

Industrial Utilization of Wild Flowers Native to Korea

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Introduction

In many countries, native plants have been used as floricultural materials since ancient times. They are closely related to the cultures of nations, sometimes representing characters of the people living in the nation.

Plants with high ornamental values were collected from the wild and utilized as horticultural crops by ancient nations. The development of floriculture was associated with economic power and cultural levels of a nation. However, the flower breeding during that time was very limited due to the lack of germplasm and scientific knowledge. Soon, the native plants of Americas and Asia with high ornamental values were introduced to Europe by the Great Powers of the time. With the germplasm and the development of flower breeding skills, floricultural industry grew rapidly, and present skills of flower breeding and cultivation are remarkable.

1. Korean floras

A. Present status of native plants

Floras are influenced by many environmental conditions, including temperature, rainfall, geology, soils, and micro-climate. Korea has temperate climate with 4 distinct seasons. Average annual temperature is 5~14°C and rainfall ranges from 500 to 1500mm. Even though the land area is not big, with mountainous terrains, many ecologically unique native plants are growing in Korea.

There are many plants with great potentials for the development as horticultural crops. The number of native plants is estimated 4,158 taxonomic groups; 170 families, 897 genera, 2,898 species, 7 subspecies, 929 varieties, 301 forms, and 23 hybrids. Also 438 taxons of introduced plants from other countries are growing in Korea (Lee, 1976; Table 1). Among native plants, 40 Pteridophyta species, 11 gymnosperms, and 1,082 angiosperms are regarded as native plant resources. Total number of plants amounts to 1/4 of total Korean native plants (Oh *et al.*, 1995).

Table 1. Number of native and introduced vascular plants in Korea.

Taxon	Family	Genus	Species	Subspecies	Varieties	Forms	Hybrids
Pteridophyta	21	62	229	0	21	4	0
Gymnosperm	4+2 ^y	11+9	26+23	0	19+1	22	1
Dicot	122+10	621+122	1,920+303	7+2	753+28	252+6	22
Monocot	23+3	203+37	723+69	0	136+4	23+2	0
Total ^z	170+15	897+168	2,898+395	7+2	929+33	301+8	23

^zTotal: 4158 (native plants) + 438 (Introduced plants) = 4596. ^yNo. of introduced plants.

Korean plant communities can be divided into 3 groups; 1) temperate middle zone, 2) warm temperate southern zone, and 3) cool temperate northern zone. Southern coast, Cheju Island, Huksan Island and Ulreung Island whose average annual temperature is 14°C belong to warm temperate zone. In this zone, about 70 perennial broad-leaved trees and herbaceous plants are growing. The number of broad leaved-trees is reduced to 20 as we reach Pusan and Mokpo area.

Korea is located between north latitude 35–43.2°C. Its floras consist of perennial narrow-leaved, deciduous broad-leaved and herbaceous plants. Plants of cool temperate zone inhabited Northern area and high mountain area. Inhabitation of *Grewia biloba* var. *parviflora*, *Fagus crenata* var. *multinervis*, *Poncirus trifoliata*, *Paulownia tomentosa*, *Empetrum nigrum* var. *japonicum* and *Vaccinium uliginosum* in Korea suggests that at one time Japan, Korea and China were connected.

Many foreign plants have been introduced to Korea by spontaneous or artificial means. *Koelreuteria paniculata*, *Crinum asiaticum* var. *japonicum* whose origins are South Africa and *Canavalia lineata* of Philippine origin, respectively, are few of the examples introduced to Korea by sea current. *Ambrosia artemisiifolia* var. *elatior* was introduced from China to Korea during Korean War. We treat indigenous plants and naturalized plants which were introduced and adapted to our climate as wild plants.

Korea has many plants with a great specific diversification, including *Crinum asiaticum* var. *japonicum*, *Pulsatilla koreana*, *Hepatica asiatica*, *Thymus quinquecostatus* var. *japonica*, *Phytolacca insularis*, *Taraxacum platycarpum*, *Hylomecon hylomeconoides* and *Chrysanthemum zawadskii* var. *latilobum*, and research on the breeding and genetics on them are needed.

Fig. 1 shows various types of colonies of native plant in Korea. To develop native plants for horticultural crops, we need to know about their physiology and to establish reliable methods to grow them. Therefore, information on light, moisture, temperature, soil conditions, and adjacent flora of habitats should be collected and analyzed for better cultivation of native plants.

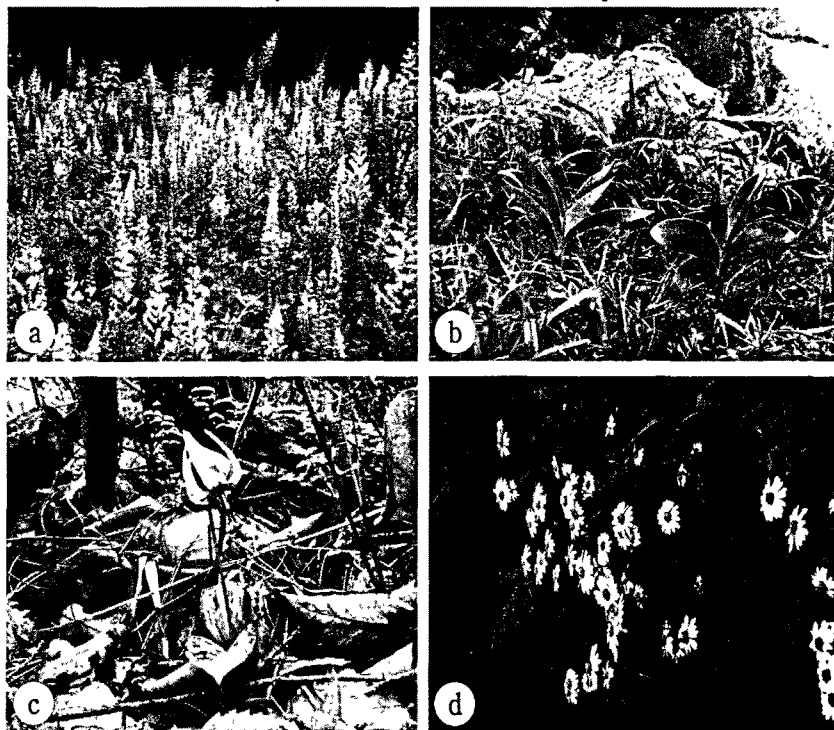


Fig 1. Plants on their natural habitat

a. *Astilbe chinensis* var. *davidii*, b. *Iris dichotoma*, c. *Erythronium japonicum*,
d. *Chrysanthemum zawadskii* var. *latilobum*

B. Korean endemic plants

Korean endemic plants are consisted of 593 taxonomic groups in 233 genera including *Rhododendron schlipenbach* Miq. and *Salix koreensis* Miq., which were collected around Wonsan area on 1854, and introduced to the world by B.A. Schlipenbach. Among these, 8 genera, such as *Megalerantis* Ohwi, *Coreanomecon* Nakai, *Echinosophora* Nakai, *Abelophyllum* Nakai, *Pentactina* Nakai, *Hanabusaya* Nakai, *Diplolabellum* Maekawa and *Mankyua* Sun et al., are growing only in Korea (Paek, 2001). Cheju Island has the highest number of 153 endemic taxons, followed by Churi mountain (61), Keumgang mountain (50), and Ulreng island (35) (Paek, 2001). Thirty five percent of the endemic plants, 214 taxons, are distributed in those two islands.

Some of the plants classified by their habitats are listed in Table 2. *Abelophyllum distichum* (inhabiting in Jinchun, Gaesan, Yeongdong, Boeun), *Hanabusaya asiatica* (Keumgang, Sobaek, Sorak, and Yongmun mountain), *Megaleranthis saniculifolia* (Sorak, Soback, Dukyu, Jiri, Halla mountain) are some of the examples. In addition, many promising endemic plants are present, such as *Cirsium rhinoceros*, *Prunus yedoensis*, *Euphorbia fauriei*, *Taraxacum hallaisanensis*, *Rubus parvifolius* var. *taquetii* and *Ligularia taquetii* in Jeju Islands; *Fagus crenata* var. *multinervis*, *Chrysanthemum zawadskii* ssp. *Lucidum*, *Thymus quinquecostatus* var. *japonica*, *Hepatica asiatica* and *Cotoneaster wilsonii* in Ulneung Island, *Aconitum chiisanense*, *Hylomecon hylomeconoides* in Chirisan; *Abelophyllum distichum*, *Hanabusaya asiatica*, *Echinosophora koreensis* and *Abelia mosanensis* in central north area.

Table 2. Names of endemic plants in Korea.

Plant groups	Name of plants
Warm temperate (Southern part of Korea)	<i>Asarum maculatum</i> , <i>Pseudostellaria coreana</i> , <i>Cirsium rhinoceros</i> , <i>Calanthe striata</i> , <i>Dystaenia takeshumana</i> , <i>Aconitum triphyllum</i> , <i>Hepatica asiatica</i> , <i>Dendropanax morbifera</i> , <i>Fagus crenata</i> var. <i>multinervis</i> , <i>Machilus thunbergii</i> var. <i>obovata</i> , <i>Neolitsea sericea</i> , <i>Syringa velutina</i> var. <i>venosa</i> , <i>Physocarpus insularis</i> , <i>Prunus takesimensis</i> , <i>Prunus leveilleana</i> , <i>Prunus serrulata</i> var. <i>spontanea</i> , <i>Prunus yedoensis</i> , <i>Philadelphus scaber</i>
Temperate (Central part of Korea)	<i>Hylomecon hylomeconoides</i> , <i>Aconitum chiisanense</i> , <i>Aconitum jaluense</i> , <i>Aconitum uchiyamai</i> , <i>Geranium koreanum</i> , <i>Geranium nepalense</i> subsp. <i>thunbergii</i> , <i>Aster koraiensis</i> , <i>Cirsium japonicum</i> var. <i>ussuriense</i> , <i>Leontopodium leirolepis</i> , <i>Scirpus triqueter</i> , <i>Corydalis ambigua</i> , <i>Corydalis ternata</i> , <i>Corydalis turtschaninovii</i> var. <i>pectinata</i> , <i>Eleocharis kurogiwai</i> , <i>Phragmites communis</i> , <i>Pennisetum alopecuroides</i> , <i>Iris muuoareua</i> , <i>Lilium amabile</i> , <i>Veratrum patulum</i> , <i>Syringa velutina</i> var. <i>kamibayashii</i> , <i>Filipendula glaberrima</i> , <i>Pulsatilla koreana</i> , <i>Thalictrum filamentosum</i> , <i>Thalictrum uchiyamai</i> , <i>Viola lactiflora</i> , <i>Viola rossii</i> , <i>Angelica gigas</i> , <i>Hydrangea serrata</i> for. <i>Acuminata</i> , <i>Forsythia densiflora</i> , <i>Forsythia ovata</i> , <i>Abelophyllum distichum</i> , <i>Forsythia koreana</i> , <i>Acer palmatum</i> var. <i>koreanum</i> , <i>Rhododendron yedoense</i> var. <i>poukhanense</i> , <i>Rhododendron mucronulatum</i> var. <i>albiflora</i> , <i>Buxus microphylla</i> var. <i>koreana</i> , <i>Buxus microphylla</i> for. <i>Elongata</i> , <i>Lonicera harai</i> , <i>Sambucus williamsii</i> var. <i>coreana</i> , <i>Berberis koreana</i> , <i>Berberis amurensis</i> var. <i>latifolia</i> , <i>Viburnum carlesii</i> , <i>Weigela subsessilis</i> , <i>Weigela florida</i> for. <i>Candida</i> , <i>Euonymus sachalinensis</i> , <i>Cephalotaxus koreana</i> , <i>Crataegus pinnatifida</i> for. <i>Paritita</i> , <i>Deutzia coreana</i> , <i>Stewartia koreana</i> , <i>Deutzia prunifolia</i> , <i>Ulmus davidiana</i> for. <i>Suberosa</i>
Cool temperate (Northern part of Korea)	<i>Anemone koraiensis</i> , <i>Sasa coreana</i> , <i>Hanabusaya asiatica</i> , <i>Echinosophora koreensis</i> , <i>Rheum coreanum</i> , <i>Senecio flammeus</i> , <i>Synurus excelsus</i> , <i>Taraxacum coreanum</i> , <i>Gentiana uchiyamai</i> , <i>Sasa borealis</i> , <i>Corylopsis coreana</i> , <i>Clematis fusca</i> var. <i>violacea</i> , <i>Betula costata</i> , <i>Abies koreana</i> , <i>Pinus densiflora</i> for. <i>Multicaulis</i>

C. Endangered and protected plants.

Like plants of other countries in the world, many Korean plants have been perished or threatened to be perished due to environmental changes, exploitation, and over-collection. Department of Environment listed 6 species including *Cymbidium kanran*, *Aerides japonicum*, *Cypripedium japonicum*, *Ranunculus kazusensis*, *Cotoneaster wilsonii*, *Diapensia japonica* var. *obovata* as endangered native plants and 52 species as protected plants. Forestry Administration also listed 217 species as rare and endangered, and 42 as possibly endangered species.

D. Native plants useful for ornamental purposes.

Native plants can be used for ornamentals, foods, medicines, animal feeds, and for timbers. Table 3 and Fig. 2 demonstrate some of 593 valuable species native to Korea, such as annuals (8.7%), perennials (23.8%), bulbs and tubers (4.5%) and woody plants (63%). Number of valuable species is increasing every year (Song, 1998). 63% of these species can be classified as garden and woody flowering plants, 24% perennials, 9% annuals and 4% bulbs and tubers. Uses of native ornamental plants are for flowers (369 species, 62%), leaves (82 species), fruits (58 species) and others (79 species) (Kim *et al.* 1999).

2. Flowering time of wild flowers

Due to 4 distinct seasons, Korean native plants flower over an extended period of time. The flowering of plants usually coincide with pollinator's peak activity, ensuring high reproduction of the species. So plants with colors preferred by pollinators have survived the competition.

Temperature has most profound effects on flowering time. Table 4 shows that flowering takes place over 4 seasons in Korea. In general, the highest number of plants flower on July, but for woody plants May has highest flowering ratio (Fig. 3). Flower colors are white, yellow, red, and blue etc. Yellow color is most predominant, followed by white, blue and red in decreasing order.

Wild plants have many problems in using for pots, bedding floricultural plants, including short flowering periods, unbalanced height and low number of branching. Also flowering is concentrated in spring season and flowers are too small for commercial production. Therefore, improvement on plant type, prolonged flowering and quality should be continued by systemic research on native plants.

Table 3. Main native ornamentals used by industry.

Division	Related plants
Annual	<i>Persicaria orientalis</i> , <i>Elsholtzia ciliata</i> , <i>Chrysanthemum boreale</i> , <i>Achillea sibirica</i> , <i>Platycodon grandiflorum</i> , <i>Pseudolysimachion linariifolium</i> , <i>Dianthus chinensis</i> , <i>Callistephus chinensis</i> , <i>Viola mandshurica</i> , <i>Primula sieboldi</i> , <i>Senecio integrifolius</i> var. <i>spatulatus</i>
Perennial	Pteridophyta, <i>Iris</i> spp. <i>Hosta</i> spp. <i>Dicentra spectabilis</i> , <i>Pulsatilla koreana</i> , <i>Lychnis cognata</i> , <i>Hepatica asiatica</i> , <i>Adonis amurensis</i> , <i>Convallaria keiskei</i> , <i>Aguilgia buergeriana</i> var. <i>oxysepala</i> , <i>Chrysanthemum zawadskii</i> var. <i>latilobum</i> , <i>Astilbe chinensis</i> var. <i>davidii</i> , <i>Lotus corniculatus</i> var. <i>japonicus</i> , <i>Polygonatum odoratum</i> var. <i>pluriflorum</i>
Bulbs and tubers	<i>Lilium</i> spp., <i>Allium</i> spp., <i>Lycoris</i> spp., <i>Erythronium japonicum</i> , <i>Scilla scilloides</i>
Orchid	<i>Cymbidium goeringii</i> , <i>Cymbidium kanran</i> , <i>Neofinetia falcate</i> , <i>Cypripedium macranthum</i> , <i>Calanthe discolor</i> , <i>Bletilla striata</i>
Flowering trees and shrubs	<i>Weigela subsessilis</i> , <i>Camellia japonica</i> , <i>Deutzia parviflora</i> , <i>Forsythia koreana</i> , <i>Spiraea prunifolia</i> for. <i>Simpliciflora</i> , <i>Prunus serrulata</i> var. <i>spontanea</i> , <i>Abelophyllum distichum</i> , <i>Magnolia kobus</i> , <i>Chaenomeles lagenaria</i>
Foliage plant	Pteridophyta, <i>Hedera rhombea</i> , <i>Sedum sarmentosum</i> , <i>Sasa borealis</i> , <i>Euonymus fortunei</i> var. <i>radicans</i> , <i>Pyrola japonica</i> , <i>Phragmites communis</i> , <i>Miscanthus sinensis</i> , <i>Phragmites japonica</i> , <i>Thymus quinquecostatus</i> , <i>Lithospermum erythrorhizon</i> , <i>Hylomecon vernale</i> , <i>Dichondra repens</i> , <i>Festuca ovina</i> , <i>Koeleria cristata</i>
Processing materials	<i>Celastrus orbiculatus</i> , <i>Echinops setifer</i> , <i>Typha orientalis</i> , <i>Phragmites japonica</i> , <i>Eragrostis ferruginea</i> , <i>Pennisetum alopecuroides</i>

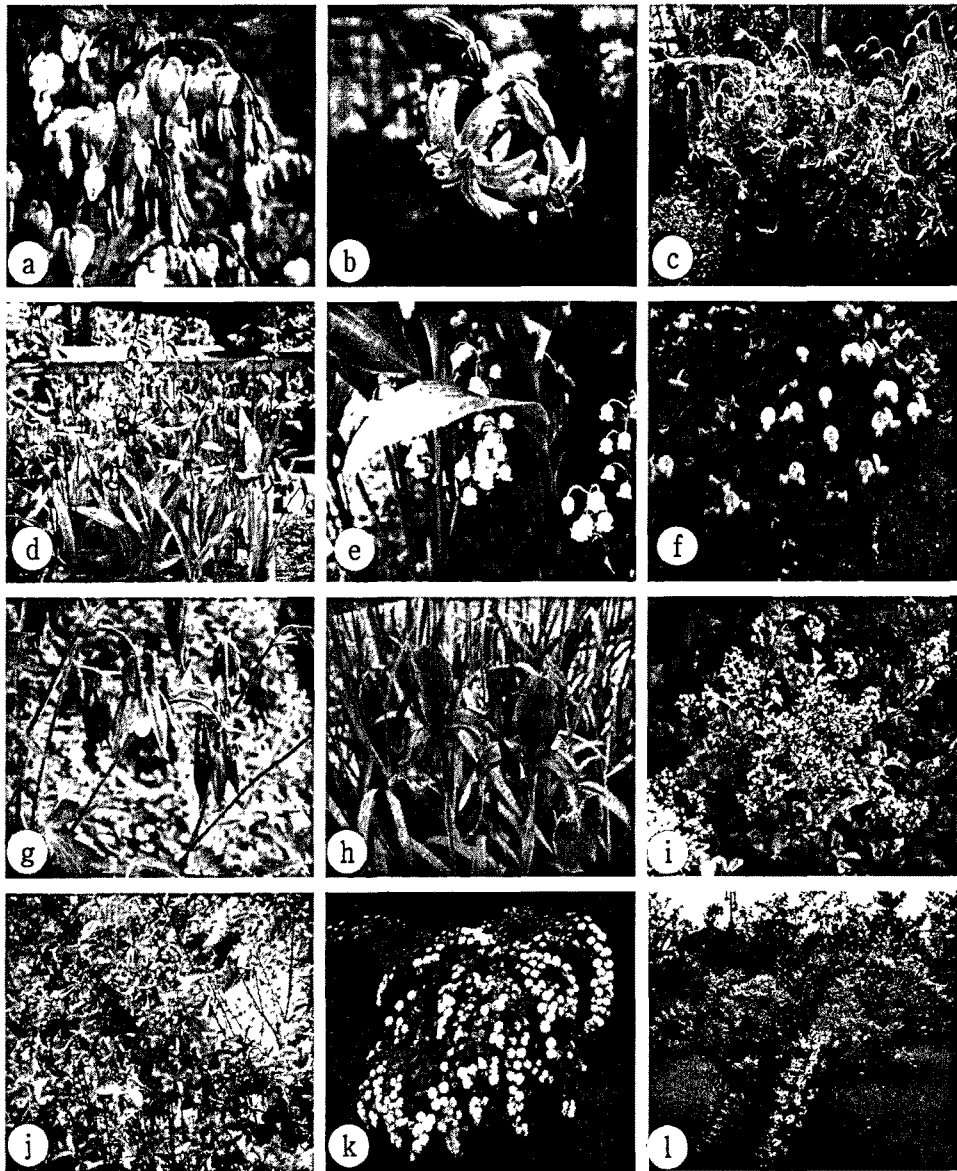


Fig 2. Popular native ornamentals in Korea.

a. *Dicentra spectabilis*, b. *Lilium hansonii*, c. *Pulsatilla koreana*, d. *Bletilla striata*, e. *Convallaria keiskei*, f. *Lotus corniculatus* var. *japonicus*, g. *Aquilegia buergeriana* var. *oxysepala*, h. *Iris sanguinea* i. Miss Kim lilac, j. *Weigela subsessilis*, k. *Spiraea cantoniensis*, l. *Deutzia parviflora*.

Table 4. Classification of plants according to flowering time.

Season	Names of plants
Spring	<p><i>Adonis amurensis</i>, <i>Hepatica asiatica</i>, <i>Primula sieboldii</i>, <i>Convallaria keiskei</i>, <i>Caltha palustris</i> var. <i>membranacea</i>, <i>Dicentra spectabilis</i>, <i>Cypripedium</i> <i>macranthum</i>, <i>Jeffersonia dubia</i>, <i>Aceriphyllum rossii</i>, <i>Hylomecon vernale</i>, <i>Narcissus tazetta</i> var. <i>chinensis</i>, <i>Forsythia koreana</i>, <i>Rhododendron</i> <i>mucronulatum</i>, <i>Lonicera maackii</i>, <i>Abeliophyllum distichum</i>, <i>Prunus yedoensis</i>, <i>Magnolia kobus</i>, <i>Iris nertschinskia</i>, <i>Pulsatilla koreana</i>, <i>Erythronium</i> <i>japonicum</i>, <i>Aquilegia buergariana</i> var. <i>oxysepala</i>, <i>Cornus officinalis</i>, <i>Hylomecon hylomeconoides</i>, <i>Majanthemum bifolium</i>, <i>Viola mandshurica</i>, <i>Glechoma hederacea</i> var. <i>longituba</i>, <i>Taraxacum hallaisanense</i>, <i>Rohdea</i> <i>japonica</i>, <i>Sedum sarmentosum</i></p>
Summer	<p><i>Sedum takesimense</i>, <i>Lychnis cognata</i>, <i>Inula Britannica</i> var. <i>chinensis</i>, <i>Astilbe</i> <i>chinensis</i> var. <i>davidii</i>, <i>Lysimachia coreana</i>, <i>Dianthus sinensis</i>, <i>Dianthus</i> <i>superbus</i> var. <i>longicalycinus</i>, <i>Dracocephalum argunense</i>, <i>Lythrum anceps</i>, <i>Paeonia lactiflora</i> var. <i>hortensis</i>, <i>Paeonia suffruticosa</i>, <i>Iris ensata</i> var. <i>spontanea</i>, <i>Rosa rugosa</i>, <i>Sorbus commixta</i>, <i>Aster koraiensis</i>, <i>Belamcanda</i> <i>chinensis</i>, <i>Liriope platyphylla</i>, <i>Thymus quinquecostatus</i>, <i>Acorus calamus</i> var. <i>angustatus</i>, <i>Hosta longipes</i>, <i>Hemerocallis fulva</i>, <i>Hemerocallis fulva</i> var. <i>kwanso</i>, <i>Coreopsis drummondii</i>, <i>Filipendula glaberrima</i>, <i>Pennisetum</i> <i>alopecuroides</i>, <i>Lycoris radiata</i>, <i>Campanula takesimana</i>, <i>Syringa wolffii</i>, <i>Rosa</i> <i>multiflora</i>, <i>Hypericum ascyron</i>, <i>Cirsium japonicum</i> var. <i>ussuriense</i>, <i>Platycodon grandiflorum</i>, <i>Phytolacca insularis</i>, <i>Hanabusaya asiatica</i>, <i>Sedum</i> <i>kantschaticum</i>, <i>Iris ensata</i> var. <i>spontanea</i>, <i>Sedum oryzifolium</i>, <i>Lycoris</i> <i>squamigera</i></p>
Fall	<p><i>Gentiana scabra</i> var. <i>buergeri</i>, <i>Miscanthus sinensis</i> Andersson, <i>Swertia</i> <i>pseudo-chinensis</i>, <i>Aconitum villosum</i>, <i>Phragmites communis</i>, <i>Elsholtzia</i> <i>ciliata</i>, <i>Patrinia scabiosaefolia</i>, <i>Aster yomena</i>, <i>Chrysanthemum zawadskii</i> var. <i>latilobum</i>, <i>Sedum spectabile</i>, <i>Caryopteris incana</i>, <i>Chrysanthemum indicum</i>, <i>Chrysanthemum boreale</i>, <i>Farfugium japonicum</i></p>
Winter in Jeju island	<p><i>Poa sphondylodes</i>, <i>Narcissus tazetta</i> var. <i>chinensis</i>, <i>Viola mandshurica</i>, <i>Stellaria media</i>, <i>Corydalis gigantea</i> var. <i>macrantha</i>, <i>Capsella bursa-pastoris</i>, <i>Brassica campestris</i> subsp. <i>napus</i> var. <i>nippo-oleifera</i>, <i>Trifolium repens</i>, <i>Camellia japonica</i>, <i>Daphne odora</i>, <i>Veronica didyma</i> var. <i>hacina</i>, <i>Callistephus</i> <i>chinensis</i>, <i>Chrysanthemum indicum</i>, <i>Cirsium japonicum</i> var. <i>ussuriense</i>, <i>Senecio vulgaris</i>, <i>Chrysanthemum zawadskii</i> var. <i>latilobum</i></p>

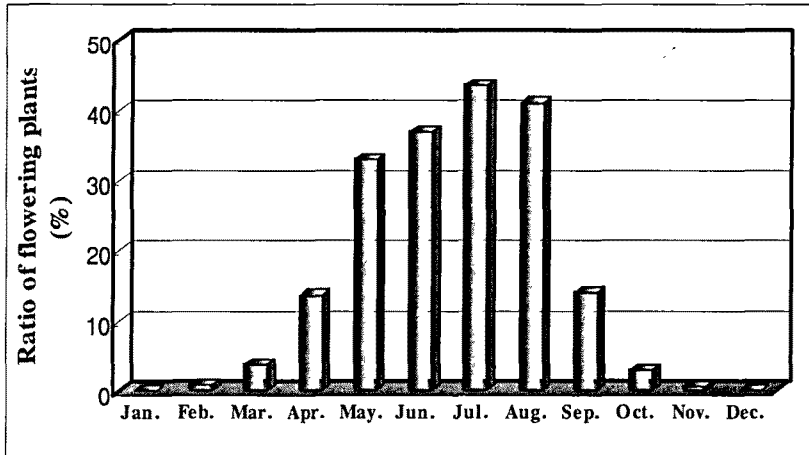


Fig. 3. Monthly ratio of flowering plants in Korea.

3. History of Korean floriculture

According to a historical document, chrysanthemums and *Paeonia suffruticosa* were grown during the era of Three Kingdoms (BC 37~AD 935). During the Korea Dynasty (AD 918~1392), indigenous plants including *Chrysanthemum sibiricum*, *Rhododendron mucronulatum*, *Iris nertschinskia*, *Abeliophyllum distichum*, *Cornus officinalis* and *Hemerocallis fulva* var. *kwanso* were grown locally. Also many plants such as *Chrysanthemum morifolium*, *Celosia cristata*, *Impatiens balsamina*, *Acorus gramineus*, orchids, *Paeonia lactiflora* var. *hortensis*, *Dianthus sinensis*, *Rhododendron schlippenbachii*, *Hibiscus syriacus*, *Laurus nobilis*, *Rosa* spp. and *Lagerstroemia indica* had been introduced to Korea by that time.

During the Chosun Dynasty (AD 1392~1910), when the Confucianism was prevalent, floriculture was developed by royal families and noble men (Yangban) who grew mainly the Four Gracious plants (*Prunus mume*, oriental orchid, *Chrysanthemum morifolium*, *Phyllostachys reticulata*), *Nelumbo nucifera*, *Pinus densiflora* and *Acer palmatum*. Heehan Kang had published 'Yangwhasorok', the first floricultural literature in Korea. The flowering of culture during King 'Sejong' era and 7-year war with Japan during 15th~16th centuries, brought in many foreign plants including *Forsythia koreana*, *Syringa velutina* var. *kamibayashii*, *Chaenomeles lagenaria*, *Rhododendron schlippenbachii*, *Acer palmatum*, *Rosa rugosa*, *Prunus serrulata* var. *spontanea*, and *Hemerocallis fulva* into Korea. Those plants made the development of horticulture by royal families, wealthy people and men of letters possible until 19th century.

The opening of port during King 'Kojong' brought many foliage, bulbs and tuber plants to Korea, but because of chaotic state of the country, and low economic power of Korea, the dark age of floriculture had lasted until the beginning of 1960's. After the liberation from Japan in 1945, many pot foliage plants and roses were introduced from U.S., but the foundation for floriculture was so weak that no horticultural industry could be established.

Like cases in other countries, foreign plants were introduced to Korea when the exchanges such as political, cultural, and even war between other countries, were active. Table 5 shows that when important

foreign plants were introduced to Korea, During the era of King 'Sejong' when national power was strong and culture was blooming, *Hosta plantaginea*, *Althaea rosea*, *Calendula arvensis*, *Trachycarpus excelsa*, *Cycas revoluta*, *Musa basjoo* and *Primula sieboldii* were introduced. *Helianthus annuus* was introduced during 7 year war with Japan, and many tropical plants, *Trachycarpus excelsa*, *Cycas revoluta* and *Musa basjoo* were given by Japan as a tribute to Chosun King 'Sejong'.

Table 5. Approximate introduction date of foreign plants to Korea.

Century	Scientific name	Century	Scientific name
1C	<i>Prunus mume</i>	15C	<i>Hosta lancifolia</i>
2C	<i>Chrysanthemum morifolium</i>	15C	<i>Althaea rosea</i>
3C	<i>Gardenia jasminoides</i> for. <i>grandiflora</i>	15C	<i>Calendula arvensis</i>
5C	<i>Nelumbo nucifera</i>	15C	<i>Archontophoenix alexandrae</i>
7C	<i>Paeonia suffruticosa</i>	15C	<i>Cycas revoluta</i>
10C	<i>Pharbitis nil</i>	15C	<i>Musa basjoo</i>
11C	<i>Impatiens balsamina</i>	15C	<i>Primula sieboldii</i>
11C	<i>Celosia cristata</i>	18C	<i>Magnolia kobus</i>

Presently, Koreans are more concerned with floriculture as the standards of living improve. Especially urban people who are tired of modern life style are interested in native plants which remind of them their native hometown and surrounding nature. Consequently more and more native plants are being used as landscaping for parks, apartments and golf courses. Also there is increasing efforts to develop new native plants for horticultural uses.

4. Present status of native plants industry

People have become interested in native plants since early 1980's, when floricultural industry started to grow in Korea. However, native plant business really began ten years later. It was around that time that methods to propagate and grow native plants were begun to be established.

The use of native plants for landscaping purpose such as park and road construction, took up 80% of plant supplies. Native plants are used for bedding plants for parks, and plants for green zone around apartment and buildings. Recently, aquatic native plants are considered to be used to prevent pollution of lakes, reservoirs and streams. Still the landscape architecture companies, city and town admiration office, country clubs and leisure companies are the main consumers of native plants. Sales to general public is not large, but should be encouraged to increase the consumption of native plants.

A. Production of native plants

Commercial production of native plants began early part of 1980's, and as the popularity increases, the demand soared. Now, the native plants become one part of floricultural industry. At the beginning, growing started as a hobby but recently many professional growers are in business in this field. Native plant growers are located across the rural area, so the landscape consumption is mainly in cities. Recently as the consumption increases, many native plant societies are formed in many cities by hobbyists and

plant lovers.

At the beginning, native plants were collected from mountains or fields, and propagated for the stock material, but now professional growers use various mass-propagation methods such sowing, cutting, division and tissues culture. Even they grow transplants by plug system. Table 6 shows the results of survey done on Feb. 2001 about the production of native plants. Number of types of plants amounts to 223. In 136 species, more than 10,000 plants are produced, 46 species 100,000 plants, and 7 species more than a million.

Table 6. Native ornamentals produced more than 100,000 plants per a year in Korea.

Scientific name	No. plants produced /year	Scientific name	No. plants produced /year
<i>Acorus calamus</i> var. <i>angustatus</i>	145,000 ²	<i>Euonymus fortunei</i> var. <i>radicans</i>	175,000
<i>Adonis amurensis</i>	118,860	<i>Farfugium japonicum</i>	254,000
<i>Aerides japonicum</i>	100,000	<i>Hedera rhombea</i>	1,140,000
<i>Agastache rugosa</i>	106,500	<i>Hemerocallis fulva</i>	1,060,150
<i>Aster ageratoides</i>	355,000	<i>Hemerocallis fulva</i> var. <i>Kwanso</i>	300,000
<i>Aster koraiensis</i>	5,080,000	<i>Hemerocallis thunbergii</i>	180,000
<i>Aster spathulifolius</i>	165,500	<i>Hosta longipes</i>	2,683,400
<i>Aquilegia buergariana</i> var. <i>oxysepala</i>	460,000	<i>Hydrangea serrata</i> for. <i>acuminata</i>	314,000
<i>Aquilegia flabellata</i> var. <i>pumila</i>	141,000	<i>Iris ensata</i> var. <i>spontanea</i>	1,003,300
<i>Belamcanda chinensis</i>	460,000	<i>Iris nertschinskia</i>	1,563,000
<i>Bletilla striata</i>	263,000	<i>Lilium tigrinum</i>	149,000
<i>Calanthe discolor</i>	143,000	<i>Liriope platyphylla</i>	384,800
<i>Campanula punctata</i>	522,000	<i>Lythrum anceps</i>	416,200
<i>Campanula takesimana</i>	162,000	<i>Neofinetia falcate</i>	101,000
<i>Caryopteris incana</i>	418,500	<i>Parthenocissus tricuspidata</i>	754,000
<i>Crysanthemum indicum</i>	429,500	<i>Platycodon grandiflorum</i>	101,000
<i>Chrysanthemum zawadskii</i> subsp. <i>coreanum</i>	162,000	<i>Pulsatilla koreana</i>	764,900
<i>Crysanthemum zawadskii</i> var. <i>latilobum</i>	1,242,400	<i>Sasa borealis</i>	150,000
<i>Dianthus sinensis</i>	390,000	<i>Sedum kamschaticum</i>	101,400
<i>Dianthus superbus</i> var. <i>longicalycinus</i>	690,000	<i>Sedum takesimense</i>	161,000
<i>Dicentra spectabilis</i>	399,000	<i>Thymus quinquecostatus</i>	123,000
<i>Epilobium angustifolium</i>	180,000	<i>Thymus quinquecostatus</i> var. <i>japonica</i>	111,000
<i>Epimedium koreanum</i>	140,000	<i>Trachelospermum asiaticum</i> var. <i>intermedium</i>	110,800

² Korean Wild Florist Association (Feb. 28, 2001).

Native plants are used for landscaping and for pot growing, so pot culture is main methods of growing. Species, which require long growing period are usually grown on the field for rapid growth, and then

transplanted to pots. Another form of growing is pot cultivation. Planned production of native plants is difficult because it is very hard to predict a demand of native plants (Fig. 4).

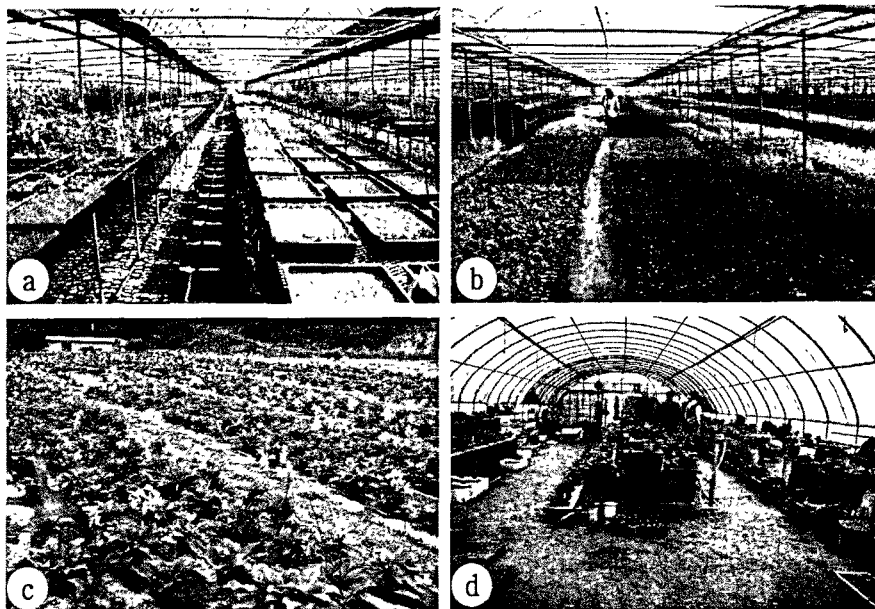


Fig 4. Cultivation of wild flowers in Korea.

a. Raising seedling, b. Pot cultivation, c. Field cultivation, d. Pot scenery cultivation.

So most growers tend to produce too many plants and too many kinds, thereby requiring large growing area. Utilization of land in this field is not efficient. Growers usually maintain stock plants because it is hard to get seeds from commercial sources. Standardization of plants is not possible due to manual works done by growers and poor financial state.

Establishment of cultural methods for promising species is also difficult because growers have to deal with a large number of species. To solve above mentioned problems, many growers are concentrating on growing just few species. By doing so technical knowledges on promising native plants can be accumulated. Recently many growers employ mass-production system to produce uniformed seedling and to reduce cost of production. Modernization of facilities, such as the greenhouses for seedling growth and low temperature storage rooms, are used by many advanced growers.

B. Marketing of native plants

Several marketing methods, such as sales in a spot and shop, consignment sale, construction, and delivery, are used for sale of Korean wild flowers. But no special shops for native plants are available now, and shipping cost is excessive because of long distance between consumers and growers. Also growers' profit is low because 2~4 steps are required in marketing. Improvement on marketing methods such as direct business between consumers and growers are urgently needed.

Many species, such as *Hepatica asiatica*, *Lycoris squamigera*, *Jeffersonia dubia*, *Lilium cernum*, *Hosta*

plantaginea, and *Paeonia lactiflora*, are promising for growers for export but growers are not willing to grow them because it takes 2~3 years to get flowering. Also some restrictions are enforced on the marketing and sales of native plants.

C. Landscape use

1) Native plants for general landscape

Native floral plants are adapted to the various different environment including high and low temperature, low and high moisture conditions, sunlight, high salt condition and air pollution. Their utilization for the landscaping is based on their characteristics. Table 7 demonstrates that many native plants can be used for various landscape plan.

Table 7. Names of native plants for general landscape in Korea.

Classification		Scientific names of native plants
Under perennials	Small scale	<i>Aster koraiensis</i> , <i>Hemerocallis fulva</i> , <i>Dracocephalum argunense</i> , <i>Iris nertschinskia</i> , <i>Chrysanthemum zawadskii</i> var. <i>latilobum</i> , <i>Campanula takesimana</i>
	Large scale	<i>Carex lanceolata</i> var. <i>nana</i> , <i>Belamcanda chinensis</i> , <i>Hosta longipes</i> , <i>Cymbidium goeringii</i>
Under broad-leaved deciduous		<i>Prunula sieboldii</i> , <i>Dicentra spectabilis</i> , <i>Adonis amurensis</i> , <i>Lycoris radiata</i> , <i>Liriope platyphylla</i> , <i>Hylomecon hylomeconoides</i> , <i>Hylomecon vernale</i> , <i>Hepatica asiatica</i> , <i>Narcissus tazetta</i> var. <i>chinensis</i> , <i>Convallaria keiskei</i>
Flower beds on lawn		<i>Dianthus</i> spp. <i>Dracocephalum argunense</i> , <i>Hemerocallis fulva</i> , <i>Chrysanthemum zawadskii</i> var. <i>latilobum</i> , <i>Aster yomena</i> , <i>Pulsatilla koreana</i> , <i>Sedum erythrostichum</i> , <i>Sedum takesimensense</i>
Roof-top landscaping		<i>Chrysanthemum zawadskii</i> var. <i>latilobum</i> , <i>Sedum kamtschaticum</i> , <i>Lysimachia barystachys</i> , <i>Veronica kiusiana</i> var. <i>maxima</i> , <i>Aster koraiensis</i> , <i>Chrysanthemum boreale</i> , <i>Pennisetum alopecuroides</i> , <i>Dianthus superbus</i> var. <i>longicalycinus</i> , <i>Hemerocallis fulva</i> , <i>Hosta plantaginea</i> , <i>Allium senescens</i> , <i>Galium verum</i> var. <i>asiaticum</i> , <i>Iris nertschinskia</i> , <i>Chrysanthemum zawadskii</i> var. <i>latilobum</i> , <i>Lilium tigrinum</i> , <i>Sedum spectabile</i> , <i>Sedum polystichoides</i> , <i>Orostachys japonicus</i> , <i>Sedum</i> spp.

Korea belongs to temperate climate of Northern Hemisphere which has distinct seasons, but it is also influenced by continental climates with big temperature differences between summer and winter. Therefore, drought resistance is one of the major factors considered for selecting plants for ground cover.

Vigorous deciduous flowering plants are recommended for the area where the pine trees are growing. These areas are known to have dry and infertile soil. Perennial flowering plants should be avoided when planted under perennial trees. From late fall to spring, it is sunny under deciduous broad-leaved tree, and from early summer to fall it is shade. So plants that are adapted to above conditions should be selected.

Usually, the area for ground covering is considered wet because underground water level is high. Also

shaded areas for entire day are bound to be wet due to low water evaporation. Plants with high moisture tolerance and plants which like moisture should be used for the area.

Plants on spacious lawns should be sun plants with drought resistance and long flowering period without leaf wilting during summer. Drought resistance should be considered when planting containers of rooftop, cut-out area, rock garden and gravel fields. Especially for rooftop landing, least amount of growth media is used to give as little burden as possible to the buildings. Consequently, low moisture by low amount of growth media causes drought very often, necessitating drought resistant plants

Diversity in plants for urban landscaping is being sought, because many cities are polluted with many things. So the plants resistant to air pollution are recommended for the urban landscaping. When the landscape of parks along coast and garden of factories are considered, we should think about moisture conditions, high salt and sea wind. So the plants with tolerance to high salt and strong wind should be used.

2) Native plants for landscape around roads

Recently many shaded areas caused by man-made structures including north side of buildings, area between buildings, underneath of overpass and highways, are planted with shade-tolerant plants.

Table 8 lists the names of plants suitable for roadside landscape. Plants resistant to dust, smog, and wind should be planted on the dividing area and green zone along the roads. Short plants are recommended for pedestrian island, vacant area and flower beds along the streets not to interfere with drivers sight. Also resistant plants to drought should be planted to avoid damages from the high heat of paved road.

For cut-out areas, usually made by road construction through mountains, where dry, medium dry, and wet conditions are co-existing, plants should be selected for the specific conditions. The seed spray of native floral plants including *Chrysanthemum indicum*, *Chrysanthemum sibiricum*, *Elsholtzia splendens*, *Aster hayatae*, *Pennisetum alopecuroides*, *Imperata cylindrica* var. *koenigii*, *Dianthus chinensis*, *Cheledonium majus* var. *asiaticum*, *Caryopteris incana* and *Sedum erythrostichum* can be done to give natural looks to cut-out area.

Table 8. Names of native plants for landscape around roads.

Classification		Scientific names of native plants
Dividing area and green zone of road	Sunny area	<i>Sedum oryzifolium</i> , <i>Diantus</i> spp. <i>Aster koraiensis</i> , <i>Iris nertschinskia</i> , <i>Hemerocallis fulva</i> , <i>Taraxacum platycarpum</i> , <i>Pennisetum alopecuroides</i> , <i>Sedum takesimense</i> , <i>Dracocephalum argunense</i>
	Shaded area	<i>Glechoma hederacea</i> var. <i>longituba</i> , <i>Convallaria keiskei</i> , <i>Hosta longipes</i> , <i>Belamcanda chinensis</i> , <i>Hosta plantaginea</i> , <i>Liriope platyphylla</i> , <i>Acorus gramineus</i> , <i>Trachelospermum asiaticum</i> var. <i>intermedium</i> , <i>Hedera rhombea</i>
Pedestrian island, vacant area and flower beds along street		<i>Diantus</i> spp., <i>Belamcanda chinensis</i> , <i>Dracocephalum argunense</i> , <i>Hemerocallis fulva</i> , <i>Taraxacum platycarpum</i> , <i>Sedum takesimense</i> , <i>Iris nertschinskia</i> , <i>Caryopteris incana</i> , <i>Sedum erythrostichum</i> , <i>Sedum sarmentosum</i>
Soundproof walls and fences		<i>Parthenocissus tricuspidata</i> , <i>Lysimachia vulgaris</i> , <i>Trachelospermum asiaticum</i> var. <i>intermedium</i> , <i>Campsis grandiflora</i> , <i>Hedera rhombea</i>
Steel structures like barbed wire and fences		<i>Lonicera japonica</i> , <i>Stauntonia hexaphylla</i> , <i>Akebia quinata</i> , <i>Celastrus orbiculatus</i> , <i>Coculus trilobus</i> , <i>Piper nigrum</i> , <i>Schizandra chinensis</i> , <i>Vitis coignetiae</i> , <i>Ampelopsis brevipedunculata</i> var. <i>heterophylla</i> , <i>Vitis flexuosa</i> , <i>Aristolochia manshuriensis</i> , <i>Pueraria thunbergiana</i> , <i>Actinidia arguta</i> , <i>Trichosanthes kirilowii</i> , <i>Clematis apiifolia</i> , <i>Clematis trichotoma</i>
Cut-out area	Dry area	<i>Chrysanthemum zawadskii</i> var. <i>latilobum</i> , <i>Aster yomena</i> , <i>Caryopteris incana</i> , <i>Sedum kamschaticum</i> , <i>Diantus</i> spp., <i>Dracocephalum argunense</i> , <i>Pennisetum alopecuroides</i>
	Optimum dry area	<i>Hemerocallis fulva</i> , <i>Iris nertschinskia</i> , <i>Lonicera japonica</i> , <i>Lysimachia barystachys</i> , <i>Belamcanda chinensis</i> , <i>Hosta plantaginea</i> , <i>Hosta longipes</i>
	Wet area	<i>Iris ensata</i> var. <i>spontanea</i> , <i>Aster koraiensis</i> , <i>Lythrum anceps</i> , <i>Inula britannica</i> var. <i>chinensis</i>

3) Native plants for landscape around water course

Aquatic plants for rivers and lakes affect the reproduction environments of fishes, birds and insects. They also influence river conditions including water purification and soil improvement of low underwater level, as well as scenery. Plants which prevent soil erosion are recommended for these areas.

Aquatic plants can be divided into 3 kinds (Table 9). Waterside hydrophyte, growing mainly at 0.05~0.4m·s⁻¹ water speeds, take root to underwater soil and their leaves grow above water, functioning ecologically and creating scenery. Floating hydrophyte, growing mainly at 0~0.2m·s⁻¹ water speed, take root to ground just below water level, and their leaves and shoots grow to the water level. So the leaves are floating on the water, and plants can prevent decomposition of the lakes due to excessive nitrogen.

They also can provide shelters for hatching of fishes and for growing places. Submerged hydrophyte, growing mainly at $0\sim 1.5\text{m}\cdot\text{s}^{-1}$ water speeds, do not take root to the soil, so leaves and stems grow underwater. They can not survive under the heavy decomposition and can be food for birds and fishes.

For planting on riverside highlands (Table 9), special care should be given, because dryness and wetness are alternating in this area by flooding and drought. Sun plants are adequate for river banks because of their resistance to drought conditions.

Plants for river banks should take roots easily and rapidly, otherwise the plants would be lost by rapid water flowing. They should also create scenery along the banks. *Sparganium stoloniferum* should be planted to the area where the water with low temperature gushes out.

Besides ornamental purposes, native plants are used for food, medicine, aromas, fibers, etc. Presently, a great deal of studies are carried on these aspects.

Table 9. Names of native plants for landscape around water course

Classification	Scientific names of native plants
Lakes, bogs and streams	<p>Water-side hydrophyte <i>Scirpus triangulatus</i>, <i>Scirpus juncooides</i>, <i>Scirpus triquetus</i>, <i>Eleocharis kuroguwai</i>, <i>Phragmites communis</i>, <i>Scirpus tabernaemontani</i>, <i>Typha orientalis</i>, <i>Scirpus radicans</i>, <i>Acorus calamus</i> var. <i>angustatus</i>, <i>Sparganium stoloniferum</i>, <i>Scirpus wichurae</i>, <i>Scirpus fluviatilis</i>, <i>Phragmites japonica</i>, <i>Miscanthus sacchariflorus</i>, <i>Alisma canaliculatum</i>, <i>Iris pseudoacorus</i></p> <hr/> <p>Floating hydrophyte <i>Nymphoides peltata</i>, <i>Nuphar Pumilum</i>, <i>Hydrocharis dubia</i>, <i>Nymphoides indica</i>, <i>Trapa japonica</i>, <i>Brasenia schreberi</i>, <i>Potamogeton distinctus</i>, <i>Persicaria amphibia</i>, <i>Nelumbo nucifera</i>, <i>Euryale ferox</i>, <i>Marsilea quadrifoli</i></p> <hr/> <p>Submerged hydrophyte <i>Vallisneria asiatica</i>, <i>Hydrilla verticillata</i>, <i>Ottelia alismoides</i>, <i>Potamogeton oxyphyllus</i>, <i>Ruppia rostellata</i>, <i>Najas graminea</i>, <i>Myriophyllum verticillatum</i></p>
Waterside	<p><i>Phragmites communis</i>, <i>Miscanthus sacchariflorus</i>, <i>Phragmites japonica</i>, <i>Acorus calamus</i> var. <i>angustatus</i>, <i>Scirpus tabernaemontani</i>, <i>Iris pseudoacorus</i>, <i>Scirpus radicans</i>, <i>Scirpus fluviatilis</i>, <i>Sparganium stoloniferum</i>, <i>Scirpus wichurae</i>, <i>Alisma canaliculatum</i>, <i>Typha orientalis</i>, <i>Zizania latifolia</i></p>
Area between waterside and terrace land of river	<p><i>Salix graciliglans</i>, <i>Phalaris arundinacea</i>, <i>Iris nertschinskia</i>, <i>Iris ensata</i> var. <i>spontanea</i>, <i>Lythrum anceps</i>, <i>Acorus gramineus</i>, <i>Juncus effusus</i> var. <i>decipiens</i></p>
Terrace land of river	<p><i>Salix gracilistyla</i>, <i>Pennisetum alopecuroides</i>, <i>Aster koraiensis</i>, <i>Inula britannica</i> var. <i>chinensis</i>, <i>Iris ensata</i> var. <i>spontanea</i>, <i>Lythrum anceps</i>, <i>Hemerocallis fulva</i> var. <i>kwanso</i>, <i>Hemerocallis fulva</i>, <i>Iris nertschinskia</i></p>
Road on the river bank	<p><i>Aster koraiensis</i>, <i>Diantus</i> spp, <i>Belamcanda chinensis</i>, <i>Chrysanthemum zawadskii</i> var. <i>latilobum</i>, <i>Aster yomena</i>, <i>Hemerocallis fulva</i>, <i>Sedum takesimense</i>, <i>Pulsatilla koreana</i></p>
Seashore	<p><i>Peucedanum japonicum</i>, <i>Aster hispidus</i>, <i>Farfugium japonicum</i>, <i>Lilium tigrinum</i>, <i>Aster spathulifolius</i>, <i>Caryopteris incana</i>, <i>Hemerocallis fulva</i>, <i>Chrysanthemum indicum</i>, <i>Dianthus sinensis</i>, <i>Sedum oryzifolium</i>, <i>Sedum takesimense</i>, <i>Campanula takesimana</i>, <i>Vitex rotundifolia</i>, <i>Cyrtomium falcatum</i></p>

5. Activities related to native plants

A. Research

The studies on native plants started around 1960's. but research on horticulturalization of native plants began 1980's at universities, Rural Developmental Agency and other research institutes. At the beginning,

distribution, collection and selection of promising species were main research subjects, but soon studying on propagation and culture methods of the plants and their breeding works followed.

Korean government that realized the importance of native plants allocated large public research funds to this field. It is putting 10 billion won/year for 10 years to develop good native plants, as one area of 21 century Frontier Research Program funded by Ministry of Science and Technology of Korean government. This task is administered by Plant Diversity Research Center. On top of this research center, supports to other research subjects concerning native plants are being made. In private sector, many research groups formed by professors, researchers and industries are holding seminars, joint meeting, and exchanging information to help growers solve their problems. It takes a lot of efforts for native plants to become horticultural crops (Fig. 5).

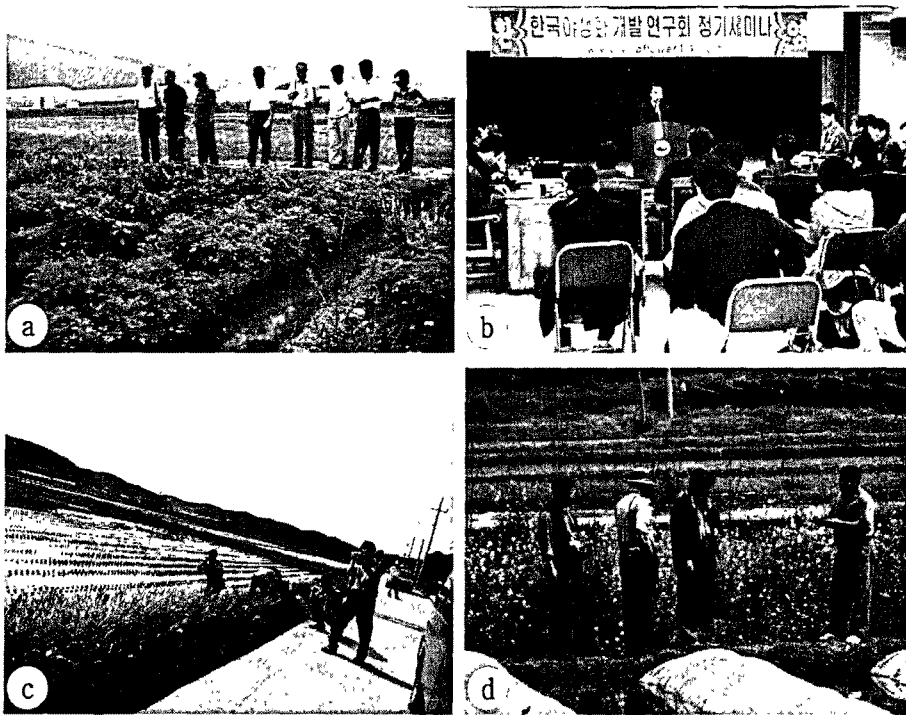


Fig. 5. Research activities.

a. Joint research, b. Periodical seminar, c. Joint ecological investigation, d. Advising of agricultural problems.

Improvement on characters such as flower color and shape should be made. Also physiology from germination to flowering, ecological characteristics and good cultural methods should be investigated continuously. Studies on enhanced germination for uniform seedlings, plug seedling growth and tissue cultures are needed. Studies on various areas of native plants should solidify industries. But many technological difficulties are expected because there are too many species to deal with, and it takes long to breed good native plants. Also different characters of propagation and growth of many species add to the difficulties.

So most growers rely on their experiences based on natural habitat to grow plants, and quantity is more emphasized than quality such as uniformity. Recently consumption of native plants is increasing due to the movement of 'Love our plants' in Korea. However, it is imperative for native plant industry to be competitive with established flower industry in quality and price. To achieve this goal, low priced□uniform seedlings with high quality should be provided throughout a year. So new varieties of native plants with high ornamental values, and techniques to produce plants year-round at lowest cost should be provided to growers.

B. Various other act

People who like native plants organized many native plant societies and they held exhibition as well as seminars for research, cultivation and preservation, etc. Central and provincial government also held expos for public relations and sale. Also many internet sites are made and this will enhance utilization and development of native plants (Fig. 6).

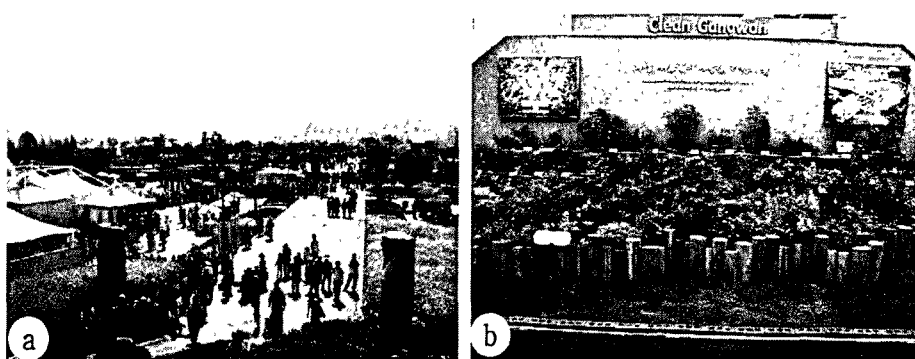


Fig. 6. Exhibition related to Korean native plants

a. Anmyeon World Flower Expo, b. Exhibition site of Korean native plants.

6. Prospects

Popularity of native plants that were neglected for a long time started to grow remarkably beginning early part of 1990's. New recognition of native plants, neglected for a long time as common flowers, was made beginning early part of 1990's. So consumption of native plants for ground-cover by public and large construction sites such as country clubs and ski resorts started to grow. Previously annuals were used for that purposes.

Government spent a lot of money on large flower beds for academic and exhibition purposes. At the beginning, the lack of technical knowledge resulted in waste of money, but now the situation is improving. Office of Housing recently announced that about 30 native species will be planted on the beds of newly-built apartment. This will surely help growers to choose plants to grow.

To maintain and create demands for native plants, many things should be done. First, extension services for growing native plants should be done. Cultural information such as soil, light moisture, seed propagation, etc. should be included in the service. Second, varietal improvement on plant shape, extension of flowering and good quality should be achieved.

For that purpose, first of all, germplasm collection should be done to use native plants as horticultural crops. Obtained plants should be classified according to morphological and ecological characters and propagated to have enough material for further research.

Then two approaches can be made with the research. First is to study the best way to cultivate native plants, based on the physiological and ecological information obtained during germplasm collection. Second is to create superior horticultural crops by genetic and breeding works. Usually conventional methods are not suitable for the job, so molecular breeding by tissue culture, genetic engineering including transformation and somatic cell fusion should be used. Successful accomplishment by above effects will guarantee the bright prospect for the horticultural industry in Korea

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