

# Planting Date and Variety Selection Effects on Wheat Yield

► Planting the right variety at the right time best ensures that wheat flowers at the optimal time, namely when the risk for freeze damage is at its lowest but before the onslaught of heat stress. Soil moisture conditions are another critical consideration. The key to maximizing wheat yields rides on two related decisions: choosing the right variety and planting it at the right time to ensure optimal flowering and, ultimately, maximum yield.

The problem with variety selection and planting is that there are no hard-and-fast rules. Both decisions are essentially a compromise with Mother Nature. Opting to plant early can improve crop establishment but can also cause early flowering, which increases the risk of frost damage. Early planted wheat is also more prone to pests, such as the Hessian fly and the fall armyworm, and diseases, such as barley yellow dwarf.

An added challenge in the Southeast is that wheat planting dates are closely tied to the harvest of summer crops, such as cotton and soybeans. Delayed harvest of these summer crops due to wet soil conditions may force producers to plant wheat later than preferred, increasing the likelihood that flowering will occur in hot, dry conditions. The end results are likely to be reduced yields and test weights.

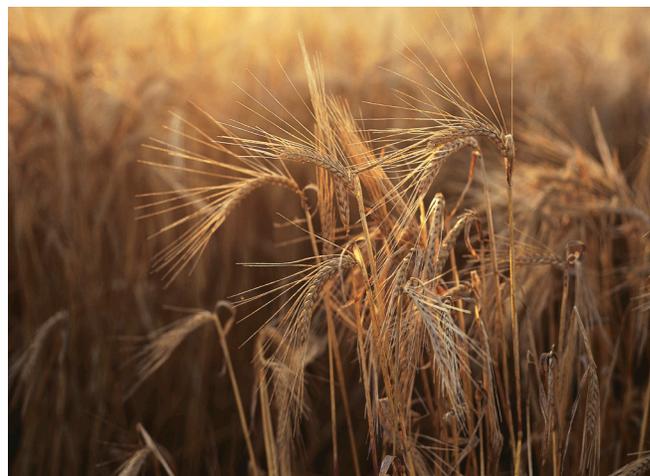
Much remains to be learned about the effects of variety and planting dates on yields and related issues. Between 2009 and 2012, researchers in Alabama conducted studies at various locations throughout the state to better understand how these decisions, coupled with seasonal climate variability, affect wheat growth and yield.

## Factors Affecting Wheat Development

### Low Temperature Exposure (Vernalization)

How well is your wheat moving between growth stages? *Development*, the term plant scientists use for this process, is heavily affected by two factors: temperature and day length. Winter wheat growth is reduced when average fall/winter temperatures drop below 50 degrees F. Wheat may even become dormant to protect itself from cold injury.

To overcome this dormancy, plants require a period of exposure to low temperatures. The process is called *vernalization* and results in the formation of flower heads.



### Key aspects

- Planting wheat too early can accelerate fall growth and increase the risk of damage from winter and spring frost as well as from Hessian fly and aphid infestations. Early wheat planting also increases the risk that the crop will run out of moisture before the reproductive stages begin.
- Late planting could result in winter damage and fewer tillers. In addition, late-planted wheat matures just when the risk for heat stress is higher, leading to the greater likelihood of reduced yields.
- Wheat varieties have specific cold temperature requirements to flower. Flowering may or may not occur depending on a combination of several factors: a variety's cold requirements, planting date, and prevailing weather conditions.
- To minimize yield risks, variety selection should be based on its cold requirements. The results from a growing number of studies have demonstrated the value of using climate forecasting to select varieties and planting dates. Research continues to demonstrate the strong correlation between projected climatic conditions for the growing season and crop yields.

Wheat head size, or the number of spikelets per head, is determined when the vernalization requirements are met. In the southeastern United States, most winter wheat varieties require three to seven weeks of vernalization.

To vernalize, early maturing varieties require less time (less exposure to cold temperatures) than do later-maturing varieties.

## Vernalization and Weather

Both warm and cold weather conditions can affect wheat growth development. Prolonged warm winter weather can cause wheat to lose some accumulated vernalization units. In such weather, varieties with longer vernalization requirements (approximately six weeks) will not fully vernalize.

A wheat variety receiving only a partial amount of cold weather required for vernalization either will produce few heads (between 1 and 10 percent) or it will produce full heads but mature when the weather is very hot, resulting in poor yield and test weight.

Note: In the Southeast, maximum vernalization occurs around 40 degrees F. An ideal vernalization day would have a nighttime low of around 38 degrees F. However, vernalization occurs even if maximum temperatures on a cold day are above 35 degrees F and nighttime low temperatures are below 50 degrees F.

The required length of low temperature exposure decreases with colder temperatures and advanced plant development.

## Day Length

Day length, the number of hours between sunrise and sunset (also known as photoperiod) can also affect the length of time required to reach flowering and heading stages. Variety selection should closely tie to a day length's anticipated effect on heading time.

There are some other special issues to consider with day length. For example, day length interacts with vernalization and heat units, which makes it difficult to predict its effect on wheat development, especially during mild winters.

Also, day length-sensitive wheat varieties are long-day plants, which means that flowering is induced by longer days. The longer the days, the fewer heat units are required to initiate flowering. When a long-day wheat variety is exposed to above average temperatures, early flowering and a short grain-filling period may occur. This might result in low yield and reduced grain quality.

**Table 1. Planting Dates Study in North, Central, and South Alabama 2010–2012. (Wheat planted within 2 days of planned planting dates.)**

Location	Planting Date			
	1	2 (Standard planting date)	3	4
North	Oct 15	Oct 30	Nov 15	Nov 30
Central	Oct 21	Nov 6	Nov 22	Dec 5
South	Oct 30	Nov 13	Nov 26	Dec 10

## Yield Differences Between Early and Late Plantings

Late planting may cause yield losses, especially on medium- and late-maturing varieties. Moreover, late-planted wheat has less time to tiller during the fall. Most tiller development occurs in the spring with late planting of late-maturing varieties, though spring tillers contribute less to yield potential than fall tillers. Late planting may also shorten the grain filling period and delay it until the weather is warmer.

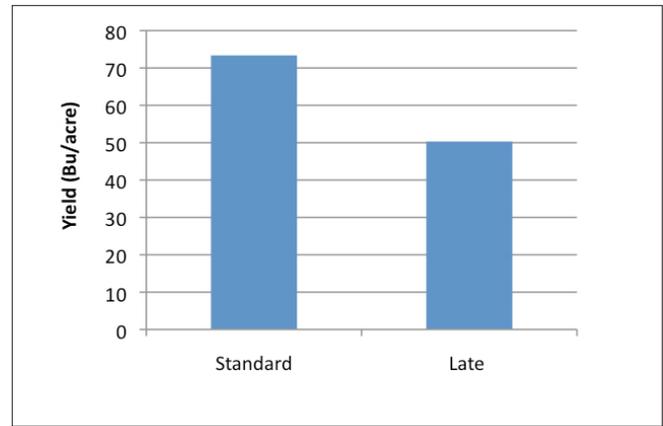
By contrast, early planting causes excessive tillering during fall and spring, which increases the risk for spring freeze injury. Excessive growth may also cause wheat to grow taller in the spring, which promotes lodging. The impact of planting date on final yield varies by location in the state.

Data from an Alabama field study conducted between 2010 and 2012 demonstrated the negative effects of delayed planting on wheat yield. Three wheat varieties, AGS 2060 (early maturity), AGS 2035 (medium maturity), and Baldwin (late maturity) were planted at different planting dates, each one 15 days apart, in north, central, and south Alabama (table 1).

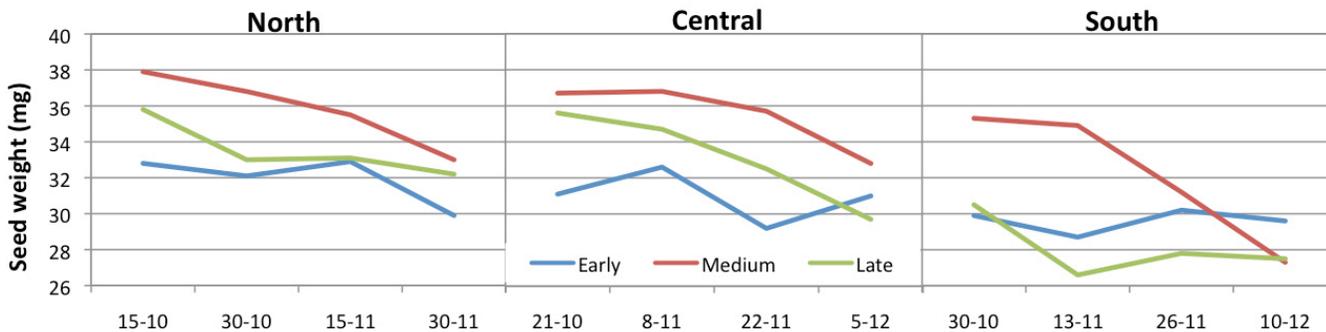
Comparing the standard planting dates used by Alabama producers (PD2) to the latest planting dates included in each test (PD4) reveals yield reduction both by year and location (figure 1). In north Alabama (Belle Mina), yield losses of 21 percent, 12 percent, and 21 percent were observed for the 2010, 2011, and 2012 seasons, respectively. In south Alabama (Headland), yield losses for the same years were 16 percent, 20 percent, and 55 percent. In central Alabama (Shorter), no yield differences were observed in 2012; however, yield losses between 26 percent and 28 percent were observed in 2010 and 2011 (figure 1). The data also



**Figure 1.** Impact of planting date on wheat yield at three locations in Alabama. Average yield of three varieties planted between 2010 and 2012



**Figure 2.** Impact of planting date on wheat yield for the AGS 2060 variety (early maturity) at Tifton, Georgia. Average wheat yield for the AGS 2060 variety planted at the Tifton wheat variety trials between 2006 and 2011.



**Figure 3.** Seed weight differences between planting dates for early, medium, and later maturity varieties planted in north, central, and south Alabama (2010 and 2011 data).

showed that planting 15 days earlier than the producers' planting date resulted in yield increases in 2010 and 2011 across all locations, though no benefits to this earlier planting date were observed in 2012.

The effect of planting date on yield was also studied using data from 14 years of trials in Tifton, Georgia, (1997–2010). Data showed yield declines in varieties the develop heads late in the season. Yield losses were higher for later planting dates than for the standard planting date. Figure 2 shows the wheat yield reductions a producer at Tifton might expect by planting an early maturity variety such as AGS 2060 a month later than the standard planting date.

### Variety and Planting Date Options

Choosing the right variety and planting it at the right time can positively affect wheat development and final yield. This means choosing varieties and planting dates best suited to your specific growing season and location.

### Important Points to cConsider:

- The differences among varieties are most expressed at heading date and least expressed at maturity when the grain moisture is almost the same.
- In selecting varieties and planting dates, be aware of freeze damage and vernalization.
- Producers in the southernmost areas might choose early plantings for short vernalization varieties. This carries some risk, because early plantings increase the likelihood of early growth, which, in turn, may result in severe winter kill or damage from late-spring freezes.
- Early maturing varieties are good options for planting late in the season. In cases where you don't have information about a variety's vernalization, remember that, as a general rule, it requires little to vernalize.
- Take special care with delayed plantings of early maturity varieties in the southernmost areas. In cases

where planting is delayed a month with respect to the standard planting date, yield losses tend to run higher than they run in northern areas. (figure 1 and figure 2).

- Later maturing varieties, which are more likely to avoid freeze damage, are generally better suited to the northernmost regions. Data collected in Belle Mina, Alabama, between 2010 and 2012 show that early plantings for medium and late maturity varieties resulted in higher yields compared to the early maturity variety. Yield losses and low test weight might be expected if choosing late-maturing varieties for late plantings because of lack of proper vernalization or late grain filling occurring in hotter weather.
- Delayed planting date may result in reduced yield, reflected in reduced seed weight, though these effects vary between varieties and locations. In north and south Alabama, the medium maturity variety (AGS 2035) exhibited the highest seed weight reductions stemming from delayed planting (figure 3). On the other hand, delayed planting of the early maturity variety (AGS 2060) had the least effect on seed weight. For the late maturity variety Baldwin, seed weight differences were significant between first and last planting across all locations.

## Seasonal Climate Variability and Wheat Yield

In the southeast United States, El Niño Southern Oscillation (ENSO) affects climatic conditions during the fall, winter, and spring and is most pronounced in precipitation and surface air temperature. ENSO has three phases: Niño, Niña, and Neutral.



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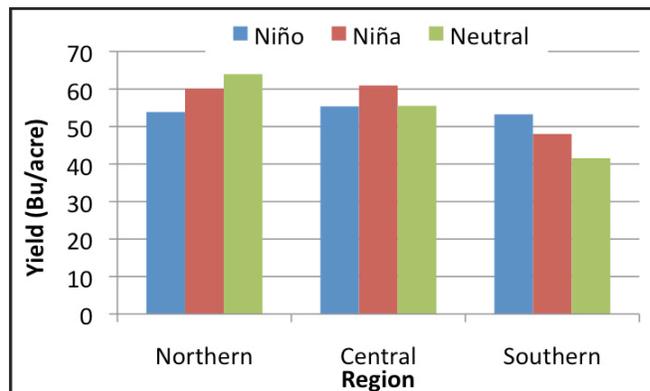
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**Figure 4.** Wheat yield differences between ENSO phases for three regions in Alabama. Source of data: Alabama official variety trials (1982-2010).

On average, El Niño winters tend to be wet and cold, while La Niña winters tend to be warm and dry across the Southeast. These changes in climatic conditions seem to be related to yearly wheat yield differences. The ENSO impacts on wheat yield change throughout Alabama. La Niña phase results in high yield in north Alabama, while the El Niño phase tends to express more positive effects on wheat in the southern areas of the state (figure 4).

The impact of planting date on yield appears to be exacerbated by seasonal climatic conditions. For example, wheat yield data from 14 years of trials in Tifton, Georgia, (1997–2010) indicated lower yields under the La Niña phase than under the El Niño phase. Tifton-area research also revealed the highest yield penalties associated with delayed planting expected during the La Niña phase rather than the El Niño and Neutral phases. Overall, yield losses associated with delayed planting are strongest during the La Niña phase, moderate during the Neutral phase, and smallest during the El Niño phase.

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