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Acknowledgement

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FRIM

Nursery Owners

Individuals

Abstract

This study has identified some potential aquatic plants and plants which can live in wet habitat, suitable for use as planting materials in the design of water garden. The plants are both native to Malaysia and non native plants which have adapted to Malaysian . Apart from plant identification in terms of origin and suitability, this study gathered information on the plants from the aspects of their benefits of use as planting material, its selection, establishment and management.

Keywords: aquatic plants, native plants , non- native plants, water garden

Abstrak

Kajian ini telah mengenalpasti tumbuhan yang akuatik dan tumbuhan yang boleh hidup di dalam habitat berair yang mempunyai potensi untuk digunakan sebagai bahan tanaman di dalam senireka taman air. Tumbuhan tersebut adalah tumbuhan 'native' atau tempatan dan yang berasal dari negara luar tetapi sesuai ditanam di Malaysia. Selain dari mengenalpasti tumbuhan dari aspek asal usul, kesesuaian penggunaan, kajian ini turut mengumpul maklumat tentang tumbuhan dari aspek faedah-faedah penggunaan tumbuhan, pemilihan, pengendalian dan pengurusan tumbuhan tersebut.

Katakunci: tumbuhan akuatik, tumbuhan tempatan, tumbuhan bukan tempatan, taman air

Chapter 1:
Introduction-
Native and non native aquatic Plants in the Landscape Industry

1.0 Introduction

The range of aquatic plants that can be used as planting materials within the Malaysian landscape industry is rather limited with most landscape architects and designers opting or selecting to use whatever that are available in the market. The current trend in the use of aquatic planting materials is due to the lack of awareness among those in the landscape industry of the presence of other native plants or non native plants that are available in the country. Most of them are also incapable of recognising aquatic plants which can be used as planting materials particularly in the design of water gardens, in wetlands, or natural landscaping, whether the sites are in the rural or urban areas. There are many benefits for the use of aquatic plants particularly if they are native plants.

Based on the issue of limited knowledge about identifying aquatic plants as planting materials, this study was carried out to identify more aquatic plants that can be used in landscape design. This study was

carried out based on the following aim and objectives as stated in 1.1 and 1.2:

1.1 Aim of Study

To identify native and non native aquatic plants that can be used as planting materials in Malaysian landscape industry.

1.2 Objectives of Study

1. To understand native and non native aquatic plants.
2. To identify some of aquatic plants available that can be found in Malaysia that can be used as planting materials in the landscape industry.
3. To understand the benefits of using native aquatic plants and how they can be used.
4. To understand the appropriate planting and management practices of native and non native aquatic plants.

1.3 Research Scope

This study will only identify the aquatic plant species available in the country which has the potentials of being used as planting material.

The plants will be identified in terms of its name, origin, its natural habitat and its possible use and benefits for use in landscape design.

1.4 Methodology

The data were collected through both secondary resources and through visits to the fields and nurseries in Johor and Selangor. The plants were recorded in the form of images and identification of plants were carried out through the use of academic books as references. The images of the plants were stored in files, labled and the information of the plants recorded.

1.5 Conclusion

This report consists of four chapters.

Chapter 1 will cover the introduction of the study including the aim of study and its objectives as well as briefly explaining the methodology of this study.

Chapter 2 presented the definitions of the main terms in this study and covers some aspects of the use of native aquatic plants as well as the benefits from the use of aquatic plants as planting materials in landscape development.

Chapter 3 will present the findings of the study. The findings will be presented using images of the plants, its taxonomy, origin and its suitability of use in landscape design.

Chapter 4 is the concluding chapter of this report which will highlight some recommendations based on the findings of this study and summarize some of the main findings of this study.

Chapter 2:
Native and non native Aquatic Plants in the Landscape Industry

2.0 Introduction

This chapter will provide the definitions of terms used in the study, the benefits of using aquatic plants, its selection and management of the plants.

2.1 Definitions

2.1.1Native Plants

A native plant is usually defined as one that grow naturally in a specific area. They are also called indigenous plants that have evolved over thousands of years in a particular region. Native plants are plants that have adapted to the geography, hydrology, and climate of a certain region and occur in communities, that is, they have evolved together with other plants. The community of native plants provides habitat for a variety of native wildlife species such as songbirds and butterflies.

2.1.2 Native aquatic plants

Native aquatic plants existed within a wetland which is an area at least periodically covered with water. Wetlands have

distinctive "hydric" soils and plant species which are adapted for saturated soil conditions. Wetland ecosystems support a variety of species. They also filter and retain water, purifying the water and reducing the potential for flooding in many areas. There are many wetland plants which could thrive in the wet areas of specific area.

2.1.3 Benefits of Native Plants

Native plants has an advantage over non-native plants because they can provide beautiful, hardy, drought resistant, low maintenance landscape while at the same time giving benefits to the environment. Native plants are also cheaper to maintain. Upon using native plants, and once they are established, time and money could be saved by eliminating or significantly reducing the need for fertilizers, pesticides, water and lawn maintenance equipment.

Benefit 1 of Native Plants: *Native plants do not require fertilizers*.

In general practice, normally vast amounts of fertilizers are applied to lawns. The use of excess phosphorus and nitrogen which are the main components of fertilizers could run off into lakes and rivers and cause excess algae growth. The presence of excess

algae in the rivers and lakes could lead to the depletion of oxygen in the waters and it could also harm aquatic life. Furthermore, it could also interfere with recreational uses.

Benefit 2: ***Native plants require fewer pesticides than lawns.***

Nationally, a large amount of pesticides are applied to lawns every year and when pesticides are drained off lawns, they can contaminate rivers and lakes. Pesticides has harzoudous effects on both human and animals. When they are in contact with chemically treated lawns, they are automatically exposed to pesticides as well. So, when we use native plants, the use of lawns and pesticides can be reduced.

Benefit 3: ***Native plants require less water than lawns.***

Plants in modern garden require significant amounts of water to thrive and in the urban areas where irrigation is used in watering plants, as much as 30% water is used. Native plants has deep root system and they increase the soil's capacity to store water. They can also significantly reduce water runoff and, consequently, flooding.

Benefit 4: ***Native plants help reduce air pollution.***

Natural landscapes do not require mowing. Lawns, however, must be mowed regularly. The use of gas powered garden tools contribute to the nation's air pollution as one gas-powered lawnmower can emit 11 times the air pollution of a new car for each hour of operation. Excessive carbon from the burning of fossil fuels contributes to global warming. Native plants sequester, or remove, carbon from the air.

Benefit 5: ***Native plants provide shelter and food for wildlife.***

Native plants attract a variety of birds, butterflies, and other wildlife by providing diverse habitats and food sources. Closely mowed lawns are of little use to most wildlife.

Benefit 6: ***Native plants promote biodiversity and stewardship of our natural heritage.***

Native plants formed a part of our natural heritage and natural landscaping and become an opportunity to reestablish diverse native plants. The presence of native plants can attract birds and butterflies back home.

Benefit 7: The use of native plants can save money

Maintenance of landscape plants can be very expensive in terms of protecting and enhancing it. However, in the case of native plants, the cost of maintenance is low. Thus, its use can be economical.

One of the categories of native plants are aquatic plants. They have additional benefits in addition to the above benefits of being native plants.

2.1.4 Benefits of Native Aquatic Plant

Native aquatic plants serve many important functions. These include:

Native aquatic plants can help stabilize shorelines:

Native aquatic plants can help stabilize shorelines. The roots of many aquatic plants, particularly emergent plants (those growing in standing water with much of their growth above the water), reinforce shorelines and protect soil against erosion from wind and wave action, boating wakes, currents, and other forces.

Native Aquatic Plants can provide habitat for living things

Many aquatic plants provide cover, food, nesting sites, and resting areas for fish, amphibians, invertebrates, birds, and mammals. Settings with a diversity of native aquatic plants will attract a variety of native animal species.

The use of native aquatic plants can help resist invasive non-native plants

A healthy native aquatic plant community will resist the establishment of invasive non-native plants, and often prevent them from becoming a serious problem.

Native aquatic plants can help reduce nutrients for problematic algae

Aquatic plants tend to bind up nutrients, leaving less available for algae and making algae blooms less likely. Emergent plants also slow water movement along shorelines, causing nutrient- laden sediment to settle to the bottom, where it is less available to algae.

Native aquatic plants can provide shade

Aquatic plants, particularly those with floating leaves, create shade below their leaves. This restricts algal growth to open areas

where light is available. The shade also reduces water temperature, which allows more oxygen to dissolve in the water, making the water more hospitable to animals that use dissolved oxygen (such as fish).

Native aquatic plants release oxygen to the water

As a by-product of photosynthesis, native aquatic plants release oxygen into the water. This is important to fish and other aquatic organisms that depend on dissolved oxygen to survive.

Native plants of the wetlands form the reservoir of ecological diversity and also the way in which the environment is cleaned of toxins, assuring water quality and soil conservation in order to be sustainable. Maintaining functional wetlands and wildlife habitat helps to enhance natural or man-made wildland or wetland habitats on properties for recreation and aesthetic purposes.

For the past few years, there has been an increase in interest for producing more naturalized landscaping, pond gardens or the construction/enhancement of man-made streams within the commercial landscape. In addition, stormwater detention ponds are also being used for integrating the many benefits of wetlands even into urban areas.

2.1.5 Selection of native Aquatic Plants

Selection of the correct species of native aquatic plants is vital because certain species of native plants are native only to certain places. Selection of the proper aquatic plants is an important step in achieving the benefits of using them in landscape planting. However, there is also a constraint in using native aquatic plants. To use a native plant strain or species outside of its natural realm comes with a risk of introducing a new weed or genetic contamination of related species. Therefore, the knowledge of the use of native plants is important before considering them as planting materials.

After selecting plant varieties, we should also determine the necessary plant size and type. The type of plant refers to whether they are in container or bare rooted. The plant size needs depends on how long you can wait for results. If you need trees above the "weeds" in one or two years, then select larger plants (these will be more difficult to establish). If maintenance can be done, then smaller plants will perform better because they adapt to transplanting quicker. It is the ratio of roots to top that affects transplant establishment.

Using Container or Bare-root aquatic native Plants

Bare-root seedlings are the least expensive and range in size from a few inches to 2 metres tall and more. Comparing plants of equal size, those in containers are more expensive than bare-root plants due to growing costs. If price is the primary consideration, bare-root plants can be used, but timing and handling considerations must be factored in.

Well-rooted container plants can be used in any month of the year but soil moisture should be adequate.

2.1.6 Establishment of native aquatic plants in the Field

Aquatic plants can be used in restoring wetlands. When they are used in restoring wetlands, the main objective would be of re-creating the "natural" hydrology of the site before alteration. When ditches and other drainage structures are closed, water covers the site. The top soil is stockpiled when a basin is excavated in the case of constructing artificial wetlands. When final grading and contouring of the excavated basin are completed, the topsoil is replaced. As the hydrologic function returns and stabilizes, distinct zones may develop on the site that affects vegetation. Because of drainage or soil conditions, some sites within the wetland are

best suited to a particular plant species. Attempts to establish unsuitable plants can be both futile and expensive.

Newly-planted tree, shrub, and seedlings may not survive the hydrology that mature plants can and may be lost soon after planting. In order to match vegetation to the wetland it is important that the hydrology of the site be evaluated. Contour maps showing different levels of inundation and soil saturation during the growing season should be useful in planning revegetation.

By comparing hydrology, soils and native plants of functionally similar adjacent wetlands, distinct zones can be identified. Then adapted species or mixes of normally occurring species can be selected.

When an area does not have distinct zones that are particularly well suited for a given species, a mix of species can be planted across the entire site. Species that are adapted to the site will survive, while the others can die off.

On urban sites, native aquatic plants may be introduced to complete the landscape when the trees and shrubs are established. Planting density depends on the goals and scope of the landscape project. Although some native aquatic plants can be purchased at nurseries, often than not, the only way to obtain them is to propagate them from plants

growing in a known area. Because many native aquatic plants are difficult to identify, samples of the plants intended to be used can be referred to an native aquatic plant specialist for identification before planting them. Otherwise, there will be risk of introducing a noxious weed or problem plant to an area or property.

2.1.7 Native Aquatic Plant Management

While there is interest in establishing native aquatic plant communities in and around waterbodies such as lakes or ponds, there may be a concern with controlling aquatic plants, particularly if the plants are creating problems.

Aquatic plant management should take into account all of a water garden users. Not only are water gardens important to people for reasons ranging from aesthetics to recreation, but there are other points to consider. They are the fauna- fish, amphibians, and other aquatic organisms, plus the birds and other wildlife that depend on a healthy waterbody such as pond or lake. In addition, local residents and resources can be impacted by the quality and quantity of water flowing out of the water body such as lake or river.

The aesthetic and wildlife habitat value of ponds, water retention areas, and other created wetlands can be greatly enhanced by establishing

and managing only desirable native aquatic plants. Native aquatic plants play important ecological roles and provide important ecological services. They can provide the best overall food sources for wildlife and support many more species than non-native plants because native wildlife evolved with native plant communities.

2.1.8 Types of Native aquatic plants which has potentials as Planting Materials in the Landscape Industry

Most wetland plants can survive a range of environmental conditions associated with wet and dry periods, but all plants possess adaptations that determine the conditions under which they grow best and the extremes that limit their survival.

A practical way of thinking about aquatic plants when planning restoration activities is to consider the needs and nature of the plant and the water depth where each specie can grows best.

In general, aquatic plants can be grouped into 3 major categories or according to zones based on their growing patterns and water depth:

- **Submerged (submersed) aquatic plants** grow entirely underwater and cannot survive out of water. Some species are rooted in the soil and some are rootless.

- **Floating aquatic plants** include plants that are rooted in the ground with leaves floating on the surface and species that float free on the surface with roots dangling in the water.
- **Emergent (emersed) aquatic plants** are rooted in the ground with the lower portion of the plant growing below and the upper portion growing above the water. This is the largest category of aquatic plants. It can be further divided into 3 subcategories to describe their growing conditions required by each species (although it is worthwhile to note that most aquaticplants tolerate a range of growing conditions):

- Emerging aquatic plants - include plants that need to be rooted in the water most of the time but have leaves and flowers projecting above the water.
- Short-stemmed marginal plants - include low-growing, bog-type plants that do well on wet mud or sand.
- Marginal plants - include ferns, grasses, flowers, shrubs, and trees that grow at the interface of wetland and upland habitats. These plants prefer changing water levels.
- Other plants that can grow in the fringes of the waterbody.

2.1.9 Planning of native aquatic planting

Site selection and preparation are the first steps toward successful aquatic plantings. Extreme changes in water levels and growing conditions, such as often occur in ponds with steep slopes, make successful establishment of aquatic plants more difficult. To increase the likelihood of success in the use of aquatic plants, the following steps should be taken:

1. **Determine the average water level (shoreline) on a yearly basis.**

This is especially important in stormwater retention/detention ponds because water levels may vary dramatically. Although some aquatic plants will tolerate dry and wet seasons, there are many that will die if they are kept too wet or too dry for extended periods.

2. **Measure maximum water depth in areas to be planted.**

Pay special attention to the shoreline and shallow areas, where most work will take place. Without proper measurements, it is hard to determine the quantity and types of plants that will be required. As the depth is measured, it is a good idea to place stakes that represent different depths. Later, these measurements will further assist in deciding the quantity and types of plants you need and the boundaries in which to plant them.

3. **Consider increasing the size of planting zones.**

In some cases, excavation can increase diversity by creating planting zones that originally did not exist. Soil and rocks removed to deepen one area can be used to create shallow areas elsewhere or can be incorporated into landscaping around the pond. Deepening the margins around the edge of a pond can help prevent undesirable plants, such as non-native grass, from invading into the water.

4. **Develop a detailed plan for planting that includes types and numbers of plants needed.**

The accuracy and detail of measurements will play a key role in the planting plan. For ease in planning, divide the wet garden zone into three major zones: shoreline (marginal plants), shallow water (emergent and submersed plants), and deep water (floating-rooted plants). A detailed plan will increase efficiency during planting and promote plant survival.

Submergent plants should be planted into pots. A wide assortment of pots is available, from plastic baskets to pulp planters. Choose pots that are large enough for your plants. Baskets may have to be lined with burlap or 2 layers of newspaper to keep the soil from falling out. To keep your soil in and the plant weighted down, add a layer of gravel to the top of the pot.

5. Handle aquatic plants with care during planting.

Careful handling of plants is important to ensure their survival. Plants should be wrapped in wet newspaper to avoid injury and drying. Do not place plants in the trunk of a car or in the back of a truck where they will overheat and cause the plant to wilt or even die. When planting, start with plants in the deep water zones and work up the banks. Planting should be conducted in the early morning or late evening to avoid the extreme heat of the sun.

6. Avoid overplanting

Avoid overplanting because it can add costs. A rule of thumb often used to decide how many wetland plants are needed is that for each 3 square metres, plan:

- 2 bunches of submersed plants*
- 1 floating rooted plant
- 1 short-stemmed marginal plant
- 1 medium-stemmed marginal plant

It should be noted that submersed plants can take over small ponds and should be used mainly for waterfowl enhancement projects.

7. Plant in clumps.

There are advantages to planting in clumps. Planting like species in clumps creates attractive concentrations of color and provides more varied habitat features. Planting in clumps can also facilitates management of weeds. Thus, it minimizes colonization of unwanted plants.

2.1.10 Placing Native Wetland Plants

Wetland plants can thrive well when placed in the correct spot. Planting species in each of the growing zones creates a more complex habitat that will benefit a greater number of aquatic, semi aquatic, and terrestrial species of wetlands wildlife.

2.1.11 Maintenance of aquatic plants

The best wildlife landscapes and water garden require a minimum amount of care. Frequent watering, fertilizing, spraying, and pruning disturb wildlife and reduce habitat values. However, especially during the first year after planting, some level of periodic maintenance will likely be needed.

1. Replace plants that die and remove undesirable aquatic plants or weeds, especially invasive non-native species that become

established. Invasive exotic plants may quickly dominate a wetland if not controlled.

2. Use herbicides sparingly during this time, because new plantings may be very sensitive to herbicides. After the first year, when wetland plants are better established, herbicides may be needed if undesirable wetland plants become established. Only herbicides that are registered specifically for use in wetlands by the Department of Agriculture can be legally used.

Control of overabundant native aquatic species will create open space, increase plant diversity, and improve habitat quality for wildlife.

2.1.13 Discussion

In addition to providing habitat for wildlife above and below the water, native aquatic plants produce oxygen and absorb carbon dioxide, a greenhouse gas associated with global warming. Native wetland plants improve water quality by removing fertilizers such as nitrogen and phosphorus and, by doing so, help control algal blooms that can kill fish. Wetland plants also filter stormwater runoff, help control erosion, and contribute to the aesthetic beauty of ponds and reservoirs.

For the fact that native aquatic plants have evolved adaptations to local environments, such as changes in water level, insect pests, and plant

diseases, they are typically easier to maintain than non-native species. The other advantage of most native wetland plants are they require little or no extra water or fertilizer. These factors save users of native aquatic plants time and money, they reduce the amount of fertilizers and pesticides that leach into surface waters, and help to conserve water.

Although native plants typically fare better than introduced species, some non-native plants have thrived well in Malaysia and spread extensively into natural areas. The right choice of non native plants is important. Some non-native plants that spread into natural areas can be invasive exotics, and they may present major ecological problems by displacing native plants, disrupting natural processes, and degrading habitat for wildlife. Invasive exotics also be costly in the need for control expenditures. However, the right choice of non native plants that has similar characteristic and those that does not impose ecological problems can complement the use of native species. Planting with native species is important for preventing the spread of invasive exotics. Unfortunately, the use of native plants in Malaysian Landscape Industry is very minimal and their use should be encouraged in order to get achieve a low maintenance and sustainable landscape.

Chapter 3:
Findings of the study:
Native and non native aquatic Plants which can be used as Planting Materials in the Landscape Industry

3.0 Introduction

The findings of this research are presented in this chapter. The plants are found to be suitable as planting materials for water gardens or areas which form wet habitats for plants. The information for the plants include its taxonomy, its origin and recommended suitability of use in the landscape.

The two categories of plants listed in this chapter are :

1. Non native plants
2. Native plants

The non native plants are listed as follows:

3.1 NON NATIVE PLANTS THAT CAN BE USED AS PLANTING MATERIALS

Aglaonema sp. Silver Queen
Suitability: Terrarium/paludarium

Aglaonema sp. 'Minima'
Origin: South East Asia
Suitability: Group Planting

Alternanthera cardinalis

Suitability: Group Planting

Alternanthera reineckii
Origin: Brazil
Suitability: Group Planting

Alternanthera sessilis
Origin:Tropical regions
Suitability: Group Planting

Alternanthera lilacina
Origin: South America
Suitability: Group Planting

Alternanthera ocipus

Suitability: Group Planting

Ammania gracilis
Origin: North and West Africa
Suitability: Group Planting

Anubias barteri var. barteri
Origin:West Africa
Suitability: Solitary Planting/Specimen Planting

Anubias barteri ' Broad Leaf'

Suitability: terrarium/Paludarium

Anubias barteri var. Nana
Origin: West Africa
Suitability: terrarium/Paludarium

Anubias hastifolia
Origin: West Africa
Suitability: terrarium/Paludarium

Anubias congensis
Origin: West Afica
Suitability: terrarium/Paludarium

Anubias lanceolata
Origin: West Africa
Suitability:terrarium/Paludarium

Anubias gigantea
Origin: West Africa
Suitability: terrarium/Paludarium

Anubias barteri Variegated

Suitability: terrarium/Paludarium

Anubias gracilis
Origin: West Africa
Suitability: terrarium/Paludarium

Anubias nana 'Wrinkled Leaf'

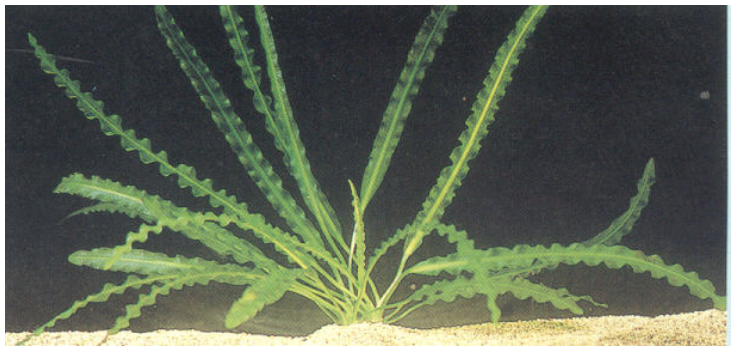
Suitability: terrarium/Paludarium

Aponogeton crispus
Origin: Sri Lanka
Suitability: terrarium/Paludarium

Aponogeton capuronii
Origin: Madagascar
Suitability: Solitary Planting/Specimen Planting

Aponoeton echinatus
Origin: India
Suitability: Solitary Planting/Specimen Planting

Aponogeton henkelianus
Origin:Madagascar
Suitability: Solitary Planting/
Specimen Planting



Aponogeton longiplumulosus
Origin*:* Madagascar
Suitability: Solitary Planting/Specimen Planting

Aponogeton ulvaceus
Origin: Madagascar
Suitability: Solitary Planting/Specimen Planting

Aponogeton undulates
Origin: Thailand
Suitability: Solitary
Specimen Planting

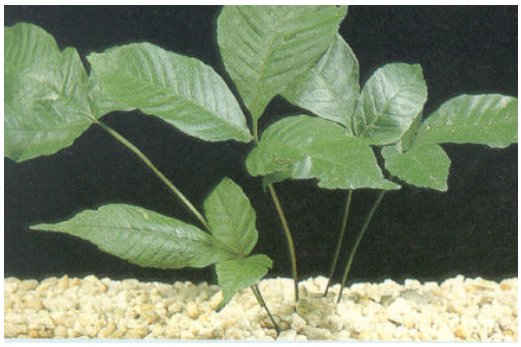
Bacopa caroliana
Origin: USA, North America
Suitability: terrarium/Paludarium

Bacopa monniera
Origin: Central America
Suitability: terrarium/Paludarium

Bacopa lanigera

Suitability: terrarium/Paludarium

Barclaya longifolia
Origin: Thailand, Burma
Suitability: Aquarium Foreground Planting
Foreground Planting



Bolbtis heteroclita
Origin: South East Asia
Suitability: Aquarium

Bolbtis heudelotii
Origin: West Africa
Suitability: Group Planting

Blyxa aubertii
Origin: Tropical Asia
Suitability: Solitary Planting/Specimen Planting

Blyxa japonica
Origin: South East Asia
Suitability: Group Planting

Cabomba piauhyensis
Origin: Central America
Suitability: Group Planting

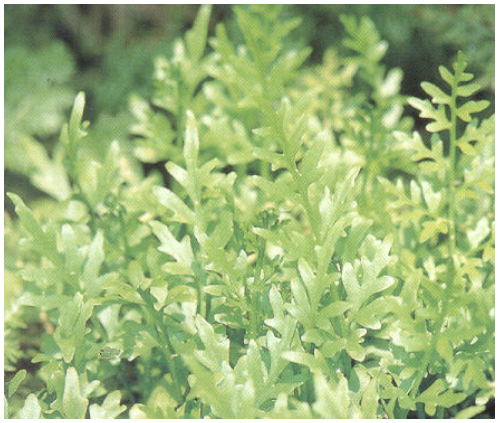
Cabomba caroliana ‘Silver Green’
Suitability: Group Planting

Cabomba caroliana
Origin: Central America
Suitability: Group Planting

Cabomba aquatica
Origin: Central America
Suitability: Group Planting

Ceratophyllum demersum

Suitability: Open pond planting



Ceratopteris cornuta
Origin: Tropical regions
Suitability: Tall plants for Aquarium Background

Ceratopteris thalicroides
Origin: Tropical regions
Suitability: Tall plants for Aquarium Background

Crinum natans 'Narrow Leaf'
Origin: West Africa
Suitability: Aquarium Middle Planting Planting

Crytocoryne albida
Origin: Thailand/Malaysia
Suitability: Aquarium Foreground

Crytocoryne wendtii 'Broad Leaf'
Origin: Sri Lanka
Suitability: Aquarium Foreground Planting

Cryptocoryne lutea
Origin: Sri Lanka
Suitability: Aquarium Foreground Planting

Cryptocoryne lingua
Origin: Borneo
Suitability: Aquarium Foreground Planting

Crytocoryne petchii
Origin: Sri Lanka
Suitability: Aquarium Foreground Planting

Crytocoryne lucens
Origin: Sri Lanka
Suitability: Tall plants for Aquarium Background

Crytocoryne aponogetifolia
Origin: Phillippines
Suitability: Aquarium Foreground Planting

3.2 NATIVE PLANTS THAT CAN BE USED AS PLANTING MATERIALS

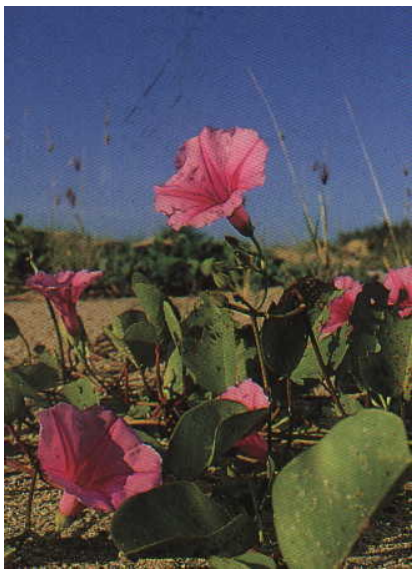
The following plants are native to Malaysia and they can also be used as plant materials of water garden, naturalised landscapes and man made wetlands. These plants can be found in areas which has waterbodies such as lake, in the forest, riverine areas and sandy beaches. They can be used as specimen plant, group planting and solitary planting.

Memycylon edule

Barringtonia asiaticum

Terminalia catappa

Eurycles amboinensis



Ipomea pes caprae

Hibiscus tiliaceus

Canavalia maritime

Scaevola sericea

Glochidion littorale

Crytocoryne ciliata

Wedelia biflora

Acanthus ilicifolis

Dolichandrone spathacea

Callophyllum inophyllum

Finlaysonia obovata

Limnocharis flava

Nymphoides indica

Ludwigia adscendens

Ottelia alismoides

Utricularia aurea

Ixora lobii

Eichornia crassipes

Chapter 4:
Recommendations:
The use of Native and non native Aquatic Plants in the Landscape Industry

4.0 Introduction

Native and non aquatic plants as planting materials are important in the landscape industry. The presence of the plants together with the sound of water has always been a delight that draws people towards a space. In order to create a water garden, one of the main elements used are plant materials and because of its wet habitat, aquatic plants or plants that can thrive well in wet areas are appropriate. Urban residents often had superficial views about native flora as plants that are unattractive, unkempt and because of this the plants are often not chosen.

This study has managed to identify some of the suitable available non native and native aquatic plants in the country. Whether they are native to the country or those that originated from other country both can have the potentials to be used as planting materials. It added to the range of choices or palette of potential plant materials, which can be used by landscape architects and designers in their landscape design or proposal.

There are some main points about the use of native plants contrived from the study.

4.1 Native planting can be done through some design considerations:

1. Identify the best habitat of the plants within the garden. When there is a need to use native plants in a garden, the design should take into consideration the relation of the garden to the sun and shade as well as the wet and dry areas.
2. The designer should identify which areas of the garden are suitable for the different categories of native or non native plants because some of the plants can grow well in shaded areas, some in full sun while others may do well in wet areas.
3. The plants should be given a lot of room to grow.
4. Whenever possible, try to create your own native seed mix.

4.1.1 Site Selection for a Water Garden

There are a few points that need to be considered before choosing a site for the water garden in relation to the choice of plants.

1. Most aquatic and marginal plants require full sunlight or a little shade especially native flowering species.
2. The designer should avoid siting the garden , pond or stream close to trees and shrubs that drop large quantities of leaves, flowers and fruit.

These material will decay in the water. It is unsightly and it would upset the balance. Some of these plants can even poison the aquatic plants and fish.

3. Make sure that you know the location of the pipes and underground cables on site because it can be dangerous as well as expensive.

4.2 Conclusion

This study has been able to identify a range of both native and non native aquatic and wetland plants which can be used as planting materials for water gardens, naturalized landscapes or man made wetlands. Some of the materials are naturally native to Malaysia climate but some originate from other countries and through the years have adapted to the environment in Malaysia. The study has also listed the benefits of using native plants and some of the appropriate planting and management practices for the use of the plant materials in the design of water garden. These findings can act as design considerations in water garden design to professionals who are involved in landscape design and planning such as landscape architects, environmental planners, landscape architecture students and those in the other design disciplines.

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