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# Planting Dates in Wheat Production in Southern Idaho

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## Introduction

APPROPRIATE PLANTING DATES help to maximize grain yields and quality. Planting date can influence susceptibility to insect pests, diseases, drought, lodging, and inclement harvest conditions. It can affect variety performance and selection, water management, and other aspects of wheat management.

Planting dates can be too early or too late, with each scenario involving specific risks. Planting winter wheat too early can increase the risk of infection by viral diseases vectored by late summer or fall insect populations and increase the risk of infection by certain soilborne or airborne pathogens. Planting winter or spring wheat too late brings its own risks involving disease susceptibility, insect feeding, and inclement conditions during seed fill and harvest.

For all their importance, planting dates cannot always be controlled. In the fall, growers must wait for the previous crop to be harvested then manage the resulting residue and prepare a seedbed. They may need to wait for seed and fertilizer, land leveling, new irrigation system installations, financing, landlord agreements, or title transfer. Growers may also delay planting while they wait for appropriate weather and soil conditions to plant. Sometimes planting other crops or conducting other field operations has greater priority.

Planting too early can occur when limited time and labor are available between other crop harvests or farm operations. Producers may opt for suboptimal wheat planting dates to ensure adequate resources are available for timely subsequent crop harvests. Whatever the reason, planting winter wheat too early or delaying plantings of winter or spring wheat can be problematic, reducing both yield and quality.

The focus of this publication will be on planting dates for southwestern (SW) Idaho, although much of the information will be pertinent to other areas. Planting dates have been a research focus in SW Idaho for three decades, in part because the cropping system is diverse and the planting date window is so long. Research has dealt primarily with the effects of late plantings.

## Planting windows and optimal planting dates

Planting windows vary in different regions of the state. Fall planting windows may be as narrow as 1 month in northern Idaho or the higher elevations of eastern Idaho, where crop harvests in late summer occur only a month or two before soil conditions hinder planting.

**Contents**

Southwestern (SW) Idaho crops are harvested from early July (peas, winter barley) to mid-November (grain corn, sugarbeets), providing a much wider planting window prior to soil freezing.

Studies conducted in SW Idaho show that winter wheat is most productive when planted from late September to mid-October (Brown, 1992). For spring wheat in SW Idaho, early to mid-March is considered optimal unless soil conditions allow earlier plantings.

In northern or eastern Idaho, weather and soil conditions generally dictate earlier optimal planting dates for winter wheat and later plantings for spring wheat.

## Planting date and tiller development

Understanding the influence of planting date on plant development can be useful in accounting for planting date effects on yield as well as for wheat's susceptibility to pests. Tillering—the increase in the number of stems developed from a single plant—is the most critical component for cereal crop yield. In fact, up to 70% of yield is directly related to tiller production (Thiry et al., 2002). Tillering begins with the emergence of the fourth leaf from the main stem. Optimum fall planting dates provide the heat units for some tillering to occur before the onset of winter dormancy. Tillering continues when plants break dormancy and resume growth in late winter or early spring and stops with the initiation of the reproductive phase of growth.

### Early planting

Fall-planted grain may tiller for an extended period during growth in the fall and spring, and planting too early may cause excessive tillering. The last tillers initiated typically have fewer and smaller kernels and may produce vegetative mass without any seed. Tillers without seed may still contribute to yield by supplying some carbohydrates and nutrients to earlier developed tillers. It is not clear if excessive tillers can actually reduce yield in irrigated wheat, but early plantings tend to be less productive even in the absence of disease or pests. Certainly excessive tillering can increase stress on plants by increasing competition among tillers for water, light, and nutrients. Excessive tillering may also increase the risk of lodging.

**Table 1.** Effect of planting date on winter wheat yield, Parma, Idaho, 1985 and 1986.

| Planting date | Heads per foot | Kernels per head | Weight per 200 kernels (ounce) |
|---|---|---|---|
| **1985** | | | |
| October 12 | 387[a] | 39[a] | 0.286[a] |
| November 15 | 315[b] (-18.6%) | 42[b] (+7.7%) | 0.293a (+2.5%) |
| **1986** | | | |
| October 18 | 335[a] | 44[a] | 0.286[a] |
| November 14 | 272[b] (-18.6%) | 46[b] (+4.5%) | 0.303[b] (+6.2%) |

*Note:* Values within years followed by different letters are significant at the 10% probability level.

### Late planting

In SW Idaho, research has focused primarily on late planting dates as historically they were more common than planting too early. Late planting results in decreased tillering. Tillering is primarily responsible for the number of heads and seeds that develop per unit area. Plants can overcome limited tillering and the production of fewer heads to some extent by producing larger heads, more kernels per head, or larger kernels, but these typically don't fully compensate for the reduction in the number of tillers and heads that occur with late plantings (table 1). Table 2 illustrates the adverse effect of late planting on wheat grain yield and quality (test weight).

**Spring vs. fall tiller emergence.** Tillers emerging in spring contribute less to yield than fall-emerging tillers. This has been observed in SW Idaho in comparisons of drilled and broadcast wheat seeded on the same day near November 1. The fall broadcast seedings produced lower yields than the drilled wheat because

**Table 2.** Effect of seeding date on wheat grain yield and test weight, Aberdeen, 1991–97.

| Planting date | Yield (bushels/acre) | Test weight (pounds/bushel) |
|---|---|---|
| **Winter wheat** | | |
| September 20–October 3 | 119.3 | 59.3 |
| October 8–October 20 | 112.9 | 58.2 |
| October 22–November 8 | 105.1 | 57.5 |
| **Spring wheat** | | |
| October 22–November 8 | 104.5 | 59.8 |

*Note:* All dates were not represented in all years. Data were adjusted for missing years.

*Source:* Adapted from: Robertson et al., 2004.

their emergence and tillering were delayed. This was the case even when the delayed-emerging broadcast wheat tillered in the spring, resulting in the same total number of tillers as the earlier-emerging drilled wheat.

**Compensation for reduced stands or winterkill.** Late-winter or spring-planted cereal crops tiller for a shorter period and, therefore, are less capable of producing adequate tiller numbers and heads. Winter wheat yield is fairly resilient to reduced stands from winterkill or poor establishment when adequate spring tillering and increased head numbers can compensate for fewer plants. With late-planted winter wheat, reduced spring tillering and fewer heads limit the yield compensation that occurs. Spring seedings have even less opportunity to compensate for poor stands as the tillering period is limited.

**Spring wheat vs. winter wheat.** Spring wheat planted in late fall or early winter is not uncommon in SW Idaho, particularly where certified seed production and potentially higher yields afford economic opportunities sufficient to justify the increased risk of winterkill. With similar late-fall planting dates, spring wheat breaks dormancy earlier and normally heads prior to winter wheat. Late-fall or winter-seeded winter wheat yield is typically more negatively impacted by delays in emergence and heading associated with delayed planting than spring wheat planted the same day (Brown, 1992).

**Photoperiod.** Varieties that are photoperiod (or day length) sensitive initiate the reproductive phase with a specific combination of daylight and darkness. Most varieties released for the Pacific Northwest are photoperiod sensitive. When the reproductive phase is initiated, the head begins to differentiate and move up the stem, the stem elongates, and tillering or new stem development ceases. Delayed plantings shorten the tillering period before photoperiod initiation of the reproductive stage. Late-spring plantings are particularly vulnerable.

**Temperature.** Grain filling occurs between flowering and physiologic maturity. Grain filling occurs more slowly, for a longer period, and more completely with cooler temperatures. Warmer temperatures cause more rapid grain filling but shorten the grain filling period and limit the amount of grain filling that occurs. Hotter temperatures during grain fill result in smaller kernels and lower test weight.

## Planting date and pests

### Early planting

Winter wheat planted too early may be more susceptible to insect feeding by aphids or the wheat leaf curl mite. The feeding results in virus infections that significantly reduce plant vigor and yield. While insect feeding and disease spread can be controlled to some extent with chemicals, either seed treatments or other products, once plants are infected there is little that can be done. Barley yellow dwarf and wheat streak mosaic are serious virus diseases associated with planting too early (Marshall and Rashed, 2014). In the past, Russian wheat aphid feeding was more severe with the earliest plantings of winter wheat, particularly where nearby wheat hosted the aphids. In some areas of northern Idaho, on the other hand, early-planted spring wheat may be less susceptible to the Hessian fly.

### Late planting

While planting too early in the fall increases the risks of virus infections in winter wheat, late-planted and later-maturing wheat may be more susceptible to late-spring insects and diseases. Newly emerged winter wheat from late-fall seedings is a more desirable host for the cereal leaf beetle than is earlier planted wheat, especially when nearby, earlier-planted wheat is further along. Likewise, later-emerging spring wheat is preferred by the cereal leaf beetle over earlier-established spring wheat. Beetle infestations in later-maturing wheat (winter or spring) may require chemical control that earlier plantings did not.

Later-maturing grain is typically also more infested with aphids that may feed on the developing grain. Avoiding planting winter wheat too early and planting spring wheat as early as possible are recommended to minimize the aphid infestation risk (Peairs, 2014).

Late-maturing wheat may also be more susceptible to spring stripe rust infection. Rust infection of late-planted wheat can occur at earlier stages of plant development and both spread and become more severe in wheat that stays green longer.

The risks of pests need to be considered together with all the other effects of planting dates. Pest considerations alone may be enough to affect planting dates, especially if no other means are available or practical to mitigate risks from those pests. However, the yield and quality concerns with planting dates in the absence of pest or pest-related issues also need to be considered.

## Late planting and yield

Extensive data collected over the years in SW Idaho clearly show that the net result of later plantings is reduced yield. During 1993–96, yield of winter wheat declined as much as 4% for each week's delay in planting beyond October 1 (figure 1).

For spring wheat plantings, the yield reduction for each week of delay ranged from 5% to 7% between late February and mid-April (figure 2). These estimates are in line with those from elsewhere in the region; the percentage yield decline was 4% in Washington and 7.7% in Utah for each week's delay in planting. Recent grower guidelines for spring wheat developed by Washington State University state that the earlier the planting date, the higher the grain yield. The recommendation is to plant as soon as soil moisture allows for fieldwork in March or April (Miles et al., 2009).

Beyond mid-April at Parma, the percentage yield decline for each week's delay in planting was 23%, but data are limited. The yield decline in SW Idaho from a mid- to late-November dormant fall seeding of spring wheat (with spring emergence) as compared to a mid-February seeding is typically less than 5% for the entire period (data not shown) because for most of the period soils are at or near freezing, and there is little physiologic activity in the seed.

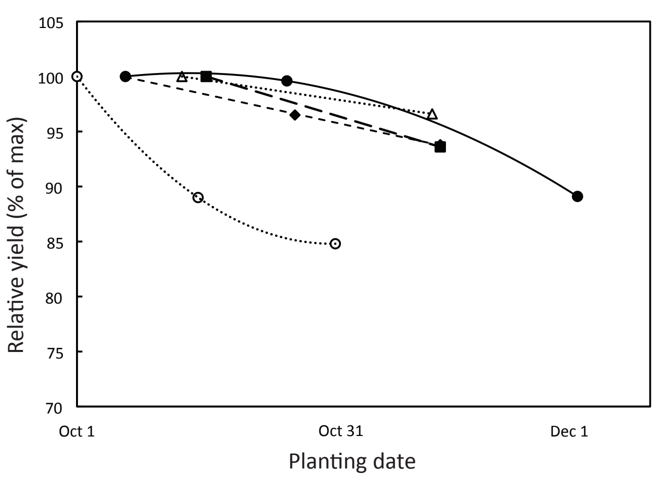


**Figure 1.** Effect of fall planting date on winter wheat yield in five different years (different lines), Parma, Idaho, 1993–96.

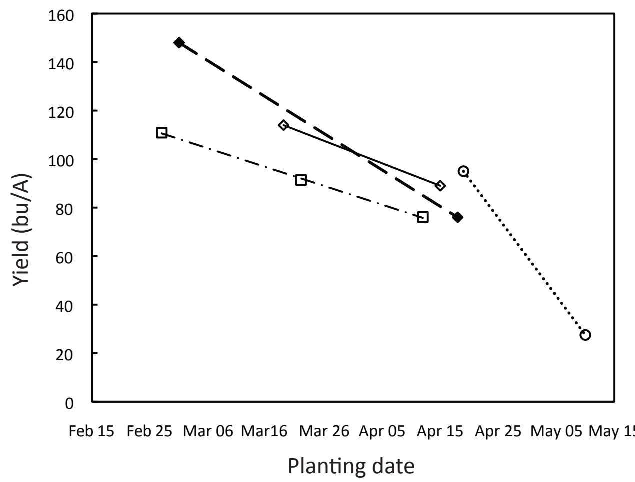


**Figure 2.** Effect of spring planting date on spring wheat yield in four different years (different lines), Parma, Idaho, 1993–96.

## Late planting and quality

Late plantings typically result in delayed maturity. Warmer temperatures during seed development may hasten seed fill, but they shorten the duration of fill even more (Herbek and Lee, 2009). Poorer seed fill not only reduces yield but can reduce test weight as well.

In the event that later-maturing wheat requires later harvest, there is also increased risk of summer showers that contribute to sprout or hail that causes physical damage. In 2014, for example, earlier maturing winter wheat in southcentral and southeastern Idaho was harvested before significant August rains, but the later-harvested wheat was largely marketed for feed at a significant price discount due to severe sprouting.

## Planting date and water

Another important consideration is soil moisture conservation. Wheat seeded very early in the fall will naturally use more soil water than wheat planted later, reducing the amount of soil water available for plant development in spring. Moisture depletion can be an issue with early fall plantings especially when fall growth is excessive. It is not uncommon in SW Idaho to observe wheat fields with evident moisture stress (lower leaves turned yellow, arrested tiller development) in late winter or early spring before irrigation water is available. Early season moisture stress can be alleviated once irrigation water becomes available, but the stress by then may affect not only tiller development but seed numbers per head as well.

Higher temperatures during grain fill also increase daily

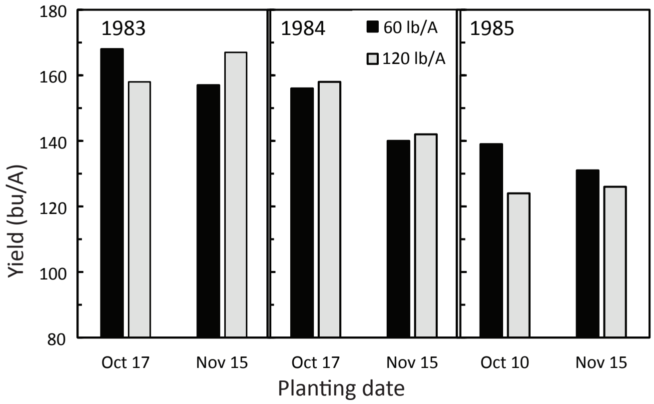


**Figure 3.** Effects of planting date and seeding rate on winter wheat grain yield, Parma, Idaho, 1983–85.

evapotranspiration (ET) and crop water needs. Soils dry more rapidly, and more frequent watering may be necessary. This can be problematic in pivot systems that may struggle to keep up with the ET demand.

Wheat maturing later due to later planting may also require later watering at the end of the season. In years when water is scarce and the irrigation season shortened, water may not be available to finish the crop. Yields are negatively affected by any stress, including high temperatures and low available water during grain fill. The unfavorable growing conditions shorten the duration of the grain-filling period, lowering yield.

# Compensating for late planting

## Seeding rate

Later seedings result in fewer tillers and fewer heads or seeds per acre. Higher seeding rates can compensate in some cases but not always.

For winter wheat in a 3-year study at Parma, a seeding rate of 60 pounds per acre was consistently more sensitive to late planting than a seeding rate of 120 pounds per acre (figure 3). With late plantings, the higher seeding rate had little effect on yield in 2 of 3 years, but increased yield in 1983.

Figure 4 shows winter and spring wheat yields as affected by seeding rates at different planting dates in eastern Idaho sites. Even when higher seeding rates provide stems and heads comparable to earlier seedings, higher temperatures during grain fill of later-maturing seedings and the associated reduced grain filling can limit the effectiveness of higher-seeding-rate strategies.

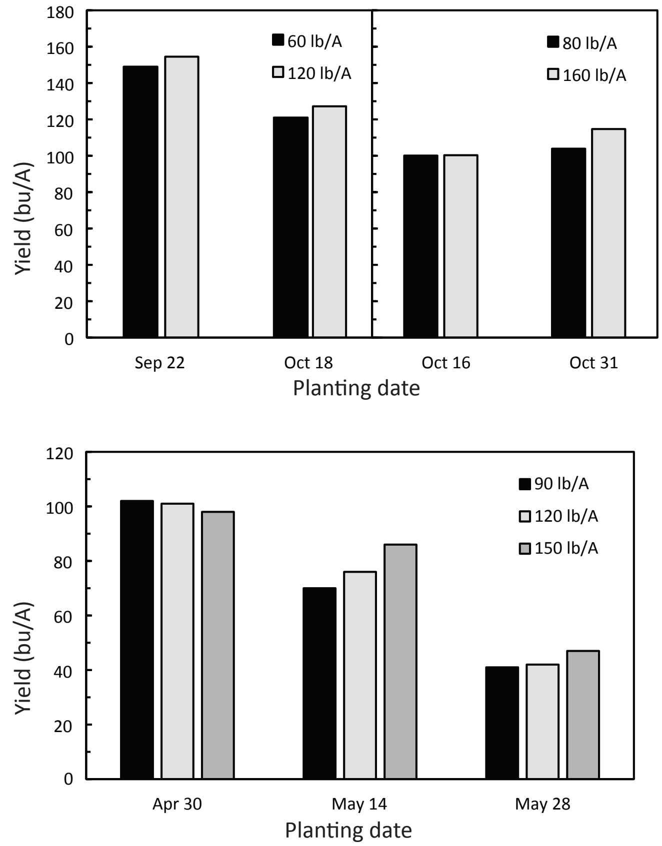


**Figure 4.** Effects of planting date and seeding rate on winter wheat grain yield, Kimberly, Idaho, 1983–84 (top), and spring wheat grain yield, Aberdeen, Idaho, 1986 (bottom).

## Phosphorus fertilization

Phosphorus (P) fertilization has been proposed to compensate for late planting, since early availability of P can increase winter survival and tillering and hasten plant development (USDA NIFA, 2015). We evaluated pre-plant, broadcast-applied P in early and late-planted winter wheat at Parma in soils with marginal available P (figure 5). Late-planted wheat was less productive in all years. In 2 of 3 years with no lodging (1985 and 1986), the yield increase from applied P was no more evident in late-planted wheat than it was in early planted wheat.

Despite this, P should be applied to late-fall-planted wheat to improve availability of this nutrient, enhancing winter survival and improving crop yield particularly when phosphorus availability is limited. Yield of late-planted wheat is not likely to increase when available soil P is already high from applications of fertilizer, compost, or manure to row crops in the rotation.

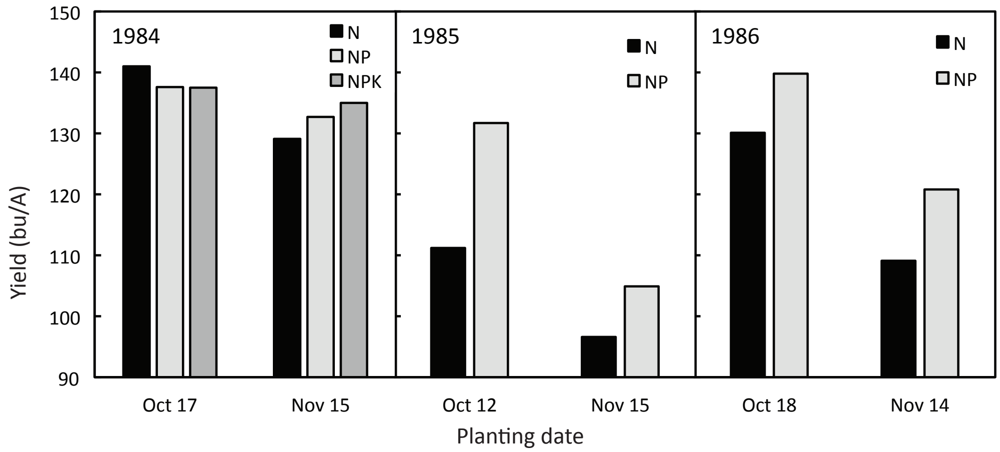


**Figure 5**. Effect of phosphorus application on grain yield of early and late-planted winter wheat, Parma, Idaho, 1984–86.

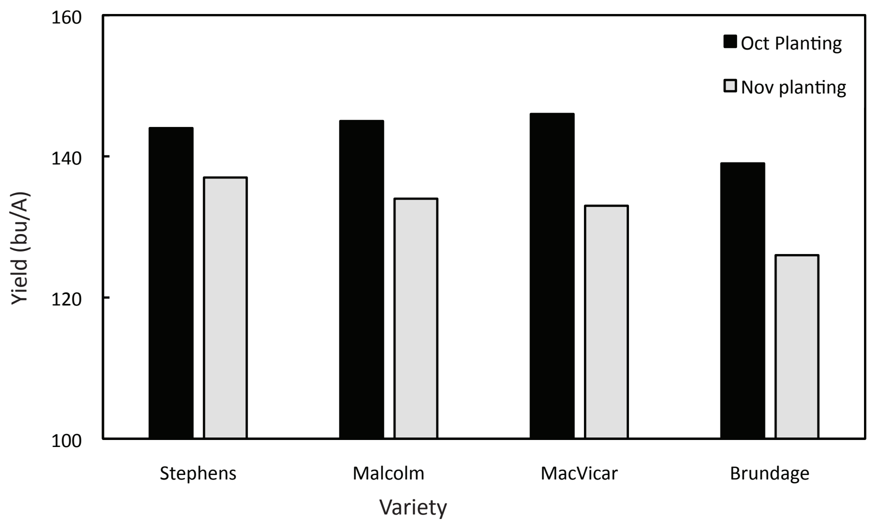


**Figure 6.** Effect of planting date on performance of winter wheat varieties, Parma, Idaho, 1996–2001.

# Variety selection

## Winter wheat

The relative performance of varieties may change with planting date (figure 6). Our first indication of this was in a 1983 trial. Stephens, Hill 81, and Daws were planted October 14 and November 15. The yield reduction with planting later (mid-October vs. mid-November) was only 0.9% for Stephens but 4.7% for Hill 81 and 6.3% for Daws, the most winter hardy of the three. The yield decline with later planting was due to either smaller kernels (Hill 81) or fewer kernels per head (Daws).

Stephens' resilience to late planting is largely responsible for its longevity as the leading irrigated soft white winter wheat grown in southern Idaho, where much of the winter wheat is planted late after the potato or sugarbeet harvests. Because so much of the wheat is late planted, a relative-performance evaluation of varieties under both early and late conditions in SW Idaho was initiated in 1996 and continued to 2008. The results over several years confirmed that some varieties, such as Stephens, are better suited for later plantings than some others.

Winter wheat varieties commonly grown in Idaho since 2001 and their relative susceptibilities to yield loss due to delayed planting are shown below:

- Least susceptible to delayed planting—Stephens, AP Legion, WB 528, Tubbs 06, Bruneau
- Most susceptible to delayed planting—Brundage, ORCF 102, Goetze, Bitterroot, Skiles

## Spring wheat

Although winter wheat is more predominant in SW Idaho, a few studies have shown that spring varieties also can differ in their susceptibility to later plantings. A study at Parma in 1996 compared March 19 and April 15 planting dates and found the later planting resulted in a 22% to 32.5% yield loss depending on the variety.

Information about new variety releases seldom includes their relative performance in late plantings. Routine comparison of the performance of new winter and spring wheat varieties in both early and late plantings in variety testing would be useful.

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