but a certain quantity of this N source could be re-utilized by the plant. The leaching losses of N-fertilizer were not heavy and N lasted several years. The chemical denitrification losses could be important in the case of acidified soil and prolonged drought. Incorporating the straw is an interesting practice; it had a positive effect on yield and on soil fertility because of its N and K production and of its modifying action on acidification due to N-fertilization. It had no effect on the N mineral dynamics in the soil nor on its absorption by the plants.

References

Bollag, J.M., Drzymala, S. and Kadros, L.T. (1973). Biological versus chemical nitrite decomposition in soil. *Soil Science* 116, 44-50.

Bremner, J.M. (1965). Organic forms of nitrogen. *In* "Methods of Analysis". (C.A. Black, ed.), pp.1238-1255. University of Wisconsin Press, Madison.

Chabalier, P. (1976). Contribution â la connaissance du devenir de l'azote du sol et de l'azote-engrais dans un systèm sol-plante. Thesis University of Abidjan, Ivory Coast.

Chabalier, P. and Pichot, J. (1976). Nitrogen fertilizer utilization in a two-year rotation in Ivory Coast. Proceedings 7th International Fertilizer Congress, Moscow.

Guiraud, G. and Berlier, J. (1972). Influence de la paille enfouie sur l'evolution de l'azote du sol et des engrais. *Comptes rendus des seances de l'Academie d'Agriculture de France* 4, 239-246.

Wild, A. (1972). Mineralization of soil nitrogen at a savanna site in Nigeria. *Experimental Agriculture* (London) 8, 91-97.

In: Rice in Africa. Proceed. of a conference held at the International Institute of Tropical Agriculture, Ibadan, Nigeria, 7-11 March 1977. Ed. by I. W. Buddenhagen and G. J. Persley.. London, New-York, San Francisco, Academic Press, 1978.

IDENTIFICATION OF RICE YELLOW MOTTLE VIRUS IN IVORY COAST

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Introduction

A virus disease has been found in irrigated rice in several areas of Ivory Coast, notably Gagnoa, Lam-To, Yamoussoukro, Katiola, Odienne and Tabou. The characteristics of the disease and the virus itself were studied in order to identify the disease and assess its importance.

On young leaves, the disease appeared as a yellow and green mottle. Older leaves were yellow at the base and orange at the tip. In an infested field, yellow-orange discolouration of leaves was seen on plants scattered throughout the field, but such plants were more prevalent at field margins. Symptoms occurred at any stage from transplanting to booting. Plants infected at an early stage were stunted. The disease has been observed under irrigated conditions on the varieties IR8 and Jaya, with symptoms more pronounced on IR8.

Transmission and Host Range

The rice yellow mottle virus (RYMV) was successfully transmitted by mechanical inoculation of leaves previously dusted with carborundum. The inoculum was prepared by grinding in a mortar at 0°C, 0.5 cm pieces of infected leaves in 0.1 M phosphate buffer at pH 7.1, containing 0.25% bentonite and 0.35% cysteine hydrochloride. The symptoms after inoculation were similar to those seen in the field. Plants less than 14 days old were killed by the disease. The distribution of the disease in the field suggested that an insect vector may be involved, but this has not been investigated. The disease was not observed in 6000 seedlings grown from seed from infected plants.

The virus was mechanically transmitted, as evidenced by symptoms of a mottle, to 15 varieties of *O. sativa* from the IRAT collection at Bouake: C 463A; Carreon; CICA 4; Iguape Cateto; IR5; IR8; Jaya; LS 104 x 144 B9;

Moroberekan; Mutant 50; OS 5; OS 6; Tetep; Zenith; and 1487/9/5. The 15 varieties were inoculated mechanically at 15, 30 and 45 days after transplanting. The effect of the virus on growth, development and yield was much greater with earlier infection, and this depended on variety.

The virus was mechanically transmitted to other *Oryza* species (Table 1), but not to the following species: *Chenopodium amaranticolor*, *Datura innozia*, *D. stramonium*, *Eleusine coracana*, *E. indica*, *Nicotiana glutinosa*, *N. tabacum* v. samsun, *Physalis alkekengii*, *P. floribunda* and *Zea mays*.

Virus Characterization and Concentration

The characteristics of the virus were investigated using methods described elsewhere (Fauquet and Thouvenel, 1977). Juice extracted from six-week old leaves of variety IR8 which had been infected two weeks previously, or purified preparations, were used. The virus was purified from 30 g samples of frozen IR8 leaves, using the method of Bakker (1974) for rice yellow mottle virus. Using an absorption coefficient of 6.5, yields were obtained of 400-600 mg virus per kg of extracted leaves. The virus was shown to be 28-30 nm in diameter and to be stable (Table 2).

TABLE 1

Symptoms of rice yellow mottle virus on Oryza species

Species	Symptoms
O. sativa (FK 135)	Mosaic, strong mottle
O. sativa (Pacita)	Light mottle, yellow discolouration
O. sativa (TN I)	Apical necrosis
O. alta	Mottle on young leaves
O. australiensis	Chlorosis
O. barthii	Mottle
O. glaberrima	Yellowing
O. latifolia	Slight mottle
O. nivara	Chlorosis
O. rufipogon subsp. balunga	Chlorosis
O. rufipogon subsp. cubensis	Chlorosis
O. rufipogon (Taiwan)	Strong mottle
O. spontanea	Necrosis

Variety IRAT 2 was grown in the greenhouse and inoculated mechanically at weekly intervals from two to six weeks. The virus concentration in the plants was estimated by harvesting the tip of the last leaf and measuring the dilution end-point by inoculating the sample dilutions onto young IR8 plants. It took four weeks for the virus to reach maximum concentration. The virus concentration was much greater in plants infected earlier than later in the

season. For IR8, loss in plant weight caused by the virus was estimated at regular intervals and the virus present in the leaves was purified and weighed. The maximum virus concentration occurred 10-14 days after inoculation. The growth was retarded maximally 21 days after inoculation. Virus concentration at the end of the growth cycle was 25% of its maximum value.

TABLE 2

Physical characteristics of rice yellow mottle virus from Ivory Coast

Characteristic	Value
Dilution end-point	10^{-6} (variable with inoculum source)
Thermal inactivation point	70°C
Longevity at 20°C	34 days
Longevity at 4°C	84 days
Particle shape and size in dip preparations	spherical, 28-30 nm diameter
U.V. absorbance	maximum at 260 nm; minimum at 243 nm, which gave the following ratios: $E_{260}/E_{280} = 1.46 \pm 0.02$; $E_{max}/E_{min} = 1.29 \pm 0.03$
Isoelectric point	6.0 ± 0.2
Density in CsCl	1.36 g/cm^3
Molecular weight virus protein subunit	27,000 ± 1000 daltons

Serology

The antiserum produced by this virus reacted specifically with crude sap up to a dilution of 1/1024. It also reacted with RYMV isolated in Kenya by Bakker (1974) up to a dilution of 1/512. RYMV antiserum from Kenya (titre, 1/1024) reacted against the virus from the Ivory Coast up to a dilution of 1/512. The presence of a spur between the two viruses indicated that the isolates were different.

Cross reactions between antisera of RYMV from Ivory Coast and Kenya and comparison of the characteristics of the Kenyan isolate (Bakker, 1975) with that of the Ivory Coast suggest that different strains of the same virus occur in these countries. An identical or similar virus disease has been reported from Nigeria, Sierra Leone and Liberia (Raymundo and Buddenhagen, 1976), so apparently rice yellow mottle virus is widespread in Africa. To date it is the only rice virus which has been isolated and described from Africa.

The provision of a rice yellow mottle virus antiserum by Dr. D. Peters, Virology Laboratory, Agricultural University, Wageningen, The Netherlands, is gratefully acknowledged.

References

Bakker, W. (1974). Characterization and ecological aspects of rice yellow mottle virus in Kenya. Agricultural Research Report 829, Wageningen, 152p.
Bakker, W. (1975). Rice yellow mottle virus. CMI/AAB Descriptions of Plant Viruses, Set 9, No. 149, 4p.
Fauquet, C. and Thouvenel, J.C. (1977). Isolation of the rice yellow mottle virus in the Ivory Coast. *Plant Disease Reporter* 61, 443-446.
Raymundo, S.A. and Buddenhagen, I.W. (1976). A rice virus disease in West Africa. *International Rice Commission Newsletter* 25, 1-2.

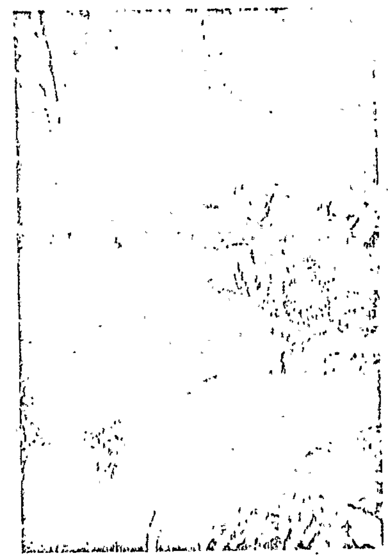

Plate 24. Recent development of steep paddy culture in the mountains of West Cameroon. 'Slash and burn' upland rice cultivation on the hills in the background.

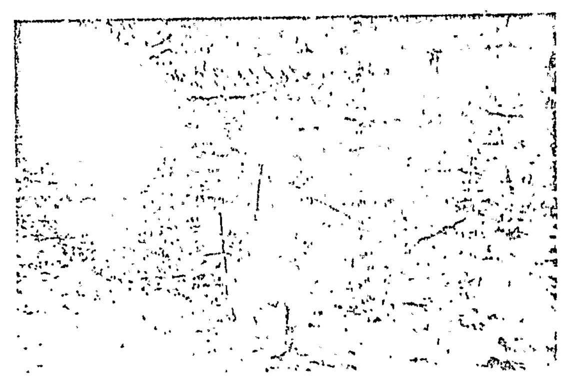

Plate 25. Inland valley swamp rice of the peasant farmer in the high rainfall area of Liberia.

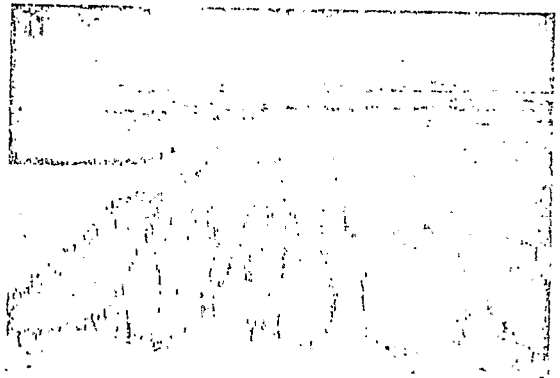

Plate 26. Testing different paddy varieties in a new, mechanized paddy scheme in a high rainfall area of eastern Liberia.

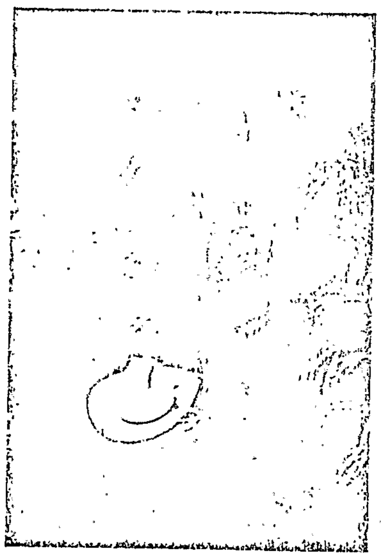

Plate 27. Recently developed, medium-statured rice for dryland situations in West Africa.

Country Statements