Applied Development of Delaus®, a Rice Blast Control Fungicide: Delaus® Prince® Granule and Its Treatment into Seedling Boxes at the Sowing Stage

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Delaus® (diclocymet) is a novel fungicide developed by Sumitomo Chemical Co., Ltd. to prevent rice blast disease in paddy field. It was registered as an agricultural chemical in April 2000 in Japan. As part of the applied development of Delaus®, we also developed a mixture of diclocymet with fipronil, named Delaus® Prince®, to prevent various pest insects as well as rice blast. In the course of investigating various laborsaving application methods, we developed a novel method of applying into seedling boxes at the sowing stage with the new equipment for the purpose.

Introduction

Recently, there have been remarkable advances in the performance of pesticides that control diseases and insect pests in rice cultivated in paddies in Japan. In particular, seedling box application techniques making use of fungicides and insecticides have been established as the core pest control technology in the cultivation of paddy rice, because the technique has long lasting efficacy for simultaneous control of harmful paddy rice diseases, such as rice blast, and paddy rice insect pests, such as the rice water weevils and leafhoppers.

However, the application timing for almost all existing seedling box insecticide and fungicide combinations has been limited to a period from three days before transplanting to the day of transplanting. This limit has made for an overlap with various kinds of work (weeding of banks and paths, field preparation, fertilizer application, maintenance of agricultural equipment such as tractors and rice planters, management of water for seedling boxes and paddies, etc.) near the rice transplanting period, causing farmers to be extremely busy. Reducing labor at each stage is particularly desirable for farmers having large-scale commercial fields, because of the large amount of work that has to be done in a short period of time before planting in paddies, as mentioned above.

Therefore we focused on expanding the application period for Delaus®Prince® granules. In this paper, we will introduce a novel method established as a newer application technique for Delaus®Prince® granules where application is done in seedling boxes at the sowing stage.

Delaus®Prince® granules were developed by Sumitomo Chemical Co., Ltd. for seedling box application; they include two active ingredients. One is the fungicide Delaus® (diclocymet, a Sumitomo Chemical Co., Ltd chemical) registered as a new agricultural chemical in Japan in April 2000 and having excellent long-lasting effects in systemic action on rice blast. The other is the insecticide Prince® (fipronil, a BASF Agro Ltd. chemical), which has superior effects on the rice water weevil, leafhopper, rice-stem borer, rice leaffolder, and other harmful insects.

Investigation of conditions for use of Delaus® Prince® granules in applications at seed sowing

The application timing of pesticides at seed sowing is earlier than conventional applications, so

there are concerns about shortening the effects of the pesticides and also about phytotoxicity in the rice plants themselves. Therefore, the influence of application at seed sowing was investigated with the above concerns in mind.

1. Efficacy and chemical behavior of diclocymet in applications at seed sowing

In the results of a comparison of the efficacy of diclocymet granules on rice blast with application (50g/seedling box) at seed sowing and application on the day of transplanting, no clear difference was found in the efficacy for the two application periods, and stable efficacy on rice blast (leaf and panicle) was confirmed. In addition, in measurements of diclocymet concentrations within the rice plants carried out in parallel, no clear difference between the two was found, and it was clear that throughout the test period, the necessary internal concentration (around 0.5ppm) to show a control value of 90 was maintained in the upper leaf body and panicle, which are the parts infected by rice blast (**Fig. 1**).[1)]

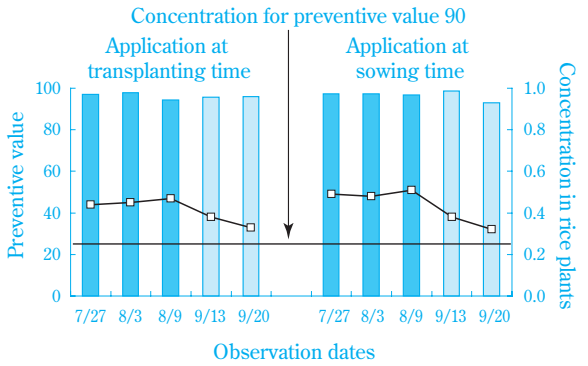


Fig. 1 Efficacy of diclocymet granules on rice blast at field stage and the variation of concentration of diclocymet in rice plants
(Sumitomo Chemical Co., 2000)

Besides this, there was concern that the chemicals would be washed out by watering during the growth of seedlings, and three waterings per day (the amount of water for each watering being set at one liter) were carried out. As a result of measurements of the amount of Delaus® eluded from the bottom of the seedling boxes, almost no elusion was found during the seedling growth period from the plot where Delaus was applied at seed sowing. The results prove that the efficacy was not affected by watering under the above conditions (**Table 1**).[2)]

Table 1 Elution rate of diclocymet from the bottom of nursery boxes due to irrigation
(Nursery box test)

Application timing	Mean elution rate/day (%)	Integrated elution rate (%)
At sowing before soil covering	0.006	0.126
Greening period of seedling	0.007	0.105
A week before transplanting	0.002	0.014

Irrigation frequency : 3 times/day (about 1 liter/ nursery box/run)

2. Effects on paddy rice plant insect pests with application at seed sowing

The effects of Delaus®Prince® granules applied at seed sowing on paddy rice insect pests were confirmed to be almost equal to those of application on the day of transplanting (**Fig. 2**).

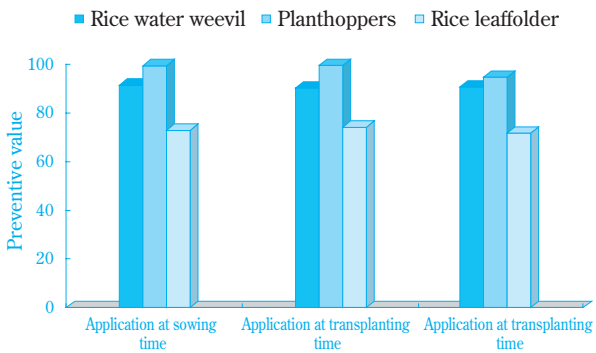
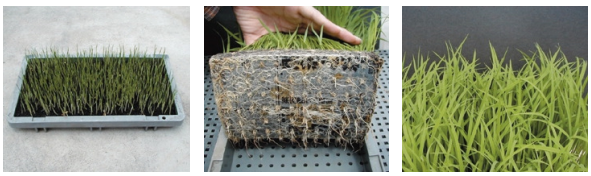


Fig. 2 Efficacy of Delaus® Prince® granules on paddy rice noxious insects
(Sumitomo Chemical Co., 2000)

The effects on controlling disease and insect pests through application at the time of seed sowing are almost the same as those of applications of existing long-lasting type formulations for seedling box application on the day of transplanting in official trials from 1999 to 2001 by the Japan Plant Protection Association and have been judged to be highly practical.

3. Phytotoxicity in rice plants with the application of Delaus® Prince® granules at seed sowing

Since application at seed sowing is an application close to sprouting seeds, it is very important to conduct phytotoxicity studies carefully. Therefore, applications of Delaus® Prince® granules at the registered dosage (50g/seedling box) and at a double dosage (100g/seedling box) were made at seed sowing to investigate the difference in phytotoxicity among various rice varieties (Koshihikari, Hinohikari, Akitakomachi, Nihonbare and Kinmaze) using various seedling soils (Nobateron, Hosaku, Ube nursery soil No. 2, Bonsoru No. 2, Biwako nursery soil) and various application programs in conjunction with seed treatment fungicides (Benlate, Techlead C, Sportak, Healthied, Trifmine, Momiguard C). As a result, no initial inhibition of budding and no phytotoxicity symptoms that could cause practical problems in the roots of rice plants or leaves were observed under any of the condictions (**Fig. 3**).[1)]



Germination | Rooting (Mat formation) | Leaf tip

Fig. 3 Phytotoxicity of Delaus® Prince® granules for rice plant by application at sowing time (Nursery box test)

Moreover, in official trials by the Japan Plant Protection Association carried out from 1999 to 2001, there was no indication of phytotoxicity that would be a practical problem with application of Delaus® Prince® granules at seed sowing. Therefore, it is thought that if these granules are used according to the registered requirements, there will be no phytotoxicity in the growth of rice plants during seedling growth or following transplanting to paddies even if application is made during seed sowing.

From the above we determined that even with application at seed sowing, Delaus® Prince® granules have superior safety in terms of chemical damage to rice plants as well as showing insecticide and fungicide efficacy comparable to conventional application on the day of transplanting and are highly practical as an agent applied at seed sowing in rice plant seedling boxes.

Development of apparatus for application of granules

To complete the laborsaving technique of application at seed sowing, it was necessary to develop a new application apparatus that could be set up in automatic seed sowing equipment. At present, the dissemination of automatic seed sowing equipment in rice paddy production is 90% or greater, and there are various seed sowing machines on the market from small seed sowing machines aimed at individuals to large-scale seed sowing machines aimed at seedling production centers. Installation of an application apparatus in these automatic seed sowing machines is the most reasonable method.

In the development of the application apparatus, it was necessary to have functions adaptable to all seed sowing equipment on the market. In other words:

1. Capable of being installed without any problems in the existing seed sowing machine space.

2. Capable of handling the differences in seed sowing speed among application apparatuses for seedling production centers or individuals (roughly 200-1200 boxes/hour).

To give the addictive value of application at seed sowing:

3. Achievement of the extremely uniform distribution for a stable effect.

4. Function making application prior to covering with soil possible to prevent loss of the chemi-

cal during application and transportation of seedling boxes.

Development of an application apparatus equipped with the above functions was carried out jointly with the major equipment manufacturers in Japan, starting with Suzutech K.K. (Ryouu-cho, Sakata, Yamagata) and Bizen K.K. (Hiraide Kogyo Danchi, Utsunomiya, Tochigi), and this application apparatus was brought to completion.

1. Application apparatus models and features

In terms of typical models of application machines, there are Suzutech ones where the dispensing part is a roller system, and Bizen ones with a shutter system. The Suzutech machines with the roller system (**Fig. 4**) are compact with a total length of 220mm, and it can be assumed that attachment to existing seed sowing equipment is possible without any problems. We prepared application capacities of 200-500 boxes/hour for small seed sowing machines aimed at individuals and 500-1200 boxes/hour for large-scale seed sowing machines aimed at seedling production centers. The application quantity can be finely adjusted by changing sprockets and a variable speed motor to make an extremely uniform application of the granules in prescribed amounts. In addition, the width of application is matched to the inside dimensions of seedling boxes, and loss of the granules during application is extremely low.

Fig. 4 An apparatus for granule application to nursery box

(Suzutech: type SDP-33S)

Total length: 220 mm Total width: 675 mm
Total height: 345 mm Total weight: 14 kg
Hopper capacity: 8L (Auxiliary hopper capacity: 20L)

On the other hand, the Bizen machine with the shutter system (**Fig. 5**) is a stationary type. It can be installed even if there is only a little space, and it is light in weight. Continuous control of the amount applied is possible using an adjustment knob, and it can be assumed that it will be able to handle everything from small seed sowing machines to large-scale seed sowing machines. Uniform application is possible with a vibrating hopper and distribution device.

Fig. 5 An apparatus for granule application to nursery box

(Bizen: type SK-10)

Total length: 449 mm Total width: 407 mm
Total height: 840 ~ 1290 mm Total weight: 5 kg
Hopper capacity: 6L

Moreover, the variance in the amount applied to each seedling box is extremely low in both models of machines compared with conventional application by hand, making for quick, accurate application.

Because we developed these application machines, it is possible to make application at seed sowing with almost all models of seed sowing machines on the market, and it was possible to further increase the dissemination of Delaus® Prince® granules.

Target diseases and insect pests and method for use

The target diseases and insects for Delaus® Prince® granules and the application methods are shown in **Table 2**.

Delaus® Prince® granules, which are the major

Table 2-1 Target pests and application methods

Delaus® Prince® granules 06
Active ingredient: fipronil 0.6%, diclocymet 3.0%

[Target pests and application methods]

Crop	Target pests	Dosage	Time of applications	Total number of times of applications	Application methods
Rice (nursery box)	Rice blast Rice leaf beetle Rice water weevil	[50 grams of Delaus® Prince® granules 06 are applied to a nursery box of 30 × 60 × 3cm packed with soil of about 5L]	Before sowing	Delaus® Prince® granules 06 (solely used): 1 application fipronil: 1 application diclocymet: 3 applications (2 applications at field stage)	Mixing uniformly with bed soil or covering soil in nursery box
	Rice stem borer Planthoppers Locust		From the time of sowing (before soil covering) to the day of transplanting		Applying uniformly on the soil in nursery box

Table 2-2 Target pests and application methods

Delaus® Prince® granules 10
Active ingredient: fipronil 1.0%, diclocymet 3.0%

[Target pests and application methods]

Crop	Target pests	Dosage	Time of applications	Total number of times of applications	Application methods
Rice (nursery box)	Rice blast Planthoppers Locust Rice stem borer Rice leaf beetle Rice water weevil Rice leaffolder	[50 grams of Delaus® Prince® granules 10 are applied to a nursery box of 30 × 60 × 3cm packed with soil of about 5L]	Before sowing	Delaus® Prince® granules 10 (solely used): 1 application fipronil: 1 application diclocymet: 3 applications (2 applications at field stage)	Mixing uniformly with bed soil or covering soil in nursery box
			From the time of sowing (before soil covering) to the day of transplanting		Applying uniformly on the soil in nursery box

product for mixed granules, come in two types according to the difference in the amount of Prince® included, Delaus® Prince® granules 06 and Delaus® Prince® granules 10. These can be selected according to the harmful insects targeted. Agricultural chemical registration (50g/seedling box, three days before to day of transplanting) was obtained on April 28, 2000, and at present there are expanded registrations for application at seed sowing (before covering with soil, mixed with bed soil and mixed with covering soil). It is possible to apply both agents targeting rice blast which is the most serious disease in paddy rice and a wide range of important harmful insects from the time before seeds are sown to just before transplanting and other periods, and regardless of the timing of the application, they exhibit superior efficacy for diseases and insect pests in paddies.

Conclusion

The appearance of novel formulation of agricultural chemicals with long lasting efficacy for seedling box application has greatly contributed to the reduction in the number of applications of agricultural chemicals to control diseases and harmful insects in paddy rice in Japan. It can also be said that this pest control technique is compatible with labor savings and reductions in cost. However, there are some points in these techniques that can be improved, so we need to develop new agricultural chemicals and pest control techniques that are given good evaluations by the people at agricultural sites, while, at the same time, agricultural chemical manufacturers and equipment manufacturers are repeatedly carrying out trial and error experiments.

Along with consistently making efforts to develop even more laborsaving and efficient crop protection techniques that meet demands from actual agricultural sites as well as maintaining strong cooperation with related organizations, we have great expectations that these techniques will be able to contribute to the stable production of rice crops.

References

1) Ogawa Masaomi, Sahara Masashi, Urakawa Motoyoshi, Yukio Oguri (2000): Jpn. J . Phytopathol. 66 (3). 304, December
2) Oguri Yukio (2001): Shokubutsu Boeki (Pl.Prot.) 55-1 23-26 (In Japanese)

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