Relationship between collection method, kernel fill, and total yield for hazelnuts at My Brother's Farm

Lauren Hallett

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Methods overview

My Brother's Farm conducted an experiment comparing the proportion of kernel to nut in relation to two hazelnut collections: shake (in which a net was placed below a shook tree to capture nuts) and traditional (in which nuts are picked up off the ground). The design included two blocks (east, west). Within each block there was strip of Yamhhill and a strip of Sacajawea hazelnut varieties. Within each strip trees were selected for either shake or traditional harvest using a stratified random design. At least 30 trees of each collection method were randomly selected for measurement (n ranged from 30 to 42), and three nuts were sampled at each tree.

Results

Proportion of nut that is kernel

I analyzed data with a mixed-effect model with treatment, variety and their interaction as fixed effects and block, variety, and tree as nested random effects. As there was no significant effect of variety, I simplified the model to only include the fixed effect of treatment. Overall, there was a marginally significant ($p = 0.06$) relationship in which a higher proportion of the nut weight is kernel in trees with a shake collection compared to traditional (Fig 1). However, the strength of relationship appears to vary spatially. Because there were only two blocks I assessed block effect by running two different models - one for the west block and one for the east, with treatment as a fixed effect and variety and tree as nested random effects. There was a pronounced treatment effect in the west block ($p = 2 \times 10^{-4}$) but no significant effect in the east block ($p = 0.51$) (Fig 2). This suggests we may want to find an environmental covariate that we can use to interpret variation between trees over space.

Why is there a higher proportion of kernel in trees that were shaken? I analyzed proportion of nut that is kernel in relation to nut size, variety and their interaction (fixed effects) and block, variety and tree (nested random effects). An overall point is that the proportion of nut that is kernel increased with total nut size ($p = 2 \times 10^{-15}$)(Fig 3). This is true for both species. The Yamhill variety has bigger nuts than Sacajawea but this is balanced out such that the Sacajewea variety has a higher proportion of kernel than Yamhill for a given nut size ($p = 0.2$). The nuts were bigger in the shaken trees than in the traditional harvest ($p = 0.01$), an effect that did not vary by variety (Fig 4).

Amount of nuts harvested

On average, 59 percent of all the nuts produced by a tree were captured by the shake method. To compare total yield from this method to traditinal, I dubbed "total yield" to be equal to nuts captured from the shake but not on the ground for the shake method, and total yield to be all the nuts on the ground for the traditional treatment. I analysed total yield with treatment, variety and their interaction as fixed effects and block, variety and tree as nested random effects. There was a marginally negative effect of the traditinal treatment on overall yield ($p = 0.08$) balanced by a significant interaction in which yield was higher under traditional pickup for the Yamhill variety ($p = 0.01$)(Fig 5). Differences in propotion kernel did not overcome this general pattern, such that total kernel yield (proportion kernel multiplied by total yield) followd the same pattern (Fig. 6).

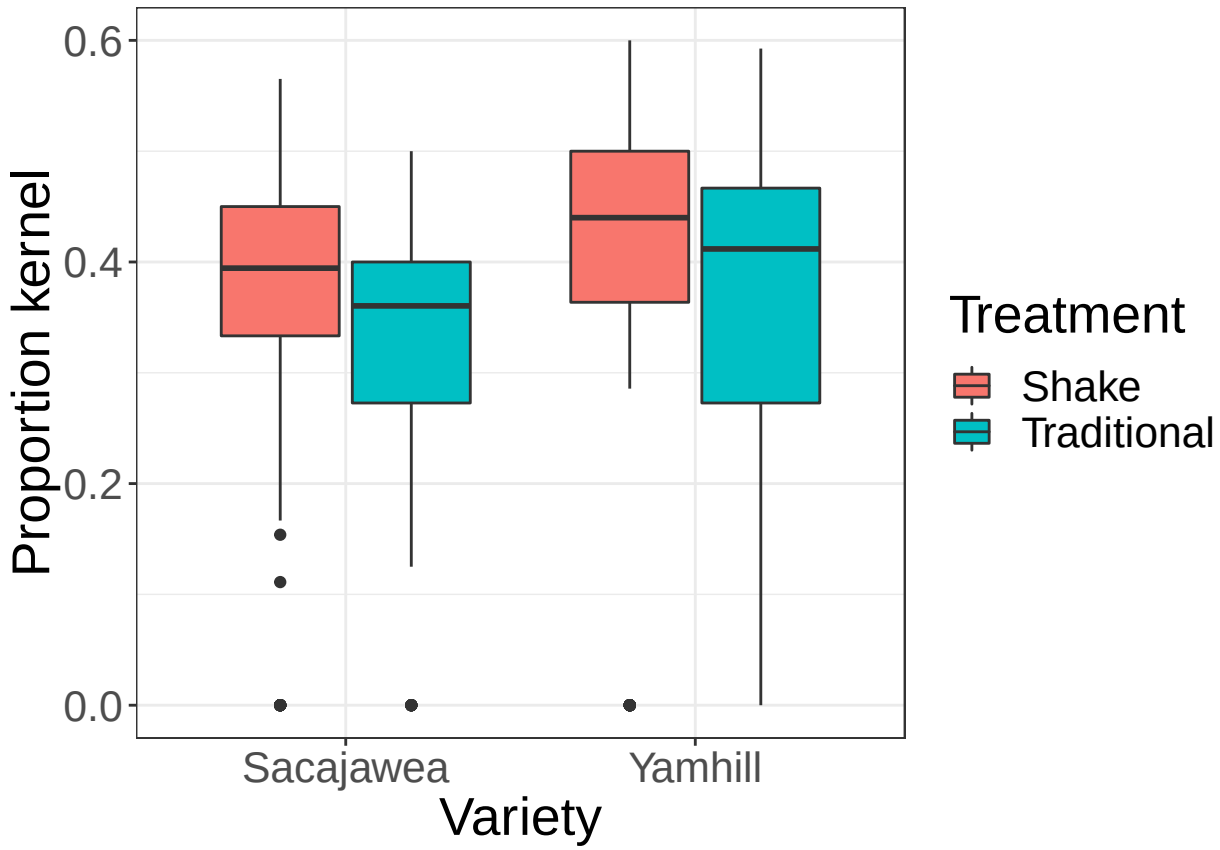

Figure 1: Overall effect of treatment and proportion edible kernel.

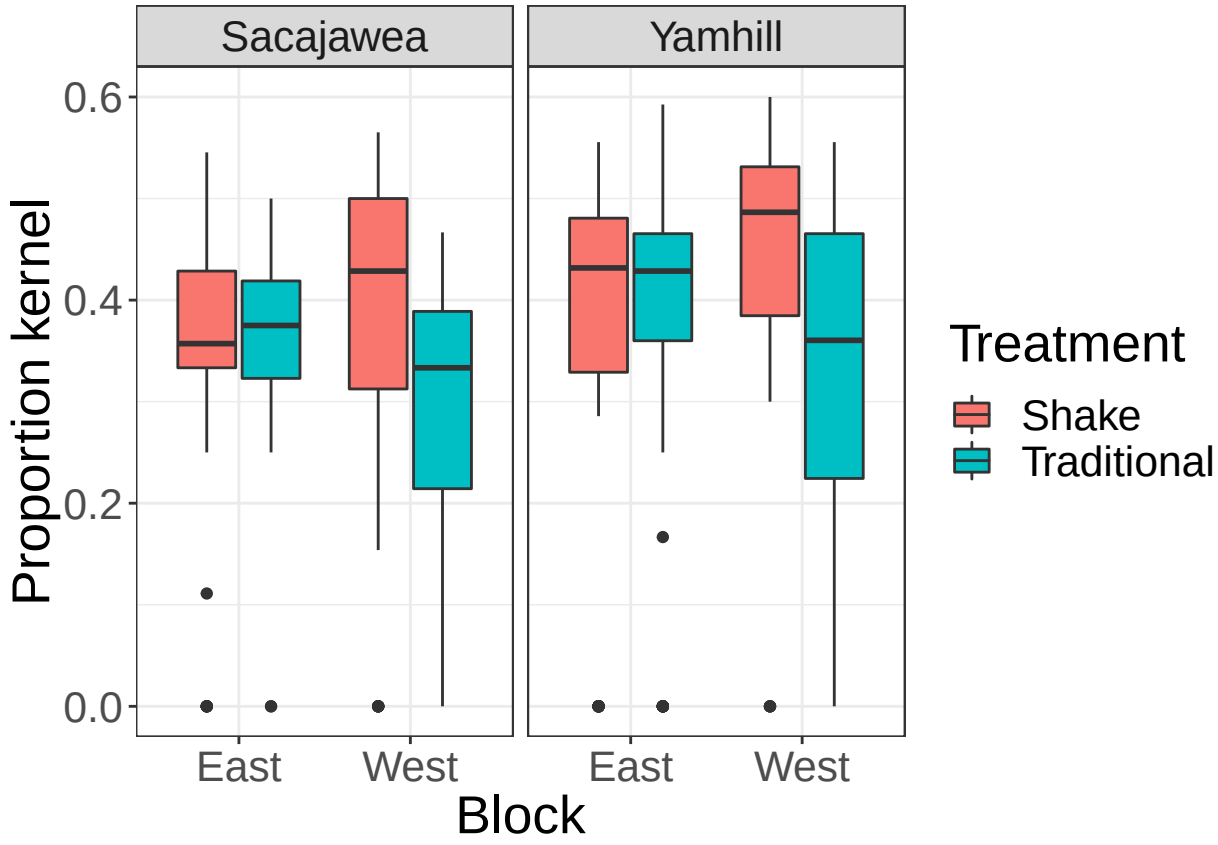

Figure 2: Effect of treatment and proportion edible kernel within blocks.

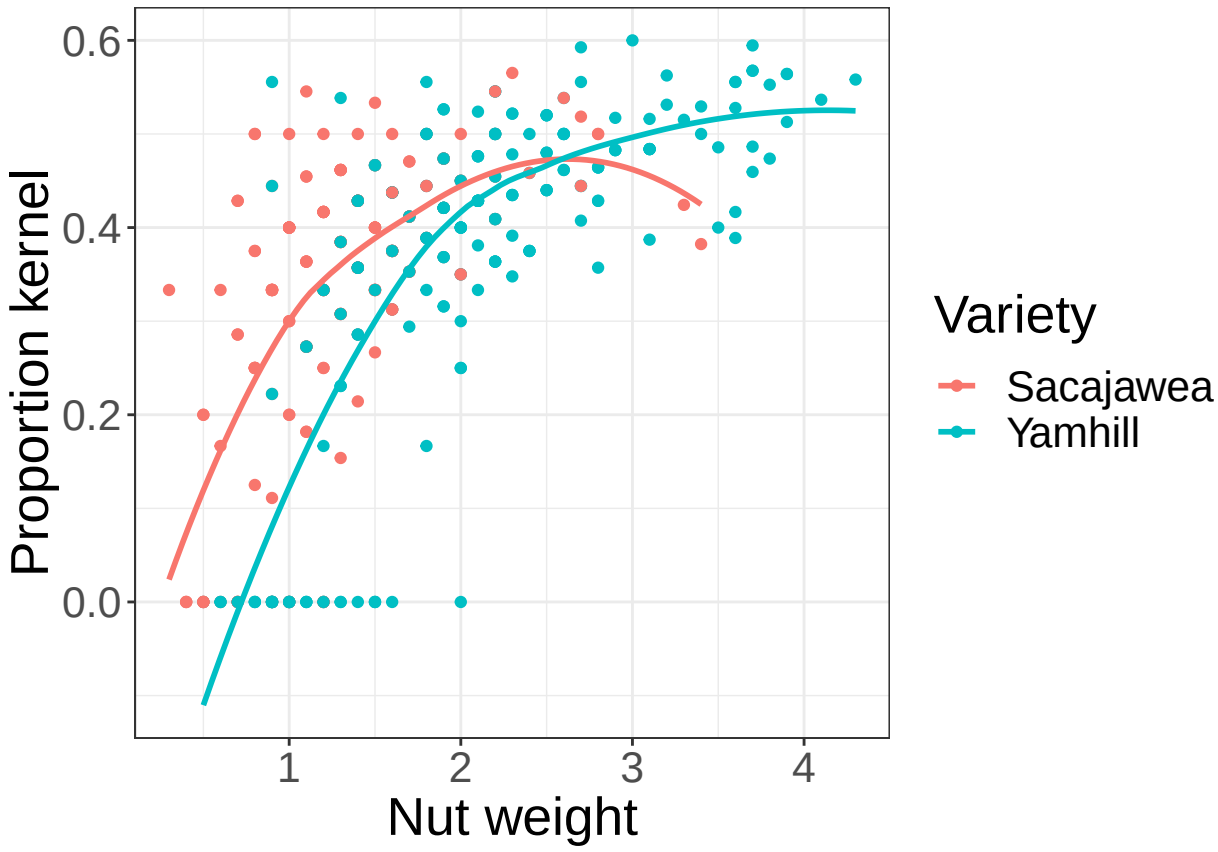

Figure 3: Proportion of nut that is kernel in relation to nut size and variety.

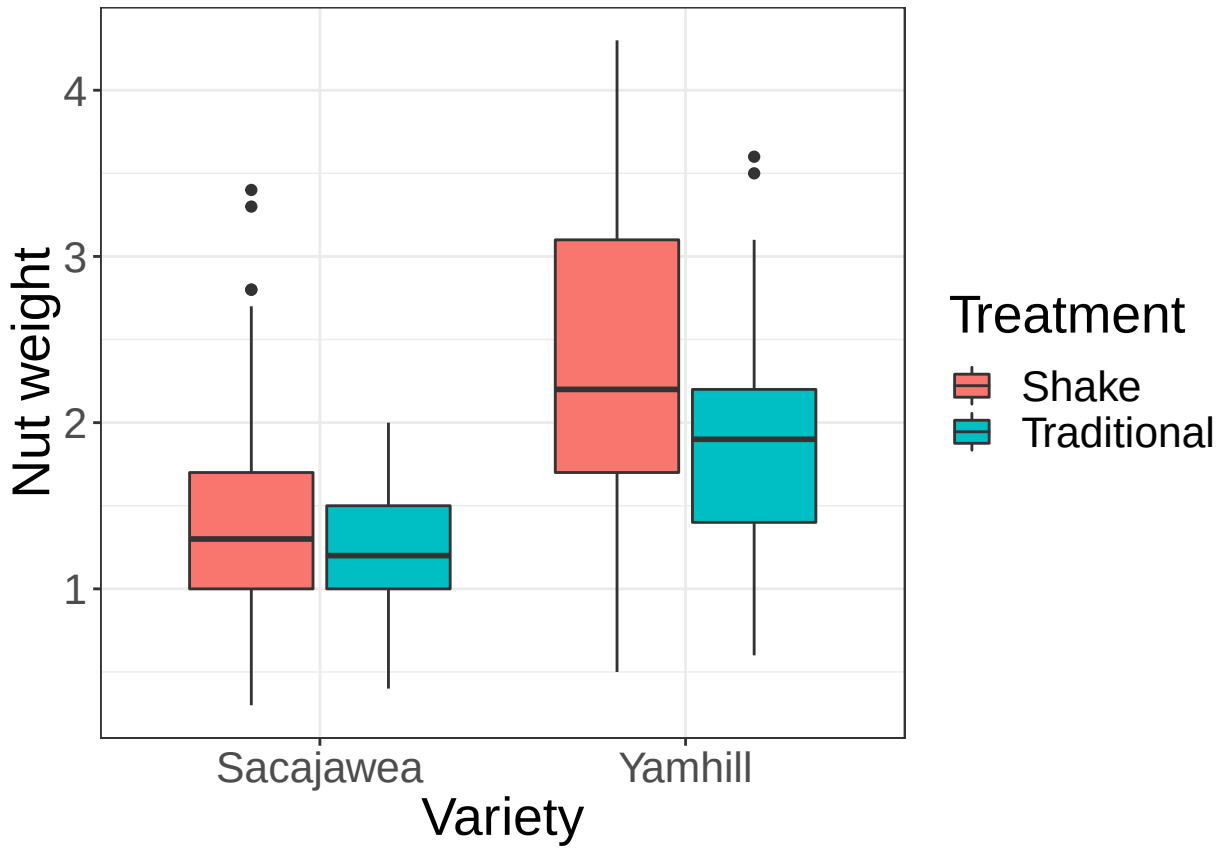

Figure 4: Nut size in relation to treatment and variety.

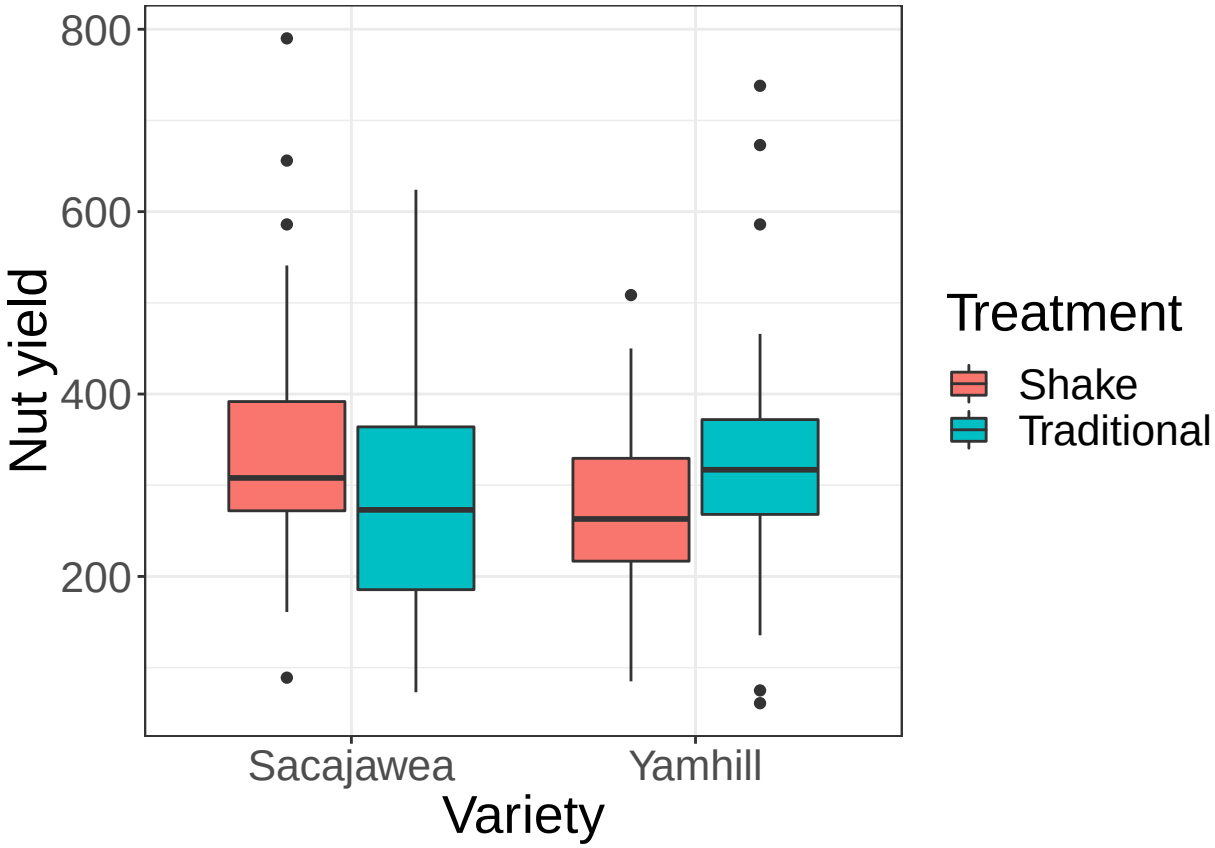

Figure 5: Total nut yield in relation to treatment and variety.

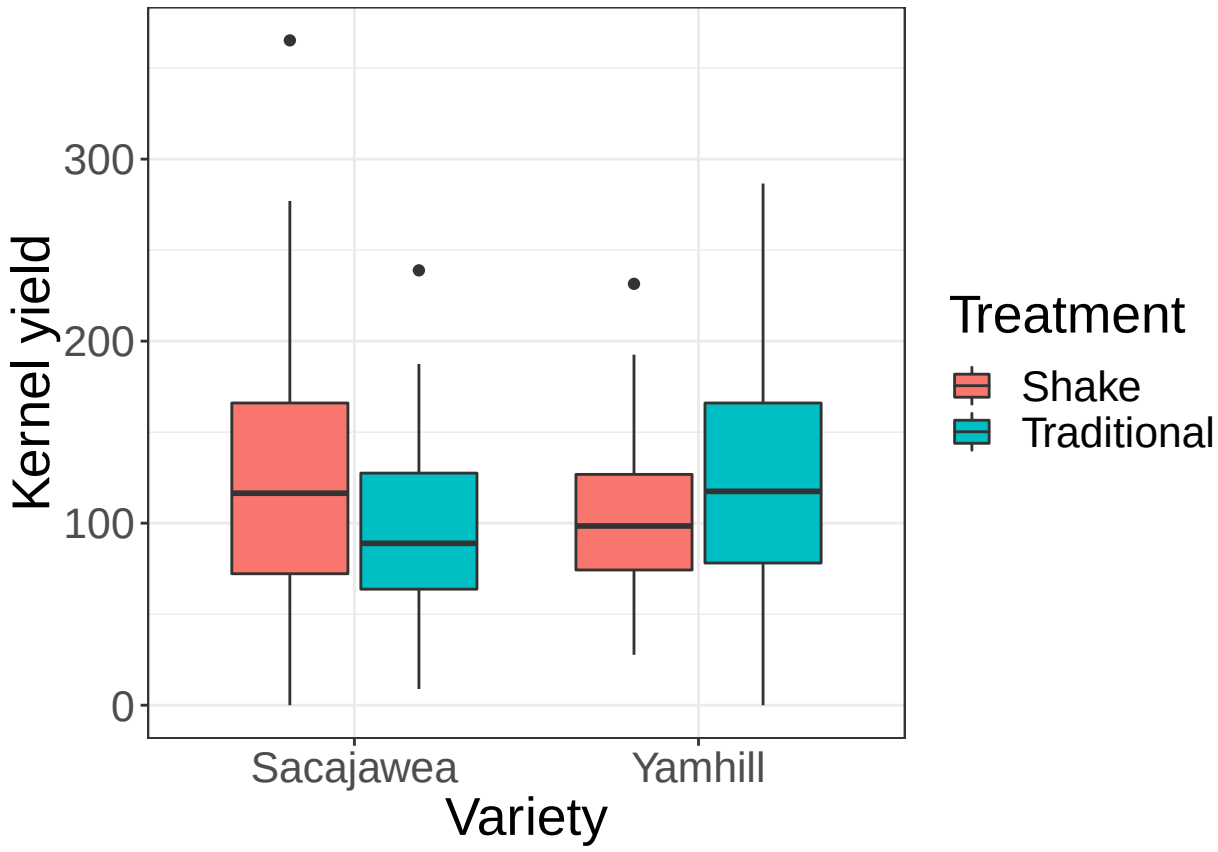

Figure 6: Total kernel yield in relation to treatment and variety.