



Foliar Injury: Spring Nitrogen Applications to Small Grains

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Introduction

Spring nitrogen (N) and sulfur (S) applications to wheat in Virginia are imperative for high yielding systems. Traditionally, Virginia farmers should apply N to wheat in 3 or 4 splits across the growing season to ensure optimal fertility and reduce chances for N loss. These applications occur in the fall to initiate tillering and again at Zadoks' growth stage (GS) 25 and 30 in the Spring (Alley et al., 2019). See figure 1 to better understand wheat growth stages. Sometimes an additional application is warranted in winter, leading to 4 total splits, but this is not a standard practice to follow.

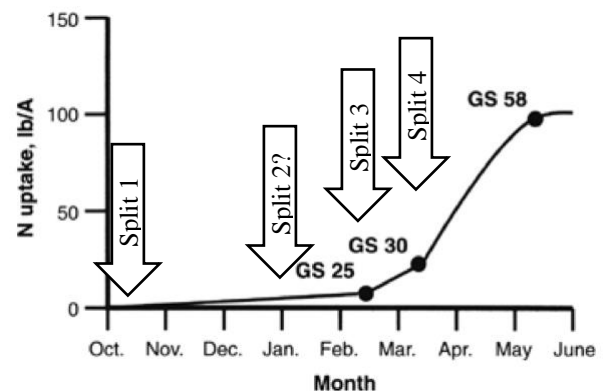


Figure 2. Nitrogen uptake over the small grains growing season in Virginia (adapted from Alley et al., 2019).

One main issue with splitting N and S fertilizer applications in Virginia is that warm weather will cause wheat and other small grains to advance quickly through growth stages. Compounded by weather conditions, i.e. too much rain, farmers may face the challenge of applying N and S fertility to wheat that is past Zadoks' GS30. Especially for S containing fertilizers, chances of foliar injury or "burn" may also increase. Fertilizers containing S may further increase injury during warm temperatures.

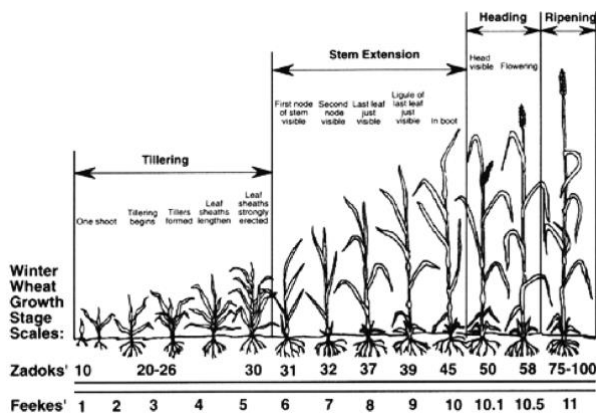


Figure 1. Winter wheat Zadoks' and Feekes' growth stages (Alley et al., 2019).

Questions often arise regarding the last Spring N and S application split (GS30) as temperatures rise and chances for wheat injury increase. However, we still recommend splitting N and S fertilizer applications over these particular growth periods to increase chances that leachable fertilizers, such as N and S, are applied as close as possible to when plants need large amounts of soil available N and S for plant uptake and growth (Figure 2).

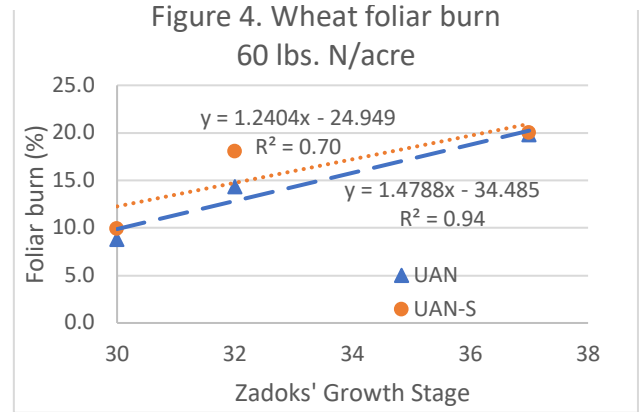
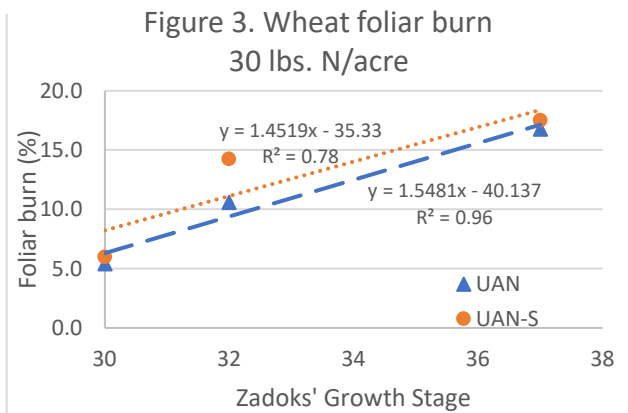
Foliar Injury

Foliar feeding any plant can lead to leaf injury (Image 1). Typically, minimal injury occurs on winter wheat during early spring growing conditions and early in the plants' lifecycle. However, greater injury occurs as the plant ages.



Image 1. Wheat injury from foliar N applications in research plots in Virginia.

For instance, work completed on the Eastern Shore of Virginia found that with 30 lbs. N/acre, wheat injury increased by 5.1% when fertilized at GS32 instead of GS30 when using urea-ammonium nitrate solution that contained 30% N (UAN; Figure 3). Overall, 10.8% foliar injury was seen when wheat was fertilized at GS37. Similar results were seen when 60 lbs. N/acre were used on the second Spring N fertilizer split, although overall leaf injury was about 5% higher than the 30 lbs. N/acre rate at each GS (figure 4). Although we would expect to see more injury from adding S into the fertilizer mix (UAN-S using 20-0-0-4S), injury was about the same as the no-S fertilizer in this particular study.



Wheat Yield

Does wheat injury from Spring N and S fertilizations matter? Yes and no. At GS30 and GS32, you may see visual injury to wheat, but yield was largely not impacted (Table 1). In work done on the Eastern Shore, applying 60 lbs. N/acre using either dry granular ammonium sulfate (AS), UAN, or UAN-S yielded the same, even though UAN and UAN-S had visual foliar injury and AS did not. However, this is not true once we delay fertilizer treatments into flag leaf development, GS37. As we would expect, foliar injury during this late growth stage did reduce yields at both 30 and 60 lbs. N/acre rates. Therefore, as we always recommend, protect the flag leaf and try to avoid plant injury at this point in development. However, in all cases, a nice yield response to N fertilizer as compared to the no-fertilizer control, was demonstrated regardless of GS or plant injury (Table 1).

Fertilizer Regime (lbs. N/acre)	GS30 (bu/acre)	GS32 (bu/acre)	GS37 (bu/acre)
No-fertilizer	55.0	56.5	58.0
AS-30	75.1	74.3	68.4
UAN-30	72.8	76.5	60.9
UAN-S-30	73.6	78.0	62.4
AS-60	78.0	80.3	81.7
UAN-60	78.8	80.3	72.8
UAN-S-60	77.3	78.0	74.3
Standard Error	5.2	5.9	3.0

Conclusions

Overall, we may see plant injury if Spring fertilizer is applied past Zadoks' GS 30. Here are a few points to remember:

1. You will likely see a N response if you apply fertilizer as late as GS37. If N is deficient, Virginia data has shown yield responses as late as GS40. Note that N rates should decrease as GS advances. No more than 60 lbs. N/acre and go down from there as GS goes up. See figure 2 for potential N uptake remaining for the season.
2. Protect the flag leaf! The closer you get to GS37, the more chance of injury and hurting yields.
3. Dry fertilizer sources will have little, if any, foliar injury. However, uniformity issues may be seen from using dry spreader trucks versus boom spray applications in small grains. Make sure you use high quality product, with consistent granule sizes, along with a spreader truck that is calibrated with

your specific dry product to aid in application uniformity.

4. We will likely see S yield responses in Virginia to wheat yield, dependent on cropping system and fertilizer history.
5. You can try to mitigate damage by applying fertilizer during cooler temperatures and before rain events, if possible. Rain events within 12 hours of application will dramatically reduce foliar injury.
6. Mixing UAN and UAN-S with water will dilute salts in solution and reduce foliar injury. Experience dictates that a 1:1 mixture of UAN:Water works well.
7. Using stream bars and stream jet nozzles will reduce leaf area that receives foliar injury. However, note that the area receiving the injury will be smaller, but more severe. In Virginia research, we did not see yield losses by applying N to wheat via streams vs. broadcast applications at GS25 and GS30.
8. Urea has much lower salt concentrations than UAN, so solutions of high-quality urea dissolved in water can be sprayed with less chance for injury. It should be noted that fertilizer grade urea often contains a coating and other impurities that require filtering before spray applications. Impurities and dissolved coatings will clog sprayer screens.
9. Currently, we have no research within VCE that demonstrates efficacy of any product additives that can reduce foliar injury to wheat. To date, no testing has been completed in this arena by VCE.

References

Phillips, S.B. and G.L. Mullins. 2004. "Foliar Burn and Wheat Grain Yield Responses Following Topdress-Applied Nitrogen and Sulfur Fertilizers." *Journal of Plant Nutrition* 27: 921-930.

Alley, M.M., P. Scharf, D.E. Brann, W.E. Baethgen,
and J.L. Hammons. 2019. "Nitrogen
Management for Winter Wheat: Principles and
Recommendations." Publication 424-026.
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