

GIS APPLICATION FOR PLANT DISEASES DISTRIBUTION ON JACK FRUIT, BAEI FRUIT AND MA KIANG TREES IN LOWER NORTHERN PART OF THAILAND

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ABSTRACT

Geographic Information System (GIS) was introduced to study on the diseases distribution of 338 Jack fruit trees (*Artocarpus heterophyllus* Lamk.), 126 Bael fruit trees (*Aegle marmelos* Corr.) and 36 Ma kiang trees (*Eugenia paniaia* Roxb.). The study area covered on 7 provinces in the lower Northern part of Thailand which consisted of 50 districts and 81 sub-district in Kamphaengphet, Nakhonsawan, Phitsanulok, Phichit, Sukhothai, Tak and Uttaradit provinces. Field survey on morphological study found that the average of perimeter on Jack fruit trees, Bael fruit trees and Ma kiang trees were 81.3, 67.4 and 133.5 cm, respectively. The percentage of plant diseases distribution on Jack fruit showed the leaf spot disease caused of *Colletotrichum artocarpi* and die back disease caused of *C. gloesporioides* were 85.8 % and 60.7 %, respectively. In this survey discovered a new disease which destroy stem of Bael fruit in Thailand. Bael fruit stem showed die back symptom. caused of *Hysterium* sp. which was 28.6% of the total. Ma kiang showed no serious plant diseases, there were lichen on their stem, sooty mold caused of *Meliola* sp., and agal disease caused of *Cephaleuros virescens* which were 11.1%, 5.6% and 2.8%, respectively. All database were input to GIS for query and display.

INTRODUCTION

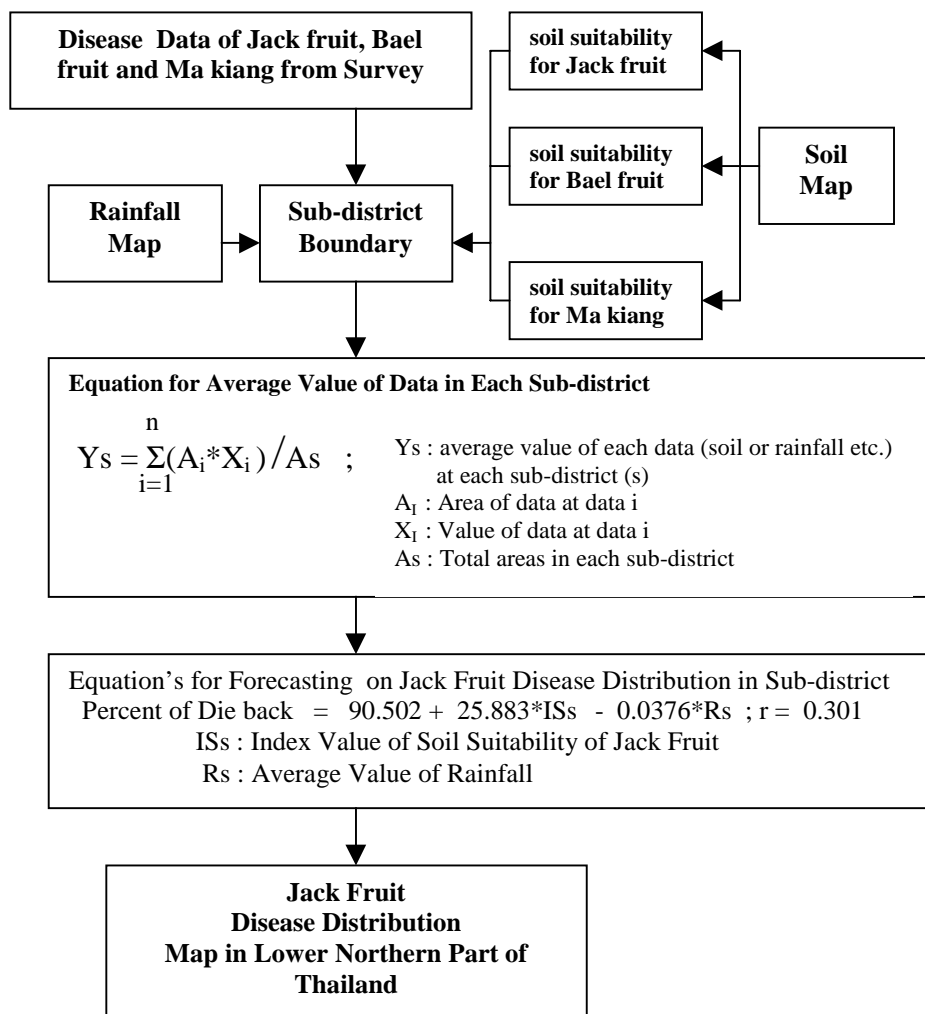
Jack fruit, Bael fruit and Ma kiang are sub-project of the main projects on genetic conservation under the Her Royal Highness Princess Maha Chakri Sirindhorn's remark. The proposal of this sub-project is study the distribution of plant diseases in 7 provinces at lower Northern part of Thailand (Fig. 1). At the present, Ma kiang and Bael fruit are very rare crops because they are not economic crops . Therefore, plant genetic conservation is very important issue. Plant diseases are the important factor for genetic conservation. In this field survey found that jack fruit is the most popular trees which are planted nearly every households because jack fruit in Thai name is very good meaning. Bael fruit trees are planted scattering in 7 provinces especially in the forest research stations. The important disease of bael fruit occurred on the twig is *Hysterium* sp. caused of die back symptom (Pandwar et al. 1974 ; Tilak and Rao. 1966) which this disease is the first report of infection in Thailand. Ma kiang is very difficult to find in the lower Northern of Thailand, it has not any serious diseases infection on their leaves. Geographic Information System (GIS) is introduced to forecast on disease distributions in the future and also study on the correlation between topography, land use, water network, reservoirs, soil suitability and rainfall database with disease severity.

MATERIALS AND METHOD

The plant diseases distribution on Jack Fruit (*Artocarpus heterophyllus* Lamk.), Bael Fruit (*Aegle marmelos* Corr.) and Ma kiang (*Eugenia paniaia* Roxb.) trees were investigated in 50 districts and 81 sub-district which located on Kamphaengphet, Nakhonsawan, Phitsanulok, Phichit, Sukhothai, Tak and Uttaradit provinces showed as a map in Fig. 2 (Chantaranothai. 1989 ; Chantaranothai and Parnell. 1990 ; Nalichit .1986 ; Vangnai . 1983.).

- Step 1. Input data from Field survey and farmers interview to GIS
- Step 2. Database management and analysis
- Step 3. Data summary in sub-district level
- Step 4. Connection and join GIS data to administration boundary
- Step 5. Overlay spatial data on soil suitability, average rainfall and disease distribution of Jack fruit, Bael fruit and Ma kiang (Fig. 3 and Fig. 4)
- Step 6. Attributes and developing program for student query and access.

Application Geographic Information System (GIS) for study on the plant disease distribution in study area on 7 provinces are processed as the below diagram.



RESULTS

A. THE FIELD SURVEY

1. Jack fruit

The average of 338 Jack fruit trees perimeter and age were 81.3 cm and 17.9 years, respectively. The frequency of plant disease distribution from field survey in 7 provinces showed that the most importance symptom distribution on nearly every plantation was leaf spot caused of fungus "*Colletotrichum artocarp*". The second distribution was the die back symptom caused of fungus "*C. gloeosporioides*". Both fungi are effect on quality and quantity of Jack fruit as Table 1 .

1.1 Leaf spot disease

In early stage of symptom showed small brown lesion on infected leaves.

The lesion expansion looked like the concentric ring. The progressive stage, the middle of lesion showed dry symptom in brown color. The surface of these lesions produced many small fruiting body of *C. artocarp*, which called acervulus in dark brown color. The percentage of leaf spot disease is 85.8 of the total observation plants.

1.2 Die back disease

This disease caused by *C. gloeosporioides* infected the young twigs. In the early stage of symptom showed dark brown spot on the Jack fruit twig. Diseases will multiplication and growth through the infected twig. The last stage of infection showed defoliation and dry rot on whole twig which symptom called dry back. The percentage of die back disease is 60.7 of the total observation plants.

2. Bael fruit

The average of 126 Bael fruit trees perimeter and age were 67.4 cm and 20.2 years, respectively. The first report and the importance disease on bael fruit tree in Thailand is *Hysterium* sp. caused of dry back symptom on the twig. *Hysterium* sp. produces many fruiting body of hysterothecium on the surface of infected twig. The hysterothecia morphology is elongate in shape, single, superficial black, dull and opening by a sunken longitudinal slit. This fungus produces brown phragmosporous ascospore and elliptical in shape. The severe infection showed defoliation and die from the end of the twig to the stem. The percentage of die back disease distribution showed 28.6 % of the total observation plants.

3. Ma kiang

The average of 36 Ma kiang trees perimeter and age were 133.5 cm and 40.6 years, respectively. From the field survey found 3 species of weak parasites, there are lichen, sooty mold and algal spot.

3.1 Lichen

Lichens are formed from combination of fungal partner and an algal partner. The fungal filaments surround and grow into the algal cells. A lichen may absorb certain mineral nutrients from any of these substrates on which it grows. Lichens growing on bark of Ma kiang tree. The percentage of lichen is 11.1 of the total observation plants.

3.2 Sooty mold

Sooty mold caused of *Meliola* sp. showed the symptom look like smut cover on the leaves surface. *Meliola* sp. is not directly causing agent of plant. This fungus grew on and absorbed the honey dew which is the by product of the aphid. The growth of *Meliola* sp. will prevent infected leaves surface from radiation. Therefore, the effect of *Meliola* sp. on the host plant is decreasing photosynthesis efficiency. The percentage of sooty mold is 5.6 of the total observation plants.

3.3 Algal spot

Algal spot, caused of *Cephaleuros virescences*, appeared on leaves showed puffy and red brown spot. This disease is also prevent photosynthesis efficacy. The percentage of algal spot is 2.8 of the total observation plants.

Table 1 The percentage of disease infection on Jack fruit, Bael fruit and Ma kiang in 7 provinces, Thailand

Provinces	Percentage of infected plants					
	Jack fruit		Bael fruit	Ma kiang		
	Leaf spot	Die back	Die back	Lichen	Sooty mold	Algal spot
Kampangphet	93.6	89.4	33.3	0	0	0
Tak	75.9	69.0	33.9	0	0	0
Nakornsawan	100.0	75.5	-	-	-	-
Phitchit	98.7	93.6	36.8	0	0	0
Phitsanulok	77.8	1.6	23.1	7.1	14.3	0
Sukothai	68.9	44.8	9.1	23.1	0	7.7
Uttradit	64.3	42.9	0.0	0	0	0
Average	85.8	60.7	28.6	11.1	5.6	2.8

B. GIS FOR DRY BACK DISEASES DISTRIBUTION ON JACK FRUIT

After process all database to GIS program, the jack fruit disease had been forecasted the percentage of die back disease distribution on Kampangphet province 70.51%, Nakornsawan province 63.88%, Phitsanulok province 55.47%, Phitchit province 59.87%, Sukothai province, 62.92%, Tak province 59.16% and Uttradit province 59.88%. From equation, $r = 0.301$, the die back disease distribution has relationship with soil index and rainfall of each sub-district as the Fig. 5.

DISCUSSION AND CONCLUSION

The disease distribution on jack fruit, bael fruit and Ma kiang are different in each area. GIS program is a best tool for disease forecasting. In case of plant disease control, the data of soil suitability index and rainfall are important information for disease prevention and control. Bael fruit is growth well in dry area especially in the forest in Thailand. Unfortunately, the disease of the bael fruit is not study so much in Thailand. GIS could create the mathematical model for distribution and showed as a map.

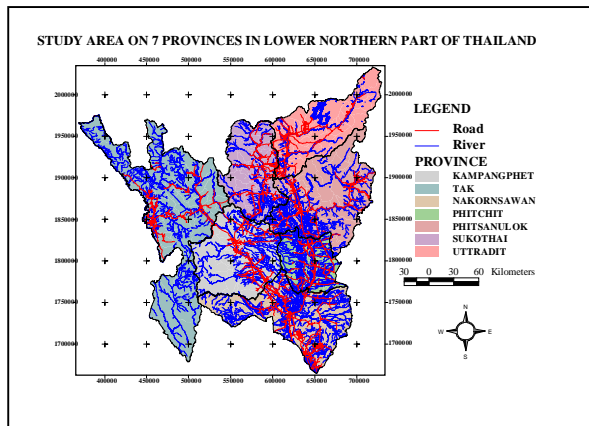


Fig 1. The study area on 7 provinces in the

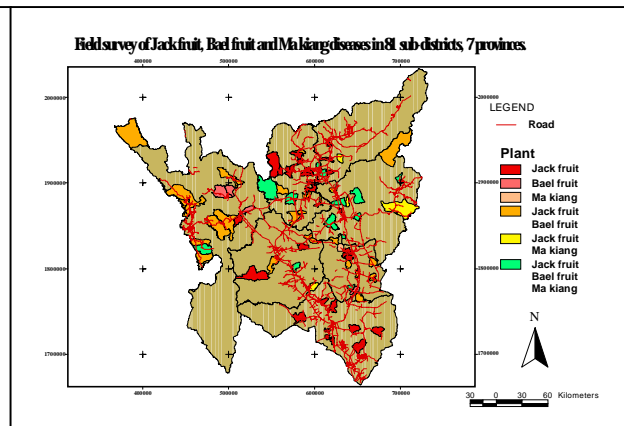


Fig 2. Field survey of Jack fruit, Bael fruit and Ma kiang diseases in 81 sub-district, 7 provinces.

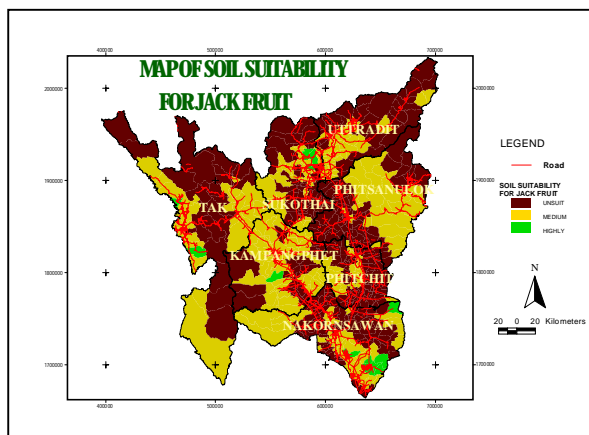


Fig.3 Map of soil suitability for Jack fruit

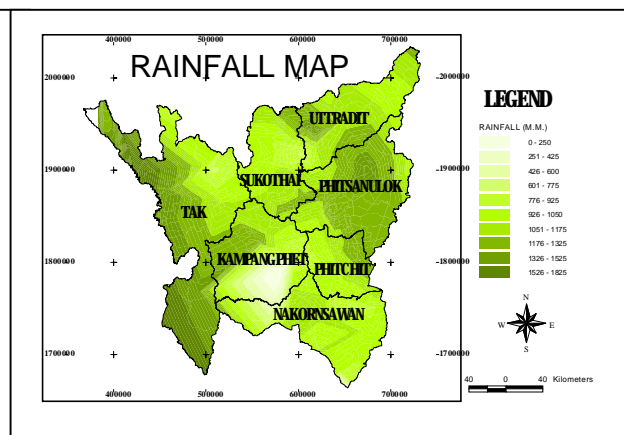


Fig. 4 Rainfall map.

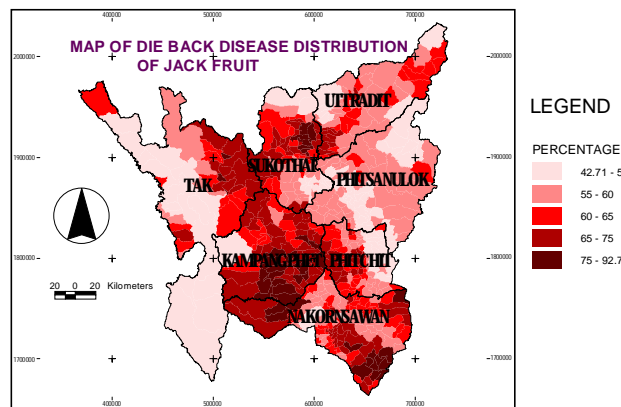


Fig. 5 Map of die back disease of Jack fruit

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