

Current Host Status of Vegetables for Root-knot Nematodes in Thailand

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Values of Vegetables (million US) from Thailand

Table 7. Value (million US\$) of vegetable production in tropical Asia

Year	Tropical Asia*	India	Indonesia	Philippines	Thailand	Vietnam	Other countries
1991	14,102	8,938	1,140	1,037	659	881	1,447
1992	13,823	8,390	1,071	1,259	627	896	1,580
1993	13,215	7,650	1,308	851	737	951	1,718
1994	15,252	8,969	1,459	1,025	834	1,099	1,866
1995	18,182	9,918	2,852	1,135	1,109	1,281	1,887
1996	19,391	10,863	2,547	1,375	1,182	1,398	2,026
1997	19,158	11,318	1,910	1,051	975	1,739	2,165
1998	19,778	12,580	1,061	983	1,031	1,672	2,451
1999	21,708	13,787	2,475	1,122	935	1,600	1,789
2000	19,325	11,842	1,873	836	908	1,662	2,204
2001	20,803	13,974	1,844	716	667	1,682	1,920
2002	20,814	13,351	2,029	798	667	1,818	2,151
2003	24,778	16,302	2,722	851	824	1,907	2,172
2004	26,809	17,938	2,904	1,030	522	1,967	2,448
2005	28,955	19,213	3,079	1,012	595	2,169	2,887
Share in 2005 (%)		66.4	10.6	3.5	2.1	7.5	10.0

Source: FAOSTAT (2007)

*Myanmar was excluded from the calculation since its value estimates seemed too high compared to regional norms.

Nematode Problems in Thailand

Mostly by root-knot nematodes (*Meloidogyne* spp.)

Why?

- Symptoms: big and conspicuous galls
clearly observed
- Crop yield losses – clearly evident
- *Meloidogyne* has a wide host range

Ten species of *Meloidogyne* identified in Thailand

No.	Meloidogyne	Crop	Location	Reference
1	M. arenaria	Onion	Central Thailand	Anon and Pliansinchai, 1980
2	M. enterolobii	Guava	Central Thailand	Jindapanapat et al., 2011
3	M. exigua	Lowland Rice	Central Thailand	Anon and Pliansinchai, 1980
4	M. graminicola	Lowland Rice	Northeast	Anon and Ratanaprapha, 1982
5	M. hapla	Ornamentals, herbs	North	Sontirat et al., 1988
6	M. incognita	About 60 plant species	All over Thailand	Chanram, 1982
7	M. javanica	Tuberos, Gerbera	Central Thailand	Chanram, 1982
8	M. nasi	Sorghum	Northeast	Leeprasert, 1976
9	M. microcephala	Tobacco	North	Gean and Hirschman, 1984
10	M. thailandica	Ginger	Intercepted at the port of San Francisco, USA	Handoo et al., 2005

Vegetable Hosts of Root-knot Nematodes In Thailand

Family:

- | | |
|-------------------|----------------------|
| 1. Alliaceae | 11. Leguminosae |
| 2. Asparagaceae | 12. Malvaceae |
| 3. Asteraceae | 13. Piperaceae |
| 4. Chenopodiaceae | 14. Rutaceae |
| 5. Compositae | 15. Solanaceae |
| 6. Convolvulaceae | 16. Umbelliferae |
| 7. Cruciferaeae | 17. Zingiberaceae |
| 8. Cucurbitaceae | |
| 9. Labiateae | |
| 10. Lamiaceae | (leamwimungsa, 2015) |

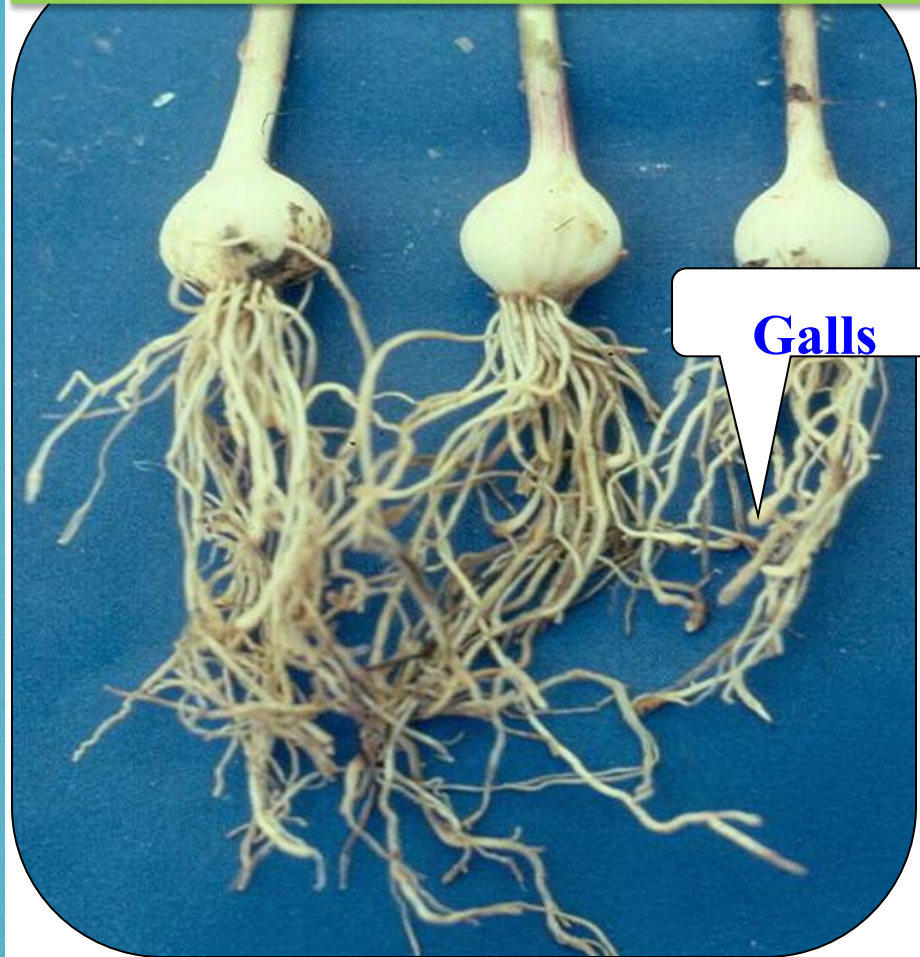
1. Alliaceae

(Garlic)

Allium sativum L.



กระเทียมพันธุ์ศรีสะเกษ

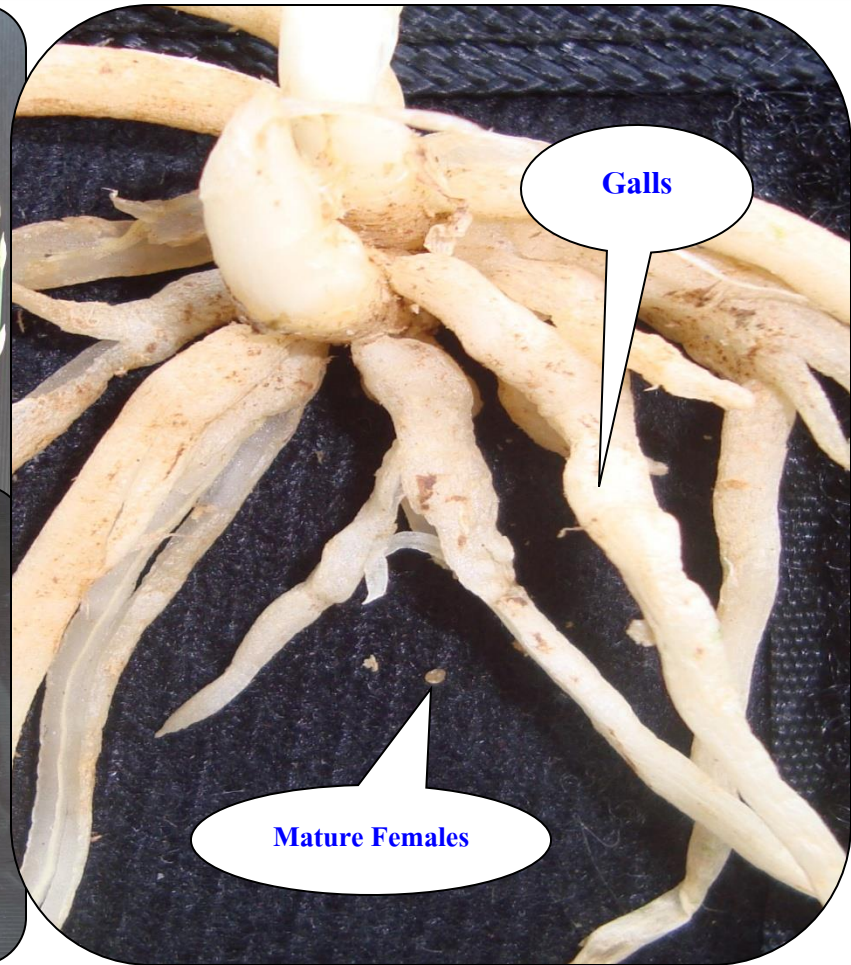


Galls

1. Alliaceae

(Chinese chive)

Allium tuberosum Roxb.



1. Alliaceae

Galls

หอมญี่ปุ่น(หอมจีน) (Welsh onion)

Allium fistulosum (L.) Aeus.



1. Alliaceae



หอมแดง (Shallot)

Allium ascalonicum L.



Galls

1. Alliaceae

หอมแบ่ง (หอมต้น) (Multiply onion, Spring onion)

Allium fistulosum L.



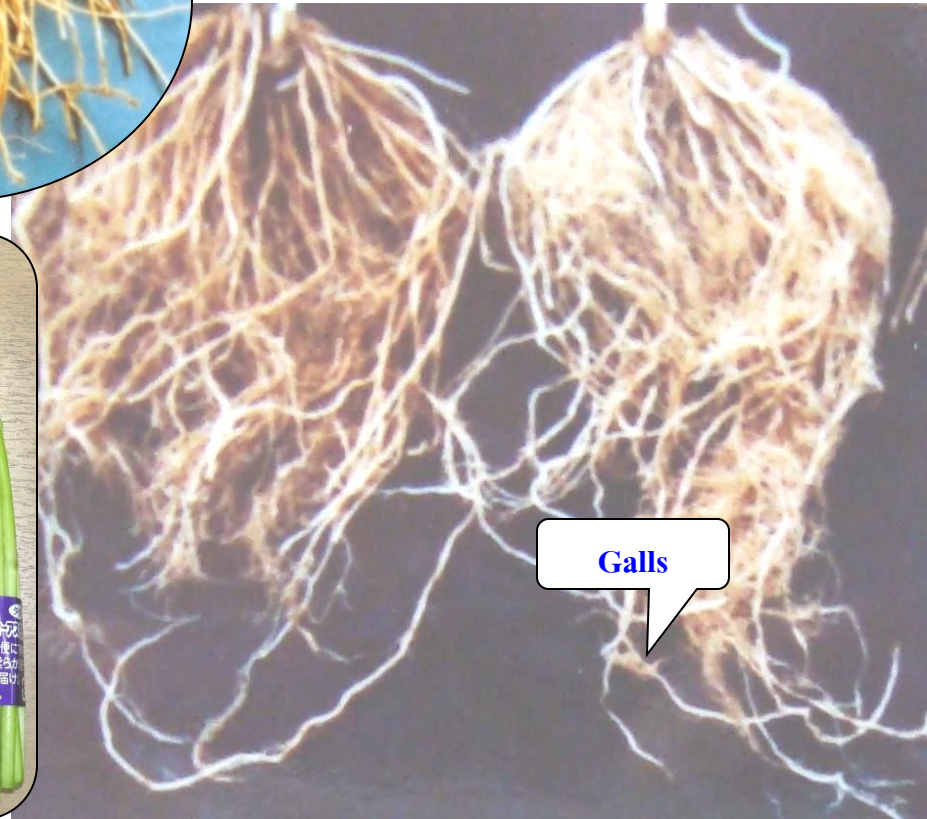
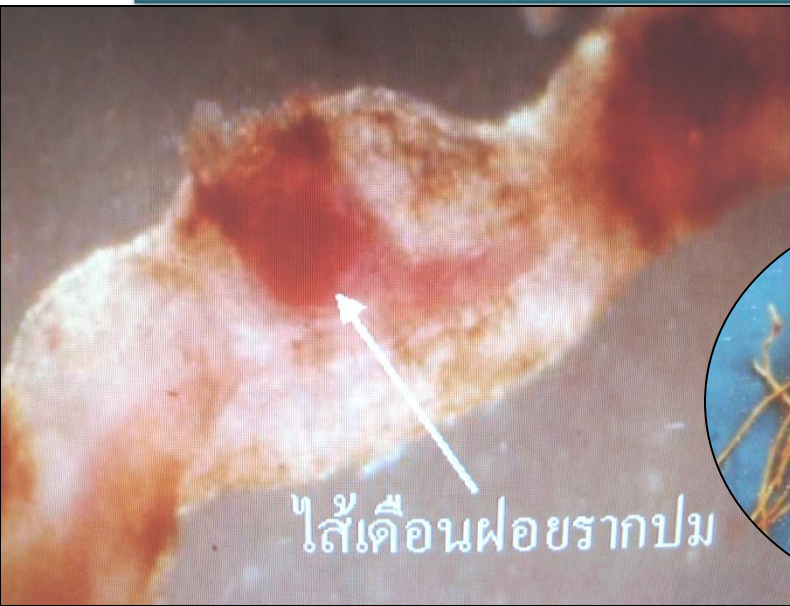
Galls



2. Asparagaceae (วงศ์หน่อไม้ฝรั่ง)

หน่อไม้ฝรั่ง (Asparagus)

Asparagus officinalis L.



3. Asteraceae

ราดิคซิโอ (Chicory, Radicchio)

Chichorium intybus L.



4. Chenopodiaceae

ปวยเล้ง (Spinach)

Spinacia oleraceae L.



Galls

5. Compositeae

จิงจูฉ่าย, โทศจุพาลำพาจีน (Ching chu chai, Kot Chula lampha chin)

Artemisia vulgaris L.var. *indica* Maxim.



5. Compositeae

ผักกาดหอม (Lettuce)

Lactuca sativa L.



Galls



6. Convolvulaceae

ผักบุ้งจีน (Chinese convolvulus)

Ipomoea aquatica Forsk.



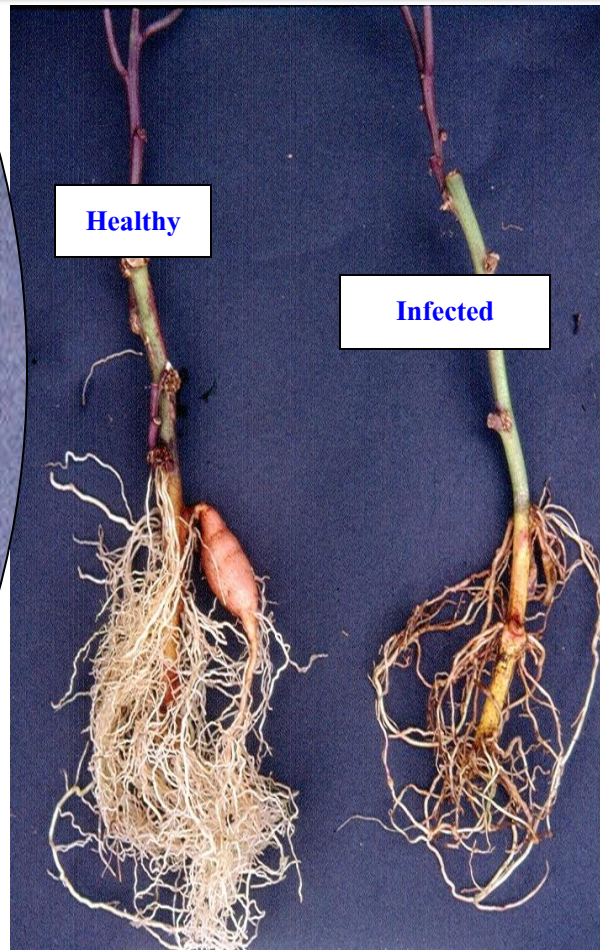
Galls



6. Convolvulaceae

มันเทศ (Sweet potato)

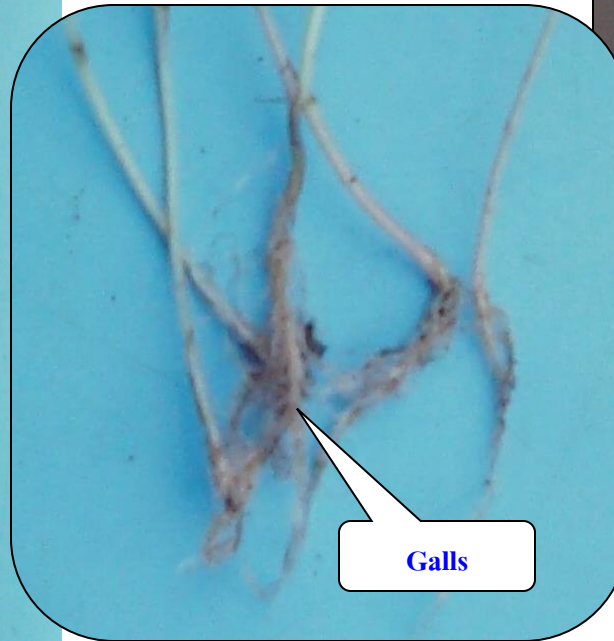
Ipomoea batatas (L.) Lam.



7. Crucifereae

กะหล่ำดอกอิตาเลียน (Broccoli)

Brassica oleracea L. var. *italica* Plenck



7. Crucifereae

กะหล่ำปลี (Cabbage)

Brassica oleracea L. var. *capitata* L.



Galls

7. Crucifereae

ผักกาดเขียวขาวกวางตุ้ง (Flowering white cabbage)

Brassica chinensis L. var. *parachinensis* Tsen & Lee



Galls



7. Crucifereae

ผักกาดเขียวปลี (Leaf mustard)

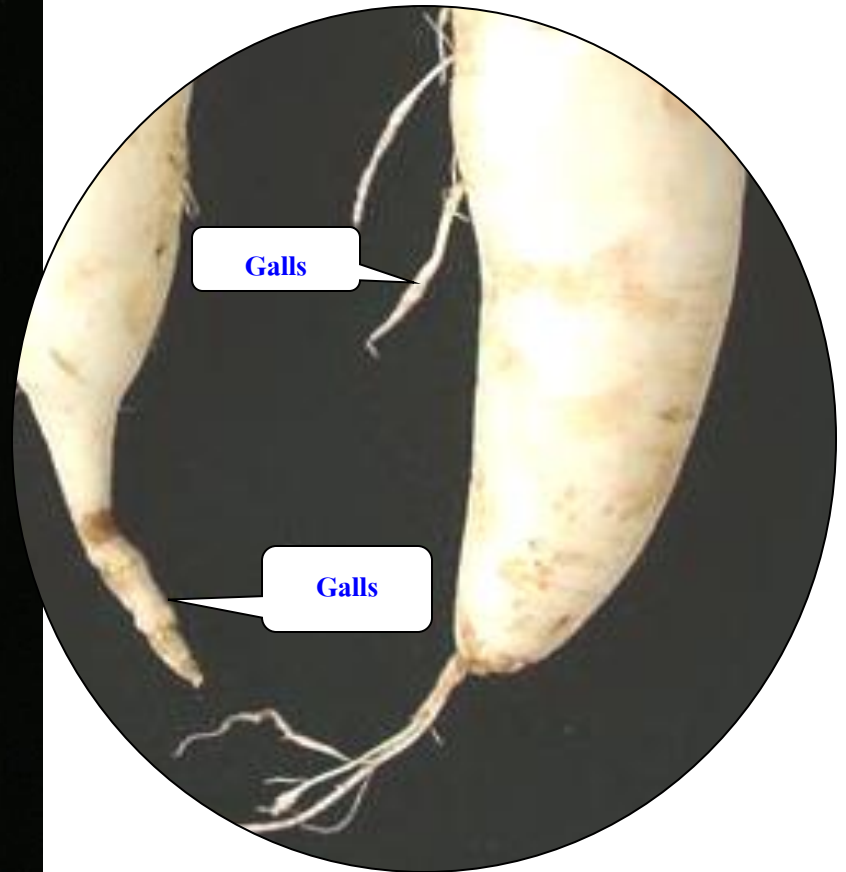
Brassica juncea (L.) Czern.



7. Crucifereae

ผักกาดหัว (Radish)

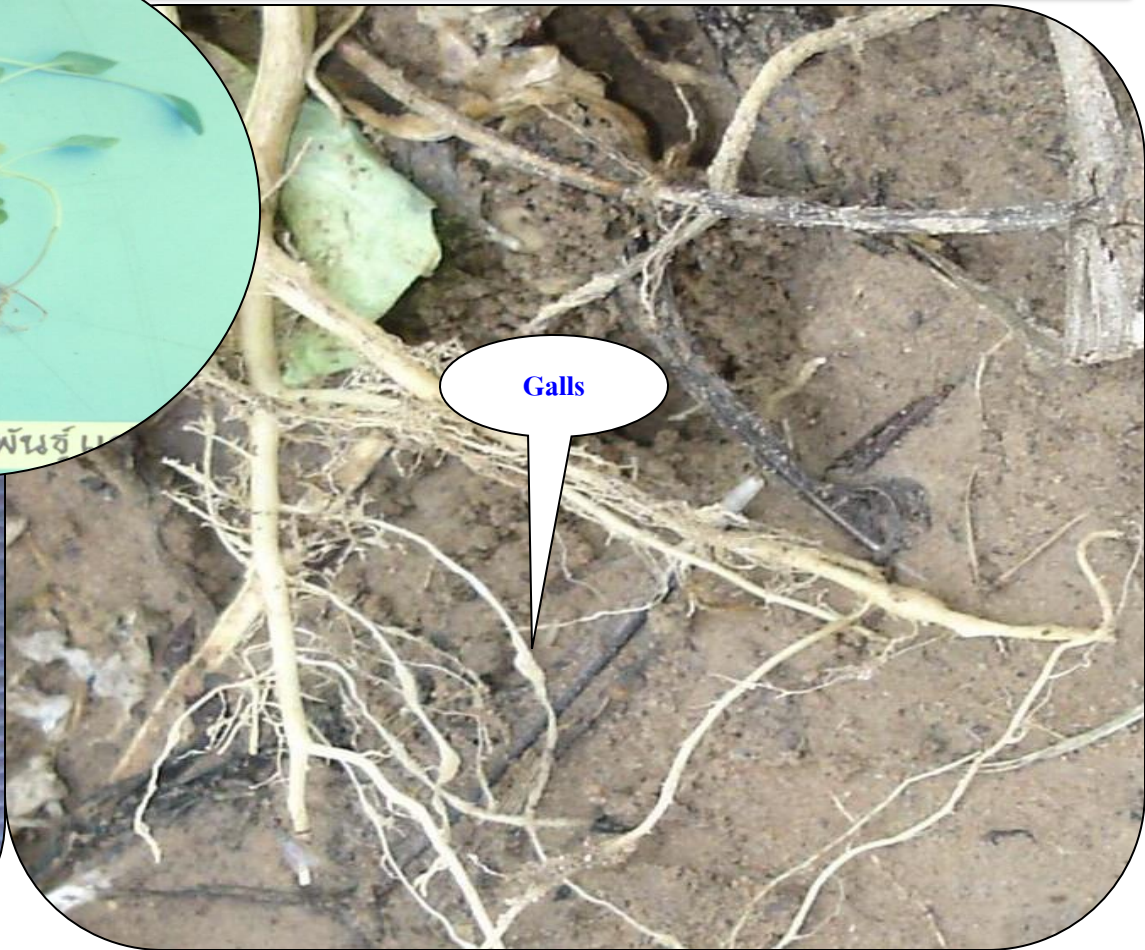
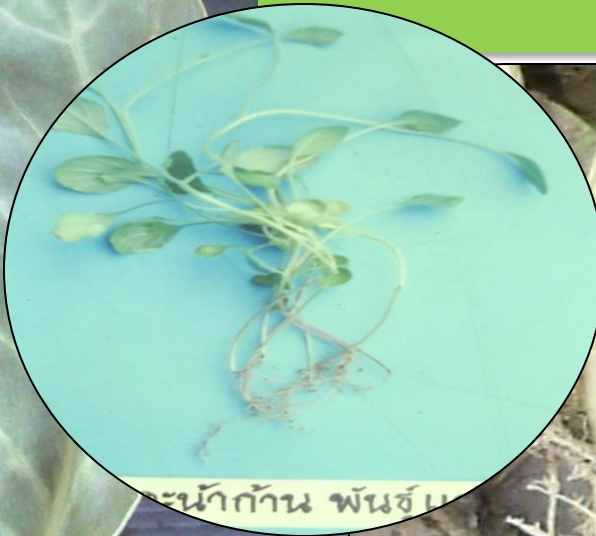
Raphanus sativus (L.)



7. Crucifereae

ผักคะน้า (Chinese kale)

Brassica alboglabra L.H.Bailey



Galls

7. Crucifereae

เล้ากอ (Bitter cress)

Cardamine hirsuta L.



8. Cucurbitaceae

ขี้กาแดง (Khi ka dong)

Gymnopetalum chinense (Lour.) Merr.



Galls

8. Cucurbitaceae

ตำลึง (Ivy gourd)

Coccinia grandis (L.) Voigt

Galls in old
plant

Galls in
seedling



8. Cucurbitaceae

แตงกวา (Cucumber)

Cucumis sativus L.



8. Cucurbitaceae

แตงแคนตาลูป (Cantaloupe)

Cucumis melo L. var. *cantalupensis*



Galls



8. Cucurbitaceae



แตงไทย (Melon)

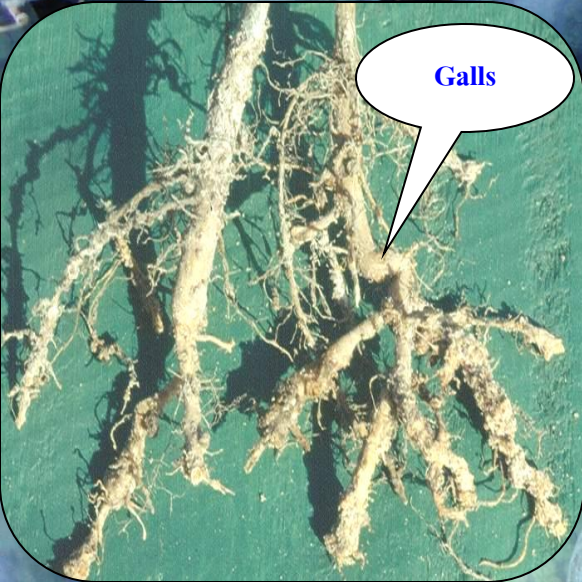
Cucumis melo L.



8. Cucurbitaceae

แตงโม (Water melon)

Citrullus lanatus (Thunb.) Matsum. & Nakai



8. Cucurbitaceae

แตงร้าน (Taeng ran)

Cucumis sativus L.

Galls



8. Cucurbitaceae

น้ำเต้า (Bottle gourd)

Lagenaria siceraria (Molina) Standl.

Galls



8. Cucurbitaceae

บวบหอม (Smooth loofah)

Luffa cylindrica (L.) M.Roem.

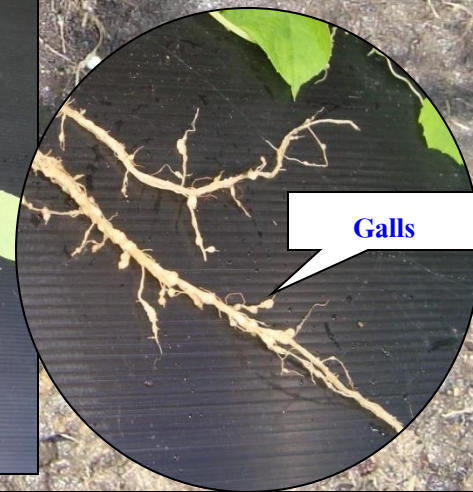


Galls

8. Cucurbitaceae

บวบเหลี่ยม (Angled loofah)

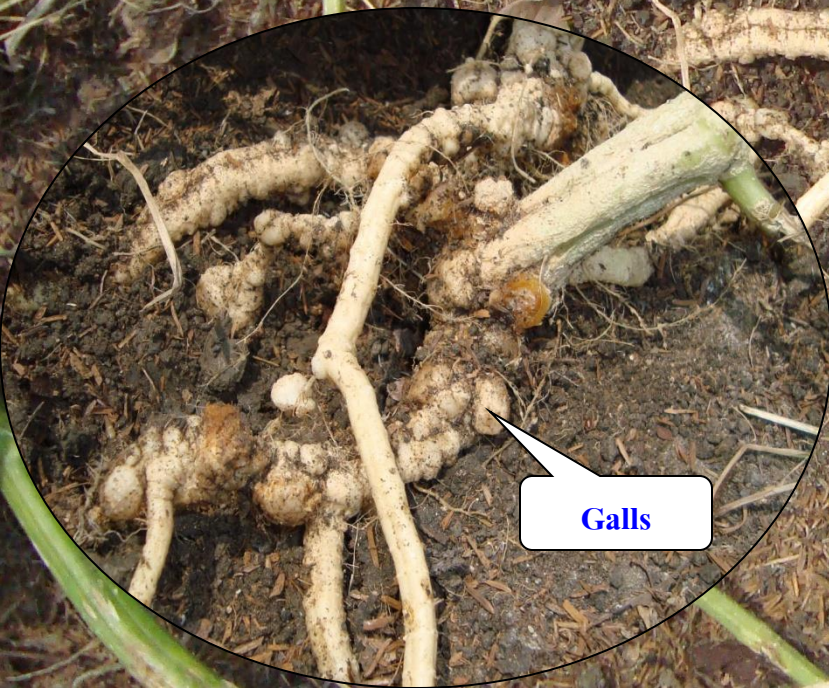
Luffa acutangula (L.) Roxb.



8. Cucurbitaceae

ผักเขี้ยวใหญ่ (Wax gourd)

Benincasa hispida (Thunb.) Cogn.



Galls

8. Cucurbitaceae

ฟักทอง (Pumpkin)

Cucurbita moschata Duchesne

Galls

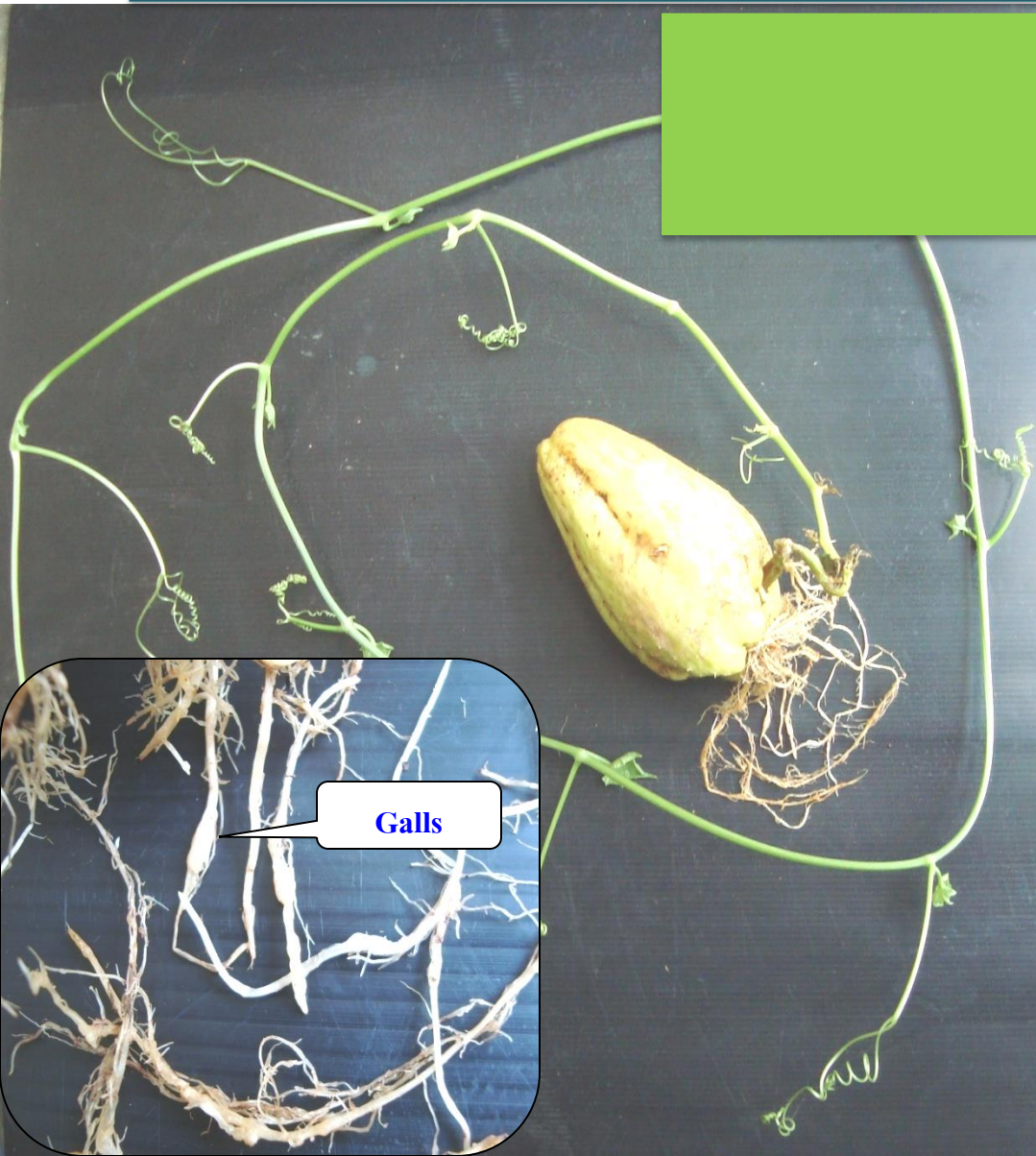
ฟักทอง



8. Cucurbitaceae

ผักแน้ว (Chayote)

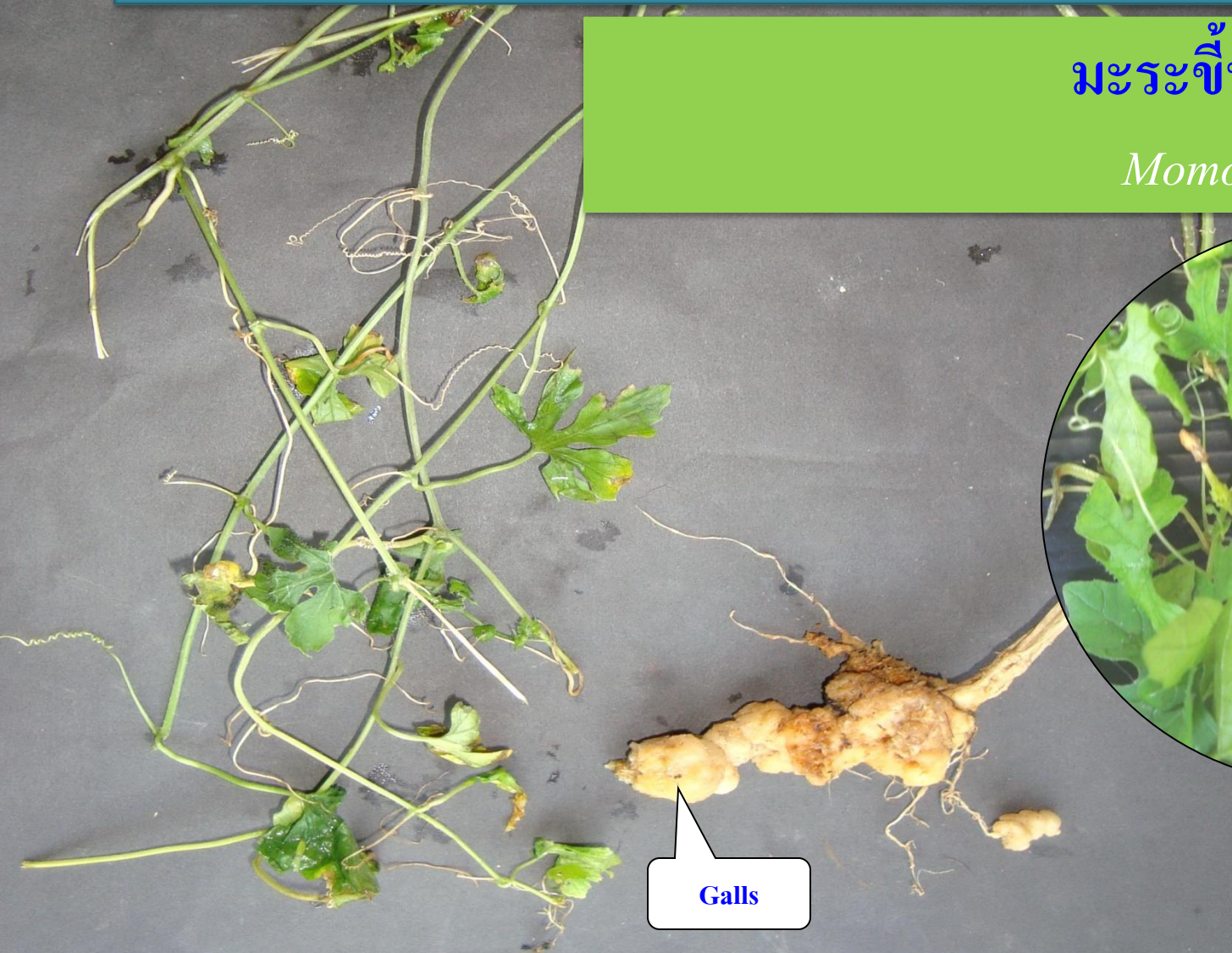
Sechium edule (Jacq.) Swartz



8. Cucurbitaceae

มะระขี้นก (Balsam pear)

Momordica charantia L.



Galls



9. Labiateae

กะเพรา (Holy basil)

Ocimum tenuiflorum L.



9. Labiateae

มันขี้หนู (Man khi nu)

Plectranthus rotundifolius (Poir.) Spreng. (*Coleus parviflorus* Benth.)



Healthy
tubers



Infected
tubers

9. Labiateae

แมงลัก (Hairy basil)

Ocimum americanum L.



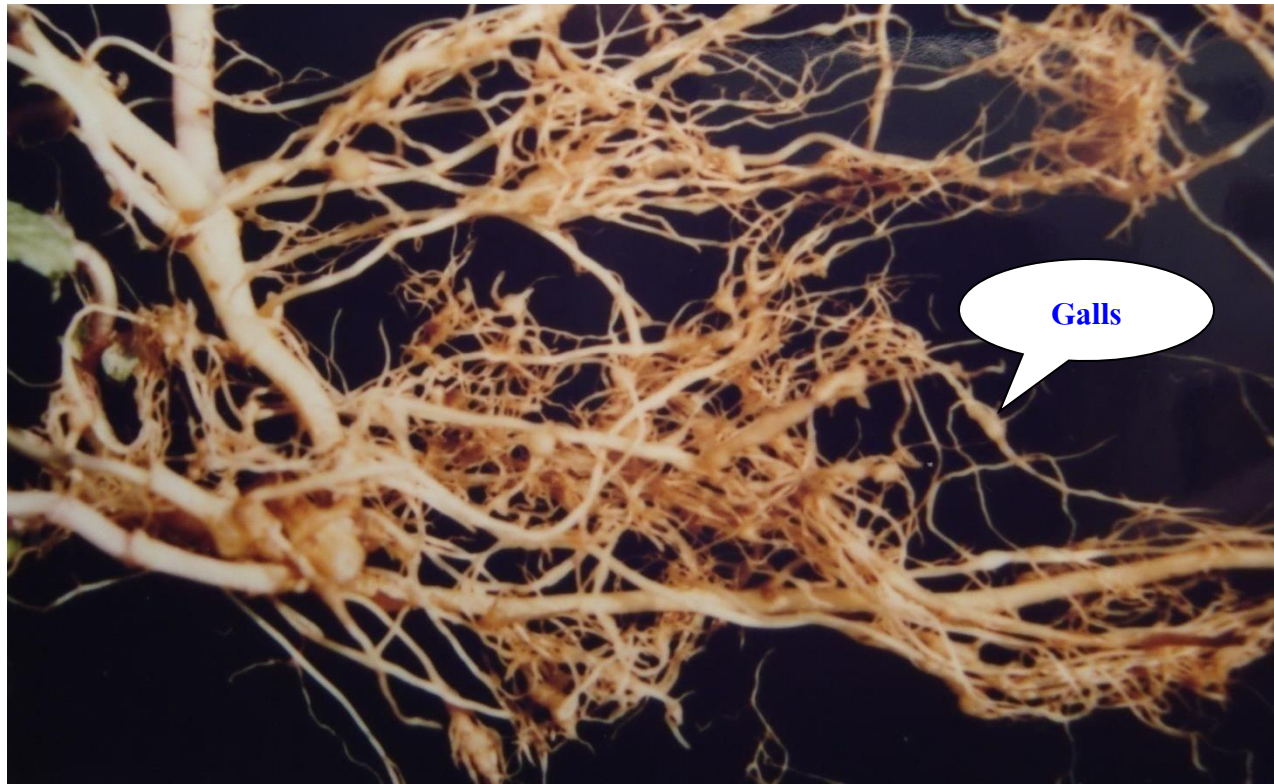
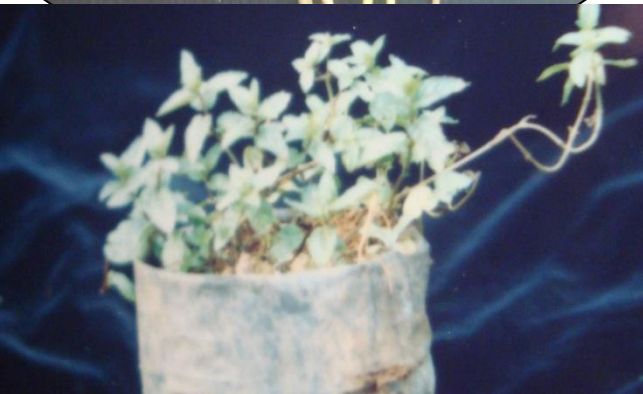
Galls

9. Labiateae



สะระแหน่ (Kitchen mint)

Mentha cordifolia Opiz ex Fresen



Galls

9.Labiatae

โหระพา (Sweet basil)

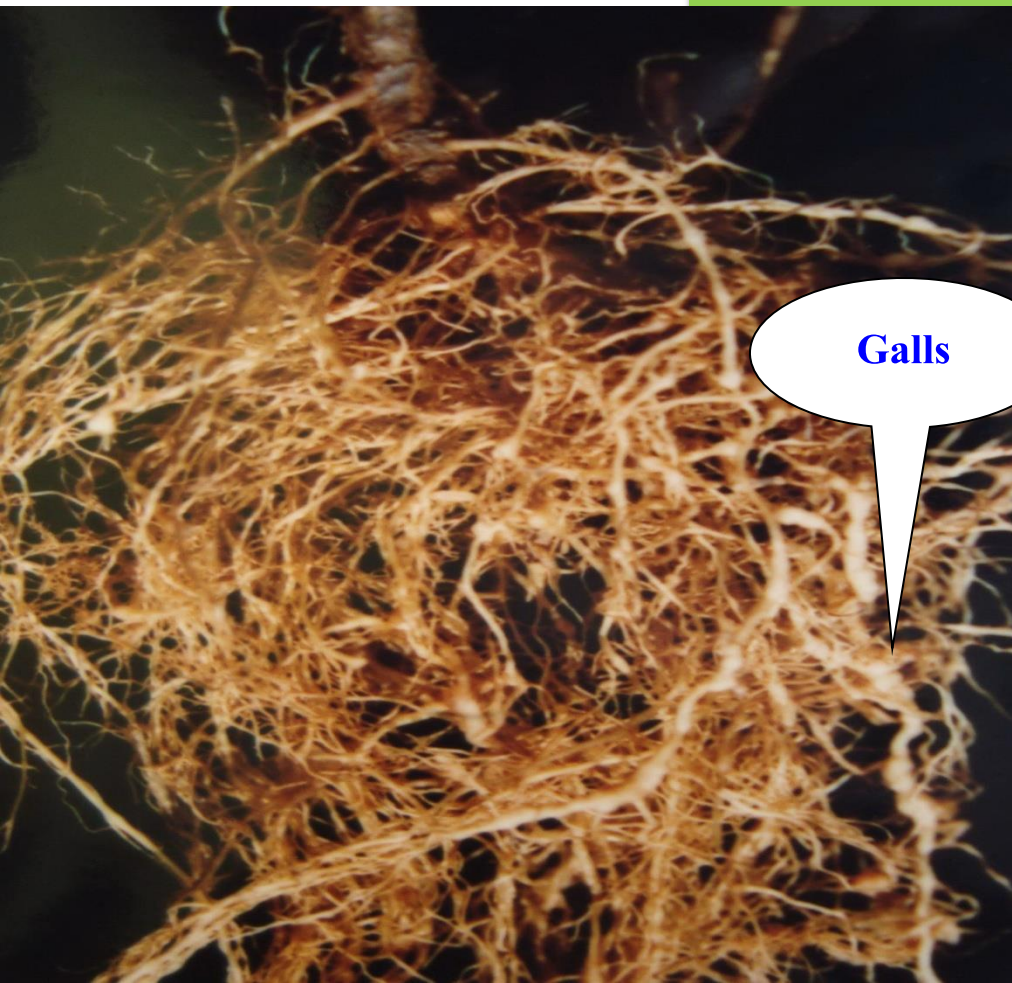
Ocimum basilicum L.



10. Lamiaceae

เสจ (Sage)

Salvia officinalis L.



10. Lamiaceae

โอรกานโอ (Oregano)

Origanum vulgare L.



Galls



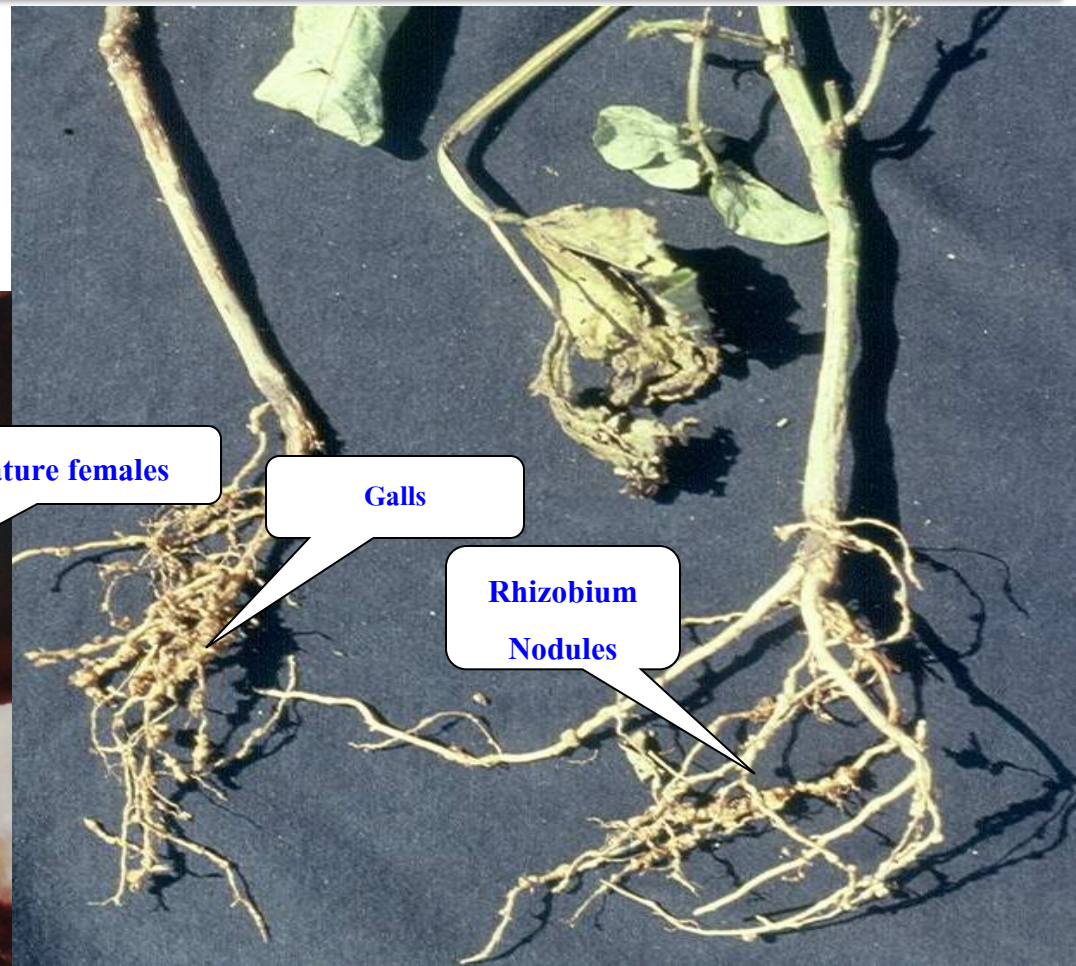
11. Leguminosae

ถั่วเขียว (Mung bean)

Vigna radiata (L.) R. Wilezek



Mature females



Galls

Rhizobium
Nodules

11. Leguminosae

Nematode Galls

Rhizobium
Nodules

ถั่วแขก (Common bean)

Phaseolus vulgaris L.



11. Leguminosae

ถั่วแดง (Rice bean)

Vigna umbellata (Thunb.) Ohwi & Ohashi

Nematode galls
embedded in
nodules

Rhizobium
Nodules

Rhizobium Nodule



11. Leguminosae

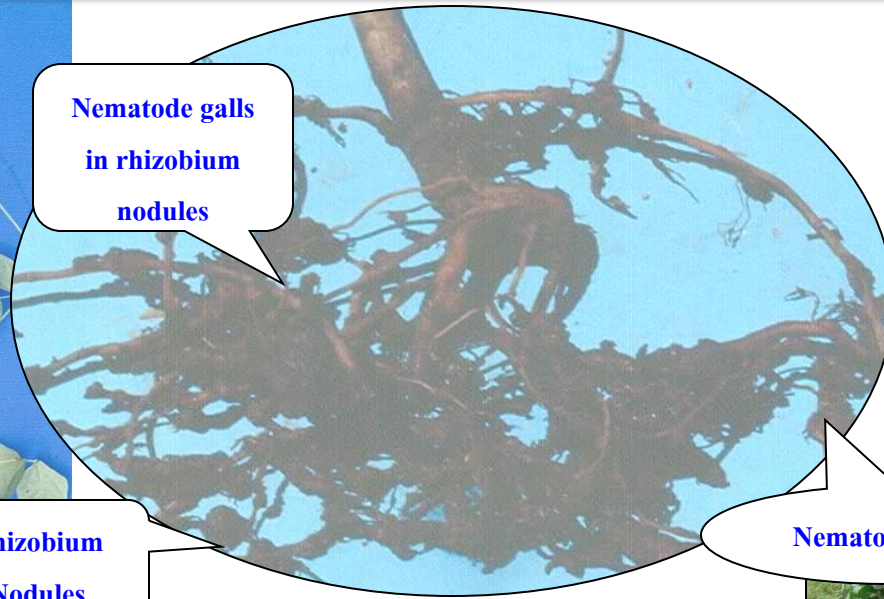
ถั่วฝักยาว (Yard long bean)

Vigna unguiculata (L.) Walp. subsp. *unguiculata* (L.) Verdc.



Nematode galls
in rhizobium
nodules

Rhizobium
Nodules



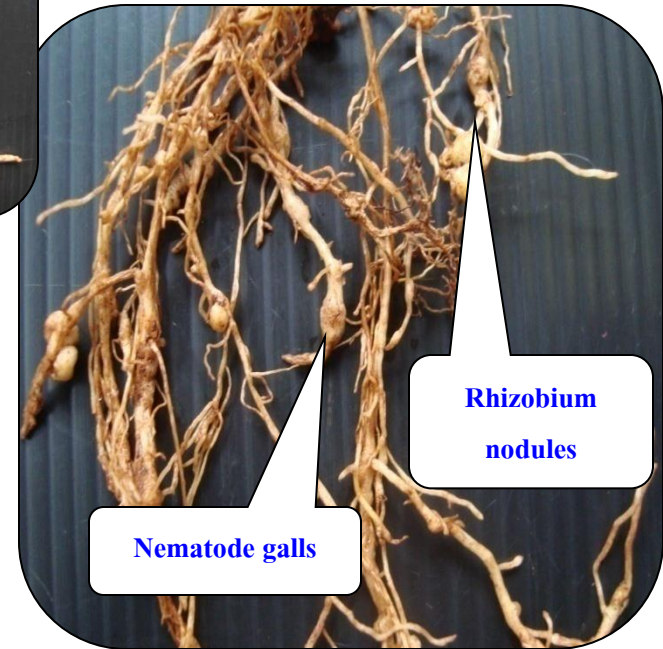
Nematode Galls



11. Leguminosae

ถั่วพู (Winged bean)

Psophocarpus tetragonolobus (L.) DC.



11. Leguminosae

ถั่วมะแฮะ (ถั่วแระ) (Pigeon pea)

Cajanus cajan (L.) Millsp.

Rhizobium
Nodules

Nematode Galls



11. Leguminosae

ถั่วลันเตา (Garden pea)

Pisum sativum L.

Nematode infested
fields

Rhizobium
Nodules



11. Leguminosae

ถั่วลาย, เซนโตรซีมา (Butterfly pea)

Centrosema pubescens Benth.



11. Leguminosae

ถั่วหรั่ง (Bambara groundnut)

Voandzeia (Vigna) subterranea (L.) Verdc.

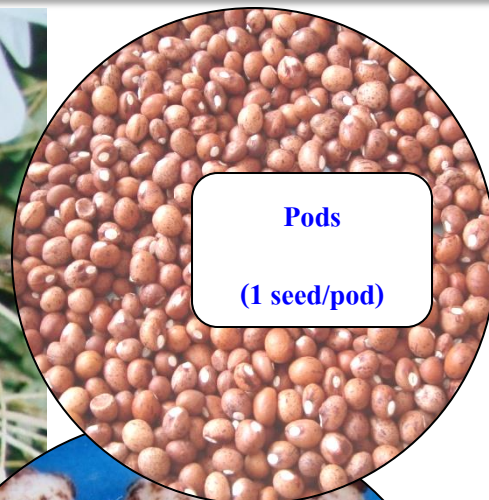


Healthy
pods



Nematode galls

Rhizobium
Nodules



Pods
(1 seed/pod)



Infected pods

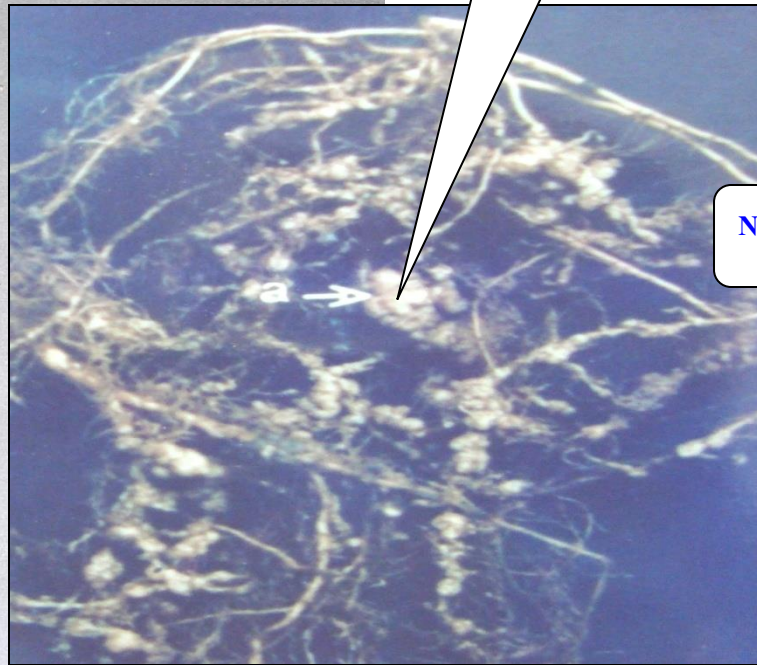
11. Leguminosae

ถั่วเหลือง (Soy bean)

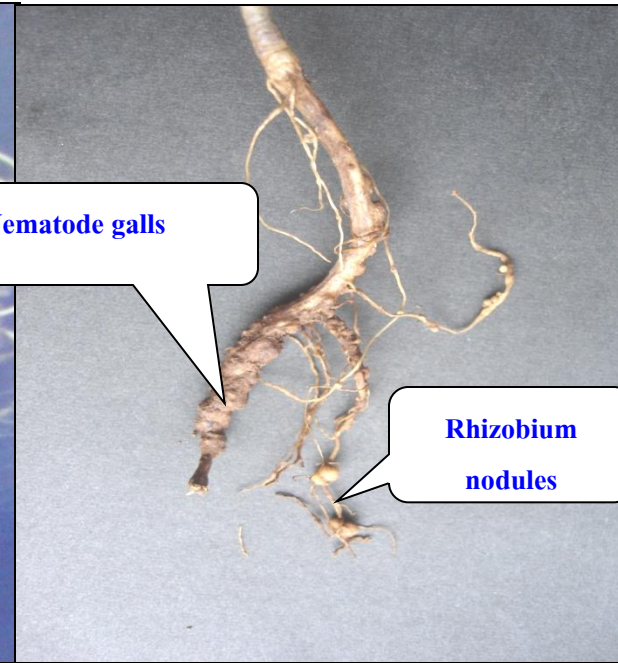
Glycine max (L.) Merr.



Nematode galls
embedded in
nodules



Nematode galls



Rhizobium
nodules

11. Leguminosae

มันแกว (Yam bean)

Pachyrhizus erosus (L.) Urb.



Galls under the
skin



12. Malvaceae

กระเจี๊ยบเขียว (กระเจี๊ยบมอญ) (Lady's finger, Okra)

Abelmoschus esculentus (L.) Moench



Galls



12. Malvaceae

กระเจี๊ยบแดง (Roselle)

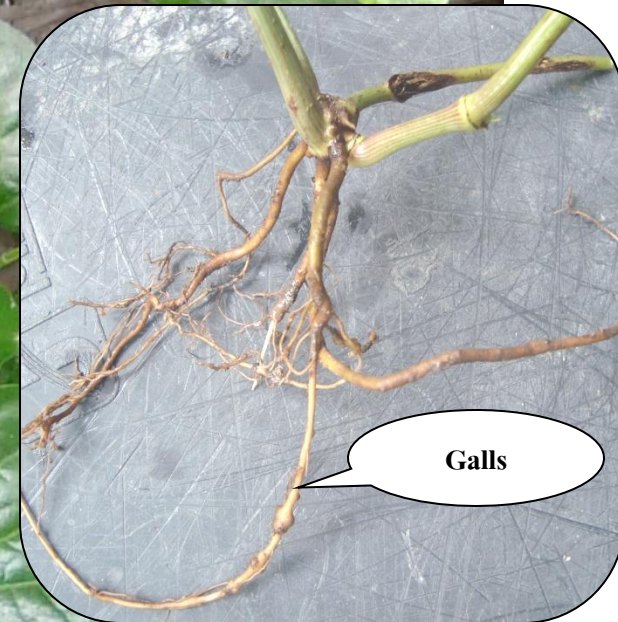
Hibiscus sabdariffa L.



13. Piperaceae (วงศ์พริกไทย) 1/4

ชำพลู (Cha phlu)

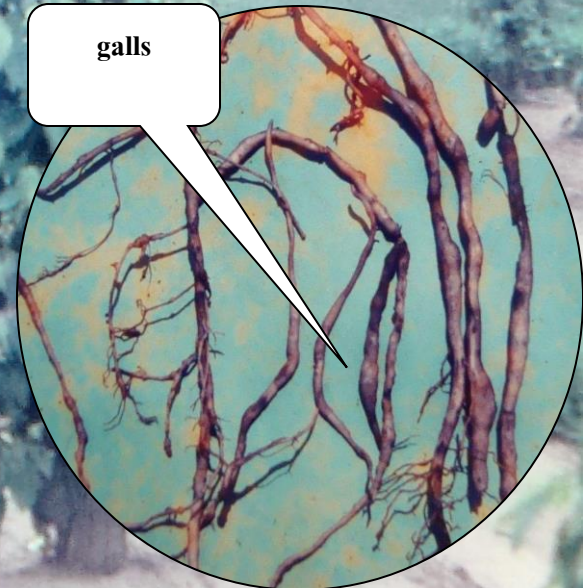
Piper sarmentosum Roxb.



13. Piperaceae (วงศ์พริกไทย) 3/4

พริกไทย (Black pepper)

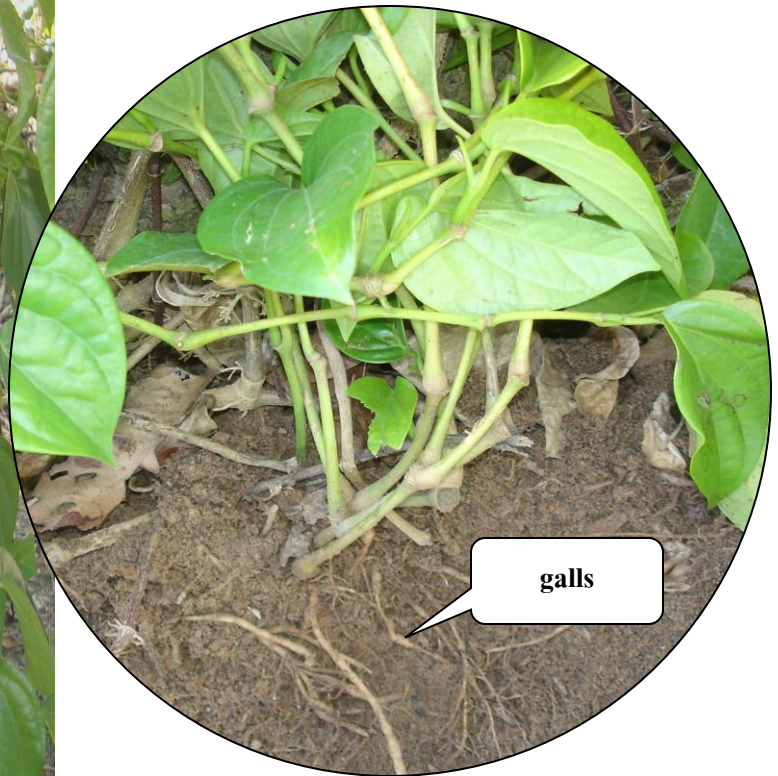
Piper nigrum L.



13. Piperaceae

พญู (Betel pepper)

Piper betle L.



14. Rutaceae (วงศ์ส้ม)

มะนาว (Common lime)

Citrus aurantifolia (Christm.) Swingle



galls

15. Solanaceae

พริกขี้หนู (Bird chilli)

Capsicum frutescens L. var. *frutescens*



Galls

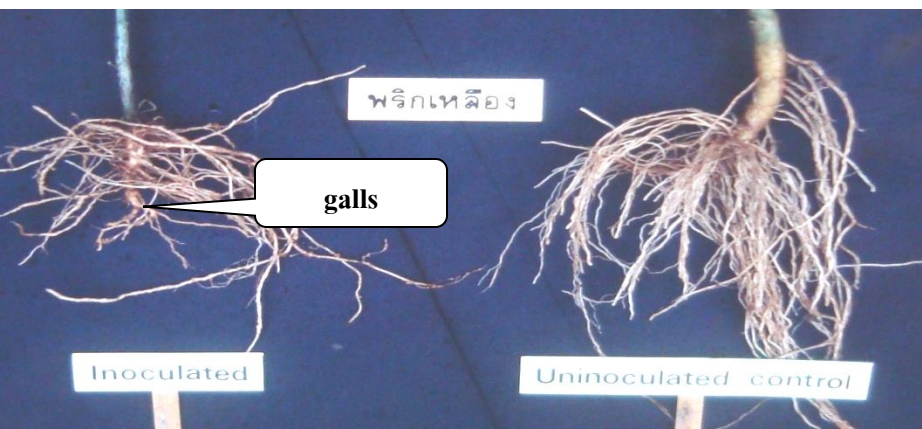
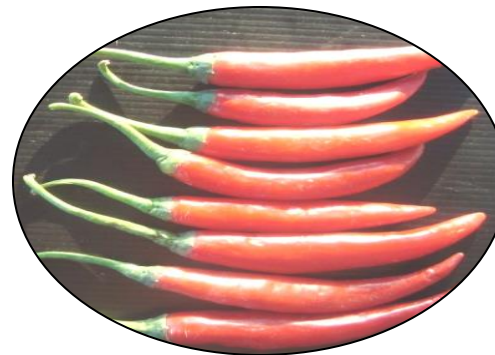
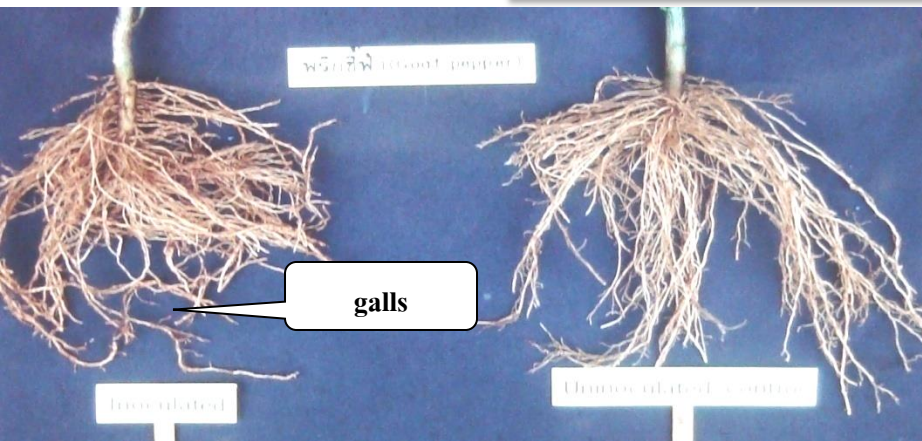


15. Solanaceae

พริกชี้ฟ้า,พริกเหลือง

(Chilli spur pepper, Goat pepper)

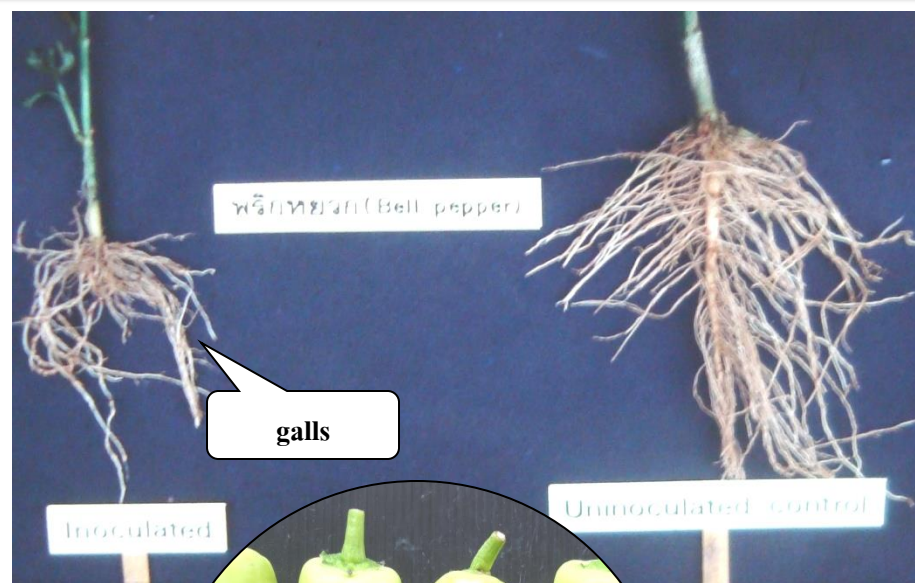
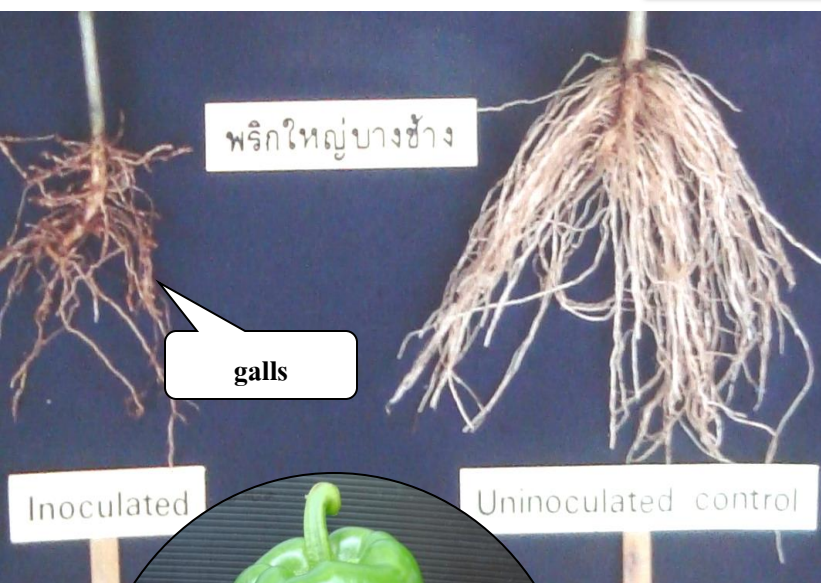
Capsicum annuum L. var. *acuminatum* Fingerh.



15. Solanaceae

พริกยักษ์, พริกหยวก (Sweet pepper, Bell pepper)

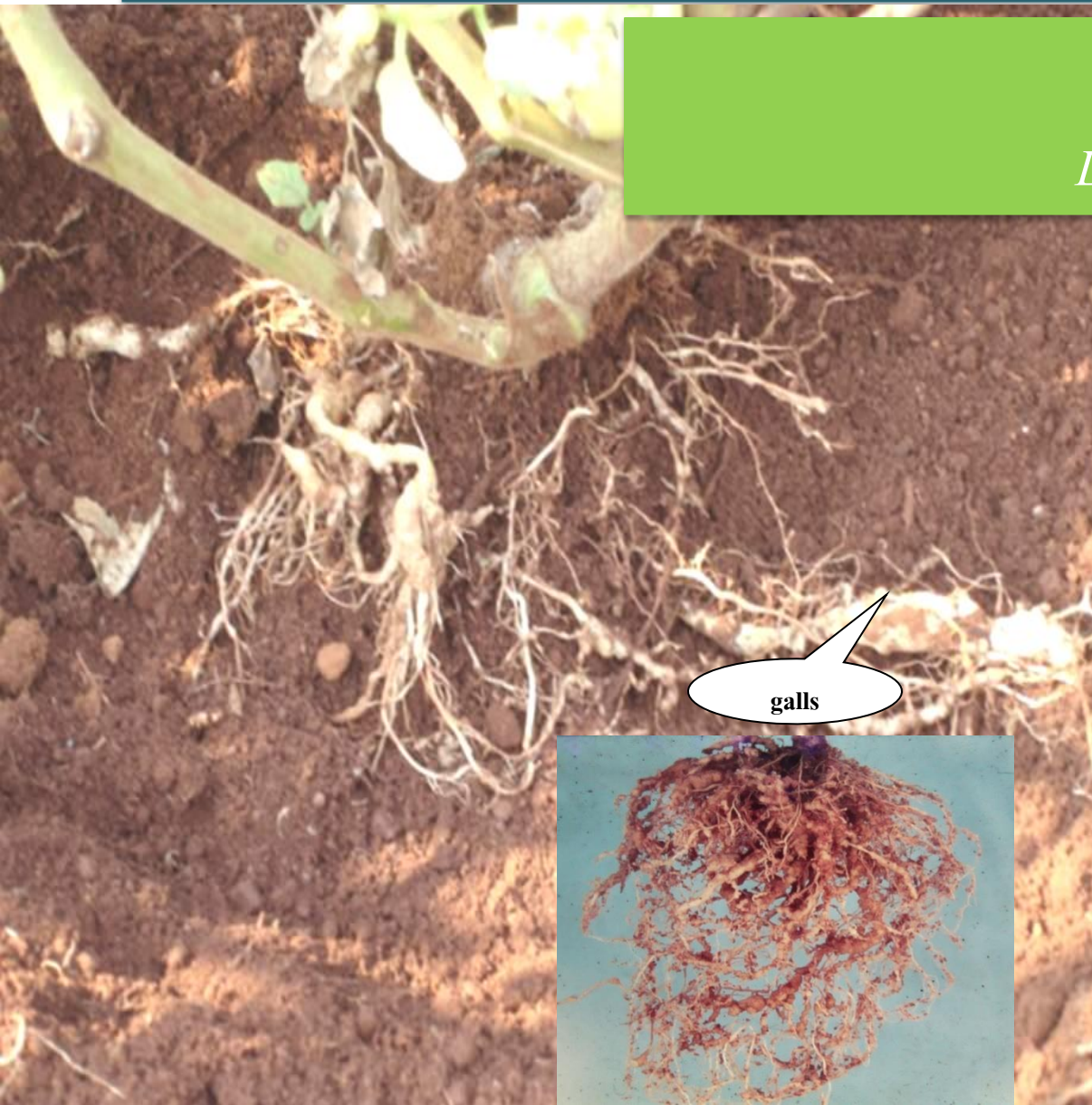
Capsicum annuum L. var. *grossum* Sendth.



15. Solanaceae

มะเขือเทศ (Tomato)

Lycopersicon esculentum Mill.



15. Solanaceae

มะเขือเปราะ (Round eggplant)

Solanum melongena L.

galls

Galls observed
at the soil
surface



15. Solanaceae

มะเขือพวง (Night shade)

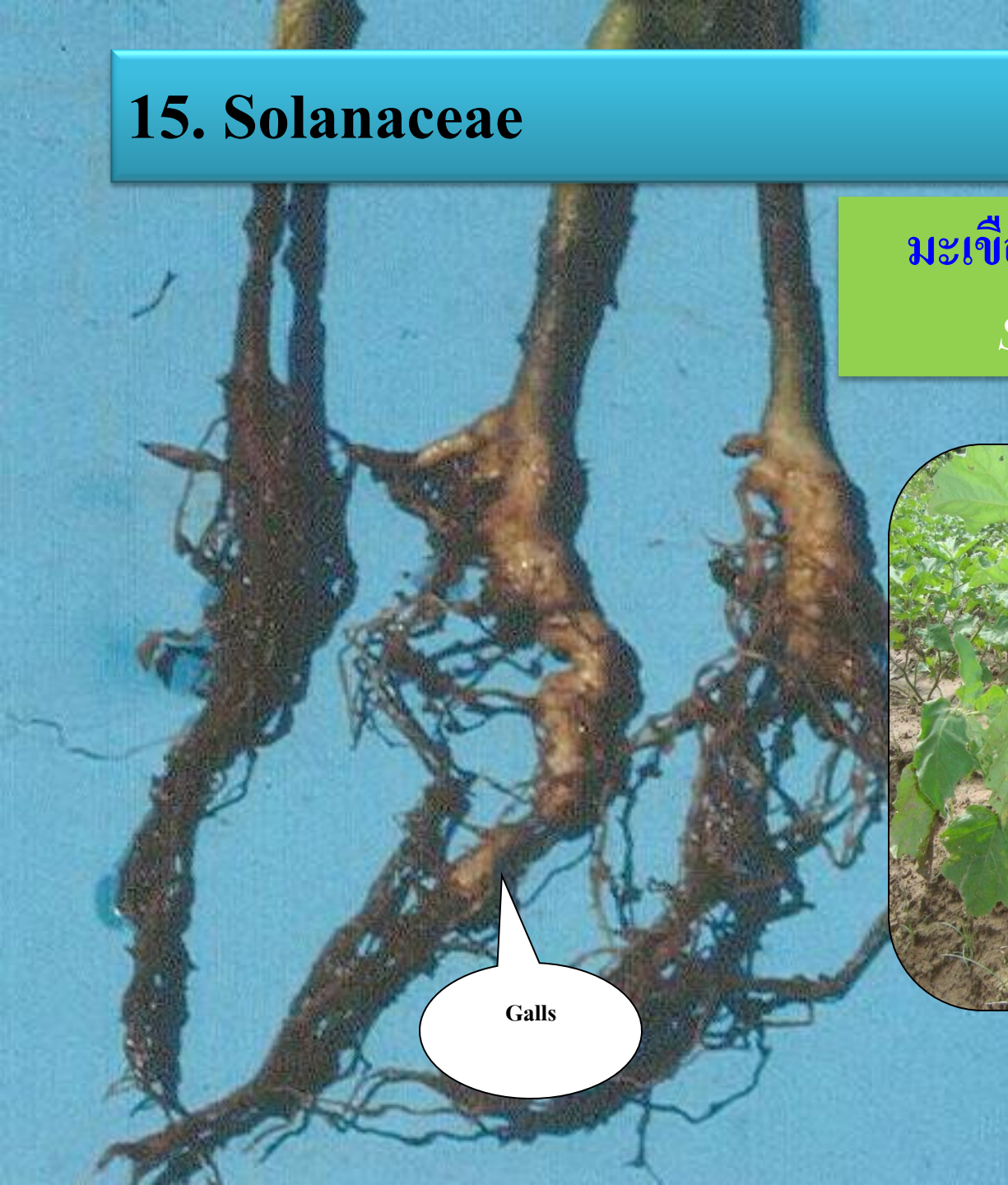
Solanum torvum Sw.



15. Solanaceae

มะเขือยาว (Long eggplant)

Solanum melongena L.



Galls



15. Solanaceae

มันฝรั่ง (Potato)

Solanum tuberosum L.

Healthy

Nematode-
infected

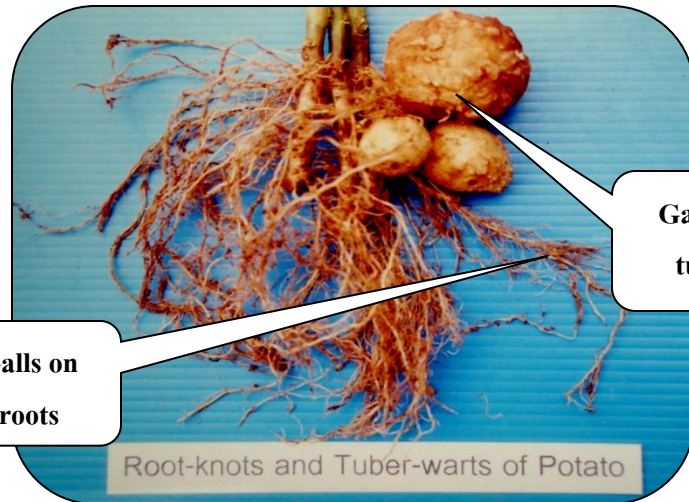
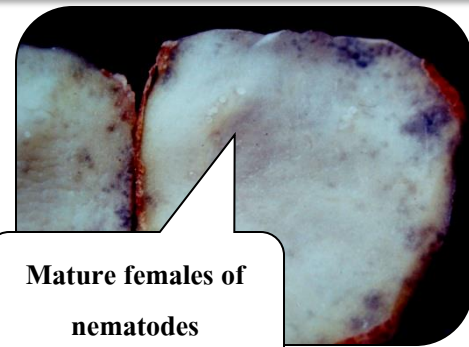
Mature females of
nematodes

tuber

Galls on
roots

Galls on
tuber

Root-knots and Tuber-warts of Potato



16. Umbelliferae

คื่นช่าย (จีนฉ่าย) (Chinese celery)

Apium graveolens L.



Galls



16. Umbelliferae

แครอท (Carrot)

Daucus carota L. subsp. *sativus* Thell.



Galls on
storage
root

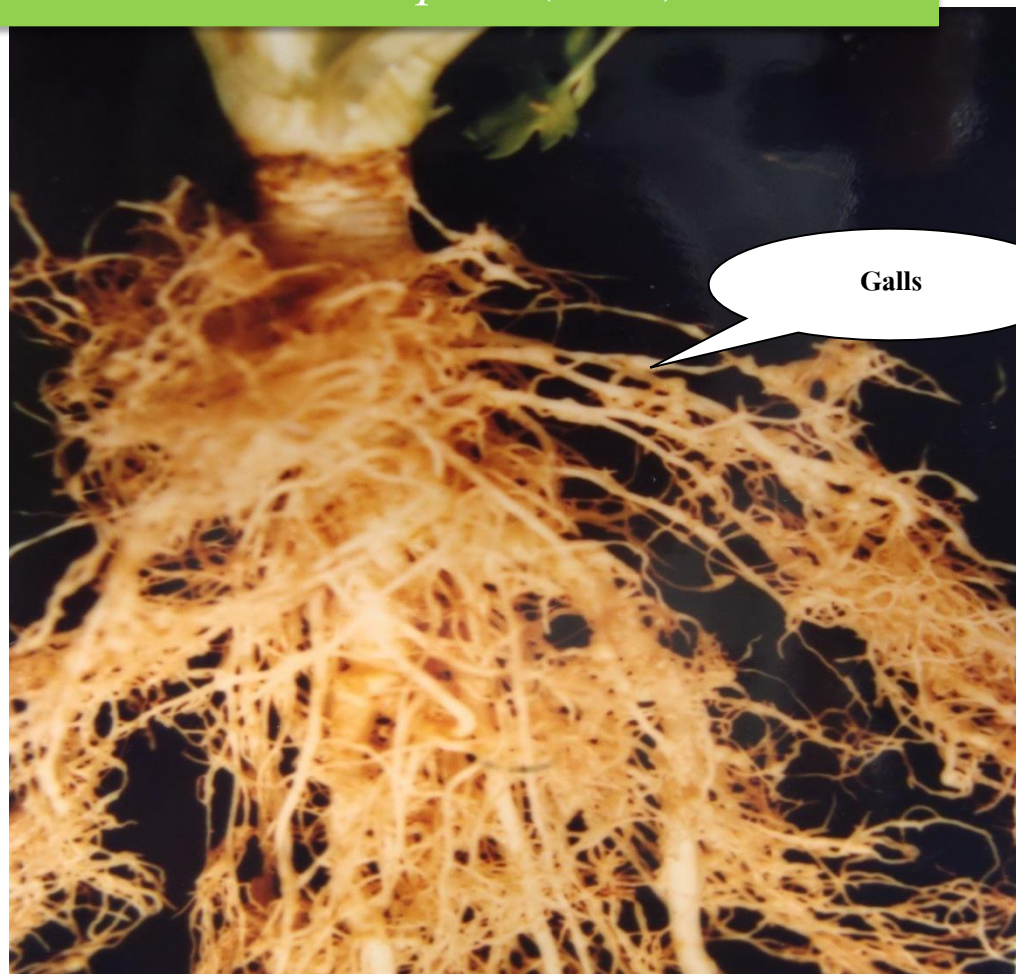


Galls on
fibrous
roots

16. Umbelliferae

ผักชีกะหรี่ปั้ว (Italian parsley)

Petroselinum crispum (Mill.) A.W. Hill



16. Umbelliferae



Galls

ผักชีไทย (Coriander)

Coriandrum sativum L.



16. Umbelliferae

ผักชีฝรั่ง (Fitweed, Stinking)

Eryngium foetidum L.



16. Umbelliferae



ผักชีลาว (Dill)

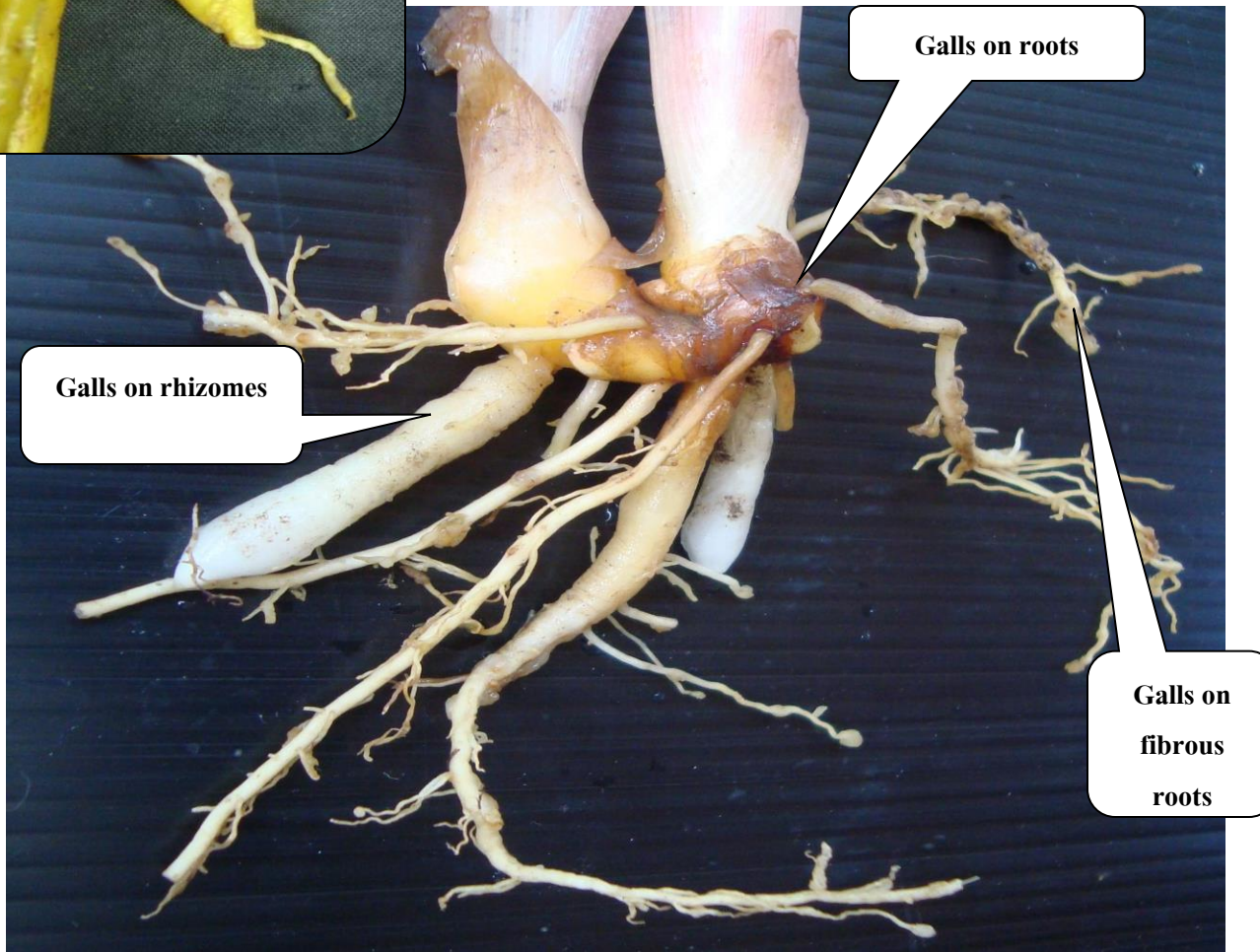
Anethum graveolens L.



17. Zingiberaceae

กระชาย (Kra chai, Kaempfer, Finger root)

Boesenbergia rotunda (L.) Mansf.



17. Zingiberaceae

Nematodes
infected into
rhizomes

Galls on
rhizomes

Mature females in the
rhizomes

Galls on
roots

ขมิ้น (Turmeric)

Curcuma longa L.



17. Zingiberaceae

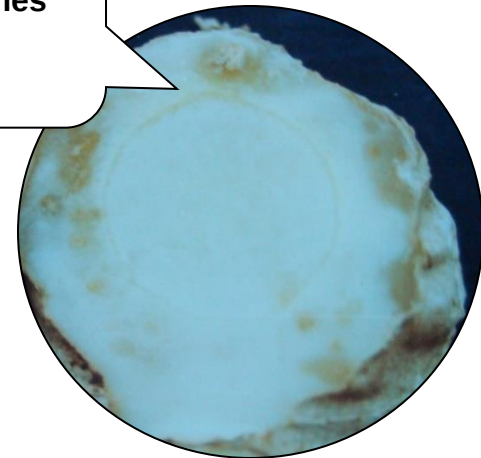
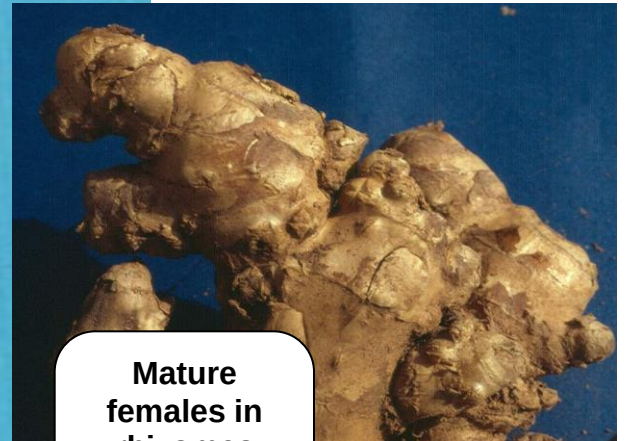
ขิง (Ginger)

Zingiber officinale Roscoe

Galls on
rhizome

Mature
females in
rhizomes

Galls on
fibrous
roots



Facts

- No formal assessment of vegetable yield losses caused by nematodes in Thailand
- A number of vegetables have been shown to be infected by root-knot nematodes
- Nematodes literally cause yield and monetary losses on vegetables

Perspective

- With the phase out or ban of synthetic effective nematicides, nematode problem could be more serious
- Alternative control such as crop rotation, resistance screening, biological control etc. are urgently needed