The Science Behind Seed Propagation©

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INTRODUCTION

There are two potential interpretations of the theme of the science behind seed propagation. The first is to attempt to review all the detailed scientific investigations which have taken place that are relevant to the propagation of plants from seed. The second is the determination of a logical and analytical (and hence scientific) approach to the complete process of seed propagation. The purpose of this short paper is to concentrate on the latter but using examples from the first.

Generally and historically the whole process of seedling production, in the nursery trade, has normally been dealt with on an empirical basis—as the starting material has been perceived as cheap. In a modern context any commercial process should look for the highest productivity that is reasonable.

Despite the fact that scientific investigation has elucidated many of the difficulties encountered in the process of seed propagation, there is still much which needs to be determined. Research programmes tend to reflect small, concentrated, piecemeal approaches to resolve very particular issues while the overall picture of the process is still unclear.

Much can be learnt from other sectors of the horticultural business (e.g., bedding plant production, vegetable cropping, the interior plant industry, and plantation crop production) but in nursery stock production the unusual diversity of starting material creates its own challenges.

THE MATERIAL

Seed is the immediate product of the sexual reproductive process in plants and hence the first implication in analysing the process is to determine any genetic parameters, expectations, and particular vagaries.

Assuming that the seeds are of known and satisfactory origin they can then be subjected to the propagation process. It is important to remember that in nature the seed propagation process is, conventionally, extremely inefficient—of the thousands of seeds a plant may produce only one needs to germinate to maintain the population size. The task of the propagator is to reduce the risks and so obtain maximum productivity.

Collection, Extraction, and Cleaning. Factors influencing the seed sample and its production are inherent issues influencing the propagation process as they affect the quantity and quality of seed available, its uniformity, size, viability, physical damage, and (often unremarked) biological damage. It is important to have an understanding of the periodicity of cropping; the relationship of propagation schedules to season; and the likelihood of pest infestation, disease infection, the presence of rotting agencies; and the presence of viruses.

Longevity, Viability, and Storage. An understanding of the level of viability in a seed sample is crucial to successful production as it is the basis on which any accurate prediction of productivity is made. Viability begins to decline as soon as the seed is harvested, with the pattern of deterioration following the shape of a sigmoid curve. In order to maintain a productive sample it is essential to provide storage conditions that arrest the rate of this decline.

The earlier good storage conditions can be provided after harvest, the more successfully will viability be maintained. Consideration should then be given to the most economic storage conditions suitable for any particular sample. The testing of viability should also reflect the quality of the seed sample remaining, as deterioration in quality—usually measured by the development of necrosis—is an important indicator of the success of crop production.

The time scale of the pattern of deterioration, however, is affected by storage and is a reflection of the inherent longevity of the seed of a particular species; i.e., whether it is relatively short- or long-lived.

Germination. The germination process itself has received most attention from researchers and has been exhaustively examined in much detail. From a practical point of view the imbibition stage is particularly significant because of the dangers of waterlogging, i.e., the presence of excessive intracellular water (usually as a result of seed dormancy breaking treatments). The pattern and interactions of the environmental parameters in the process are well publicised and the pattern of physiological development and cell differentiation is also fairly clear. However the practical problems of seed germination in the production of nursery stock are more usually associated with overcoming inherent blocks to the germination process.

Blocks to Germination. The seed of many species develop blocks to prevent the process of germination (often referred to as "dormancy") from occurring as soon as environmental conditions are suitable. This strategy, depending on the process, evolved to delay germination until conditions are suitable for seedling survival and establishment, or to spread germination in time. In temperate regions, for example, a chilling requirement prevents seeds from germinating on a warm autumn day thus producing a seedling that would be killed by winter cold. Other examples are tough seedcoats, hard seedcoats, "smoke" requirements (these latter two being evident in fire ecologies) and combinations of any of these.

It is these natural strategies which tend to cause the chief challenges to the nursery propagator and, strangely, have received little real or effective attention from scientific research.

Seedling Production. Once germination is feasible and can be activated the final challenges relate to the survival and establishment of the seedling. Attention to such issues as seedling density, the presence of suitable mycorrhizal associations, the provision of suitable environmental conditions, soil reaction, and nutrient status are relatively obvious.

CONCLUSION

The significance of the origin of the seed in the propagation process is paramount as it constitutes the fundamental basis of the whole system. It is the genetic status of the material that is to be expressed and this quality determines the end product, however the remainder of the process is conducted. It encompasses the whole gamut of requirements from correct naming and identification to the detail of strain and the uniformity that may be required.