

CHAPTER 2

REVIEW OF LITERATURE

Forest is the biggest source of gene pool of living organisms. There are still many organisms in the forests which we know very little. They may be a valuable thing to human such as a source of raw materials for medicine; some plants can be used as a genetic resource for plant improvement (Gardner *et al.*, 2000). The forest in Thailand can be classified into evergreen and deciduous forest. The evergreen forest can be further divided into hill evergreen forest, tropical rain forest, dry-evergreen forest, pine forest, mangrove forest and peat-swamp forest (Wanajak, 1998). At present there is only 30 % of the evergreen forest remaining accounting for only 7.5 % of the country area.

Plant Physiology

Plant Physiology is a biology process dealing with functions and processes carried out by plants. The processes were the modified biochemistry within cells and the activities occurred when plants develop. The processes involve the environment such as light, temperature and humidity which are important for plant growth and development (Youngstone and Wallace, 1990). The physiological processes occur in plants for growth and development are photosynthesis, respiration, transpiration and translocation while growth and development involve cell division, enlargement and differentiation (Pessarakli, 1995). The living mechanism has learned to capture photons of light and utilized the energy by raising the electron pair to higher energy level from the ground stage to the excited stage and returning them to the ground stage. On the returning trip the excess energy is released and goes to the biological mechanism to drive the light process. Photosynthesis is a system exploiting energy and supplying it for food that yields crop plants. Plant yields depend on the efficiency of the photosynthetic system. Plant pigments and chloroplasts are the photosynthetic apparatus of plants for transformation of light energy to chemical energy. The chloroplast consists of chlorophyll which absorbs the spectrum of light. Leaf serves as the major photosynthetic organ of higher plant; leaf evolution has provided a structure

that withstands environment. When light level gradually increases, photosynthesis increases. Species differ in their responses to light level (Gardner *et al.*, 1985). The effect of light on the rate and quantity of photosynthesis involves properties of light such as light intensity and duration of light period (Pessaraki, 1995). Youngstone and Wallace (1990) grew 5 genotypes of *Phaseolus vulgaris* in 2 conditions at 29°C 12 hours of light per day and 23°C more than 14 hours of light per day but lower in light intensity. They found that the plants similarly responded to light by increasing leaf number which was resulted from the compensation of light duration with light intensity. Rosa and Ferreira (1999) studied the effect of temperature with climbing plants, *Smilax campestris*'s. Germination tests were carried out in petri dishes containing 1 % agar in the dark with the temperature of 10° C, 15° C, 20° C, 25° C, 30° C and 35° C with alternated dark and in the presence of light at 50 $\mu\text{mol}/\text{m}^2/\text{sec}$. Percentage of germination was high under high temperature in the absence of light. At 25°C the germination was 83 % and increased to 88 % at 30°C and to 91 % at 35° C. Mitchell (1970) found that by day length control some varieties of plants could be induced to off season especially the flowering plants. Kasemsap (1989) mentioned that saran net could be used to reduce the light intensity if it was too high. Hantanapong (2001) found that by reducing light intensity by 50 % the production of Borneo camphor (*Pogostemon calslin* Benth.) was increased. Gardner *et al.* (1985) stated that photon had the direct effect on photosynthesis; plant will absorb photon by chlorophyll and enter photosynthesis process by changing light energy to chemical energy. Sampet (1999) said that light absorption efficiency depends on the concentration of chlorophyll of plants. Plants having high chlorophyll concentration also had high photosynthetic rate (Chinorak and Chinorak, 1998). Phuwiwat (1996) found that in kale, the quantity of chlorophyll changed when received different light intensity. Low light intensity reduced plant growth. Different plant species need different light intensity. Therefore plants can be divided into 3 groups C3, C4 and CAM (Gardner *et al.*, 1985). Fitter and Hay (1987) reported that plants adapted to low light intensity by increasing chlorophyll content that improved photosynthesis and Wanapat (1984) reported that palisade-mesophyll in plants could be developed well under high light intensity resulting in less cell spaces and increased respiring tissues.

Light intensity affects cell elongation which is the main factor affecting plant growth. The experiment suggested that it might be due to the activity of auxin which responds under low light intensity (Bilang *et. al*, 1993)

Having considered light requirement, plants can be classified into 2 groups, full sunlight (heliophytes) and low light intensity (sciophytes). It appears that most ornamental plants are sciophytes. If leaves receive light intensity greater than optimum level, the photosynthesis will be reduced (Hall and Rao, 1994). Zhang *et al.* (2000) found that receiving too high light level stress during the day time, *Zingiber officinale* will have photo inhibition which will then reduce growth. Theerakulpisut (1997) stated that leaf weight in the shade will be higher than that in the light. Besides light intensity, temperatures also play an important role in photosynthesis while plant respiration will affect plant growth and yield (Sampet, 1999). Different plant species require different temperatures (20–30° C) for photosynthesis (Nilsen and Orcutt, 1996). The desirable ranges of temperatures needed for plant growth are cardinal points from minimum through optimum and maximum meaning that plants will stop growth when temperatures exceed maximum and below minimum. Cardinal temperatures differ among plants, different plant organs and various stages of development (Mitchell, 1970). Gardner *et al.* (1985) studied the relationship between light and temperature and found that the photosynthesis will be double when the temperature increased by 10° C. Krasaechai (1992) mentioned that day temperature controls stem growth and night temperature controls the floral number of chrysanthemum. Water can be called “the fluid of life” and also made up greater part of the globe. Water composes over 90 % of an organism and participates indirectly or directly in all metabolic reactions of organisms (Pessarakli, 1995). Plants need water for photosynthesis process by combining with carbon dioxide to get carbohydrate used for their growth. Different plant varieties need different amount of water depending on plant age and size (Ramingwong *et al.*, 1990). Plants need water in relative large amount to exist the anatomical features of the leaf structure. Gardner *et al.* (1985) mentioned that water often limits crop growth and development to its metabolic activity, morphology, stage of growth and yield potential.

Plant Cytology

In plant, chromosome numbers can be used to classify plant species. The DNA information of each species is organized in a characteristic number of chromosomes. The number of chromosomes is a reasonable indicator of the relatedness of similar species. Chromosomes can sometimes fuse with each other or can exchange chromosome "arms". When this happens, DNA information is not always lost, but it can become mixed up. This sort of rearrangement may not cause problems for the individual who carries the change as long as all DNA is still present. The fact that plants have different chromosome numbers tells scientists that these are different species (Swanson, 1957). Apisitwanich and Masuthon (1991) reported their chromosome studied in *Hippeastrum reticulatum*, *Eucrosia* sp. and *Crinum asiaticum* from root tips by using 3 techniques, general technique by dyeing the chromosome with aceto orcein or aceto carmine, Feulgen's technique and digested cell by enzyme cellulose RS 2.0 % , pectolyase Y-23 0.3% and macerozyme RA 1.5% then dyed with giemsa. They found that the digested cell technique was the best where cell spreaded nicely and showed individual chromosome for easy counting. They also found that *Hippeastrum reticulatum* and *Crinum asiaticum* had $2n = 22$ chromosomes and *Eucrosia* sp. had $2n = 28$ chromosomes. Bhattarai and Malla (1993) studied chromosome numbers of *Cymbidium cyperifolium* Lindl. Karyotypic studied of 5 diploid plants of *C. cyperifolium* showed that one (cytotype A) had a chromosome number of $2n = 36$ and the other 4 (cytotype B) had $2n = 40$. The basic number of chromosome arms were estimated to be 68. Chromosome fusion or fission appears to have played a major part in the chromosome evolution of *C. cyperifolium*.

Lin *et al.* (1994) studied the chromosome of *Pyrus* all over China, from 200 hybrids, 350 cultivars, 11 forms and 12 species of *Pyrus* from 22 provinces using the wall degradation hypotonic method. The results indicated that the wall degradation hypotonic method had the advantage and was easy to operate giving rise to the clear image when compared with a conventional squash method. Oliveira *et al.* (1999) studied the chromosome number of *Anthurium* and *Philodendron* spp. (Araceae). The chromosome numbers of four species of *Anthurium* and four species of *Philodendron*

from Bahia, Brazil, were determined and revealed the number $2n = 30$ for *A. longipes* and *A. affine*, $2n = 32$ for *P. pedatum* and $2n = 34$ for *P. blanchetianum* and *P. pachyphyllum* for the first reports. The $2n = 32$ found for *P. imbe* and $2n = 90$ for *A. bellum* differ from the earlier reports, whereas $2n = 30$ and 60 for *A. pentaphyllum* var. *pentaphyllum* confirms previous counts. *A. affine* had one to four B-chromosomes. They suggest secondary base numbers $x = 15$ for *Anthurium* and $x = 16, 17$ and 18 for *Philodendron*.

Plant Anatomy

Plant anatomy is the plant biology that deals with the structures of plants, internal organization of the plant bodies consisted of cells, group of cells called tissues. Plant anatomy is a very interesting science; it is about evolution of development of structure, complexity and the remarkable orderliness in the organization of the plant. It can also tell the successes or failures of many horticultural practices such as grafting, pruning and vegetative propagation (Esau, 1965). Stern and Judd (2001) studied the anatomy of five types of orchid in Family Catasetinae. They compared the anatomy of pseudobulb in both cross and longitudinal by using paraffin embedding method of Johanson (1940). They found that the trichome of the samples showed slightly different among them in cell number 3 and 4 cells with the thick epidermal cell of the stomata, besides the vessel bundles scattered and not well organized. DeBenedetti and Berlyn (1994) studied the effects of five different light intensities on the anatomical structure and the pigment contents in leaves of *Tradescantia pallida* cv. *purpurea*. Once light intensity became lower, the thickness of leaf lamina and mesophyll were reduced. Adjustments in light-harvesting antenna size were observed an increase in chlorophyll a + b/carotenoids ratio at low-light growth conditions. There was a strong positive linear correlation between the light intensity values and anthocyanin contents. Hence, *T. pallida* cv. *purpurea* acclimatization to distinct environmental conditions might be related to its capacity of altering structurally and physiologically its phenotype. Poonpong (2001) compared the anatomy of modified leaves and shoots of 29 types, 30 groups of *Fimbristylis* (Cyperaceae) by pilled and cross section the epidermis of the leaves and modified

leaves. From this studied, the distribution of trichomes at the stomata was identified and also the deposit of cutin scattering of the bundle sheath at the epidermis.

Plant Taxonomy

Plant Taxonomy is the science of classification of organisms and the arrangement of organisms into systematic grouping such as species, genus, family and order. There are over one million known species on earth and probably several million more not yet identified. Taxonomists are responsible for identifying, naming, and classifying all these different species. Systematic is a discipline of biology that explicitly examines the natural variation and relationships of organisms including the field of taxonomy. Systematic also deals with the relationships of different groups of organisms, as most systematicists strive to construct natural classification systems reflecting evolutionary relationships. Many biologists use the terms taxonomy and systematic interchangeably (Stace, 1980). Taxonomy consists of plant identification, nomenclature and classification. Sometime it can be used to compare the known plant variety with the unknown. (Young and Allen, 1995). In the modern classification, species are grouped according to the shared physical characteristics and molecular systematic with the use of DNA sequences. Scientific classification belongs to the science of taxonomy or biological systematic. Kidyue *et al.* (2005) studied the numerical taxonomy of the *Hoya parasitica* (Asclepiadaceae) complex in Thailand and found that it was a climbing epiphyte of the Family Asclepiadaceae. It was finally proposed that the *H. parasitica* complex in Thailand should be treated as 3 species; i.e. *H. rigida* Kerr (Form I), *Hoya* sp. nov. (Form II) and *H. parasitica* (Roxb.) Wall. ex Wight (Form III-IX). Ae-Kyung *et al.* (2003) studied the analysis of genetic relationships of *Ardisia* spp. using RAPD markers. They showed that three *Ardisia* species, *A. pusilla*, *A. japonica*, and *A. cranata*, are native to the southern part of Korea, Japan, and China, and have been marketed as a berry-bearing ornamental plant. The genetic relationships among those three native *Ardisia* plants collected from various locations in Korea as well as commercially available *Ardisia* of unknown origin were investigated by analysis of randomly amplified polymorphic DNA (RAPD) markers. Molecular markers generated by RAPD analysis were

successfully used to characterize genetic relationships among three species of the genus *Ardisia* and to characterize different accessions.

Plant Propagation

Plants can be reproduced both, sexually or asexually. Sexual reproduction is the natural combination of pollen and stamen to produce seeds. On the other hand asexual propagation, also known as vegetative propagation, is a human-assisted cloning of a plant. This can be done by cuttings, division, grafting, or air-layering. The method used depends on the type of plant being multiplied (Hartmann *et al.*, 1990). Forcing a cutting to produce roots is the most common method of propagation. This method can be used on leaves or stems, depending on the type of plant. There are some requirements to successful cuttings and the use of hormone treatment helps the plant to rapidly develop new roots when propagating from cuttings (Davies, 1995). In many groups of hormones that regulate plant growth, auxins influence the growth of stems toward light (phototropism) and against the force of gravity (geotropism). Auxins affect many developmental processes, including pattern formation in embryo development, in cell division and differentiation, in fruit development, induction of rooting and vascular tissue differentiation (Taiz and Zeiger, 1998). And Obsuwan (1996) studied on improvement of hypocotyl cutting techniques of *Bruguiera gymnorhiza* Lamk. by dividing hypocotyl into 2 pieces, apical half and basal half and using auxins : IBA and NAA. The result indicated that both IBA and NAA had different effected on root number and root length formed on the cuttings. The apical cutting produce more roots than the basal ones. In the apical cuttings both IBA and NAA 1000 mg/l were considered to be the best concentration for rooting. While the basal cuttings NAA concentration 1,000-10,000 mg/l or IBA 10,000 mg/l were the best. But Soomro *et al.* (2003) studied propagation of *Rosa indica* in vitro, callus cultures were initiated from internode segments of post grown *Rosa indica* on modified Murashige and Skoog (1962) basal medium containing basic salts and 30 g/l sucrose supplemented with different concentrations of IBA and NAA excellent callus formation and growth was observed in 0.6 and 0.8 mg/l of IBA and 0.1 mg/l NAA. Induced callus was then tested for root initiation on full MS medium supplemented with different concentrations of indolebutyric acid and NAA. The best root formation

was observed on a medium containing 0.6 and 0.8 mg/l of IBA and 0.1 and 0.3 mg/l of NAA. The rate of root initiation (50%) and an increase root length (1-3 cm) over a period of 12 weeks was greatest in the medium containing 0.6 mg/l of IBA and 0.1 mg/l of NAA. Shoot formation was achieved from nodal segment supplemented with 2.0 mg/l IBA and IAA respectively. The rate of shoot formation (70%) and an increase in shoot length (2-3 cm) over a period of 12 weeks was greater in medium containing 2 mg/l IAA.

Tchigio and Duguma (1998) studied the vegetative propagation of *Calliandra calothyrsus* (Meissner). They showed the effects of propagation medium and the type of auxin on root and shoot development of stem cuttings of *Calliandra calothyrsus*. Zimmerman *et al.* (1991) studied the micropropagation of wild flower *Dyssodia pentacheta* (D.C.) by using stem cuttings. The shoot segments were dipped in IBA solution at different concentrations of 0, 3, 10, 30, 100 and 300 mM for 30 seconds, nodal segments were also dipped for 30 seconds. After 4 weeks, rooting percentage and the number of root were high in 3 or 10 mM at all IBA concentrations, but in 300 mM was lethal. Jirakiattikul and Limpraditthanont (2006) studied the shoot multiplication and rooting of *Philodendron xanadu* cultured in vitro. Single shoots were cultured in vitro on MS medium supplemented with 0, 2 and 4 mg/l BA or in combination with 0.2 mg/l IAA for multiplication. The results showed that shoots cultured on the media supplemented with BA alone or with IAA proliferated more profusely than those cultured on medium without PGR. Explants produced a maximum number of 5.8 shoots on the medium supplemented with 4 mg/l BA but shoot length was significantly shorter. Rooting was induced on half-strength MS medium ($\frac{1}{2}$ MS), MS medium supplemented with 0, 0.5 and 1.0 mg/l IAA, NAA or IBA. Shoots rooted on all media but 100% rooting occurred on $\frac{1}{2}$ MS and MS medium supplemented with 0.5 and 1.0 mg/l NAA or IBA. Survival was 100% after transplantation.

Jambor and Marta (1990) used tissue culture technique to propagate *Philodendron tuxtlanum* by using different formula. They found that $\frac{1}{2}$ MS with BA at 5 mg/l can produce a lot of shoot while using MS with NAA at 0.5 mg/l increased root growth. Zhang *et al.* (1997) found that MS with BA at 4 mg/l increased shoot number. Besides, Kumar *et al.* (1998) found that the application of MS with BA at 1

mg/l plus BA at 2 mg/l and IAA at 1 mg/l in *P. pertusum* stimulated root growth but IAA at 3 mg/l gave the best result (Korish and Al-Manie, 2000).

Effect of solution on vase life.

Flowers are exquisitely beautiful especially when they haven't been cut from their mother plants. But as soon as these flowers are cut and brought indoors, wilting reduces their beauty and quality. When a flower starts to wilt, its vase life is shortened; consequently, its market value falls. Florigene has developed and marketed the world only commercially available cut flower crop genetically modified for novel flower colour. These products have been accepted in the market. Chantanantapipat (1995) studied on vase-life of 4 growth stages of chrysanthemum (*Chrysanthemum morifolium* L.) showed that 50% open stage of flower was the most suitable stage. distilled water was the most suitable for holding associated with stem cutting and water changing everyday at 25° C. From anatomical study indicated that there were the same kinds of tissue in all growth stages of flower stem, and secondary growth was observed. Increase of secondary xylem varied on the age of flowers. Various kinds of solution were used for pulsing flowers at several periods of time. It was concluded that at 30 minutes pulsing with 10% sucrose + 0.03% AgNO₃ or 5% sucrose + 0.02% 8- HQS or 10% sucrose + 0.3% CuSO₄.5H₂O gave the good average vase-life 8.7, 9.0 and 10.0 days respectively. As Anjum *et al.* (2001) studied of cut spikes of tuberose were kept in CaCl₂.2H₂O, AgNO₃, ascorbic acid and Tri-Miltox Forte (a fungicide) solutions with various concentrations to see their effects on keeping quality and vase-life of the flowers. A control (tap water) and a standard preservative were also included in the experiment. AgNO₃, CaCl₂.2H₂O and Tri-Miltox Forte delayed flower opening as compared to ascorbic acid and standard preservative, but stood at par with control. CaCl₂.2H₂O at concentrations of 750 to 1250 ppm and Tri-Miltox Forte at 1500 ppm resulted in minimum flower wilting after six days. AgNO₃ was found to have adverse effects on fragrance of the flowers. Water uptake by the spikes was more in those kept in standard preservative and CaCl₂.2H₂O 750 and 1000 ppm solutions. However, AgNO₃ 50 and 200 ppm solutions resulted in maximum vase-life (8 days) of cut flowers. Percentages of flowers opened and wilted

were significantly negatively correlated with the vase-life. However, vase-life was not correlated with fragrance of the flowers and net water uptake.



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