upward as a leading rice producing locality.

Another noteworthy feature of these new varieties is that they have greatly promoted farmers' willingness in growing rice. Figs. 4-(1), (2), (3) indicate close relation of the prefectural average yield increase and the distribution percentage of short stemmed varieties in Saga, Fukuoka and Kumamoto prefectures, respectively. No doubt such an actual yield increase by the use of these varieties stimulated farmers' interest in rice production.

The Saga Prefectural Government was alert enough to advocate cooperative group activities in growing rice with improved methods and power machines, etc. The modes of these activities were by no means uniform, but they varied within a wide range from rather simple and elementary to the higher and advanced. However in all of them the first step was always the unification of the varieties to be grown that were best fitted to each of the localities. The farmers' organizations and the Prefectural Government jointly supported and promoted the movement with every conceivable means, with hearty cooperation. Activities of the people from technical circles and from the extension service to prefectural government, experimental station, etc. were quite eye-catching. All people concerned united for the promotion of rice production. Such an impressive overall "grow more rice" movement seemed to have come basically from the productive potentials of the new varieties.

The time will come, however, when Hoyoku and other new varieties will become obsolete, and be unable to meet the farmers' requirements, because the farmers' requirements would be rapidly changing, and the new varieties here introduced are by no means perfect. Breeding more new varieties better fitted for the future demands is the role to be played by the rice plant breeders. Thus, breeding new and better varieties are the old and yet the new problem, always awaiting solution.

Tropical Paddy Soils

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Most of the readers of this paper would generously admit that researches in the nutrition of the rice plant and in the fertility of the paddy soil are somewhat more advanced in Japan than in other countries. However, Japonica type varieties grown in Japan and their environmental conditions, such as soils and climates, are all considerably different from those in the tropics. This fact would suggest knowledge, experience and methodology of Japanese specialists might not be directly applicable to improvement in rice productivity in the tropics without conducting much research work on the tropical rice culture.

In 1963 the author and his group initiated a systematic study of the paddy soils in Southeast Asia and have so far covered the larger part of Thailand, Malaysia, and Ceylon and a very small part of Cambodia and the Philippines. Using field observations and the analytical results as a basis, the author attempts here to clarify certain features of the tropical rice soil in comparison with those of Japanese rice soil.

I From field observation.

a) Characteristics in the soil profile.

One of the questions most frequently met by the author in Southeast Asia is that why

Japanese paddy soils show the distinct horizon differentiation which is not common for paddy soils in Southeast Asia.

Paddy soils in Japan, which have developed on riverine sediments brought about by a relatively rapid flow as conditioned by occasional heavy rains and steep ranges, have generally a coarser texture, unlike those on a great deltaic plain, and, where the ground water level is relatively low, they are characterized by reductive-eluviation and oxidative-illuviation processes resulting in the formation of characteristic profile pattern of "dry paddy soils", i. e. Apg/Bg/C. Paddy soils on a low marshy land having a horizon sequence of Apg/G or ApG/G are wet throughout a year and are called "wet paddy soils" in contrast to the "dry paddy soils". Between these two extremes there are transitional soils of a hydromorphic series, having horizon sequences of Apg/Bg/C, Apg/Bg/G and etc.

Soils with a horizon sequence of Apg/Bg (Fe)/Bg(Mn)/C, which is characteristic of the soils artificially brought under rice cultivation on a land with a low ground water table, are found in Thailand, Malaysia and Ceylon, and are also known to occur in Indonesia and Burma on literature.

So far as a downward movement of water exists, the soil formation under paddy rice follows the above described process irrespective of the climatic zones, and where the parent material is sandy and poor in iron, the paddy soil is gradually degraded to the Aki-ochi-type soils.

In Southeast Asia, however, a real distribution of the soils having a similar horizon sequence to that of the typical "dry paddy soils" of Japan is very limited. The reason for this is primarily a heavy texture of the soils of great deltaic plains that are the major rice growing area. Severe weathering conditions may be an auxiliary cause of the occurrence of the heavy textured soils. Occurrence of a fair amount of the expanding clays may be another reason. After the cracks formed in the dry season are closed with the re-wetting of the soil in the beginning of the rainy season, downward movement of water may be almost completely hindered throughout the rice growing season. This is evidenced by the presence of slickensides in the subsoil of many paddy fields in the great deltaic plains. In such a case the fundamental horizon sequence is Apg/Cg type.

In rice cultivation in Japan all the management practices inclusive of ferilization are, in most cases, based on the premise of a moderate percolation of water. It is one of the subjects imposed on us to investigate cultural techniques on the Apg/Cg type paddy soils.

b) Rate of weathering of soil materials.

As far as the paddy soils of Thailand. Malaysia and Ceylon are concerned, no colored minerals except biotite are present regardless of the parent materials. This and the absence of chlorite in the clay mineral composition together would indicate a high rate of weathering of soil materials.

Acid sulfate soils and boggy paddy soils distributed scatteredly throughout Southeast Asia have their equivalents in Japan. Problems related to rice cultivation on these soils have almost entirely been solved. However, Japanese workers have very little experience with grumusol-like paddy soils.

II From analytical data.

At the present time sufficient analytical data are available only for Thai and Malaysian paddy soils. Here only plow layer soils are dealt with.

a) Nitrogen.

The general rule that organic matter content and, accordingly, total nitrogen content of the tropical soil are less than these of the soil in the temperate zone, is held also for paddy soils. A customary practice to burn the stubbles promotes this trend. However, there are some paddy soils of low marshy lands where the nitrogen content is very high, and, moreover, not a few soils show a high ammonification percentage upon submergence.

An striking result is given here. Table 1 shows acid-hydrolyzable nitrogen content and percentage ammonification upon submergence of the soils in the Central Plain of Thailand

Table 1. Nitrogen in acid-hydrolysate of a plow layer soil

Region	Soil No.	Texture	Total N %	N in acid-hydrolysate %*	NH_4-N on submerging %*	Remarks
Thailand, Korat	T-67	LiC	0.064	73.4	5.0	
〃 , North	T-204	LiC	0.159	64.8	5.4	
Malaysia, West	M-18	HC	0.468	71.3	4.7	
〃 , East	M-35	LiC	0.216	72.2	9.9	
Japan, Kyoto		SL	0.227	74.2	6.2	
Thailand, Central	T-201	HC	0.169	55.1	2.1	
〃	T-205	HC	0.154	53.3	2.0	acid sulfate
〃	T-207	HC	0.165	42.5	4.0	
〃	T-208	HC	0.236	49.2	3.5	acid sulfate
〃	T-209	HC	0.158	54.9	3.3	grumusol
Malaysia, North West	M-7	HC	0.312	45.4	2.2	
〃 , West	M-43	LiC	0.450	57.1	2.0	high yield

*% of total nitrogen

and the Northwest part of Malaysia, where soils have a very heavy texture and experience a dominantly dry season, in contrast to the other areas of Thailand and Malaysia. The soils of the Central Plain are divergent with respect to their taxonomic group, but have in common a low hydrolyzable nitrogen content and a low ammonification rate after submergence. Furthermore, they have highly humidified humus as compared with those of the other regions.

The author does not attempt to discuss the merits and demerits of these properties, but wishes to stress that these characteristics must first be recognized before adequate management and fertilization practices are planned. It is also necessary to elucidate if these characteristics are shared by the soils on the other continental deltaic plains.

b) Phosphorus.

It is well known on the analytical basis that readily soluble phosphorus is generally poor in the paddy soils of Southeast Asia. Here the followings are pointed out.

i) Although readily soluble phosphorus content is generally low, there are some soils on recent marine sediments that have very high phosphorus content even after years of rice cultivation without any fertilizer application. Mechanism of local accumulation of phosphorus in marine sediments have not yet been elucidated.

ii) Variation of readily soluble phosphorus content among genetically similar soils is considerably more pronounced than that of nitrogen and potassium.

iii) Correlations among organic matter, readily soluble phosphorus and readily soluble potassium are not conspicuous among genetically similar soils.

c) Potassium, magnesium and calcium.

From the plant nutritional standpoint soils which are thought to be deficient in these elements are rare, except for soils which have been extremely weathered and leached like those in Korat region of Thailand. Soils which have a developed B horizon are occasionally deficient in potassium.

d) Composition of clay minerals.

In Table 2 regional variations in the clay mineral composition of paddy soils are given. The followings may be stated from the data.

i) Regional characteristics in the clay mineral composition are readily detectable.

Table 2. The composition of clay minerals of a plow layer soil

Class	Kaolin %	Illite %
A	<35	<15 abundant in Mont.
B	<35	>20 abundant in Verm.
C	40-55	<10 abundant in Mont.
D	40-55	>15 abundant in Verm.
E	60-75	
F	>80	

Region	Number of soils for each class					
	A	B	C	D	E	F
Thailand, Korat	0	0	4	0	4	2
Thailand, North	0	0	0	2	4	0
Thailand, Central Plain	2	3	0	16	2	0
Malaysia, West	12	0	9	0	5	3
Malaysia, East	0	0	0	0	3	9

ii) Illite content is proportional to vermiculite content and is inversely proportional to montmorillonite content.

iii) No single soil so far analyzed contains chlorites.

e) Available silica.

Application of silica results in an increase in the rice yield for about one-forth of the total acreage of Japanese paddy soils. When the amount of available silica in the soil as determined with pH 4 acetate buffer extraction method is lower than 10.5 mg SiO_2/100 g air dry soils, a response to silica application is expected for Japanese paddy soils. It is not yet known what the criterion would be for the tropical paddy soils. The author has taken 7.0 mg/100 g as a tentative criterion for silica deficiency, then the number of soils having silica less than this value is as in Table 3.

Table 3. Deficiency of available silica in a plow layer soil.

Region	Number of soils		
	Examined	Deficient*	Severely** deficient
Thailand, Korat	31	24	21
Thailand, North	10	6	2
Thailand, Central Plain	46	6	3
Malaysia, West	29	8	2
Malaysia, East	12	6	3

*pH 4 acetate soluble SiO_2
<6.9 mg/100g air dry soil
** do <3.9 mg

Table 4. Deficiency of iron and manganese in a plow layer soil.

Region	Number of soils					
	Iron			Manganese		
	Examined	Deficient*	Severely** deficient	Examined	Deficient*	Severely** deficient
Thailand, Korat	32	24	22	17	8	0
Thailand, North	10	3	0	6	2	0
Thailand, Central Plain	43	10	2	20	4	1
Malaysia, West	29	21	14	29	22	16
Malaysia, East	12	4	3	12	6	3

*Photo-chemically reducible Fe_2O_3
<1 % of air dry soil
** do <0.5%

*Easily reducible MnO_2
<2.5 mg/100g soil
** do <1.0mg

Deficiency of available silica may be caused by the nature of the parent material and also by leaching in the course of soil formation.

f) Iron.

For Japanese paddy soils one percent of active Fe_2O_3 as determined with Mg-ribbon reduction method is critical. Below this value unfavorable effects on the growth of rice may be expected. This threshold value has been adopted for the results of iron determination with a photo-chemical reduction method which is somewhat more drastic than the Mg-ribbon reduction, then soils having less than one percent of iron oxide may be grouped as "susceptible to deficiency", while these having less than 0. 5 percent as "severely deficient". The number of the iron deficient soils as grouped here is given in Table 4.

Among the three iron oxides, goethite, hamatite and lepidocrosite, which are common in Japanese paddy soils, no lepidocrosite has so far been detected in Thai and Malaysian soils.

g) Easily reducible manganese.

If criteria established for the Japanese soil are tentatively adopted, manganese deficient soils in Thailand and Malaysia are distributed as in Table 4. The term "manganese deficiency" as used here signifies physio-nutritional deficiency of the rice plant, while the iron deficiency as refered to above means probable insufficiency in keeping the environmental conditions for rice growth optimum. But both the deficiencies may be caused mainly by the nature of the parent material.

Due to the economical situation of rice in Southeast Asia it may not be practical at the present time to recommend the use of materials containing silica, iron and manganese. However the knowledge that not a few paddy field soils are deficient in these elements would have to be kept in mind in taking various actions, such as selecting varieties, improving cultural techniques, conducting fertilizer experiments, acting against diseases and insects, analyzing soils and plants, and so forth. It would be much more unreasonable to underestimate the importance of these elements besides N, P, K than to take the deficiency of these elements very serious.

Two Rinderpest Live Virus Vaccines, "Lapinized" and "Lapinied-Avianized"

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During the period from the second to the fourth decade of this century, several types of inactivated rinderpest vaccine were developed and contributed a great deal to the control of the disease in different countries in the world. Of them, the well known are the glycerin-inactivated (Kakizaki, 1917), the formalin-inactivated (Cursson and Delpy, 1926), the toluol-inactivated (Kakizaki et al., 1927), the chloroform-inactivated (Kelser et al.. 1928) and the formalin-inactivated and alminium-hydroxyde gel added (Jacotot, 1940). However, two facts, including (1) the vaccine is very expensive and (2) the immunity produced by its use lasts only for a few months, were considered as the great disadvantages common to these vaccines. And these became the main obstacles in massive application in the field, because control and eradication were usually urgent with this disease.

Edwards reported, in 1927 and 1930, of his success in the development of an attenuated