What is the optimal seed and plant density for maximum yields?

Achieving maximum yields requires starting out with a uniform plant stand of optimal density. In 2015 we conducted an experiment to determine the optimal seeding rates and stand density for rice (M-206). We conducted a trial at the Rice Experiment Station (RES) with two planting times (May 25 and June 1). We had five seeding rates: 5, 15, 25, 35, 45, 55 seeds/ft^2. All treatments were replicated 4 times. We measured plant stand density, tiller #, panicle #, panicle weight, and yield.

Results

1. For both planting dates the plant density (the number of living plants per square foot) was about half of the seed density (Figure 1). Putting out 50 seeds/ft^2 resulted in about 25 living plants/ft^2. In other words, half of the seed were lost – likely due to not germinating or losses due to wind, pests and disease.

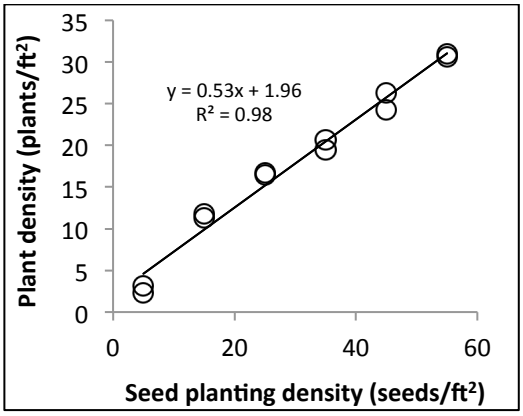

Figure 1*. The relationship between seed density and plant density. Results are combined for the two planting dates.*

2. For both planting dates maximum yields were between 9,800 and 10,000 lb/ac. Also for both planting dates, maximum yields were achieved with a plant density of 25 plants/ft^2 (Figure 2). Below this value, yields declined. At half the optimal plant density (12.5 plants/ft^2) yields were 90% of maximum. **Importantly, optimal plant density may differ across varieties and year.**

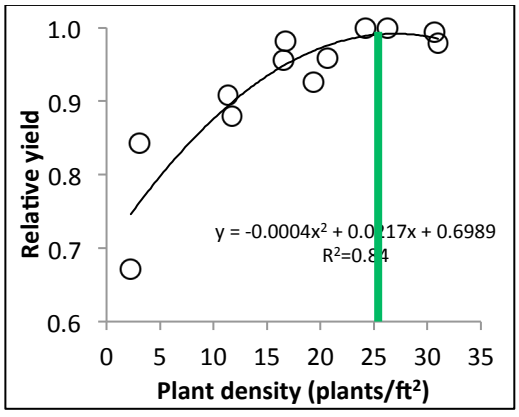

Figure 2. *Relative yield versus plant density. Results are combined for the two planting dates.*

3. Combining these two results indicates that under the conditions of this study and for M-206 a seeding rate to achieve a seed density of 50 seeds/ft^2 was needed to achieve 25 plants/ft^2 which was required for maximum yield. For M-206 a seeding rate of 141 lb/ac results in 50 seeds/ft^2. Since seed size varies among varieties (Figure 3), the seeding rate will vary depending on variety. For example, a small seeded variety like L-206 requires only 125lb seed/ac to achieve the same seed density while a larger seeded variety like S-102 requires 157 lb seed/ac to achieve the same seed density.

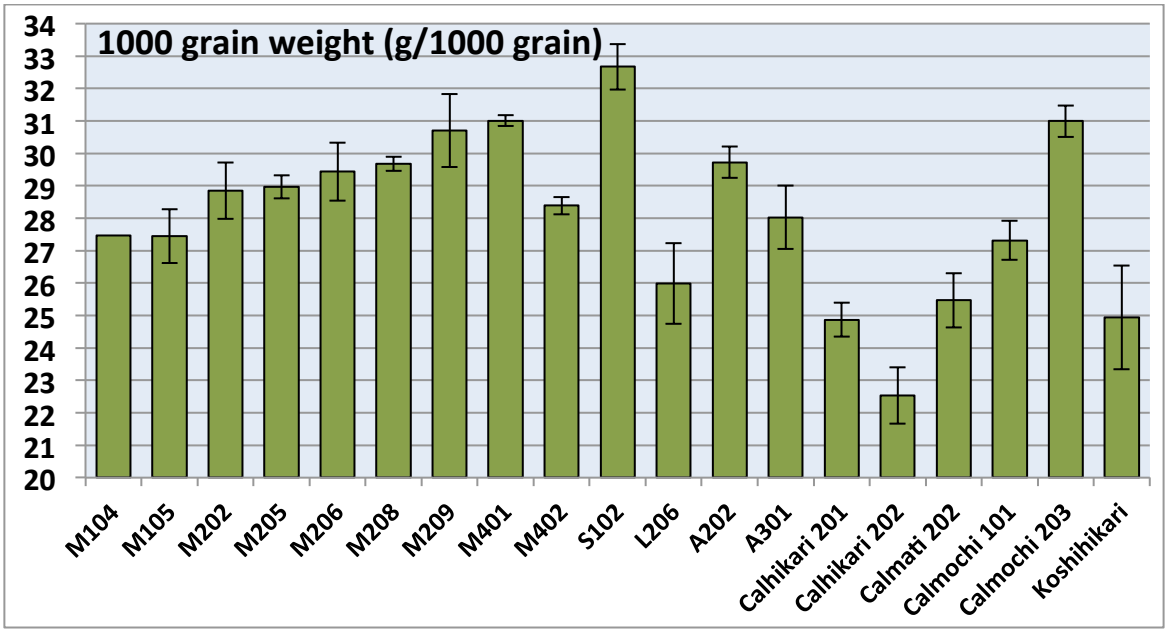

Figure 3. *Seed size for common California varieties*

4. A tool is available at http://rice.ucanr.edu/Rice_Calculator/ to help you determine the correct seeding rate to achieve a desired seed density for all the varieties listed above.
5. These results are what we found in 2015 on two fields with M-206 that were planted relatively late (i.e. warmer air and water temperatures). Results can vary and higher seed and plant densities may be required if temperatures are cooler or if salinity is a problem. Too high of a plant density may result in increased foliar and panicle diseases. Other California research on this issue can be found in the following:
    a. Miller, B.C., J.E. Hill, and S.R. Roberts. 1991. Plant population effects on growth and yields in water-seeded rice. Agronomy Journal 83:291-297.
    b. Caton, B.P., T.C. Foin, K.D. Gibson, and J.E. Hill. 1998. A temperature-based model of direct-, water-seeded rice (Oryza sativa) stand establishment in California. Agriculture and Forest Meteorology 90:91-102.
    c. Zeng, L. and M.C. Shannon. 2000. Salinity effects on seedling growth and yield components of rice. Crop Science 40:996-1003.