideal range for the forage crop that you are growing. Many producers add lime either in the fall or very early spring but if you haven't applied needed lime yet, now is an excellent time to have it applied.

How do you know if your pasture or hay field needs lime? The answer as most growers know is to soil test but do you know what depth the sample should be taken? I think many growers especially if they also grow field crops automatically go with the traditional 0-6 or 0-8 inch soil sample. The problem with this type of soil sample is that applied lime only moves downward neutralizing soil acidity at about 1 inch per year. Assuming that you apply enough lime to neutralize the acidity in the top 8 inches of soil and that no additional soil acidity is generated during the interval between application and complete neutralization, the change in pH in the 0-8 inch layer will take about 8 years to occur. Obviously, this long interval would not maximize your economic return from a lime application. Most pasture fertility experts suggest that you use a 0-4 or even a 0-2 inch soil sample to more efficiently and economically manage the soil pH in your pasture and hay fields. The 0-4 inch sample is the best choice for using the soil test to determine both soil liming needs and phosphorus (P) and potassium (K) needs (Photo 1).

Why is soil pH so critical? If you have legumes in the pasture or are using a mixed grass and legume as a hay crop, the legume plant requires a higher pH than does the grass crop to produce the best yields. Legumes are useful in that they fix nitrogen (N) from the atmosphere and share this N with the surrounding grass plants. That reduces your need to spend money to buy N fertilizer. Another aspect of soil pH is its impact on soil nutrient availability, especially P but really for all nutrients. When the pH is in the optimum range for your soil type, the availability of all nutrients and especially P will be improved and can reduce the need for added fertilizer. In addition, the ability/quantity of the soil to hold cations (cation exchange capacity) which includes calcium, magnesium, K, the micronutrients, and ammonium increases. Low soil pH (highly acid conditions) especially on light or sandy soil can increase the leaching loss of K from the soil rooting zone and this can significantly increase the need for K fertilization. With today's price for K fertilizer, any loss of K can affect your profitability negatively.



Photo 1. This photo shows the correct sampling depth (0-4 inches) for pasture and hay fields as well as for turfgrass and other non-tillable areas. Note the use of duct tape to mark the four inch

mark on the soil probe. This greatly enhances your ability to take the soil sample at a consistent known depth.

After pH, the next important fertilizer addition will be K and P. Potassium has a tremendous impact on forages by helping them tolerate the heat and possibly drought stress associated with summer weather. Potassium also helps plants tolerate stress associated with insects and diseases. We usually recommend that half of the needed K be put out in late May to mid-June and the other half applied in late August or early September. The second application helps plants with the stresses experienced during the winter months from cold temperatures and wet soils. Phosphorus can all go out in the late spring application and will help with root development as well as with energy transfers within the plant as the sun's energy is captured by the leaves and converted into glucose and then into plant components such as cellulose and hemicellulose. Both P and K should be applied based on your soil test results and recommendations from the same 0-4 inch deep soil sample.

Finally, let's consider N. If it's a pasture or hay field and the legume component is more than 25% of the forage present, you possibly do not need any additional N fertilizer although yield, especially the grass component, will be increased with a small addition of N. To prevent the legume-bacteria association from reducing its fixation of N, you should limit fertilizer N application to no more than 30 lbs N/acre at any given application. If a drought seems imminent or has begun, it will be best to postpone fertilizer N applications to pasture or hay fields until after the soil is rewetted by rainfall (or irrigation, if available).

For grass hay producers, fertilizer N application will increase your yield potential as long as soil moisture levels remain adequate for vigorous grass growth. Nitrogen applications should be based on the expected yield potential of your next harvest so review your records to see what your field has for hay potential. Dr. Marvin Hall from The Pennsylvania State University found in his research that from 40 to 60 lbs N/acre are needed for each ton of expected hay production. The one caution that should be taken into account is that if dry weather occurs the higher rate of N can lead to nitrate accumulation in the grass hay crop so if you expect soil moisture to be limiting before the next hay harvest use the lower rate of N per acre per ton of expected production.

Optimizing Pasture for Horses

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Horses evolved as grazing animals that are well adapted to foraging. Many owners today rely heavily on supplementing the horse's diet with grain and hay, but good quality pasture can meet the nutritional requirements of the mature horse at a more affordable price. Pastures cost approximately one-third the price of hay, thus it is beneficial to optimize pasture productivity and use (Sheaffer et al., 2009). Improving the productivity of your pasture offers several benefits. First and foremost, you can reduce the amount of hay and grain that is purchased to meet the energy and protein needs of your horse. From an environmental standpoint, proper pasture management reduces soil erosion and waste runoff. Well-managed pastures provide room for exercise and help control parasites improving horse welfare. In this article, we will focus on the nutritional value of pasture for horses, estimating pasture intake for the horse, and keys to establishing a good pasture management system.

Meeting the digestive and nutritional needs through grazing

A mature horse (24 months and older) will consume about 2 to 2 ½ percent of its body weight in feed on a dry-matter basis per day. Dry matter (DM) is the portion of hay, pasture, or feed left when all water is removed. Therefore, a 1,000 pound mature horse should consume approximately 20 to 25 pounds (90 percent dry matter) of feed daily. The horse's digestive system requires roughage to function properly, so at least half of a horse's daily intake should come from forages as either pasture or hay. Mature horses can, in fact, thrive on forage-only diets. Growing, breeding or working horses require supplemental feed to meet their additional nutrient requirements. Pasture can provide the horse's digestible energy (DE), crude protein (CP), and vitamin A and E requirements. Pasture's ability to provide minerals is variable to limited, so it is important to always provide a mineral supplement when horses are on pasture.

Pasture's greatest contributions are made toward DE (i.e. calories) and CP requirements. Digestible energy values for grass pastures have been reported to range from 1.78 to 2.74 Mcal/kg DM (Dairy One, 2011). This caloric range nearly mirrors the range of DE requirements for horses (1.67 to 3 Mcals/kg DM; NRC, 2007). A similar situation exists when CP concentrations of grass pastures are compared with the range of CP requirements. Crude protein values for grass pasture can range from 7.5% to 22.7% (Dairy One, 2011) compared to requirements ranging from 6.3% to 13.9% (NRC, 2007).

What makes a pasture ideal?

Pasture quality is directly related to several factors: fertilization, forage species selection, stocking rates, the growth stage of the forage, and the environment. Most of these factors can be controlled with or through sound management practices.

The ideal horse pasture should have:

- A dense stand of nutritious and palatable forage species
- Ample area to permit grazing and exercise
- A smooth ground surface free from holes, noxious plants, and trash and other potentially harmful objects
- Safe fences and gates
- Ample supply of fresh, clean water

Pasture should provide space to maintain a dense stand of forage adequate to meet the horse's nutrient requirements. Experts generally recommend 2 acres of pasture per mature 1,100 pound horse. Those two acres, with modest management, can produce 6 to 8 tons of forage annually. If the pasture is seeded or sprigged, lime and fertilizer is applied, and grazing is properly managed, you can reduce those 2 acres to 1 acre. The key is not to use pastures as dry lots, and to add and remove animals at the correct times to obtain optimum nutrition, rapid forage regrowth, and stand persistence.

Establishing Pastures

The first step in establishing pasture is to take a soil test. The soil test will indicate needs for lime, phosphorus, potassium, and other nutrients necessary for the species to be seeded. Next, you will want to use a high-quality seed that performs well in your area. High-quality seed has a high rate of germination and is mostly free of contamination from seed of other crops or weeds. This information can be found on the seed tag.

Seeding rates will be affected most by the forage crop to be sown. When sowing a mixture, less seed of each component is used than when it is sown alone. Grasses and legumes can be seeded in either spring or fall. However, cool-season grasses (bluegrass, orchardgrass, tall fescue) are most easily established in the late summer and early fall. Lastly, it is very important to allow the immature seedlings to become established before allowing horses to graze the pasture. Overgrazing newly seeded areas is a major cause of seeding failures. For new seedlings of grass, it is best to allow it to grow to maturity and then to harvest one cutting of hay before returning the pasture to full use. An important consideration is that a pasture needs 12-18 months to establish, so animals should be kept off during this time.

Once established, grazing management becomes the key to promoting healthy plant growth and to extending the pastures productive life. Two conventional grazing methods that are commonly used are continuous and rotational grazing systems.

Continuous grazing involves keeping horses in one pasture all the time. This system can work well if the pasture is large enough to prevent overgrazing and with the right type of forage. The major problem with this system is that the grazing behavior of horses encourages "spot grazing". A horse grazes from the top of the forage downward, positioning the choicest plants with its sensitive lips, then snipping of the blades with its teeth. As soon as there is young, tender regrowth, the horse bites it off, weakening the plant until it dies. Grazing and re-grazing the choicest plants leaves less desirable species and weeds to out compete the desired plants.

Rotational grazing involves dividing the pasture into two or more smaller paddocks that are then grazed and rested in some sequence. With this system, horses are rotated from one paddock to another as forage growth and consumption rate dictate. The time for grazing one paddock may vary from one or two days to several weeks depending on stocking rates (number of animals per acre) and forage growth. If you cannot stock enough horses per acre, your pastures will develop excess mature forage and horses will spot graze. Spot grazing is most severe if you graze horses in a pasture with appreciably more grass than they can use in a short time (3 to 5 days). The horse will avoid the older, more mature plants in favor of young regrowth. With too many horses per acre, the pasture will be overgrazed. It is ideal to maintain the stocking rate so that you optimize consumption of young, leafy forage without overgrazing.

Estimating Pasture Intake

Like previously stated, most adult horses can thrive on a forage-only diet. However, a horse's relatively small digestive system limits its ability to consume and digest feedstuffs. For example, a horse is not able to digest and use poor-quality, mature forages as well as a ruminant. Another factor limiting intake is gut fill. Fresh forages are extremely high in moisture, which dilutes their nutrient concentration. Therefore, a horse needs to consume more fresh forage to obtain the same dry-matter amount of forage fed in a dried form (hay). Table 1 presents average dry-matter nutrient levels of various pasture species that are commonly used for horse pastures in the mid-Atlantic region.

1707).						
	Stage of	DM	DE	СР	Calcium	Phosphorus
	Maturity	(%)	(Mcal/lb)	(%)	(%)	(%)
Tall Fescue	Early*	28	1.34	15.1	0.51	0.38
	Mature ^{**}	35	1.19	8.9	0.42	0.30
Orchardgrass	Early	28	1.32	13.1	0.25	0.29
	Mature	30	1.32	8.4	0.23	0.22
Kentucky	Early	31	1.44	17.4	0.33	0.30
Bluegrass	Mature	42	1.12	9.5	0.30	0.25
Alfalfa	Early	21	1.21	20.5	2.30	0.31
	Mature	25	1.21	16.5	1.53	0.27
White Clover		19	1 38	25.1	1 33	0.37

 Table 1.
 Nutrient levels of selected pasture species (U.S.-Canadian Tables of Feed Composition, 1969).

*, The reference cited does not define the stage of maturity but we will assume that the early stage of maturity for the grasses listed is the vegetative state (jointed stems are not present) and for alfalfa flower buds are not visible.

^{**}, We will assume that the mature growth stage for grass is that stage when the seed heads are in full flower (anthers are visible on all the seed heads) and for alfalfa that the crop is at least at 1/10 bloom

Notice that in Table 2, while mature forage supplies higher dry-matter levels, the same forage in its early growth stages provides higher levels of many nutrients. The legumes are considerably higher in protein and calcium than grasses. Again, the reference for Table 2 did not define mature and immature forage but assume that the definitions listed as footnotes in Table 1 describe the growth stages.

Combining what we have learned about a horse's expected feed consumption (Mature maintenance horse, 2.0% BW) and the nutrient levels of several pasture species (Table 1), we can estimate how much pasture the horse will consume in a 24 hour period and determine whether the horse's nutrient requirements will be met. Table 2 summarizes the nutrient needs for a mature maintenance horse with an estimated mature body weight of 1,100 pounds.

Table 2. A Model Pasture Feeding	g Program.	(National Research Council, 2007)				
Nutrient Requirements	DE	СР	Phosphorus			
	(Mcal/day)	(lbs/day)	(grams/day)	(grams/day)		
Maintenance horse	16.7	1.39	20	14		
Nutrient Intake						
Tall Fescue						
Immature 22 lb. DM	29.48	3.32	50.89	37.92		
(79 lb. as fed)						
Mature 22 lb. DM	26.18	1.96	41.91	29.94		
(63 lb. as fed)						
Grass/Legume mixed (60/40						
immature fescue/white clover)	29.9	4.2	83.9	28		
22 lb. DM (90 lb. as fed)						

As seen above, grazing immature and mature tall fescue or grazing grass/legume mixed pastures, not only meets the nutrient requirements for the mature maintenance horse, but actually provides nutrients in excess of requirement.

Pasture often has the potential to provide more nutrients than required, so the ability to control intake is sometimes desired. The main component that needs to be controlled is the amount of DE (i.e. calories) consumed. When excess DE is consumed, the horse will gain weight. In order for the horse to consume only what it needs to meet maintenance requirement and maintain BW (instead of gaining), the horse's pasture dry-matter intake would have to be decreased to approximately 1.5% of BW. This can be achieved by removing the horse from the pasture for a portion of the day, or by placing a grazing muzzle on the horse for a period of time.

Moving Towards More Effective Feeding

Well-managed pastures can play an important role in achieving a successful horse management program. Pastures are a relatively inexpensive feed source (up to 35% cheaper than feeding hay) that can produce enough protein, energy, and some vitamins to meet the nutritional needs of most adult horses. It is important to remember that not all vitamin and mineral

requirements can be met, so a vitamin/mineral supplement should be provided, along with free access to clean water. High-quality fresh forage can ensure proper nutrition and normal digestive function for your horse and may also be helpful in reducing behavioral problems such as cribbing.

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Triticale—History and Use

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Throughout the past century, the climate has begun to change. Temperatures are increasing and as the climate changes, forage growing conditions change as well creating new complications for farmers. With the ability to genetically enhance and modify plant species, scientists are attempting to create plant species and strains to better suit the needs of today's farmers. Today, more emphasis is being put on growing forages that are drought resistant and disease resistant. Also, with the increasing demand for food worldwide, increasing the yield of forages is also important.

Past and Present

In 1875, the Botanical Society in Edinburgh used cereal rye (*Secale cereale*) pollen to fertilize common or bread wheat (*Triticum aestivum*) and create the new crop species, triticale (Oettler, 2005). However, these first plants were sterile and fertile triticale plants were not produced until 1930 (Salmon et al., 2004). It took scientists until 1969 to release the first commercial triticale cultivar (Ammar et al., 2004). In the late 1970s, the Armadillo type of triticale was released with improved ability to self fertilize (Salmon et al., 2004). Early on, two types of triticale plants were produced, hexaploid triticale, which combined the genomes of

durum wheat, turgidum wheat, and rye; and octoploid triticale, which combined the genomes of durum wheat, turgidum wheat, rye, and bread or common wheat (Salmon et al., 2004).

Hexaploid triticale was created more for use in animal diets and as a forage crop while octoploid triticale was more for use in bread making and baking (Salmon et al., 2004). The octoploid variety ended up having poor seed development and unstable reproduction and because of this, most triticale breeding today involves the hexaploid types (Salmon et al., 2004).

Although triticale production started out slow, as seen in Figure 1, worldwide production began to increase in 1980 because more triticale was being planted (FAO, 2003). In 2003 it was estimated that 7.4 million acres and 420 million bushels of triticale were grown worldwide (Mergoum et al., 2004). Today, most of the triticale production, about 88%, is in Europe with Germany, Poland, and France producing the most (FAO, 2003).



Figure 1. a) Worldwide triticale production from 1974-2002; b) Area of triticale planted from 1974-2002 (FAO, 2003)

Benefits

Triticale is a plant that was created in an attempt to combine the best traits of wheat and rye. This plant has the high yield and increased grain quality of wheat and the disease resistance and environmental tolerance of rye (Oettler, 2005). This crop is adaptable to a wide range of soil

conditions such as acidic and alkaline soils as well as soils that have been waterlogged or droughty (Oettler, 2005). Triticale can survive in soils that are phosphorus deficient, contain high concentrations of aluminum or boron, or have high salinity (Qualset and Guedes-Pinto, 1996; Mergoum et al., 2004; Oettler, 2005). Due to the extensive root system, triticale plants can survive in soils that are nutrient deficient (Salmon et al., 2004). Triticale plants have been shown to grow well in both arid and semi-arid climates (Mergoum et al., 2004).

Triticale plants can thrive in environments where disease, insects, or weeds pose a problem (Mergoum, et al., 2004). For example, triticale has shown resistance to pests such as smuts, powdery mildew, cereal cyst nematode, and Hessian flies (Mergoum et al., 2004). This plant is also resistant to viruses such as barley yellow dwarf, wheat streak mosaic, barley stripe mosaic, and brome mosaic (Mergoum et al., 2004). Triticale plants often produce a higher yield than wheat or barley. Characteristics such as more efficient transpiration, increased vigor and root growth early on, and better carbohydrate storage in the stem have been identified as playing a part in increasing yield (Bassu et al., 2011).

Drawbacks

Even though there have been many advances in triticale breeding and production, the use of this crop worldwide is still limited (Qualset and Guedes-Pinto, 1996). There are several reasons behind this lack of use. First, triticale is not used often for human consumption because in some countries, triticale is marketed only as a livestock grain (Qualset and Guedes-Pinto, 1996). There has also been less improvement in genetic characteristics important in baking and bread-making which contributes to triticale's limited use as a food crop (Mergoum et al., 2004). Another reason why triticale production is relatively low is that although there have been great developments in producing highly fertile triticale plants, some reproductive instability may still occur (Qualset and Guedes-Pinto, 1996). Finally, triticale plants require a longer grain-fill period and are slower to mature than wheat making triticale a less desirable forage species to some farmers (Mergoum et al., 2004). Another drawback to triticale is that it is susceptible to viruses such as spot blotch, scab, and ergot (Oleke et al., 1989). Although triticale exhibits resistance to numerous pests and diseases, today, insects, pests, and diseases are beginning to adapt causing triticale plants to no longer be resistant (Mergoum et al., 2004).

Varieties

There are two types of triticale cultivars, spring-type and winter-type. The winter type has been shown to produce higher yield and is therefore the more desirable option for grazing, cutforage, silage, or hay (Mergoum et al., 2004). The winter type requires cold treatment or vernalization after germination to in order to enter reproductive stages (Salmon et al., 2004). Winter types are typically planted in fall and exhibit prostrate growth early on (Myer and Lozan del Rio, 2004).

The spring type does not require vernalization to enter the reproductive stages (Salmon et al., 2004). Spring types are typically planted in spring, grow upright, and have a high yield earlier than the winter type (Myer and Lozan del Rio, 2004). The spring type is grown in regions where there is a longer growing season, adequate moisture levels, and limited cold periods (Salmon et

al., 2004). In early growth, spring types are light sensitive and require over 12 hours of light per day (Salmon et al., 2004). Intermediate, or facultative, types of triticale also exist. This type is in-between spring and winter but does not require vernalization (Myer and Lozan del Rio, 2004).

Human Consumption

In the beginning, triticale was produced for human consumption and used in baking and bread-making (Oettler, 2005). Today, triticale can be milled into flour and recent studies have shown that this flour can be used to make cakes comparable in quality to cake made with wheat flour (Oliete et al., 2010). In the past, triticale plants produced a low flour yield because the grains were long, deeply creased, and not completely plump (Pena, 2004). Today, triticale plants produce a flour yield similar to that of wheat because over time, triticale has been bred for better kernel density, smoothness, and plumpness (Qualset and Guedes-Pinto, 1996; Pena, 2004).

In the past, triticale has been shown to be inferior to other grains, such as wheat, when it comes to bread-making (Oleke et al., 1989). This is due to the decreased strength of the gluten found in triticale along with increased alpha-amylase activity (Pena, 2004). Today, research is being done to target genes responsible for gluten strength and bread-making quality to improve this crop's ability to be used in bread-making (Mergoun et al., 2004). Triticale is a moderate candidate for pasta making because in some varieties, the high ash content causes the pasta to have an unappealing, grayish color (Pena, 2004). The high alpha-amylase found in triticale makes it an ideal candidate for malting and brewing processes (Pena, 2004). Research efforts are underway in an attempt to see if triticale can be used in breakfast cereals (Oleke et al, 1989).

Ethanol Production

Triticale is used in the production of ethanol because it might be less expensive than wheat (Wang et al. 1997). The fermentation efficiency of triticale in the production of ethanol is 90-91%, comparable to that of wheat (Wang et al., 1997). Triticale distillers grains, a by-product of the ethanol industry, can be used in livestock diets (Mustafa et al., 2000). Studies have shown that feeding triticale distillers grains had no effect on intake or milk production of dairy cows when compared to corn distillers grain, corn meal, or soybean meal (Greter et al., 2008; Oba et al., 2010). There is also no difference in milk composition, such as fat, protein or lactose, when comparing milk from cows fed triticale distillers grains or corn distillers grains (Greter et al., 2008).

Livestock Diets

Triticale is used as a grain source in diets for cattle, chickens, sheep, pigs, and turkeys due to its high feed value (Oettler, 2005). Bird et al. (1999) recently suggested that due to its high starch digestibility, triticale may be a better grain choice than wheat, barley, and oats in ruminant diets. Triticale seeds have increased in plumpness overtime causing the seeds to have increased starch. Therefore, today, triticale grain is more energy rich than in the past (Myer and Lozan del Rio, 2004).

Triticale grain can be beneficial in pig diets because pigs have a high lysine requirement (Oleke et al., 1989). This grain is also used in diets for broilers or laying hens because of the high energy content (Myer and Lozan del Rio, 2004). However, triticale grain contains non-starch polysaccharides, like pentosans, which can negatively impact nutrient absorption and digestions by poultry (Choct and Annison, 1992). The combination of high energy, protein, and starch makes triticale a desirable grain source for ruminant diets (Myer and Lozan del Rio, 2004). In ruminant diets and pig diets, triticale grain should be processed and due to the soft kernel; processing of this grain is relatively easy.

Forage and Grazing Use

Due to its high yield, triticale can be used for grazing, green chop, silage, or hay (Oettler, 2005). As a forage crop, several different methods can be used when planting triticale. Aside from being planted separately, the spring and winter types can be mixed and planted together to extend the growing season. Triticale can also be planted in a mix with other cereals, such as barley, to extend harvest, control disease, and decrease lodging (Myer and Lozan del Rio, 2004). Finally, triticale can be inter-planted with a legume to increase the quality and nutritive value (Myer and Lozan del Rio, 2004).

Triticale can be used in grazing systems. When used for grazing, triticale is sometimes planted with ryegrass to increase the grazing period, improve tolerance to foot traffic, and increase palatability (Myer and Lozan del Rio, 2004). Grazing should start when triticale plants are 25 to 30 cm high and then be grazed to 7 to 10 cm (Myer and Lozan del Rio, 2004).

Nutritive Value

The nutrient compositions of spring and winter-type triticale grain as compared to wheat and rye are shown in Table 1. Triticale grain tends to contain about 63% starch (Wang et al., 1997) and 10 to 15% protein (Oleke et al., 1989) on a dry matter basis. There is about 20 to 30% less gluten protein in triticale than in wheat (Pena, 2004). Triticale contains high amounts of lysine and other essential amino acids (Oleke et al., 1989).

A comparison of the nutrient composition of triticale when it is used as forage, hay, or silage is shown in Table 2. As a forage crop, the nutrient composition of triticale is comparable to that of other cereal crops (Myer and Lozan del Rio, 2004). When triticale is used in ethanol production, triticale dried distillers grains are produced as a by-product (Mustafa et al., 2000). Triticale distillers grains have a similar protein degradability and rumen degradability to other distillers grains such as wheat, rye, and corn (Mustafa et al., 2000; Oba et al., 2010). The concentration of essential amino acids, such as lysine, tends to be higher in distillers grains from triticale rather than from corn (Greter et al., 2008).

Table 1. Proximate composition of triticale, wheat, and rye on a dry matter basis.								
			Crude	Ether	Free			
	Protein	Starch	fiber	extract	sugars	Ash		
Cereal	(% ^a)	(%)	(%)	(%)	(%)	(%)	Reference ^b	
Spring triticale	10.3-15.6	57-65	3.1-4.5	1.5-2.4	3.7-5.2	1.4-2.0	1, 2, 3	
Winter titicale	10.2-13.5	53-63	2.3-3.0	1.1-1.9	4.3-7.6	1.8-2.9	4	
Spring wheat	9.3-16.8	61-66	2.8-3.9	1.9-2.2	2.6-3.0	1.3-2.0	1, 2, 3	
Winter wheat	11.0-12.8	58-62	3.0-3.1	1.6-1.7	2.6-3.3	1.7-1.8	4	
Spring rye	13.0-14.3	54.5	2.6	1.8	5.0	2.1	1, 2	

^a Nx 5.7

^b 1 = Bushuk and Larter, 1980; 2 = Peňa and Bates, 1982; 3 = Johnson and Eason, 1988; 4 = Heger and Eggum, 1991. Data used in value ranges for spring triticale, spring wheat, and spring rye were pulled out from one or more of the references indicated.

Table 2. Nutrient composition of triticale as a fresh forage, silage, and hay.							
rem Fresh forage Silage ^a Hay ^a							
Dry matter (%)	20	35	89				
Crude protein (% dry matter basis)	20	12	8				
Acid detergent fiber (% dry matter basis)	30	35	40				
Neutral detergent fiber (% dry matter basis)	50	60	70				
Calcium (% dry matter basis)	0.4	0.4	0.2				
Phosphorus (% dry matter basis)	0.3	0.3	0.2				
Total digestible nutrients for ruminants (% dry							
matter basis)	$(70)^{b}$	60	55				
Metabolizable energy in beef cattle (kcal/kg dry							
matter $(2,500)^{\rm b}$ 2,200 2,000							

^a Early-dough stage.

^b Estimated.

Source: Sun and Wang, 1991; ZoBell, Boonewarene and Engstrom, 1992; Khorasani et al., 1993; McCartney and Vaage, 1994; Royo and Tribé, 1997; Juskiw, Salmon, and Helm, 1999; Maloney, Oplinger, and Albrecht, 1999; Juskiw, Helm, and Salmon, 2000; NRC, 2000

Conclusion

Even though triticale production worldwide is limited, this hearty, well adapted plant can be used in multiple different areas. The high nutritive content and heartiness in different environments as well as resistance to some diseases and pests makes triticale an option for use in livestock diets whether as grain, forage, hay or silage. Triticale can also be used for human consumption and ethanol production, although use in these areas is not extensive. Since 1980, worldwide triticale production has increased overtime. As scientists continue to create triticale hybrids more suited for each industry and niche, hopefully triticale production will continue to rise, providing another beneficial crop for the world.

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Nutrient Dynamics in Cool-Season Pasture: Measuring Changes through Time

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One of the purported benefits of raising livestock on pasture is efficient nutrient cycling. Compared to grain production and confined feeding, pasture-based livestock operations often have low requirements for imported feed or fertilizer, and well-managed perennial pastures should experience only small nutrient losses. While these concepts are well known, there has been little study of the actual change in soil nutrient concentrations in tall fescue-based pasture under rotational stocking management.

A cow-calf grazing experiment began at the Shenandoah Valley Agricultural Research and Extension Center in Steele's Tavern, VA in 2008. Groups of large and small-framed cows were rotationally-stocked in two different types of creep grazing system. There were three replications of each of the four animal size and creep grazing combinations—a total of 96 paddocks, about 2 acres each. Seven or eight cow-calf pairs were stocked in each grazing system at a rate of approximately 2 acres per pair. The pasture was tall fescue, bluegrass, orchardgrass,

and white clover previously established on Frederick and Christian silt loams. Soil pH, phosphorus, and potassium were corrected to soil test recommendations prior to grazing, but no fertilizer was added between 2008 and 2012. Soil from each paddock was sampled each November and analyzed by routine soil test at Virginia Tech. Forage was harvested from each paddock once per month from April through October and analyzed for its mineral composition.

Through five years of rotational stocking, soil pH declined by 0.04 - 0.06 pH units per year, which is a very small decrease. Soil phosphorus declined by 1.9 - 3.2 lbs per acre per year and potassium concentrations did not change with time through this study. Given these trends, it could take 8 - 13 years before pH or phosphorus concentration of these soils would decline to a level negatively affecting pasture productivity. Neither cow frame score nor type of creep grazing had an effect on changes in soil nutrient concentration. The soil from paddocks in which hay was fed showed increased concentrations of phosphorus and potassium. Forage analysis showed that pasture provided sufficient concentrations of macronutrients—nitrogen, phosphorus, potassium, calcium, magnesium and sulfur—to meet the requirements of dry beef cows throughout the growing season, but only meet the higher nutritional requirements of lactating beef cows in early spring.

These results confirm the idea that nutrients are efficiently recycled and retained in pastures. Soil pH likely declined as a result of leaching as rainwater moved through the soil profile. The decline in phosphorus may have been related to the transportation of nutrients from general grazing areas to less productive areas, such as near waterers. These results would likely differ depending on the soil type and larger losses are expected in heavily stocked continuously grazed pasture soils. Soil testing at least every five years is recommended to ensure adequate conditions for pasture growth, and the strategic placement of hay feeding can help to replenish essential soil nutrients. The use of supplements containing macronutrients appears to be unnecessary for dry beef cows on this type of pasture, but supplementation with salt and micronutrients is still recommended.

Notices and Upcoming Events

June 26, 2013

2013 Weed Science Field Day, University of Delaware Research and Education Center (old office building), 16686 County Seat Highway, Georgetown, DE 19947. CCA CEUs will be offered along with DE Pesticide credits. To register, please call Karen Adams at 302-856-7303 ext. 540 or by email <u>adams@udel.edu</u> or, for more information, contact Dr. Mark VanGessel at 302-856-7303 or by email <u>mjv@udel.edu</u>.

June 27, 2013

2013 Weed Science Field Day, Morning tour at the Wye Research and Education Center, Queenstown, MD. CCA CEUs will be offered along with MD Pesticide credits. For more information, contact Dr. Ron Ritter at 301-405-1329 or by email <u>rlritter@umd.edu</u>.

June 27, 2013

2013 Weed Science Field Day, Afternoon tour at the Beltsville/Hayden Farm, Beltsville, MD. CCA CEUs will be offered along with MD Pesticide credits. For more information, contact Dr. Ron Ritter at 301-405-1329 or by email <u>rlritter@umd.edu</u>.

July 10, 2013

Making the Most of Fescue, August County Gov't Center on the Veranda at the south end of the building where the Farmer's Market is located. For questions or assistance, call Augusta Extension Office at 540-245-5750.

July 13, 2013

Cattlemen's Summer Field Day, To be held at the Helen Beamer Farm, 1984 Gardner Mill Rd., Hillsville, VA. For questions, assistance, or preregistration, call Carroll County Extension Office at 276-730-3110 or the Grayson Extension office at 276-773-2491 for meal count.

July 17, 2013

VFGC 2013 Native Warm Season Grass Tour, Buck Hill Farm, 310 Oak Hill School Road, Mount Solon, VA. Registration is \$10 paid prior to July 10th and \$20 per person at the door. For more information about this tour, contact Matt Booher at 540-245-5750 or by email at <u>mrbooher@vt.edu</u>.

July 19-20, 2013

Grazing for Profit in the 21st Century, West Fork Conservation District Field Day at the John L. Spiker Farm located near Jane Lew and a dinner meeting at the Hickory House Events Center near Weston, WV. Featuring Kit Pharo of Pharo Cattle Company, Cheyenne Wells, Colorado. Contact West Fork Conservation District at 304-627-2160.

July 25, 2013

Maryland Commodity Classic, Queen Anne's County 4-H Park located near Centreville, MD. Private Pesticide Applicator license credits available for Maryland farmers during the morning program. Contact Dr. Bob Kratochvil for more information by email at <a href="https://rkratoch.gov/rkratoch

August 1, 2013

VA Ag Expo "Agriculture: Bringing Promise to our Future" Tour, Tour starts at 8:00 am (gates open at 7:30 am) at Land of Promise Farms, 3169 Land of Promise Road, Virginia Beach, VA. For more information, please see our website at <u>http://www.virginiagrains.com/agexpo/</u> or contact Ben Rowe at 804-726-6022 or by fax at 804-359-9680 or via email at <u>Ben@VirginiaGrains.com</u>. For exhibitor and sponsorship information contact John Smith at <u>VaAgExpo@aol.com</u>.

August 14, 2013

DNLA Summer Turf and Nursery Expo, University of Delaware Botanic Gardens behind Townsend Hall at 531 South College Avenue, Newark, DE. For more information, please call Valann Budischak at 302-831-4188 or by email <u>valannb@udel.edu</u>.

August 22, 2013

Delaware Soybean Tour, Tour starts at the UD Research and Education Center in Georgetown, DE. For more information, please call Karen Adams at 302-856-7303 ext. 540 or by email <u>adams@udel.edu</u>.

August 22, 2013

Herbicide Resistance Field Day, UD Research and Education Center in Georgetown, DE. For more information, please call Dr. Mark VanGessel at 302-856-7303 or by email <u>mjv@udel.edu</u> or to pre-register contact Karen Adams at 302-856-7303 ext. 540 or by email <u>adams@udel.edu</u>.

September 4, 2013

Sustainable Agriculture and Reduced Tillage Organic Grain Field Day, UD Research and Education Center in Georgetown, DE. For more information, please call Dr. Mark VanGessel at 302-856-7303 or by email <u>mjv@udel.edu</u>.

November 19-21, 2013 Mid-Atlantic Crop Management School, Ocean City, MD. Contact Josh McGrath at 301-405-1351 or by email <u>mcgrathj@umd.edu</u>.

January 13-17, 2014

Delaware Ag Week, Harrington, DE. For more information, contact Cory Whaley at 302-856-7303 or by email <u>whaley@udel.edu</u>.

Newsletter Web Address

The Regional Agronomist Newsletter is posted on several web sites. Among these are the following locations:

http://www.grains.cses.vt.edu/ Look for Mid-Atlantic Regional Agronomy Newsletter

or

www.mdcrops.umd.edu Click on Newsletter

or

http://extension.udel.edu/equine/ Click on Fact Sheets and look under Forages (Hay and Pasture

Photographs for Newsletter Cover

To view more of Todd White's Bucks County photographs, please visit the following web site:

www.scenicbuckscounty.com