International Waterlily and Water Gardening Society

Water Garden Journal

1st Quarter, 2011 Volume 26, Number 1

***N.* ‘Miss Siam’ x *N.* ‘Nangkwag Fah’ (Hybrid # 1)**
Hybrid and photo by Pairat Songpanich

In This Issue

Nymphaea 'Midnight Caprice'
Hybrid by Manfred Kuo (Taiwan)

It's time to plan for the

2011 Symposium
Qingdao, China
July 22 - 30, 2011

The IWGS invites you to attend our Symposium in China. This event is co-hosted by the International Waterlily & Water Gardening Society and the Executive Committee of 2014 Qingdao International Horticultural Exposition. The 2011 Symposium showcases unique aquatic plants for ornamental use, as staple foods and for other practical uses. We visit Chinese Waterlily World, learn from some of the prominent aquatic plant researchers throughout the world and tour the beautiful seaside city of Qingdao. We invite you to join us on our post tour to Beijing and visit the Beijing Botanical Gardens, the Forbidden City, the Great Wall of China and much more!

Travel Details

Attendees must book their own air transportation to Qingdao and home from either Qingdao or Beijing.

Valid Passport required for travel

Valid Chinese tourist visa required (see website for necessary documents)

Attire

Generally IWGS Symposiums are informal gatherings with the exception of the Annual Awards Banquet. In China it is more formal with the general attire for women being dresses and skirts. For men, short pants are rarely worn except at the beach. It is our recommendation that men wear long pants for the banquets, ceremonies and Educational Day events.

Visit ***www.iwgs.org*** for complete information and to download registration forms.

IWGS 2011 Symposium Itinerary
Qingdao, China and Beijing Post Symposium Tour
July 22 – 30, 2011

Main Symposium – July 22 to 26, 2011
Cost $300 USD per person (Includes all meals…hotel paid separately)
Friday, July 22
Registration and Welcome Banquet
Saturday, July 23
Chinese Waterlily World and 1st International Waterlily & Lotus Exhibition
Lunch at Chinese Waterlily World featuring aquatic plant dishes
Qingdao Flower Market and Qingdao Jinlinxun Koi Aquarium
Visit the hotel exhibit rooms and purchase waterlilies provided by the IWGS and Chinese Waterlily World, other products, books, artwork, etc.

Qingdao, China
Zhan Qiao photo

Sunday, July 24
IWGS 2011 Symposium Education Day
Technology lectures on Special Topics, IWGS Sales and Silent Auction continues
Monday, July 25
Sightseeing in Qingdao - Lao Shan (Mount Lao, Tai ging gong)
Tour Polar Ocean World, Qingdao Olympic Sailing Center, & Wusi Square
Farewell and IWGS Awards Banquet at hotel
Tuesday, July 26
Departure for Post Tour of Beijing or on to your other destinations of choice

Tiananmen
Charlie Fong photo

Qingdao Symposium Hotel Accommodations
Qingdao Guangye Jinjiang Hotel phone +86532-8193-8888
Room Rate is $80 USD per night, includes breakfast
Guangye Jinjiang Hotel is a four-star foreign rated hotel. It is a 10-minute drive from Qingdao's Liuting International Airport and about 10 minutes from the beach. They provide a business center, ticket center, gift shop, fitness center and indoor swimming pool. The restaurant offers Chinese and Western style meals featuring delicious Cantonese cuisine and Shandong cuisine, although all meals are included during the symposium.
To simplify the reservation process, the IWGS office will coordinate hotel reservations. Please indicate your arrival date and departure date on your registration form. Rooms are either two single beds or one double bed. We regret that non-smoking rooms may not be available. Our hosts provide free transportation to the hotel from the International Airport.
Post Symposium July 26 to July 29, 2011
Cost $549 USD per person (includes hotel, includes train, most meals and English-speaking guide)
Tuesday July 26
High speed train to Beijing
Tiananmen Square, Forbidden City
Wednesday July 27
Great Wall, Jade factory, Summer Palace
Thursday July 28
Beijing Botanical Garden, Pearl Market, Wangfujing Pedestrian Mall.
Friday July 29
Depart for home or other destination from Beijing.

Great Wall at Mutianyu
J. Samuel Burner photo

Presidential Address

by Jim Purcell

Greetings, members

Fast times are upon us.

States in the US are increasingly contemplating legislation against aquatic plants they consider noxious. California, for example, recently added such notables as *Nymphaea odorata* and *Pontederia cordata* (pickerel), among others, to their already sizeable prohibited list. Now that they ban two of the three primary waterlily species (the other outlawed one being *N. mexicana*, parent of all yellow, orange, peach, salmon and changeable colors) that hardy waterlily cultivars are hybridized from, it wouldn't take much to forbid hardy waterlilies altogether.

Which, of course, California has already accomplished officially on a county-by-county basis—any county in California has legislative permission to outlaw all hardy waterlilies at their discretion. To date, only one county banned hardies completely. It has since back-pedaled to merely requiring a registration process (guns and waterlilies—talk about strange bedfellows). I guess all the angry pond owners in Siskiyou County were too much for their plant police. Nevertheless, registration allows local government officials to change their minds whenever they please and know exactly where to lay their hands on the culprits.

My goal to coordinate legislative efforts nationwide is about to pick up speed toward fruition. During the next few months, working along with others, we will collaborate with water gardening clubs and businesses. Nelson Water Gardens (NWG) is an excellent example of coordinating efforts in the state of Texas. Their cooperative campaign succeeded in overturning a huge pending piece of pending legislation that threatened water gardening in Texas and ultimately in the entire USA.

NWG and their organized network were opposed by the formidable Texas Park and Wildlife Department (TPWD) with all their government money and political influence aiming to enact and enforce their very restrictive proposed aquatic plant legislation. Now, in the spirit of cooperation, NWG and their network of water garden friends are working cooperatively with TPWD to develop a reasonable plan taking into account the native ecosystem, personal enjoyment, and economic impact.

We intend to spread their kind of dedication throughout the rest of the country while we still have plants and fish to put into our ponds.

Another exciting project on the fast track is our IWGS website. We are working on an enhanced design to make our website more user-friendly and educational. Your Board of Directors plans to vote on a design proposal on March 15th, so by the time you read this we will have a lively discussion behind us, and have some resolution about our direction. No matter what the outcome of this particular vote is, I view our website as a critical component of being relevant in our hobby today. I am committed to making significant upgrades to the current design. Expect to have good news on this front in my next journal message.

Meanwhile, good weather is about to break, so we can better enjoy our ponds.

Sincerely,

Jim

PS Be sure to order your own Wanvisa waterlily while supplies last!

http://www.iwgs.org/2011-CAPY-Purchasing.html

Radiation-Induced Mutant Of American Yellow Lotus and Its Interspecific Crosses with Thai Lotus

by Vichai Puripunyavanich[1] , Woranuch La-ongsri[2] and Kanokporn Boonsirichai[1]
[1]Research and Development Division, Thailand Institute of Nuclear Technology, 9/9 Moo 7, Sai Mun, Ongkharak, Nakhon Nayok 26120, Thailand
[2]Queen Sirikit Botanic Garden, Botanical Garden Organization, P.O. Box 7, Mae Rim, Chiang Mai 50180, Thailand

Abstract

Gamma radiation was utilized to induce a photoperiod-response mutation in American lotus *Nelumbo lutea* and in the interspecific hybrid *N. lutea* x *N. nucifera* 'Poontarik'. Rhizomes were irradiated at the dose of 10 Gy and grown to maturity in Chiang Mai and Chiang Rai, Thailand. Normally, *N. lutea* requires at least approximately 14.5 hrs of day-length period to flower. Upon gamma radiation, plants from subsequent generations were obtained which yielded complete flowers in Chiang Mai, where the maximal day-length period is approximately 13.5 hrs. They were further propagated via rhizomes and cross-pollinated to five *N. nucifera* cultivars local to Thailand. Out of eight interspecific crosses, only four crosses involving three local cultivars yielded viable plants, suggesting either cross-incompatibility or genomic incompatibility between *N. lutea* and certain cultivars of *N. nucifera*.

'Chandrakomen', a hybrid between *N. nucifera* 'Bua Luang Phrarachinee' x the mutant *N. lutea*, was selected for further characterization. The hybrid exhibited a large flower size, approximately 30 cm (1 ft) in diameter, similarly to the 'Bua Luang Phrarachinee' parent. The petal color was pink on the first blooming day and gradually turned into a creamy yellow color on the last blooming day. The hybrid showed good adaptability in the mountainous northern Thailand (Chiang Mai Province) as well as in the central plain (Nakhon Nayok Province). In Chiang Mai, its rhizomes became dormant during the cool season in December, while in Nakhon Nayok, its growth continued throughout the cool period. Also, in Nakhon Nayok, the hybrid flowered normally even in the short-day period of December and January.

1 Introduction

Lotuses belong to the genus *Nelumbo*. The American lotus, *N. lutea* (Willd.) Pers., is native to the American continent and produces yellowish white to yellow flowers [1]. Cool weather is known to promote dormancy of plant growth, following which formation of floral buds is induced. However, flowers develop only in long days when day length lasts longer than 14.5 hours. This period corresponds to June – July in the central states of the United States, where the species is found in abundance [2,3]. Although American lotus can grow to maturity in Thailand, it never produces flowers as the longest day length (found in the northern region of the country) lasts approximately 13.5 hours [4,5,6].

In Thailand, local cultivars of lotuses belong to the species *N. nucifera* Gaertn., which is native to tropical and subtropical Asia, and to Australia [7,8]. These include 'Album Plenum' (magnolia lotus) and 'Poontarik' (hindu lotus), both of which produce flowers with white petals, and 'Roseum Plenum', 'Patoom' (sacred lotus) and 'Bua Luang Phrarachinee', which possess pink to reddish pink flowers [9]. No cultivars of this lotus species produce yellow flowers [8]. In order to expand the diversity of local cultivars, gamma radiation was used to induce a photoperiod-response mutation in the yellow American lotus and in the hybrid *N. lutea* x *N. nucifera* 'Poontarik'.

Gamma is a low linear-energy-transfer radiation which can result in damage to molecules in the cells by ionization. Gamma radiation, even at very low doses, has been shown to induce breakages of the DNA backbones as well as oxidative damages to the nitrogenous bases of the DNA [10,11]. This damage, especially DNA double-strand breaks (DSBs), has been shown to be the cause of radiation-induced mutation in biological systems [12]. In addition, gamma radiation has been successfully applied to induce mutations in lotus in tissue culture [13]. Here, we report our success in the isolation of gamma radiation–induced photoperiod-response mutants that could flower in the northern part of Thailand, and

Radiation-Induced Mutant Of American Yellow Lotus and Its Interspecific Crosses with Thai Lotus

by Vichai Puripunyavanich[1] , Woranuch La-ongsri[2] and Kanokporn Boonsirichai[1]
[1]Research and Development Division, Thailand Institute of Nuclear Technology, 9/9 Moo 7, Sai Mun, Ongkharak, Nakhon Nayok 26120, Thailand
[2]Queen Sirikit Botanic Garden, Botanical Garden Organization, P.O. Box 7, Mae Rim, Chiang Mai 50180, Thailand

our attempt in using them as male and female parents for the production of hybrid lotus.

2 Materials and Methods

2.1 Irradiation of *N. lutea* and the hybrid *N. lutea* x *N. nucifera* 'Poontarik' and isolation of mutants

Twenty rhizomes of *N. lutea* were irradiated for 10 Gy with gamma radiation from 60Co of a Gammabeam 650 (MDS Nordion, Canada) at the dose rate of 16 Gy/min. They were planted and grown in nursery pots at Agricultural Occupation Promotion and Development Center, Chiang Rai and Chiang Mai, Thailand, until new rhizomes were produced. The new rhizomes were replanted, and mutant plants that produced flowers were further propagated via their rhizomes at the Sirikit Botanic Garden, Chiang Mai.

Five rhizomes of the hybrid *N. lutea* x *N. nucifera* 'Poontarik' were irradiated with 10-Gy gamma radiation from 60Co of Gammacell-220 (MDS Nordion, Canada) at the dose rate of 20 Gy/min. They were planted and grown to maturity in a nursery pond at the Sirikit Botanic Garden.

Table 1: Crosses between Thai cultivars of *N. nucifera* and the mutant *N. lutea*

No.	Pollen acceptor	Pollen donor	Number of viable seeds	Rhizome production	Flower production
1	*N. nucifera* **'Roseum plenum'**	Mutant *N. lutea*	8	No	No[a]
2	*N. nucifera* **'Patoom'**	Mutant *N. lutea*	10	Yes	Yes[b]
3	*N. nucifera* **'Poontarik'**	Mutant *N. lutea*	0	N/A[c]	N/A[c]
4	*N. nucifera* **'Album Plenum'**	Mutant *N. lutea*	15	Yes	No[a]
5	*N. nucifera* **'Bua Luang Phrarachinee'**	Mutant *N. lutea*	7	Yes	Yes (named **'Chandrakomen'**)
6	Mutant *N. lutea*	*N. nucifera* **'Patoom'**	2	No	No[a]

[a]No flower production and the plants died within three months.

[b]Not selected for further studies because of its undesirable flower form.

[c]N/A = Not applicable as no viable seeds were obtained.

Radiation-Induced Mutant Of American Yellow Lotus and Its Interspecific Crosses with Thai Lotus

by Vichai Puripunyavanich[1] , Woranuch La-ongsri[2] and Kanokporn Boonsirichai[1]
[1]Research and Development Division, Thailand Institute of Nuclear Technology, 9/9 Moo 7, Sai Mun, Ongkharak, Nakhon Nayok 26120, Thailand
[2]Queen Sirikit Botanic Garden, Botanical Garden Organization, P.O. Box 7, Mae Rim, Chiang Mai 50180, Thailand

2.2 Interspecific crosses

Hand pollinations were conducted between the mutant *N. lutea* and local *Nelumbo* cultivars. Active pollens were obtained from flowers three days after their first bloom. They were brushed on receptive stigma before anthesis. Fruits were allowed to develop to maturity. Seeds were collected after the fruits turned brown and planted in nursery pots at the Sirikit Botanic Garden.

3 Results

3.1 Isolation of the photoperiod-response mutant of *N. lutea*

10-Gy gamma-irradiated rhizomes of *N. lutea* were nursed to maturity at the Agricultural Occupation Promotion and Development Center in Chiang Mai and Chiang Rai. None of the plants flowered during their first year of growth. Therefore, they were further propagated via rhizomes. During the second year, a mutant plant was found to produce flowers, the stigma and anthers of which were yellow. The petals were yellow at the base but the color was paler in the middle. Also, the base of the petals appeared narrower but more obtuse at the tip (Figure 1A and 1B).

Although the flowers were complete with stigma and stamen, seeds could not be obtained. The plants were propagated via rhizomes and found to consistently produce yellow flowers in subsequent generations.

Unlike *Nelumbo* spp. native to Thailand, which can produce flowers at any time of the year, the mutant *N. lutea* only flowered in June through August when day length is the longest. In addition, the plant temporarily ceased its growth during the cool season similar to the original *N. lutea*.

3.2 Isolation of the photoperiod-response mutant of interspecific hybrid *N. lutea* x *N. nucifera* 'Poontarik'

Similar to *N. lutea*, the interspecific hybrid *N. lutea* x *N. nucifera* 'Poontarik' failed to flower in Thailand, where the longest day length is approximately 13.5 hrs. Hybrid rhizomes were irradiated with 10-Gy gamma radiation in order to induce a photoperiod-response mutation. Irradiated rhizomes were grown to maturity in Chiang Mai and plants were found to produce flowers in their first year of growth. The photoperiod-response mutant exhibited flower characteristics of both *N. lutea* and *N. nucifera*. The hybrid petal color was yellowish/greenish white (Figure 1C) and the stigma and stamen were yellow. Similar to *N. lutea*, but in contrast to *N. nucifera*, the plants only flowered from June through August and went through dormancy during the cool period in December and January.

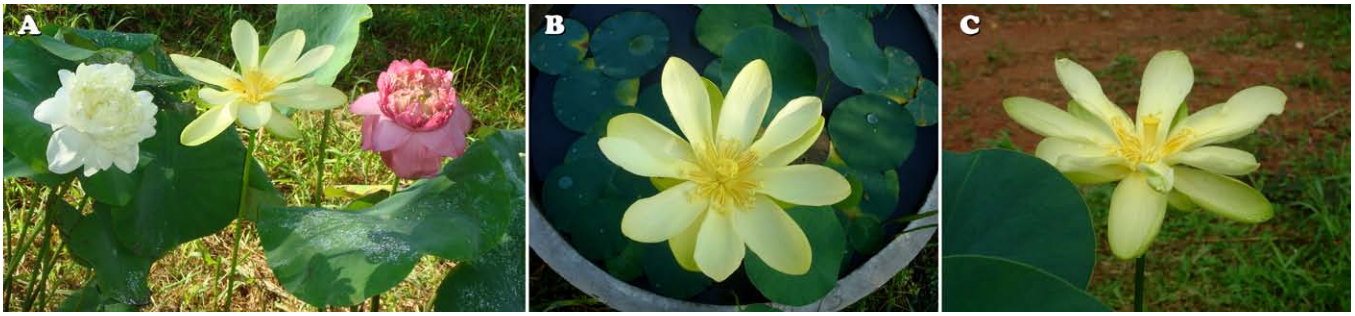


Figure 1: A. *N. nucifera* 'Album Plenum' (left), mutant *N. lutea* (middle) and *N. nucifera* 'Roseum Plenum' (right), showing different shade of petal colors. B. Mutant *N. lutea*. C. Mutant hybrid of *N. lutea* x *N. nucifera* 'Poontarik'.

Radiation-Induced Mutant Of American Yellow Lotus and Its Interspecific Crosses with Thai Lotus

by Vichai Puripunyavanich[1] , Woranuch La-ongsri[2] and Kanokporn Boonsirichai[1]
[1]Research and Development Division, Thailand Institute of Nuclear Technology, 9/9 Moo 7, Sai Mun, Ongkharak, Nakhon Nayok 26120, Thailand
[2]Queen Sirikit Botanic Garden, Botanical Garden Organization, P.O. Box 7, Mae Rim, Chiang Mai 50180, Thailand

3.3 Single crosses between the mutant *N. lutea* with Thai cultivars of *N. nucifera*

Six crosses were conducted between the mutant *N. lutea* and Thai cultivars of *N. nucifera* (Table 1). Eight fruits were obtained from ten flowers, which yielded forty-two enlarged seeds in total. From these seeds, only crosses between *N. lutea* and *N. nucifera* 'Patoom', 'Album Plenum' and 'Bua Luang Phrarachinee' yielded viable plants that produced rhizomes. Crosses with *N. nucifera* 'Roseum Plenum' and 'Poontarik' failed to produce viable plants.

American lotus is known to undergo dormancy during the winter season, but a Thai lotus does not. Hybrids obtained from the above crosses halted their growth during the winter period (December – January), indicating that hibernation is a dominant trait.

3.4 Three-way crosses between the mutant hybrid *N. lutea* x *N. nucifera* 'Poontarik' with Thai cultivars of *N. nucifera*

The mutant hybrid of *N. lutea* x *N. nucifera* 'Poontarik' was crossed to three cultivars of Thai lotus (Table 2). Only crosses to *N. nucifera* 'Bua Luang Phrarachinee' and 'Patoom' resulted in viable plants, which went through dormancy during the winter time. The cross with *N. nucifera* 'Roseum Plenum' failed to produce viable seeds. Also, an attempt was made to fertilize the mutant hybrid ovaries with its own pollen. No fruits were obtained.

Table 2: Crosses between Thai cultivars of *N. nucifera* and the mutant hybrid of *N. lutea* x *N. nucifera* 'Poontarik'

No.	Pollen acceptor[a]	Number of viable seeds	Rhizome production	Flower production
1	*N. nucifera* **'Bua Luang Phrarachinee'**	7	Yes	[b]No
2	*N. nucifera* **'Roseum Plenum'**	0	[c]N/A	[c]N/A
3	*N. nucifera* **'Patoom'**	15	Yes	[b]No

[a]The mutant hybrid served as the pollen donor for all crosses.

[b]No flower production and the plants died within three months.

[c]N/A = Not applicable as no viable seeds were obtained.

3.5 'Chandrakomen': an interspecific hybrid *N. lutea* x *N. nucifera*

American lotus and Thai lotus have been classified into two different species and they do not naturally grow in the same location. As a result, their genetic compatibility has always been a question. Our study showed that *N. lutea* and *N. nucifera* are cross-compatible for some cultivars of *N. nucifera*. Three out of five cultivars of *N. nucifera* could produce vegetatively viable plants when crossed to *N. lutea*. 'Chandrakomen', a hybrid between *N. nucifera* 'Bua Luang Phrarachinee' and the mutant *N. lutea*, was selected for further characterization.

'Chandrakomen' exhibited a large flower size, approximately 30 cm (1 ft) in diameter, similar to its 'Bua Luang Phrarachinee' parent (Figure 2). Its height was more than 1.5 m (5 ft). It produced large

Radiation-Induced Mutant Of American Yellow Lotus and Its Interspecific Crosses with Thai Lotus

by Vichai Puripunyavanich[1] , Woranuch La-ongsri[2] and Kanokporn Boonsirichai[1]
[1]Research and Development Division, Thailand Institute of Nuclear Technology, 9/9 Moo 7, Sai Mun, Ongkharak, Nakhon Nayok 26120, Thailand
[2]Queen Sirikit Botanic Garden, Botanical Garden Organization, P.O. Box 7, Mae Rim, Chiang Mai 50180, Thailand

leaves and displayed rapid rhizome growth, both in terms of size and number of rhizomes. There were 12-15 carpels on the gynoecium, which were completely enclosed in the receptacle. However, their seeds were sterile. The petal color was pink on the first blooming day and gradually turned into a creamy yellow color with a tiny pink rib on the last blooming day (Figure 3). The hybrid showed good adaptability in the mountainous northern Thailand (Chiang Mai Province) as well as in the central plain (Nakhon Nayok Province) (Table 3). In Chiang Mai, its rhizomes became dormant during the cool season in December similar to the mutant American yellow lotus, while in Nakhon Nayok, its growth continued throughout the cool period similar to Asian lotus. Also, in Nakhon Nayok, the hybrid flowered normally even during the short-day period of December and January. It showed a good potential to flower all year round.

Table 3: Growth characteristics comparison between the mountainous area and central plain planting

Area / **Trait**	**Chiang Mai (mountainous area)**	**Nakhon Nayok (central plain)**
Petal color	dark pink (1st day) yellow (3rd day)	light pink (1st day) cream (3rd day)
Blooming duration	4-5 days	3-4 days
Flower diameter	25-30 cm	15-20 cm
Growth dormancy	yes	none
Plant height	1.5-2 metre height	1-1.5 metre height
Rhizome propagation	3-5 tubers/year	7-8 tubers/year
Rhizome size	large (> 20 cm in length)	Small (10 -20 cm in length)

4 Discussions

4.1 Radiation-induced mutations of *N. lutea* and its hybrid

Puripunyavanich and Boonsirichai reported an LD30 and an LD50 of 10 Gy and 17 Gy, respectively, for *N. lutea* rhizomes [4]. Due to the limited availability of *N. lutea* and the hybrid *N. lutea* x *N. nucifera* 'Poontarik' rhizomes, only a single gamma radiation dose of 10 Gy was chosen for mutation induction in this report. We decided upon using the LD30 value instead of the LD50 in order that more rhizomes would survive the radiation treatment while a moderate density of mutations would still be available for screening.

For *N. nucifera* 'Poontarik', Soontornyard and Puripunyavanich recommended a gamma-radiation absorbed dose of up to 20 Gy for induced mutations [14]. In this report, we showed that an absorbed dose of as low as 10-Gy gamma radiation could be applied to rhizomes of *N. lutea* and its hybrid to

Radiation-Induced Mutant Of American Yellow Lotus and Its Interspecific Crosses with Thai Lotus

by Vichai Puripunyavanich[1] , Woranuch La-ongsri[2] and Kanokporn Boonsirichai[1]

[1]Research and Development Division, Thailand Institute of Nuclear Technology, 9/9 Moo 7, Sai Mun, Ongkharak, Nakhon Nayok 26120, Thailand

[2]Queen Sirikit Botanic Garden, Botanical Garden Organization, P.O. Box 7, Mae Rim, Chiang Mai 50180, Thailand

Figure 2: The hybrid 'Chandrakomen' (left) compared with 'Bua Luang Phrarachinee', the Thai parent (right), in third-day blooming.

induce photoperiod-response mutations regarding flowering requirement. The observation corresponded well with the recommended dose range, indicating that rhizomes of *N. lutea* and *N. nucifera* responded similarly to gamma irradiation.

Radiation-induced mutations are stochastic in nature due to stochastic interactions of radiation with atoms and molecules in the cells, including DNA [15]. Therefore, not every cell of the lotus rhizomes would have the same mutations. To obtain a mutant *N. lutea* and a mutant hybrid that could flower, cells that had been primed with suitable mutations from radiation treatment must divide to form a group of cells that eventually would become a floral bud. This situation arose in the first year of growth of the irradiated hybrid lotus, while it took the second year for irradiated *N. lutea* to produce floral buds. We hypothesize that the required mutation event did not occur in cells of an appropriate spatial location in the rhizome to form the first-year floral bud in *N. lutea*. Additional cell division was required to place these mutant cells in the appropriate location for floral bud formation.

4.2 Induction of flowering in the mutant *N. lutea* and the mutant hybrid

Being a long-day plant, flowering of *N. lutea* requires an appropriate day length that must equal or exceed its critical day length requirement. Hall and Penfound reported that in its habitat in Tennessee, USA, *N. lutea* only flowers between 1st June – 1st July, when day length is the longest of the year, approximately 14.5 hours [2,3,6]. In Thailand, the longest day length lasts only 13.5 hours, in Chiang Rai and Chiang Mai [5, 6]. No reports of naturally flowering *N. lutea* in Thailand could be identified, although the plants have been cultivated in multiple regions of the country [4]. Radiation has proven successful in inducing photoperiod-response mutations in *N. lutea* and the hybrid *N. lutea* x *N. nucifera* 'Poontarik' regarding floral development.

Previous studies suggested at least two factors that contribute to flower formation in *N. lutea*. Cold weather during the winter season is required for the formation of floral buds, while long day length of the summer induces flower development [4]. Since the mutant *N. lutea* and the mutant hybrid undergo

Radiation-Induced Mutant Of American Yellow Lotus and Its Interspecific Crosses with Thai Lotus

by Vichai Puripunyavanich[1] , Woranuch La-ongsri[2] and Kanokporn Boonsirichai[1]
[1]Research and Development Division, Thailand Institute of Nuclear Technology, 9/9 Moo 7, Sai Mun, Ongkharak, Nakhon Nayok 26120, Thailand
[2]Queen Sirikit Botanic Garden, Botanical Garden Organization, P.O. Box 7, Mae Rim, Chiang Mai 50180, Thailand

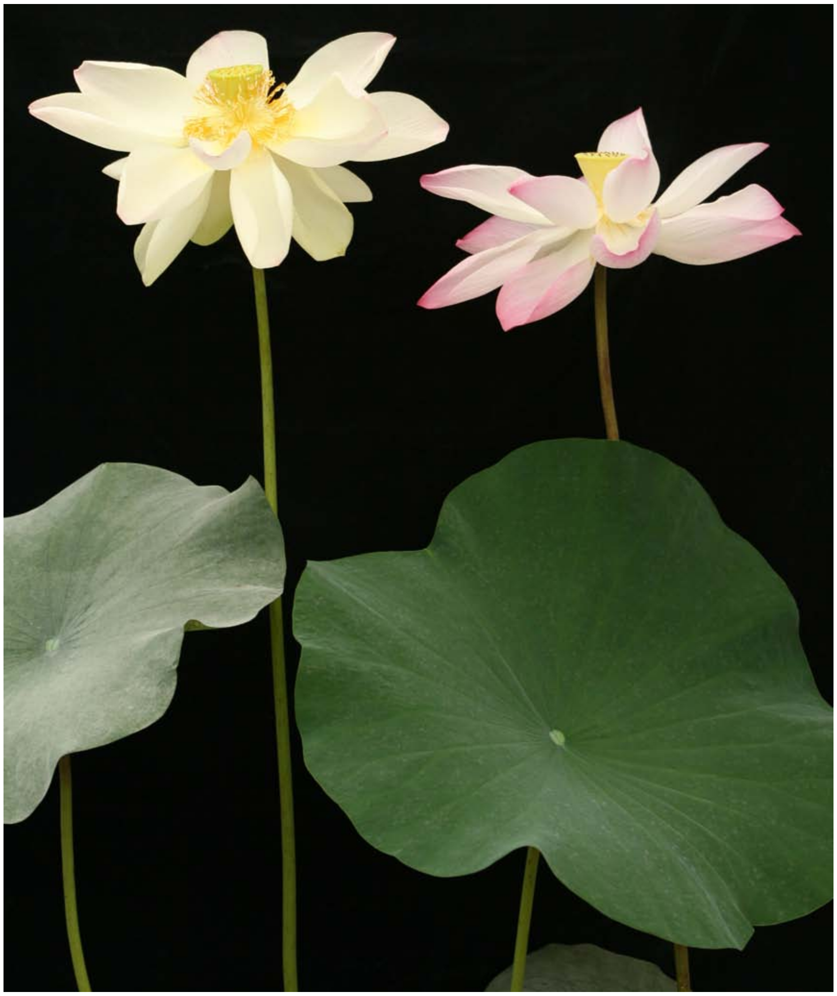


Figure 3: The hybrid 'Chandrakomen' on its first (left) and third (right) blooming day.

dormancy during the cool season, their response to cool weather must be intact. A hypothesis would be that these mutants carry mutations in a gene that functions in the photoperiod response, thus shortening the day-length requirement for floral development.

Responses to photoperiods or length of day and night in plants are mediated by photoreceptor proteins which carry photoreceptor molecules called phytochromes, cryptochromes and phototropins. Only phytochromes and cryptochromes are shown to be involved in the control of flowering time [16]. Phytochromes exist in two forms: PR, which shows a maximal absorbance between 650-670 nm, and PIR, which shows a peak of absorbance between 705-740 nm. On the other hand, cryptochromes mediate responses to blue and UVA light (390-530 nm) [17]. The mutant *N. lutea* and the mutant hybrid obtained in this report still preserved responses to the photoperiods regarding flowering ability, but the day length requirement was reduced to less than 13.5 hours of day light. It is possible that the two mutants may carry mutations in a gene encoding phytochrome or cryptochrome receptor protein that would modify its response to the photoperiods but did not eliminate its function entirely.

4.3 Petal color changes in 'Chandrakomen'

Petal colors ranging from yellow to red could result from the carotenoid group of pigments [18]. The yellow color could be caused by pigment compounds such as lutein, while the red color could be caused by compounds such as lycopene [18]. 'Chandrakomen' integrated pigment production capability from

Radiation-Induced Mutant Of American Yellow Lotus and Its Interspecific Crosses with Thai Lotus

by Vichai Puripunyavanich[1] , Woranuch La-ongsri[2] and Kanokporn Boonsirichai[1]

[1]Research and Development Division, Thailand Institute of Nuclear Technology, 9/9 Moo 7, Sai Mun, Ongkharak, Nakhon Nayok 26120, Thailand

[2]Queen Sirikit Botanic Garden, Botanical Garden Organization, P.O. Box 7, Mae Rim, Chiang Mai 50180, Thailand

both its parents having a pink petal color on the first blooming day and a yellow petal color on the last blooming day. Fading of the pink color during the course of the bloom might be caused by combinations of pigment instability, enzymatic degradation or conversion as well as changes in the expression of pigment biosynthetic genes. As a consequence, red pigments might not be produced in an amount that would be sufficient to replace the degraded pigments, resulting in yellow-colored flowers. Detailed analyses of pigment identity and pigmentation genes would further improve our understanding of the changes in petal color that were observed in the hybrid.

5 Conclusion

Photoperiod-response mutations were successfully induced in *N. lutea* and its hybrid using gamma radiation. The mutant plants were used as a genetic source to transfer the yellow-flower trait to Thai cultivars of *N. nucifera*, as no other compatible genetic source for yellow flowers was available in Thailand. Since interspecific crosses were required, only five out of nine crosses yielded plants that produced rhizomes.

'Chandrakomen', the selected interspecific hybrid between *N. nucifera* 'Bua Luang Phrarachinee' and the mutant *N. lutea*, exhibited characteristics of both parents. It produced flowers, the petal color of which changed from pink on the first blooming day to yellow on the last blooming day. Although 'Chandrakomen' appeared mostly sterile, hormone treatments, embryo rescue and chromosome duplications are being attempted in order to obtain segregated progeny from this hybrid to generate varieties of petal color for lotuses.

References

[1] P.D. Slocum and P. Robinson, *Water Gardening: Water Lilies and Lotuses* (Timber Press Inc., Oregon, 1996) 322 p.

[2] T.F. Hall and W.T. Penfound, *The Biology of American Lotus, Nelumbo lutea (Willd.) Pers., American Midland Naturalist 31* (3) (1944) 744-758.

[3] *Old Farmer's Almanac*. http://www.almanac.com.

[4] V. Puripunyavanich and K. Boonsirichai, *Induced Mutation in Yellow Lotus by Gamma Radiation*. The Proceedings of 44th Kasetsart University Annual Conference, Subject: Plants (Kasetsart University Press, 2006), p.439-444.

[5] Weather Forecast Group. *Sun Rise-set Index*. (Northern Meteorological Center, 2008). http://www.cmmet.tmd.go.th.

[6] Astronomical Applications Department. U.S. Naval Observatory Chiangrai. Rise and Set of the Sun 2007. Sun or Moon Rise/Set Table for One Year. http://aa.usno.navy.mil.

[7] V. Mitranont, *Botanical Study of the Genus Nelumbo Adans. in Thailand*, Master Thesis, (Kasetsart University, Bangkok, 1985).

[8] S.C. Sharma and A.K. Goel, *Philosophy and Science of Indian Lotus (Nelumbo nucifera)*, EnviroNews Archives 6 (1) (2000) http://isebindia.com/2000/00-01-08.html.

[9] S. Wasuwat, *Ornamental Nymphaea, Nelumbo, and Victoria in Thailand* (Nation Books International,Bangkok, 2004), p.159-169.

[10] W. Sudprasert, P. Navasumrit and M. Rujirawat. *Effects of Low-dose Gamma-radiation on DNA Damage, Chromosomal Aberration and Expression of Repair Genes in Human Blood Cells*. Int. J. Hyg. Environ. Health. 2009 (6) (2006) 503.

[11] W.K. Kaufmann and R.S. Paules. *DNA Damage and Cell Cycle Checkpoints*. FASEB 10 (1996) 238.

[12] J. Ward. *Radiation Mutagenesis: the Initial DNA Lesions Responsible*. Radiat. Res. 142 (3) (1995) 362.

[13] S. Arunyanart and S. Soontronyatara. *Mutation Induction by □ and X-ray Irradiation in Tissue Cultured Lotus*. Plant Cell Tiss. Org. Cult. 70 (1) (2002) 119.

[14] S. Soontornyard and V. Puripunyavanich, *Effect of Gamma Ray on Mutation of In Vitro Sacred Lotus "Boontharik,"* Kingmongkuts Agriculture 20 (1) (2002) 11.

[15] B.R. Scott. *Stochastic Thresholds: a Novel Explanation of Non-linear Dose-response Relationships for Radiobiological Effects. Dose Response* 3 (4) (2005) 547.

[16] T. Mockler, H. Yang, X. Yu, D. Parikh, Y.-C. Cheng, S. Dolan and C. Lin. *Regulation of Photoperiodic Flowering by Arabidopsis Photoreceptors*. Proc. Natl. Acad. Sci. USA. 100 (4) (2003) 2140.

[17] M. Ahmad, N. Grancher, M. Heil, R.C. Black, B. Giovani, P. Galland and D. Lardemer.Action Spectrum for Cryptochrome-dependent Hypocotyl Growth Inhibition in Arabidopsis. Plant Physiol. 129 (2) (2002) 774.

[18] E. Grotewold. *The Genetics and Biochemistry of Floral Pigments*. Ann. Rev. Plant Biol. 57 (2006) 761.

Pure and Faithful Love: The Story of Pink Lotus Porcelain Masterpieces of Chinese Export Porcelain 1740-1790

by Cynthia Lee Johnson
Interior Designer and Porcelain Collector

Photo # 1 - Lotus Plate

Author's note: For simplicity, I have used the older Wade-Giles system for translating Chinese characters into the English language for most historical names. Pinyin, the newer system, developed in the mid-20th century is used sparingly for familiar names. ex. Ching (Wade-Giles) is Qing (Pinyin).

The story of Pink Lotus porcelain is a specific and fascinating sliver of the history of the China Trade. My interest and dedication to the collection and study of Pink Lotus began over 10 years ago when I was first captivated by its vibrant colors and sophisticated shapes. This article briefly reviews my current research of the porcelain known as Pink Lotus, the lotus plant *Nelumbo nucifera* that inspired its design, and the China Trade story. The unique tale of Pink Lotus porcelain and its journey from China to Europe 250 years ago is full of adventure and intrigue.

Background

During the Qing Dynasty under the reign of Emperor Qianlong (1736-1795), the fourth emperor of the Manchu line, an appreciation for arts and splendor prevailed. Passion for Chinese porcelain and tea with all of its social customs flourished in the West. The Chinese adapted their artistic designs to suit Western tastes.[1] This adjustment, "export art" was pivotal in expanding custom orders of porcelain, as teacups with handles, monteths for rinsing wine glasses, gravy boats, tea tables, wallpaper and the like were all made to capture the new market. Later, what the Europeans could not acquire from China, they produced themselves in Europe. These fanciful and whimsical versions of Chinese artistic style were called "Chinoiserie".[2]

At this time a new and exciting polychrome enameling process was developed that successfully added soft pinks, roses, lavender, white and gold to porcelain, opening up a whole new generation of porcelain design. This new color palette was immediately embraced by the Europeans and later christened *famille rose* by the French and *fencai* by the Chinese. Combining the new colors with Chinese artistry resulted in delicate and precise objects d'arte. Of all the *famille rose* porcelains, one stands out as the most exquisite and delicate, the Pink Lotus pattern.

Pure and Faithful Love: The Story of Pink Lotus Porcelain Masterpieces of Chinese Export Porcelain 1740-1790

by Cynthia Lee Johnson
Interior Designer and Porcelain Collector

China Trade

The Europeans, or "foreign devils" as they were referred to by the Chinese, conducting business in 18th century China were governed by austere regulations. All official foreign trade was restricted to one small allotment of land in Canton. Reading Chinese books and speaking the language were forbidden, no foreign women were allowed and trade could only be handled through specially designated Chinese Hong merchants within a certain period. These were but a handful of the inconveniences, but so much money could be made, greed prevailed and all sides were determined to continue.

Photo #2 Teapot, cup and saucer

Meanwhile, European countries wanting to manage supplies and control prices to navigate these high-risk ventures established charters. A charter was the grant of authority giving royal permission to conduct all trade within a specific region. The most successful were from Holland, the Verenigde Oost Indische Compangnie (V.O.C.); England, the Honourable East India Company (H.E.I.C.); and Sweden, the Swedish East India Company (S.E.I.C.). The V.O.C. and the H.E.I.C. had a monopoly over the Far Eastern trade, eventually becoming political and economic powerhouses. Later, after America's rebellion against English high tea taxes led to the War of Independence, it too sponsored charters to begin direct trade.

According to the Imperial Court, all Chinese goods, including the most coveted teas, spices, silks, and porcelains, were to be traded for Spanish silver coins. At the same time, an enchantment with and insatiable desire for Chinese porcelain emerged in Europe. Immense fortunes were there to be made on both sides, so trade flourished rapidly. To put this into perspective, "in 1725, 250,000 pounds of tea were imported by the English; by 1800, an average of 24 million pounds had arrived."[3] Despite piracies, diseases, lost lives, the charters were making huge fortunes, sometimes as much as a 300% gain over their initial capital investment.

Though the East India Companies offered a wide array of goods to the Chinese for trading, there was little that China thought worthy. The required silver coins eventually created a huge West-East trade imbalance which threatened to deplete the European coffers.

By the mid 1800s, a monumental shift in trade developed as the West discovered a more valuable, though illegal, trading currency: opium. Britain could supply opium quickly and cheaply from British Bengal. "One of every ten citizens was said to use opium."[4] It was said that in 1730, 15 tons of opium were exported to China and by 1775, 75 tons were exported annually.[5] Hostilities arose on both sides leading to the First Opium War. "British parliament voted in favor of sending a British fleet of 16 warships, four armed steamers and four thousand troops to Canton Harbor in 1840."[6] China was powerless in the face of the mighty British technology and power. The Treaty of Nanking was signed in 1842, "forcing China to open four more ports, which would be immune from Chinese jurisdiction and pay a sum of 21 million silver dollars . . . The only demand that China refused to honor was the legalization of opium."[7] As Professor Yang Lien-sheng explained in his book, *Excursions in Sinology*, "intensified corruption …. (within) the imperial bureaucratic government system with all its red tapes and checks and balances.…the bureaucratic machine became so complicated that the functioning of every joint had to be

Pure and Faithful Love: The Story of Pink Lotus Porcelain Masterpieces of Chinese Export Porcelain 1740-1790

by Cynthia Lee Johnson
Interior Designer and Porcelain Collector

oiled with silver . . . the system was doomed to fail in the face of the challenge of the modern West."[8]

Porcelain

For thousands of years China held the secret to making fine porcelain, which was incredibly hard, sometimes feather light, distinctly elegant and beautiful. In Europe, all families needed basic tableware, and mass-produced "blue and white" porcelain chinaware became hugely popular. This common tableware became the perfect ballast material in the trading ships as they traveled the thousands of miles from Canton to the European ports: it was heavy, waterproof, helped stabilize the ship, and the ideal flooring upon which to place the hundreds of tea chests high and dry above the water. [9] More than 68 million pieces of porcelain were exported to the West of which only a tiny portion was Pink Lotus.

Apart from the mass-produced wares, there was also "Private Trade" porcelain. This was the personal allotment of chests that each crewmember on board the ship was permitted to fill for one's own use or to sell for a large profit at their home port. The higher the rank, the greater number of chests permitted. The most senior members on board, the Supercargoes (on-board business managers who represented the company's Directors) and the Captains, were able to use their private quarters in addition to the ship's common space. Private Trade goods were always better quality, more unusual, fragile and expensive.

Within Private Trade was "special order," primarily commissioned pieces but sometimes speculative wares. Dinner services or tea and dessert sets with family crests, initials or political, religious and other personal designs were all special order. Large soup tureens imitating boar's heads, geese and other animals, plus figurines, furniture and other fancy goods were all part of the Private Trade. Pink Lotus porcelain falls into this category of special order.

According to the late David S. Howard, noted author and heraldry expert on Chinese Export, porcelain comprised less than ten percent of traded goods in the 18th century, but because it was based on the aesthetic desires of the most fashionable European markets, its artistic and historical importance dramatically exceeds its numbers. In addition, as it was significantly more valuable, porcelain secured through Private Trade was used carefully and protected in display cabinets and pantries so that many more pieces have survived as compared to the mass-market wares.[10] As a result, these pieces are featured in numerous museum and private collections in England, Holland, Sweden, Portugal and Spain.

Nelumbo nucifera

The sacred lotus plant, *Nelumbo nucifera*, is a historical and spiritual expression of the Chinese ideals of balance, harmony, and pure and faithful love. Buddha sits on a flowering pink lotus only to rise above to transmit calm energy and enlightenment.

Photo #3 Lotus Spoon

The hidden meaning of the auspicious lotus is: "may your marriage be blessed with many sons" and the rebus of lotus seeds, *lian zi*, representing "many sons" has deep symbolism in Eastern culture.

Not only is the lotus beautiful and spiritual, it is totally functional. The plant is edible, nutritious, and medicinal. Mark Griffiths in his book, *The Lotus Quest*, describes how the whole lotus plant "provides the dinner service as well as food: its leaves are used as plates and its concave petals as exquisitely fragile spoons and saucers."[11] Perhaps this was the inspiration for the life-like formed Pink Lotus porcelain pieces. More recently, the plant's "lotus effect" has even inspired innovation in water- and stain-resistant

Pure and Faithful Love: The Story of Pink Lotus Porcelain Masterpieces of Chinese Export Porcelain 1740-1790

by Cynthia Lee Johnson
Interior Designer and Porcelain Collector

paint.

Pink Lotus Porcelain

The Bencao Gangmu, The Pandects of Natural History, written by Li Shizhen and published in 1596 is the most important historical text and systematic account of approximately one thousand plant and animal designs. Originally written as a guide for herbal medicine, it has proved to be an invaluable source for the Ming and Qing dynasty potters.[12]

Pink Lotus porcelain was made for both the Imperial Court and for the foreign trade in the town of Jingdezhen. Jingdezhen, about 500 miles north of Canton, had more than 3000 kilns in operation in the 1700s. It is situated near the mountains for the needed raw materials and the Chang River for transportation. Later, to ease the long delays of export custom orders, glazed and pre-fired pieces were transported from Jingdezhen to Canton for final decorative polychrome enameling. They were then fired at low temperatures one last time to vitrify the coloring agents.[13]

Photo #4 Lotus Punch Bowl

The 18th Century Chinese porcelain artists with their great love and reverence for the lotus plant expanded the *famille rose* designs with *Nelumbo nucifera* as their muse. A rare porcelain pattern called Pink Lotus was born which was a collision of pure Eastern thought and Western aesthetic appreciation. The creation of Pink Lotus porcelain was most likely influenced by the artistry, creativity and precision of Tang Ying, the most prominent and prolific writer and director of the Imperial Kilns (1736-1749).[14] Director Tang Ying managed every facet of porcelain production, design and even the potters' lives. His profound observations and brilliant drawings were documented in T'aoYeh T'ou Shuo,[15] which were translated into English by S.W. Bushell in 1899. Incredibly, many of the same methods from the mid-1700s are still used today.

Unlike other porcelains, the lotus shapes are naturalistic, often organic in form with fragile molded lotus petals, stems, seed pods and leaves. The creation of Pink Lotus pieces was far more time-intensive and expensive as most pieces were hand-molded into delicate three-dimensional shapes. Pink Lotus porcelains were not made into large dinner sets, but were designed for tea and dessert sets, which could then be more fancifully shaped. According to the South African author and collector, C. S. Woodard, "the finest dessert services did not match the dinner service; the table was cleared after the main course, the table cloth removed, and dessert in specialty porcelain pieces was set out on the polished boards of the table."[16] This explains perfectly how the Pink Lotus was used and why there are so few dinner plates and platters in existence.

One of the most amazing aspects of this Pink Lotus design was that *Nelumbo nucifera* was not grown in Europe, as the temperatures were far too cool, dry and the soil insufficient. In the 1750s, the famous Swedish botanist, Carl Linnaeus, had one small pressed specimen named *Nymphaea nelumbo*. The name

Pure and Faithful Love: The Story of Pink Lotus Porcelain Masterpieces of Chinese Export Porcelain 1740-1790

by Cynthia Lee Johnson
Interior Designer and Porcelain Collector

was later changed to the "currently accepted binomial of the sacred lotus, *Nelumbo nucifera*"[17]. This dwarf specimen was possibly… "A miniature cultivar version that traveled from the Far East . . ."[18] It cannot be explained fully how Carl Linnaeus acquired his specimen, but he had very able students who traveled to the Far East in different capacities. Daniel Solander, the pioneering student of Linnaeus and the first surgeon on Captain Cook's world exploration, also brought back one *Nelumbo nucifera*. Both specimens are currently housed in the strongroom at the Linnean Society in London and are digitally archived. They can be viewed at [***www.linnean-online.org***](http://www.linnean-online.org) , Genus #673, sheet #7 and Genus #673, Sheet #8. In 1752, Peter Osbeck, Swedish botanist, chaplain and author of his highly regarded personal journey, *A Voyage to China and The East Indies*, also made a notation of *Nelumbo nymphaea* under *Polyandria, Monogynia*.[19] Despite the absence of this celestial plant in Europe, Pink Lotus porcelain was sought after and appreciated for its distinct beauty and realistic depiction of the lotus plant.

Pink Lotus Ongoing Research

My research to date has confirmed the following facts:

- o *Nelumbo nucifera* did not grow in Europe in the 18th century.
- o The porcelain was made between 1730 and 1840 by highly skilled potters and artists.
- o The porcelain was crafted as tea and dessert sets.
- o Only small quantities were produced, possibly less than .01%.
- o The porcelain was made for both the Imperial Court and the Export Market as Private Trade.
- o It was made most often by hand-molding using the finest *famille rose* techniques.

I am currently researching private letters, invoices and logs to find records of Pink Lotus porcelain to help trace its history and establish its significance in the decorative arts, including questions such as: Which countries and families purchased these pieces? Was the lotus design pre-selected in Canton by Supercargoes or Captains or was the lotus design specially commissioned?

With my continued research, I hope to enhance overall knowledge of Chinese export ceramics and China Trade and look forward to sharing any new findings of my pure and faithful love.

References

1 Patrick Conner, *The Hongs of Canton*, (London, English Art Books, 2009), 56.
2 Dawn Jacobson, *Chinoiserie*, (London, Phaidon Press Limited, 1993), 7.
3 Amanda E. Lange, *Chinese Export Art at Historic Deerfield*, (Massachusetts, Historic Deerfield, 2005), 10.
4 Hannah Pakula, *The Last Empress*, (New York, Simon and Shuster, 2009), 34.
5 Jack Benning,*The Chinese Opium Wars,1st. ed*,(New York, Harcourt Brace Javanovich,1975)
6 Beatrice Hohenegger, *Liquid Jade* (New York, St.Martins Press, 2006), 142.
7 Ibid., 143.
8 Lien-sheng Yang, *Excursions in Sinology*, (Massachusetts, Harvard University Press, 1969), 230,231.
9 William R. Sargent,*The Copeland Collection*,(The Peabody Essex Museum, Salem, Massachusetts,1991),19
10 David S. Howard, *The Choice of the Private Trade*, (London, Zwimmer, 1994), 10.
11 Mark Griffiths, *The Lotus Quest*, (New York, St. Martin's Press, 2009), 22.
12 Robert H. Blumenfield, *Blanc de Chine*, (Berkeley, CA, Ten Speed Press, 2002), 151.
13 Michel Beurdelry and Guy Raindre, *Qing Porcelain, Famille Verte, Famille Rose*, (London, Thames and Hudson Ltd., 1987), 166. Trans.
14 Tang Ying, *T'ao Yeh T'ou shuo*, (undertaken by Imperial Command,1743)
15 Ibid.
16 C.S. Woodard, *Oriental Ceramics of Cape of Good Hope 1652-1795*, (Capetown,A.A. Balkema,1974),129
17 Mark Griffiths, *The Lotus Quest*, (New York, St. Martin's Press, 2009), 5
18 Ibid.
19 Peter Osbeck, *A Voyage to China and the East Indies, added A Faunula and Flora Sinesis Vol.II*, (London, Horace's Head, 1771), 352.

The Parents and Sibling of *Nymphaea* 'Siam Blue Hardy'

by Pairat Songpanich and Vipa Hongtrakul, Thailand

1. Parents of *Nymphaea* 'Siam Blue Hardy'

The International Waterlily and Water Gardening Society published "*Nymphaea* 'Siam Blue Hardy': The World's First Blue Hardy Waterlily" in *The Water Garden Journal*, 2nd Quarter, 2008, and later published "Intersubgeneric Cross in *Nymphaea* spp. L. to Develop a Blue Hardy Waterlily" in *The Water Garden Journal*, 2nd Quarter, 2009.

N. 'Siam Blue Hardy' was reported as the intersubgeneric hybridization between subgenus *Nymphaea* (pod parent) and subgenus *Brachyceras* (pollen parent). The names of both parents were withheld for later disclosure to the public.

The Water Garden Journal, 2nd Quarter, 2009 (Figure 4, Hybrid # 1-20), featured 20 intersubgeneric hybrids including three already-named ones: *N.* 'Siam Blue Hardy' (Hybrid # 3), *N.* 'Siam Pink Tips' (Hybrid # 8), *N.* 'Siam Pink' (Hybrid # 9). These hybrids are from subgenus *Nymphaea* (the hardy waterlily *N.* 'Supranee Pink' [Figure 1] as pod parent) and subgenus *Brachyceras* (the open pollinated hybrid tropical day bloomer waterlily *N.* 'Nangkwag Fah' [Figure 2 – 3] as pollen parent).

Figure 1 *N.* 'Supranee Pink'

Figure 2 *N.* 'Nangkwag Fah'

· *N.* 'Supranee Pink'

Parentage: the hybrid of *N.* 'Mayla' x *N.* 'Perry's Fire Opal'

Sepal color: dark pink Petal color: pink

Sepal number: 4 Petal number: 36 – 49

http://www.watergardenersinternational.org/checklist/supranee_pink/form.htm

· *N.* 'Nangkwag Fah'

Parentage: unknown

Sepal: distinguish form, known as "Nangkwag Characteristic"

Sepal color: green Petal color: purple-blue

Sepal number: 8 Petal number: 24-29

N. 'Nangkwag Fah' Synonym: *N.* 'Nang Kwag Fah' / *N.* 'Nang Kwak Fah' / *N.* 'Indian Goddess Blue'

http://www.watergardenersinternational.org/journal/1-2/primlarp/page1.html

http://www.hilohs.k12.hi.us/uemura/nymphaea/nangkwak.htm

2. Sister lines of *N.* 'Siam Blue Hardy'

After successfully producing hybrids from intersubgeneric hybridization, more sister lines (offspring of the same parent) had been developed from the middle of 2007 till 2010. Intensive cross pollinations of *N.* 'Supranee Pink' as pod parent with *N.* 'Nangkwag Fah' as pollen parent had been performed, yielding 57 pods

Figure 3 *N.* 'Nangkwag Fah'

The Parents and Sibling of *Nymphaea* 'Siam Blue Hardy'

by Pairat Songpanich and Vipa Hongtrakul, Thailand

with 10,065 seeds, of which 783 seeds germinated. Thirty-nine hybrid seedlings grew to maturity and produced flowers (Figure 4: Hybrid # 21 - 59).

3. The amazing *N.* 'Nangkwag Fah'

N. 'Nangkwag Fah' produces a peculiar flower shape compared to other waterlilies. Not only can it hybridize well within the tropical group, but it also hybridizes readily with *N.* 'Supranee Pink', and *N.* 'Miss Siam' (Figure 5) http://www.watergardenersinternational.org/checklist/miss_siam/form.htm. *N.* 'Supranee Pink' and *N.* 'Miss Siam' are sister lines, coming from the same pod parent.

Figure 5 *N.* 'Miss Siam'

After using the right pair of parents having genetic compatibility to produce well-formed seeds following pollination, intersubgeneric hybrid seeds are no more difficult to obtain. From 2008 to 2010, crosses between *N.* 'Miss Siam' with *N.* 'Nangkwag Fah' yielded more than 90% fruit/pod setting. Altogether, 64 pods were obtained with 9,367 seeds, from which 2,369 seeds germinated. Eighty-seven hybrid seedlings grew to maturity and produced flowers (Figure 6). However, the hybridization between *N.* 'Perry's Fire Opal' x *N.* 'Nangkwag Fah' had some difficulty. Fruit setting was obtained sporadically. Intersubgeneric hybrids from *N.* 'Perry's Fire Opal' x *N.* 'Nangkwag Fah' are shown in Figure 7.

4. Important characteristics of the intersubgeneric hybrids

The important characteristics of intersubgeneric hybrids are summarized as follows.

- **Seed**

Seed sizes of the hybrids from hardy and tropical day bloomer waterlilies were between those of their parent. The average size of the hybrid seed was 2 mm, whereas seed sizes of hardy and tropical

Figure 4 *N.* 'Supranee Pink' x *N.* 'Nangkwag Fah'

The Parents and Sibling of *Nymphaea* 'Siam Blue Hardy'

by Pairat Songpanich and Vipa Hongtrakul, Thailand

waterlilies were 3 mm. and 1 mm, respectively (Figure 8).

The average seed number of the intersubgeneric hybrids was 170 seeds/pod. Percentage of hybrid seed germination was about 15%. After germination, intensive care of the seedlings is needed in order to get well formed plants able to produce flowers. The average percentage of flowering plants obtained was about 0.72% of the starting seeds.

- **Flower**

The intersubgeneric hybrids had various flower colors, i.e. purple-blue, purple, pink with different shadings, white and white with pink at petal tip. However, no true blue color of flower was seen in any hybrid. The flowers of the hybrids were both cup-shaped and star-shaped. Not any hybrid inherited the distinctive sepal shape of "Nangkwag Characteristic." This means that "Nangkwag Characteristic" should be controlled by recessive allele, whereas the normal sepal characteristic should be controlled by dominant allele. The "Nangkwag Characteristic" should be observed again following the self-pollination of the F1 hybrid. We performed selfing and backcrossing of F1 more than 50 times, but no fruit setting was obtained. The chromosome numbers of the parent were investigated under the light microscope. *N.* 'Supranee Pink' has chromosome numbers of 56 (4x), whereas *N.* 'Nangkwag Fah' has 2x = 28. Thus, the hybrids from *N.* 'Supranee Pink' x *N.* 'Nangkwag Fah' should have chromosome numbers 3x = 42. This triploid hybrid should be sterile.

The total number of hybrid sepal and petal were about 30, which is less than those numbers observed in both pollen and pod parents.

- **Ovary carpel**

Cross sections of the hybrid flowers were performed to reveal the characteristic of ovary carpels. All intersubgeneric hybrids were categorized to be syncarpous same as the pod parent.

Figure 6 *N.* 'Miss Siam' x *N.* 'Nangkwag Fah'

- **Pad**

The hybrids had both flecked pads like the pollen parent and plain green pads like the pod parent.

The Parents and Sibling of *Nymphaea* 'Siam Blue Hardy'

by Pairat Songpanich and Vipa Hongtrakul, Thailand

The pad or leaf margin characteristic of most hybrids was smooth edged like the pod parent. Some hybrids combined pad margin characteristic from both parents (minor dentate on entire leaf). All hybrids had pubescent at the petiole and peduncle, like the pod parent.

- **Rootstock**

All hybrids had rootstock that grew horizontally from and along a fleshy rhizotomous rootstock like the pod parent. "Eyes" at points along the rhizome produced new crowns from which new rhizomes would be generated and could be used for propagation. Some intersubgeneric hybrids produced rhizomes easily, but some had difficulty to produce new rhizomes, including *N.* 'Siam Blue Hardy.' It is now four-years old, but still does not generate any new rhizomes. In contrast, *N.* 'Siam Pink,' the sister line of *N.* 'Siam Blue Hardy' with the same age, produced many new rhizomes. Astonishingly, new hybrids with purple-blue flower color behaved the same as *N.* 'Siam Blue Hardy' in not generating any new rhizomes, whereas the hybrids with purple flower color were able to produce new rhizomes.

- **Winter Hardiness**

In 2008, *N.* 'Siam Pink' (Figure 9) was sent to The Royal Botanic Gardens, Kew and has been taken care of by Carlos Magdalena. His report on *N.* 'Siam Pink' is as follows:

N. 'Siam Pink' was proven fully hardy for two winters. Plants outdoors went dormant but resumed growing in late spring in the same way that other *Nymphaea* subg. *Nymphaea* species do in the UK. However, *N.* 'Siam pink' did not seem to be as vigorous outdoors as it was indoors, under glasshouse conditions at Kew. Only 2 flowers bloomed on the peak of the season each year which was lower performance compared to typical hardies. Winters were very harsh, specially the winter 2009/2010 and the winter 2010/2011. A thick layer of ice was observed at the top of the tanks sometimes, for several days. Despite its hardiness, further work needs to be carried out to determine what are the reasons why the variety did not perform as prolifically as desired, bloom wise, despite growing with ease (leaf development). Two reasons are suspected:

a) the size of the rhizome was too small

b) the plant may need higher temperatures to bloom prolifically.

Figure 7 *N.* 'Perry's Fire Opal' x *N.* 'Nangkwag Fah'

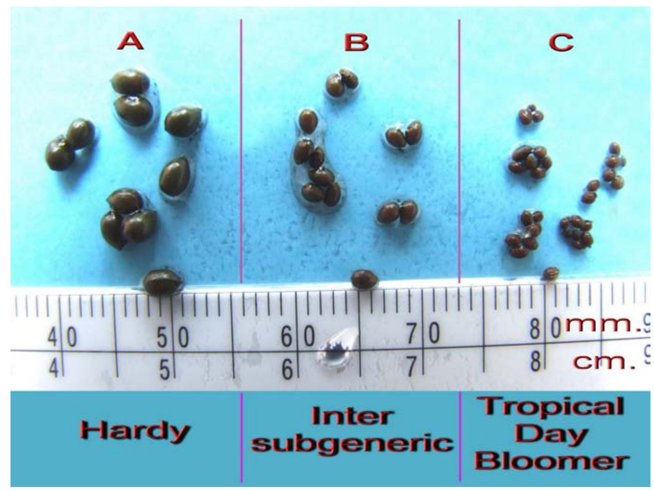


Figure 8 Seed size comparison of hardy, intersubgeneric hybrid and tropical day bloomer

Figure 9 *N.* 'Siam Pink' (*N.* 'Supranee Pink' x *N.* 'Nangkwag Fah' : Hybrid #9)

Further tests are required but it may happen that *N.* 'Siam Pink' is more suited for places that have

The Parents and Sibling of *Nymphaea* 'Siam Blue Hardy'

by Pairat Songpanich and Vipa Hongtrakul, Thailand

long hot climates such as central Germany, France or anywhere in Southern Europe or continental North America. Further test would be carried at Kew using larger clumps.

5. Obstacles to intersubgeneric hybridization

Getting the right combinations of the parent pair between hardy and tropical waterlilies is a time- consuming step. We performed trial and error tests to look for the genetic compatible pair of parent in order to get fruit and seed sets following pollination. Two reasons of failure in fruit and seed setting are as follows:

a) genetic incompatibility

Genetic incompatibility between the intersubgeneric pairs results in no pollen germination on the stigma or no pollen tube germination through the style to fertilize with egg. However, fertilization may occur but fail in developing mature intersubgeneric zygotes, resulting in zygote abortion.

Table 1 Chromosome numbers of various species/cultivars in the genus *Nymphaea* L. (Gupta, 1980*; Pagels, 2000**; Diao et al., 2006***; Hossain et al., 2007****)

Species / Cultivars		Chromosome numbers
subgenus *Nymphaea*		
N. alba	2n =	48 aneuploid, 56 (4x), 64 aneuploid, 70 (5x), 84 (6x), 96 aneuploid, 105 aneuploid, 112 (8x) and 160 aneuploid
N. candida	2n =	112 (8x) and 160 aneuploid
N. lotus	2n =	28 (2x), 56 (4x) and 84 (6x)
N. maxcicana	2n =	56 (4x) and 84 (6x)
N. odorata	2n =	42 (3x), 56 (4x) and 84 (6x)
N. pubescens	2n =	84 (6x)
N. rubra	2n =	56 (4x), 84 (6x) and 112 (8x)
N. tetragona	2n =	28 (2x), 84 (6x), 112 (8x) and 120 aneuploid
N. tuberosa	2n =	56 (4x) and 84 (6x)
N. 'Helvola'	2n =	84 (6x)
N. 'Laydekeri Alba'	2n =	56 (4x)
N. 'Sunrise'	2n =	84 (6x)
subgenus *Anecphya*		
N. gigantea	2n =	224 (16x)
subgenus *Brachyceras*		
N. caerulea	2n =	28 (2x)
N. capensis	2n =	28 (2x)
N. micrantha	2n =	56 (4x)
N. nouchali	2n =	28 (2x), 42 (3x), 56 (4x), 70 (5x) and 84 (6x)
N. 'Daubeniana'	2n =	42 (3x)
N. 'General Pershing'	2n =	42 (3x)
N. 'Pamela'	2n =	42 (3x)

b) the difference in chromosome numbers

The differences in chromosome structure and numbers between the subgenera of hardy and tropical waterlilies increase the probability of genetic incompatibility between the parent pairs. Variation in chromosome numbers in a single species are most apparent in a wide-ranging species both in aneuploid and polyploid series based on x = 14. The information on chromosome numbers is listed in Table 1.

Basic chromosome number (x) = 14

* Gupta, P.P., 1980. Cytogenetics of aquatic ornaments VI. Evolutionary trends and relationship in the genus *Nymphaea. Cytologia* 45: 307-314.

** Pagels, W., 2000. *Chromosome Counts of Waterlilies and Other Nymphaeaceae*. www.victoria-adventure.org., 25/05/2003.

*** Diao *et al.*, 2006. Nuclear DNA C-values in 12 species in Nymphaeales. *Caryologia* 59(1): 25-30.

**** Hossain *et al.*, 2007. Cytological studies of *Nymphaea* species available in Bangladesh. *J. bio-sci.* 15: 7-13.

6. Interesting intersubgeneric hybrids

Some intersubgeneric hybrids were selected, firstly based on a beautiful, well-formed flower and secondly based on other characteristics such as the number of flowers per plant, color, and flower shape. Of the selected hybrids shown in Figures 10-19, some have already been named and others are in the process of receiving their names.

All hybrids and photos in this article were created by Mr. Pairat Songpanich IWGS Hall of Fame Member

The Parents and Sibling of *Nymphaea* 'Siam Blue Hardy'

by Pairat Songpanich and Vipa Hongtrakul, Thailand

Figure 10 *N.* 'Siam Purple 1'
N. 'Supranee Pink' x *N.* 'Nangkwag Fah'
(Hybrid # 47)

Figure 11 *N.* 'Siam Purple 2'
N. 'Supranee Pink' x *N.* 'Nangkwag Fah'
(Hybrid # 26)

Figure 12 *N.* 'Siam Pink 2'
N. 'Supranee Pink' x *N.* 'Nangkwag Fah'
(Hybrid # 37)

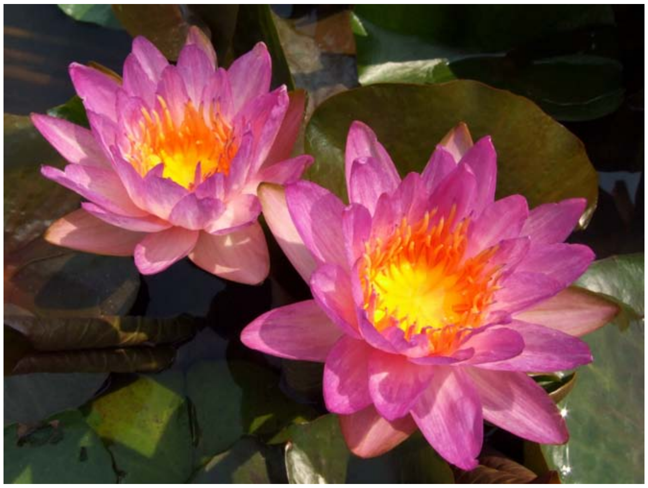


Figure 13
N. 'Supranee Pink' x *N.* 'Nangkwag Fah'
(Hybrid # 57)

Figure 14 *N.* 'Miss Siam' x *N.* 'Nangkwag Fah'
(Hybrid # 1)

Figure 15 *N.* 'Miss Siam' x *N.* 'Nangkwag Fah'
(Hybrid # 10)

The Parents and Sibling of *Nymphaea* 'Siam Blue Hardy'

by Pairat Songpanich and Vipa Hongtrakul, Thailand

Figure 16 *N.*'Miss Siam' x *N.* 'Nangkwag Fah' (Hybrid # 11)

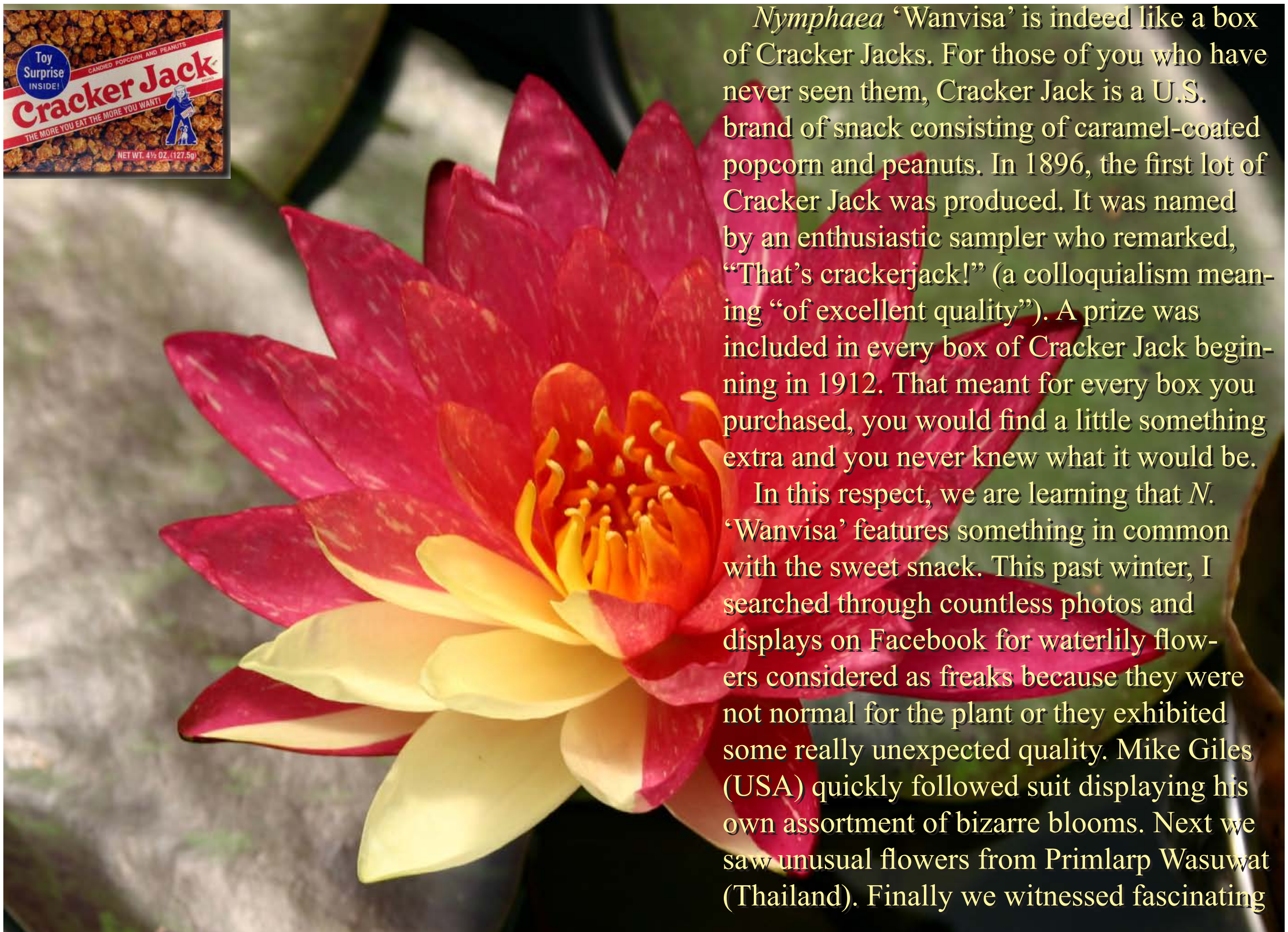
Figure 17 *N.* 'Miss Siam' x *N.* 'Nangkwag Fah' (Hybrid # 30)

Figure 18 *N.* 'Miss Siam' x *N.* 'Nangkwag Fah' (Hybrid # 54)

Figure 19 *N.* 'Perry's Fire Opal' x *N.* 'Nangkwag Fah' (Hybrid # 2)

Nymphaea 'Wanvisa' Is Like a Box of Cracker Jacks

by Tim Davis



Nymphaea 'Wanvisa' is indeed like a box of Cracker Jacks. For those of you who have never seen them, Cracker Jack is a U.S. brand of snack consisting of caramel-coated popcorn and peanuts. In 1896, the first lot of Cracker Jack was produced. It was named by an enthusiastic sampler who remarked, "That's crackerjack!" (a colloquialism meaning "of excellent quality"). A prize was included in every box of Cracker Jack beginning in 1912. That meant for every box you purchased, you would find a little something extra and you never knew what it would be.

In this respect, we are learning that *N.* 'Wanvisa' features something in common with the sweet snack. This past winter, I searched through countless photos and displays on Facebook for waterlily flowers considered as freaks because they were not normal for the plant or they exhibited some really unexpected quality. Mike Giles (USA) quickly followed suit displaying his own assortment of bizarre blooms. Next we saw unusual flowers from Primlarp Wasuwat (Thailand). Finally we witnessed fascinating *N.* 'Wanvisa' pictures from Dr. Nopchai Chansilpa (Thailand). To see the reversions of *N.* 'Wanvisa' that show characteristics of *N.* 'Joey Tomocik' is really exciting. We had not seen this trait displayed at Sarah Duke Gardens for the New Waterlily Competition or at the International Waterlily Collection last year.

Through further discourse with Dr. Chansilpa, we learn that he sees this reversion tendency in about five percent of his blooms on *N.* 'Wanvisa'. He reports that when you see pads showing a portion of the pad looking like *N.* 'Joey Tomocik' along with the normal *N.* 'Wanvisa' coloration, this is the time to get excited. You might soon find your prize, a bloom that looks like the one on this page.

The IWGS bought 300 plants from Dr. Chansilpa to sell as CAPY plants. Half of the plants are in Oregon and the other half are in Texas at Nelson Water Gardens where part-owner and lead grower Mike Swize cares for them. I visited their facility a few weeks ago and discussed this rare trait with Mike. I noticed several pad reversions and pointed them out to him.

Last week he sent me a picture message on my phone that he had a great bloom. I had to see it for myself. Mike said that as soon as you enter the greenhouse the bloom demands your attention. I went to see the bloom. Mike was right, this was stunning!

I know there are purist-hybridizers who may see this as a flaw and view it as a plant to cull. Those who are not such purists see that this is not a cull, but that it is really cool. I know that seeing a normal *N.* 'Wanvisa' bloom for the first time is incredible. This bloom took the experience to a higher level for me.

Wherever you live and grow it, *N.* 'Wanvisa' is a showstopper plant. It produces beautiful flowers normally and then there is always the incredible possibility of a Cracker Jack. ***Order yours*** as soon as you can, after all, who doesn't like a great surprise?


Texas Water Lilies.com
Nature's Beauty is in the flower
Texas Water Lilies is a large individual grower of Aquatic Plants. We have products ranging from Lotus, Marginal's, Tropical water lilies and hardy water lilies. TWL also offers no-hole aquatic growing pots and aquatic fertilizer tabs. We at TWL have been growing water lilies since 1991. We are very knowledgeable of how to propagate, grow, maintain, harvest, and ship our plants and products. We go to great lengths to support our customers once shipments are received.
Texas Water Lilies guarantees everything it sells.
We are our own grower meaning when you order your plant s they will be picked fresh straight from the farm. Texas Water Lilies has 8 acres of production at two locations. TWL carries large numbers of each variety so no matter how big or small your needs, we should be able to provide.
http://www.texaswaterlilies.com/
email: Cmomobotan@aol.com
Dusty & Jesse Culp
25999 North Lake Rd.
Waller, Texas 77484
Phone: 936-931-9880
Cell:281-460-0473
Fax: 936-372-9804


Alpine Corporation manufactures...
RELIABLE,
DEPENDABLE
& ECONOMICAL
LANDSCAPE
& POND
SUPPLIES
Mag-driven pumps for better efficiency
Pumps ranging from 65GPH up to 10,300GPH
Koi Safe filtration system
New 24 watt self cleaning filter
Brighten up a landscape, garden, pond or fountain with LED or Halogen Lights
3 year warranty
Full section of tubing and more...
Corporate Office:
877-710-0162
E-Mail: alpinecorp2@aol.com
Web: www.alpine4u.com
Alpine


Add Water
Add Value
DECORATIVE PONDS
NATURAL PONDS
REFLECTION PONDS
KOI PONDS
WATER GARDENS
STREAMS
WATERFALLS
Tap Into the $250 Million Decorative Water Feature Market
At the heart of thousands of decorative, residential water features are Firestone PondGard™ Rubber Liners. Combining extreme conformability and ease of with lasting durability, PondGard liners are the perfect choice for your customers who want to add enjoyment and value to their home.
Firestone
POND GARD
Lining for Life
To learn more about PondGard, visit us at www.firestonesp.com/iwgs1
Firestone Specialty Products
800-428-4442 | info@firestonesp.com


Visit Central Texas' Most Unique Nursery
AND COMPLETE WATER GARDENING RESOURCE
HILL COUNTRY WATER GARDENS & NURSERY
www.hillcountrywatergardens.com
(512) 260-5050
1407 N. Bell Blvd. (Hwy 183) in Cedar Park


DANNER
MANUFACTURING, INC.
PONDMASTER POND PRODUCTS
ProLine
Supreme
DANNER MANUFACTURING, INC.
160 Oval Drive
Islandia, N.Y. 11749-1489
The Market Leaders in Magnetic-Drive Technology and Filtration
Danner Mfg. Inc. has been in business for more than 50 years. The brand names which we manufacture and market are: PondMaster, ProLine, Supreme, Magnetic-Drive, Hampton Water Gardens, Cover-Care, Pool-Care, Spa-Care, Skilter, AquaMaster, AquaKing, SuperKing, HeetMaster, DynaMaster, Challenger, Ovation, Mainstream and BioMatrix.
DANNER
TRADE SHOWS
NOT OPEN TO THE PUBLIC - TRADE ONLY
These brands can be found in the Water Gardening, Aquarium, Pool/Spa, OEM, Hydroponic industries throughout North America and the offshore markets. We are committed to offer our customers high quality and reasonably priced products, creating the best values.
Phone: (631) 234-5261
Fax: (631) 234-4778
http://www.dannermfg.com/contact.asp

THE WATER GARDEN JOURNAL
Volume 26 Number 1

The Official Publication of the
INTERNATIONAL WATERLILY AND
WATER GARDENING SOCIETY

www.iwgs.org

Registrars

Nymphaea Registration
Jim Purcell – ***jim@oregonaquatics.com***
Verena Liechti – ***verena@oregonaquatics.com***
Nelumbo Registration
Daike Tian - ***tiandk@scbg.ac.cn***

ADMINISTRATIVE ADDRESS and SUBSCRIPTION ENQUIRIES

International Waterlily and Water Gardening Society
7443 Buffalo Road
Churchville, NY. 14428 USA
585-293-9144
Fax: 585-293-3886
info@iwgs.org

EDITORIAL ADDRESS

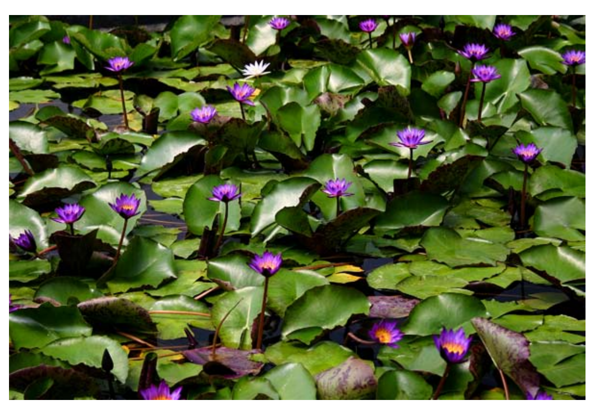
Tim Davis
IWGS *Water Garden Journal*
1121 G. Hill Rd.
Houston, TX 77037 USA
832-274-3377
timgod555@hotmail.com

Front cover and back cover photos
© Pairat Songpanich
all inside uncredited photos
© Tim Davis

Mission Statement—The International Waterlily & Water Gardening Society (IWGS) is a non-profit organization of multinational membership dedicated to the furtherance of all aspects of water gardens and their associated plants. As an organization we support and promote education, research, and conservation in these areas.

Volume 26, Number 1 The IWGS Water Garden Journal (ISSN 1069-5982) is published quarterly by The International Waterlily and Water Gardening Society (The Society), 7443 Buffalo Road,Churchville, NY. 14428, USA. Phone 585-293-9144, Fax: 585-293-3886, Email ***info@iwgs.org***. is indexed in EBSCO's Garden, Landscape & Horticulture Literature Index.

Postage paid at Churchville NY, USA and additional mailing offices. Basic subscription/ membership rate for one full year is free for the online Journal. Hard copy can be mailed for an additional $25 per year. Further details and back issues are available from the administrative office in NY. All changes of address and incidents of non-arrival of Journals should be notified to the office in NY.



Nymphaea **'Lindsey Woods'**
Hybrid by Nelson Water Gardens

International Waterlily and Water Gardening Society

Water Garden Journal

N. **'Miss Siam' x** ***N.*** **'Nangkwag Fah' (Hybrid # 1)**
Hybrid and photo by Pairat Songpanich