18. BREEDING OF RICE FOR RESISTANCE TO MAJOR DISEASES IN INDONESIA

B. H. Siwi* and Ida Njoman Oka*

Introduction

A number of diseases affecting the rice crop in Indonesia have been reported. Some of them are considered not to be of economic importance while others are very destructive.

"Mentek" disease has been reported to cause serious damages to the rice crop in Java since more than a century ago. Detailed studies on the nature of the disease were conducted by various workers. Several hypotheses were suggeted to explain the possible cause of the disease[1), 3), 9), 15), 22), 23), 24)].

Bunt disease caused by *Neovossia horrida* (Takahashi) Padwick and Azmatullah Khan was first reported by Rutgers in 1914[18)], to be present in different parts of Java. The incidence of the disease was rather low and consequently not of much econmic importance.

Hall[6)] reported on the occurrence of false smut, *Ustilaginoidea virens* (Cke) Tak. in Java.

Tojib[21)] conducted experiments with stem rot disease caused by *Sclerotium sigmoideum* Nak. and *Rhizoctonia* app. to study the reaction of several rice varieties. He reported that *Sclerotium sigmoideum* Nak. caused damage on some varieties while several other varieties were susceptible to *Rhizoctonia* spp. Both fungi reduced the number of grains per panicle and caused increased percentage of sponginess.

Brown leaf spot, *Cochliobolus* (*Ophiobolus*) *miyabeanus* Ito and Kuribayashi (*Helminthosporium oryzae* Breda de Haan) was described by Breda de Haan[2)]. The disease has recently been observed to be widely distributed in Indonesia and is considered to be of significant importance.

Blast disease, *Piricularia oryzae* Cav. was reportedly not of economic importance [18)], however, since the outbreaks in 1957 much attention has been paid to study the nature of the disease.

Another disease was reported in 1948 by Reitsma and Schure[17)] who called it "kresek". The pathogen was identified by Schure[19)] to be a new species and was called *Xanthomonas kresek* Schure. However, Goto[4)] identified the pathogen to be *Xanthomonas oryzae* (Myeda & Ishiyama) Dowson, a bacterial disease commonly found in the tropics.

Rivera, a plant virologist of the International Rice Research Institute, who made a survey on "mentek" disease in Indonesia very recently, identified tungro like disease, grassy stunt and yellow dwarf disease to be present in West Java.

Among the diseases mentioned above *Piricularia oryzae* Cav., "mentek" and "kresek" or bacterial blight may be classified as major diseases and will be dealt with in this paper. However, in the attempt to develop resistant varieties through breeding the other diseases should certainly not be neglected. The presence of virus diseases of rice in Indonesia should be considered as a serious warning, since they may become a potential threat to the rice crop in the future.

* Respectively, Plant breeder and Plant pathologist, Central Research Institute for Agriculture, Bogor, Indonesia.

No effective measures have been suggested to control wide spread deseases economically. Developing resistant varieties is, therefore, a fundamental approach.

The Importance of Blast Disease in Indonesia

The first scientific report on blast disease or *Piricularia oryzae* Cav. in Indonesia was published by Rutgers in 1914[18]. The incidence of the disease was observed by Metselaar, a teacher in Agriculture at Modjokerto, to occur on the nursery beds near Surabaja and Madura. Specimens of the diseased plants were identified by the Research Institute in Bogor to be caused by *Piricularia oryzae* Cav.

In a study on the tillering and flowering of the rice variety Untung, Kuilman[10] observed symptoms of *Piricularia oryzae* Cav. on the leaves at the time the stem started to elongate. No incidence of economic importance, however, have been reported.

Since 1957 the disease has attracted serious attention. Outbreaks of the disease occurred in North Sumatra causing damage to the upland rice crop. A serious problem arose, since several of the improved varieties being released by the Rice Research Institute in Bogor were reported to be very susceptible to blast disease. The varieties Mas and Salak, were found to be very susceptible and were officially withdrawn from the list of recommended varieties.

Reports from the local testing station in Tamanbogo, South Sumatra, mentioned damage of upland rice crop of the variety Sigadis. About 80 per cent of the crop was destroyed by neck blast. Wet nurseries of Djelita, Syntha and Sigadis were also observed to be infested by blast at Tjitajam and Muara near Bogor. The incidence of the disease was also reported from Central Java and East Java[7], [8].

The outbreaks of the disease in several regions might be due to the increased levels of nitrogen application, the use of improved varieties which have never been tested before for blast reaction, or the occurrence of new virulent races of the pathogen[20].

Varietal Reaction to Blast

Testing of varieties as to their reaction to *Piricularia oryzae* Cav. was initiated since 1963 [8]. More than 500 varieties were entered in blast nursery tests including 223 lowland, 104 upland and 181 introduced varieties. Three locations were selected for the project, two of them are situated in West Java on soil classified as red brown latosol, and the other one is located in South Sumatra on soil classified as red yellow podsolic. The choice of the locations was based on the information of frequent occurrence of blast.

The testing technique recommended by IRRI was used[14]. Based on the 1964 test at Tjikeumeuh (Bogor), 15 per cent of the lowland variety group, 41 per cent of the upland variety group, and 54 per cent of the introduced variety group were found to be resistant.

The varieties Bengawan, Sigadis, Remadja, Djelita, Dara, Syntha and Dewitara which are extensively being grown turned out to be highly susceptible to blast in the 1964 test (Table 2). Some resistant varieties were found among the upland variety group (Table 3). These were Sibudjang, Malio, and Leter. Among the introduced varieties Tetep, Tadukan, Dular, Kataktara and K. P. F. 6 were all highly resistant at 3 locations (Table 4).

Seventy progeny lines were tested in 1963 of which 60 were derived from the cross Bengawan and Sigadis (Cross No. 221) and 10 from the cross Sigadis and FAO 5772 (Cross No. 268). None of the progenies of cross No. 221 showed resistance to blast, while 9 out of 10 progenies of cross No. 268 were found to be resistant. According to Ou[16] 7 progenies of this cross were found to be resistant to blast and bacterial blight in the Philippines.

Table 1. Parent varieties used in the hybridization program and desirable characteristics to be combined.

Parents	Desirable characteristics
Taichung (N)1) (Syntha) (Baok IR 5-47-2)×(Solo) (Arimbi IR 8-288-3) (Sukanandi (Bengawan	Short stature, plant type, good cooking quality, responsive to nitrogen.
Seratus malam) (Syntha Belle Patna)×(Sukanandi Cartuna) (Arimbi	Short maturity, good ccoking quality.
Malio) (IR 5-47-2 Leter) (IR 8-288-3 Dawn)×(Taichung (N) 1 Kataktara) (Syntha Zenith) (Peta	Resistance to *Piricularia oryzae* Cav.
Solo) Djalen) Sri Makmur) (IR 5-47-2 Bengawan)×(IR 8-288-3 Sigadis) (Taibhung Zenith) B 589 A 4-18)	Resistance to kresek and bacterial blight.
Peta) Pankhari) Sigadis) (IR 5-47-2 Mas)×(IR 8-288-3 Gam Pai) (Taichung (N) 1 Bengawan)	Resistance to tungro, other virus diseases, and mentek.
(IR 5-47-2 TKM-6)×(Syntha (Sukanandi (IR 8-288-3	Resistance to stemborer.
(IR 5-47-2 Leter)×(IR 8-288-3 (Syntha	Moderately shattering, resistance to *Piricularia oryzae* Cav.
Taichng (N) 1) (BPI-76 IR 8-288-3)×(Malio IR 5-47-2) (Bengawan	Non-photosensitive.

Table 2. Reaction to *Piricularia oryzae* Cav. of 25 improved lowland rice varieties at 3 locations, 1964. (Harahap, 1967)*

Variety	Tjikeumeuh	Tjitajam	Tamanbogo
Tjere (indica)			
Bengawan	MS	HS	MS
Sigadis	HS	HS	HS
Remadja	HS	HS	HS
Djelita	HS	HS	HS
Dara	HS	HS	HS
Syntha	HS	HS	HS
Dewitara	HS	HS	HS
Tjina	MS	HS	HS
Latisail	MS	MS	MS
Pelopor	R	HS	MS
Fadjar	R	HS	HS
Mas	R	HS	HS
Bulu (javanica)			
Baok	MS	HS	HS
Solo	MS	HS	HS
Benong 130	MS	HS	HS
Dendek kolom	MS	HS	HS
Brondol Putih 277	HS	HS	HS
Sukanandi	S	HS	HS
Gendjah ratji	MS	HS	HS
Gendjah beton	HS	HS	HS
Djambu	MS	HS	HS
Kentjana	S	HS	HS
Ketan Serang	HS	HS	HS
Blanak Kesambi	S	HS	HS
Beak ganggas	MS	HS	HS

* HS=Highly susceptible HR=Highly resistant MS=Moderately susecptible
S =Susceptible R=Resistant

Table 3. Reaction to *Piricularia oryzae* Cav. of 28 upland rice varieties at 3 locations, 1964. (Harahap, 1967)*

Variety	Tjikeumeuh	Tjitajam	Tamanbogo
Tjere (indica)			
Gendjah Lampung	MR	S	S
Sibudjang	R	MR	MR
Cartuna	MS	HS	S
Pulut Nangka	MS	HS	HS
Malio	R	R	R
Siarias	MS	HS	MS
Kretek	MR	MS	MR
Seratus malam	S	HS	HS

Table 3. (Cont'ed)

Variety	Tjikeumeuh	Tjitajam	Tamanbogo
Sibakas	MS	HS	—
Dajang rindu	MS	HS	HS
Mas Kenikir	S	HS	HS
Gubuh balai	MS	HS	S
Arakan	MS	HS	HS
Silandjah	MS	HS	HS
Bulu (*sub-japonica*)			
Leter	R	MR	MR
Salak	MR	HS	MS
Gundil kuning	R	MS	MS
H. K. Temu	R	MS	MR
Tjempo welut	HS	MR	—
Djanda mandja	MS	HS	HS
Koneng gede	R	MS	MR
Salakan	—	HS	HS
Sampangkunir	MS	MS	—
Sampangan	MR	MS	—
Sereh	R	HS	HS
Padi kuning	MR	HS	MS
Peuteuj	R	MS	MR
Tjolok mato	R	MS	MR

* HS=Highly susceptible HR=Highly resistant MS=Moderately Susceptible
MR=Moderately resistant S=Susceptible R=Resistant

Table 4. Reaction to *Piricularia oryzae* Cav. of 28 introduced varieties at 3 locations, 1964. (Harahap, 1967)*

Variety	Origin	Tjitajam	Tjikeumeuh	Tamanbogo
C I 7787	U. S. A.	HR	HR	R
P I 180061	〃	HR	R	MR
P I 201902	〃	HR	HR	MR
Tetep	Japan	HR	HR	HR
Tadukan	〃	HR	HR	HR
Cho-koto	〃	HR	S	R
Ginga	〃	R	HS	HS
Hakkoda	〃	R	HS	HS
Aimasari	〃	R	HS	MS
Kimaze	〃	R	HS	MS
Norin 24	〃	R	HS	MS
Norin 22	〃	R	HS	S
Miho miakihi	〃	R	HS	S
Norin 1	〃	R	HS	MS
Kwang-fu	Taiwan	R	HS	MS
Pai-kan-tao	〃	R	R	R

Table 4. (Cont'ed)

Variety	Origin	Tjitajam	Tjikeumeuh	Tamanbogo
Taichung 170	Taiwan	R	HS	MS
C 33-18	Burma	R	R	MS
C 46-15	〃	HR	HR	R
H-4	Ceylon	HR	MR	R
H-6	〃	R	HS	MR
59-811 (Mas×Ptb-16)	〃	R	R	MS
Dular	Pakistan	HR	HR	HR
Kataktara	〃	HR	HR	HR
K. P. F. 6	〃	HR	HR	HR
B. J. 1	India	R	R	R
Ram Tulasi (Sel)	〃	MR	R	HR
BR 24	〃	MR	HS	MS

* HS=Highly susceptible HR=Highly resistant MS=Moderately susceptible
MR=Moderately resistant S=Susceptible R=Resistant

Table 5. Reaction of U. S. differential varieties to blast specimens of Indonesia.*

No. Culture Differential	563	564	566	567
Zenith	R	R	R	R
Rexoro	S	S	S	S
Lacroce	S	?	S	S
Caloro	S	S	S	S
5309	R	S	S	S
Dular	R	S	R	M
NP 125	R	R	R	R
Taichung 65	R	S	S	S
Wagwag	R	?	R	?
Reminad	R	R	R	R
Tetep	R	R	R	R
USEN	M	R	S	S
Chokoto	R	S	S	S
Yakeiko	R	S	S	S
Kanto 51	R	S	S	S
Ishikari-Shiroke	R	S	S	S
Ginga	S	S	S	S
Homarenishiki	S	S	S	S
Aichi asahi	S	S	S	S
Norin 20	S	?	S	S
Norin 1	R	?	S	S
Norin 17	R	S	S	S
Pi 1	S	S	S	S
Pi 2	S	S	S	S
Tonewase	R	S	S	S
Ayanishiki	?	S	R	S

Table 5. (Cont'ed)

No. Culture Differential	563	564	566	567
Pai-kan-tao	R	S	S	M
Tep Saigon	R	R	R	R

* S = Susceptible M = Moderately resistant R = Resistant
? = Notidentified

Identification of Physiologic Races of Blast

Forty Blast specimens from West Java and South Sumatra were sent for identification to the US Marine Biological Laboratory, Maryland, USA, in 1964. Four isolates were inoculated to several US differential varieties. Results of the test indicate that at least 3 physiologic races of blast were found in the two locations (Table 5). This might be the reason of the different reactions found in West Java and South Sumatra in the 1964 tests (Tables 2, 3, 4).

The Problem of "Mentek" Disease

"Mentek" disease was known in Indonesia to be very destructive to rice. Crop failures of 10-40% were reported from Pekalongan, Central Java, in 1921. In fact, since the beginning of the twentieth century Dutch scientists in Indonesia had devoted much of their time to clarify the nature of the disease and to find measures to control it.

Several hypotheses on the cause of the disease have been advanced. Breda de Haan[1] suggested that the nematode *Radhopholus oryzae* was responsible for bringing about the disease symptoms. Van der Elst[3], postulated that the disease was of physiolgic nature. Kuilman[9] stated that potassium deficiency induced "mentek" symptoms. Van der Vecht and Bergman[24] reported that both the pathogenic nematode, *Radhopholus oryzae*, and unsuitable environmental conditions are responsible for the expression of the disease symptoms. Tojib[22] put forward a hypothesis that "mentek" disease might be caused by virus. The virus hypothesis has received much attention only recently.[15]

Temporary control measures have been recommended to prevent the occurrence of the disease, such as good preparation of the soil, using nitrogenous and phosphate fertilizers, control of weeds, and drainage of the field if "mentek" symptoms occur.

Van der Meulen[12], however, made a significant contribution to tackle the "mentek" problem by developing new resistant rice varieties.

Breeding Procedures to Develop "Mentek" Resistant Varieties

None of the previous workers had succeeded to reproduce the typical "mentek" symptoms. Therefore, it was difficult to have a sound technique to screen the varieties or lines against the disease. It was found, however, that in field conditions several varieties were very susceptible, while others were tolerant to "mentek". Since the early studies Breda de Haan[1] noticed that among the rice varieties grown in the "mentek" infested regions, some degree of resistance did exist. Several varieties were observed to be resistant to "mentek", such as Brondolputih T 43, Brondolputih 277, Djalen, Untung, Urang-urangan, Lusi, Tuntang, George sail and Chingfow. Later it was observed that Lati sail, an introduced variety from India, did have a high degree of resistance to "mentek" disease[11), 12), 13)].

In the hybridization program Lati sail was used as parent material for "mentek" resistance and was crossed with the variety Tjina, originally introduced from China (Cross no. 40c). The progenies of this cross were exposed to natural infection of "mentek" by growing them in different locations where the disease was known to be prevalent. A diagram of the cross

is presented in Fig. 1

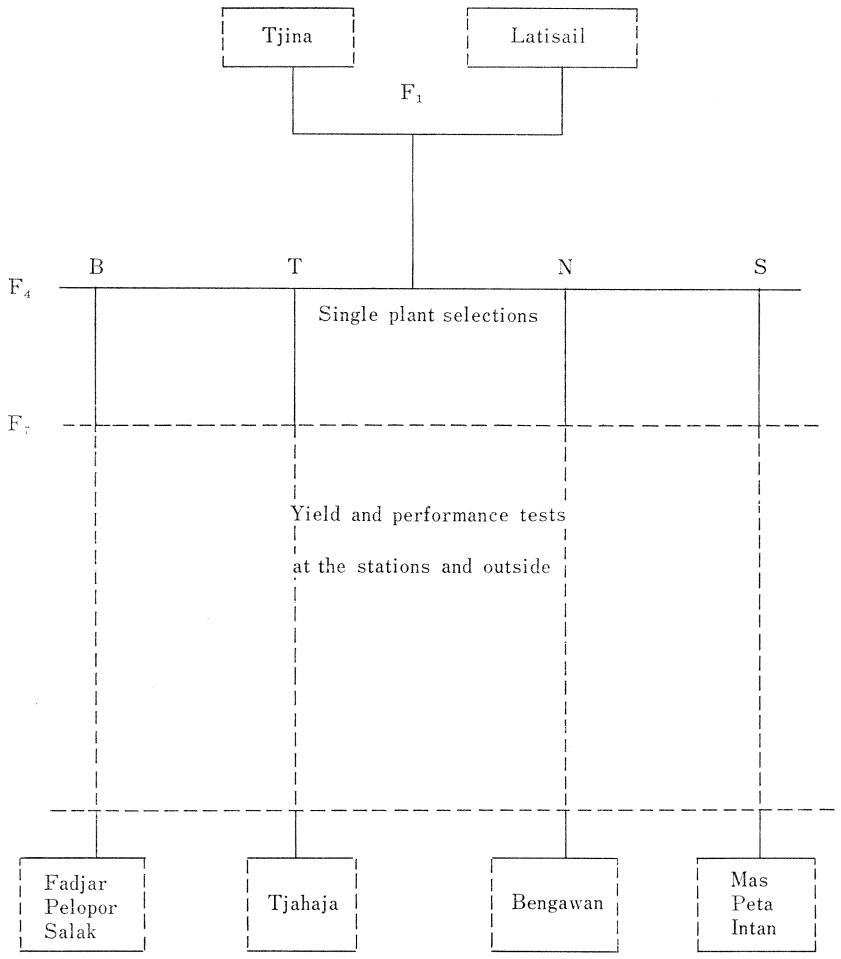


Fig. 1. Breeding processes to develop "mentek" resistant varieties.

Van der Meulen[12] did the initial cross in Bogor in 1934. The bulk method of breeding was followed. F_4 seeds were grown at 4 local testing stations, three of them were located in West Java, while the other one was located in East Java, where individual plant selections were started. Promising lines were entered in yield performance tests at the 4 local testing stations. Extensive testing of the lines were carried out on farmer's fields. Strict selections were carried out in the advanced generations. Several pure lines possessing high yielding capacity and good agronomic characteristics combined with resistance to "mentek" disease were developed. These were Bengawan, Peta, Salak, Tjahaja, Mas, Intan, Fadjar and

Pelopor.

Bengawan was developed at Ngale near Madiun, East Java. Peta, Mas and Intan were developed at Singamerta, West Java. Fadjar, Pelopor and Salak were developed at Bogor, and Tjahaja was developed at Tjitajam near Bogor, West Java. Insan and Mas were released for commercial production in 1940, Tjahaja, Fadjar, Pelopor, Bengawan and Peta in 1941, and Salak in 1942. Within a short time these varieties were distributed all over the country. Especially in regions where "mentek" disease was known to be prevalent these resitant varieties gradually replaced the local varieties. Crop failures by "mentek" were very much reduced since then. It is important to notice that the varieties Bengawan, Peta, Mas, Intan, Tjahaja, and Salak which are resistant to "mentek" in Indonesia[12] are also found to be resistant to tungro virus disease in the philippines[16].

The Importance of "kresek" Disease

"Kresek" disease was first described by Reitsma and Schure[17]. This disease has caused severe damage to several tjere (indica) varietes in Muara near Bogor in 1948. The causal organism, called *Xanthomonas kresek* by Schure[19], was later identified Goto[4] to be idetical to *Xanthomonas oryzae* (Uyeda & Ishiyama) Dowson.

Reitsma & Schure observed that the tjere (indica) varieties Mas, Bengawan, Peta, Tjina, and seletion no. 2783 were all very susceptible to the disease, while the bulu (javanica) varieties Djalen and Solo were more tolerant. The reaction of tjere (indica) and bulu (javanica) varieties to kresek needs further investigation. Using certain isolates of *Xanthomonas oryzae* Goso[5] observed that more susceptibility did occur among the indica than among the japonica varieties. The indica varieties Lusi, Skrivimankotti, Remadja, Mas Sigadis and 221c/446/2 from Indonesia were found by Goto to be highly susceptible to bacterial blight isolate B 72 from the philippines.

In Indonesia it is a common practice to cut the tips of the leaves before transplanting. It was found that cut leaves are more likely to be attacked by "kresek" than uncut leaves[17]. Therefore, it was recommended not to cut the leaves before transplanting.

No data on the distribution and the extent of damage by "kresek" are available, however, it was noticed that the disease is widespread in Java. Growing susceptible varieties may cause serious outbreaks of the disease.

Breeding Program

1. General Objectives

The rice breeding program in Indonesia is aimed to develop high yielding varieties which are responsive to higher levels of nitrogen, early maturing (100–120 days), nonsensitive to the prevailing photoperiods, resistant to major diseases, short and erect stature, nonlodging, moderately shattering and suitable cooking quality.

2. Breeding for Brast Resistance

With regard to blast disease several procedures are being conducted.

(1) Testing of varieties and promising lines in blast nursery tests in West Java and South Sumatra.

(2) Make crosses using Zenith, Kataktara, Dawn, Leter and Malio as one of the parents to transfer the blast resistant characteristic.

(3) Use the pedigree method of breeding and enter the progenies in blast nursery tests at different locations.

(4) Select promising blast resistant progenies.

3. Breeding for Resistance to "mentek" Disease

The cause of "mentek" disease is not yet definitely stated. The symptoms of "mentek"

previously described are still very confusing. Therefore, it is difficult to set up a sound breeding program for resistance to "mentek". It is true that "mentek" resistant varieties such as Bengawan obtained, however, with regard to other characteristics these varieties are still to be improved. In the attempt to develop new "mentek" resistant varieties two procedures will be approached.

(1) Procedure 1 (orthodox method).

Step 1. Make crosses using the known "mentek" resistant varieties Bengawan, Peta, Mas etc. as one of the parents.

Step 2. Use the bulk method of breeding. Grow the bulk population at several testing stations.

Step 3. Make individual plant selections.

Step 4. Test the advanced progeny lines as to their reaction to "mentek" disease at the local testing stations and on "mentek" areas. "Mentek" resistant lines may be developed through natural selection.

A longer time is needed to develop "mentek" resistant varieties by this method.

(2) Procedure 2 (short cut method).

This method is still very speculative and will be applicable only if "mentek" is definitely caused by virus.

Step 1. Make surveys to "mentek" areas to identify the disease.

Step 2. Specimens of diseased plants are studied in the green house to investigate if leafhoppers such as *Nephotenttix* spp. or *Nilaparvata* spp. are able to transmit the disease symptoms.

Step 3. Test varieties and progenies for resistance to "mentek" using the vectors as transmitters of the disease. This procedure can be done in the green house or on covered nursery beds.

Step 4. Select resistant varieties and lines.

A similar method will be used to develop varieties that are resistant to several virus disease.

4. Breeding for Resistance to "kresek"

Very little information is available on the reaction of varieties to "kresek" in Indonesia. Breeding for resistance to "kresek" should, therefore, be preceded by:

(1) Isolating virulent races of *Xanthomonas oryzae*

(2) Developing a good testing technique.

(3) Screening of varieties to "kresek"

Field observations suggest that Bengawan, Djalen, Solo and Sri Makmur are tolerant to the disease. These varieties are being used in the hybridization program.

5. Hybridization Program

Crosses are being made to combine several desirable characteristics.

The varieties being used as parent materials are as follows:

(1) Good Plant type : Taichung (N) 1, IR 8-288-3, IR 5-47-2

(2) Short maturity : Seratus malam, Belle Patna, Cartuna

(3) Reristance to blast : Malio, Leter, Dawn, Kataktare, Zenith

(4) Resistance to tungro, other virus diseases and "mentek": Peta, Pankhari, Sigadis, Mas, Gam Pai, Bengawan

(5) Good cooking quality: Syntha, Bengawan, Sukanandi, Arimbi

(6) Resistance to "kresek"-leaf blight: Sri Makmur, Bengawan, Sigadis, Zenith, B 589A4-18

(7) Resistance to stemborer: TKM-6

(8) Non-shattering and resistance to blast: Leter

(9) Photoperiod insensitive: Taichung (N) 1, IR 8-288-3, IR 5-47-2, I-g-t, D-g-w-g
The cross combinations are shown in Table 1.

Summary

The importance of rice diseases has been realized early in the history of scientific agriculture in Indonesia. Resistant varieties to "mentek" disease have been develeped. Until now sporadical occurrence of "mentek" disease in Indonesia has been reported. The extent of crop failures, however, has considerably been reduced due to the use of "mentek" resistant varieties.

Research is still in progress to find the cause of "mentek" disease. Recent hypothesis suggested that "mentek" is of virus nature. If this hypothesis is true the disease may become a potential threat to the rice crop in the future. Breeding for new resistant varieties is, therefore, essential.

Two breeding procedures pertaining to "mentek" disease is being suggested. One is the conventional bulk method as used by Van der Meulen to develop "mentek" resistant varieties, and the other is a screening technique to be used only, if "mentek" is proved to be definitely caused by virus.

The importance of *Piricularia oryzae* Cav. was realized only a decade ago. Variety screening trials are in progress. A hybridization program was set up to develop new blast resistant varieties.

The source of resistance to major races of *Piricularia oryzae* Cav. in Indonesia may also be sought among the local upland rice varieties in Sumatra and in other areas. Many local upland varieties which are now being grown have been exposed to natural selection for years and may, therefore, have developed some degree of resistance to the major races of *Piricularia oryzae* Cav. prevalent to the region.

Several IRRI varieties have been introduced to Indonesia. Almost all the desirable characteristics have been combined in certain IRRI varieties. IR 8 showed susceptibility to bacterial blight, nevertheless, the yield was comparatively high. Crosses are being made to improve IR 8 with respect to its reaction to bacterial blight.

Tungro like disease, grassy stunt, and yellow dwarf disease have recently been identified in Indonesia. Control of leafhoppers should be done to prevent spreading of the disease. Breeding for resistance to virus diseases is urgently needed.

Discussion

K. Toriyama, Japan: Suppose mentek is virus disease, after the variety Bengawan was recommended and grown for many years. In this case have new virus races appeared?

Answer: Since the release in 1941 Bengawan has retained its resistance to mentek disease. If mentek is caused by virus it is unlikely that more virulent races have occurred.

H. Oka, Japan: On crop seasons in Indonesia, could you account for briefly?

Answer: There are two rice crop seasons in Indonesia, the wet crop season and the dry crop season. The main crop is grown in the wet seaeson.

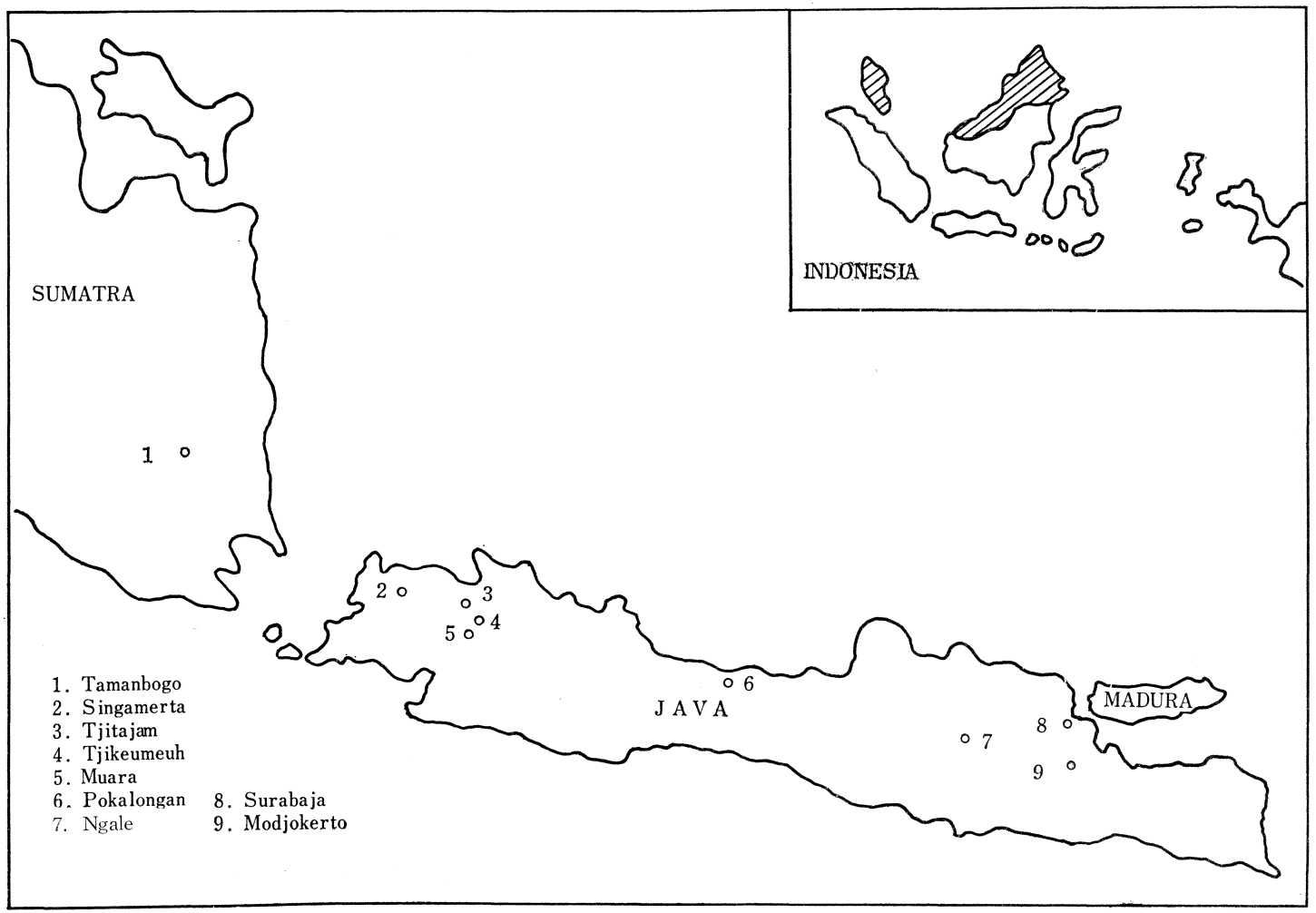
In Java the wet season starts from about November to April, the dry season starts from about May to October. These two crop seasons are not so pronounced in the other islands.

S. Samoto, Japan: What are the characteristics of the varieties Tjina and Lati sail (Note: tall, plant type, resistance to blast).

Answer: Tjina is a tall variety with long straw, intermadiate tillering, long panicles, slight spreading of culms, good ability to grow in rapidly rising water, less sensitive to photoperiod, moderately resistant to mentek, moderately to highly susceptible to blast.

Lati sail is a short variety with short straw, good tillering, short panicles, spreading culms,

Location of the Stations



slightly able to grow in rapidly rising water, sensitive to photoperiod, highly resistant to mentek, moderately susceptible to blast.

Y. Hashioka, Japan: Have you any experience of applying nematocides to the mentek-affected fields? If it is due to nematodes, nematocides may answer to the cause of the disease.

Answer: Application of nematocides to mentek-affected fields have not been done so far.

H. M. Beachell, USA: Do you have areas in Indonesia where mentek attack can be expected to be heavy each year. If so field testing of breeding lines might be possible. What is your opinion?

Answer: The most important mentek areas are the river valleys on both sides of the Kendeng Mountains in Central and East Java, a low ridge running from south of Sematang to Surabaja. One of the testing stations of the Central Research Institute of Agriculture is located in this area. At this station field testing of breeding lines is possible. In fact, the variety Bengawan is developed at this station.

A. Alim, Pakistan: Do you get this mentek disease in directly sown dry field crop?

Answer: Mentek disease has never been found in directly sown dry field crop.

D. N. Srivastava, India: What are the cultural, climatic and soil conditions which favor mentek? How does it differ from tungro and Penjakit Merah disease?

Answer: Mentek disease is favored by inadequate soil preparation, stagnant water, heavy soils and late planting. The aboveground symptoms of mentek is very similar to tungro. The general criteria to describe mentek are: discoloration of leaf parts from yellowish tinge to reddish color, increasing discoloration of the outer leaves followed by desiccation, the plants practically stops growing resulting in short internodes. Rotting of the roots is also used as a criterion to describe mentek.

References for Paper 18

1. Breda de Haan, J., Van, 1902. Een aaltjesziekte der rijst "omo mentek" of "omo abang". Meded. uit s'Lands plantetuin LIII: 1–65.
2. Breda de Haan, J., Van. 1900. Vorlatfige beschreibung von pilzen bei tropischen kultur pflanzen beobachet. Bull. de Inst. Bot. de Buitenzorg 6: 1–13.
3. Elst, p., Van der, 1930. The mentek diseases of rice. Proc. of the 4 th Pacific Sci. Congr. Java, 1929, 4: 329–331.
4. Goto, Masao, 1964. "Kresek" and pale yellow leaf, systemic symptoms of bacterial leaf blight of rice caused by *Xanthomonas oryzae* (Uyeda & Ishiyama) Dowson, P 1. Dis. Rptr. 48: 858–861.
5. Goto, Masao, 1965. Resistance of rice varieties and species of wild rice to bacterial leaf blight and bacterial leaf streak diseases. Repr. The philip. Agric. Vol. XLVIII, pp. 329–338.
6. Hall, C. J. J., Van, 1917. Ziekten en plagen der cultuurgewassen in Ned. Indie in 1916. Meded. Lab. Planteniekten 29: 1. 37.
7. Hamzah, Purakusumah and Ida Njoman Oka, 1966. Beberapa penjakit penting pada padi. Unpublished. LPPP, Bogor, Indonesia.
8. Harahap, Z., 1967. Pegudjian kesahanan varitas-varitas padi terhadap penjakit *Piricularia oryzae* Cav. Unpulished. LPPP, Bogor, Indonesia.
9. Kuilman, L. W., 1936. Symptomen van de mentek ziekte vande rijstplant. Landbouw XII: 225–245.
10. Kuilman, L. W., 1940. Uitstoeling en bloei van de rijstplant. III. Vatbaarheid van de (op voedingsoplossingen gekweekte) varieteit Untung voor *Piricularia oryzae* Cav. Meded. Alg. Proefst. v. d. Landbouw No. 45.

11. Meulen, J. G. J., Van der, 1941. De rijstselectie in Nederlandsch Indie. Meded. Alg. Proefst. v. d. Landbouw No. 52: 1–87.
12. Meulen, J. G. J., Van der, 1950. Rice improvement by hybridization and restults obtained. Contr. Gen. Agric. Res. Sta. No. 116: 1–38, Bogor, Indonesia.
13. Meulen, J. G. J., Van der, and A. J. Ophof, 1948. De rijstvarieteit Oentoeng. Meded. Alg. Proefst. v. d. Landbouw No. 62.
14. Ou. S. H., 1965. The rice blast disease. Proc. of a symposium at the Intern. Rice Res. Inst,. July 1963: 441–446. The Johns Hopkins Press. Baltimore, Md.
15. Ou. S. H., 1965. Rice diseases of obscure nature in tropical Asia with special reference to "mentek" disease in Indonesia. IRC Newsletter Vol. XIV, No. 2.
16. Ou. S. H., 1966. Varietal resistance to three major diseases of rice in Southeast Asia. Symposium on Plant diseases in the Pacific. XIth Pacific Sci. Congr. Tokyo, August 25–27, 1966: 49–70.
17. Reitsma, J., and P. S. J. Schure, 1950. "Kresek" a bacterial disease of rice. Contr. Gen. Agric. Res. Sta., No. 117: 1–17, Bogor, Indonesia.
18. Rutgers, A. A. L., 1914. Ziekten en plagen der cultuurgewassen in Ned. Indie in 1913. Meded. Lab. Plantenziekten 9: 1–24.
19. Schure, P. S. J., 1953. Attempts to control the kresek disease of rice by chemical treatment of the seedling. Contr. Gen. Agric. Res. Sta., No. 136: 1–17. Bogor, Indonesia.
20. Siregar. H., 1964. Pemuliaan varitas padi tanah kering. Unpublished, LPPP, Bogor, Indonesia.
21. Tojib, Hadiwidjaja, 1945. Rapporten en Verslagen Inst. Plantenziekten, Bogor. Unpublished.
22. Tojib, Hadiwidjaja, 1956. Matibubjang disease of the clove tree. Ph. D. Thesis, Ueiv. of Indonesia, Bogor.
23. Vecht, J., Van der, 1953. The problem of the mentek disease of rice in Java. Contr. Gen. Agric. Res. Sta., Bogor, Indonesia, No. 137: 1–88.
24. Vecht. J., Van der, and B. H. H. Bergman, 1952. Studies on the nematode *Radhopholus oryzae* (Van Breda be Haan) Thorne and its influence on the growth of the rice plant. Contr. Gen. Agric. Res. Sta., Bogor, Indonesia, No. 131.