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

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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 65), and three nuts were sampled at each tree. This experiment was repeated in 2018 and 2019; this write-up focuses on 2019 but contextualize findings in relation to 2018.

In a nutshell

- The proportion of nut weight that is kernel was consistently higher in the shake than traditional treatment across years, despite the fact that the total number of nuts produced was an order of magnitude lower in 2018 than 2019
- The significance of this difference varied, having no effect on total kernal yield in 2018 and increasing total kernel yield in 2019

Results

Proportion of nut that is kernel

I analyzed the 2019 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 significant ($p = 10^{-10}$) relationship in which a higher proportion of the nut weight is kernel in trees with a shake collection compared to traditional (Fig 1), which aligns with the 2018 results. While in 2018 this result was only significant in the west block, in 2019 the effect was significant across both the west ($p = 2.3 \times 10^{-9}$) and the east block ($p = 5.2 \times 10^{-4}$), while becoming extremely pronounced in the west block, with many nuts having verly little kernal in the west block (Fig 2).

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). This year's findings were consistent with the 2018 year. Specifically, the proportion of nut that is kernel increased with total nut size ($p = 1.49916 \times 10^{-10}$)(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 ($p = 0.24$). Unlike last year there was no significant difference in the nut size of shaken or traditional trees($p = 0.59$) (previously nut size was higher under the shake treatment) (Fig 4).

Amount of nuts harvested

On average, 79 percent of all the nuts produced by a tree were captured by the shake method. This is higher than in 2018, in which 59 percent of all nuts produced were captured. To compare total yield from this method to traditional, 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 and variety as fixed effects and block, variety and tree as nested random effects. Unlike last year, there was no effect of treatment on overall yield ($p = 0.24$) (Fig 5). The effect of treatment on proportion kernal aggegrated such that there was a marginally more total kernel yield (proportion kernel multiplied by total yield) in the shake compared to traditional treatment (Fig. 6). The total yield was an order of magnitude lower than last year, driven largely by fewer total nuts produced, and secondarily by a lower proportion of kernal in the nuts.

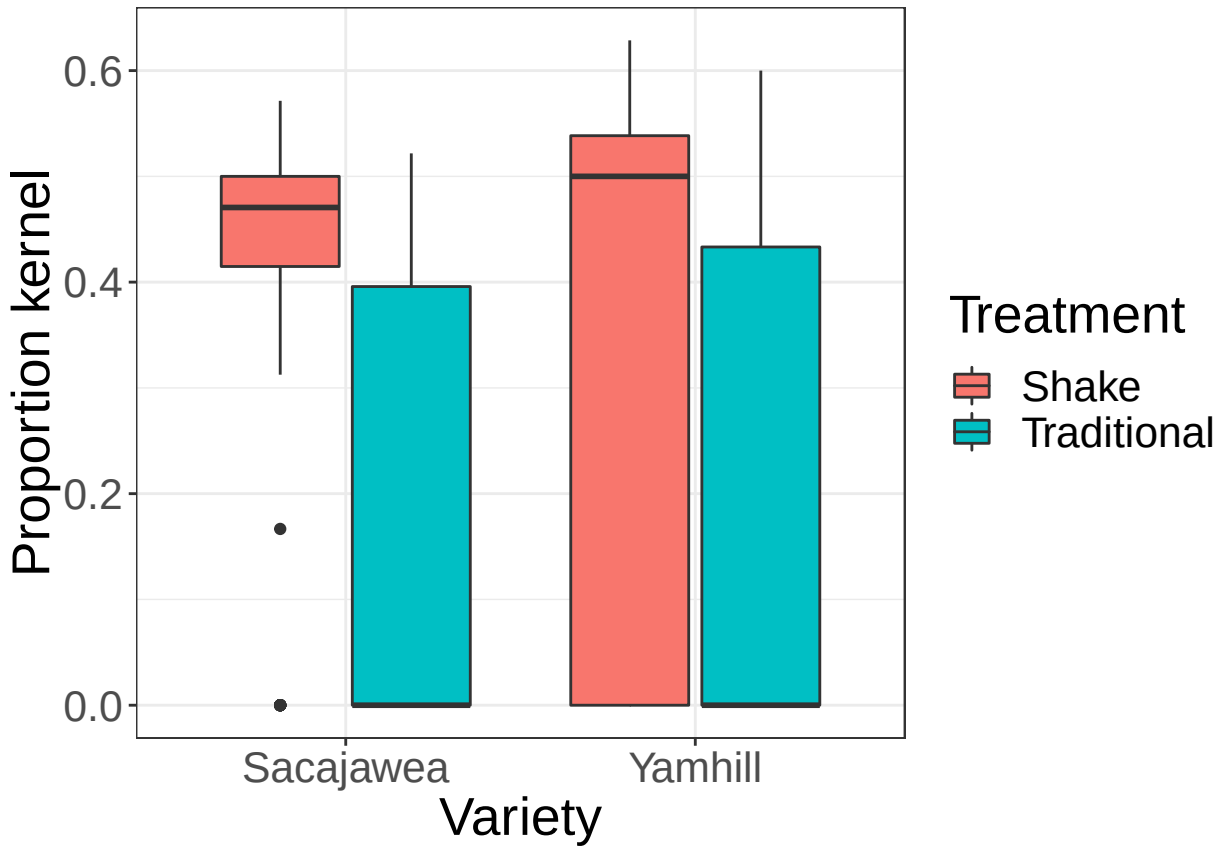

Figure 1: Overall effect of treatment and proportion edible kernel.

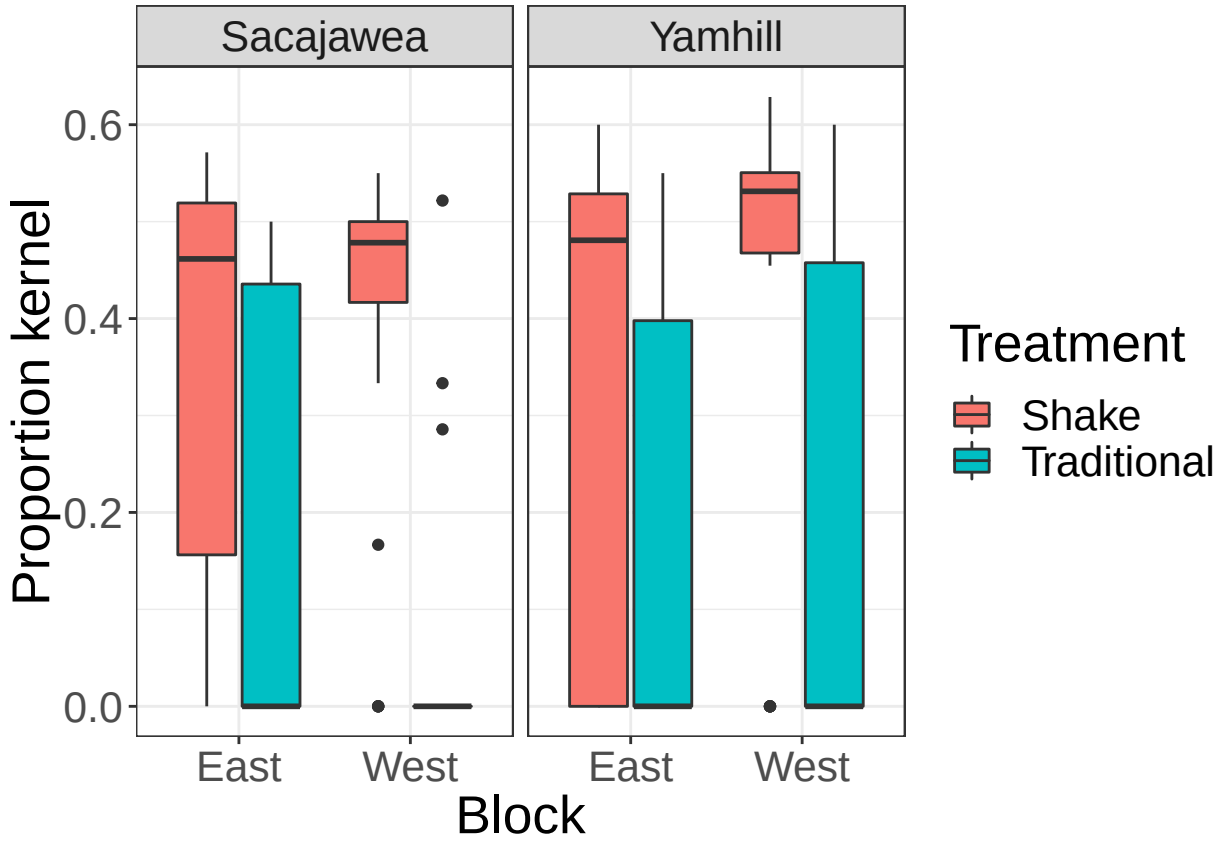

Figure 2: Effect of treatment and proportion edible kernel within blocks.

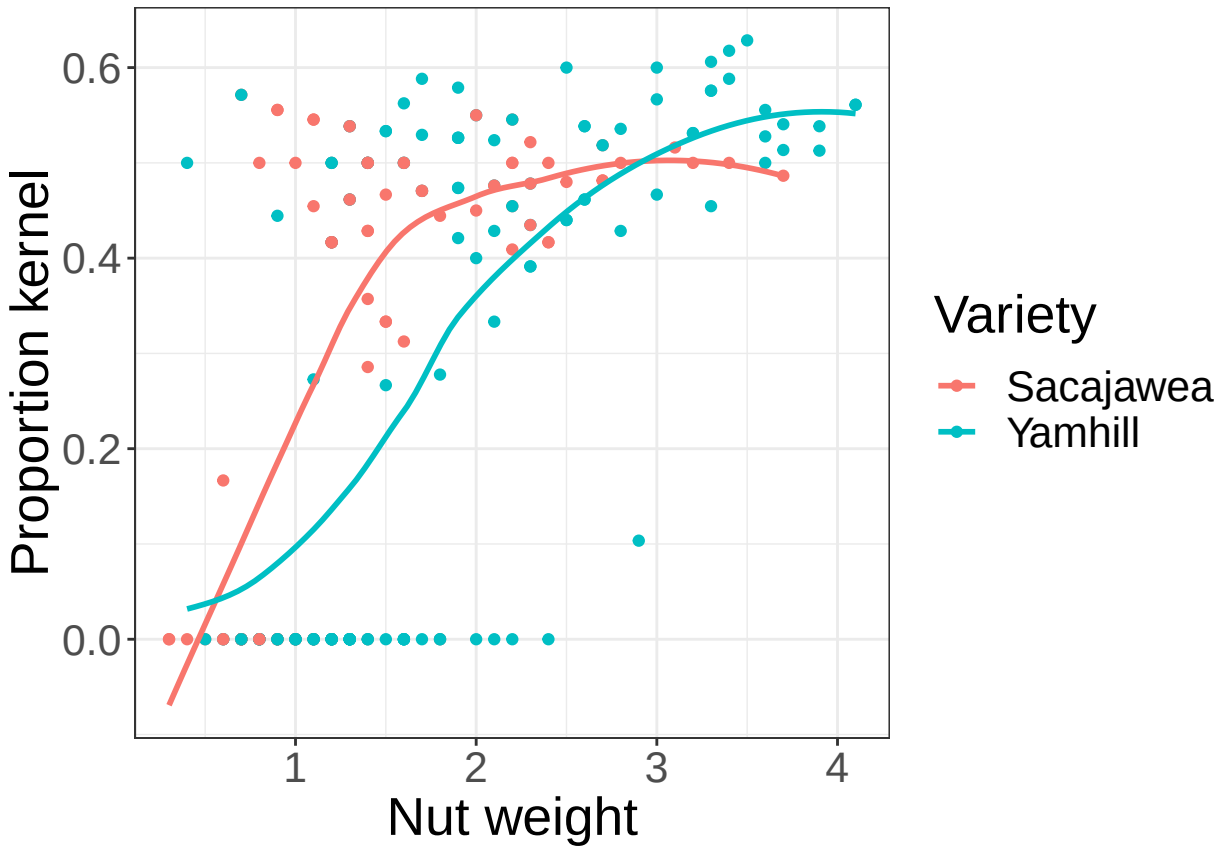

Figure 3: Proportion of nut that is kernel in relation to nut size and variety.

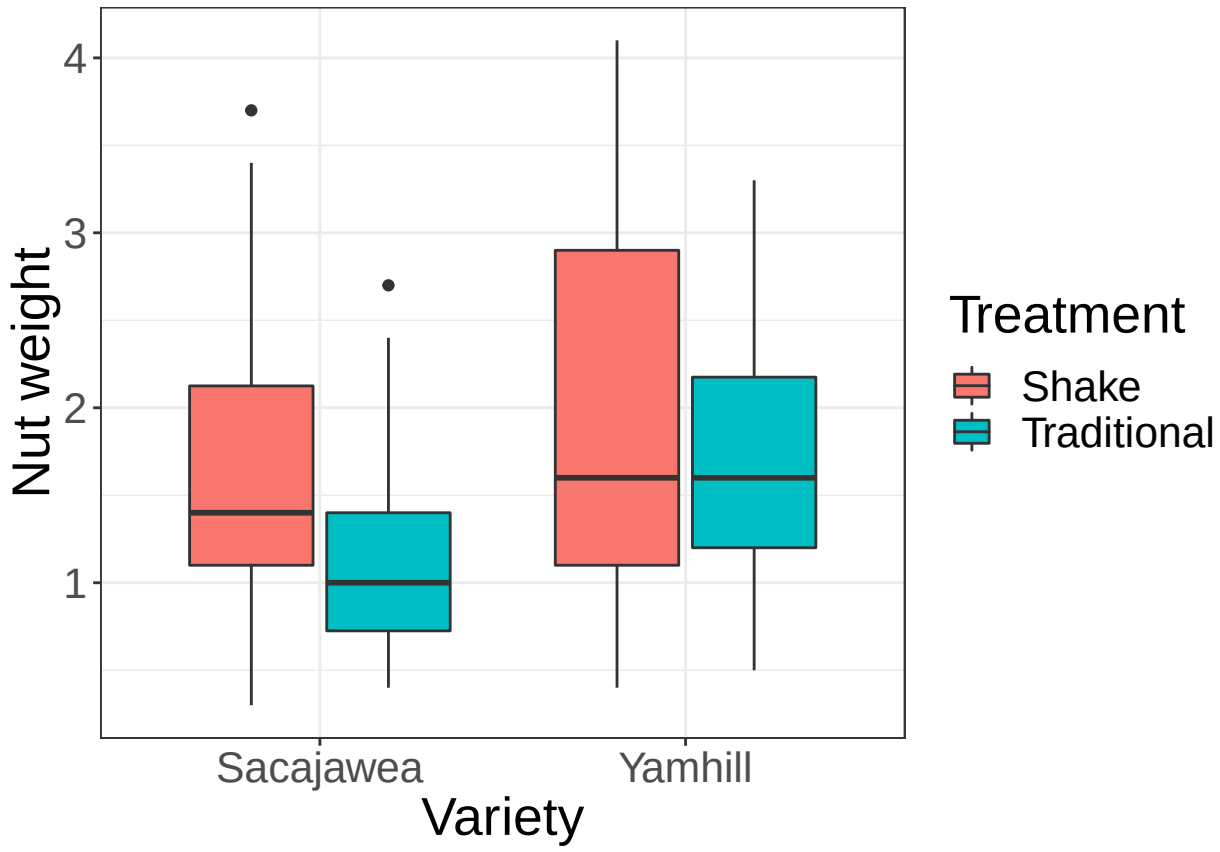

Figure 4: Nut size in relation to treatment and variety.

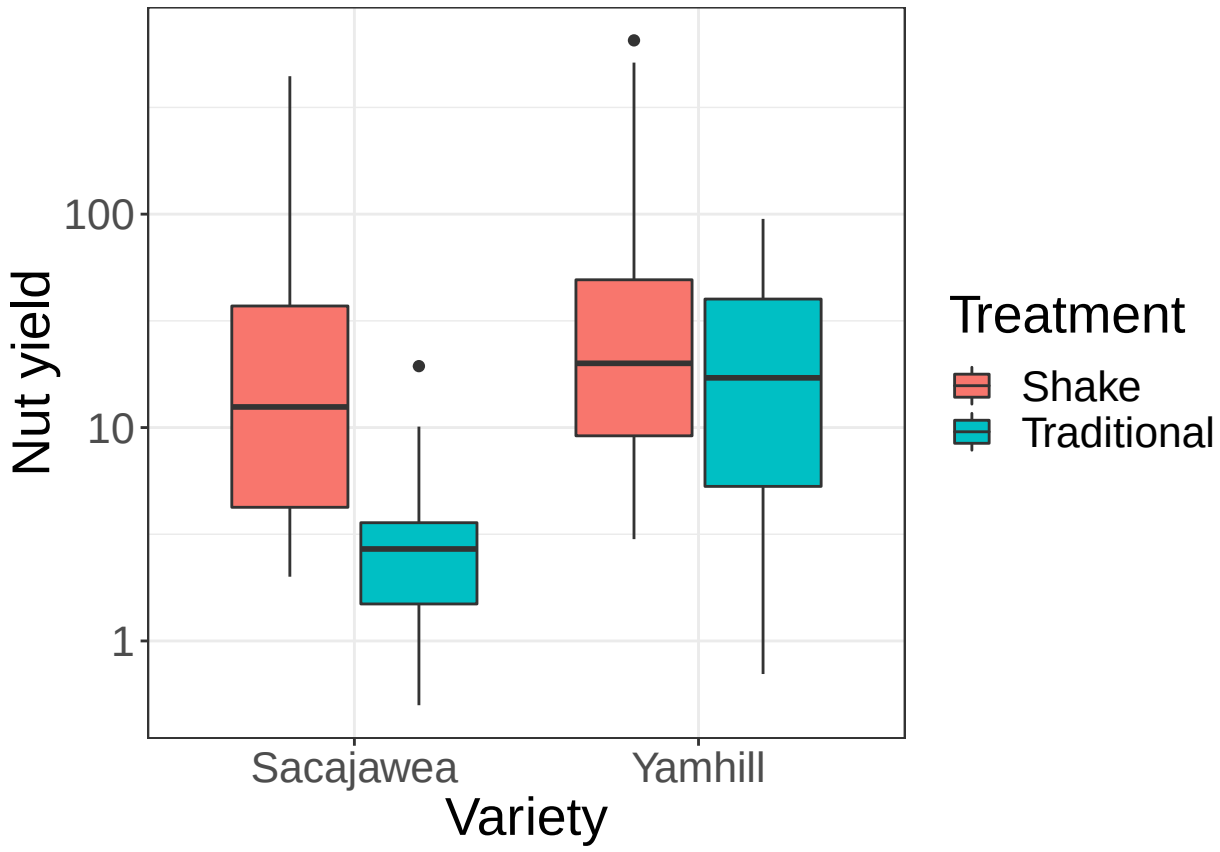

Figure 5: Total nut yield in relation to treatment and variety.

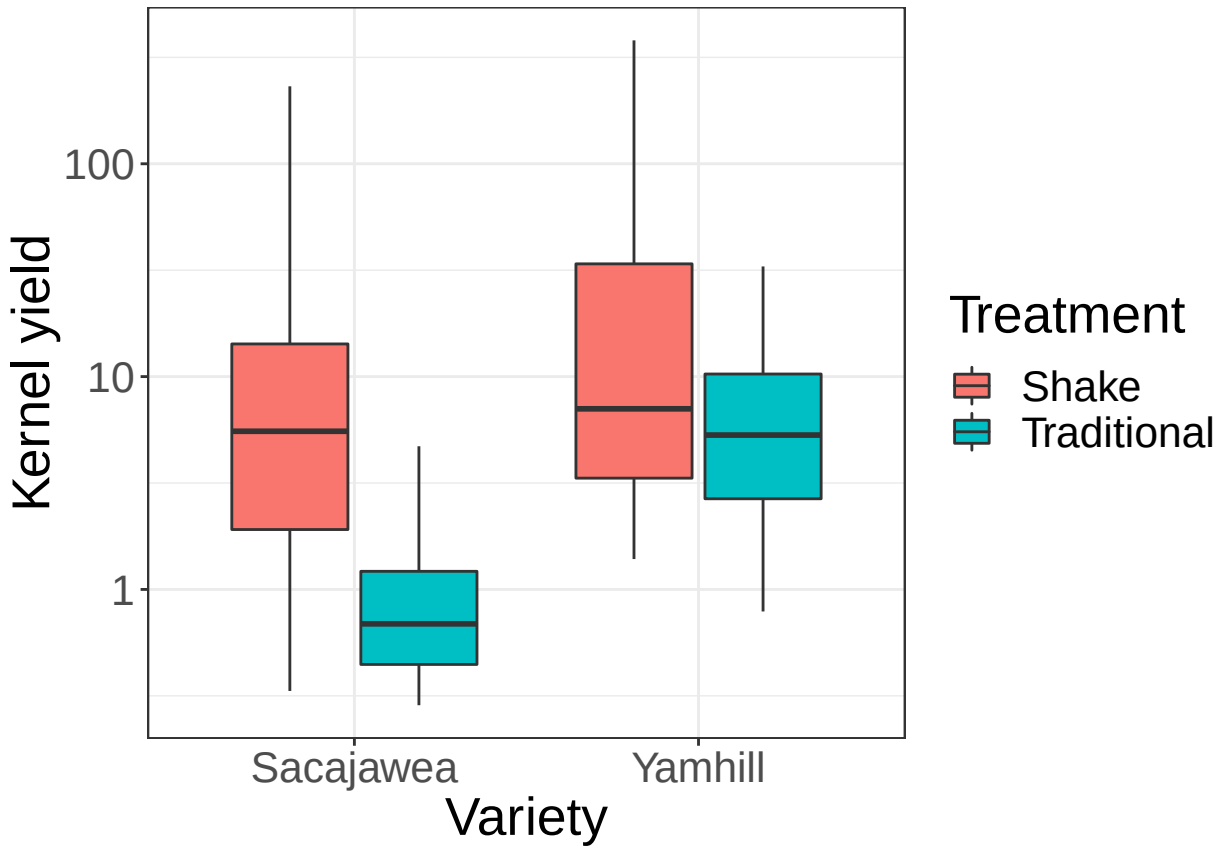

Figure 6: Total kernel yield in relation to treatment and variety.