CHALLENGES FOR THE COMMERCIAL DEVELOPMENT OF S-ABSCISIC ACID (ABA)

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ABSTRACT

ABA is one of the natural hormones found ubiquitously in plants. ABA is involved in many major events of plant growth and development including dormancy, germination, bud break, flowering, fruit set, general growth and development, stress tolerance, ripening, abscission, and senescence. One of the most well known roles of ABA is the regulation of water relations in plants through the control of stomata opening and closure. Over 5000 scientific papers and patents on the molecular biology, biochemistry, physiology, and applied efficacy of ABA have been published since Okhuma et al. proposed its chemical structure in 1965. Despite this breadth of information, a commercial use for ABA in agriculture has not yet been identified or pursued. Like other PGRs, commercialization of ABA must meet several critical challenges. First, an ABA use must solve a commercial problem with a favorable return on investment for the user. Second, ABA must be manufactured at a cost that is commensurate with the value of its agronomic applications. Third, ABA must be registered and approved for commercial use. Overall, the commercialization of ABA requires a substantial investment in production optimization, laboratory research, field development, and regulatory support.

The commercial development of a PGR follows both sequential and parallel paths. These paths include research and development on the active ingredient (discovery of activity, laboratory/greenhouse research, field research, field development, and commercial development), production of the active ingredient (initial production through synthesis, fermentation, or extraction, and optimization of production) and registration of the active ingredient (physical and chemical properties testing, safety testing, and environmental safety testing).

For agrochemicals such as herbicides, insecticides, and fungicides, the question is often known and the answer is found. For example: How do I kill this weed, but not my crop? For PGRs, the answer is often known and the question is found. For example: Here is ABA, now find a use. The primary challenge for commercial development of ABA is to find the question that ABA can answer. The steps to meeting that challenge include the following:

1. Review the background information. In the published literature there are more than 5000 articles on abscisic acid based on a search through Agricola. Most studies on ABA pertain to biochemistry or basic physiology. Few of them pertain to exogenous application. The lack of applied ABA studies is due in part to the cost of ABA. Field studies require gram quantities of active ingredients. For example, S-ABA in the 2004-2005 Sigma catalog cost $533/mg. One liter of 1000 ppm S-ABA would cost $533,000.

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Among patents there are more than 60 patents on abscisic acid based on a search through the US Patent Office. Many of the patents pertain to conifer embryogenesis. Additionally academic researchers with ABA experience have been consulted.

2. List the potential targets. This may be done by first identifying targets based on a review of the background information, second organizing targets based on chronology of plant life, and third prioritizing targets based on most credible evidence and potential utility.

3. Develop the methodology. This requires, first determining how to evaluate the targeted effects (e.g. lab/greenhouse studies vs. field trials and internal research vs. external cooperator), second developing a usable formulation prototype that maintains a soluble and stable active ingredient, and third developing protocol to evaluate effects of active concentration, application timing, adjuvant requirements, and application method (e.g. spray, drench, or sprench).

4. Execute the studies, review the data, and reprioritize. Examples ABA effects include the increase in grape coloration, reduction in sweet corn chilling injury, extension in shelf-life of ornamentals, reduction of transpiration (Figure 1, top) and reduction in growth (Figure 1, bottom).

Conclusion

The critical challenges for the commercial development of S-abscisic acid include: 1. Identifying commercial opportunities with favorable returns on investment for the user. 2. Reducing in the cost of manufacturing to a level that is commensurate with the value of its agronomic application. 3. Registering the product with the US EPA and obtaining approval from state agencies for commercial use.

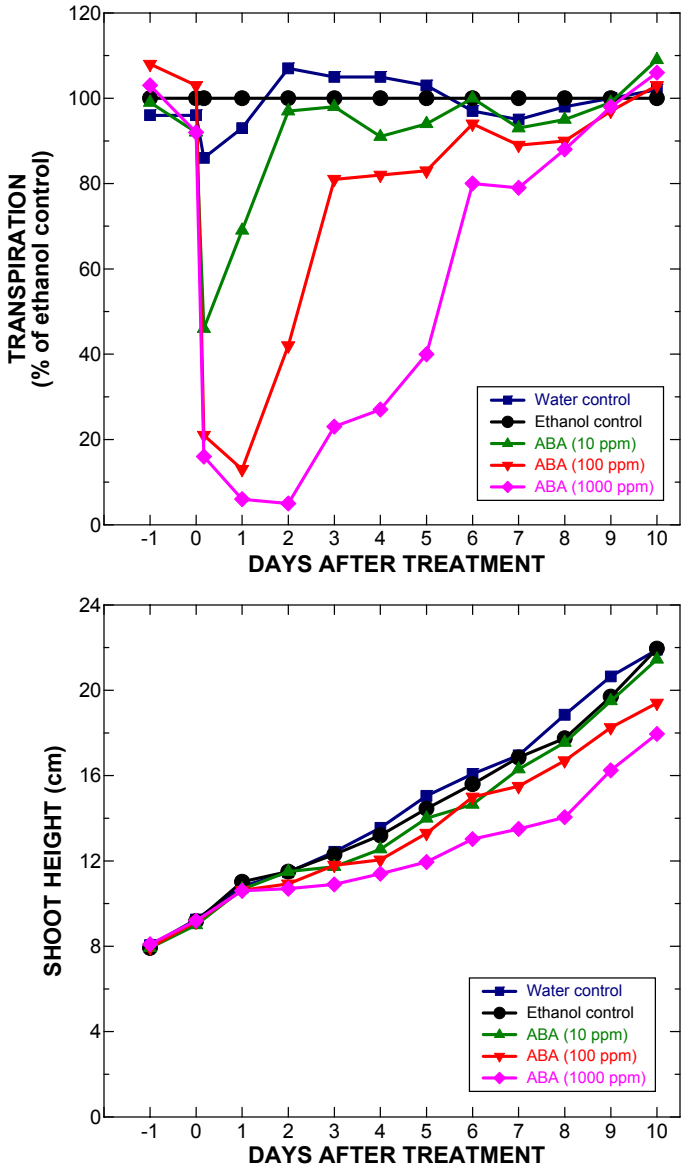

Figure 1. Rutgers Tomato seeds were planted in Promix PGX and seedlings were grown for in a 25C growth chamber with a 16-hour light cycle for the first 10 days. The seedlings were transplanted into standard 6-inch pots with Promix BX and held in a 25/18C greenhouse. Fourteen days after planting (n = 10 plants/treatment), plants were treated by pipetting 10 ml of treatment solution (water control, ethanol control, 10, 100, or 1000 ppm ABA) onto moist soil of each pot. The seedlings were watered daily. Transpiration was measured daily with a LiCor Li-1600 steady state porometer attached to the newest leaf large enough to span the orifice of the porometer (top figure). Height to the tallest node was measured daily (bottom figure).