Rice Seed Treatment Method for a Low Input Ric Cultivation

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INTRODUCTION

The time has come to compile accumulated data from many experiments by TBIC participants of rice cultivation training course. A rice cultivation of high input type as Japan is not general, and rather, in countries of the participants, a rice technology for stable production by low input type is demanded.

A fall in yield caused by diseases of rice is a serious problem, and there are many cases originating in damage due to seedborne diseases. So I discussed on the seedborne diseases and their control based on experimental reports published and by the ex-participants. I discuss on the methodology of rice seed treatment for control as a countermeasure of low input rice cultivation.

The seed selection is important work to push forward paddy rice production profitably. Because the understanding of its importance was not enough in many of developing countries, through the training, I felt strongly it is necessary to deepen understanding of its necessity. In addition, as for the seed disinfection of rice, it is effective to soak seeds into hot water of 60°C for 5 min., which has been practiced by farmers in Japan from old physical seed disinfection, scientific proof has been done by researchers, but there are distinct points.

Several experiments have been done at TBIC to reconfirm the effectiveness of seed disinfection by the specific gravity selection and the soaking treatment. It became clear that the practice of the specific gravity selection and heat treatment at 60°C for 5 min. of the dry rice seed were effective for seed disinfection to control seedborne diseases.

SEEDLING QUALITY

I-1. Influence of the specific gravity of rice seed on germination and seedling growth[1)]

Participants of Rice Production in French Course in 1992 and H. Konagaya

Objective: To examine effects of the specific gravity of rice seed on germination and seedling quality.

Materials and method

Materials: The tested seeds were cultivar Kinuhikari (Japonica, glutinous variety) harvested with a thresher in 1992; They were divided into (1)<1.00, (2)1.00<1.06, (3)1.06<1.08, (4)1.08<1.10, (5)1.10<1.13, (6)1.13<1.16 and (7)1.16< by the specific gravity of seeds.

Experiment; Influence of the specific gravity of rice seed on germination
Method: As a standard, two pieces of filter paper were laid in petri dishes of 9 cm

diameter. Next, 50 seeds were put in each petri dish, and 15 ml of distilled water was added to the dishes, and they were placed in an incubator kept at 30°C. It was watered appropriately. Six repetitions were made.

Investigation: The germination was examined at seven days after sowing. The germination was defined as the seed with a coleoptile or a seminal root 1 cm or more tha

I-2. Influence of specific gravity of rice seed on the seedling grow

Participants of Rice Production in French Course in 1993 Hayaand H. Kon

Method: Ten grains were sown into 2 lines each in the respective box (L×W×H = 5×10×10 cm) with bed soil (Kumiai granular bed soil K. N: 3, P: 11, K: 7, 6.7 g/box, pH: 5.3 = 5) and the boxes were heated up at 30°C for 48 hours. The seedling boxes were placed in an artificial greenhouse u seedling stage. During raising seedlings, the seedlings were watered appropriately. Six repetitions were made.

Investigation: Seedling growth such as plant age in the number of leaf, plant length and dry matter weight were investigated on the 21 days after sowing.

Results and discussion of Expt. I-1 and Expt. I-2

From the viewpoint of grain distribution of number of grains by the specific gravity, a half of the grains were obtained from more than 1.13, and plants were grown normally. The grains with more than 1.13 of the specific gravity occupied the 84% grains. Then the almost grains were able to use as the good quality seed. When the specific gravity of the grains were lager, the germination rate was higher, and more healthy seedlings were obtained (Table 1).

Table 1 Distribution of seeds of 100g by the specific gravity and the growth quantity

Items / Specific gravity	Distribution of grains due to the specific gravity per 100g grains**		Distribution of grains due to the weight per 100g grains** (g)		1,000 grains weight** (g)	Germination rate** (%)	Plant age in leaf number**	Weight /length ratio** (mg/cm)
<1.00	127	3%	1.41	1%	13.14	38.3	3.2	0.373
1.00<1.06	93	2%	1.23	1%	16.58	65.8	3.2	0.716
1.06<1.08	65	2%	0.77	1%	17.60	76.7	3.3	0.806
1.08<1.10	65	2%	0.82	1%	18.38	80.8	3.2	0.921
1.10<1.13	542	13%	11.02	12%	20.95	84.2	3.4	1.321
1.13<1.16	1322	32%	31.29	33%	24.04	95.8	3.6	1.531
1.16<	1915	46%	48.97	51%	25.86	99.2	3.7	1.661
Total	4128	100 %	95.51	100%				
／Average					23.14	92.9	3.6	1.525

**: Significant at 1 % level by Tukey test.

In addition, it is extremely important to enforce the specific gravity selection before sowing because the seeds with higher specific gravity are highly correlated with high yield of rice. Examination results of Agricultural Experimental Station in Yamaguchi[2] and Tamura & Shiroishi[3] have been proved the positive relationship between the specific gravity of seeds and rice yield (Table 2).

Table 2 Relationship between the Specific Gravity of Seeds and Rice Yield

Specific gravity of seeds	Yield of brown rice (kg/ha)	Yield ratio (%)
Winnower selection	4,071	100
Specific gravity selection		
< 1.00	4,002	98
1.00 <	4,350	107
1.05 <	4,441	109
1.10 <	4,509	111
1.15 <	4,516	111
1.20 <	4,911	120

2) Agricultural Experimental Station in Yamaguchi Prefecture

HOT WATER TREATMENT

II. Influence of hot water temperature and soaking time in the hot water treatment of seeds on the germination

Objective: To understand combination of hot water temperature and soaking time in the hot water seed treatment for obtaining good germination.

Materials and method:

II -1. Influence of hot water temperature in soaking on germination of seeds with small and big sizes

Konagaya, H. 1996

Materials: Tested cultivars:
Koshihikari (small size grain, average grain length: 7.1 mm, av. grain width: 3.4 mm, non-glutinous) and
Ohchikara (big size grain, av. grain length: 10.5 mm, av. grain width: 4.0 mm, non-glutinous).
The both varieties were harvested in 1995. The seeds of Koshihikari were used in this experiment.

Treatments: Soaking times were set for 10 sec., 30 sec., 1 min., 3 min., 5 min., 8 min., 10 min. and 15 min., and hot water temperatures were set 55°C, 60°C, 65°C, 70°C, 75°C and 80°C.

Methods: Seeds (100g) were put into the net ball (5.5 cm in diameter). Hot water of 10 liters was

poured in a water bath (28 cm in diameter) with automatic control. After treating the seeds, the seeds were cooled in tap water (18°C water temperature) to avoid damage by hot temperature. Hot water in the water bath was always stirred with keeping screw, for temperature in constant. The temperature was controlled at ± 1°C.

Investigation: Based on the standard, seeds treated with soaking method were sown in petri dishes promptly, and the dishes were placed in an incubator at 30°C. The germination test and a definition of the germination were mentioned previously. (see E)

Results: Combinations of soaking times with water temperatures shown in Table 3. Appropriate combinations of soaking times with water temperatures were for at 60°C for 10 min., 65°C for 1 min. and 70°C for 1 min. It was considered if soaking is fixed for 3 to 5 min., hot water temperature between 60°C and 65°C may be limit. A difference in the heat tolerance between seeds of different variety was found, namely the short grain seed was easier influence of hot water than bigger one.

Table 3 Influence of germination percentage of Koshihikari (K) and Okachikara (O) on various hot water treatments and combination of hot water temperatures and soaking times

Soaking time \ Water temperature	50°C	55°C	60°C	65°C	70°C	75°C	80°C
10 sec.	-*	-	-	-	-	-	100 (K)
30 sec.	-	-	-	-	-	98-80 (K)-(O)	0 (K)
1 min.	100 (K)	-	96 (K)	94 (O)	98-94 (K)-(O)	40-18 (O)-(K)	0 (K)
3 min.	-	-	100-94 (K)-(O)	86-82 (K)-(O)	72-42 (K)-(O)	0 (K,O)	-
5 min.	100 (K)	98 (K)	98 (O)	86-56 (O)-(K)	22-4 (O)-(K)	-	-
8 min.	-	-	94-92 (K)-(O)	72-22 (O)-(K)	-	-	-
10 min.	100 (K)	100 (K)	96-56 (O)-(K)	50 (O)	0 (K,O)	-	-
15 min.	-	100 (K)	-	-	-	-	-

-* not examined.

II -2. Influence of different soaking times with water temperature of 60°C on the germination[4)]

Participants of Rice Production in French Course in 1996, Y. Sagiyama and H. Kon

Materials:

Tested varieties:

(1) Belle Patna (long grain, non-glutinous, av. grain length: 8.3mm, av. grain wide: 2.8mm),
(2) Hatsuboshi (short grain, non-glutinous, av. grain length: 4.7mm, av. grain wide: 3.4mm),
(3) Takanari (long grain, glutinous, av. grain length: 7.4mm, av. grain wide: 3.0mm),
(4) Tsukubahatamochi (short grain, glutinous, av. grain length: 8.8mm, av. grain wide: 3.9mm).

All the varieties were harvested in 1995.

Treatment:

Hot water temperature; 60°C
Soaking time; (1) 2.5 min., (2) 5 min., (3) 7.5 min., (4) 10 min., and (5) 12.5 min.

Investigation: Based on the standard, seeds treated with hot water soaking treatment were sown in petri dishes promptly, and the dishes were placed in a room at 30°C. The germination test and a definition of the germination were mentioned previously. (see E.g. 1)

Results: The germination percentages of the varieties were more than 90% for soaking times of 2.5, 5 and 7.5 minutes, except Tsukubahatamochi. Generally, it is said that glutinous variety is lower than the non-glutinous variety on the tolerances from some environmental factors. Accordingly it needs to examine the tolerance for hot water temperature between glutinous and non-glutinous varieties. Table 4 shows germination percentages of 4 varieties at 60°C treatment.

Table 4 Influence of 4 varieties in different soaking times at 60°C on germination percentage

Cultivars \ Soaking time	2.5 min.	5 min.	7.5 min.	10 min.	12.5 min.
Belle Patna	94	96	96	64	64
Hatusboshi	100	98	100	64	96
Takanari	100	94	96	88	71
Tsukubahatamochi	94	92	84	80	88

Results and discussion: It became clear that germination was suddenly lost when the seed is soaked into the hot water. Because man cannot keep an exact time sometimes. In consideration of that fact, I recommend a hot water treatment for about 5 min. soaking.

In the present experiment, a proper hot water temperature and soaking time agreed with the method of Sato[3)] who practiced the hot water treatment method for a long time.

According to report of Nagano Agricultural Experimental Station[6)] in 1996 and Hayasaka[7)], using a Japanese non-glutinous variety, germination percentage of the seeds with the treatment of hot water soaking at 60°C for 10 min. was more than 90%.

Generally morphological structure of seeds is different between Indica and Japonica varieties, and the Indica varieties are easier for absorption of rain water. The influence of different structure of the seeds on water absorption will need to be investigated.

DISEASES CONTROL

III. Disease control by seed selection and by hot water soaking

Objective: In Japan, 7 kinds of seedborne diseases of rice have been confirmed currently. Effect of control by seed selection and by hot water soaking are examined for these diseases.

1. Bakanae disease (*Gibberella fujikuroi*)

I. Effect of the specific gravity selection of rice seed and the hot water soaking treatment to control Bakanae disease [8] (1)

Bernard Sanada Brima of Rice Research Techniques Course and Kyagaya H. 1997,

Materials: Seeds of variety Koshihikari were provided kindly from Ibaraki Agricultural Center. In the Center, the seeds were harvested from a paddy field in which had been inoculated artificially with Bakanae disease fungus in 1996.

I-1. Control of Bakanae disease by the specific gravity of seed selection

Treatment: The rice seeds were categorized by the specific gravity into the following three;
(1) lower than 1.00, (2) lower than 1.13 and (3) higher than 1.13

Method: 50 seeds were set in a petri dish added distilled water and the petri dish was kept in an incubator at 30°C.

Investigation: The germination test and a definition of the germination were mentioned previously (see Expt. I-1).

Results: In the case of seeds having the specific gravity lower than 1.13, Bakanae disease was not controlled. However, seeds which the specific gravity was higher than 1.13 showed slightly control effect for Bakanae disease (Table 5).

I-2. Control of Bakanae disease by hot water soaking of seed

Treatments: 4 seed treatments:
(1) control (no hot water soaking),
(2) soaking in hot water of 50°C for 5 min.,
(3) soaking in hot water of 60°C for 5 min., and
(4) soaking in water of 70°C for 5 min.

Method: Bed soil (N:P:K= 6.7:13.3:11.7, g/m^2, pH= 5) was put in a seedling box (L× W×H=12×17× 4 cm), and 50 seeds were seeded in the soil bed. Then, the boxes were heated up in an incubator at 30°C for 48 hours for acceleration of germination.

Investigation: Thirty days after sowing, number of heads and seedlings of Bakanae diseased seedlings were investigated.

Results: The treatments with hot water of 50°C to 60°C could not control Bakanae disease occurrence. The treated seeds at 70°C did not show Bakanae symptom at all. But, seedling establishment was less than 50%, therefore the treatment of 70°C for 5 min.) is not suitable

practically.

From the result, the treatment at 60°C for 5 min. was effective to control Bakanae disease (Table 6).

Table5 Effect of the specific gravity selection of seed on controlling Bakanae disease

Specific gravity	No. of Bakanae disease occurrence	% of damaged plant by Bakanae (Control=100)
Control	70	100
1.00>	72	103
1.13>	70	100
1.13<	64	91

Table 6 Effect of the hot water soaking of seed on controlling Bakanae disease

Temperature of water and soaking time	% of seedling establishment	% of damaged plant by Bakanae (Control=100)
Control	100	100
50°C, 5 min.	96	70
60°C, 5 min.	100	12
70°C, 5 min.	46	0

Discussion: If seeds are sorted by the specific gravity higher than 1.13, it is considerable that control effect of Bakanae disease may rise more (Table 5). Because that the treatment of hot water soaking at 60°C decreased in the seedling establishment rate (Table 6), it is supposed that the reasonable hot water treatment should be between 60°C and 65°C.

From the results, it may be able to recommend that soaking hot water treatment at 60°C for 7.5 min. is most practical for controlling Bakanae disease.

II. Effect of the specific gravity selection of rice seed and hot water soaking treatment on controlling Bakanae disease(2)

Participants of Rice Cultivation Course in 1999 and Konagaya Lab.

Treatments: Because the difference in Bakanae disease control was not found between specific gravity 1.13 and 1.16 by the specific gravity selection in the preliminary examination, the specific gravity selection of seeds was done only with specific gravity 1.13 in the final examination.

50 seeds of Bakanae disease contaminated seeds were mixed with 1,000 healthy seeds. Four treatments were established as follows;

(T1) the seeds which were no specific gravity selection and hot water soaking treatment,

(T2) the seeds which were not selected by the specific gravity, but disinfected with thiram-benomyl wettable powder,

(T3) the seeds which the specific gravity selection is done with specific gravity 1.13, but hot water soaking is not treated,

(T4) the seeds which treated by hot water soaking for 5 min. at 60°C after selecting seeds with the specific gravity 1.13.

Method: Bed soil (N:P:K= 6.7:13.3:11.7, g/m², pH= 5) was put in a seedling box (L×W×H=12×17×4 cm), and tested seeds are seeded in the bed soil. Beds were heated up in an incubator at 30°C for 48 hours, to accelerate germination, and kept in use. Watering is done at necessity.

Investigation: It was investigated number of normally developed seedlings and of Bakanae diseased

seedlings 50 days after sowing.

Results: The effect of specific gravity selection (T3) was a half of the pesticide treatment (T2). Effect of pesticide treatment was similar to a combination of specific gravity selection with hot water treatment (T4).

Table 7 Effect of specific gravity selection and hot water treatment on Bakanae disease control

Treatment	No. of Grains tested	No. of seeds after selection by 1.13 gravity water	No. of healthy seedling	No. of no-germinated seeds	No. of Bakanae-affected seedlings	No. of dead or growth interrupted seedlings	No. of Damaged seeds[7]	% of Damaged seeds[7]	Control Value
		(A)	(B)	C=A-B	(D)	(E)	F=C+D+E	G=F/A*100	(G1-Gn) /G1*100
T1	400	400	210	190	25	4	219	55%	0.0
T2	400	400	354	46	28	1	75	19%	65.8
T3	400	225	151	74	3	4	81	36%	34.2
T4	400	227	191	36	8	2	46	20%	63.0

[7] Damaged seeds means not germinated and unhealthy seeds.

Experiments at TBIC of following diseases should be repeated from, and previously reported results are cited here.

2. Helminthosporium leaf spot (*Cochliobolus miyabeanus*)

Sato[10] reported that the specific gravity selection for Helminthosporium leaf spot control was not effective for seedlings in the nursery box. There was no difference in disease occurrence rate among the seeds selected by the specific gravity, disinfected seeds without the specific gravity selection.

3. Rice blast disease (*Pyricularia oryzae=Magnaporthe grisea*)

According to a report of Nagano Agricultural Experimental Station[6], hot water treatment for 5-10 min. was enforced at 55-60°C from the viewpoint of blast spore formation rate, the control effect of the hot water treatment to rice blast was equal with thiram-benomyl wettable powder treatment.

The disease suppression effect of seedling blast disease was slightly by soaking seeds in hot water at 55°C for 10 min. However, the effect was not high as compared with benomyl wettable powder treatment. Control rates were 85% by soaking with hot water at 60°C for 10 min. and 100% on thiram-benomyl wettable powder treatment.

Hayasaka[7] carried out an examination on the blast spore formation in Domannaka (Japonica, non-glutinous rice). As a result, seed hot water treatment at 60°C for 10 min. was effective in 95%, while thiram-benomyl wettable powder was in 10 %.

4. Bacterial brown stripe (*Pseudomonas avenae*)

According to a report of Nagano Agricultural Experimental Station[6], control of bacterial brown stripe by the hot water soaking treatment of seeds was effect, but the treatment was

less effective as compared with copper wettable powder. treatment

Effect of the hot water soaking treatment of seeds on the seedling growth in the early stage was also investigated. The seedling growth of 3 varieties was not affected by 2 treatments such as at 55°C for 5 min. and at 60°C for 5-10 min.

5. Bacterial grain rot (*Pseudomonas glumae*)

Makino[11], Toga[12], Goto[13] and Yasunaga[14] reported clear results that ratio of bacteria carriers, rot symptom of seedling disease occurrence in field decreased by seed selection in salt water treatment. In addition, the seeds having more than the specific gravity 1.13 showed that ratio of bacteria carriers was less than 50%. Furthermore the seeds having more than specific gravity 1.16 showed ratio of bacteria carriers was less than 10%.

A report of Nagano Agricultural Experimental Station[6] showed that the hot water soaking treatment at 60°C for 5 min. was positive effect for bacterial grain rot control. However, in the preliminary examination of TBIC, control effect was not confirmed on treatment at 60°C for 5 min. After that, an informal report from Nagano Agricultural Experimental Station showed control effect of 99% is shown with hot water soaking treatments at 58°C for 10-12 min. and 40% on treatment at 60°C for 10 min.

6. Bacterial seedling blight (*Pseudomonas plantarii*)

Nagano Agricultural Experimental Station[6] showed that effect of hot water soaking treatment of seeds to control bacterial seedling blight was relatively high at 60°C for 5 min. and was more superior than copper wettable powder treatment.

On the other hand, Hayase[7] reported that soaking treatment at 60°C for 10 min. is not effective for Haenuki (Japonica, non-glutinous variety).

7. White tip, Nematode disease (*Aphelenchoides besseyi*)

Yoshii & Yamamoto[15] reported that it was controllable of White tip by the method mentioned below; after soaking nematode infected seeds in water for at 12-20 hours, put the seeds in hot water at 50-52°C for 5-10 min..

Mieda[16] reported that the seeds were treated with a hot water soaking at 56°C for 10-15 min. and removed in cool water immediately. White tip was controlled sufficiently.

I used the seeds of Tamaminori (Japonica, non-glutinous variety) obtained from Saitama Agricultural Station in which rice plants were infected by natural nematode. The seeds were classified into 5 treatments, (1) control (no treated), (2) specific gravity less than 1.00, (3) more than 1.00, (4) more than 1.13 and (5) more than 1.16. Twenty seeds for each treatment were inspected in the number of nematodes by Belleman's method. About 20 heads of nematode in each of the treatments were found and there were no difference among the treatments.

The seeds mentioned above were stored in a refrigerator (8°C) for one week after salt water selection. Number of heads and nematode activity were investigated, but the activity of nematodes was not able to be confirmed. A further experiment is necessary to establish a technique which is simple and easy to control white tip.

DISCUSSION

Major registered and utilizing pesticides are shown in Table 8 as disinfectants in Japan. There is no pesticide which is effective for bacterial, fungal and nematode diseases. Seed disinfectant(s) should be selected properly for preventing seed pathogen(s) which may occur at paddy field. Generally, disinfectant(s) is chose for disease(s) may be forecasted its occurrence

in the paddy field.

Table 8 Rice seedborne diseases and major disinfectants

	ISO name / Disease	thiram / benomyl	triflumizole	pefurazoate	ipconazole	acetic acid	calcium hypochlorite	copper hydroxide	oxolinic acid / triflumizole	thiocyclam
Fungal disease	Bakanae	○*	○	○	○	○			○	
	Helminthosporium leaf spot	○	○	○	○	○			○	
	Blast	○	○	○	○				○	
Bacterial disease	Brown stripe					○		○	○	
	Grain rot					○	○	○	○	
	Seedling blight							○	○	
Nematode disease	White tip	○				○				○

○*: effective.

The effect of the specific gravity selection method or the soaking in hot water treatment are not absolute for controlling seedborne diseases, but these methods control several diseases sufficiently. Table 9 shows the effect of seedborne disease control increase by combining the specific gravity selection with hot water soaking treatment.

Table 9 Effect of specific gravity selection and hot water for rice seedborne diseases

	Effect	Seed selection by specific gravity		Seed soaking in hot water	
	Disease	Effective	Not effective	Effective	Not effective
Fungal disease	Bakanae	◎		◎	○
	Helminthosporium leaf spot		○		
	Blast	○		○	
Bacterial disease	Brown stripe			◎	
	Grain rot	◎		◎	
	Seedling blight	◎		○	○
Nematode disease	White tip		○	◎	

Note) ○: Datum from an experiment, ◎: Data from a few experiments.

CONCLUSION

As the result of various experiments, there is a prospect of disease control by means of physical seed treatment on a low input type rice culture. Tamatsukuri Rice-Duck Farmers Association, which the author belongs, a method since 1997 in which rice seed is disinfected with the specific gravity seed selection together with a hot water treatment at 60°C for 5 min. This method, which was based on experimental results obtained by JIRCAS, is very effective for disease control at the seedling stage.

Last year, I presented "Control of seedborne diseases of rice by hot water soaking treatment" at Japan Rice-Duck Farming Forum[8] in 1999. In the 2000 Forum, some farmers reported that the method was effective for seedborne disease control. In future, there is a possibility that this low input method for seedborne disease control will be applied instead of chemical control.

Notes of the specific gravity selection of rice seeds and hot water soaking treatment

It is important that the seeds must be (1) big and well covered with chaff, (2) not affected to neither diseases nor insects, and (3) not contaminated with other varieties and seeds of weed.

[Seed production]

In case of the rice seeds which are produced from the farm cultivation, it is necessary to avoid mixtures of strange varieties, for example, an individual which is different in height or which has the early or late heading should be pulled up before ripening. In addition, removing weeds from the farm before flowering, avoiding excessive fertilization which may cause disease occurrence severely.

[Specific gravity selection]

Rice seeds are put in a net bag, and the bag is trampled down in water, removing awns, because if a seed has the awn or rachis branch, it is easily floated. Seed selection with salt solution is done for a purpose of eliminating immature grains and diseased grains.

In case of carrying out the seed selection with salt solution, salt is dissolved in water, and an fresh egg is put in the salt solution, and the specific gravity is increased. When the surface of the egg comes out a bit on the surface of the solution, it is the equivalent specific gravity of 1.13. In this case, add salt to water at a rate of 4kg in 20 liters.

When the specific gravity solution was prepared, rice seeds are put in water, and the bubbles on the surface of seeds should be removed by stirring. The seeds floated are removed. It is assumed that the seeds floated are edible, and sank seeds in the solution is used as seed rice. Seeds are not sorted precisely if a lot of seeds were put in the solution at once. Because there is not enough spaces among seeds in the solution, immatured seeds can not float.

To the salt solution of 20 liters, seeds of 10 liters can be soaked. This solution is usable repeatedly, but an fresh egg should be put into the solution every time because it becomes diluted, and adjust the specific gravity again. Sometimes after the salt selection appear germination obstacle which is caused by the sticking salt on the surface of seeds. For preventing it,

selected seeds should be rinsed with water enough immediately after selection, and are dried in the shade.

[Seed disinfection by hot water soaking]

As for the disinfection of rice seed, dry seeds are better than wet seeds for disinfection. While it can be handled, but temperature management is paid much attention more.

First of all, some small sacks or bamboo baskets and the prepared seeds are subdivided in each. A big container is prepared, and water is boiled in it.

When the hot water temperature became at 63°C, the subdivided seeds in a sack or basket will be soaked for 5 min. in the hot water. During soaking seeds in the hot water temperature must be regulated at about 60°C.

Because avoiding uneven temperature (distribution) the inside of bag with seeds, it is always moved up and down during dipping the seeds in hot water. Hot water temperature has suddenly fallen down when a lot of rice seed is put in water. There is no effect of hot water treatment. It should pay attention to keep hot water temperature. To 100 liters of water, less than 10kg seeds are reasonable to be soaked at once.

After soaking rice seed in hot water, cools the seeds with water immediately. Germination ability has been suddenly taken away if this cooling is not done. Then rice seed cooled are dried in the shade.

When the treated rice seed is utilized as the same as usual seed, seedborne diseases can be prevent.

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