

## **Profitability of Nitrogen Applications for Stockpiling Tall Fescue Pastures 2015 Guide (AEC 2015-15)**

### **Introduction:**

The winter of 2014-2015 will be remembered for a long time by cattle producers. Multiple large snow storms and several rounds of extremely low temperatures created management challenges and led to increased hay feeding over the winter. The wisest Kentucky cattle farmers left for warmer climates during these weather events and let their partners deal with snow covered roads, waist high drifts, frozen ball waterers, and other cold-weather challenges. USDA's May 1 Hay Stocks estimate showed a 13% decrease in Kentucky hay stocks from 2014 to 2015. Rainfall was more than plentiful this spring and summer which has resulted in good hay production. However, scarce harvesting windows will likely result in lower quality hay.

The combination of tighter hay supplies coming into this growing season and questions about hay quality may lead to increase interest in stockpiling fescue. Applying Nitrogen to pastures in late summer provides an opportunity to increase forage production and decrease hay feeding days for the upcoming winter. Due to the unusually wet summer, soil moisture conditions are good across most of Kentucky, which typically makes fall fertilization more attractive.

The primary cost associated with fall fertilization of pastures, the cost of the nitrogen itself, is a little cheaper than last year. Ammonium nitrate is becoming difficult to purchase and could not be priced. Urea treated with urease inhibitors is ranging from \$525-575/ton (\$.57-.63/unit) in Central Kentucky. 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 usually variable throughout the state, multiple response rates are used in this analysis to simulate different soil moisture conditions for your location. *The primary objective of this publication is to help farmers identify those situations where applying nitrogen to late summer pastures will be profitable in 2015.*

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.

## **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:**

This analysis determines changes in profitability from nitrogen applications to late summer tall fescue pastures of 40 and 80 units (120 lbs and 240 lbs of ammonium nitrate respectively and 87 lbs and 174 lbs of urea respectively) compared to the no application situation. Multiple factors affect this profitability including 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. 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<sup>1</sup>

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<sup>1</sup> 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.

between \$.50-.70 per unit<sup>2</sup> which are representative of urea prices with a urease inhibitor in mid-July 2015. For pure urea (not recommended), you should multiply the actual price by 1.2-1.4 to get an effective price, or use a lower response rate to account for volatilization losses. 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 prices 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 25%. Forage quality was estimated at 55% TDN for hay and 65% for stockpiled fescue. 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 \$.09 per cow day for grazing<sup>3</sup>, and machinery and labor cost of \$.29 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 \$.40/lb for P<sub>2</sub>O<sub>5</sub> and \$.40/lb for K<sub>2</sub>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 (\$.60/unit or actual lbs N), hay (\$80/ton), and assuming a medium response rate resulted in a savings of \$30 and \$45 per acre in pure-fescue stands and \$5 and \$5 acre savings in fescue-clover stands with 40

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<sup>2</sup> \$.50/unit N = \$335/ton AmmNit and \$460/ton Urea; \$.60/unit N = \$400/ton AmmNit and \$550/ton Urea; \$.70/unit N = \$470/ton AmmNit and \$650/ton Urea.

<sup>3</sup> Assumes weekly cattle move on stockpiled pastures.

and 80 unit applications respectively. The high response rate resulted in a savings of \$50 and \$80 per acre in pure-fescue stands and \$20 and \$30 per acre costs savings in fescue-clover stands with 40 and 80 unit applications respectively. When the price of hay dropped to \$60/ton, the costs savings on the pure fescue stands with medium response rate fell to \$15 and \$20/acre for the 40 and 80 unit applications respectively, while the cost savings with the high response rate fell to \$30 and \$50 for the 40 and 80 unit applications respectively. 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.*

In terms of current soil moisture conditions, this means that in areas with at least decent soil moisture conditions, mostly pure stands of fescue should provide good opportunities for applying nitrogen and stockpiling forage for late fall and winter grazing.

As noted previously, hay quality was assumed to be medium-quality, mixed hay with a 55% TDN. There is a lot of hay produced for cattle in Kentucky that has a much lower feed value. For each 5% reduction in TND (e.g. going from 55% to 50%), add \$6-9/acre in savings for 40 unit applications and \$10-15/acre 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 figures from the table.

If other assumptions for waste rates, labor and machinery costs, nutrient recycling rates, etc. are much different than those used here, contact the authors (contact information on the last page) so they can customize the analysis.

### Conclusions:

Mostly pure fescue stands present good opportunities for profitably applying nitrogen and stockpiling in 2015 with current nitrogen and likely hay prices. In these stands, applying nitrogen will likely be moderately profitable at hay prices of \$60/ton assuming a high response rate, and moderately profitable at hay prices of \$80/ton assuming a medium response rate.

Moderate cost savings were present with the mixed fescue-clover stands with \$80/ton hay assuming a high response rate, and \$120/ton hay assuming a medium response rate. Additionally, any potential savings in the fescue-clover stands need to be balanced against the potential loss of clover due to N applications, and are thus not generally recommended.

### Table 1 - Cost Savings of Applying Nitrogen to Late Summer Pastures Kentucky (2015)

		<i>Low Response to Nitrogen</i>				<i>Medium Response to Nitrogen</i>				<i>High Response to Nitrogen</i>			
		<i>Fescue</i> <sup>1</sup>		<i>Fescue-Clover</i> <sup>2</sup>		<i>Fescue</i> <sup>3</sup>		<i>Fescue-Clover</i> <sup>4</sup>		<i>Fescue</i> <sup>5</sup>		<i>Fescue-Clover</i> <sup>6</sup>	
<i>Price Nitrogen (\$/unit)</i>	<i>Price Hay (\$/ton)</i>	40 units N Savings (\$/acre)	80 units N Savings (\$/acre)	40 units N Savings (\$/acre)	80 units N Savings (\$/acre)	40 units N Savings (\$/acre)	80 units N Savings (\$/acre)	40 units N Savings (\$/acre)	80 units N Savings (\$/acre)	40 units N Savings (\$/acre)	80 units N Savings (\$/acre)	40 units N Savings (\$/acre)	80 units N Savings (\$/acre)
\$0.50	\$60	\$5	\$10	(\$5)	(\$10)	\$20	\$30	\$0	\$0	\$35	\$60	\$10	\$20
\$0.50	\$80	\$15	\$25	\$0	\$0	\$30	\$50	\$10	\$15	\$55	\$90	\$20	\$35
\$0.50	\$100	\$25	\$40	\$5	\$10	\$45	\$75	\$20	\$30	\$70	\$120	\$35	\$55
\$0.50	\$120	\$35	\$55	\$10	\$20	\$60	\$95	\$25	\$45	\$90	\$150	\$45	\$75
\$0.60	\$60	\$5	\$0	(\$10)	(\$20)	\$15	\$20	\$0	(\$5)	\$30	\$50	\$5	\$10
\$0.60	\$80	\$10	\$15	(\$5)	(\$10)	\$30	\$45	\$5	\$5	\$50	\$80	\$20	\$30
\$0.60	\$100	\$20	\$35	\$0	\$0	\$40	\$65	\$15	\$20	\$70	\$110	\$30	\$45
\$0.60	\$120	\$30	\$50	\$10	\$10	\$55	\$90	\$20	\$35	\$85	\$140	\$40	\$65
\$0.70	\$60	\$0	(\$5)	(\$15)	(\$30)	\$10	\$15	(\$5)	(\$15)	\$30	\$40	\$5	\$0
\$0.70	\$80	\$10	\$10	(\$10)	(\$15)	\$25	\$35	\$0	\$0	\$45	\$75	\$15	\$20
\$0.70	\$100	\$20	\$25	\$0	(\$5)	\$35	\$60	\$10	\$15	\$65	\$105	\$25	\$40
\$0.70	\$120	\$30	\$40	\$5	\$5	\$50	\$80	\$20	\$25	\$80	\$135	\$35	\$60

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: \$.50/unit N = \$335/ton AmmNit and \$460/ton Urea; \$.60/unit N = \$400/ton AmmNit and \$550/ton Urea; \$.70/unit N = \$470/ton AmmNit and \$650/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 = \$.09/cow/day with weekly cattle move on stockpiled pasture.

Assumptions Feeding Hay: TDN=55%; DMI=2.0% hay+grain; Waste=35%; labor and machinery cost=\$.29/cow/day.

Assumptions Nutrient Value of Hay: Assumes 50% of P and K effectively recycled into pasture; \$.40/lb P<sub>2</sub>O<sub>5</sub>; \$.40/lb K<sub>2</sub>O.

Fescue<sup>1</sup>: 15.5 lb avg. dry matter response per lb N (80 lb application)

Fescue-Clover<sup>2</sup>: 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<sup>3</sup>: 21.1 lb avg. dry matter response per lb N (80 lb application)

Fescue-Clover<sup>4</sup>: 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<sup>5</sup>: 28.8 lb avg. dry matter response per lb N (80 lb application)

Fescue-Clover<sup>6</sup>: 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.

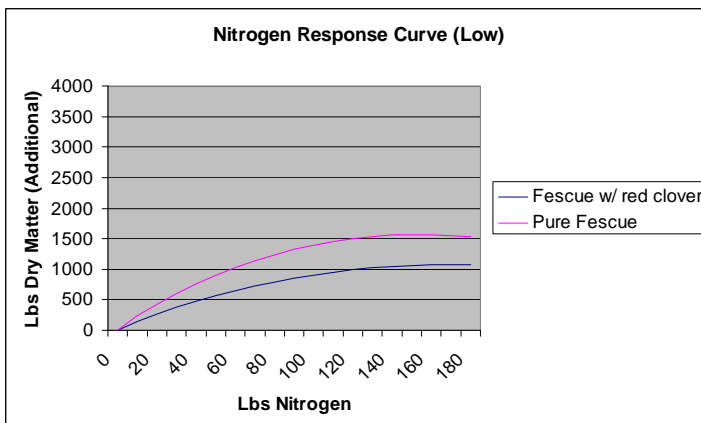
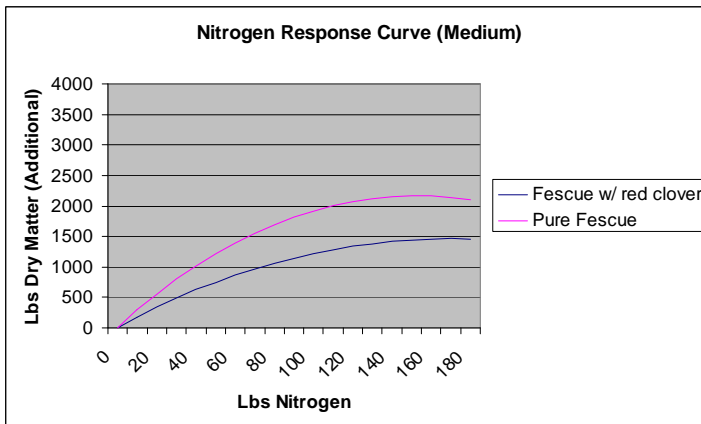
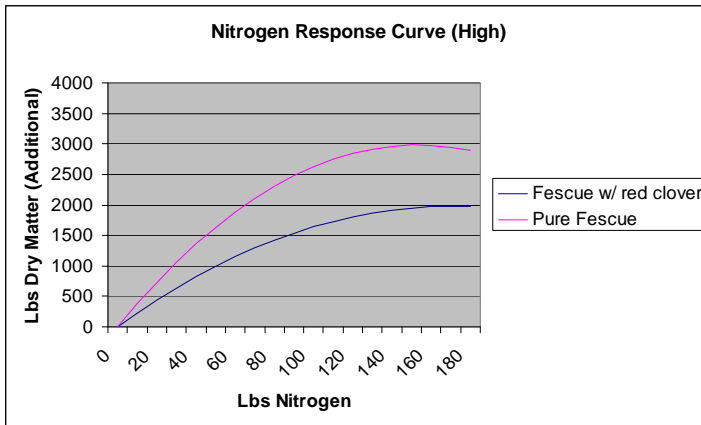
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**Table 2 – Recommended N Response Rating Based on Soil Type/Moisture Condition**

	Soil Moisture Conditions		
Soil Type	Ideal	Avg.	Low
Excellent	High	Med / High	Low
Good	High	Medium	Low / -
Fair	Med / High	Low / Med	-

**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.



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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):  
<http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>