Introduction:

Calf prices in the spring of 2012 had many cow-calf operators optimistic about the next several years and possible herd expansion. Widespread drought in the Corn Belt, however, has resulted in higher feed prices and had a negative effect on feeder cattle prices. In Kentucky, the early summer drought has also forced many operations to consider reducing numbers or purchase additional feed. This drought has negatively impacted the 2nd cutting of hay which should result in higher hay prices for this winter.

However, recent rains have improved pasture moisture conditions in many areas, which may provide an opportunity for Kentucky cattle producers to reduce their winter hay requirements by applying nitrogen on selected pastures to stockpile for fall and winter grazing. By increasing the total pasture production during this time period, the grazing season can be extended and the amount of hay reduced. The higher hay prices that will likely be faced this winter make the value of the additional grazing days higher than was seen in 2011.

The primary cost associated with fall fertilization is the cost of the nitrogen itself, which has increased significantly from a year ago. Ammonium nitrate is currently around $550/ton ($0.82/unit) and urea is ranging from $750-800/ton ($0.82-.87/unit). The ultimate decision that must be made is whether the value of the additional grazing days added through fertilization exceeds the cost. Since soil moisture conditions are highly variable throughout the state, multiple response rates are used in this analysis to simulate different soil moisture conditions for your location. Those areas that have received more rainfall will offer the best opportunities for applying nitrogen and stockpiling. The primary objective of this publication is to help farmers identify those situations where applying nitrogen to late summer pastures will be profitable in 2012.

There are two main sections in this publication: 1) “Agronomic Basics for Stockpiling Fescue”, and 2) “Potential Savings from Applying Nitrogen to Tall Fescue Pastures”. The first section provides the basics for applying nitrogen to late summer pastures and how to stockpile this forage for fall and winter grazing. The second section describes the methods used in the profitability analysis, discusses important assumptions, and provides a summary of the profitability for stockpiling tall fescue pastures given various scenarios. Three prices for nitrogen and four prices for hay are evaluated as well as multiple nitrogen response rates for both tall fescue and fescue-clover pastures.
Agronomic Basics for Stockpiling Pastures:

Stockpiling can be defined as growing pasture for later use. In Kentucky this typically means applying nitrogen (N) to tall fescue pastures in August, letting them grow through the fall, and then grazing during the late fall and early winter. Kentucky bluegrass and other cool-season grasses will also respond to nitrogen applications in the fall, but this publication focuses on tall fescue since it shows a higher N response and stockpiles better for winter grazing.

The best pastures to target are those with the thickest stands of fescue. Fescue responds extremely well to N applications in late summer and has an amazing ability to retain its nutrient value through the winter. Targeted pastures should have low concentrations of weeds and low amounts of clover since legumes do not stockpile well after frost and the yield benefit of added N is less than in pure fescue stands. Moreover, N has the potential to reduce the clover component of the sward as the additional fescue growth will compete with the legumes. A good rule of thumb is that where clover makes up more than 20% of the stand, the short-term yield increase from nitrogen will not typically outweigh the long-term forage quality and nitrogen fixation benefit of the lost clover.

Pastures should be grazed or mowed to reduce fescue height to 2 to 3 inches during early to mid-August. Remove animals before overgrazing occurs or initial regrowth will be slow. Grazing or mowing removes low quality summer growth and allows the plant to produce high quality leaves. Assuming that there is adequate soil moisture, a considerable amount of growth will occur within four to six weeks, but waiting 8 to 12 weeks before grazing is preferable.

The optimal time to apply N is in early to mid-August. Prior applications may encourage the growth of weedy grasses like crabgrass. Waiting until September will reduce the efficiency of N conversion into plant growth. For example, one Kentucky study showed that N conversion efficiency (lbs dry matter fescue growth per unit N) was 27:1 on Aug 1, 26:1 on Aug 15, 19:1 on Sept 1, and 11:1 on Oct 1. Therefore, when N application is delayed until September or beyond, optimal N application rate will decrease, and you should carefully consider the benefit of increased fescue growth compared to the cost of purchased hay. N response efficiency also depends on soil moisture. Without rain and/or adequate soil moisture, N response will be low, but even with small amounts of rain tall fescue has an amazing potential for fall growth. In areas that are exceptionally dry, applying N can be somewhat of a gamble in terms of the response.

Traditional “stockpiling” involves keeping cattle off the pasture until late fall, but this practice may be difficult when pasture production is low. If forage is needed, N fertilized pastures can be grazed in the early fall, but it is recommended that cattle be kept off these pastures for at least a month. An alternative strategy is to feed hay during the stockpiling period to supplement the pastures that cattle are on.

Tall fescue growth will occur without added N, but University of Kentucky Cooperative Extension emphasizes the importance of adding N for maximum growth and forage quality. In Kentucky, nitrogen (90 units or actual lbs N) increased forage production by over a ton and protein by 5 percentage points. In Ohio, nitrogen (90 units or actual lbs N)
increased protein by 9 percentage points and improved overall digestibility. Another reason to stockpile fescue is that it retains its quality extremely well through the winter months. In an Arkansas research study, stockpiled fescue was higher quality (12% CP and 55% TDN) even in early March than average quality hay. This attribute can be particularly beneficial for a late winter or spring calving cow-herd.

There are several forms of N available for pasture use, but the two main types are ammonium nitrate and urea. Ammonium nitrate is an excellent form to use in late summer because it is not subject to surface volatilization. Urea is generally a cheaper source of N, but a significant amount of N can be completely lost under hot, humid, and dry soil conditions favoring volatilization. Typical urea losses in late summer range from 15-30%, but can approach 40-50% when there is no rainfall for several weeks after application. Fortunately, urease inhibitors (e.g. Agrotain) have been recently developed to reduce volatilization losses with urea (see AGR-185 referenced on last page and at http://www.ca.uky.edu/agc/pubs/agr/agr185/agr185.pdf). Even though they add to the overall cost, urease inhibitors are recommended in the summer for urea due to the unpredictable rainfall in August. The most effective urease inhibitors will typically prevent volatilization for two weeks without rain, compared to pure urea where volatilization begins immediately after application. Be aware that all urease inhibitors are not equally effective.

Besides the application of N, it is important that stockpiled fields be limed and fertilized with P and K to acceptable levels (see AGR-1 referenced on last page). Where possible, stockpiled tall fescue fields should be strip grazed and stocked heavily enough to graze down each paddock in 7 to 10 days or less. This allows the forage to be efficiently utilized without excessive trampling and waste. Since tall fescue does not re-grow in the winter, a back fence is not needed when strip grazing stockpiled growth.

Greater detail of the stockpiling process can be found in the UK extension publication AGR-162 “Stockpiling for Fall and Winter Pasture” which can be found at: http://www.ca.uky.edu/agc/pubs/agr/agr162/agr162.pdf or your county extension office.

**Potential Savings from Applying Nitrogen to Tall Fescue Pastures:**

The analysis presented here accounts for the major factors that impact the profitability of nitrogen applications to late summer tall fescue pastures, and includes the price of nitrogen, price of hay, response rate of nitrogen, labor costs of feeding hay and stockpiled fescue, waste rates, nutrient recycling of hay, and forage quality. For example, as the price of N increases, profitability of the practice will decrease. As the price of hay increases, profitability will increase. As soil moisture conditions improve, profitability will increase. This analysis determines the changes in net revenue from late summer nitrogen applications of 40 and 80 units (120 lbs and 240 lbs of ammonium nitrate respectively) compared to the no application situation. Changes in profitability are based on a 30-cow, spring-calving herd.
Two of the most important factors in this analysis are the price of nitrogen and the price of hay. The price of nitrogen was evaluated on an elemental (lbs actual N) or unit basis\(^1\) between $.80-.90 per unit\(^2\) which were representative of prices in mid-July 2012. For urea, you should multiply the actual price by 1.2-1.4 to get an effective price (or use a lower response rate). Hay values were evaluated on a per ton basis between $60-120. These values should capture most of the variability in market conditions that is likely to occur this year. Users of this publication need to use their best judgment for anticipated price(s) including those outside the range presented here.

The application cost for spreading the nitrogen was set at $5/acre. Waste rates for both grazing and hay feeding (the latter includes both losses from weathering and feeding) were set at 35%. Machinery and labor costs were set to be representative of the average Kentucky cow-calf operation in both size (30 cow herd) and management intensity. This resulted in a labor cost of $.06 per cow day for grazing\(^3\), and machinery and labor cost of $.25 per cow day for hay feeding. Feeding hay results in imported nutrients being deposited in pastures. It is assumed that 50% of the P and K from feeding hay are effectively recycled into the soil at $.57/lb for P\(_2\)O\(_5\) and $.52/lb for K\(_2\)O.

Finally, three nitrogen response rates were used in the analysis: low, medium, and high. Consult Table 2 to determine which nitrogen response curve is most appropriate for your specific condition. The choice of response rate is probably the single most important determinant in the analysis. These response rates are based on a four-year Missouri study. The high response rate used in the model was actually the average of the four years from this study that included both wet and dry years. However, the study site was on deep, fertile soil and would be representative of the best soil types in Kentucky. Thus adjustments needed to be made from this base response rate depending on the soil quality and the specific soil moisture conditions present. University of Kentucky agronomists (Drs. Lloyd Murdock and Ray Smith) adjusted the response functions for various combinations of soil quality and moisture conditions (see Table 2).

In addition to the response rates, the model also separately evaluates pastures that are predominantly fescue, and stands that are a fescue-clover mix. “Fescue-clover” stands in the Missouri study had an average of 20-30% clover (mostly red). “Fescue” stands were on average about 95% tall fescue. Thus if you have a fescue-clover stand that contains 10-15% clover you would probably want to average the results for the two stand types. As mentioned earlier, nitrogen has the potential to reduce the clover component of the sward, so nitrogen applications are not normally recommended where clover makes up more than 20% of the stand.

**Results:**

Table 1 summarizes the cost savings from applying 40 or 80 units of nitrogen on a per acre basis. Using the most likely price estimates for nitrogen ($\$.85/unit or actual lbs N

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1. To convert elemental N to urea: Multiply elemental value by 2.17. E.G. 100 units N = 100x2.17 = 217 lbs urea. To convert elemental N to ammonium nitrate: Multiply elemental value by 2.99. E.G. 100 units N = 100x2.99 = 299 lbs ammonium nitrate.
2. $\$.80/unit N = $540/ton Ammnit and $740/ton Urea; $\$.85/unit N = $570/ton Ammnit and $780/ton Urea; $\$.90/unit N = $600/ton Ammnit and $830/ton Urea.
3. Assumes open-access to stockpiled pasture (not “strip grazed”).
for ammonium nitrate) and hay ($80/ton), applying nitrogen with a low response rate resulted in a break-even proposition for pure fescue stands and a net loss for fescue-clover stands compared to feeding hay. The medium response rate resulted in net savings of $17-22 per acre in pure fescue stands and a net loss in fescue-clover stands for these mid-range prices. The high response rate resulted in net savings of $38-58 per acre in pure fescue stands and net savings of $7 in fescue-clover stands for these mid-range prices. Thus significant savings are possible for applying nitrogen this year on mostly fescue stands with good to excellent moisture conditions. Note that even where the small potential cost savings in the fescue-clover stands exist, this needs to be balanced with the potential loss of clover due to N applications and would generally not be recommended.

Use Table 2 to determine which response function is most appropriate for your soil conditions and then use Table 1 to estimate potential savings (if any) based on your estimates for hay and nitrogen prices. *Make sure to use an appropriately lower nitrogen response rating if applications occur after mid-August.*

If you plan to use urea (without an effective urease inhibitor) as your nitrogen source, you should make adjustments in Table 2 to reflect volatilization losses generally experienced at this time of year. There are two ways to do this: 1) Increase the effective price of the nitrogen. An increase from $.80 to $.90/unit N will approximate a 12% volatilization loss, while an increase from $.80 to $1.00/unit N will approximate a 24% volatilization loss. 2) Use a response rating one level below what you would have otherwise. This will approximate a 25% volatilization loss. In either case, you will have to adjust the nitrogen application rates upward by the expected volatilization loss.

Hay quality was assumed to be medium-quality, mixed hay with a 55% TDN. For each 5% reduction in TDN (e.g. going from 55% to 50%), add $6-9 in additional value for 40 unit applications and $10-15 in additional value for 80 unit applications. Use the lower part of this range for the medium response rate and the higher part of this range for the high response rate. For increases in TDN you would subtract these from the table value.

If your other assumptions for waste rates, labor and machinery costs, nutrient recycling rates, etc. are much different than those used here, you will want to run your specific parameter estimates through the model. Contact the authors (contact information on the last page) so they can assist you.

**Conclusions:**

Mostly pure fescue stands present good opportunities for profitably applying nitrogen and stockpiling in 2012 with current nitrogen and likely hay prices. In these stands, hay prices at or above $50/ton offer moderate savings at the high response rate, while hay prices will need to be at or above $60/ton with the medium response rate.

Significant cost savings generally did not occur in the mixed fescue-clover stands. Additionally, any potential savings in the fescue-clover stands need to be balanced against the potential loss of clover due to N applications. As a consequence, it does not appear that mixed fescue-clover stands would be good candidates for N applications this year.
Table 1 - Cost Savings of Applying Nitrogen to Late Summer Pastures Kentucky (2012)

<table>
<thead>
<tr>
<th>Price Nitrogen ($/unit)</th>
<th>Price Hay ($/ton)</th>
<th>Fescue(^1) 40 units N Savings ($/acre)</th>
<th>Fescue(^1) 80 units N Savings ($/acre)</th>
<th>Fescue(^2) 40 units N Savings ($/acre)</th>
<th>Fescue(^2) 80 units N Savings ($/acre)</th>
<th>Fescue(^3) 40 units N Savings ($/acre)</th>
<th>Fescue(^3) 80 units N Savings ($/acre)</th>
<th>Fescue(^4) 40 units N Savings ($/acre)</th>
<th>Fescue(^4) 80 units N Savings ($/acre)</th>
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<td>($13)</td>
<td>$41</td>
<td>$62</td>
<td>$9</td>
<td>$10</td>
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</table>

Note: Results are applicable for ammonium nitrate. For urea, use a lower response rating or a higher effective N cost to approximate volatilization losses.

Note: $.80/unit N = $540/ton AmmNit and $740/ton Urea; $.85/unit N = $570/ton AmmNit and $780/ton Urea; $.90/unit N = $600/ton AmmNit and $830/ton Urea.

Assumptions Cattle: Spring Calving (late pregnancy in mid-winter); 30 cow herd.
Assumptions Grazing: TDN=65%; Waste=35%; Application cost N = $5/acre; labor cost = $.06/cow/day with open access to entire pasture.
Assumptions Feeding Hay: TDN=55%; DMI=2.0% hay+grain; Waste=35%; labor and machinery cost=$.25/cow/day.
Assumptions Nutrient Value of Hay: Assumes 50% of P and K effectively recycled into pasture; $.57/lb P\(_2\)O\(_5\); $.52/lb K\(_2\)O.

Fescue\(^1\): 15.5 lb avg. dry matter response per lb N (80 lb application)
Fescue\(^2\): 9.9 lb avg. dry matter response per lb N (80 lb application); savings need to be balanced with potential loss of clover due to N applications.
Fescue\(^3\): 21.1 lb avg. dry matter response per lb N (80 lb application)
Fescue\(^4\): 13.3 lb avg. dry matter response per lb N (80 lb application); savings need to be balanced with potential loss of clover due to N applications.
Fescue\(^5\): 28.8 lb avg. dry matter response per lb N (80 lb application)
Fescue\(^6\): 17.8 lb avg. dry matter response per lb N (80 lb application); savings need to be balanced with potential loss of clover due to N applications.

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Table 2 – Recommended N Response Rating Based on Soil Type/Moisture Condition

<table>
<thead>
<tr>
<th>Soil Moisture Conditions</th>
<th>Soil Type</th>
<th>Ideal</th>
<th>Avg.</th>
<th>Low</th>
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<td>Med/High</td>
<td>Low/Med</td>
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<tr>
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<td>High</td>
<td>Medium</td>
<td>Low</td>
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<tr>
<td>Fair</td>
<td>Med/High</td>
<td>Low/Med</td>
<td>Low</td>
<td></td>
</tr>
</tbody>
</table>

*Note:* N should be applied by mid-August for maximum effectiveness. Use appropriately lower N response rating for later applications.

Based on consultations with faculty at the University of Kentucky, Department of Plant and Soil Sciences.

Nitrogen Response Curve (High)

Nitrogen Response Curve (Medium)

Nitrogen Response Curve (Low)
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Publications and References (most are available at UK County Extension Offices):

AGR-162: Stockpiling for Fall and Winter Pasture
http://www.ca.uky.edu/agc/pubs/agr/agr162/agr162.pdf

AGR-1: Lime and Fertilizer Recommendations:
http://www.ca.uky.edu/agc/pubs/agr/agr1/agr1.pdf

AGR-185: Nitrogen Transformation Inhibitors and Controlled Release Urea
http://www.ca.uky.edu/agc/pubs/agr/agr185/agr185.pdf

NRCS Online Soil Survey (can also access soil survey data at County Extension Office):