resulted in an increase in "cosmetic breeding" — the production of cultivars with very minor distinctive characteristics which represent little or no improvement in horticultural or agricultural merit. This is a problem faced by all Rights authorities and the question of "minimum distances" between cultivars is continually under discussion.

New Zealanders, in general, have benefited from the introduction of Plant Selectors' Rights. An increasing number of cultivars (both overseas and local) are now available and further plant breeding is continuing, particularly in the horticultural sector. The breeding of improved plant cultivars which may contribute to the national agricultural and horticultural productivity is thus encouraged.

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SHRINK WRAP — OUR EXPERIENCE

IAN DUNCALF

Duncan & Davies Nurseries
P.O. Box 340, New Plymouth

The processing of open ground grown nursery plants in preparation for sale and despatch, is a very expensive and time consuming operation. This factor, coupled with the lack of customer appeal of the traditional "balled" plant, lead us to look at shrink wrap plastic as a means of speeding up this "processing" operation and to improve the plants' appearance and handleability.

Our programme was to shrink a plastic cover to the outside of our field-balled plants, just prior to despatch, which would improve the packaging and handling of the product, as well as carrying the company's logo and planting instructions. The shrink wrapping system was designed to allow the plants to be held for the normal length of time for balled products in garden centres and retail outlets, and to be easily and conveniently handled by the customer who would remove the film just like an ordinary polythene bag prior to planting.

We carried out this programme for one despatching season, and as far as we are aware we are the only nursery to have tried shrink wrap plastic on a commercial scale with nursery stock. The shrink wrap system did have some problems, and we have recently returned to more traditional methods of processing. However, we would like to share the considerable experience we gained with this product with other nurseries who may well have other applications for this fascinating material.

WHAT IS SHRINK WRAP?

Shrink wrap is a plastic film that is similar to other plastic films in that it can be extruded, welded, printed and coloured in the same way as normal, but it differs in that it has undergone a process called orientation. This orientation process changes the molecular alignment in the film so that when it is exposed to heat it shrinks and returns to its original dimensions. Simply, the film is stretched during its manufacturing process, but retains a "memory" of its original size and will shrink to try to reach its original state when heat is applied.

When a bag made of this film is heated, it will shrink uniformly and surround its contents closely and tightly, revealing their actual shape, which usually is an attractive form of packaging. At the same time the film increases in thickness during the shrink process and so becomes tougher and stronger. Shrink plastic is commonly used in the presentation of foodstuffs and in a wide range of other product presentation operations.

It was the shrink plastic's properties of shrink, toughness, and appearance that attracted us to look at it as a means of packaging plants. After various trials and experiments we used the following method to shrink this plastic film on to our plants.

SHRINKING WRAPPING METHOD

This operation was used on field-grown plants that had been lifted and balled using an elasticised netting with either a hessian or a raylon biodegradable liner. The process was carried out just prior to the plants being despatched from the nursery.

A number of various sized printed bags were made for us with shrink film and the bag size used on any plant was such that the bag would easily slip over the ball giving a very loose fit. The loosely fitting bag was then held in place over the ball with a rubber band which was positioned at the neck of the plant and kept some tension on the bag to hold it in place,

while allowing for air movement out of the bag during the shrinking process.

The operator held the plant by the stem, (not the bag) and immersed the ball of the plant to the depth of the rubber band at the plant's neck into a water bath kept at a temperature of 91°C ± 3°C. This dipping process was very quick and a one second immersion was sufficient time for a full tight shrink.

To ensure hot water did not spill into the inside of the bag, which would damage sensitive plant roots, the bags were designed to be of sufficient size to allow for at least a 10cm "collar" above the plant neck. After shrinking, this collar was either rolled down or ripped off at a tear line scored on to the bag.

Finally, the shrunk wrapped balled plant was dropped onto a plate of pointed nails to make a series of drainage holes to allow irrigation or rain water to drain out of the balled plant as normal. This completed, the plants were then ready for despatching in the usual way.

Although this shrink wrap operation was basically very simple and quick, we did identify a number of key points as being important for the successful operation of the process.

a) *Water temperature* — It was essential that the water bath be maintained at approximately 91°C. Temperatures lower than this resulted in poor and incomplete shrinkage, often leaving untidy "ears" on the bottom ends of the bag. On the other hand, water temperatures too close to boiling point caused shrinking to be too rapid which could lead to ripping of the bag at the widest point of the ball.

To maintain our water baths at the desired temperature, we used simple water heating elements thermostatically controlled in an insulated metal tank and floated polystyrene balls on the water surface to reduce heat loss.

b) *The method of attachment of the bag to the ball prior to shrinking* — We found it to be essential that the bag was positioned correctly prior to shrinkage to ensure that any printing was correctly located after shrinking and that the bag sat uniformly on the ball. Because the plant cannot be held by the bag during shrinking (the bag simply moves out of the operator's hands) the rubber band system of support was very good. It provided tension and allowed positioning of the bag, yet didn't restrict the movement of the air from the inside of bag, but allowed it to escape through the open top during shrinkag.

c) *Smooth, uniform-shaped balls* — Ripping of shrink bags occurred during shrinking if any pointed or sharp roots pro-

truded outside the plant's ball. This was a particular problem on some types of plants with thick lateral roots. As these roots sat proud of the main ball, they would take all the initial tension during shrinkage, and would become a weak point in the bag and often pierced the skin, resulting in serious ripping.

d) *Operator skill* — One of the properties of shrink film is that it only shrinks once. If for some reason the first shrinkage was not complete, such as when the ball was not placed deeply enough in the water bath, or the bag was not aligned properly, then it was almost impossible to get a further shrink by re-dipping. Hence it was most important that the operator was skillful enough to get it right the first time.

To summarize our experience with this process, we can identify the following points in favour and points against this type of "processing" balled nursery plants.

Favourable features includes:

1) Shrink wrap is a safe, simple, rapid, and cost effective method of applying an outer cover to balled nursery plants.

2) Shrink wrap provides a tough and durable protective cover, which can be printed and coloured as required.

3) Shrink wrap provides a neat, tidy cover over well shaped uniform balls that improves the appearance and presentation of traditionally balled plants.

The unfavourable features include:

1) The tight plastic skin rounds the shape of balls and this rounding at the base can reduce the stability, especially of taller plants, once put down or spaced out in the nursery.

2) The variability in shape of field balling presents difficulties in controlling the shrinkage of the film at the neck of the plant. Over-shrinkage can reduce the top opening which restricts water entry into the shrunk wrapped ball during the plant's holding period prior to sale. Under-shrinkage leads to a loose, rather untidy covering.

3) The tight fitting cover reflects exactly the shape of the ball underneath and odd-shaped or uneven balls can detract in appearance with the shrunk film on. This problem is magnified by the glossy reflective surface of the film.

4) Exposed root stubs in a ball leads to ripping during shrinkage.

Our experience illustrated that shrink wrapping using the water bath system can safely be used on nursery stock without damaging the plant. It does have some other drawbacks, but there may be other possible uses for shrink wrap film, in nursery production, even using other ways of inducing shrink-

age, such as hot plates, or hot air blasts.

Despatching operations that need to keep plants tightly held together with a protective skin to reduce in-transit drying out could utilise the speed and handling advantages of shrink wrap. Two operations in our own nursery are presently being investigated in this regard. Firstly the export of small rooted cuttings or liners sent by air, which are presently packed in plastic insulated rolls, may be better prepared and presented using shrink wrap film. Secondly, plants that are held in cold store during transporation or storage, and are therefore likely to dehydrate, could also benefit from a protective shrunk wrap coating.

Whatever shrink wrap plastic's potential is in nursery production, it is an extremely fascinating and interesting product and one option that nurserymen may look to in the future, to improve the handling, despatching, and presentation of plants.

PROPAGATION OF AMARYLLIDS: A BRIEF REVIEW

C.B. CHRISTIE

Department of Horticulture and Plant Health
Massey University
Palmerston North

INTRODUCTION

The amaryllids comprise a family of interesting monocotyledonous plants that have long been prized for their very attractive inflorescences. A small number of the genera have become economically significant as cut flowers and potted flowering plants, e.g. *Narcissus, Nerine,* and *Hippeastrum.*

The propagation of the Amaryllidaceae may be achieved by use of the following four methods: seed, separation, bulb cutting, and tissue culture. The techniques employed in each of these methods will be briefly reviewed.

PROPAGATION BY SEED

Most species will produce seedlings that are reasonably true to type; however the natural heterozygosity and capacity for interspecific and intergeneric hybridisation has been exploited in the production of hybrid nerines (20) and plants such as × *Amarine* (*Amaryllis belladonna* × *Nerine*) and × *Brunsdonna* (*Brunsvigia* × *Amarylyis belladonna*).

Plants are easily propagated from seed if it is set. Seed of amaryllids is of two distinct types: