Nitrogen and Texas Wheat Grain Production—Topdress N Timing is Critical

Twelve Common Grower Questions about N for Wheat Grain

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In Texas, the timing of topdress nitrogen applications to wheat is a critical strategy towards optimizing grain production. There are some common misunderstandings about the practice which this publication will address. The most important concept discussed is the need for topdress nitrogen applications by the Feekes 5.0 growth stage (leaf sheaths are strongly erect, jointing is at hand—see below) to ensure the maximum potential yield. Additionally, twelve common questions regarding nitrogen fertilizer practices in Texas wheat grain production received by Texas A&M University AgriLife Extension specialists are addressed.

Key Definition: "Initial jointing"—This can refer to:

1) Development of a plant with an individual stem that now has a node in it (the stem is elongating as the head has been initiated), or
2) Initiation of scattered plants across a field that are starting to joint as described in #1 above. This publication emphasizes the latter scenario.

Understanding the importance of the latter definition is a key to properly timing mid-season N applications on wheat to increase yield potential.

In Fig. 1 topdress fertilizer N should have already been applied preferably at least one week prior if this individual plant is typical across the field. If it is typical, the first node of a few scattered plants observed in the field (key definition #2), topdress N should be applied immediately.

Leaf Sheaths Strongly Erect (Feekes Growth Stage 5.0)—Optimum N Topdressing

For a summary relating topdress N requirement and wheat growth stage, consult "Growth Stages of Wheat: Identification and Understanding Improve Crop Management." SCS-1999-16, from Texas A&M AgriLife Extension, http://varietytesting.tamu.edu/files/wheat/docs/mime-5.pdf
Many varieties of winter wheat have a prostrate growth habit during tillering but now grow vertically at Feekes 5.0 (Fig. 2). Historically once the wheat plant becomes strongly erect, all meaningful tiller development has ceased (the exception may be compensatory tiller growth after a damaging freeze). After the appropriate amount of winter chilling, growth resumes, and the growing point differentiates (growing point is located below the soil surface, e.g. crown). *At this stage of growth, the maximum size of the head—the number of seeds per spikelet, and the number of spikelets per head—is being determined.* Optimally timed field applied topdress nitrogen must influence this process for the best economic return. Topdress N application at

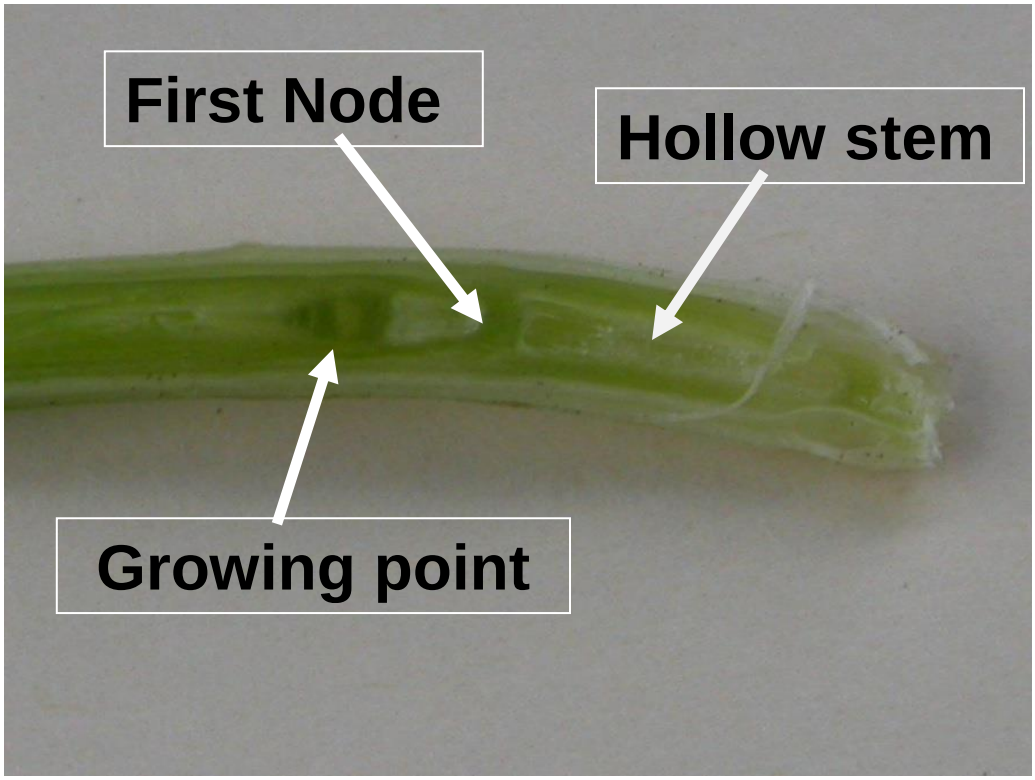


Figure 1. Sliced wheat stem reveals young growing point differentiation with hollow stem to the right. Growing point differentiation in this stem—spikelet number and seeds per spikelet—is likely complete. (Photo courtesy Dr. Rob Duncan.)

later dates, though still needed to meet plant N demand, will not affect the potential number of seeds per head (environment will). Delayed N fertilizer after jointing can still help yield but to a lesser degree, especially if the field was N deficient.

In summary, any tillers that develop after Feekes 5.0 are not expected to contribute to yield. Nitrogen applied at Feekes 5.0 likely increases seeds per head and seed size (though it will not likely affect the number of heads harvested). Thus Feekes 5.0 is the ideal time for "spring" *or late winter* topdressing optimum timing in Texas. (As one moves north in the central U.S. it is common in wheat country like Kansas to speak of 'spring topdressing,' which would be correct, but in all of Texas except the northwest Panhandle, topdressing N in Texas is truly late winter.) By the time jointing occurs, up to a week or so beforehand, the growing point begins differentiating from producing leaves to now determine the maximum number of potential spikelets and seeds per spikelet in the head.

N Timing Tip: It is sometimes difficult to decide when to topdress. Watch for the earliest nodes in the field. By the time the first few appear, if you have not applied your topdress N already, then do so immediately as the rest of the stems across the field likely have growing points that are now differentiating on most tillers.

Many producers miss the jointing stage of growth with their N topdress applications. Or though the N may have been applied there has been no rain or irrigation to move the N into the root zone. Therefore, growers are encouraged to apply topdress N prior to jointing to ensure the initial topdress N is on the field, in the root zone, and available to plants as the growing point differentiates. (For an explanation of how this N must be in the root zone and what you can do to influence the N getting there, see Question 3 below.) Initial jointing seems to average about March 1 (±7 days) in the Texas South Plains (Lubbock area) then later as you move north into the Panhandle, about March 15-20 in the northwest Panhandle. In contrast jointing in South Texas can occur up to a month earlier, by mid-February in Central Texas, and late February in the northern Rolling Plains. Wheat variety maturity will affect the timing in some cases, but that usually doesn't vary by more than a week at the most. There isn't all that much difference among varieties though early vs. medium-long maturating varieties will have a small influence as will late planting dates which delay jointing. Moderate to heavy grazing will also delay jointing (but grazing systems should have significant N already applied to drive forage growth).

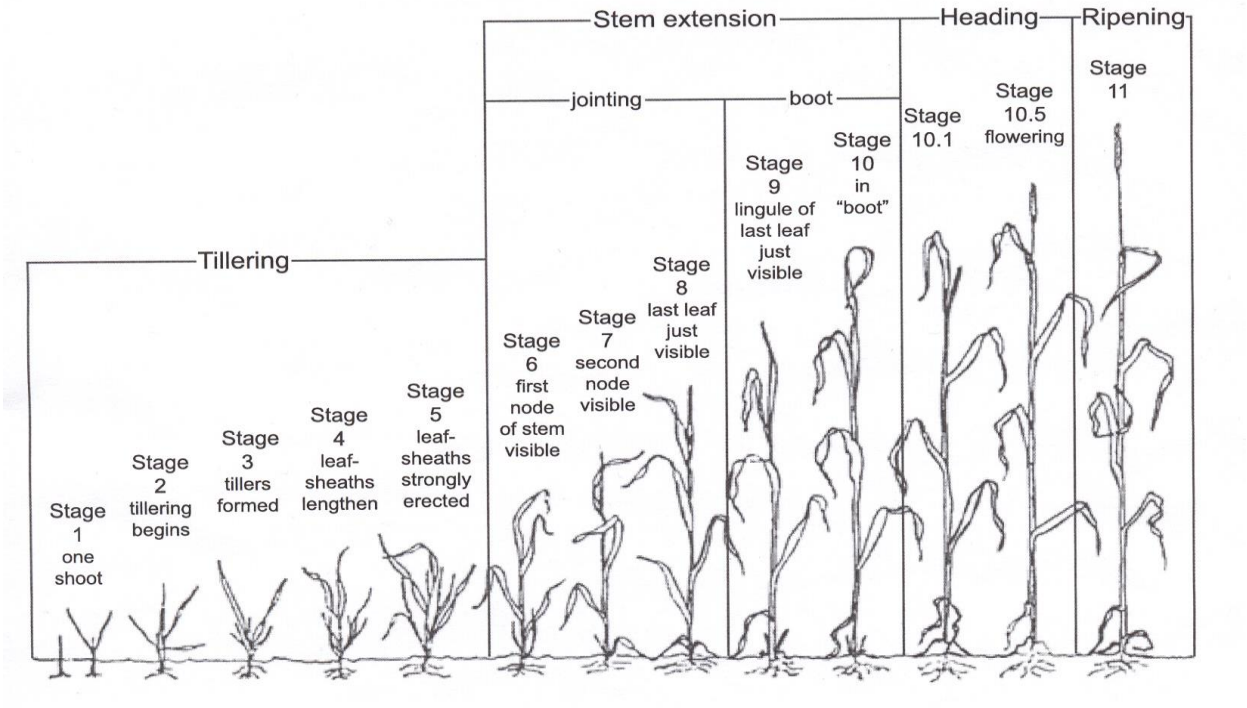


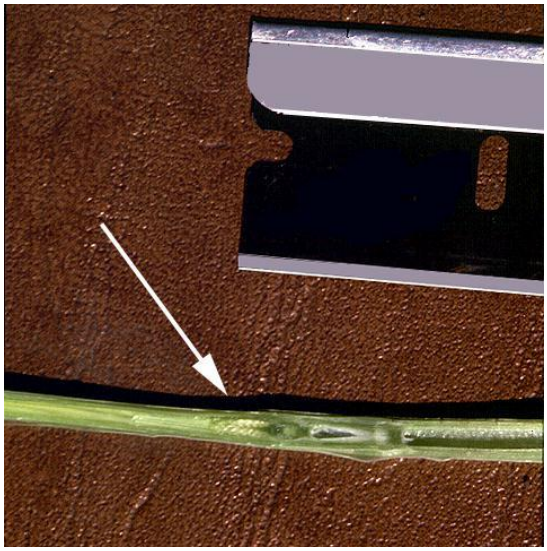
Figure 2. The Feekes scale of growth stages for wheat. Jointing occurs by Stage 6. By the time boot stage (10) occurs most of the N required by the plant has already been taken up. (Modified from Large et al., 1954).

<u>The following dozen questions summarize nitrogen issues for wheat grain production</u>.

1) What is the general N requirement for wheat grain production?

About 1.25 lbs. of N per bushel is removed from the field. (In contrast the same bushel of wheat grain removes about 0.45-0.50 lbs. of P per bushel.) Applied fertilizer N will reflect some inefficiency. Fertilizer N recommendations may vary due to the methods and interpretations used by an individual laboratory.

A



B

Figure 3A-B. A) Leaf sheaths are now strong erect, and jointing is likely underway. B) Growing point differentiation in stem is complete and a small head is developing down in the stem—spikelet number and seeds per spikelet have already been determined. If grazing and then going to grain, then cattle should have been off about 7 to 10 days prior. (A: Courtesy IPNI; B: Courtesy Billy Warrick.)

2) What are the common rules of thumb for gauging the amount of N to apply for wheat grain?

Through the years Texas A&M AgriLife across Texas has used the same rule of thumb for fertilizing nitrogen (N) in wheat for grain and wheat for grazing/grain depending on available soil test information:

Rule 1A) No soil test: 1.2 lbs. N per bushel of yield goal.

Rule 1B) With soil test: 1.5 lbs. N per bushel of yield goal, then reduce fertilizer N according to the level of nitrate-N reported in the soil test. The conventional soil test is based on a 6" sample, but the Texas A&M AgriLife Soil, Water and Forage Lab can provide recommendations for reducing N fertilizer to a depth of 24" (view the Profile Soil Sample Information Form under "Our Submittal Forms" at http://soiltesting.tamu.edu/). Additional information concerning manure or nitrate-containing irrigation water applications can be used to further reduce N fertilizer recommendations.

Rule 2) If grazing then going to grain, fertilize up to 2 lbs. of N per bushel of yield goal at planting. Then when the cattle come off (by first jointing), fertilize again with another 0.75 lbs. N per bushel of yield goal. Cattle must be taken off prior to jointing to ensure that grazing doesn't remove heads and reduce grain potential. It

is important to understand that the growing point has already begun differentiating (potential seed number and spikelet number already being determined). Therefore, the critical time for N topdress can be easily missed. Contact AgriLife Extension for a more refined version of Rule 2 that includes stocker weight, days of grazing, and a constant that may more closely detail N requirements.

Other states may also include factors such as soil type (sandy, clayey), previous crop (a possible N credit if a legume), and soil organic matter, but these factors are not currently included in Texas A&M AgriLife soil test recommendations for any crop.

3) When is the best time to top-dress N for grain yield?

All nitrogen should be on the field and in the root zone by the time the growing point differentiates during Feekes growth stage 5 (see page 2). Substantial declines in yield potential may occur if all or even a portion of topdress N is delayed after this stage.

Earlier application may be merited in following instances:

- If you put out minimal N in the fall at planting or are relying on higher residual soil N to carry the crop to jointing, then at least some N otherwise targeted for initial jointing should be moved forward for earlier application.
- *In dryland wheat production consider the weather forecast*. Topdress N applications do not become effective until the N is moved into the root zone by rain or melting snow. Therefore, once you are within about one month of when you would normally anticipate N topdressing based on growth stage, watch the weather forecast for a day or two when precipitation chances are significant (especially if well above 50%). Consider fertilizing in advance of the rain or snow chances. If you decide NOT to fertilize and ultimately you do not receive a rain or snow before initial jointing, then you will have missed this initial opportunity to effectively supply timely needed N to the developing wheat crop, and at this point you hope you do not have a prolonged dry spell that extends past jointing.
- **N Timing Tip**: Here is a good rule of thumb for N topdressing on wheat: "If you are having doubts about whether you should go ahead and topdress N on your wheat, go ahead and do it." The downside of being late is lost yield potential.

4) If I make a ground application of N fertilizer vs. applying through an irrigation center pivot, should I change my application timing?

When irrigation is available, it is best to time broadcast N applications to coincide with the next irrigation to dissolve and wash nitrogen into the root zone. If you need to irrigate but it is a little sooner than you anticipated putting the N on, consider making the N application early to take advantage of the water.

When N is applied through pivot irrigation it is advisable to go ahead and apply at least some of the needed N early to coincide with necessary/unavoidable irrigation events (as long as you will irrigate again by the time jointing commences). When applying N through the pivot ensure that your total N target is applied by growing point differentiation. Good moisture conditions are important at this time as well to increase yield potential.

5) Is there any benefit for N applied after jointing? What if I am late applying my N, should I still do it?

Late N in some cases may only affect grain protein content, but that is usually ignored when wheat is bought though the issue has come up in some years. Some buyers balk if wheat grain protein is less than about 11%. However, if a field has a general N deficiency, then it is possible that late application after jointing (e.g., growing point differentiation completed) is still needed to achieve the yield potential, though less, than what was set by the growing point differentiation into the numbers of seeds per spikelet and spikelets per head at that time. So, you may "catch up" to the pre-existing yield potential that was set, but you cannot increase it.

6) Should I split N applications between fall and late winter for rainfed/dryland wheat?

If you are fertilizing dryland wheat in the fall in drier climes of the state (Rolling Plains, High Plains), it is acceptable to put all N on in the fall at once. Splitting the N application is still agronomically a good idea (historically the split is about 1/3 fall, 2/3 at jointing). But this may be impractical for smaller amounts of N. On the other hand, if winter precipitation is good, and the wheat crop looks very good, you may wish to add additional topdress N in the late winter if yield potential appears higher than normal.

Conversely, especially for drier regions of Texas, you may choose to not apply fall N to dryland wheat (especially if you have modest residual N fertility) until you see that you have a satisfactory stand that appears to be worth fertilizing. If you postpone initial N, then consider moving topdress N forward (sooner) in the late winter.

7) There is a good chance of rain or snow in the forecast. Should I go ahead and apply my topdress N?

Yes, especially for dryland. This is especially important for drier regions of the state where average rainfall even for March is less than one inch. In fact, for dryland, you should place high emphasis on this, even if it might be up to a month before you would otherwise normally topdress. Rain or snow dissolves the N fertilizer, which is mobile, and moves it into the root zone. You might not get meaningful precipitation for another six weeks in the Rolling Plains and High Plains of Texas, which could be after jointing/growing point differentiation is complete. Furthermore, no applied N is of any value until it is incorporated by water into the soil, whether naturally or through irrigation.

8) My wheat stand is thin but uniform. Can N management help me overcome this thin stand?

Yes. Fall or winter fertilizer while the crop is still tillering, preferably before you begin to see any significant erect growth should help. So, consider advancing some of your N application to drive increased tillering to compensate for the thin stand in the field.

9) Is there a preferred N form to use for wheat topdressing?

Common N forms are all readily soluble, unless they are specifically designated as slow release. Nitrogen will dissolve and wash in to the root zone. Choose your N form based on cost per actual unit of N and/or the method or ease of application.

10) Is there a limit on how much liquid N can be applied with a ground rig without burning the leaves?

Texas A&M AgriLife has not documented the burn potential of liquid fertilizer N on the leaves. Other reports and field observations suggest that 50 units of N is safe, and possibly much more, however, this N must be irrigated into the root zone (and we would not gamble on getting a rain to wash it in). Nitrogen from liquid application may be subject to N losses due to high microbial activity on the leaves, especially if temperatures are warm (into the 70s°F). Ask your fertilizer dealer or applicator for guidance.

Similarly, foliar-applied N products are not recommended to serve the 2/3 N requirement at topdressing. These products are expensive per-N unit and wheat will respond quickly (2 to 4 days) to soil-applied N if the N can be moved into the root zone.

11) My irrigation water has nitrate-nitrogen (nitrate-N, or NO_3-N) in it—should I apply this toward my wheat crop N requirement?

Yes. This nitrate-N is fully available to the crop, and it should be credited 100% toward wheat N needs. Most irrigation waters in Texas average about 3 to 10 ppm nitrate-N, and some are much higher, even 20 to 50 ppm nitrate-N. Regions within Texas that tend to have higher irrigation water nitrate-N include the Texas South Plains and several 'hot spots' in Texas Rolling Plains aquifers, especially the Seymour Aquifer.

For every 1 ppm nitrate-N in one acre-inch of irrigation, you apply 0.23 lbs. of N per acre. For example, if you have 5 ppm nitrate-N and irrigate 12" then you have applied 14 lbs. N per acre, or about 23% of the N requirement for a 50 bu./A crop.

For further information, see Texas A&M AgriLife's "Nitrates in Irrigation Water—An Asset for Crop Production, E-619" (DeLaune & Trostle), http://agrilifebookstore.org

12) I had a major freeze that may have hurt my yield potential. Will late N applications drive compensatory tiller growth to recapture yield potential?

Doubtfully. If you have adequately managed your N fertility program for wheat it is doubtful that more N will be required. Nitrogen is mobile within the plant so if the growing point on a stem is killed, then that stem will not grow any more, and N within that stem can be mobilized to other stems. Furthermore, when freeze damage occurs, producers are inclined to minimize further inputs as yield potential has likely decreased. I do not recommend changing your N program after a damaging freeze. Added N at this point might in fact drive unwanted vegetative growth that does not contribute significantly to yield.

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Updates to this publication well be posted at the URLs below.

For updated Texas wheat production information and statewide wheat variety trial results (including "Pick" varieties for four regions of Texas), as well as past summaries, view reports online at:

- http://varietytesting.tamu.edu/wheat/
- https://amarillo.tamu.edu/amarillo-center-programs/agronomy/wheat-publications/

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