

CHAPTER TWO

REVIEW OF LITERATURE

This part includes an exploration of topics related to information from the literature reviewed. These topics include: (1) international systems of testing new plants for varieties protection; (2) DUS testing on *Phalaenopsis* Blume; (3) an introduction to the orchid: *Dendrobium* species; (4) history of the orchid trade in Thailand; and (5) orchid commerce around the world.

2.1 INTERNATIONAL SYSTEM OF TESTING NEW PLANTS FOR VARIETY PROTECTION

The International Union for the Protection of New Varieties of Plants (UPOV) was established by the International Convention for the Protection of New Varieties of Plants. The Convention was adopted in Paris in 1961 and it was revised in 1972, 1978 and 1991 with the objective of protecting new varieties of plants with intellectual property rights. In addition, it provides and promotes an effective system of plant variety protection, with the aim of encouraging the development of new varieties of plants, for the benefit of society (“Plantum NL the association”, 1993).

It is the so-called *sui generis* system form of intellectual property protection, which has been specifically adapted for the process of plant breeding and has been developed with the aim of encouraging breeders to develop new varieties of plants (Cullet, 1999). Moreover, it also reflects technological developments in plant breeding and experience acquired with the application of the UPOV Convention. The UPOV Convention came into force on August 10, 1968, having been ratified by 55 countries. Most of them are developed countries, which have laws on plant variety protection in line with the Act of the Convention such as the countries of the European Union, the United States of America, Australia, and Japan, (“International Union for the Protection of New Varieties of Plants”, 2003).

Although their laws conform to the UPOV act, the systems of testing new plants or DUS testing in each country is somewhat different (Table 1) and determined

by the sovereignty of each especially. Practically, there are three systems conducting the test as follows: (“The International Union for the Protection of New Varieties of Plants”, 2002)

2.1.1 Government Growing Test - competent authorities conduct the trial at the government places or stations or the so-called a "state-run" testing system (“Plant Products Directorate”, 2003).

2.1.2 On-site Inspection by Government Officials - competent authorities conduct the trial at the breeders own premises. This is also called a "breeder-run" testing system (“Plant Products Directorate”, 2003).

2.1.3 Documentary Examination - This trial is not necessary if the data of Government Growing Test is reliable.

Whereas many UPOV member countries have those system for DUS testing in which the trial would be conducted in at least two seasons of crop growing as in most of the temperate countries, some long life cycle or climate sensible crops like orchids can be harvested only once a year. Hence, the trial period would be fixed at a suitable time for each crop. For instance, an orchid is tested between spring and summer (“The Community Plant Variety Protection Office”, 2003).

As a result of its long involvement with variety testing, the European Union, EU has built up a unique centralized testing system which is used in order to provide a common environmental basis for the examination of varieties and to facilitate the control of the interaction between varieties and environmental conditions. Under the centralized system, all new varieties and reference varieties are described and compared in the same environment, (The International Union for the Protection of New Varieties of Plants, 2005). For example, a rose is tested in Wageningen, The Netherlands, an apple is tested in Angers, France, and Crown of Thorn is tested in Hanover, Germany (Kiewiet, 2005).

Thailand, on the other hand, conducts tests via the On- Site Inspection or a breeder-run system but the procedures are not exactly the same as the above mentioned ones as the breeders are able to choose the site for testing i.e. on either

their own premises or a government-owned (“สำนักคุ้มครองพันธุ์พืชแห่งชาติ”, 2543). The table below shows the testing systems in some countries.

Table 1. DUS Testing Systems in Some Countries

Country	Growing Test	On- site Inspection	Documentary Examination
Australia, France, Japan, USA	✓	✓	✓
Canada	-	✓	✓
China	✓	-	-
Croatia	✓	-	✓
Most EU Member countries	✓	-	-
Thailand	-	✓	-

Distinctness, Uniformity, and Stability (DUS)

Distinctness, uniformity, and stability are the key elements that have been used as criteria in the plant varieties protection framework (“The International Union for the Protection of New Varieties of Plants”, 2002). Even though all plant varieties protection acts have defined these terms in different ways, their meaning are mostly the same. For instance:

(1) The International Convention for the Protection of New Varieties of Plants (UPOV) defined that the distinctness of plant is the existence of at least one essential characteristic that differs from any known variety of the same species; uniformity is in reference to their homogeneity within a specific generation; and

stability is the maintenance of characteristics after continued propagations (“The International Union for the Protection of New Varieties of Plants”, 2002)

(2) In Japan, according to the Japanese Plant Variety Protection Act, distinctness is a qualification of the new variety that must be clearly distinguishable from any other existing varieties while uniformity is a qualification that its generations are sufficiently uniform. Stability is a qualification that defines that the breed be stable in essential characteristics.

(3) According to the Thai Plant Varieties Act 1999, they are prescribed under Article 12, as follows:

Distinctness – "The variety shall be deemed to be distinct if it is clearly distinguishable from any other variety whose existence is a matter of common knowledge at the time of the filing of the application"

Uniformity (or homogeneity) – "The variety shall be deemed to be uniform if, subject to the variation that may be expected from the particular features of its propagation, it is sufficiently uniform in its relevant characteristics."

Stability – "The variety shall be deemed to be stable if its relevant characteristics remain unchanged after repeated propagation or, in the case of a particular cycle of propagation, at the end of each such cycle."

2.2 DUS TESTING ON *Phalaenopsis* Blume

Phalaenopsis Blume is a kind of orchid that has already been carried out the DUS testing in some UPOV member countries like the Netherlands, Japan and China. As the result of the test is an intellectual property document, the test report is therefore rarely found in the public domain. Countries in temperate areas have conducted the DUS testing of the orchid in the appropriate manner. The tested plants were in the form of two-year old plants that had not previously flowered. The minimum quantities of plant material were 10 plants for vegetatively propagated varieties and 50 plants for seed-propagated varieties. All of them were visibly healthy, not lacking in vigor, nor affected by any important pest or disease. Moreover, the plants had not undergone any treatment which would affect the expression of the

characteristics of the variety, unless it was necessary to request such treatment. Full details of the treatment for the plants were reported.

The duration of the tests were the equivalent to a single growing cycle. The tests were conducted in a greenhouse in three periods; first, from March to April when the optimum temperature is 21-30 C°. The second period, using high temperature treatment, the tests were conducted during September to October when the minimum temperature was 25 C°. The last period was conducted at low temperature from November to December.

The assessment of Distinctness, Uniformity and Stability and the minimum duration of tests reflected, in general, that the differences in characteristics are sufficiently consistent. A difference between the two varieties was clear depending on many factors, and considered, in particular, the type of expression of the characteristic being examined, i.e. whether it is expressed in a qualitative, quantitative, or pseudo-qualitative manner. For the vegetatively propagated varieties, to the assessment of uniformity, a population was applied a standard of 1% and an acceptance probability of at least 95%. In these cases of a sample size of 10 plants, 1 off-type was allowed. For seed-propagated varieties, the assessment of uniformity of seed-propagated varieties, the UPOV recommendations in the General Introduction for cross-pollinated and/or a hybrid variety was applied.

Practically, it is not usual to perform tests of stability that produce results as certain as those from the testing of distinctness and uniformity. However, experience has demonstrated that, for many types of variety, when a variety has been shown to be uniform, it can also be considered to be stable. Where appropriate, or in cases of doubt, stability may be tested, either by growing a further generation, or by testing a new seed or plant stock to ensure that it exhibits the same characteristics as those shown by the previous plants supplied ("The International Union for the Protection of New Varieties of Plants", 2003).

2.3 AN INTRODUCTION TO THE ORCHID: *Dendrobium* species

When we review the long history of the orchid, we find that it has been known to mankind for more than two thousand. Linneus, a famous botanist, retained that it is of the genus *Orchis* in his "Species Plantarum" of 1753. John Lindley in 1836 modified it to form the name of the family Orchidaceae. So, beginning its career in one of the oldest botanical manuscripts, the term "Orchis" has preserved its identity in the genus *Orchis* and in the name of the largest family of flowering plants (วีระชัย, สุรางค์รัชต์, 2543, น.17-20).

Orchidaceae is the largest family in the plant kingdom, and its members are among the world's most specialized plants. There are more than 30,000 known species, and more are being discovered and documented every year (Imes, 1993). Among those, *Dendrobium*, its name coming from the Greek word which means life in a tree, is one of the largest and most beautiful genera in the whole of the orchid family. There are over 1000 species geographically distributed from India, the Himalayas and Sri Lanka to China, Burma, Malaysia, Thailand, the Philippines, Japan and southwards through Papua New Guinea, Australia and New Zealand (Williams, Mark, 1988).

Moreover, J. Elliot. (1993) described that *Dendrobiums* are very much beginners' orchids, being mostly hardy and comparatively easy to grow. In addition, Chan, 1994 reported that most *Dendrobiums* can easily be propagated from old back bulbs. If it is cut between some of the older pseudobulbs or stem, a couple of months before repotting, it may grow several new bulbs starting at once from the old plant which can be completely separated when repotting them in order to get several plants.

However, it is not so easy to make them really flourish and flower, the plants come in varied shapes, sizes, and colors. As a genus, *Dendrobium* has more than 1,500 species grouped into about 20 sections. A section is a group of related species. The majority cultivated in Thailand are hybrids in approximately 120 varieties ("ระเบียบกรมวิชาการเกษตรว่าด้วยการตรวจสอบลักษณะของพันธุ์พืชที่จะขอจดทะเบียนเป็นพันธุ์พืชใหม่", น 63-69, 2546).

Because of their sheer numbers and extensive native ranges, *Dendrobiums* vary greatly in their physical characteristics and cultural requirements (Elliot, 1993). The inflorescence is usually lateral with one to many flowers, or flowers may appear along leafless stems singly or in twos and threes. Sepals are sub equal with the lateral pair joined at the base of the column foot to form a mentum, a crucial part of flower that is used to differentiate each variety. Petals are smaller or larger than sepals, but usually thinner. The lip is more or less trilobate and adnate to the foot of the column. The side lobes may be large and spreading or almost absent; the midlobe narrow, or broad and flat, or concave or saccate. Lamellae are often present on the disc. Pollinia, the fertilizer part of flower, are in four part in two pairs (Williams, Mark, 1988).

2.4 HISTORY OF THE ORCHID TRADE IN THAILAND

Having discovered an interest in orchid growing, Prince Krompranakornsawanvorapinit developed orchid growing into a hobby and commercial interest. In 1934, Den.Pompodur was launched. The orchid society of Thailand was formed under royal patronage in 1957, by Rapee Sagarik who earlier became associated with the growing and studying of the species (วีระชัย, สุรางค์รัชต์, 2543, น.15-16).

Tissue culture propagation and work on orchids started in 1967 at Chulalongkorn University and later spread to other establishments. Bangkok and nearby provinces where climate conditions and infrastructure exists today are centers of Orchid cultivation and an estimated area of 2300 hectares of orchids exist. The other major centers are Nonthaburi, Ratchaburi, Kanchanaburi, Ayutthaya, Pathumthani and Chonburi (สัจฉ, 2543).

Thailand has a long history in orchid trade, especially in terms of export. It is estimated that 54% of the orchids produced are exported, making Thailand the world's largest orchid exporter with 2,240 ha of orchids in production, (Fenton, 2005), and the remaining 46% is consumed in the domestic market. Of those export amounts, it can be expressed in term of quantity and value that quantity is equal to 0.2% of total

ornamental export and the value is equal to 90% of total ornamental export value. (Table 2, “สำนักควบคุมพืชและวัสดุการเกษตร”, 2547). Although Thailand is a natural habitat for several diverse species of orchids, the interest to grow cultivars of economic value was first recorded in 1913 with the introduction of some exotic materials by a foreigner (สัจจ, 2543).

Table 2 . Export of Thai Orchid, 2000-2004

Year	Quantity (No. of plants)	Value (MBht)
2004	19,576,425	490
2003	18,437,015	478
2002	19,289,147	483
2001	20,448,020	525
2000	17,938,658	450

2.5 ORCHID COMMERCE AROUND THE WORLD

The world export/import trade of orchid cut flowers and orchid plants exceeded \$150 million in the year 2000. Of this, \$128 million was in cut orchid flowers and about \$23 million in orchid plants, according to United Nations Comstats. Of those, Thailand exported \$50 million in cut orchids and \$4 million in orchid plants, mostly to Japan (Fenton, 2005).

Singapore is also an important exporter, with \$7.7 million in exports cut orchids and \$8,000 in orchid plants. Malaysia, much smaller, exported \$2.8 million in orchid cut flowers and \$15,000 in pot plants. New Zealand exported \$830,000 in cut orchids and \$93,000 in orchid plants. Only one European country is a significant exporter of orchids, Italy, which exported \$652,000 in cut orchids and \$399,000 in

potted plants. International commerce in orchid cut flowers is eight times as important as international trade in orchid plants.

Japan is the world's largest cut orchid import market, where cut orchids are a passion for florists throughout the country. Japanese flower auctions sold \$230 million worth of cut orchids to Japan in 2001. Most of these orchids were produced domestically, including the cut dendrobium. Moreover, Japan is also the world's largest importer of fresh cut orchid flowers. Imports of over 5.8 milliard stems were valued at \$54 million. Though only 23% of the orchids bought by Japanese consumers were imported, Japan imported 42% of all of the fresh cut orchids traded around the world. Over half of the imports were from Thailand, 19% from New Zealand, 13% from Singapore and the remainder from Taiwan, Malaysia, Sri Lanka and others.

Italy is the world's No. 2 importer of cut orchids, which were valued at \$24 million. Of these cut orchids, \$12 million were imported from Thailand and \$11 million cut orchids were imported by truck from the Netherlands. Many of the Dutch imports were Dendrobium imported from Southeast Asia into the Netherlands before being re-exported to Italy (Fenton, 2005).