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Rice diseases in the region of Valencia and methodologies for testing varieties resistance

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Abstract. The favourable environmental conditions, good cultural and management practices, use of rice seed of good quality and the growth of a high percentage of cultivars adapted for the area causes that rice diseases are not a serious economic problem in Valencia. Nevertheless, high losses in individual fields from specific diseases sometimes occur. In the Valencia area, most of the known rice diseases to occur are caused by fungi. Only one is a virus disease and none has yet been reported to be caused by bacteria, nematode or by physiological disturbance. Storage molds are included in this paper.

i) Mycoflora of rough rice. Among the "field fungi", the most common are: *Bipolaris, Pyricularia, Nigrospora, Fusarium, Alternaria,* and *Epicoccum*; among the "storage fungi": *Aspergillus* and *Penicillium*.

ii) Seed rot and seedling diseases. They are caused by both soil *(Fusarium* spp.*, Pythium* spp.*, Saprolegniaceae* group*)* and seedborne *(Bipolaris oryzae Shoem., Fusarium* spp.*)* fungi. A large number of fungicides have been tested for rice seed treatment in Valencia.

iii) Blast. Caused by *Pyricularia oryzae* Cav., it is not important in Valencia. Nevertheless, under favourable atmospheric conditions, when some foreign cultivars are often damaged, chemicals are used: tricyclazol, pyroquilon. Although a specific breeding program for blast resistance has not yet been initiated, a disease nursery is planted to determine resistance levels in selected lines and rice cultivars. Bahia, Senia and Sequial are among the less susceptible cultivars.

iv) Brown spot. It is caused by *Bipolaris* spp. and almost all rice cultivars grown in Valencia are susceptible to it. Under good cultural and environmental conditions it causes slight damage. Selection for resistance has not yet been started in Valencia. Research work on control by fungicides was carried out in 1980-1985. Actually, no chemical measures are considered by rice growers.

v) Stem rot. It is caused by *Sclerotium oryzae* Catt. and is endemic all over Valencia's rice producing area. Quantitative loss measurements have not been done. Losses can be held to a minimum through good cultural and fertilizing practices. To determine resistance levels, screening tests are used: inoculation on internodes on wounded plants by spreading sclerotia. Niva and Jucar are very susceptible cultivars. Bahia was the least susceptible.

6. The "Enrojat" disease. Caused by a strain of barley yellow dwarf virus (BYDV) and transmitted by an aphid, *Rhopalosiphum padi*, it was observed in all the rice cultivars in Valencia. Several authors reported a high susceptibility of Balilla and the susceptibility of Balilla x Sollana, Bahia and Italpatna varieties. In the direct-seeded rice culture system of Valencia, its occurence is actually scarce.

I – Introduction

Due to favourable environmental conditions, good cultural and management practices, the use of rice seeds of good quality and the increasing percentage of varieties adapted to the area, rice diseases are not a serious economic problem in Valencia. Nevertheless, losses in individual fields from specific diseases are sometimes high. In the Valencia area, the most well-known rice diseases are caused by fungi. Only one is a virus disease and none has yet been reported to be caused by bacteria, nematode and physiological disturbance. Storage molds are included in this paper.

II – Mycoflora of rough rice

Mycoflora is a major cause of deterioration in rough rice and results in a loss in quality, economic value and perhaps in quantity. Among the parasitic and semiparasitic genera found in rice, as "field fungi", some of the most common are *Bipolaris, Pyricularia, Nigrospora, Fusarium, Alternaria, Cladosporium, Trichothecium* and *Epicoccum*. Infection of rice kernels takes place in the field but growth and the resul-

ting deterioration may continue after the harvest until the moisture and temperature of the grain are reduced to inconsistent levels by the fungi. The deterioration caused by micro-organisms in rice after storage is largely caused by species of the genera *Aspergillus* and *Penicillium* (called “storage fungi”): *A. niger, A. candidus, A. glaucus, A. ochraceus, P. expansum* and *P. digitatum* (Hernández et al., 1968).

III – Seed rot and seedling diseases

Within a few days after seeding, water-sown rice is often severely infected by seed rot and the seedling disease, resulting in reduced plant stands. The disease is prevalent throughout the rice producing area of Valencia (Carreres, 1980; 1981) when temperatures are cool and unfavourable to growth.

Both soil and seedborne fungi cause seed and seedling blight. Among the seedborne fungi identified, *Bipolaris oryzae* Shoem and *Fusarium* spp. are the most important. *Fusarium* spp., *Pythium* spp. (terrestrial, though living in moist soil) and the water molds involved in the *Saprolegniaceae* group (possibly *Achlya* genus) are among the soil fungi causing seedling blight. Other fungi are probably involved to some extent.

A large number of fungicides have been tested as rice seed treatment in Valencia over a period of many years (Carreres 1982a; 1982b; and 1986). Since registration has been withdrawn on the mercury fungicides, the current available chemicals are mancozeb, himexazol, carbendazim + maneb, TCMTB and carboxina + thiram.

Seed treatment by either slurry or spray mist with flowable formulations has been shown to be an effective control for the rice seedling disease. Some seed processors in Valencia are now equipped to provide this service to Valencian growers. Some growers make application by adding the chemicals to the soak water and most of them compensate for the lack of plant stand by increasing seeding rates and in severe cases by reseeding. In any case, satisfactory stands are generally obtained through use of good quality seed and seeded under cultural and environmental conditions favourable for rapid emergence from water surface.

IV – Blast

Blast is caused by *Pyricularia oryzae* Cav. On the leaves, the blast fungus causes oval to elliptical spots with brown margins and greyish centers. The fungus can attack the “neck” (top node and internode) and branches of the panicle. The lower nodes are sometimes affected (node blast).

Blast was for many years an important rice disease in the Valencia area before the *Departamento del Arroz* was established in 1913 at Sueca for the purpose of improving varieties less susceptible to blast. In recent years, at the current environmental conditions, the growth of these varieties adapted for the area and the use of good cultural practices make that blast is not an important disease in Valencia from the standpoint of economic loss. So, early fungicide treatments are not used for protection against blast disease.

Valencia's rice farmers know that damage from blast could be controlled or reduced by using the following cultural practices: making a right land leveling, providing a suitable water management for rice growth, fertilizing at light nitrogen rates and delaying field drainage for harvest. Nevertheless, under favourable atmospheric and/or cultural conditions, some foreign varieties are often damaged: head blast affects Thainato and Thaibonnet; leaf blast, Smeraldo. Then, some chemicals are used: for instance, tricyclazol, pyroquilon, isoprothiolane.

Evaluation of fungicides (thiabendazol, prochloraz, isoprothiolane and tricyclazol) in controlling blast was carried out during two crop seasons (1984, 1985) at Valencia in rice fields sown with a highly susceptible variety (Bomba). Unfortunately, during 1984, no disease entered throughout the trial and no assessment was done. In 1985 (unpublished data), with a weak intensity of blast, isoprothiolane reduced blast leaf and

tricyclazol and isoprothiolane were effective in reducing neck and node infection. The fungicides were applied as fortnightly foliar spray after disease symptoms appeared (post panicle initiation-flowering).

A specific breeding program for blast resistance has not been initiated; however, disease nursery is planted to determine resistance levels in selected lines and varieties of rice. Testing plot and scale for classifying disease reaction of rice plants to the rice blast disease are those adopted by the Symposium on the Rice Blast Disease in 1963 (OU, 1963). Among the varieties tested and under nursery conditions, no Spanish variety was resistant to leaf blast; Bluebonnet cv. has shown some degree of resistance; Sequial cv. was moderately resistant; Senia, Leda, Clot, Bahía, Balilla x Sollana and Tebre cv. were moderately susceptible and Thaibonnet, Albada, Lido, Rubino, Niva and Venería cv. were susceptible. Generally, neck and node blast reactions have shown some correlation with leaf blast reaction (unpublished data).

V – Brown spot

It is caused by *Bipolaris* spp.. The spots occur chiefly on the leaves but are frequently on the hulls. Almost all rice varieties grown in Valencia are susceptible to brown leaf spot. However, under good cultural and environmental conditions, it causes slight damage and is considered a minor rice disease from the standpoint of rice production. Only in individual fields, with a high percentage of weak plants, brown spot may affect up to 20% leaf area. Generally, damage is limited to reducing grain quality and germinability.

No chemical measures with spray field applications are considered by individual rice growers to control brown spot. However, research work on its control by fungicides has been undertaken from 1980 to 1985. Three treatments each season were applied as fortnightly foliar sprays with: prochloraz, propiconazole, imazalil, biloxazol, mancozeb, isoprothiolane, copper oxycloride, thiabendazol and carbendazim. Applying prochloraz and mancozeb reduced disease incidence but the relationship between disease ratings (by the method of Chakrabarty et al., 1975) and the effects of disease on rice yield was not established (Carreres, 1982c; 1985).

Selection for resistance has not been started in Valencia.

VI – Stem rot

Stem rot is caused by *Sclerotium oryzae* Catt. It is endemic all over the Valencia rice-producing area. Sclerotia overwinter either in the soil or in association with crop residue. In water sown, sclerotia float to the water surface infecting young rice plants at the water line. When infection occurs on susceptible cultivars, very early in the season stem rot often kills tillers. Infections occurring later enhance lodging resulting in yield and grain quality losses (Carreres, 1979). Quantitative loss measurements have not been done. However, under field conditions, a mean of 50% and 5% of the tillers were found infected with sheath and stem lesions respectively (unpublished data).

No chemical treatments are used by rice growers to control stem rot. Losses from stem rot disease can be held to a minimum through good cultural and fertilizing practices: burning of rice residue as soon as possible after harvest (the majority of Valencia's rice farmers have traditionally burned their rice residue mainly due to the need to eliminate the large volume of straw and stubble from interferring with preparation of fields for continuous rice culture), improving precision in use of nitrogen fertilizers, delaying field drainage for harvest and deep-plowing in the fall.

The use of resistant varieties is a practical approach to control stem rot. In Valencia a systematic program has not been made in this line. However, screening tests were used to determine resistance levels in selected lines and varieties of rice during some seasons. The tests were:

- Laboratory test: inoculation on internodes by the method of Ashrafuzzaman and Kamal (1978). The disease index used was a modification of Ashrafuzzaman and Kamal´s system of disease measurement (Carreres, 1981b).

- ❏ Inoculation on wounded plants: sclerotia was placed in between the leaf sheath and the stem at wound region (Carreres, 1981b). The plants were rated for disease by the method of Krause and Webster (1973).
- ❏ Inoculation on plants by spreading an amount of sclerotia on the water surface (method of Krause and Webster, 1973).

The method based on inoculation by spreading sclerotia on water gave the highest disease index. Therefore, this method was the best for testing rice varieties. Niva and Jucar were the most susceptible cultivars. Bahia cv. with a disease index of 3.35, on a rating scale 1-5, was the least susceptible and Betis, Italpatna and Sequial cv. were found moderately susceptible (Carreres, 1983).

VII – The "Enrojat" disease

Is a disease caused by a strain of Barley Yellow Dwarf Virus (BYDV) (Medina et al., 1979) included in the list of the luteoviruses (Rochow and Duffus, 1981). It is transmitted by an aphid, *Rhopalosiphum padi* (Medina et al., 1978).

The leaves of the infected rice plants become yellow starting from the tip and the edges; later on the whole leaf is yellowish-orange with irregular brown spots, in a greater or lesser degree according to the variety of rice. The disease causes plant stunting and reduces tillering. Infections that occur early in the season often kill tillers or reduce the panicle length with unfilled grains resulting in yield losses. Root development is poor and in some cases the infected plants may die. The first symptoms generally appear in plants isolated or grouped, usually situated at the edges of the fields near the banks. Later, the disease spreads giving rise to patches which enlarge and might extend covering most of the rice field.

The disease was observed in all the varieties of rice cultivated in Valencia. López Campos et al. (1980) reported the high susceptibility of Balilla cv. and the susceptibility of Balilla x Sollana, Bahía and Italpatna varieties.

In the direct-seeded rice culture system of Valencia seedlings emerge from the water surface when there is low or no presence of aphids in the rice fields. Therefore, the occurrence of the "enrojat" disease is actually scarce.

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