

# Disinfection of Rice Seeds

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Disinfection of rice seeds is just a preliminary work of plant disease control in rice culture. It is for extermination of disease germs on the seeds so that rice might grow soundly. Disinfection of rice seeds is very effective and easy to do as one of the disease control methods.

There are many kinds of pathogens infesting rice seeds among which the principal ones are those of Bakanae Disease, Blast, Brown Spot (*Helminthosporium* Leaf Spot), Damping-off and White Tip. Those should be, first of all, disinfected on the rice seeds.

Incidentally, this same method is applied in the northern parts of central Japan to control the Seed and Seedling Rot disease whose pathogens dwelling in the soil cause trouble after seeding is done. Before explaining seed disinfections, some characteristics of these diseases to which the disinfection method is effective will be summarized hereunder.

## Contagious diseases of rice seeds

### 1) Bakanae disease

The pathogen is *Gibberella Fujikuroi* (Sawada) Wollenweber, kind of filamentous fungi. This disease appears in the seedlings bed stage when the infected seeds are sown. The seedling leaves become longer, narrow and yellow-coloured; the plants being unusually high, themselves. The unusual height of the plants above the other ordinary and sound seedlings makes distinguishable the infected stocks in the paddy field. Having started in the seedling bed, the disease causes the same symptom to appear even in the paddy field; furthermore, there some infinite roots are observed at the stem nodes of the plants. The aggravation of the

disease sometimes causes the plants to wither or ear poorly. The pathogen prevailing at the infected stocks communicates the disease through the seeds.

### 2) Blast

The pathogen is *Piricularia Oryzae* Cavara, kind of filamentous fungi, infecting through the air by conidiophores. The disease occurring in the seedling bed (i.e. seedling blast) and in the paddy field during the tillering period (i.e. leaf blast) or for the ear inclining or maturing period (i.e. blast at node, ear neck and rachis branch), greatly influences rice yield reduction. The seeds infected by this disease often result in a poor germination or a poor growth of the plant.

### 3) Brown spot

The pathogen is *Cochliobolus miyabeanus* (S. Ito et Kuribayashi) Drechsler, kind of filamentous fungi, forming ordinarily conidiophores, by which the infection is made through the air and also through the seeds during the growth of the plant. This disease easily occurs in the case of a poor growth of rice plants caused by fertilizer deficiency or affected by the root rot. The occurrences are observed on the leaves at the end of the seedling bed period and in the stage from the maximum tillering to the maturing, and then after earing, at the ears (ear neck, rachis branch, grain) and at the nodes. The infected grains do not germinate well and even if they did, they would not grow well.

### 4) Damping-off

This disease is mostly observed in the upland seedling bed or upland rice field; several kinds of pathogens have been found, among which the principal one is *Fusarium*, a filamentous

fungus. The pathogens are transmitted not only through the soil but also by the grains. And the disease occurs mostly in a rather low temperature, damaging the sprout or bringing about a poor growth sometimes to end in the perishing of the plant.

#### 5) White tip

The pathogen of this disease is *Aphelenchoides besseyi* Christie (A. *Oryzae* Yokoo), kind of nematode. If the infected seeds are sown, they will produce this disease that can be easily observed from far, as the top of boot leaf or the second one becomes white after the maximum tillering stage. And the height of damaged plants is lower than that of sound stocks and the maturity is heavily decreased. Rice seeds issuing from the damaged stocks are invaded by nematodes which communicate the disease through the seed.

#### 6) Seed and Seedling Rot

For this disease, there are some pathogens of filamentous fungi, *Achlya* and *Pythium*, which, dwelling in the soil and water of the seedling bed, will attack pre-sprouting or pre-rooting of the sown seeds, so as to cause rice to rot or perish, or to delay its growth conspicuously. This disease is largely produced in a seedling bed with water of a low temperature, which is observed widely in the northern parts of Japan and partially found in an earlier culture's seedling bed in the mountainous regions of the central and western parts of Japan.

### Methods of rice seed disinfection

#### 1) Collection of rice seeds

For the control of rice diseases communicated through the seeds, an attentive treatment of rice grains is needed not only at seeding time of the year but also that of the preceding year. It is important to prevent thoroughly the insect pest and diseases early at growing time so as to produce clean rice seeds. As far as Bakanae Disease, White Tip and Seed and Seedling Rot are concerned, their symptoms become difficult to identify in the maturing stage of the plants. So, it is very important to produce carefully rice seeds cleaned from any disease. Moreover, it is vital to select the right opportunity for seed collection because a delayed yielding could crack grains which is the incentive of the occurrence of the Bakanae and Seed and Seedling Rot diseases. In addition, scratches made at threshing time could also cause those two diseases. To avoid this incidence, power thresher should be used with lowered rotation. Hand threshing rake or pedal thresher is preferred.

#### 2) Seed selection

Rice seeds which are damaged by diseases have a comparatively low weight due to their incomplete maturing so that they might be excluded by using a selection method of specific gravity such as selection with winnow or salt water. The specific gravities are different, according to the kinds of rice, as shown in Table 1. The seed selected by use of salt water should be washed in natural water afterwards.

Table 1.

Kinds of Rice	Specific Gravity	Salt melted in a litre of water
Non-glutinous	1.13	2.5
Non-glutinous Upland rice	1.12	2.2
Glutinous	1.08	1.6
Glutinous Upland rice	1.06	1.1

#### 3) Choice of disinfectant

Formalin, copper sulfate and organo-mercuric compound are applied as rice seed disinfectants. Formalin is extremely effective to Bakanae Disease, Blast and Brown Spot, which are diseases communicated through the grains by parasitical fungi. The defect in its

application is that it is ineffective to the Seed and Seedling Rot disease and is supposed to be harmfully effective to rice plants. Copper sulfate which has high effectiveness for the control of Seed and Seedling Rot does not act so well against the infectious diseases originating from the grain because it is apt to cause

chemical damage. On the other hand, organo-mercuric compound is distinguished for its effectiveness to general grain communicating diseases and to Seed and Seedling Rot except White Tip, with its chemical quality of less harmful effect to the plants. This is why organo-mercuric compound has come to be applied so widely, taking the place of formalin and copper sulfate. But the actual disinfectants of organo-mercuric compound have advantages or disadvantages, according to their components. Therefore when one of them is chosen for application, close attention should be paid to it.

#### 4) Disinfectants of organo-mercuric compound

There are many kinds of organo-mercuric compound disinfectants for rice seed disease control of which the major one mainly consists of ethyl mercuric phosphate (EMP., Ruberon Tab.), ethyl mercuric chloride (EMC., Riogen Tab.), methoxyethyl mercuric chloride (MEMC., Uspulun Tab.), phenylmercuric acetate (PMA., Microgin Tab.) and phenylmercuric dinaphthylmethane disulfonate (phenylmercurifixtan, Meru). They have two forms of powder and solution, respectively. For the solution, powder, grain, granule and emulsion are prepared. Recently, grain disinfectants have been improved. The grain weight is mostly one to two grams.

#### 5) Dilution of disinfectant and duration of disinfection

Rice seeds are disinfected by using organo-mercuric compound in forms of powder, granule or emulsion, which is soluble generally in 1,000 to 2,000 times of water, or by using it in the form of grain, of which about five tablets are soluble generally in 10 litres of water.

Duration of seed soaking in a disinfectant solution depends on the kind of disinfectants because the disinfectant components act on the seeds differently. For example, MEMC and PMA need usually 6 to 12 hours' soaking duration, but as the disinfection effect is largely influenced by the temperature, six hours are required as soaking duration when the temperature of the solution is 18°C. And when the solution temperature is lowered by 1°C, soaking time is lengthened by an hour show-

ing that is 12 hours under 12°C of solution temperature are necessary for it. At less than 10°C, prolongation of soaking hours does not cause any effect. EMP and EMC are effective enough in the cooler solution in which the seeds are dipped only for six hours so as to be well disinfected. This difference of disinfection duration according to the kind of disinfectants requires a keen knowledge of the time needed for each of the disinfectants.

Some disinfectants are effective, even though their density is increased or the disinfection hours are shortened to less than three hours.

### Special method of disinfection

#### 1) Disinfection against white tip

For application of the rice seeds supposed to be damaged by nematode of White Tip, disinfection for its control should be executed without using mercuric compound. Nematodes that penetrate the rice seed between its husk and grain can be controlled with heat. That is to put dried rice seeds in hot water of 57 to 58°C for 5 to 10 minutes and right after that put them in fresh water to cool down the seeds. It is necessary to keep the exact time length and temperature in this heating method with the aid of a thermometer because if there are mistakes, this method would damage the germination of the seeds.

This method of using heated water to control White Tip is remarkably effective in itself but it is partially difficult for the farmers to apply it in an actual farm work. Instead, the control method of using chemical disinfectant has recently become quite popular. As chemicals, there are Sassen consisting mainly of ethyl-ester rhodarate and Kaya-ace powder consisting chiefly of organo-mercuric compound (DSP powder). Sassen is diluted with 500 to 600 times of water in which rice seeds are dipped for 12 hours before they are rinsed in water. Kaya-ace powder is applied to the dried rice seeds in a weight proportion of 3 to 5 per cent of it to the seed amount.

#### 2) Rice seed disinfection in the cold district

In cold districts, control measures are necessary to be executed not only against the diseases



brought about through rice seeds, but also against that of Seed and Seedling Rot. The pathogen of this disease inhabits the soil and the rice seeds to which the chemicals are made well to adhere should be sown. In cold districts, it prevents the disinfection work of stimulating the sprouting of seeds because the disinfection some chemical. For avoiding it, it is advisable to apply damages the method where by the disinfectant is put in hot water to stimulate sprouting which accomplishes the one and the other. As an example, in water heated slightly over 45°C and with the mercuric disinfectants added to make it 1/1,000 solution, jute or strawbags containing rice seeds would be dipped in it for five minutes. The treated rice seeds are kept for one or two days in the sprout stimulation bed. After all, the seeds well disinfected and stimulated to sprout would come to be sown.

### 3) Upland rice and upland seedling bed

There are frequently observed at upland rice plants or upland seedlings Bakanae, Blast, Brown Spot, and Damping-off caused by *Fusarium* kinds. In order to control them, the organo-mercuric compound disinfectants are naturally very effective. A point to note is that the chemicals in powder as well as in solution can be applied to upland rice plants or seedlings in the ratio of three to five grams of the chemicals to one kilogram of rice seeds.

## Advice on rice seed disinfection

Hereunder are described some important points common to all engaged in rice seed disinfection work.

### 1) Cleanness

When the water used for seed disinfection is contaminated with much of the soil or organic matter (such as slight pieces of animal or plant), the chemicals will not be quite effective as they adhere to them. Therefore, clean well water for instance, is needed for this disinfection. It is important to apply the rice seeds and the containers which are clean, or to rinse

them all well when they are contaminated.

### 2) Quantity of disinfectant solution

If the quantity of disinfectant solution is not enough, the main component of it is absorbed in the rice seeds when they are dipped in the solution so that the disinfecting effect should go down. The total quantity of the solution is preferred to be more than enough, that is twice of the total seed amount.

### 3) Disinfectant contacting with rice seeds

In case of dipping the dried seeds in the solution, it happens that the seeds do not contact well with the solution and makes bubbles, which do not give a favorable disinfecting effect. So, the solution in which the seeds are dipped directly should be stirred with a baton. The seeds in bag or basket which are dipped in the solution should be made to move up and down well. These operations would make the solution contact fully with all the surface of the seeds.

### 4) Repeated use of the disinfectant solution

The same solution can be applied repeatedly for rice seed disinfection, but when the seed amount is large, the disinfectant effect decreases. If possible, the repeated use of the solution should be avoided.

### 5) Prevention of chemical damage

In case the seeds stimulated to sprout are disinfected, the occurrence of chemical damage deepens on the kind, density or duration in applying the disinfectant. Thus, disinfection is better executed before sprouting is stimulated.

### 6) Treatment of rice seeds after disinfection

When seeding time is inevitably delayed for some days after the disinfection, the seeds should be dried in the shadow by spreading them out on the straw mat.

Since the adhesion of pathogens to the seed after the disinfection naturally causes a decrease of the disinfecting effect, jute or strawbags containing disinfected seeds should be used as far as they are aseptic or their disinfection is executed.