Flameless catalytic infrared radiation is a new method of drying that is being studied. Although infrared drying began being researched in the 1970s, the methods used then used open flames that were dangerous due to the use of an open flame that could cause the dusts associated with grains to combust. Previous studies have shown that infrared radiation can successfully dry grains such as wheat and rice. While drying the grain, infrared can disinfect the grain of stored-product insect pests and fungi. Not only is infrared drying much quicker (minutes versus months) than traditional air drying, it is a pesticide free alternative. This is important as some stored-product insect pests such as the lesser grain borer (*Rhyzopertha dominica*) are becoming resistant to frequently used pesticides such as phosphine. The lesser grain borer is a common stored-product insect pest that feeds and develops internally in grain.

Although studies have shown the drying and disinfection potential of infrared radiation, very little research has been done to look at the post-drying effects of infrared on the grain. Therefore, this study was completed to evaluate 1) the effect of infrared drying on the germination of two long grain rice cultivars (CL152 and XL745) and 2) if infrared radiation caused the grain to be more susceptible to post-drying insect infestations comparing the amount of progeny and kernel damage produced by the lesser grain borer on infrared dried rice in comparison to traditional air dried rice.

### Study 1: Post-Infrared Drying Germination

<table>
<thead>
<tr>
<th>Rice Cultivar</th>
<th>Intensity (kW/m²)</th>
<th>Percent Germination (%)</th>
<th>Mean Plant Growth ±SE (mm³)</th>
<th>Mean Root Growth ±SE (mm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>XL745</td>
<td>0°</td>
<td>91.8</td>
<td>57.4 ± 1.3a</td>
<td>39.6 ± 2.0a</td>
</tr>
<tr>
<td></td>
<td>2.15</td>
<td>88.3</td>
<td>55.1 ± 1.3a</td>
<td>88.8 ± 2.2a</td>
</tr>
<tr>
<td></td>
<td>2.83</td>
<td>86.8</td>
<td>56.0 ± 1.4a</td>
<td>87.4 ± 2.1a</td>
</tr>
<tr>
<td></td>
<td>10.84</td>
<td>68.8</td>
<td>42.5 ± 1.6b</td>
<td>68.8 ± 2.6b</td>
</tr>
<tr>
<td>CL152</td>
<td>0°</td>
<td>91.2</td>
<td>57.5 ± 1.3a</td>
<td>41.3 ± 1.9a</td>
</tr>
<tr>
<td></td>
<td>2.15</td>
<td>53.3</td>
<td>32.0 ± 1.2a</td>
<td>39.4 ± 1.8a</td>
</tr>
<tr>
<td></td>
<td>2.83</td>
<td>54.8</td>
<td>34.1 ± 1.3a</td>
<td>41.0 ± 1.9a</td>
</tr>
<tr>
<td></td>
<td>10.84</td>
<td>45.0</td>
<td>27.2 ± 1.3b</td>
<td>32.3 ± 1.9b</td>
</tr>
</tbody>
</table>

*0° = Control kernels that were dried using a traditional drying method.*

**Results**

*Fig. 1.1. (Left) Number above each kernel represents the treatment number (1-8). CL152 control and three intensities were assigned the values of 0.4 respectively and XL745 control and three intensities were assigned the values of 0.2. The arrangement of kernels within each treatment were randomized using a random number generator. Fig. 1.2. (right) Image displays what was measured for plant and root growth.*

**Conclusions**

- The highest intensity of 10.84 kW/m² caused a negative effect on the proportion of kernels that germinated for both cultivars.
- The highest intensity of 10.84 kW/m² caused a negative effect on the length on both plant and primary root growth for both cultivars.
- Having brown rice available in comparison to rough rice was the biggest factor in the amount of progeny and grain damage.
- Although intensity alone had no effect on progeny or damage, it was a variable in some of the interactions examined.
- CL152 brown rice dried with 10.84 kW/m² had the greatest amount of frass.
- CL152 dried with 10.84 kW/m² produced the greatest amount of adult lesser grain borers.
- X-ray imaging successfully allowed for the identification of larvae, pupae, and adult lesser grain borers inside of the rice kernels.
- X-ray imaging successfully allowed for the categorization of damage internally of the kernel not otherwise visible.

**Industry Recommendation**

- If flameless catalytic infrared radiation is used for drying, it is recommended that the highest intensity tested (10.84 kW/m²) not be used.
- Based on the results of this study, it appears that the two lower intensities would be safe to use for drying grain without causing negative effects.

**Future Work**

- Continued evaluation of infrared radiation as a grain drying and disinfection method.
- Further exploration of x-ray as an agricultural tool; creating an algorithm to use to detect stored-product insects within the grain.

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