GERMINATION ENVIRONMENT

Temperature is a critical factor in germination of 'Goldsturm'. Traditional germination techniques usually involve cold stratification (40–50 °F, 4–10 °C) for several weeks before moving trays to a warm (70–75 °F, 21–24 °C) environment.

Raker uses a warm (85 °F, 30 °C), lit germination chamber for germinating 'Goldsturm'. Trays remain in the warm chamber for 4 days after sowing and are then moved into a greenhouse at 72–75 °F (22–24 °C).

Trays in the germination chamber are wrapped individually in clear plastic to ensure high humidity and proper moisture levels. Light enhances germination in 'Goldsturm', so seed is not covered.

SOWING

To help ensure good plant stands and meet our guaranteed tray counts, we sow multiple 'Goldsturm' seeds per cell in trays. For 288 trays, we sow two seeds per cell; for 128s, three seeds per cell. We also sow extra trays to use in the patching process ("overstart"), to help ensure can-ship full-plug trays. Overstart for 'Goldsturm' is 40% extra trays, regardless of tray size.

Ensuring good sowing accuracy, with seeds placed directly in the centers of cells, is important in producing high quality seedlings. Seeder operators should be trained well enough to understand their equipment and how to get the best efficiency and accuracy from it.

CROP TIMING

Crop timing for plug production is generally 6–7 weeks to finish a 288-cell plug and 8–9 weeks to finish a 128-cell plug.

Propagation of *Sarracenia* Species©

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INTRODUCTION

The notion that the Sarraceniaceae family of carnivorous plants evolved recently in geological time can be attributed to a complete lack of any fossil records (D'Amato, 1998). Most carnivorous plants evolved modified leaves as a survival mechanism to supplement low mineral and nutrient levels. Low nutrient availability within the root zone is due to the inherent wet, mineral deficient, acidic, peaty soils of the habitats in which they are found. North America has probably the widest range of carnivorous plants in the world — most *Sarracenia* species are found in the southeast United States of America (Schnell, 2002). Charles Darwin, among others, studied carnivores and published *Insectivorous Plants* in the 1875.

Carnivorous plants have developed various methods to capture animals; primarily these techniques of capture can be divided into "passive" and "active" methods. All Sarracenias use the passive method of "pitfall." In order to be considered a "carnivorous plant," a plant must lure, catch, kill, and digest its prey (D'Amato, 1998). Glands in the modified leaf shoots of many carnivorous families often produce digestive enzymes. The Victorian botanist, Sir Joseph D. Hooker (1859), was the first

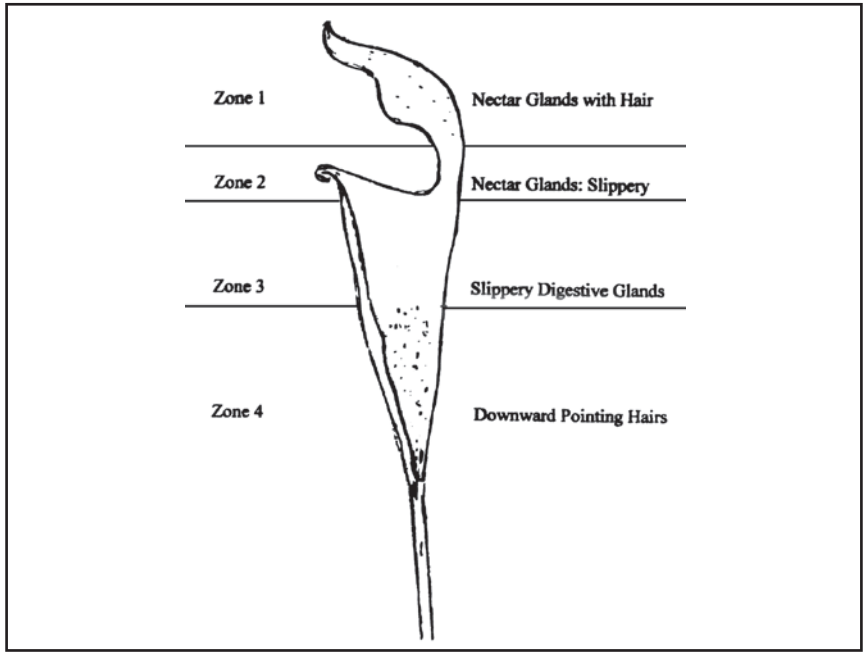

Figure 1. Zonation.

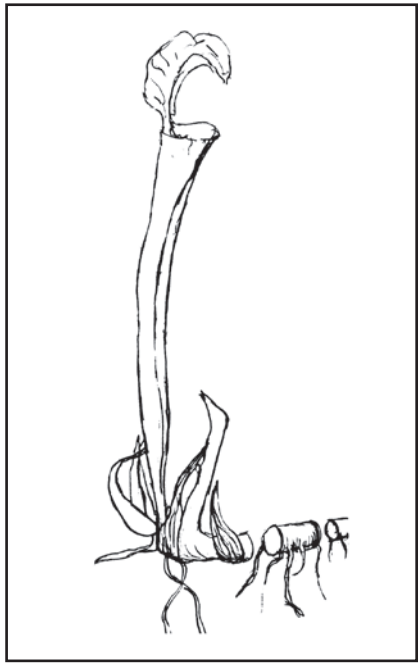

Figure 2. Division of *Sarracenia* rhizome.

to identify four distinct zones within the modified tube leaves of the *Sarracenia* species (Fig. 1).

During the late 1800s commercial nurseries provided a source for unusual exotic plants from all over the world. Among these were members of the Sarraceniaceae family. Many colorful hybrids were produced and subsequently lost over the years. Venus flytraps revived the craze for carnivorous plants in the 1960s. In the 1970s several individuals, including Don Schnell, produced a newsletter and formed the International Carnivorous Plant Society (Slack, 1998). In the 1980s and 1990s huge areas of carnivorous plant habitat were transformed and lost to development, roadways, and forestry. Vegetative propagation through tissue culture and traditional methods has increased proportionally to meet increasing demand for plant material. Seed production/hybridization of existing complex

and simple crosses continues to be a source for new seemingly endless range of propagules, many of which exceed the beauty of the natural hybrids found in the world (Mellichamp, 2000).

PROPAGATION

Vegetative. Most sarracenias produce offshoots of new growing plants along a rhizome. Some species such as *S. purpurea* and *S. psittacina* are extremely slow. We have observed *S. rubra* producing up to 10 offshoots per year. We have found January through February to be most favorable for vegetative divisions in our 60 °F production greenhouse. We divide only after dormancy has broken but prior to the actual growth period where flower buds and new tubes have emerged. Growing tips can be identified easily at this time because they often become enlarged and sprout new roots at the terminal end. The shoots are manipulated in such a way as to delicately snap the offshoot from the longer rhizome sections. A properly harvested propagule should be white inside and have some roots attached (Fig. 2). Notching of the *Sarracenia* rhizome is another method of vegetative production. In this method, the growing tip is allowed to remain growing attached, and "V"-shaped notches are made along the surface of the elongated rhizome. The rhizome is exposed to filtered light, and new growing points often appear along these cuts. Care must be given to prevent fungal infections. Healthy old gnarly rhizomes without growing tips may also be used with some success (Fig. 3).

Vegetative propagules are sized and planted into appropriately sized seed cells filled with pre-moistened 1 perlite : 1 peat moss (v/v) mix. The top of the rhizome should be placed at the surface of the medium and the roots buried under the medium. The propagules are then watered in with a fine mist from overhead and resituated within the media mix if necessary. Thereafter all watering is done via bottom up method with alternated wet/dry periods. The plants must never be allowed to dry out completely. However the "drying down" of the medium increases oxygen concentration within the root zone, helping to promote more root development, which increases survival rate. Fertilizers can be applied routinely with caution at approximately 20% the recommended rate during the active growth period. As with watering, liquid fertilizers are added to the cells bottom up and allowed to come in contact with the root zone for approximately 24 h, after which the fertilizer solution is flushed out from above using overhead irrigation. Neutral, low mineral water must be used in order to flush out any residual salts. Sarracenias as well as most carnivorous plants are salt intolerant. Propagules vary in their growth rates according to their individual vigor, specific species, or cultivar type. A 2-inch × 2-inch plug can be produced in 1 year. A typical 2-inch × 2-inch plug will generally fill out a 1-qt container in the 2nd year. Most species take at least 4–5 years to reach maturity, bloom, and produce seed.

Seed. Sarracenia flowers are perfectly designed for cross-pollination by bees, although self-pollination is possible. Petals remain open for 1–2 weeks. Pollen will drop when ripe into the umbrella shaped styles. Pollen can be transferred between open flower stigmas or its own to self-pollinate. Pollen stores several weeks in the fridge in dry sealed containers. Phil Sheridan of Woodford, Virginia, has reported dry pollen stored at freezing temperatures may be viable for months (Sheridan, 2004).

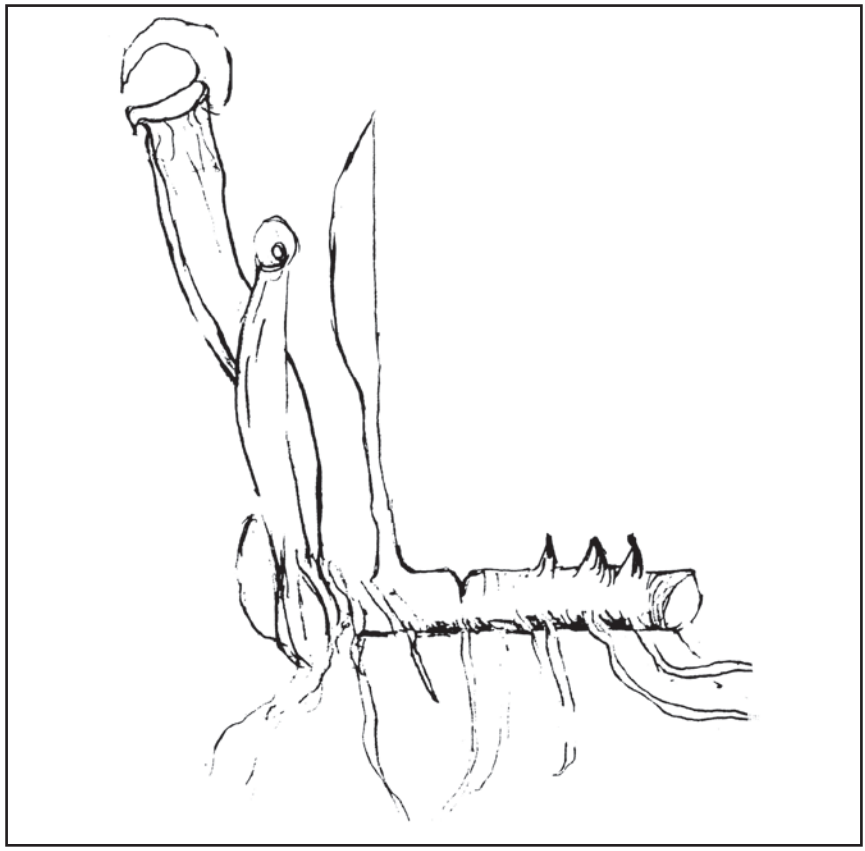

Figure 3. Notching a Sarracenia rhizome will usually encourage new growing tips.

Reciprocal crosses should be done if possible. All crosses are labeled and documented. When possible, record any and all information about parental heritage, origin, date acquired, etc. Petals drop off after 2 weeks; the umbrella style and sepals remain. The ovary continues to ripen throughout the summer. In fall the seed pod often splits. Up to 200 seeds may be produced in one pod. The seeds are reddish brown and the size of a pinhead. Seed can be stored dry in airtight containers at 35–40 °F for several years without significant losses. All Sarracenia seeds should be cold wet stratified prior to sowing for at least 30 days. In a warm greenhouse the best time for sowing is early spring/late winter when daylight hours are increasing and soil temperatures are rising. Germination rates of 90% are not uncommon if fresh seed is sown when ambient temperatures are at least 70 °F during the daytime and 40 °F at night. As with most wetland obligate species, seed must be surface sown and watered in lightly. The medium is 1 sand : 1 peat moss (v/v) mix. Germination occurs within 10–20 days. Seed trays are kept at constant moisture levels and allowed to remain in full sun. Seedlings are sorted, sized, and graded in July and placed in appropriately sized cells.

Table 1. Simple *Sarracenia* hybrids.

S. ×*catesbaei*	=	*S. purpurea* × *flava*
S. ×*moorei*	=	*S. flava* × *leucophylla*
S. ×*popei*	=	*S. flava* × *rubra*
S. ×*harperi*	=	*S. flava* × *minor*
S. ×*mitchelliana*	=	*S. purpurea* × *leucophylla*
S. ×*exornata*	=	*S. purpurea* × *alata*
S. ×*chelsonii*	=	*S. purpurea* × *rubra*
S. ×*courtii*	=	*S. purpera* × *psittacina*
S. ×*areolata*	=	*S. leucophylla* × *alata*
S. ×*readii*	=	*S. leucophylla* × *rubra*
S. ×*excellens*	=	*S. leucophylla* × *minor*
S. ×*wrigleyana*	=	*S. leucophylla* × *psittacina*
S. ×*ahlesii*	=	*S. alata* × *rubra*
S. ×*rehderi*	=	*S. rubra* × *minor*
S. ×*gilpini*	=	*S. psittacina*
S. ×*formosa*	=	*S. minor* × *psittacina*

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