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New Plant Evaluation and Propagation Processes©

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INTRODUCTION

In the society that we live in today, new and improved products are what the consumers are expecting. In the green industry, this means that we also have to keep up with society by developing new and improved selections of plants to keep up with the trends. The development of new and improved plants presents growers and breeders alike with many challenges. To develop new plants there are certain steps and processes that you must go through that are very time consuming and in some cases very expensive. The first step in this process is to obtain a plant that is new and improved. Next it must be evaluated for an extended period of time to be sure the plant will perform for the end consumer in such a fashion that will prove it to be a plant worthy of introduction. Once you have a new plant you then must develop the methods to propagate and produce such a plant. When you have a plant that will perform and can be produced, you still have to determine how you will market this product so the end consumer will see the added value and a premium price charged.

DISCOVERY

While the idea of a new and improved plant selection is easy to conceive, actually coming up with this new product is much more difficult. There are several methods that we use to discover new and improved plant selections. The most obvious way to find these new selections is to just use your eyes. Plants are living things, and they sometimes develop mutations or sports that can be developed into new plants. In mass production where you are planting thousands of plants, the odds are somewhere in the middle of the masses there will be plants that do something unusual. The hard part is finding that needle in the haystack. We spend numerous hours riding and looking through the masses that we have already produced looking for that one diamond in the rough. However, mutations must be evaluated during propagation to determine if the characteristics will remain the same in the plants that are produced as they were in the original.

Another method that we use to discover new selections of plants is to try to manipulate plant genes through the use of chemicals to cause mutations. There are a couple herbicides that are commonly used and on the market along with other types

of chemicals that cause the chromosomes in plants to be disrupted and sometimes to be multiplied. When the chromosomes on plants are multiplied they often display unusual characteristics that lead to improved qualities such as a magnification of color, a decrease in internode length, and thickening of the exterior cuticle. Some of these characteristics can be developed to lead to new and interesting plants.

Probably the easiest way to discover new plants is to have someone else develop them for you. Developing a relationship with breeders who work hard at developing new plant material and creating a win/win working relationship with them is an outstanding way to obtain new plant material that will benefit both your company and the breeder. Providing the development services for breeders who cannot afford the timely and expensive steps that are needed to get a new plant from discovery to the market is a major tool in finding new plant material. By providing the resources necessary to develop new selections such as nursery space, containers, evaluation, and the ability to mass propagate the plant, we are able to make progress on the new selection that the breeder may not have had the time or money necessary to complete. In return we have developed a new plant and relationship that will continue to benefit everyone.

EVALUATION

The evaluation of newly discovered plants can be the most costly and time-consuming process in the development of new and improved plant. First there has to be the evaluation to determine whether the properties of the new plant are such that it will be significantly different than what is available on the market already. As well, does it or does it not have traits that would make it desirable for the end consumer. The evaluation of very large seed crops can be most expensive since you end up throwing most of the plant material away.

We have discovered that it is equally important to be able to recognize and discard the plant material that is not desirable — as it is to be able to pick the best plants for the trial. We have often found that by removing the losers first that the final winner will show up further along in the evaluation with much more ease. It is during this phase of evaluation where some people tend to be very attached to their plants. The biggest obstacle is being able to throw out those that are not what you are looking for. The breeder often gets too attached and is not the person for this job. It takes many trips to the field to observe the plants in all seasons to be able to determine which will be the winner. However, do not judge the plants too quickly; on many occasions it may not be the first choice that ends up being the winner. The opinions of others are always very useful in this process. After looking at the same plants day after day you may become partial to one or the other whereas someone with a new view may have other ideas to help you in making your choice. We have as many people as possible pick their favorites so that we can get an overall picture of what the public will want.

Now that you have a plant that displays the traits that you are looking for, the second evaluation process begins. It must be determined if the plant will continue to show the improved characteristics in production and over time as it matures and develops. This evaluation process takes time. No one knows how much time is necessary to evaluate a plant before you can predict its dependability. A plant needs to go through all the seasons of a year to evaluate performance in all conditions. This needs to continue for several years to determine if it will hold up to the environment.

This phase also allows the collection of information such as cold hardiness, sun tolerance, and other growing conditions that are vital to the success of the plant. There is no real way to determine everything about the performance of the plant but a very thorough evaluation over a long period of time is necessary to be able to predict performance for the end consumer in the years to come as plant matures.

PROPAGATION

Last but not least, the plant needs to be evaluated for the ease of propagation and production in the nursery setting. The plant must be able to be propagated in such a fashion that large numbers can be produced. The plant must also perform in production under normal operations of the nursery or it may be too time-consuming and expensive to continue. There are many plants out there that fit the new and improved category but if these plants cannot be produced in mass quantities in a nursery setting, then they are not commercially viable.

Once you have discovered a plant and it has been evaluated and proven that it is commercially viable and worthy of production the best method of propagation must be determined. Often ease of propagation can help to decide, which plant will be the winner. If the plant is a mutation or sport of a plant already in production the most logical starting point is to try the methods that are already in place for that particular species of plant. There may be some minor adjustments to the processes of propagation such as hormone levels and timing of mist, but in general not much modification is necessary.

There are, however, many plants that have been discovered that are new to the system and an entire new protocol for propagation has to be determined. The first step is to determine if the plant is in the same family or genus as any other plant that is currently in the system. If so, the protocol for the related plant would be a good place to begin and then make adjustments as necessary. Experience has taught us that in many cases the trial and error method is the only way to go. Through experience and research in most cases a protocol can be developed and then adjusted. There will always be those plants that just will not propagate efficiently or fast enough to obtain the quantity necessary. In these situations tissue culture or micropropagation may be the best option. Tissue culture propagation may be the only option available on some hard to root plants. Tissue culture may also be the best option on plants that are slow to propagate such as those that have to be reproduced through division. Once the propagation protocol is established and adjusted then all that is left is to produce the numbers necessary and release a new and improved plant for the public to enjoy.

CONCLUSION

The processes of finding and producing new and improved plant selections can be exciting, but very expensive and time consuming. The consumer is always looking for the newest and best products nurserymen have to offer. We have no choice but to keep up with their demands. Through observation of existing plant material, chemical manipulation of plant material, or developing relations with breeders, there are many new and exciting plants to be found. Once found, plants must be thoroughly evaluated to insure they will perform reliably in nursery and landscape environments. Nurserymen must evaluate new plants long enough and in variable climates and be able to educate the consumer on the best conditions for growing

the plants if the product is to be successful. However, the best new plant in the world will never be successful if a propagation method cannot be established to supply the quantities that the consumer will demand. If the evaluation and propagation of new plant selections is done in a scientific and appropriate manner and marketed correctly, then the new product will be a success for the consumer, retailer, and wholesaler.

Growing Plants for NASA — Challenges in Lunar and Martian Agriculture©

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INTRODUCTION

Technology advanced rapidly during the 20th Century. One hundred years ago, 17 Dec. 1903, the Wright Brothers flew the world's first powered aircraft at Kitty Hawk, North Carolina. It was a flight of 37 m (120 ft) that lasted 12 sec at a maximum speed of 16 kmph (10 mph). Forty-four years later Chuck Yeager would break the sound barrier — Mach 1 at 1086 kmph (675 mph). Twenty-two years after that in 1969, Neil Armstrong landed on the moon.

So what is the role of plants for human life support? Plants reduce the level of carbon dioxide (CO_2) and produce oxygen (O_2) during photosynthesis. They can also help convert wastewater into potable water through transpiration and subsequent condensation and collection of clean water. Plants also produce carbohydrates and food for human consumption (Fig. 1). In the international space station and NASA's space shuttle, physical-chemical methods are primarily used to produce oxygen and absorb or vent carbon dioxide from the cabin atmosphere (Fig. 2). NASA plans to use plants to supplement physical-chemical systems to produce oxygen and absorb carbon dioxide. Plants also have a role in supplementing human nutrition as part of NASA's "salad bar" program of fresh greens and vegetables. Plants are also important for the psychological well being of the crew.

THE PROBLEM

It will be a tough environment to grow plants in lunar and Martian agricultural systems (Salisbury, 1991; Bugbee, 1999; Corey et al., 2002;). The atmospheric pressure of the moon is a vacuum and Mar's atmosphere is 1/100th of the earth's pressure. Gravity is another factor — the moon is 1/6th and Mars is 2/5ths that of earth's gravity. Capturing, producing, and using light for plant growth is another challenge. The moon has 14.8 days of consecutive darkness followed by 14.8 days of consecutive light. While Mar's has an atmosphere composed of 95% CO_2 (compared to 360 ppm or 0.036% CO_2 on earth), the moon has no CO_2, nor the carbon needed to produce it, i.e., carbon, oxygen, nitrogen, and carbon dioxide will need to be transported from earth or artificially produced in controlled environmental structures on the moon and Martian surface. Another problem is that travel to Mars and the return flight to Earth is a 3-year process, i.e., you cannot cram enough food into a