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Agricultural Plant Diversity of the Orchards along the Bank of Chao Phraya River and Ko Kret Areas in Nonthaburi Province

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ABSTRACT

A survey of the agricultural plant diversity in the orchards on the bank of Chao Phraya river and Ko Kret areas of Nonthaburi province was conducted in the year 2005. The soil in these areas was Banglen Series : (Bl, clay and silty clay loam) and pH was between 4.2-6.6. Soil fertility was considered to contain high plant nutrients, ranging form good to very good level, and the quality of water was also good. The total plant diversity of 48 orders, 96 families, 246 genera and 429 species of agricultural plants was recorded. The majority of plants was ornamental plants, 52.57 percent. Agricultural crops were categorized into 3 groups, i.e. native species, threatened species and extirpated species. Variability in cultivars of durians and rose apples were decreased. The threatened species were Kruai (*Horsfieldia irya* Gaertn Warb), Chomphu Mamiao *(Syzygium mallacsense* L. Merr. & L.M. Perry *ST*), Somsa (*Citrus aurantium* L. var. aurantium *ExST*), Reo (*Alpinia nigra* gaertn. Burtt *H*), and Dipli (*Piper retrofractum* Vahl *C*). The extirpated species were Chanthet (*Myristica fragrans* Houtt. *ExS*), Clove (*Syzygium aromaticum* (L.) Merr.& L.M. Perry *ExST*), Langsat (*Landsium domesticum*), Raksorn (*Calotropis giganted* R.Br.), Payom (*Shorea roxburghii*), and purple Chabasorn (*Hibiscus rosa-sinensis* L.). The results of this survey should be further used as the base line for plant genetic conservation policy and for environmental conservation.

Key words: agricultural plants, species diversity, agro-ecological system

INTRODUCTION

The soil of Nonthaburi province area is Banglen Series : Bl and the same as Bangkok Series: Bk, clay and silty clay loam soil, very fertile soil, pH 7.0-8.0, low to medium organic matter, medium phosphorus, medium to high potassium and it was caused from marine and Chao Phraya river sedimentary soil (http://idd.go.th/thaisoils muscum-museum/pf-desc /central /Bn.htm). This condition is suitable for plant growing. Moreover, durian cultivars in Nontaburi, is considered to be the best in terms of taste and quality. In addition, it has been reported that the soil condition along the bank of Chao Phraya river in Nontaburi province has high silicon (Si) content (Poovarodom *et al*., 2001), and soils fertility of Nonthaburi has been increasing fruit quality. At present, these indigenous varieties are diminished because the area is always inundated. Durian plantations can not survive from such a situation, therefore, the decrease in durian varieties is occurred.

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The usual flooding of Nonthaburi province is about 3-6 years per time that is in 1983, 1986, 1989, 1995, 1996, 2002 and 2006. Especially, the floods in 1983, 1995, 1996, and 2006 were vigorous and caused several plants to die. For examples, the 40 cultivars of durians were lost (Treetaruyanont *et al*., 2006) and the other agricultural plants also died and decreased (by farmers interviewed). In addition, housing business problems caused the decrease in number of agricultural plants because the housing companies can pay for the land more than the farm incomes. However, the conservation of plant diversity in Nonthaburi is very important in this area since Nonthaburi province is the originated agricultural land for fruit crops, vegetables, flower and ornamental plants, medicinal plants, and others. The fruit trees are mangoes, durians, coconuts, papayas, bananas, etc. Especially, in this place there are 58 cultivars of the indigenous varieties of durian (Treetaruyanont *et al*., 2006) such as Monthong, Chani, Kop Chainam, Kop Takhum, Kop Chaokhun, Yammaewat including other plants such as santols (var. E-Wai, Nimneaun and Loongchom), rose apples (var. Chomphu-Ngachang, Chomphu-Numdorgmai and Chomphu-Sakkabeaur), coconuts (var. Chaokhun-Watmi), Kruai, Roe, herbs (Somsa and Dipli), flowers (Rak Sorn and Chaba Sorn) and ornamental plants (http : // nonthaburi. doae.go.th /plant with out of non.htm.).

As a member of CBD (The Convention of Biological Diversity), Thailand needs to run the activities in accordance with its' rules and regulations that leading to the conservation of biodiversity and environment. The objective of this study was to survey the agricultural plant diversity of the orchards along the bank of Chao Phraya river and Ko Kret areas in Nonthaburi province. The data obtained can further used as the base line for the plant genetic conservation policy and for environmental conservation.

MATHERIALS AND METHODS

By the standard method, the analysis of soil containing nitrogen, phosphorus, potassium, calcium, magnesium and soil pH were analyzed (Mengel and Kirkby, 1987). The water quality (carbonate and bicarbonate) was examined by the Project of Development of Soils, Fertilizers and Environments, Department of Soils Science, Kasetsart University. Moreover, the study is conducted by surveying the diversity of the agricultural crops. After surveying and gathering data on agricultural plant diversity, the information was classified according to the international standard into order, family, genera and species (Smitinand, 2001). The plant habitats, growing system, plant ecology, evaluation of soil fertility and structure and water quality in the orchard along the bank of Chao Phraya river (Klong Orm) and Ko Kret of Nonthaburi province were studied. Agricultural crops such as fruit trees, vegetables, flowers crops, ornamental and medicinal plants, were categorized into 3 group, i.e. native species, threatened species and extirpated species. This survey was done in two locations, i.e. the orchards along the bank of Chao Phraya river (3 orchards were randomly selected, i.e. Sawai's, Sawaeng's and Wad Maduea's orchards) and Ko Kret areas (3 orchards were randomly selected, i.e. Somchai's, Akhaladeth's and Kasem's orchards).

RESULTS AND DISCUSSION

Part I Soil fertility and water quality

From the soil fertility analysis, the soil characteristic is classified as a mostly clay soil with the pH ranged from 4.2 to 6.6. The amount of organic matter is moderate to high. The highest contents are phosphorous, potassium, calcium and magnesium respectively (Table 1). The water pH ranged from 6.8 to 6.9. EC ranged between 0.52 and 0.65 dS/m while the bi-carbonate content was between 2.96 and 3.64 meq/liter (Table 2). The

Table 1 The data of soil fertility analysis in the bank of Chao Phraya river and Ko Kret areas.

Locations	pH	Soil texture				Organic matter		Phosphorus		Potassium		Calcium		Magnesium	
		% Sand	% Silt	% Clay	Texture	%	Rate	ppm.	Rate	ppm	Rate	ppm.	Rate	ppm.	Rate
Sawai's orchards	4.2	21	32	47	Clay	5.45	High	106	Very high	185	Very high	1520	High	150	High
Sawaeng's orchards	5.3	26	26	48	Clay	3.1	Medium	32	High	220	Very high	3440	High	880	High
Wad Maduea's orchards	4.3	26	62	12	Sandy loam	3.1	Medium	160	Very high	480	Very high	2560	High	680	High
Ko Kret areas	6.6	32	20	48	Clay	1.5	Medium	69	Very high	100	High	4320	High	820	High

soil texture, P, Ca and Mg, of both areas were not different in tendency, but the organic matter and K of the bank of Chao Phraya river tended to be greater than Ko Kret. However, the soil of the bank of Chao Phraya river showed lower pH than the other one, which had to be promoted the fruit qualities of tomatoes (Bugarin *et al.*, 2002), oil seeds (Tiwari, 2005) and the other plants (Masood *et al.*, 2004; Lester *et al.* , 2007), and durian quality were also accelerated (Poovarodom *et al.*, 2001).

Part II Native species

According to the survey, there were eight orders (euphorbiales, magnoliales, malvales, myrtales, palmales, sapindales, spindales and zingiberales), nine families (Anacadiaceae, Bombacaceae, Meliaceae, Myristicaceae, Myrtaceae, Palmae, Piperaceae, Rutaceae and Zingiberaceae). Nine species and 29 cultivars were santols (*Sandoricun koetjape* (Burm.*F.*) Merr. (var. Loongchom), rose apples *(Syzygium mallacsense* L. var. Chomphunghachang and Sakkabeur), coconuts (*Cocos nucifera* L. var. Chaokun-Watmai), mangoes (*Mangifera indica* L. var. Yaikum, Intorachit and Faab), durians (*Durio zibethenus*. Merr. 18 cultivars of Kradum Thong, Kop Maethao, Kop Tamak, Kop Takhum, Kop chainum, Kop Lep-yiao, Kop Wat Klual, Kop Suwan, Kanyao, Kampan Nuealueang (Chaokrom), Kampan phuang, Chok-loi, Chani, Thongyoichat, Yammawat, Chaongao, Saochom, Monthong), Somsa (*Citrus aurantium* L. var.

Table 2 The data of water analysis in the bank of Chao Phraya river area in Nonthaburi province.

Locations	Water		
	pH	EC (dS/m)	HCO^-_3 (meq/liter)
Sawai's orchard	6.9	0.52	3.64
Sawaeng's orchard	6.9	0.55	2.96
Wad Maduea's orchard	6.8	0.65	3.28

aurantium), Kruai (*Hornstedtia irya* (Gaertn.) Warb.), Roe (*Alpinia nigra* gaertn. Burtt *H*) and Dipli (*Piper retrofractum* Vahl *C*) (Table 3) of plants in the orchards along Chao Phraya River Bank and Ko Kret areas of Nonthaburi province. Most of them are tropical fruit crops such as santol, durian, banana, rose apple and mango. A few plants were already extirpated, while it is possible that some of them are likely to be seen, such as durian (except Monthong and Chani). The exception of Monthong and Chani cultivars are marketable consumption. In this survey, it was found that only 18 out of 58 cultivars still existed. Besides, other fruit crops such as santol, mango, rose apple (especially *Syzygium malaccense* (L.) Merr.& L.M. Perry) were declined.

Less than 10 trees were found in Ko Kret area as a result of the tendency that people grew rose apple cv. "Chomphu mamiao" *(Syzygium mallacsense* L. Merr. & L.M.Perry *ST*) for the economical purposes. The other vegetable crops and medicinal plants that almost disappear are *Citrus aurantium* L. var. *aurantium*, and *Alpinia nigra* (Gaertn.) D.L. Burtt). The plants that already disappeared are Chanthet (*Myristica fragrans* Houtt. *ExS*), Clove (*Syzygium aromaticum* (L.) Merr.& L.M.Perry *ExST*), Langsat (*Landsium domesticum*) , Rak sorn (*Calotropis giganted* R.Br.), Payom (*Shorea roxburghii*), purple Chabasorn (*Hibiscus rosa-sinensis* L.). It should have the insufficient conservation of important local plants remaining in Nonthaburi. Furthermore, some plants such as *Gloriosa superba* L. and *Piper chaba* Hunt. can still be found although it has been reported extirpate as Nonthaburi province was flooded in 1983, 1991, 1992, 1993 and 1996 which caused many species to be decreased and died.

Part III Plants varieties that penetrated in an agricultural ecosystem

The number of plants which have been penetrated are 41 orders, 86 families, 88 genera and 420 species (Table 3). The largest plants species are flowers and ornamentals (Table 4), such as Chuan chom (*Gaillardia pulchella* Foug), orchid (*Helixanthera pulchra* Danser *PaS*), Fueang fa (*Bougainvillea glabra* Choisy *EXC*), ornamental palms (*Ptychosperma* spp.) etc. Nonthaburi is one of the most important areas where flower and ornamental plants are grown. Therefore, the migrated plants both from other places in Thailand and foreign countries were imported. The plant diversity then varies accordingly. An agricultural variety being introduced to the area is durian. Some of extinct varieties (Kob, Kradum, Krathoei, Kampun and the other group cultivar of durians) were brought back from Chanthaburi and Rayong provinces. Therefore, it should have the campaign to reduce the plants from another area or perhaps zoning area to bring the limited plants in Nonthaburi.

Part IV Plant classification and utilization

From the survey, the results are following, e.g.

1. Plant differentiation according to its physiology

The agricultural plants of the orchards on the bank of Chao Phraya river and Ko Kret of Nonthaburi province, can be classified into 48 orders, 96 families, 246 genera and 429 species (Table 3).

2. Plant species

The dominated species are flowers and ornamental plants. These plants are used mostly for decoration (Table 4).

3. Plants growing system

Most of the plants growing system are for housing and building decorations, and growing along the surrounding area (Table 4).

4. Plant behavior

Most plant habitats are shrub of 28.81% (Table 4), follow by annual plants, trees, creepers, succulents, others and not much for grasses.

5. Utilization

Most of the plants are used as medicine

Table 3 The agricultural plants of the bank of Chao Phraya river and Ko Kret areas.

Orders	Families	Scientific name
Apiales	Araliaceae	*Polyscias balfouriana, Polyscias fruiticosa*
Arales	Amaryllidaceae	*Agave utahensis* Engelm, *Alocasia lindenii, Eucharis sp., Eucharis* x *grandiflor*a Planch., *Eucrosia bicolor* Ker-Gawl, *Hippeastrum reticulatum* (L. Herit.) Herb. , *Hippeastrum reticulatum striatifolium, Hippeastrum sp., Hymenocallis littorlis* (Jacq) Salisb cv. Variegata, *Hymenocallis punicheum* (Lam.) Urban, *Hymenocallis sp.*
	Araceae	*Aglaonema* spp., *Alocasia cuculata, Alocasia cucullata* Schoot., *Alocasia regina , Antherium tetragonum, Caladium* "Changjer", *Caladium bicolor* (Ait.) Vent., *Dieffenbachia picta barraquiniana, Homalomena lindenii* (Rodigas) Lindl, *Homalomena rubescens, Homalomena sp., Homalomena sp., Lasia spinosa* (L.) Thwaites, *Philodendron xanadu, Spathiphyllum sp., Typhonium trilobatum* (Linn.) Schoot
	Araliaceae	*Scheffer leucantha* Viguier
Asparagales	Asparagaceae	*Asparagus sprengeri* Regel
	Asphodelaceae	*Aloe vera* (L.) Burm.f.
	Dracaenaceae	*Sansevieria cyrindrica* Bojer
Asterales	Compositae (Asteraceae)	*Chrisanthemum sp.* And hybrid, *Cosmos bipinatus., Gynura procumbens* (Lour.) Merr., *Gynura pseudochina* DC. var. hispida, *Lactuca sativa* L., *Melampodium paludosa* HBK, *Tagetes* sp., *Zinnia elegans* Jacq., *Vernonia elliptica* DC.
Begoniales	Begoniaceae	*Begonia* "*Bow-Joe*", *Begonia* "*It*", *Begonia* "*Tingle Mallet*"
Bromeliales	Bromeliaceae	*Ananas comosus* (L.) Merr.
Buddlejavade	Laganiaceae	*Buddleja madagascariense*
Capparales	Cruciferae	*Brassica alboglabra* L.H. Bailey., *Brassica chinensis* L. var. chinensis, *Brassica chinensis* L. var. parachinensis Tsen & Lee, *Brassica pekinensis* Rupr. var.cylindrica Tsen & Lee , *Raphanus satevus* L.
Caryophyllales	Amaranthaceae	*Gomphrena globosa, Gomphrena globosa alba*
	Cactaceae	*Ariocarpus fissuratus* (Eng) Schumann, *Astrophytum capricorne, ErioSuc leninghausii (Haage) Back bg., Mammillaria schiedeana* Ehrenberg, *Pilosocereus palmeri* (Britton & Rose) Byles & Rowley
	Nyctaginaceae	*Bougainvillea spectabilis, Bougainvillea spectabilis* "Mary palmer", *Bougainvillea spectabilis* "Variegata", *Bougainvillea spectabilis x buttiana* "San Diego Red", *Bougainvillea* spp.
Commelinales	Commelinaceae	*Murdannia loriformis, Rhoeo spathacea, Tradescantia spathacea* Stearn
Cucurbitales	Cucurbitaceae	*Cucumis sativus* L., *Cucurbita moschata* Duchesne, *Luffa acutangula* (L.) Roxb., *Luffa cylindrica* (L.) M. Roem., *Momordica charantia* L., *Momordica charantia* L., *Momordica chochinchinenese* Lour. Spreng
Dilleniales	Dilleniaceae	*Dillenia indica* L.
Dioscorales	Stemonaceae	*Stemona tuberosa* Lour.
Ebenales	Ebenaceae	*Diospyros areolata* King & Gamble, *Diospyros decandra* Lour.
	Sapotaceae	*Manilkala zapota* (L.) P. Royen

Remarks : * = Native plants of the bank of Chao Phraya river and Ko Kret areas in Nonthaburi province, beside that penetrated in agricultural ecosystem.

Table 3 (cont.)

Orders	Families	Scientific name
Euphorbiales*	Euphorbiaceae	*Acalypha hispida*, *Anitidesma acidum* Retz., *Baccaurea ramiflora* Lour., *Baliospermum solanifolium* (Burm.) Suresh, *Bridelia ovata* Decne. , *Codiaeum varicgatum*., *Codiaeum variegantum* "Annie Rutherford", *Codiaeum variegantum* "Craigii", *Codiaeum variegantum* "Jan Bier", *Codiaeum variegantum* "Mortimer", *Codiaeum variegantum* and hybrid, *Codieum sp*. and hybrid, *Codieum variegantum* "Capt. Kidd", *Codieum variegantum* "Dayspring", *Codieum variegantum* "Fred Sander", *Codieum variegantum* "King George", *Codieum variegantum* "Rosette", *Codieum variegantum* "Rubrum", *Drypetes roxberghii* (Wall.) Hurusawa, *Euphorbia millii* Des Moul., *Euphorbia obesa* Hook, *Euphorbia pulcherrima*, *Euphorbia resinifera* Berg, *Euphorbia tirucalli* L., *Jatropha integerrima* Jacq., *Jatropha podaagrica* Hook.f., *Manihot esculenta* Crantz, *Manihot esculenta* Crantz, *Pedilanthus tithymaloides* (L.) Poit, *Phyllanthus acidus* (L.) Skeels, *Phyllanthus emblica* L., *Phyllanthus pulcher* Wall. ex Mull. Agr., *Phyllanthus reticulatus* Poir., *Sauropus androgynus* (L.) Merr., *Trewia nudiflora* L.
	Rutaceae*	*Aegle marmelos* (L.) Correa ex Roxb., *Citrus aurantifolia* (Christm.) Swingle, *Citrus aurantium* L. var. aurantium*, *Citrus hystrix* DC., *Citrus madurensis* Lour., *Citrus maxima* (Burm.f.) Merr., *Citrus reticulata* Blanco, *Citrus sinensis* (L.) Osbeck, *Feroniella recemosa* L. , *Murraya paniculata* Jack
Filicales	Aspleniaceae	*Asplenium nidus* L.
	Woodsiaceae (Athyriaceae)	*Diplazium esculentum* (Retz.) Sw.
	Pakeriaceae (Adiantaceae)	*Alpina purpurata* (Vieill) Schum
Gentianales	Apocynaceae	*Adenium obesum* Balf, *Allamanda carthatica* var. Williumsii, *Allamanda sp*., *Alstonia scholaris* (L.) R.Br., *Catharanthus alba*, *Catharanthus roseus* G. Don., *Cerbera odolam* Gaetrn., *Ervatamia coronaria*, *Holarrhena densiflora* Ridl., *Nerium indicum* Mill, *Nerium oleander* var. cranium, *Nerium rubra*, *Parameria laevigata* , *Plumeria rubra*, *Plumeria spp*. and hybrid, *Saritaea magnifica*, *Tabernaemontana divaricata* (L.) R. Br. ex Roem. & Schult., *Wrightia religiosa* (Double), *Wrightia religiosa* Benth.
	Asclepiadaceae	*Calotropis gigantea* R. Br., *Calotropis gigantia* (L.) Dryander ex W.T. Aiton
	Gramineae (Poaceae)	*Bambusa multiplex* (Lour.) Raeusch, *Bambusa ventricosa* McClure, *Bambusa vulgalis* Schrad, *Cymbopogon citratus* Stapf, *Cymbopogon nadus* Rendle, *Oryza sativa L*., *Phyllostachys*

Table 3 (cont.)

Orders	Families	Scientific name
		sulphurea, Schizostachyum sp., Thyrsostachys siamensis Gamble, *Zea may* L. Var. Saccharata
Iridales	Iridaceae	*Belamcanda chinensis* (L.) DC.
Lamiales	Lamiaceae (Labiatae)	*Cherodendrum inerme* (L.) Gaertn., *Ocimrm gratissimrm* L., *Ocimum basilicum* L., *Ocimum tenuiflorum* L., *Orthosiphon grandiflorus* Bolding
	Verbenaceae	*Citharexylum spinosum* Linn, *Clerodendron siphonantus*, *Clerodendrum philippinnum* Schaner var. pleniflorum, *Lantana* "hybrid", *Lantana alba, Lantana camara, Lantana camara* "purple-yellow form", *Lantana sellowwiana* Link & Otto, *Lantana* sp., *Vitex glabrata* R.Br.
Laurales	Lauraceae	*Cinnamonum bdjolghota* Sweet, *Cinnamonum camphora* (L.) J. Presl
Lecythidales	Lecythidaceae	Baringtonia acutangula (L.) Gaerth., *Couroupita guinanensis* Aubal.
	Caesalpiniaceae	*Bauhinia purpurea* Linn, *Brownnea ariza* Benth., *Cassia surattensis* Burm.f.
	Leguminosae	*Bauhinia winitii* Craib, *Caesalpinia vesicaria, Clitorea alba, Clitorea ternatea*
	Leguminosae-Caesalpinioideae	*Senna alata* (L.) Roxb., *Senna spectabilis* (DC.) Irwin & Barneby, *Tamarindus indica* L.
	Leguminosae-Mimosoideae	*Acacia pennata* (L.) willd. Subsp. insuavis (Lace) I.C. Nielsen, *Albizia lebeckkoides* (DC.) Benth, *Neptunia oleracea* Lour., *Parkia speciosa* Hassk., *Pithecellobium dulce* (Roxb.)
	Leguminosae-Papilionoideae	*Agnope heptaphylla* (L.) Polhill C., *Erythrina indica* L., *Erythrina variegata* L., *Glycine max* (L.) Merr., *Vigna radiata* Wilczek , *Vigna unguiculata* (L.) Walp. subsp. unguiculata
	Mimosaceae	*Acacia auriculaeformis* A. Cunn
Liliales	Agavaceae	*Agave angustifolia* Haw., *Sansevieria trifasciata* hort. ex Prain
	Alliaceae	*Allium ascalonicum L., Allium sativum* L.
	Liliaceae	*Aloecasia sp., Cordyline* sp., *Gloriosa superba* L., *Aloe brevifolia* Mill., *Chlorophytum bichetii* (Karrer) Backer, *Chlorophytum comosum, Chlorophytum comosum* "Vittatum", *Haworthia fasciata* (Willd.) Haw, *Sansevieria sp.*
Magnoliales*	Annonaceae	*Annona reticulata* L., *Annona squamosa* L., *Cananga odorata* (Lam.) Hook.f. & Thomson var. odorata, *Cananga odorata* Hook.f. & Th., *Desmos chinensis* Lour.
	Magnoliaceae	*Michelia alba* D.C., *Michelia champaca* L.
	Myristicaceae*	*Hornstedtia irya* (Gaertn.) Warb.*
	Piperaceae*	*Piper chaba* Hunt*, *Piper nigrum* L., *Piper sarmentosum*
Malpighiales	Guttiferae	*Calophyllum inophyllum* L., *Garcinia cowa* Roxb. ex DC., *Garcinia dulcis* (Roxb.) Kurz, *Garcinia mangostana* L., *Garcinia*

Table 3 (cont.)

Orders	Families	Scientific name
		schomburgkiana Pierre
Malvales*	Bombacaceae*	*Durio zibetinus* Merr.*
	Dipterocarpaceae	*Hopea odorata* Roxb., *Vatica diospyroides* Symington
	Elaeocarpaceae	*Elaeocarpus hygrophilus* Kurz
	Malvaceae	*Abelmoschus esculentus* (L.) Moench., *Abelmoschus Medicus spp. Tuberosus* Borss, *Hibicus* Hybrid, *Hibicus schizopetalus* (Mast.) Hook.f., *Hibiscus mutabilis* L., *Hibiscus ro-sa sinensis, Hibiscus ro-sa sinensis* "Mist", *Hibiscus ro-sa sinensis* "Ping Wings", *Hibiscus ro-sa sinensis* cv. Nata, *Hibiscus rosa-sinensis* "Cooperi"
Marsileales	Marsileaceae	*Masilea crenata* C. Presl
Myrtales*	Combretaceae	*Quisqualis indica* L., *Terminalia bellirica* (Gaertn.) Roxb.,*Quisqualis indica* Linn.
	Lythraceae	*Lagerstroemia speciosa* (L.) Pers.
	Myrtaceae*	*Callistemon lanceolatus* D.C., *Psidium guajava* L., *Syzygium cumini* (L.) Skeels, *Syzygium jambos* (L.) Alston, *Syzygium malaccense* (L.) Merr. & L.M. Perry*, *Syzygium samarangense* (Blume) Merr. & L.M. Perry var. samarangense*
Myrtiflorae	Punicaceae	*Punica granatum* L. var. granatum
Oleales	Oleaceae	*Jasminum andulatum, Jasminum nitidum*
Orchidales	Orchidaceae	*Ascocentrum ampullaceum, Ascocentrum curvifolium, Cymbidium aloifolium* (L.) Sw. , *Grammaatophyllum speciosum* Blume, *Rhynchostylis coelestis, Rhynchostylis coelestis*-Purple form, *Rhynchostylis gigantea* var illustre, *Rhynchostylis gigantea* var rubrica, *Rhynchostylis retusa*
Oxalidales	Oxalidaceae	*Averrhoa bilimbi* L., *Averrhoa carambola* L.
Palmales*	Palmae*	*Actinorhytis calapparia, Areca catechu* L., *Borassus Flabellifer* L., *Caryota mitis* Lour., *Chrysalidocarpus lutescens* (Bory) H. Wendl., *Coccothrinax crinata, Cocos nucifera* L., *Corypha umbraculifera, Cyrtostachys lakka, Phoenix loureiri* Kunth, *Pinanga dicksonii, Ptychosperma macarthuri, Rhapis subtilis, Roystonea regia, Teysmannia altifrons, Veitchia merrillii* (Becc.) H.E. Moore, *Cocos nucifera* L.var. nucifera*
Pandanales	Pandanaceae	*Pandanus amaryllifolius* Roxb.
Plumbaginales	Plumbaginaceae	*Plumbago auriculata* Lamk, *Plumbago zeylanica* L.
Polemoniales	Convolvulaceae	*Porana paniculata, Ipomaea horsfalliae, Ipomoea aquatica* Forstk., *Ipomoea batatas* "Tricolor", *Ipomoea batatas* (L.) Lam., *Ipomoea carnea* Jacq
Polygalales	Malpighiaceae	*Thryallis glauca*
	Polygonaceae	*Antigonon leptopus, Muehlenbeckia maderaspatana (L.)* M. *Roem.*
Primulales	Malpighiaceae	*Thryallis glauca*

Table 3 (cont.)

Orders	Families	Scientific name
Rosales	Caesalpiniaceae	*Bauhinia purpurea*., *Caesalpinia pulcheririma* Sw., *Saraca indica* Linn
	Crassulaceae	*Dolichothele longimamma* (de Candolle) Br & R, *Echeveria co* "Meridian", *Echeveria paraguayense* Hort, *Echeveria runyonii* Rose, *Echinocereus pectinatus* var. rigidissimus (Eng) Rumpl , *Furocactus fordii (Orc.) Br & R., Kalancho millottii* Hamer et Perr, *Kalanchoe tomentosa* Baker, *Mammillaria compressa*, *Pachyphytum compactum* Rose, *Parodia sanguiniflora*. Fric. ex. Back bg.
	Leguminosae	*Mucuna benetii* F. Muell
	Mimosaceae	*Calliandra haematocphala* Hassk., *Pithecolobium dulce*
	Rosaceae	*Rosa chinensis* Jacq. , *Rosa chinensis* Jacq. var. minima Voss
Rubiales	Rubiaceae	*Ixora chinensis* Lamk, *Ixora* hybrid, *Ixora javanica*, *Ixora macrothyrsa*, *Ixora* sp., *Ixora* spp., *Morinda citrifolia* L., *Mussaenda erythrophylla*, *Mussaenda philippica* var. aurorae
Sapindales*	Meliaceae*	*Azadirachta indica* A. Juss. var. siamensis Velaton, *Lansium domesticum*, *Sandoricum koetjape* (Burm.f.) Merr.*
Scrophulariales	Acanthaceae	*Acanthus ebracteatus* Vahl , *Andrographis paniculata* (Burm.f.) Wall. ex Nees, *Barleria cristata* Linn, *Clinacanthus nutans* (Burm.f.) Lindau , *Graptophyllum pictum* (L.) Griff., *Justicia fragilis* Wall.
	Bignoniaceae	*Tabebuia chrysantha* Nichols, *Tecomaria capensis* Spach
	Gesneriaceae	*Aeschynanthus hildebrandii*
	Scrophulariaceae	*Angelonia salicariaefolia* Humb. & Boupl, *Torenia fournieri* Lind.
	Thunbergiaceae	*Thunbergia erecta* T. Anders., *Thunbergia laurifolia* Linn.
Solanales	Solanaceae	*Brunfelsia hopeana* Benth, *Capsicum annuum* L. var. acuminatum Fingerh., *Capsicum frutescens* L. var. frutescense, *Cestrum nocturnum* Linn., *Lycopersicon esculentum* Mill., *Solanum aculeatissimum* Jacq., *Solanum aculeatissimum* Jacq., *Solanum incanum* L., *Solanum stramonifolium* Jacq., *Solanum torvum* Sw.
Spindales*	Anacardiaceae*	*Bouea maxcrophylla* Griff., *Mangifera indica* L*., *Spondias bipinnata* Airy shaw & Forman, *Spondias cytherea* Sonn.
	Sapindaceae	*Dimocarpus longana* Lour. Supsp. Longan var. longan, *Lepisanthes fruiticosa* (Roxb.) Leenh., *Lepisanthes rubiginosa* (Roxb.) Leenh., *Litchi chinensis* Sonn.
Umbelliferales	Umbelliferae	*Centella asiatica* (L.) Urb
Urticales	Moraceae	*Artocarpus altilis* (Parkinson) Fosberg, *Artocarpus heterophyllus* Lam., *Artocarpus integer* (Thrunb.) Merr., *Streblus asper* Lour.
Violales	Bixaceae	*Bixa orellana* Linn
	Caricaceae	*Carica papaya* L.

Table 3 (cont.)

Orders	Families	Scientific name
	Cochlospermaceae	*Cochlospermum gossypium* De Candole
	Turneraceae	*Turnera unmifolia* Linn.
Zingiberales*	Cannaceae	*Canna generalis* L.H. Bail.
	Costaceae	*Costus speciosus* (Koen.) Sm.
	Heliconiaceae	*Heliconia psittacorum*
	Marantaceae	*Calathea* spp.
	Musaceae	*Musa* (AA group) "Kluai khai", *Musa* (AA group) "Kluai Leb Mu Nang", *Musa* (AA group) "Kluai Nam Thai", *Musa* (AAA group) "Kluai Hom Kieo", Musa (AAA group) "Kluai Hom Thong", *Musa* (AAA group) "Kluai Naki", *Musa* (ABB group) "Kluai Hak Muk", *Musa* (ABB group) "Kluai Nam Wa", *Musa balbissiana* Colla, *Musa paradisiaca* L.
	Zingiberaceae*	*Alpinia galanga* (L.) Willd., *Alpinia nigra* (Gaertn.) D.L. Burtt*, *Alpinia purpurata* "variegata", *Alpinia purpurata* (Vieill.) Schum, *Alpinia zerumbet "Variegata", Amomum krervanh* Pierre, *Boesenbergia rotundus* (Ll.) monst*globba* spp., *Kaempferia rotundum, Zingiber montanum* (Koeing) Link ex Dietr., *Zingiber zerumbet* (L.) Sm.

Table 4 Percent of agricultural plants classification in the bank of Chao Phraya river and Ko Kret areas.

Type of agricultural plants [1/] (%)	Habit [1/] (%)	Agro-ecological systems [1/] (%)	Cropping system of plants [1/](%)	Utilization [1/] (%)
Fruits	Trees	Mobile farms	Mono cropping	Food
15.44	23.19	0	27.59	30.59
Vegetables	Shrubs	Rainy farm	Multiple cropping	Drugs
10.29	28.81	5.27	18.35	56.71
Rice & Cereal	Annual plants	Irrigation farm	Inter cropping	Others : land scape/
0.20	26.23	42.90	0.25	construction 12.71
Agronomy	Creepers	Non system	Cover cropping	-
0.67	10.54	51.83	0.12	
Ornamenta	Grasses	-	Crop rotation	-
plants 52.57	0.47		1.76	
Herbs	Succulents	-	Forests/agro-	-
17.67	5.62		forests 11.24	
Others	Others : ferns,	-	Others /non system/	-
3.13	bamboos etc.		cultivated near	
	5.15		house 40.70	

Remarks [1/] The summation in each column is equal to 100%

(56.71%), for daily consumption (30.59%) and for decoration and other (12.71%).

The opened agricultural cropping system and housing landscape are the same as multiple cropping system, also causing the plant conservation, especially, native plants, threatened plants, rare and extirplated plants are remained.

CONCLUSION

After surveying the agricultural plant diversity in the orchards on the bank of Chao Phraya river and Ko Kret of Nonthaburi province, the soil fertility was found to be in the good to very good level, and the quality of water was also good. The native plants were durians *(Durio zibethenus*. Merr. 18 cultivars), coconuts (*Cocos nucifera* var.Chaokhun-Watmai) and mangoes (*Mangifera indica* L. var. Yaikum, Intorachit and Faab). Furthermore, there were threatened species such as rose apples (*Syzygium malaccense* (L.) Merr.& L.M. Perry), Somsa (*Citrus aurantium* L. var. aurantium), Kruai (*Hornstedtia irya* (Gaertn.) Warb.), Roe (*Alpinia nigra* gaertn. Burtt *H*) and Dipli (*Piper retrofractum* Vahl *C*). All of these plants are important and should be conserved. Finally, the extirpated species of these areas were Chanthet (*Myristica fragrans* Houtt. *ExS*), Clove (*Syzygium aromaticum* (L.) Merr.& L.M. Perry *ExST*), Langsat (*Landsium domesticum*), Raksorn (*Calotropis giganted* R.Br.), Payom (*Shorea roxburghii*), and purple Chabasorn (*Hibiscus rosa-sinensis* L.). The results of this survey should be further used as the base line for plant genetic conservation policy and for environmental conservation.

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LITERATURE CITED

Bugarin, M.R., A.G. Spinola, P.S. Garcia and D.G. Paredes. 2002. Potassium demand of processing tomatoes. **Terra.** 20 (4) : 391-399.

http://idd.go.th/thaisoils muscum-museum/pf-desc /central /Bn.htm

http : // nonthaburi. doae.go.th /plant with out of non.htm.

Lester, G.E., J.L. Jifon, R.Mc Conchile and G. Rogers. 2007. Foliar applied potassium : effects on cantaloupe quality. **Acta Hort.** 731 : 115-119.

Masood Ali, K.K. Singh and AA.Saad. 2004. Balanced fertilization for nutritional quality in pulses. **Fert. News** 49(4) : 47-55.

Mengel, K. and E.A. Kirkby. 1987. **Principles of Plant Nutrition.** International Potash Institute. Worplaufen-Bern, Switzerland. 687 p.

Poovarodom, S., P. Ketsayom, V. J. Prasittikhet, S. Maisaing and N. Tawinteung. 2001. Seasonal variations in nutrient concentrations of durian (*Durio zibethinus* Murr.) leaves. **Acta Hort**. 564: 235-242.

Smitinand, T. 2001. **Thai Plant Names**. The Forest Herbarium. Royal Forest Department. 810 p.

Tiwari, K.N. 2005. Meeting the challenge of oilseeds production through balance use of potash. **Fert. Mark. News** 36 (3) : 5-14.

Treetaruyanont, K.,V. Yeisawas, B. Ya-oob, P. Suthisaksopon, W. Phosunk, D. Sookchalerm, N. Poomiparkpun, P. DoungKae, V. Chimchom, N. Juntawomng and S. Jenjutkarn. 2006. Biodiversity of agricultural systems 7(9) : 1-121. *In* **The Final Reports of Biodiversity Survey and Information System Project.** Forest Research Center, Faculty of Forestry, Kasetsart University, Bangkok.