When is the optimal time to plant rice in the Sacramento Valley?

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Factors affecting planting date

In the Sacramento Valley, most rice is planted in May with 50% of the acreage typically being planted by May 10. However, timing varies from year to year. Growers typically plant rice in the Sacramento Valley as early as possible and this depends on three primary factors:

1. *Sufficiently dry weather to prepare a seedbed*: Following the winter flood period rice fields are drained usually in early February and allowed to dry. When sufficiently dry enough to allow machinery on the field, the field is "opened up" with a plow which helps speed up the drying process. Fields are "typically" dry enough to begin seedbed preparation (plowing, disking, leveling, fertilizer applications) in early to mid-April. Under such cases planting can begin in late April and early May. A dry early spring can make these operations proceed a bit faster while rain in March, April and May can significantly delay field operations.
2. *Warm temperatures*: Temperatures need to be sufficiently warm to allow the rice seed to germinate and the seedling to grow. Optimal temperatures for seedling emergence and growth are above 77^{o}F. Such temperatures typically occur late April in most parts of the Sacramento Valley.
3. *Availability of water:* Unless there is access to a well, planting cannot proceed until there is irrigation water available from the irrigation district.

While planting on a certain day may be optimal, growers usually have a number of fields which they cannot have ready all on the same day. Rather it takes time to get fields ready for planting and equipment is moved from one field to the next in order to prepare a seedbed as fast as possible. Certainly having more equipment and labor help speed up land preparation but this is not always an option for growers. Also, just because a field is ready for planting does not ensure there will be enough water to flood the field. Flooding a field for the first time in a season requires a large head of water and irrigation districts are limited in the amount of water that they can provide at any given time based on the canal system.

Effect of planting time on harvest

Planting time affects the harvest date. Harvest typically occurs in September and October and this is affected by planting time and variety. Delayed planting, cool years which delay crop development, and planting late duration varieties too late can result in harvest during late October and November which coincides with the onset of cool weather and rain. Cool weather and rain further delay harvest for three reasons (1) it takes rice longer to mature, (2) rice grain does not dry down fast, (3) it is harder to get harvest equipment into the field. In addition, late harvests can have negative effects on grain quality (both physical and increased molds) and increase drying costs due to having to harvest grain at higher moisture contents.

Effect of planting time on rice yields

Does time of planting affect rice yields? We compiled and analyzed data from all UC Cooperative Extension variety trials from 1999 to 2014. During this period rice was planted between April 20 and June 9. Yields across planting dates were highly variable due to many factors that can affect planting on any given date; however, there was a significant effect of planting time on yield with every day delay in planting reducing yield by 0.23% (Fig. 1). This equated to 21.1 lb/ac; thus a delay of 30 days would reduce yield by over 630 lb/ac. In order to provide another

assessment of planting date on yield we calibrated the ORYZA2000 (V3) rice model for California rice systems. Using weather data (Durham CIMIS station) from near the Rice Experiment Station (RES) we simulated rice yield potential for the RES for planting dates from April 29 to June 18 for every year from 1999 to 2014. The model indicates that for each day delay in planting during this period that yields decline by 0.26% (Fig. 1). This value is very similar to the observed data from the RES.

From a physiological standpoint this yield reduction with delayed planting makes sense. The yield potential of California rice is high due to high solar radiation and long days. The most solar radiation occurs when days are longest (June 21 being the longest day of the year). It is important for plants to capture as much solar radiation (light) as possible in order to achieve high yields. Depending on temperature, canopy closure occurs about 5 to 6 weeks after planting. If the canopy has not closed, then some of the light is not captured by plant leaves. Planting early ensures that canopy closure occurs early and maximizes use of solar radiation when it is highest. Planting in early June, ensures that much of the light during the longest days of the year will not be captured.

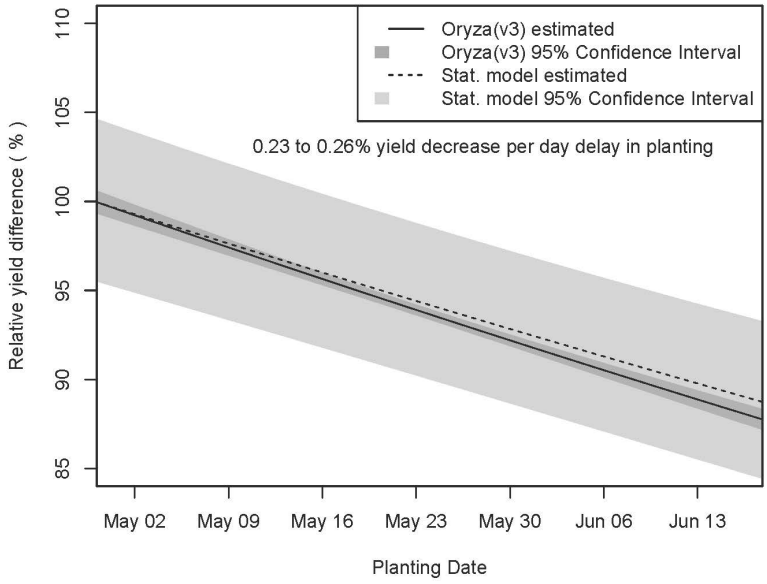

Figure 1. The effect of different planting dates from Apr. 29th to June 18th on the yield of rice variety M-206 grown at the Rice Experiment Station (Biggs, CA) as estimated by two different techniques. One estimate was made from simulating potential yields using the Oryza(v3) dynamic crop model calibrated and validated for rice variety M-206 (solid line). The other estimate was made from statistical analysis (dashed line) of yield data from released medium-grain rice varieties grown in the Statewide Rice Variety Trials from 1999 to 2014 using a random-effects statistical model (n = 3230). Both estimates were normalized to relative yield (for actual yields see Fig 2 and 3). The crop model estimated a yield decrease of 0.262% per day delay in planting (95% confidence interval: 0.244 to 0.282%, dark grey area), while the statistical model estimated a 0.232% decrease per day delay (95% confidence interval: 0.190 to 0.289, light grey area).

In conclusion, planting late can reduce yields as well as reduce rice grain quality and increase drying costs if harvest is delayed substantially. Therefore, we suggest planting early – provided a good seedbed has been prepared, temperatures are conducive to rice growth, and water is available.

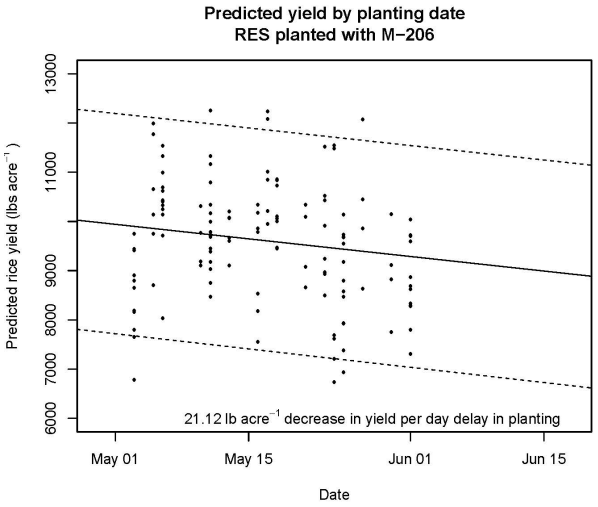

Figure 2. The predicted effect of planting dates from Apr. 29th to June 18th on the yield of rice variety M-206 grown at the Rice Experiment Station (RES; Biggs, CA). The effect was estimated from an analysis of yield data from released medium-grain rice varieties grown in the Statewide Rice Variety Trials from 1999 to 2014 using a random-effects statistical model. The solid line is the mean predicted yield, while the dotted lines represent the 95% prediction interval (the interval of expected yields). Points represent observed yields of M-206 at the RES from 1999 to 2014. For every day delay in planting dates there was an estimated 21.12 lb acre^{-1} decrease in grain yield (95% confidence interval 18.78 to 28.70 lbs acre^{-1} of 816 simulations).

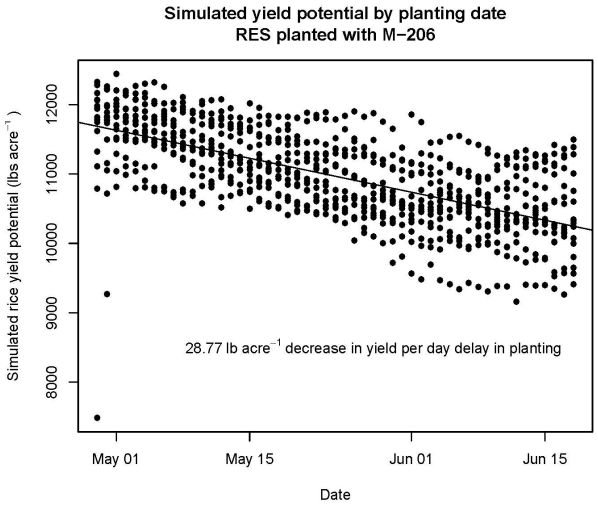

Figure 3. The simulated effect of planting date from Apr. 29th to June 18th on grain yield for rice variety M-206 grown at the Rice Experiment Station (RES; Biggs, CA). Yields were simulated using the Oryza (v3) dynamic crop model calibrated and validated for rice variety M-206 and weather data from the California Irrigation Management Information System (CIMIS). Points are simulated yields, which were simulated for 1999 to 2014 in daily intervals (total of 816 simulations). For every day delay in planting date, there was a 28.77 lb acre^{-1} decrease in simulated grain yield (95% confidence interval: 26.45 to 31.08 lbs acre^{-1}).