research is that conducted by each nurseryman and the subsequent gearing of the successes and failures to improve his particular system.

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HYPOBARIC STORAGE — AN OVERVIEW

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Hypobaric or low pressure storage (LPS) is a relatively new technology that may significantly alter many production and/or marketing procedures presently being used in horticulture. It is the purpose of this paper to briefly introduce LPS by discussing the history, principles, capabilities and present status of this technology.

History. The storage of horticultural commodities and other perishables is limited by pathological and/or physiological disorders. Of major concern is the influence of carbon dioxide, ethylene and other gases on commodity longevity. For example, it has been well documented that ethylene can promote many detrimental processes that can reduce commodity usefulness (5).

Studying fruit storage in 1965, Burg and Burg (8) observed that if gas exchange (i.e. CO_2, ethylene) from within the fruits to the atmosphere was enhanced, storage longevity increased. Expanding this concept, Burg and his associates developed LPS and have had two U.S. patents issued (4,10). After extensive research especially by Burg (6,7,9,10), Dilley (11-15), and their co-workers, LPS units are presenting being manufactured commercially in the U.S.

Principles. Low pressure storage consists of placing various commodities in a flowing stream of air essentially saturated with water at a controlled temperature and under reduced pressure. Under these conditions, the partial pressure (amount) of oxygen is decreased which results in a reduction of metabolic activities like respiration and commodity longevity is increased. Of possibly more significance is the rate at which gas exchange (diffusion) is increased at reduced pressures. At 1/10 atmosphere, gas diffusion is increased by a factor of 10 compared to atmospheric pressure. By having a continuous exchange of air, gases like CO_2 and ethylene being produced by the stored commodities are removed from the storage area before they can influence longevity.

Besides reducing oxygen levels and enhancing gas diffusion, the LPS system was so designed as to maintain high humidity which reduces weight loss and/or desiccation. Adding water vapor to the air stream passing through the storage area is accomplished by passing air through a water phase *after* the pressure has been reduced.

Low pressure storage units do not have to operate continuously to be effective. In fact, often added advantages in commodity longevity are noted when the units do not operate continuously.[1] Thus, LPS units may be opened daily or whenever desired. In summary, increased gas diffusion, reduced metabolic activities, proper temperatures, and high relative humidity all help enhance commodity longevity when held under IPS.

Capabilities. Data presented in Table 1 demonstrates the broad capabilities of LPS for the storage of various perishable commodities. The vast majority of data was compiled by Burg, Dilley, Carpenter and their co-workers (6, 7, 9-15).

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[1] Personal communication from S.P. Burg, 1976.

Table 1. Comparative storage lives of commodities stored under normal refrigerated or hypobaric conditions.

RIPE, FULLY MATURE FRUIT

Type	Storage Life - Days: Cold Storage	Storage Life - Days: Hypobaric Storage
Pineapple (field ripe)	9-12	30-40
Strawberry, 'Florida Ninety' and 'Tioga'	5- 7	21-28
Cherry, sweet	14	60

VEGETABLES

Type	Storage Life - Days: Cold Storage	Storage Life - Days: Hypobaric Storage
Green pepper	16-18	35-49
Cucumber	10-14	35-42
Bean, pole	10-13	30
Onion, green	2- 3	15+
Corn	4- 8	21-28
Lettuce, 'Iceberg'	14	40-50
Mushroom	1- 2	21-28

NON-RIPE, FULLY MATURE FRUIT

Type	Storage Life - Days: Cold Storage	Storage Life - Days: Hypobaric Storage
Tomato, 'Mature Green'	14-21	60
Tomato 'Breaker'	10-12	28-35
Banana, 'Valery'	10-14	90-150
Avocado, 'Lula'	14-28	52-84
Lime, 'Tahiti'	14-35	60-70
Apples (general cultivars)	10-90	300
Mango	7-14	28
Papaya	7-14	21-28

FLOWERS / CUT

Type	Storage Life - Days: Cold Storage	Storage Life - Days: Hypobaric Storage
Carnation	10	91
Chrysanthemum (bud cut)	7-14	42
Rose	7-14	56

CUTTINGS

Type	Storage Life - Days Cold Storage	Hypobaric Storage
Non-rooted cuttings:		
Chrysanthemum		
(numerous cultivars)	10-28	42-94
Carnation	90-120	300
Rooted cuttings		
Chrysanthemum	7-14	90

In addition to increasing storage life, commodites held under LPS often exhibit beneficial characteristics after removal under standard conditions. For example, with some crops after removal from LPS, ethylene production is delayed (14). The delay in ethylene production partially accounts for such crops actually having greater longevity after LPS compared to freshly harvested crops. A second example deals with a disorder in roses called "bent neck". This disorder results in a severe bending or wilting of the flower stem immediately below the inflorescence. Unpublished research by this author and by Dilley and Carpenter indicates that very short low pressure treatments immediately after harvest can greatly reduce subsequent bent neck of roses.

Status. The present state of the art is that Grumman Allied Industries of Garden City, New York, has purchased the rights to the LPS patents and is presently constructing commercial units. These units can be used as over-the-road trailers or as containers for sea or train transportation and are of comparable size to standard refrigerated units now in operation. Of the LPS units already being used commercially, no major mechanical problems have been experienced and the various products being stored and/or transported all have been of exceptional quality upon removal.

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LOW PRESSURE STORAGE OF ROOTED AND UNROOTED GERANIUMS

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Abstract. Unrooted and rooted geranium (*Pelargonium* × *hortorum* L.H. Bailey.) cuttings were stored for 2, 4 and 6 weeks utilizing a low pressure (LP) storage system maintained at 2.2°C. Unrooted cuttings stored at 1/30 atm were of acceptable quality after 2, 4 or 6 weeks of storage and rooted equaled cuttings directly rooted without storage. Rooted cuttings removed after 2 and 4 weeks of LP storage were acceptable while similar material removed from common-cold (CC) storage were unacceptable. In all cases LP storage extended the life of rooted and unrooted geraniums when compared to CC storage.

Many rooted and unrooted cuttings stored for extended periods show reduced rooting and deterioration of foliage. A new storage system termed hypobaric, sub-atmospheric or low pressure storage (LPS) offers a means for long-term commodity storage while preventing post-storage breakdown.