An Investigation of Nut Blanking and Shell Splitting of Pistachio Based on Thermal Unit

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INTRODUCTION

Pistacia vera is the genus and species in which endocarp dehiscence occurs with fruit maturation. Earlier research has provided evidence that physical forces exerted on shell suture by seeds causes shell split. In developing our fruit growth phenology model, we also measured the volume of both nuts and embryos, and used the calculated embryo:nut volume ratios (ENR) to determine the correlations between nut split, ENR and heat units. The results are presented here.

METHOD

The cultivar samples and locations were collected weekly from mid-August through harvest. Nut clusters were collected from the south, north, east and west canopies. Hourly temperatures were monitored in each location, and thermal unit accumulation was calculated with a 7℃ (45°F) base temperature. In the lab we measured 20 tip nuts per trial for nut split and blank percentage, and nut and embryo volume using the water-displacement method.

RESULTS

Blank, Split and Cultivars: In all locations, the nut-split percentage of Kerman and Pete1 were consistently lower than that of Golden Hills, Kaleghouchi and Lost Hills. The nut-split rate in our research was evaluated using only tip nuts, to eliminate the possibility that the resource distribution to nuts lower on the clusters was not an issue. Therefore, our results suggest that the weak split rate of Kerman and Pete1 could be induced by a cultivar's potential non-split characteristics.

We also observed that the Lost Hills blanking percentage statistics were consistently higher than that of the other four cultivars. Because we excluded the possibility of pollen density and lower nuts factors, this suggests that cross-incompatibility and embryo abortion could be the factors causing blanks in the Lost Hills cultivar.

Split and Heat: The coefficient of determination, R^2=0.822, not surprisingly, showed a strong correlation between heat accumulation and nut split. In Fig 1, the result also demonstrated that nut split in Kerman initiated at 2000 heat units, and that the value of split rate quickly increased to 60 percent with an additional 600 heat units.

Embryo and Split: The average embryo:nut ratios (ENR) were summarized based on the measurements of 1600 individual nuts. The average ENRs of non-split nuts was 35.6, and 44.1 for split nuts. For the Kerman cultivar, the ENR values (non-split 34.44, split 43.03) and embryo volumes (non-split 1.15cm^3, split 1.63cm^3) between split and non-split nuts were both significantly different. However, the nut volumes of Kerman did not vary with locations or nut types (split/non-split). Collectively, these results suggest that nut split is a result of embryo growth that can be predicted using a phenology model.

CONCLUSION AND APPLICATIONS

The results show Kerman and Pete1 have naturally low split nuts compared to Golden Hills, Kaleghouchi and Lost Hills, and that Lost Hills consistently has higher blank percentages. The results also demonstrate that nut split is a function of heat unit and the embryo:nut volume ratios. Using this information, we can develop a model to predict an optimal harvest date based on the correlations between ENR and embryo growth.

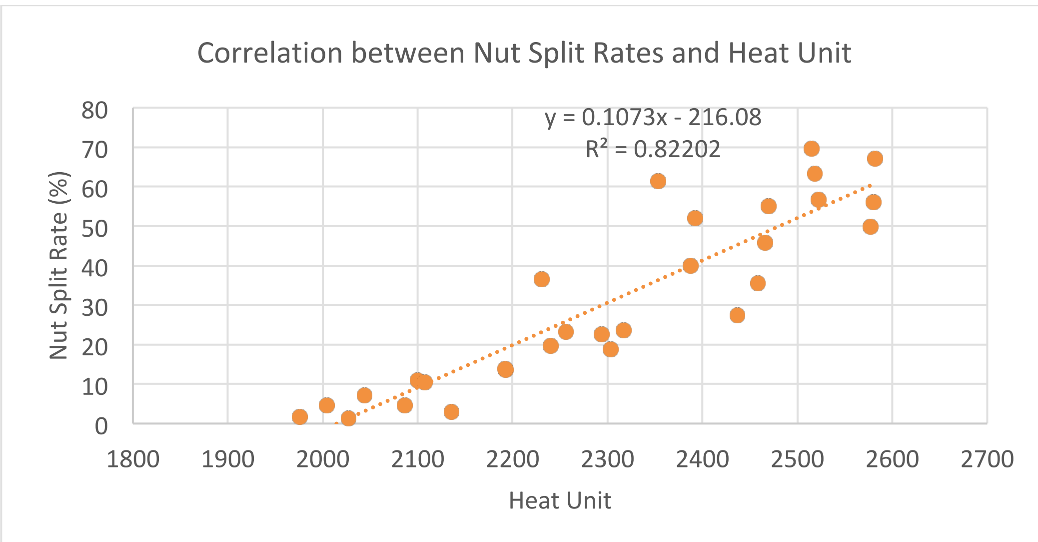

Fig 1. Correlation between the nut-split rate and heat unit of nuts collected from six orchards from mid-August to harvest date in Kerman cultivar. The coefficient of determination R^2=0.822 reveals a strong relationship that nut split is caused by heat.