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(1) Distribution and Some Ecological Features of Wild Rice in Deep-Water Rice Areas in Thailand (Preliminary Report)

°Hiroshi Hyakutake, Chaiyot Supatanakul, Siriporn Zungsontiporn and Kenji Noda (Weed Science Branch, Department of Agriculture, Thailand)

(2) Effect of Herbicides on Seed Germination and Early Seedling Growth of Wild and Cultivated Species of Rice.

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(3) Effect of Pre-emergence Herbicides and other Chemicals on Seed Germination of Mimosa pigra L.

Cha-um Premasthira and Hidejiro Shibayama (Weed Science Branch, Department of Agriculture, Thailand)

(4) Distribution and habitats of Mimosa pigra L. in aquatic and other areas of Thailand.

°Hidejiro Shibayama, Paitoon Kittipong, Tawee Sangtong, Chaiyot Supatanakul and Cha-um Premasthira (Weed Science Branch, Department of Agriculture, Thailand)

(5) Effects of soil and water conditions on seed germination and growth of Mimosa pigra L.

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Distribution and Some Ecological Features of Wild Rice in Deep-Water Rice Areas in Thailand (Preliminary Report)

°Hiroshi Hyakutake, Chaiyot Supatanakul, Siriporn Zungsontiporn and Kenji Noda
(Weed Science Branch, Department of Agriculture, Thailand)

Wild rice species having submergence and elongation capacity as deep-water rices are causing great concerns in deep-water rice areas of approximately 2.7 million ha in Thailand. The areas are Central Plain, Northern and a part of Southern Regions, where rice culture is practised by direct broadcasting method on dry soils after the first plowing in March to April, and the field remains dry. With rain, wild rices germinate at the same time with deep-water rice seedlings and offer serious competition from the start of their initial growth. Thus, the infestations of wild rices reduce yields of cultivated species, lower the grade of rice due to the presence of wild rice and cause cross-polination. The series of surveys were attempted from March 1981 to January 1982.

1. Distribution of wild rice

Wild rices are distributed mainly in deep-water rice areas in Prachin Buri, Nakorn Nayok, Ayuthaya, Singh Buri, Chainat and part of Songkhla and Nakhonsrithamrat (Fig.1). So far only Oryza ridleyi (black hull) has been identified as one of the serious wild rices in the above-mentioned Provinces. Wild types are easily distinguished from cultivated species of rice. Intermediate types, however, are difficult to differentiate among cultivated types owing to the similarities in gross morphological features. "Black hull" wild rice is significantly more prevalent than the "straw hull" type as a weed in these Provinces.

2. Characteristics of wild rice species (Table 1 & 2)

"Black hull" wild rice starts to head and matures earlier than cultivated type and panicles shatter at maturity and are able to remain dormant in soil.

3. Germination and emergence (Table 3 & 4)

Wild rice rarely emerged under submerged condition and there was a tendency to emer under aerobic conditions, although some variations existed amoung wild rice species. Wild rice seeds . dormant after shattering and this dormancy was broken to some extent by heat treatment of 50°C. The degree of dormancy in wild rices are deeper than that in cultivated Indica type.

Farther investigations on identification, growth habit and agronomic traits of wild rices will be carried in conjunction with control measures.

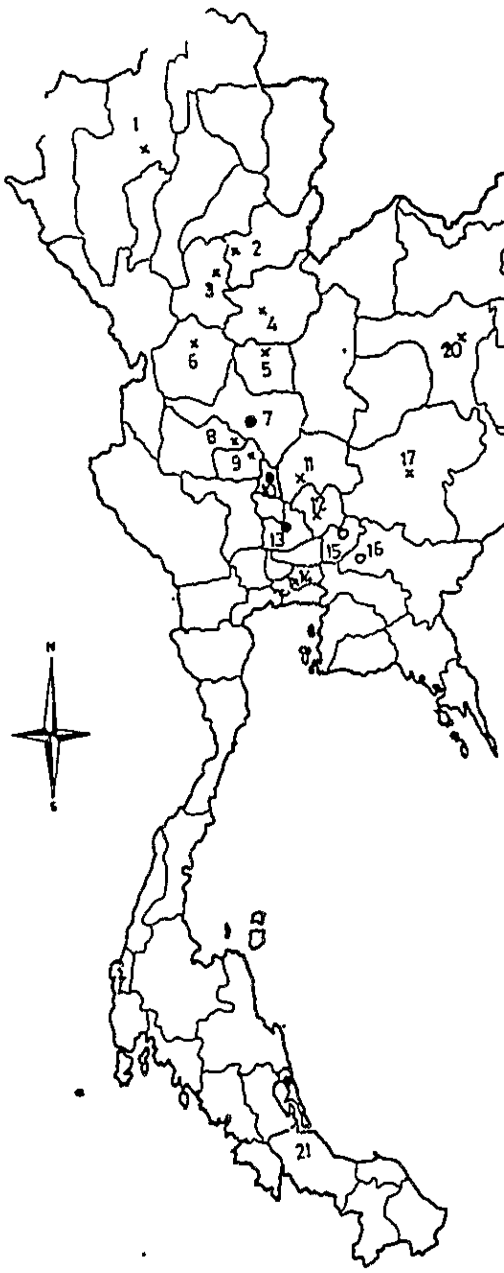
Table 1. Some Characteristics of Wild Rice Species Collected from Deep-Water Rice Areas in Thailand (1981).

Species No.	Awn	Shattering	Nodal Color	Location
1.	awned	tight	red	Nakorn Nayok
2.	awned, long	tight?	red	Nakorn Nayok
3.	awned, red	tight	green	Prachin Buri
4.	awned	tight	green	Nakorn Nayok
5.	awned	shattering	green	Nakorn Nayok
6.	awned	tight	green	Nakorn Nayok
7.	awned, short	tight	green	Nakorn Nayok
8.	awnless	tight	red	Nakorn Nayok
9.	awnless	shattering	green	Nakorn Nayok
10.	awnless	shattering?	green	Nakorn Nayok
11.	awnless	shattering	green	Nakorn Nayok

Table 2. Some Adult Plant Characteristics of Wild Rice in Thailand.

Species	Awn Presence	Awn Color	Hull Color	Nodal Color	Culm length	Infested Provinces
A	awnless	-	straw	brown-black	long	Prachin-Buri
B	awned,	straw	black	brown-black	long	Prachin-Buri
C**	awned,	pink	black	black	long	Singh-Buri
D	awned,	pink	black	green	long	Singh-Buri
E	awned,	red-brown	straw	green	short	Sukho-Thai

* The seeds of wild rices were collected from several Provinces and were grown in net-house.
** Species C is indentified as Oryza ridleyi.



o = intermediate type (annual), serious weed
● = wild type (perennial), serious weed
x = wild type (perennial), non-serious weed

1. Chiangmai
2. Uttaradit
3. Sukhothai
4. Pitsanuloke
5. Pichit
6. Kampeangpet
7. Nakornsawan
8. Uthai thani
9. Chainat
10. Singburi
11. Lopburi
12. Saraburi
13. Ayuthaya
14. Bangkok
15. Nakorn Nayok
16. Prachinburi
17. Nakornrajsima
18. Surin
19. Roi-et
20. Khon-Kaen
21. Songkla

Fig.1. Distribution of wild rice

Table 3. Effect of Soil Water Regimes on Emergence of Wild Rice.

Species No.	Emergence (%) Moist	Saturated	Submerged to 1 cm
1	2	0	2
2	17	13	5
3	3	2	0
4	3	3	0
5	0	0	0
6	13	20	0
7	25	15	3
8	2	3	0
9	0	0	0
10	25	18	0
11	5	0	2
12	32	17	0
13	12	8	2
14	0	0	0

1) Seeds of wild rices were buried to the depth of 5 mm from soil surface. Water regimes were maintained for moist, saturated and submerged by watering lower than soil surface level, up to soil surface level and submerged to 1 cm, respectively.

2) Species No. 1-11 : from Nakorn Nayok
12 . cultivated var. (Indica type - from Nakorn Nayok)
13 : from Prachin Buri
14 : from Singh Buri

Table 4. Effect of Heat Treatment on Dormancy Breaking of Wild Rice (1981).

Species No.	Germination (%) Without treatment	Heat-treatment at 50°C 1 day	3 days	6 days
1	0	4	25	45
2	0	19	32	39
3	0	0	15	34
4	0	9	10	42
5	0	0	2	2
6	0	25	55	82
7	1	27	65	79
8	0	2	15	40
9	0	0	3	12
10	0	5	38	77
11	0	7	18	39
Cultivated Var. (Indica type)	2	55	85	100

Germination tests were routinely performed at 30°C for 10 days using freshly hervested panicles.

Effect of Herbicides on Seed Germination and Early Seedling Growth of Wild and Cultivated Species of Rice.

°Hiroshi Hyakutake, Siriporn Zungsontiporn and Kenji Noda (Weed Science Branch, Department of Agriculture, Thailand)

With infestations of wild rice in deep-water rice areas in Thailand, control methods are being earnestly sought by farmers concerned. Chemical control of wild rice would be more meaningful in case ome highly selective herbicides were to be found. Since the conditions in deep-water rice field are such ld and cultivated species of rice start to germinate almost at the same time and grow with the same pace, herbicide should be equipped with the nature of high selectivity between the two species. reover, it would be difficult to expect good control of rice unless herbicide is applied within the early seedling growth stage of wild rice. The present studies were conducted to find selectivity between wild and cultivated species of rice.

Petri-dish test on CNP indicated that there existed some varietal differences in response to the herbicide as post-emergence application. Among the recommended rice variety in Thailand, RD-21 and RD-25 showed higher tolerance whereas RD-9 was susceptible as the same degree with wild rice against post-emergence treatment (Table 1). No inhibition of the germination was observed.

The applications of propanil at three different growth stages were not effective against wild rice. Wild rices from two different provinces showed tolerance at almost same degree with cultivated varieties (Table 2).

Benthiocarb strongly inhibited the growth of both wild and cultivated species of rice at lower concentration and completely inhibited germination of *Oryza ridleyi*. When protected with NA (naphtalic anhydride), Leb Mue Nahng (Indica type) showed some tolerance against benthiocarb, whereas protective effect of NA in Nihonbare (Japonica type) was not observed. CNP was distinctly effective against *Oryza ridleyi* but not against other wild rice species. In this experiment, pyrazolate, molinate and propanil were not effective for the control of wild species of rice (Table 3).

Farther investigations or the search for potential herbicide,application method and combination with different antidote will be conducted subsequently.

Table 2. Effect of Propanil on Cultivated and Wild Rice.

Plant	Propanil (g/a)	Shoot dry wt. (% of control) applied at 1-leaf stage	2-leaf stage	3-leaf stage
Leuang Pra-tew 123	20	82	106	111
	40	85	93	70
	60	73	88	62
* Leb Mue Nahng 111	20	101	95	101
	40	91	63	98
	60	83	57	93
* Ta-pow-gaew 161	20	119	108	86
	40	88	96	84
	60	82	87	72
Nihonbare	20	81	93	76
	40	83	90	69
	60	82	93	71
Oryza ridleyi (from Singhburi)	20	84	84	118
	40	88	81	108
	60	82	73	102
Wild Rice (from Prachinburi)	20	95	84	122
	40	92	78	105
	60	85	74	86
Echinochloa crus-galli	20	35	4	66
	40	26	3	65
	60	4	2	64

*Floating Rice

Table1. Effect of CNP on Germinatation and Early Seedling Growth of Cultivated and Wild Species of Rice.

Cultivated rice var. or wild rice	CNP (M)	Shoot dry Wt. (% of Control) *Pre-emergence treatment	CNP (M)	**Post-emergence treatment
Leuang Pra-tew 123	10^{-6}	105	10^{-6}	94
	10^{-5}	95	10^{-5}	77
	$5x10^{-5}$	82	10^{-4}	73
Khao Pahk Maw 148	10^{-6}	99	10^{-6}	92
	10^{-5}	83	10^{-5}	84
	$5x10^{-5}$	72	10^{-4}	59
RD 7	10^{-6}	95	10^{-6}	96
	10^{-5}	84	10^{-5}	93
	$5x10^{-5}$	86	10^{-4}	83
RD 9	10^{-6}	95	10^{-6}	129
	10^{-5}	87	10^{-5}	64
	$5x10^{-5}$	80	10^{-4}	40
RD 21	10^{-6}	102	10^{-6}	105
	10^{-5}	87	10^{-5}	110
	$5x10^{-5}$	85	10^{-4}	101
RD 23	10^{-6}	79	10^{-6}	87
	10^{-5}	60	10^{-5}	87
	$5x10^{-5}$	56	10^{-4}	60
RD 25	10^{-6}	85	10^{-6}	134
	10^{-5}	81	10^{-5}	109
	$5x10^{-5}$	69	10^{-4}	108
Nihonbare	10^{-6}	107	10^{-6}	121
	10^{-5}	92	10^{-5}	107
	$5x10^{-5}$	92	10^{-4}	91
Wild Rice (from Prachin-Buri)	10^{-6}	100	10^{-6}	85
	10^{-5}	79	10^{-5}	56
	$5x10^{-5}$	68	10^{-4}	46

* Ungerminated rice seeds were placed in a 9 cm petri-dish containing designated CNP solution.

** CNP was treated to greenned rice seedlings of approximately 5 in length in petri-dish.

Table 3. Susceptibility of Wild and Cultivated Rice to Herbicides and Antidote (NA 2%)

Species	Treatment (g/a)	A		B		C	D	E	F	G	H
NA		O	NA	O	NA	O	O	O	O	O	O
Benthiocarb	10	53	84	44	63	37	-	55	61	98	0
	20	36	70	37	40	32	-	43	48	23	0
	30	12	69	36	0	21	-	44	35	0	0
CNP	15	99	78	68	73	57	-	83	95	91	30
	30	66	72	59	56	31	-	46	79	76	21
	45	55	70	56	40	24	-	43	56	69	14
Pyrazolate	15	102	95	82	89	74	-	90	111	107	59
	30	90	86	78	87	65	-	79	111	98	41
	45	84	59	72	33	50	-	71	94	78	38
Molinate	20	82	-	79	-	68	74	77	77	66	-
	30	75	-	72	-	48	65	76	50	18	-
	45	61	-	57	-	37	49	51	60	11	-
Propanil	20	95	-	111	-	105	114	138	94	95	-
	40	82	-	100	-	100	105	117	91	89	-
	60	82	-	103	-	93	92	98	87	102	-

1. Species A. Leb Mue Nahng 111
   B. Nihonbare
   C. Species No. 1
   D. Species No. 4
   E. Species No. 6
   F. Species No. 7
   G. Species No. 11
   (C.–G.: refer to the Table 1 in previous report (Title No.84) in this Supplement.)
   H. Oryza ridleyi
2. Benthiocarb, CNP, Pyrazolate, Molinate : preemergence treatment, propanil : 2-leaf stage treatment
3. Seeds of cultivated var. were soaked in NA 2% solution for 16 hrs.
4. Shoot dry wt. (per 30 plants) in control and NA treatment: Leb Mue Nahng 111 0.40 g(100), 0.38 g (95); Nihonbare 0.54 g (100), 0.37 g (69)
5. - : no experiment

Effect of Pre-emergence Herbicides and other Chemicals on Seed Germination of Mimosa pigra L.

Cha-um Premasthira and Hidejiro Shibayama (Weed Science Branch, Department of Agriculture, Thailand)

Mimosa pigra L. was introduced into Thailand to be used as a cover crop on the irrigation canal banks but later have become a noxious weed in Northern Thailand. Attempts to control it in the pa... were by using post-emergence herbicides and biological means. This paper reports on effects of certain growth regulators and pre-emergence herbicides at different concentrations on germination of Mimosa seeds and their subsequent development. Results revealed that one week after seeds of Mimosa pigra were treated with 0.1,1, 10, 100 and 1,000 ppm of 2,4-D, IAA, Ethephon, NAA and GA, there were marked retardation of shoot and root elongation of those treated with 2,4-D, IAA, Ethephon and NAA.The effect was most pronounce... at the concentration of 100 ppm and above for 2,4-D and above 100 ppm for the rest. As for GA it promote... shoot and root elongation of Mimosa pigra at the concentration above 1 ppm, but at the concentration... 100 ppm and above it inhibited, root growth (Fig. 1 and 2).

Results of testing on effects of certain herbicides on the germination of Mimo... vitro indicated that amiben markedly reduced both root and shoot growth to less than 10% at 1 ppm, alachlor, butachlor and benthiocarb also limited the root growth to less than 40% at 1 ppm while nitrofen, oxadiazon, and diuron produced the same effect at 100 ppm. As for effect on shoot growth, nitrofen was effective at 1 ppm reducing shoot growth to less than 40% while benthiocarb, butachlor, alachlor were as effective at 10 ppm and oxadiazon at 100 ppm and diuron had no noticeable effect at the three concentrations tested (Fig. 3 and 4).

When the above-mentioned herbicides were tested as pre-emergence in the clay-po... 1 kilogram (ai) /rai results indicated that there was no seed germination in the oxadiazon treate... at both concentrations while there were germinations on all other treatments except amiben at 1 kg. After 3 weeks plants in 1 kg treatments if nitrofen, alachlor and diuron were all killed and so did those in the 0.5 kg treatments of amiben, alachlor and diuron. Nitrofen at 0.5 kg and benthiocarb and butachlor at both concentrations were not satisfactory (Table 1).

Note

ALA	-	alachlor
AMI	-	amiben
BEN	-	benthiocarb
BUT	-	butachlor
DIU	-	diuron
2,4-D	-	2,4-D amine salt
Eth	-	ethephon
NIT	-	nitrofen
Rai	-	1,600 m^2 or 0.5 kg(ai)/rai = 3.125 kg/ha
		1.0 kg(ai)/rai = 6.25 kg/ha

Table 1 Effect of pre-emergence herbicides on *Mimosa pigra* germination.

treatment	nitrofen		oxadiazon		benthiocarb		amilon		alachlor		butachlor		diuron	
	0.5	1.0	0.5	1.0	0.5	1.0	0.5	1.0	0.5	1.0	0.5	1.0	0.5	1.0
G1	93.62	89.34	0	0	95.72	102.11	68.09	0	114.87	68.09	123.26	114.87	114.87	112.76
G2	19.23	0	0	0	62.5	37.5	0	.0	0	0	123.26	114.87	0	0
D.M	7.69	0	0	0	84.61	15.38	0	0	0	0	61.53	53.84	0	0

Note. application rate of herbicides were 0.5, 1.0 kg (ai)/rai

G1 = percentage of germination at 1 week.

G2 = percentage of germination at 3 weeks.

D.M = percentage of dry matter at 3 weeks.

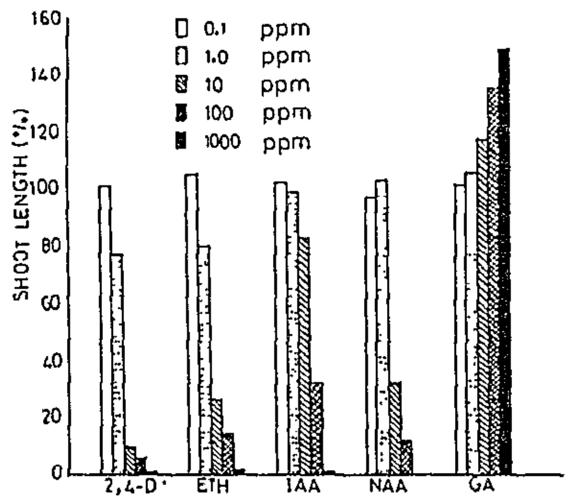


FIG 1 EFFECT OF GROWTH REGULATOR ON MIMOSA GERMINATION

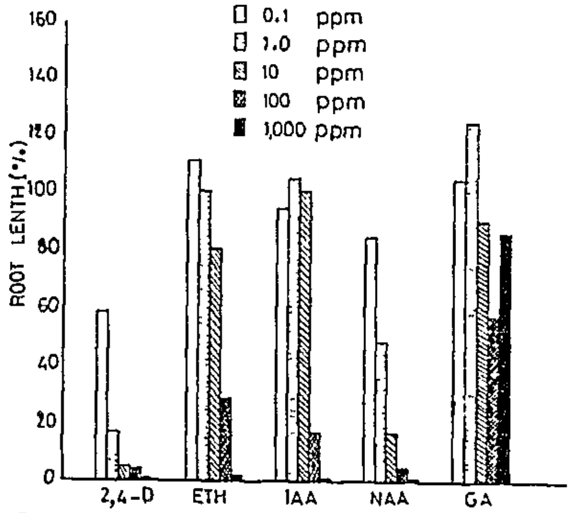


FIG 2 EFFECT OF GROWTH REGULATOR ON MIMOSA GERMINATION

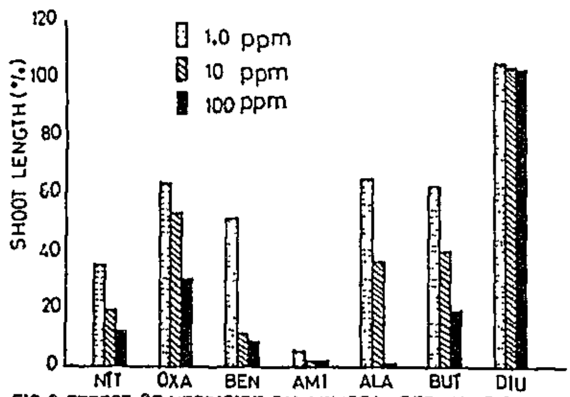


FIG.3 EFFECT OF HERBICIDE ON MIMOSA GERMINATION

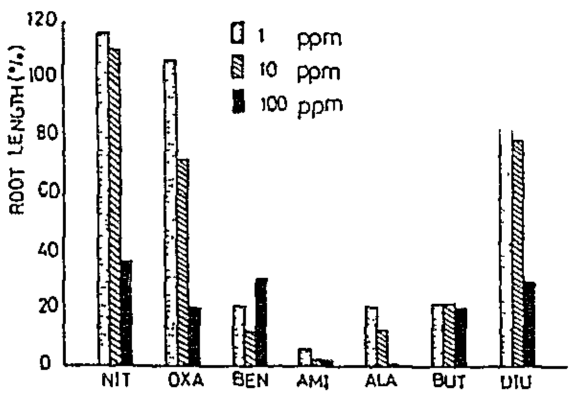


FIG.4 EFFECT OF HERBICIDE ON MIMOSA GERMINATION.

Distribution and habitats of Mimosa pigra L. in aquatic and other areas of Thailand.

°Hidejiro Shibayama, Paitoon Kittipong, Tawee Sangtong, Chaiyot Supatanakul and Cha-um Premasthira (Weed Science Branch, Department of Agriculture, Thailand)

Mimosa pigra L. is the thorny and sensitive leguminous woody spicies which naturalized in Thailand many years ago.[*] In recent years, it became one of the most serious weeds especially in aquatic areas of Northern Thailand.

Distribution of Mimosa pigra L. vegetations and their habitats were investigated in March to November of 1981. As having been reported by some officials and researchers of Thailand, M. pigra vegetations were found mainly in the Northern Region of this country. They were also found along the Chao Phraya river (so-called Me-Namu Gawa, in Japanese) down to near Nakorn Sawan, or several spots in Saraburi and Nakorn Nayok Provinces, etc. (Figure 1).

In Chiang Rai Province, dense vegetations of Mimosa pigra L. were distributed along Ing and Warn river,Kok and Lao river, Kham and Chan river, Ruak river, their main stream, Mekhong river, and small branch streams of these rivers. In Chiang Mai, Lam Phun and Lam Pang Provinces, Ping river and Doi Tao and Bhumipol Dam, Wang river and Kiu Lom Dam, and their branch streams were infested with Mimosa plants (Figure 1).

On habitats of this species, plants were mainly growing at marginal areas of canals, rivers and lakes, but they also inhabited water-logged areas as seen in Kiu-Lom, Doi Tao and Bhumipol Dams. Concerning on this habitat, by our greenhouse experiments as mentioned in another report, it is probable that they had germinated from soils in upland condition, when water level was low in dry season. As an example, water level of Kiu Lom Dam fluctuated about seven meters during one year in 1980. After germinating, young plants of Mimosa pigra L. might be able to grow up in flooded condition, as water level rose up month by month.

Momosa pigra L. infested lots of abandoned fields and road sides, especially around Chiang, Mai city. The area of these habitats are not so much in other Province, but it shows the adaptability of this species to some environmental conditions.

This survey and greenhouse experiments suggest that Mimosa pigra L. have the potentiality to infest many other water systems in future, although this species can not grow at aquatic areas where soil is covered or flooded with water whole year.

*) Patcharin Wanichanantakul, et al., 1979. Proc. 7th APWSS conf. 381-383.

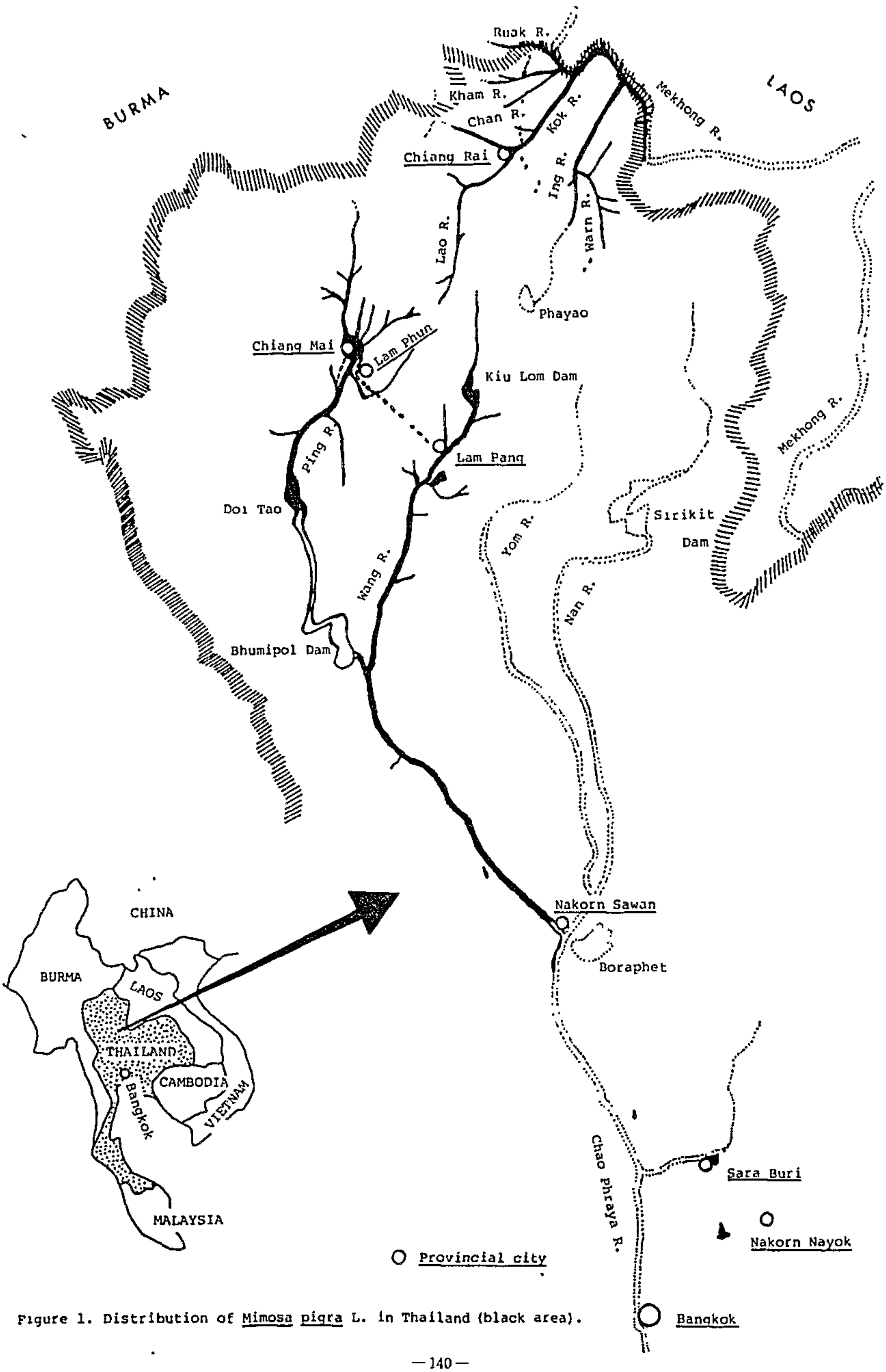


Figure 1. Distribution of *Mimosa pigra* L. in Thailand (black area).

Effects of soil and water conditions on seed germination and growth of Mimosa pigra L.

°Hidejiro Shibayama and Cha-um Premasthira (Weed Science Branch, Department of Agriculture, Thailand)

In natural habitations, Mimosa pigra L. plants are growing mainly in/and along aquatic areas as lakes, rivers, dams, irrigation canals and so on. This study was conducted to investigate in what soil and water conditions their seeds can germinate and grow, because this information would be necessary to keep areas from Mimosa's invasion.

Experiment 1. Effects of soil conditions on seed germination.

Seed germination rates of Mimosa pigra L. were different by the tested six kinds of soil in upland condition (Table 1). Effects of sowing depth in soil on seed germination were also investigated by using sandy soil and sand in upland condition (Table 2). In both soils, germination was best when seeds were sown in 1 cm depth, but germination rates decreased as the sowing depth increased. Furthermore, this result shows that Mimosa seeds can not germinate when they are buried from the surface soil into the deep one of 10 cm or more.

Experiment 2. Effects of water levels on seed germination.

Seeds of Mimosa pigra L. germinated on the soil surface of flooded condition even under 10 cm water depth, but their roots could not grow into flooded soil and almost all of the germinated plants floated up on water surface, and finally decayed to die. Only a few seedlings were alive in 0 cm-flooded pots (flooded at soil surface level) in this experiment (Figure 1). Therefore, practically, Mimosa seeds could germinate only under the upland condition where water levels were 1 cm or more below soil surface. In natural vegatation, Mimosa seeds will germinate when water level will go down below soil surface, and the soil condition of the area will be in upland one.

Experiment 3. Effects of flooding on the growth of seedlings.

In this experiment, effects of water flooding on lives and subsequent growth of Mimosa pigra L. seedlings were investigated, after they were germinated in upland soil condition (Figure 2 and Table 3). Complete flooding (all leaves, in Table 3) over Mimosa seedlings during 2 weeks (flooded at Cotyledon stage), 3 weeks (flooded at 1st leaf stage), 4 weeks (flooded at 2nd leaf stage), and 5 weeks (flooded at 3rd leaf stage) killed all plants in treated pots, but 2 weeks flooding (at 2nd leaf stage) or 1 and 3 weeks flooding (at 3rd leaf stage) did not kill some seedlings, and they recovered their growth soon. On the other hand, soil surface flooding under Cotyledon or other leaves did not kill Mimosa seedlings, although root developments were inhibited much in these seedlings as shown in smaller top-root ratio than 4.7 of the untreated control plant (Table 3).

Table 1. Effects of soil types[1)] on seed germination of *Mimosa pigra* L.

Soil type	Germination rate 1 week	2 weeks	3 weeks
Sand	85%	85%	85%
Upland soil, sandy[3)]	3	61	61
Upland soil, black[4)]	78	78	78
Upland soil, red[5)]	84	84	84
Mountain soil, Marl[6)]	79	82	82
Paddy soil, dried[7)]	34	49	57
Paddly soil, wet[7)]	64	68	69

1) In upland condition
2) No germination after 3 weeks
3) From Pakchong, Nakok Ratchasima
4) From Pattananikom, Lopburi
5) From Mahasarakam, Muang
6) From Tarea, Saraburi
7) From Bangkhen, Bangkok

Table 2. Effects of sowing depth[1)] on seed germination of *Mimosa pigra* L.

Sowing depth		Germination rate 1 week	2 weeks[2)]
Upland soil Sandy	1 cm.	71 %	75 %
	3	40	44
	5	43	45
	7	34	36
	10	-	-
	15	-	-
	20	-	-
Sand	1 cm.	86	87
	3	82	84
	5	67	r
	7	32	
	10	-	
	15	-	-
	20	-	-

1) In upland condition
2) No germination after 2 weeks

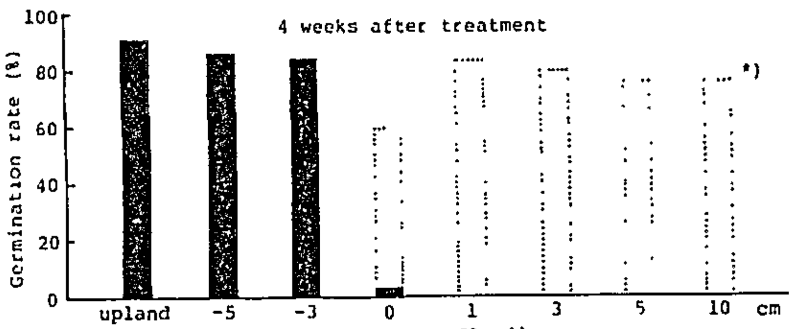


Figure 1. Effects of water levels on seed germination of *Mimosa pigra* L.

*) In the flooded condition (water level 0-10 cm), some seeds could germinate, but decayed (0 cm) or floated up on the water surface and could not grow at all (1-10 cm) (dotted line).

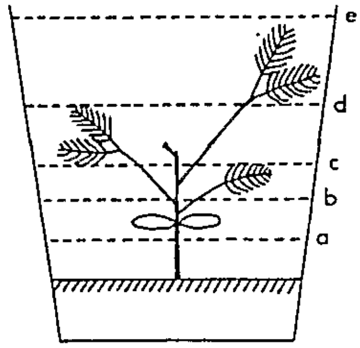


Figure 2. Levels of water flooding in experiment 3.
a: under cotyledon
b: under 1st leaf
c: under 2nd leaf
d: under 3rd leaf
e: all leaves (complete)

Table 3. Effects of flooding on the growth of *Mimosa pigra* L. seedlings.

Leaf stage of *M. pigra* at flooding	Depth of flooding	Number of survived plants	Fresh weight per plant	Top-root ratio (T = 1)
Cotyledon	All leaves (2 weeks)	0 %	0 %	0
	Under Cotyledon	85	76	3.6
1st leaf	All leaves (3 weeks)	0	0	0
	Under 1st leaf	31	60	2.6
	Under Cotyledon	98	39	3.0
2nd leaf	All leaves (4 weeks)	0	0	0
	All leaves (2 weeks)	86	66	3.5
	Under 2nd leaf	88	42	2.2
	Under 1st leaf	92	57	2.9
	Under Cotyledon	89	48	3.8
3rd leaf	All leaves (5 weeks)	0	0	0
	All leaves (3 weeks)	46	20	1.9
	All leaves (1 week)	95	107	3.9
	Under 3rd leaf	80	29	1.7
	Under 2nd leaf	86	75	3.1
	Under 1st leaf	96	67	4.0
Untreated Control		100	100	4.7