

Comparison of Determinate vs. Indeterminate Inflorescences to Determine the Roles of PGRs, Carbohydrate, Nitrogen, and Other Nutrients in Fruit Set of the 'Hass' Avocado

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Introduction

Avocado trees, including 'Hass', are outstanding with respect to the large number of flowers they produce (e.g., 1 to 2 million per tree) relative to the low number of fruit harvested; yield represents only 0.001% fruit set (Bergh, 1985). Flowering coincides with the spring vegetative flush. In indeterminate inflorescences (*i.e.*, floral shoots ending with a vegetative flush), inflorescence leaves are reported to compete with flowers and setting fruit for assimilates until they are 2/3 fully expanded and start to support the developing fruit (Whiley, 1990).

Recent avocado field studies of Blanke and Lovatt resulting from Dr. Blanke's visit in spring of 1992 provided two key results of importance to fruit set: (i) determinate and indeterminate inflorescences are comprised of a similar number of panicle branches (7.2 ± 2.3 and 7.6 ± 1.1 , respectively), and bear a similar number of flowers (86.6 ± 16.7 and 62.4 ± 16.1 , respectively); and (ii) due to consumption of H₂O by inflorescence leaves, indeterminate inflorescences transpire 25 mls more H₂O than determinate inflorescences both before and after anthesis. Thus, there are likely significant differences in the content of PGRs, carbohydrate, nitrogen, and other nutrients in developing fruit borne on indeterminate vs. determinate inflorescences, one or more of which may play a key role in avocado fruit set, fruit size, and postharvest fruit quality.

We are conducting three projects to characterize the similarities and differences between determinate and indeterminate inflorescences. The first is a field study to determine the distribution of each type of inflorescence in the cohort of early-opening vs. the cohort of later-opening inflorescences of the 'Hass' avocado and the potential of each to set fruit that survive to harvest. The second is to quantify differences in the flux of PGRs (cytokinins, ABA, GA, or IAA) into an inflorescence and the distribution of PGRs within each type of inflorescence. In addition, the research will confirm that the differences are indeed due to the presence or absence of inflorescence leaves. In the

third project, we are screening precursors of IAA to identify one which can effectively replace the application of IAA in avocado.

In addition, Dr. Michael Blanke will visit my laboratory again this spring. Thus, we will be able to obtain a second year of data to confirm at what stage of leaf development the 'Hass' avocado leaf under California conditions becomes a carbon exporter and how this relates to the time of anthesis and fruit set.

Results

The results of the first year of research to determine the percent of fruit set by determinate vs. indeterminate inflorescences of early- and late-opening cohorts of inflorescences provided evidence that late-opening determinate inflorescences set more fruit that survive to harvest ($p < 0.02$).

Dr. Isa Bertling has completed establishing and standardizing the methods for isolating and quantifying PGRs by both high performance liquid chromatography (HPLC) and radioimmunoassay (RIA). In addition, Dr. Bertling synthesized several radiolabeled tracers for use in the RIA assays.

Her results thus far, employing detached inflorescences with their stems immersed in a solution of PGRs, provide evidence of significant movement of PGRs in the transpiration stream into the leaves of indeterminate inflorescences. The most striking result thus far is that leaves are stronger sinks than flowers and divert each species of PGR examined except zeatinriboside, a cytokinin, away from the flowers in the indeterminate inflorescences. Thus, flowers in determinate inflorescences have greater concentrations of ABA and GA but lower levels of zeatinriboside, whereas flowers in indeterminate inflorescences have a greater cytokinin to ABA ratio. With regard to zeatinriboside, flowers are stronger sinks than the leaves, and flowers within an inflorescence do not compete with each other. Total movement of zeatinriboside into each inflorescence type increased in an additive manner with each additional flower in the inflorescence above a threshold number of approximately 7.5 flowers per inflorescence. We are in the process of analyzing the PGR content of fruit during the fruit set period. The significance of the results cannot be fully ascertained until the relative transport of PGRs in avocado xylem sap to the inflorescence during anthesis and fruit set is quantified.

The amount of IAA available to developing avocado fruit might be a factor limiting its growth and ability to set. It is well known that IAA is not transported into developing fruit along its basipetal transport route. Therefore, IAA present in fruit must be synthesized *in situ*. Tryptophan is known to be a precursor of IAA. We investigated the possibility that avocado leaves can convert tryptophan to IAA; that tryptophan, or its metabolites, is transported from leaf to fruit, and whether tryptophan, or its metabolites, is translocated apically or basipetally. We found that avocado leaves synthesized IAA from tryptophan, that transport was apical (towards the growing end of the shoot where flowers, fruit, and new leaves are located), and that within 24 hours a significant amount of tryptophan, or its metabolite, moved from the leaves to the fruit. This suggests the possibility of using tryptophan to alter the IAA content of fruit to improve size and/or set. Indeterminate inflorescences import more IAA which accumulates in the leaves; fruit borne on indeterminate and determinate inflorescences imported similar amounts of IAA.