Prediction of macadamia shelf life and factors affecting long term storage

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Figure 1: Whole kernel has longer shelf life than pieces.

General background

- Macadamia deterioration in long term storage and on the retail shelf is primarily in the form of oxidative rancidity
- Oxidation occurs at the double bonds of unsaturated fatty acids, which comprise approximately 80% of the fatty acids in macadamia kernel (Figure 4)
- Prior research has shown that broken kernel is more susceptible to oxidation than whole kernel (Figure 1) and that kernel susceptibility to oxidation increases as the harvest season progresses
- There are no current protocols in the macadamia industry for **predicting shelf life** for processed kernel
- **Factors contributing to differential deterioration** of kernel batches (besides the presence of O_2 and moisture) in storage and on the shelf are also not well understood

Predicting shelf life

- The South African macadamia industry requires a means to apply accurate and relevant sell-by and eat-by dates to batches of kernel.
- All export kernel is currently subject to numerous quality tests including determination of peroxide value (Pv) – the question arises as to whether this test can be used to predict shelf life.
- Previous work has already established a tentative relationship between shelf life and the pre-storage induction time obtained from an accelerated oxidation test (Rancimat method).
- This work showed that there is a strong relationship between induction time measured prior to storage and Pv measured after one year in storage – more so for kernel pieces (Figure 2) than whole kernel (Figure 3).
- Similar results were recorded for the relationship between Pv measured prior to and after one year of storage.

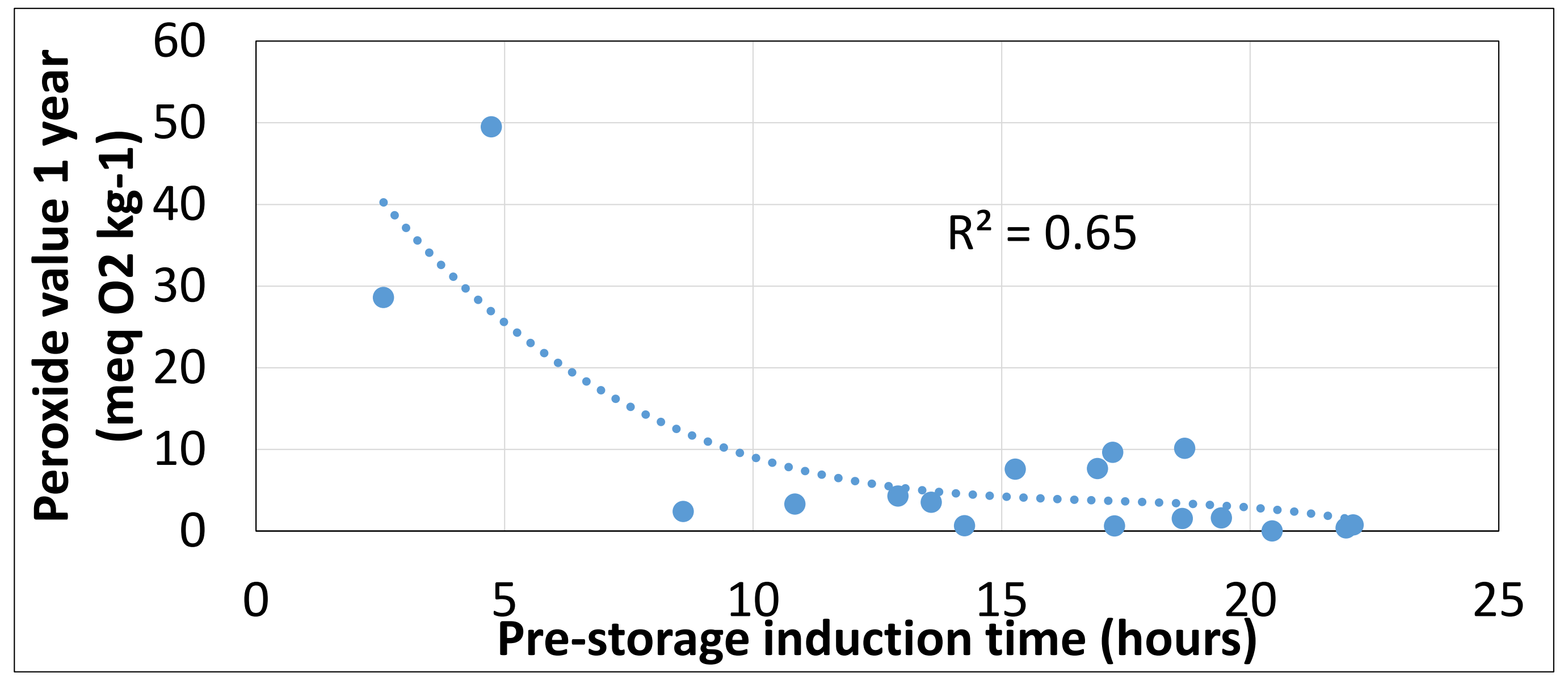

Figure 2: Relationship between pre-storage Rancimat induction time and post-storage peroxide value for whole kernel. Each point represents kernel from one of seventeen farms, n = 6.

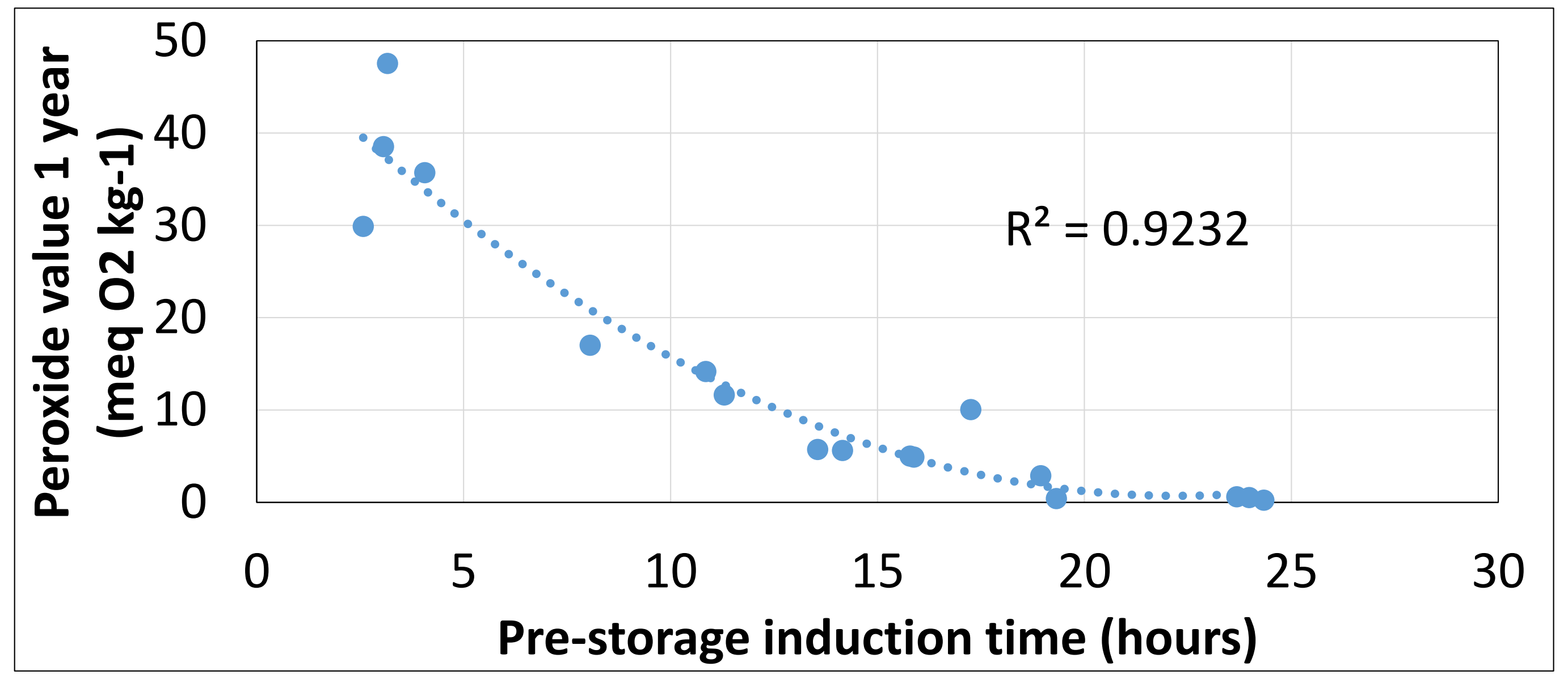

Figure 3: Relationship between pre-storage Rancimat induction time and post-storage peroxide value for kernel pieces. Each point represents kernel from one of seventeen farms, n = 6.

Conclusions

To date, considerable differences have been found between macadamia cultivars in terms of their fatty acid profiles. However, with the exception of linoleic acid content, no other aspect of the fatty acid profile directly correlated with the oxidative stability of macadamia kernel. There is potentially a role for anti-oxidants in the oxidative stability and this aspect is under investigation. Accelerated oxidation tests and peroxide value determined at packing may provide a means of predicting shelf life.

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Factors contributing to shelf life

- Peroxide formation is a result of oxidation at double bonds of unsaturated fatty acids, suggesting the fatty acid profile of macadamia kernel may affect quality. It is not currently known what factors affect fatty acid profile in South African kernel.
- This work examined the effect of cultivar, harvest date, growing region and fatty acid profile on kernel quality as measured by an accelerated oxidation test (Rancimat method).
- There were considerable differences in the fatty acid profiles of different cultivars (figure 4) but the total level of unsaturated fatty acids did not influence measured quality (Figure 5). While linoleic acid had a small effect on oil oxidation (Figure 6), no other fatty acid had any effect on quality. Cultivar effects seemed to be significant (Figure 7).

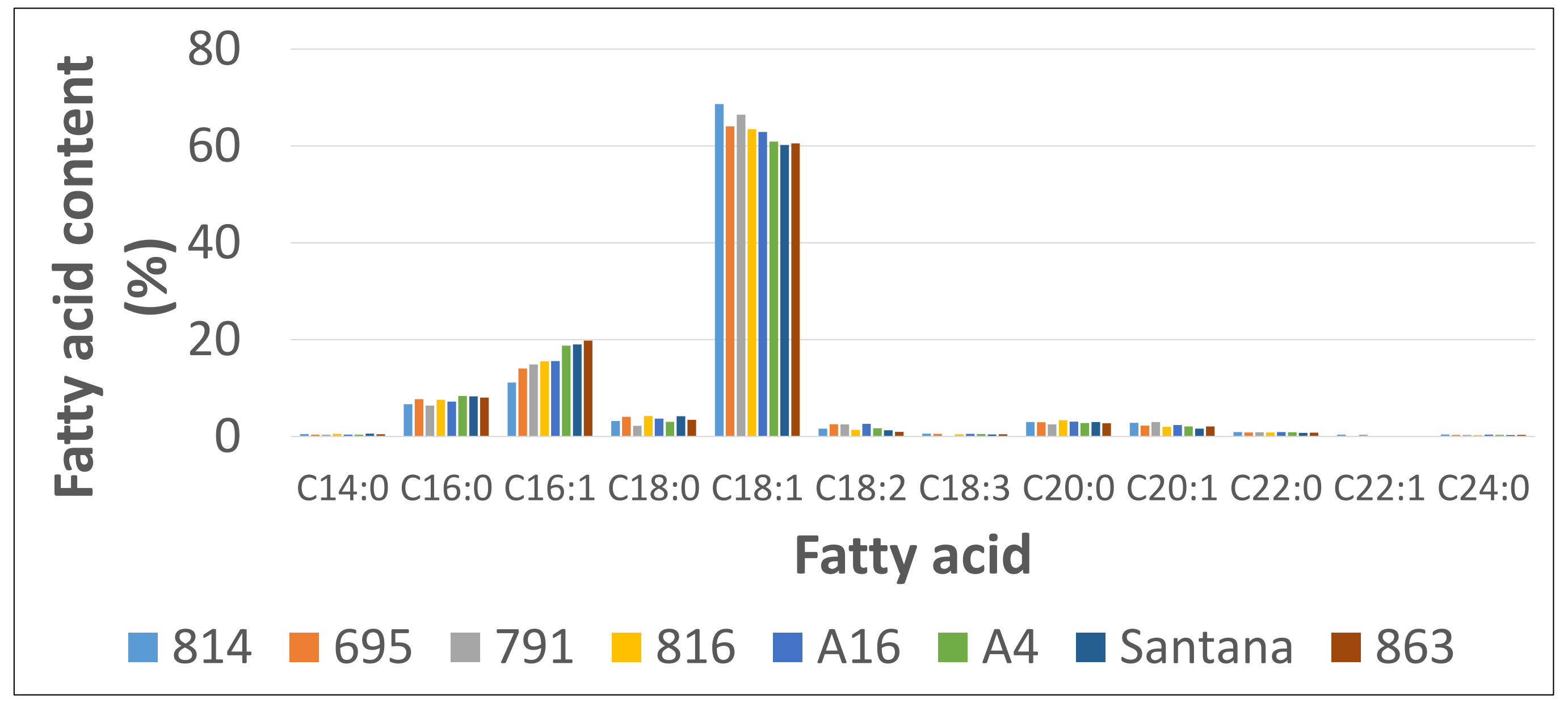

Figure 4: Fatty acid profiles of eight macadamia cultivars in a single germplasm orchard.

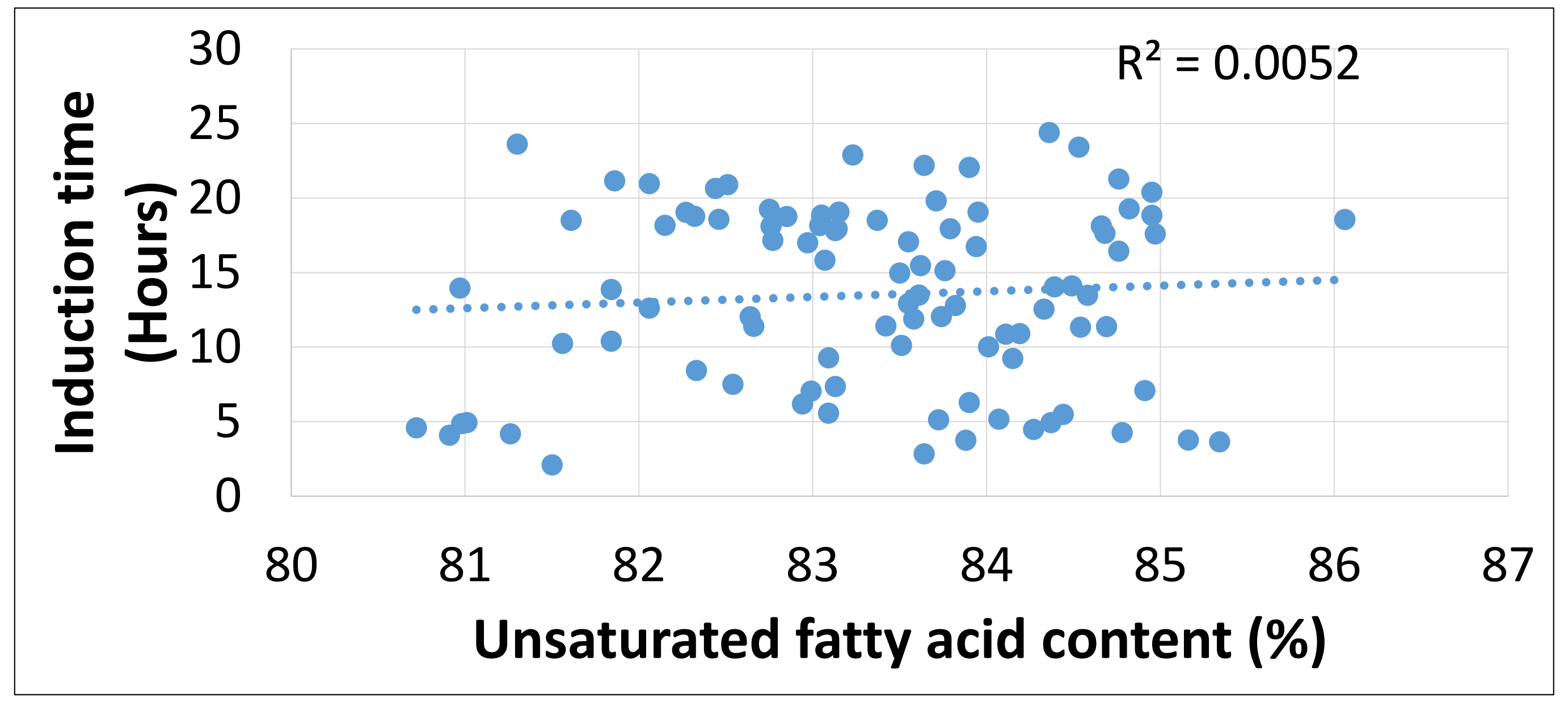

Figure 5: Oxidation time as affected by total unsaturated fatty acid content for 30 cultivars at multiple sampling dates and locations.

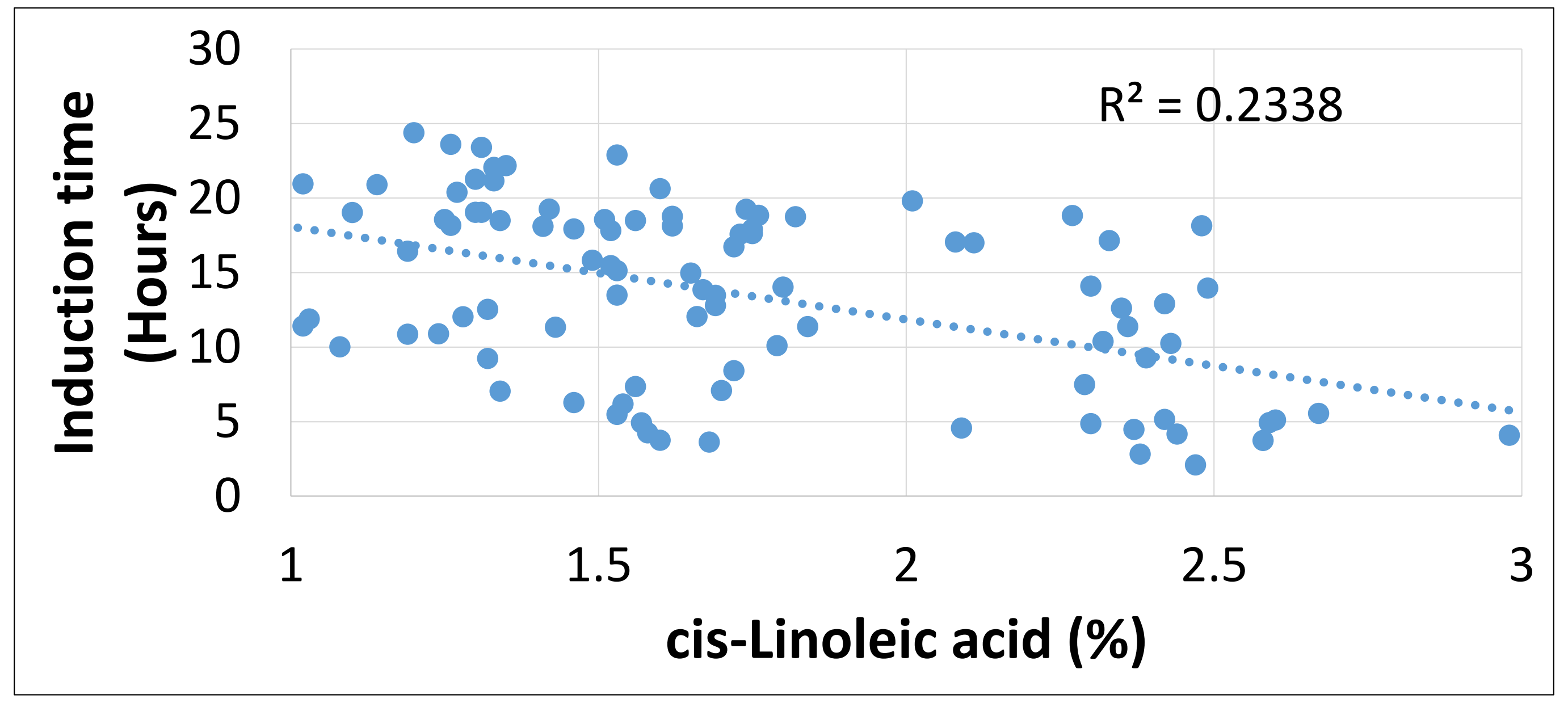

Figure 6: Relationship between induced oxidation time and linoleic acid content for 30 cultivars at multiple sampling dates and locations.

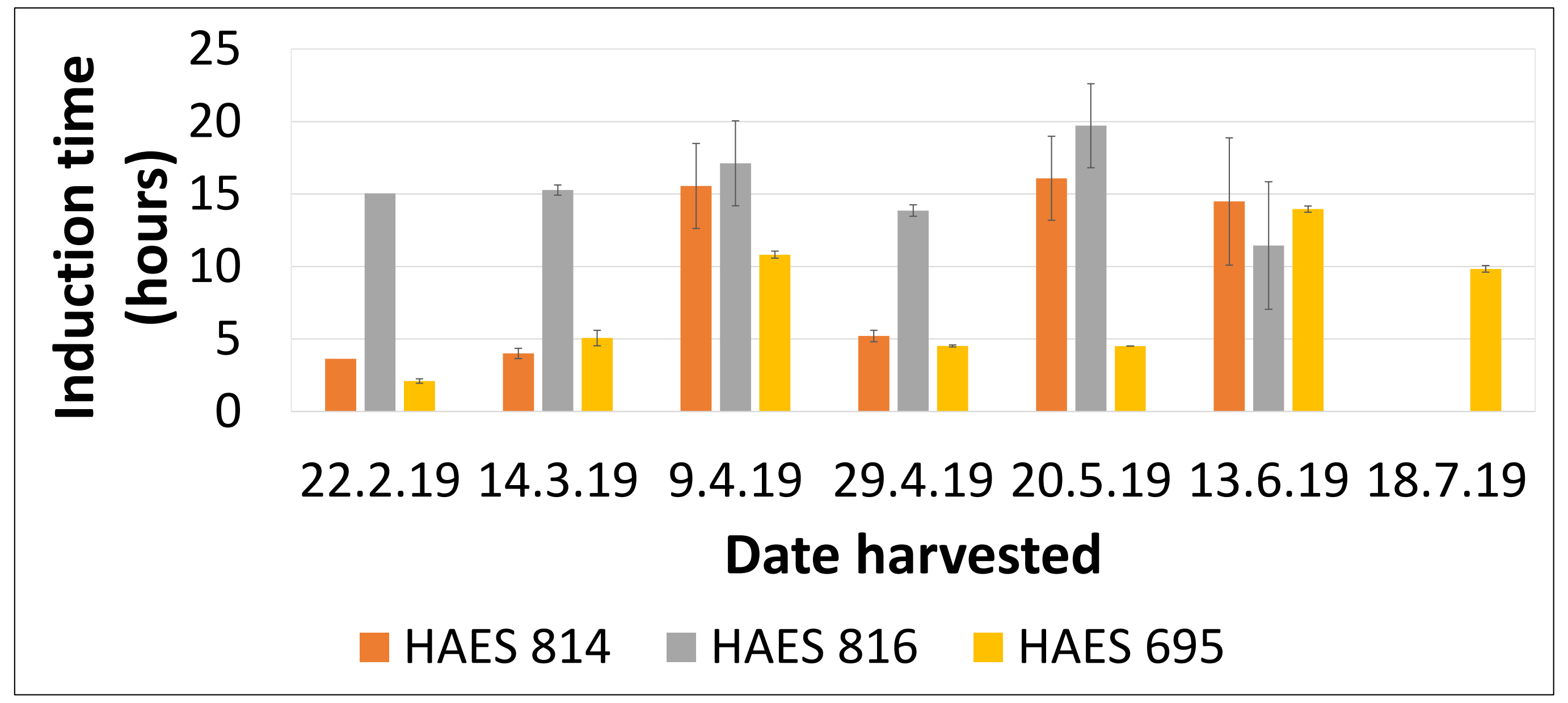

Figure 7: Induced oxidation times for three cultivars harvested at seven sampling dates.