REPORT ON THE PLANT PATHOLOGICAL WORKS OF CITRUS TREES AT CITRUS AND VEGETABLE SEED RESEARCH CENTRE UNDER BANGLADESH AGRICULTURAL RESEARCH INSTITUTE, JOYDEBPUR, DACCA.

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Japan International Cooperation Agency

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March 21st to May 29th, 1980

Submitted by

(Dr. Hiroshi Daito)

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I N T R O D U C T I O N

I was assigned by the JICA to see the problems of citrus diseases in Bangladesh and I came here on March 21st, 1980 and stayed upto May 29th, 1980. During my 72 days stay in Bangladesh, I visited various citrus fields at main centre Joydebpur and sub-centres at Jaintiapur and Ishurdi. I made a thorough survey on different varieties of citrus plants and identified 7 diseases and some nutritional deficiency symptoms. By this time we set some experiments and taught the procedure to my counter-part Mr. Ashraf Khan (S.S.O. Plant Pathology) how to take the protection measures of various diseases and deficiency symptoms of citrus plants.

I Would like to express my sincere gratitude to Japanese team leader Dr. S. Iwasa, Citrus expert Mr. Y. Kodera and other Japanese experts for helping me to complete the work. My heartfelt gratefulness to Dr. Kazi M. Badruddoza, Director, BARI and Mr. Abdur Razzaque, Principal Scientific Officer, Citrus and Vegetable Seed Research Project for their helpful co-operation. The services of Mr. Ashraf Khan S.S.O. (Plant Pathology) during my research works, field survey and other activities are gratefully acknowledged. Lastly, I express my gratitude to Mr. B. C. Roy, S.S.O. (Plant Pathology) and other staffs of Citrus and Vegetable Seed Research Project, for their help during my stay in Bangladesh.

IDENTIFICATION OF CITRUS DISEASE AND ITS CONTROL

1. Twig dieback

Twig dieback is one of the most serious citrus disease in Bangladesh. Almost all varieties of sweet orange and lemon were susceptible to this disease and cause heavy damage to the citrus plantation.

There are many agencies which accelerate the cause of dieback disease. The agencies were deficiency of mineral nutrients, some insect injuries, fungi and nematodes. Injury to roots by cultivation equipments, excess or less soil moisture and excessive transpiration.

In Bangladesh probably the high incidence of this desease is due to excessive sunshine and strong wind during dry months, which cause the cracking of barks and twigs and ultimately permits the entrance of dieback fungus *Diplodia citri*. Some fungus, like *Fusarium*, *Colletotrichum* and *Diaporthe* which also cause the dieback disease.

During a tour to different places, it was observed that almost every variety of both sweet orange and lemon was attacked by this disease. Twig dieback affected shoots were removed from the citrus field of Joydebpur and from other places and I advised the scientists to remove all dieback affected twigs immediately. After pruning, the cut ends were covered with white paste to protect the entrance of fungus. I advised the scientist to plant wind breaker plants to protect them from strong wind and excessive sunshine. To reduce the incidence of dieback the persons concern were suggested to use optimum fertilizer and irrigate the land during dry months.

2. Citrus canker

Citrus canker (cancrosis A) caused by the bacterium *Xanthomonas citri*, is a very destructive disease which originated in Bangladesh, probably from northwest India. The disease is considered as a serious disease in Bangladesh. Almost every varieties of lemon are severely affected by this disease. Sweet orange also moderately affected by the disease.

The bacterium attacks all young developing parts of citrus plants. On young twigs, leaves and fruits, at first, the lesions start as white pin-head sized eruption, change to tan and finally turn to brown. The margin become waterly glazed and greasy, and greenish to yellow brown in colour, producing a halo like effect. Lesions resembling small craters.

Eradication is the most effective control measures of this disease. In Florida the disease caused heavy damage in citrus industry, and they destroyed all the plants by burning, after the disease free new plantation, there was no citrus canker.

Resistant stock may be used to reduce the disease. Bordeaux mixture is most effective fungicide to control the citrus canker. Planting wind breaker plants also reduce the disease incidence.

During the survey it seems to be that almost every variety of lemon is susceptible to this disease. At Jaintapur it was observed that lemon varieties were heavily infested by citrus canker. To control the disease, spraying of Bordeaux mixture was done at field No.2 of Joydebpur Centre on four lemon varieties. In each variety four plants were selected for spray and four kept as control. Regular observation are going on.

3. Gummosis

Gummosis is one of the common and serious citrus disease. In Bangladesh only old sweet orange and lemon varieties are attacked by this disease.

There are many factors which cause the gummosis disease, some fungi eg, Phytophthora parasitica, Phytophthora citrophthora, Sclerotinia sclerotiorum and Diplodia natalensis, which are associated with causing the gummosis of citrus plants. Strong sunshine and heavy wind attribute to the cause of this disease as sunshine destroy the bark and callus tissues of the trunks. Affected dieback twigs contain many Diplodia spore and washed downward through rain water and get entrance through the crack and cause infection to the wood. Turgidity of cells occurs during rainy season and the cells swelled, and shrinking of cell may occur during dry months, so this alternation of swelling and shrinking of plants may cause the cracking of barks which ultimately harbour the fungus and cause gummosis of citrus plants.

The most evident effect of the disease is the profuse exudation of clear, sometimes frothy amber-brown gum from gum pockets under the bark over the affected wood. In severe cases large patches of bark are killed and the wood underneath is blackened and killed by invasion of the fungus.

The disease can be checked by using white paste ($CaCo_3$), covered with rice straw and by planting shade plants. Using bamboo poles and fixed the branches which may check the splitting of branches reduce the incidence of gummosis. Removal of dieback affected shoots, whenever observed is desireable, because

dieback is one of the prime cause of this disease. Application of proper fungicides may lessen the incidence of gummosis.

During the survey, it was observed that only old sweet orange and lemon trees were attacked by this disease at different places. Affected barks were removed from the trunk and applied DAIFAH at a rate of 2.0 gms/l liter of water and after that applied Bordeaux mixture mixed with adhesive chemical to see the affect of the fungicides at Joydebpur and Jaintiapur.

Another method of application of Bordeaux mixture (CuSo4-700 gms, CaCo3-1400 gms and water 10 liters) was done with fixing material casin (100 gms) at Joydebpur and Jaintiapur, Sylhet.

4. Citrus scab

It is a common disease of citrus in Bangladesh. The disease is not so serious and the intensity of attack is not high. The fungus Elsinoe fawcettii caused the disease.

The first appearence of the disease on the leaves, small lesions with semi-translucent dots that become sharply defined, pustular elevations which sometimes are flat or somewhat depressed at the center. Leaves are often stunted, wrinkled and distorted. Lesion surface become dark brown with age. On fruit conical growths develop and bear lesions at apices. On succulant twigs of the most susceptible varieties, scab lesions form like those on leaves.

The disease can be reduce by pruning the affected scab twigs and leaves whenever observed. Removal of dead leaves and twigs from the plant affected by strong wind may lessen the incidence. Plantation of wind breaker plants which protect the plants from strong wind. Control of leaf minor as leaf minor feed on leaves and cause injury to the leaves and get entrance of the scab fungus. Application of Bordeaux mixture and Benlate may control the disease. Application of excess nitrogen usually soften the young shoots which are favourable to scab infection, so optimum use of nitrogen may lessen the infection of scab.

An observation trial was set by applying Bordeaux mixture to the lemon plants at citrus field of Joydebpur to see the effect of the chemical on controlling scab disease. Regular observation of the trial are going on.

5. Melanose

Melanose caused by the fungus Diaporthe citri that induces a stem end rot and increase the severity of lemon shell bark. Melanose occurs on fruits leaves and twigs. The marking of melanose consists of small raised, superficial dots or pustules made up of gum-filled cells often arranged in lines, curves, rings and irregular shape.

Around the margins and across the surface lines of breakage give an appearance in miniture of dry caked mud. Melanose may be distinguished from scab by the darker color of the lesion and from rust mite injury by its rough texture. The disease is much important in Bangladesh. Assessment of the intensity of disease incidence could not be done because fruits are too small and are not attacked by melanose, only leaves were found affected by this disease. To protect the disease, application of Bordeaux mixture is necessary at a rate of (3-4-100) when the disease is observed. Prunning out dead wood and twigs may lessen the incidence of the disease.

6. Wind burn

Wind burn is indicated by a number of different effects directly or indirectly on the fruits and leaves of citrus plants. Wind burn is frequently associated with or followed by a dying back of twigs. Mechanical injury caused by whipping about and knocking against branches and thornes. Dehydration and death of cells by removal of water from the leaves. Prolonged dry winds may have serious effect on leaves causing them to blast and either off or dry up while remaining attacked to the twigs.

It was observed that fruits and leaves of lemon varieties were affected by thornes through strong wind. To protect from wind burn, wind breaker trees may be planted and fixing the branches by using bamboo poles etc.

7. Sooty mold

Sooty mold caused by the fungus Capnodium citri form a superficial black cluster on citrus leaves due to secretion of honey dew by the white fly larvae and other insects. In the severly affected plants, the leaves of whole plants were covered by this fungus and create troubles on the formation of photosynthesis by leaves.

During the stay in Bangladesh, it was observed that only Seedless lemon variety at Jaintiapur affected by this fungus. Control of insects by using

insecticides may lessen the attack by this fungus.

VIRUS

During the time of visit at different places, it was not possible to recognize any virus diseases of citrus plants. This is due to the short period of staying in Bangladesh. Another important factor is that at Jaintiapur and Sylhet, it was observed that almost all varieties of sweet orange and lemon were suffered from various nutritional deficiency symptoms. At Joydebpur, varieties of sweet orange and lemon were healthy and there was no deficiency symptoms or virus affected plants. If the nutritional deficiency symptoms can overcome it is possible to recognize the virus diseases.

However, there may or may not citrus virus diseases in Bangladesh. To protect the citrus virus there should be a control of aphids because aphids are the main sources of virus transmitting vector and transmit the virus from one plant to another and from one variety to another variety.

DEFICIENCY SYMPTOMS OF CITRUS PLANTS

1. Nitrogen

Nitrogenous fertilizer is generally required in greater amount by citrus plants than any other fertilizer. Nitrogen disapper from the soil through leaching, voltilization, etc. It plays a dominant role in citrus nutrition. In nitrogen defficent citrus plants, the first symptom to occur is a lightening of the green colour of the leaves. In advance cases the leaves more pronunced until the leaves on the tree are generally a distinct yellowish green in colour and some may lack a green tinage almost altogether. Leaves on young flushes are more green than leaves of old flushed. Some drying of twigs accompaines thinning of the foliage. Nitrogen deficient plants yield very little fruit and less in number. Nitrogen defficiency can ordinarily be distinguished from many other deficiencies by the general nature of the yellowing of leaves over the entire plant.

Nitrogen deficiency is readily corrected by application of proper amount of nitrogenous fertilizer. When readily soluble nitrogenous fertilizer is applied and watered in soil, under deficient trees, a visible response may be seen within one week. Application of cowdung, manure and urea may control nitrogen deficiency symptoms of citrus plants.

2. Phosphorus

In the phosphorus deficient citrus trees the symptoms shows as the reduced in growth and the plants become stunted. The leaves are smaller and more narrower than healthy leaves. The fruits are coarse and rough in texture with a coarse, thick rind. Fruit from deficient trees have a high acidity in proportion to total solids. The fruit tends to drop before maturing.

Application of manure, cowdung and adequate phosphorus fertilizers like T.S.P., S.P. may control the phosphorus deficiency in citrus plants.

3. Potassium

Potassium apparently performs many functions in the citrus plants, it is an activator of enzymes, growth in meristem tissue, neutralizes oranic acids and activates stomata opening and closing. In the potassium deficient plant there is a reducation in growth, size of the leaves are small, and new growth so weakened that the shoots are easily broken from the tree. The principal sympstoms, however, are in the fruits. The fruits are small in size and have a very thin peel of smooth texture.

Application of manure, cowdung, ashes and various potash fertilizer eg. M.P. etc. control the plants from the potassium deficiency.

4. Calcium

Calcium is very essential for the growth of citrus trees and the chemical is present in fibrous root, leaves and twigs of mature plant. In the calcium deficient plant leaves shows that, leaf vein may green but the interveins of leaf blade shows yellowing. Dropping of immature leaves and ultimately dieback of the twigs may takes places.

Application of $CaCo_3$ and Bordeaux mixture in plants may reduce the deficiency symptoms as Bordeaux mixture contains calcium.

5. Magnesium

This is also essential element for the growth of citrus plant. Due to less nitrogen in the soil magnesium deficiency may takes places. Megnesium translocate from the old leaves to young leaves and then to the fruits. So deficiency of this chemical takes place on older leaves and fruits. Magnesium deficient plants shows yellowing of the intervein but the leaf vein remain green, during winter months defoliation of leaves takes place. The plant can

not manufacture sufficient chlorophyll and the fruits become small ultimately yield decreases. The juice quality less and trend to decaying of the fruits. Application of excess potassium disturbed the uptaking of magnesium. Magnesium deficient citrus plants can not uptake nitrogen and phosphorus properly.

6. Manganese

The leaves in manganese deficient plants shows dark green bands along the midrib and main veins with lighter green areas between the bands. In mild cases the symptom appears in the young leaves and sometime after disappear with the light green areas becoming darker. Severely manganese deficient plants, dark green areas persists the entire life of the leaf. In very severe cases, the light green areas changes to a gray or even whitish colour.

The foliage become thin and dead twigs shows in heavy manganess deficient plants. Yield reduction may also takes places due to manganess deficiency. In manganese deficient plants, fruits become mearly small, hard and the colour slightly different from healthy fruits. Below 20 - 30 ppm manganess shows deficiency symptom in leaves. In alkaline soil (P^H 6.5) manganese solubility is less and the plant cannot uptake manganese properly. In acidic soil manganese leached due to heavy rain and irrigation water. In the less humus soil buffer action may not carry properly and it accumulate calcium which ultimately decrease manganese.

Application of manganese sulphate on leaves at a rate of 1 lb/100 gallons of water may check the deficiency of manganese.

7. Iron

Iron deficiency first appears on the leaves. Moderately deficient plants shows the leaf vein more darker green than the interveinal areas of young leaves. In severe cases, the leaves may be chlorosis and disappear when the leaves become mature. The leaves become ivory colour in heavily deficient plants. The tree become partially defoliated causing dieback, and in many instances the tree die. Fruits in deficient plants are not good quality and tend to develop yellow colour and lower soluble solids and higher in acids.

Leaves containing less than 40 ppm shows the iron deficiency. To protect from iron deficiency spraying 0.1 ∿ 0.2% Fe EDTA (Ethylene-diamine-tetracetic acid) reduce the iron deficiency.

8. Boron

Boron deficient plant leaves show the symptoms of corking and splitting of the upper surface of the main veins and curling of the leaf blades. The leaves become brownish to yellowish and brittle. The fruits become small, irregular shape and hard, the rind of the fruits become thick dry and unhealthy. The yield from boron deficient plants is less. On the surface of young fruits, brownish spots were observed and fruits drop before maturing.

In addition gumming on the outside of the fruits and brown areas on the albedo, central core and fleshy part of the fruit are present. Seeds may darkened and shrivelled or missing.

Boron deficiency occurs due to dryness of soil, high temperature and excess application of calcium in soil. In alkaline soil boron is less and the plant can not uptake easily. At Jaintiapur, Sylhet, high sloping and excess rainfall boron may be leached easily.

To protect the soil from boron deficiency the soil should be adjusted the P^H range 6.0 ∿ 6.5. Application of manure and irrigation water in the soil may reduce the boron deficiency. Spraying of Borax on leaves at a rate 0.1 ∿ 0.2% may check the boron deficiency in plants. Application of Borax to the soil at a rate of 20 ∿ 80 gms/tree reduce the boron deficiency.

At the time of survey it was observed that the citrus plants at Ishurdi and Joydebpur did not show any nutrient deficiency symptoms. This may be that the soil of Ishurdi and Joydebpur contained optimum trace elements. But the citrus plants of all varieties at Jaintiapur showed deficiency symptoms. Heavy rainfall and excessive slopeness of soil at Jaintiapur cause the leaching of nutrients from the soil and ultimately inhence the deficiency of citrus plants.

To overcome the deficiency symptoms of citrus plants, the soil should be mulched regularly and applied cowdung, manure and adjusted the soil P^H by applying $CaCo_3$ etc. Optimum use of fertilizer eg. Supper phosphate which contains many trace elements. Spraying of nutrient elements to the plants also reduce the deficiency symptoms.

ANALYSIS OF LEAVES AND SOIL SAMPLES

During the time of visit to Jaintiapur, Sylhet, Ishurdi and Bangladesh Agricultural University at Mymensingh, it was observed that almost all sweet orange and lemon varieties were suffering from various nutritional deficiency

symptoms. Photography of the leaves of deficient plants were taken, and after that collection of deficient and healthy leaves for analysis in the laboratory were done to determine that the nutrient element of leaves are less, moderate or excess.

From the laboratory analysis and calculation it was observed that moderate range of nitrogen was present in all the varieties both healthy and deficient leaves. Analysis of phosphorus showed that all the varieties suffering from phosphorus deficiency in leaves, although the healthy leaves of Jaffa and Nagpuri were little below moderate range. In case of potassium, deficient leaves showed low range of potassium, and healthy leaves showed over range of potassium in all the varieties. According to the analysis of calcium it was observed that deficient leaves contained less range of calcium in all varieties and in case of healthy leaves little less than moderate range. The range of magnesium showed that in the varieties of Feutrell's early and Khasia very low range in deficient leaves, other varieties also showed low range of magnesium. Healthy leaves contains moderate range of magnesium in all varieties. Every varieties of deficient leaves have shown very low range of manganese while all varieties of healthy leaves showed moderate range of manganese. Both healthy and deficient leaf, analysis of all the varieties contains very low range of iron and boron. (Table 1 and 2).

To assess the relationship of soil nutrient with deficiency symptoms of citrus leaves, soil samples were collected from Jaintiapur and Joydebpur. Soil from different depth both from healthy and deficient planation were collected and dried in the oven. The soil samples were analysed in the laboratory, and from the data (Table 3), it is not possible to make any conclusion, whether there is any effect of soil for causing deficiency on citrus plants. Further discussion with the soil scientist will be needed to make the conclusion about the soil component of citrus field. However optimum use of manure and fertilizer may reduce the deficiency symptoms of citrus plants.

SPRAYING OF NUTRIENTS ON LEAVES

Application of different nutrient elements to control the deficiency symptoms of citrus plants were done on April 28th, 1980 at Jaintiapur Citrus Research Farm. The varieties were:- Mosambi, Jaffa, Feutrell's early, Nagpuri, Satsuma, Khasia and Elachi lebu. In each variety 2 plants were selected for spraying the nutrients. By selecting the deficient leaves one branch was taken from each plant for spray.

The doses were;

1. $ZnSo4, 5H_2O$ - 1.2 gms/1 liter of water
2. $MnSo_4, 5H_2O$ - 2.0 gms/1 liter of water
3. $MgSo_4, 7H_2O$ - 2.0 gms/1 liter of water
4. H_3BO_3 - 1.2 gms/1 liter of water
5. Urea - 5.0 gms/1 liter of water
6. T.S.P. - 5.0 gms/1 liter of water
7. K_2So4 - 5.0 gms/1 liter of water
8. CuSo4 - 5.0 gms/1 liter of water
9. CaCo3 - 5.0 gms/1 liter of water
10. $(NH_4) 6MO_7O_{24}, 4H_2O$ - 1.2 gms/1 liter water

Before spraying the nutrient solution, photography was taken from each branch of Elachi lebu, Nagpuri and Khasia varieties selected for treatment by different chemicals. To compare the effect of spraying chemicals of treated branches, another photography was taken on May 22nd, 1980.

APPLICATION OF MANURE AND FERTILIZER

At the time of first visit to Jaintiapur sub centre on March 28th, 1980. It was observed that almost every plants in each variety suffered from different deficiency symptoms. On examination of the soil and digging out the soil of affected plants, it was observed that the fibrous roots spread on the top layer of four inches soil. It may cause poor strand, when the soil moisture is less and if rainfall is heavy, the nutrients from the top soil may leached. Senior Scientific Officer of the farm was advised to mulch and dug-out the soil at a depth of 1 ft. and width 1 ft. of a distance of the outer surface of the crown and applied cowdung, manure and fertilizers in each plot, and accordingly he finished the work. It may be assumed that, in the comming year, fibrous new roots will grow and go downwards and can uptake the nutrients properly.

STUDY ON CITRUS NEMATODES

Many parasitic citrus nematodes cause diseases directly or indirectly by injury the roots of plant eg. dieback of twigs, root rot and some nutritional deficiency symptoms.

To determine the effect of citrus nematodes, soil and root samples were collected from Jaintiapur and Sylhet and sent it to the Plant Pathology Laboratory of BARI for isolation and identification of parasitic citrus nematodes.

After careful examination, they reported that Helicotylenchus sp. was present in all the soil samples collected from 7 citrus varieties. Tylanchus sp. Hoplolaimus sp. were also present in negligible number in the soil of some varieties. These nematodes are not so destructive to the citrus plants.

Tylenchulus semipenetrans is very destructive citrus nematode and this nematode was not present in the soil samples collected from the field of 7 citrus varieties.

PATHOGENETIC TEST OF THE TWIG DIEBACK

Twig dieback of citrus trees contains the fungus Diplodia sp. and Diaporthe citri. The Diaporthe citri caused melanose of citrus trees and fruits. If the affected shoots are not removed from the plants, the healthy leaves and fruits will be attacked by this diseases through rain water and wind.

An experiment was set up to see the effect of shoots which causes melanose on citrus leaves and fruits. Dieback shoots were collected from the affected citrus plants and divided into four bundles. Each bundle was hunged on four varieties of lemon, and watered 4 times in a day. Bamboo made shades were placed on the top of each plant to protect the dieback shoot from dryness because during that period dry months prevailed. Regular observation were done but no symptoms of melanose were developed on leaves and fruits. Further observations are going on.

Another observation trial was done to see the effect of dieback affected shoots causes disease on healthy plant by rain water and wind, if the shoots after cutting do not remove from the field. Dieback affected shoots were bundled and kept in the bottom of healthy citrus plants. Regular observation are going on.

C O N C L U S I O N

In Bangladesh citrus cultivation is going popularised day by day, but about the cultivation of citrus specially sweet orange, the farmers have got

little knowledge about the cultivation of this fruit. Only farmers plant the trees without application of fertilizers, insecticides and fungicides, and as a result they do not get sufficient quantities of fruits. Heavy rainfall during monsoon time and drought during dry months, roots of this fruit plants can not develop properly and can not uptake sufficient quantities of soil nutrients. This weaken the plants and causes diseases to the plants, which ultimately can not produce good qualities and quantities of fruits.

To overcome of these problems, the citrus plants should be watered regularly during dry months and there should be good drainage system to remove excess water. Plantation of shade plants to protect the citrus plants, as sunshine is one of the factor to cause many diseases eg. gummosis, melanose by cracking barks, trunk etc. Shade plant protect the citrus plants from strong wind which causes splitting of branches, knocking and rubbing the throne to trunk, fruits and leaves which help to get entrance of fungus to the plants. Bamboo pole should be used to protect the plants from strong wind. The scientist of citrus project specially citrus production specialist and pathologist should take proper care to grow good qualities of fruits and to get high yield from citrus plants.

There should be maintained good soil condition by applying, manure, cowdung and optimum fertilizer to the soil. Constant survey should be done to identify the citrus diseases and applying fungicides to the plants properly. Diseased twigs and barks should be removed from the plants whenever observed, because if these twig or barks are not removed from the plants the disease may spread quickly. The farmers and commercial citrus growers should be educated about the modern technology of citrus cultivation.

Virusea are also one of the problem to cause yield reduction to all citrus growing countries, so, constant observation should be done to identify the virus diseases and its remeadial measures.

At present there is no plant pathologist working on citrus diseases in this project although citrus diseases are one of the factor for causing low yield. For survey, identification and control of various citrus diseases Mr. Ashraf Khan, S.S.O. (Plant Pathology) should be placed at Citrus and Vegetable Seed Research Project to look after the citrus diseases and their control measures, because Mr. Khan already gathered much knowledge, how to control citrus diseases and deficiency symptoms.

Table - 1. Comparative Inorganic Composition of Leaves of Nutrient Deficient and Healthy Citrus Trees

Kind of citrus or variety	Condition	Constituents of dry matter							
		N	P	K	Ca	Mg	Mn	Fe	B
1	2	3	4	5	6	7	8	9	10
		%	%	%	%	%	ppm	ppm	ppm
JAFFA	deficient	2.36	0.075	0.25	0.50	0.15	5	10	10
	healthy	2.70	0.100	2.00	2.50	0.40	25	10	20
MOSAMBI	deficient	2.66	0.075	0.25	1.00	0.15	5	5	20
	healthy	2.51	0.125	2.00	2.00	0.40	25	10	20
NAGPURI	deficient	3.46	0.050	0.25	0.50	0.15	5	5	15
	healthy	2.54	0.100	2.00	2.50	0.30	50	25	20
SATSUMA	deficient	2.49	0.075	0.25	0.50	0.20	5	5	20
	healthy	2.42	0.150	2.00	2.50	0.40	25	25	20
FEUTRELL'S EARLY	deficient	2.31	0.025	0.25	0.50	0.05	5	10	15
	healthy	2.84	0.125	2.00	2.50	0.40	25	10	20
PINEAPPLE ORANGE (Ishurdi)	deficient	1.99	0.025	0.20	1.00	0.10	5	5	15
KHASIA	deficient	2.53	0.075	0.25	1.00	0.05	5	5	15
	healthy	2.34	0.125	2.00	2.50	0.40	25	25	15
SEEDLESS LEMON (BAU)	deficient	1.69	0.05	0.50	1.00	0.20	10	5	10
	healthy	2.51	0.125	2.00	2.50	0.30	50	10	20
ELACHI LEBU	deficient	2.19	0.075	0.50	1.00	0.15	5	10	10
	healthy	2.77	0.125	2.00	2.00	0.40	50	10	20
WASHINGTON NAVEL ORANGE	healthy	2.68	0.125	2.00	2.50	0.40	25	10	20

Table - II. Element Variations in Citrus Leaves

Element	Low range	Usual range	High to excess range
1	2	3	4
Nitrogen (N) %	< 1.9	2.4 ∿ 2.7	> 3.3
Phosphorus (P) %	< 0.08	0.12 ∿ 0.16	> 0.3
Potassium (K) %	< 0.6	1.2 ∿ 1.7	> 2.4
Calcium (Ca) %	< 1.5	3.0 ∿ 5.5	> 7.0
Magnesium (Mg) %	< 0.15	0.3 ∿ 0.6	> 1.2
Manganese (Mn) ppm	5.0 ∿ 24.0	25.0 ∿ 100.00	100.0 ∿ 1000.0
Iron (Fe) ppm	< 40.0 ∿ 60.0	60.0 ∿ 150.0	> 150.0
Boron (B) ppm	< 15.0 ∿ 40.0	50.0 ∿ 200.0	200.0 ∿ 1679.0

Table - III. Comparative Inorganic Composition of Soil from Jaintiapur and Joydebpur

Location	Soil in Citrus Field.	Mineral elements in dried soils							
		NH4-N	P	K	Ca	Mg	Mn	Ferric Fe+	PH
1	2	3	4	5	6	7	8	9	10
		ppm	ppm	ppm	%	ppm	ppm	ppm	
JAINTIAPUR	ELACHI LEBU	50	12.5	25	0.5	10	1.0	100	5.71
	NAGPURI	70	12.5	150	0.5	10	2.5	100	5.30
	JAFFA	25	12.5	25	0.5	10	1.0	250	6.20
	MOSAMBI	50	12.5	100	0.5	30	2.5	100	6.15
	SATSUMA	70	5.0	200	0.25	10	2.5	100	4.71
	KHASIA	50	12.5	150	0.25	30	2.5	100	4.90
	FEUTRELL' EARLY	25	12.5	150	0.5	10	2.5	250	5.31
JOYDEBPUR	ELACHI LEBU	150	25.0	200	1.25	60	5.0	250	5.10
	JAFFA	150	25.0	200	1.50	40	10.0	250	5.63
	SATSUMA	150	25.0	200	1.00	60	5.0	250	5.38

I. NH_4-N, K, Ca, Mg and Mn were extracted by 0.05 N KCI solutions

II. P and Fe were extracted by 0.05 N HCI solutions

Fig. 1. Dieback affected twigs

Fig. 2. Canker affected citrus twigs leaves and fruits.

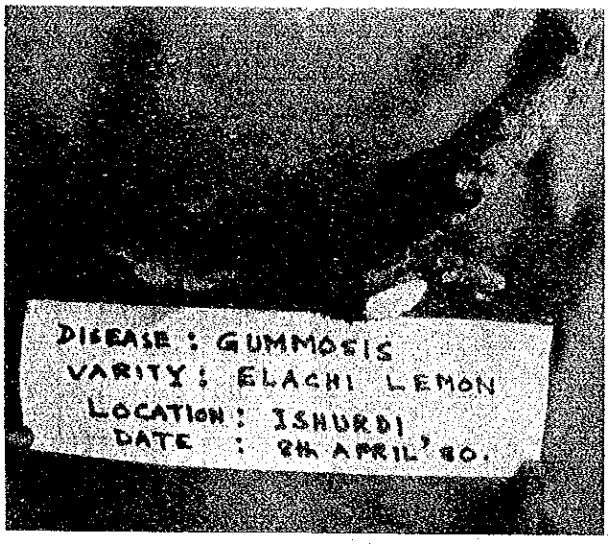

Fig. 3. Gummosis of citrus trunks

Fig. 4. Controlling of gummosis by applying DAIFAH, Bordeaux mixture paste and canker by Bordeaux mixture.

Fig. 5. Scab affected twigs and leaves.

Fig. 6. Melanose affected leaves

Fig. 7. Wind burn affected citrus leaves.

Fig. 8. Sooty mold affected leaves of citrus plant

Fig. 9. Application of nutrient elements on deficient citrus plants.

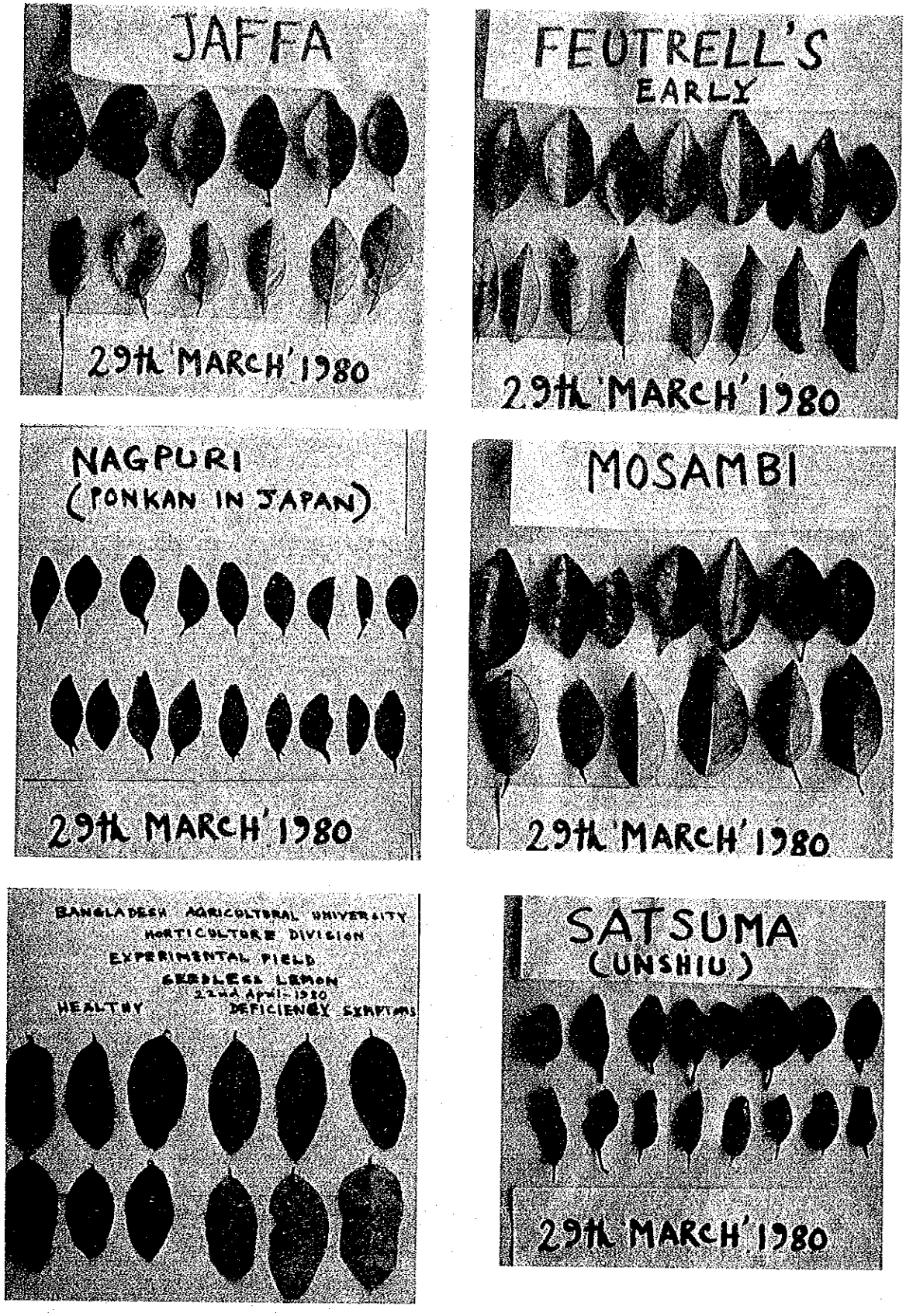

Fig. 10. Deficiency symptoms of citrus leaves.

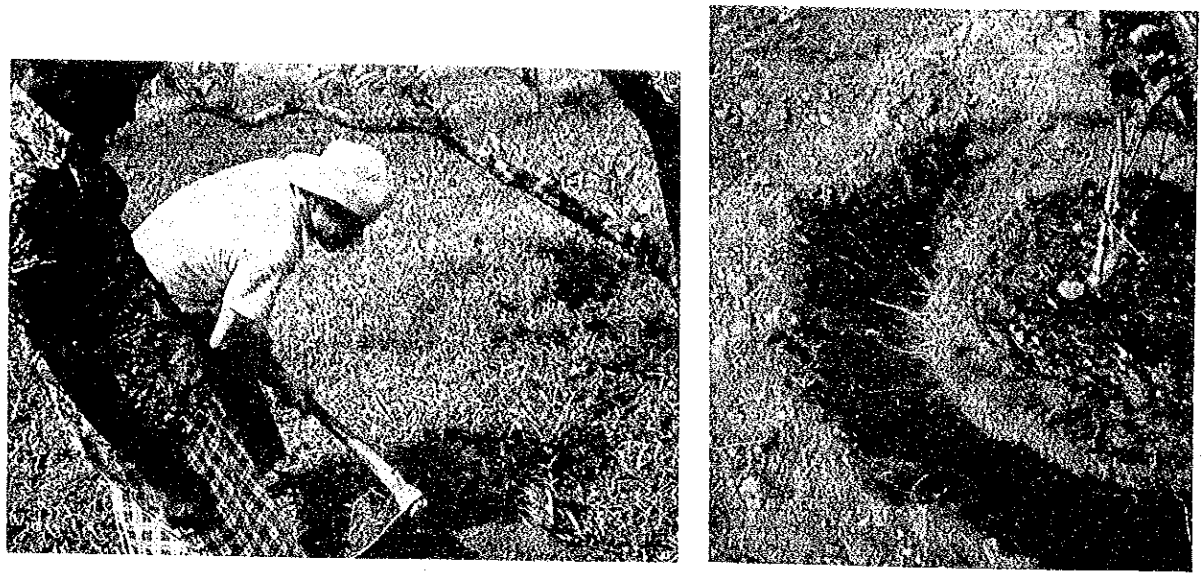

Fig. 11. Application of manure, cowdung and fertilizers of citrus plants.

Fig. 12. Inoculation test of melanose on citrus plants.