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Control of Soft Rot after Harvest of Cabbage in Indonesia

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Abstract

The highland of West Java is the main cabbage producing district of Indonesia. Soft rot sometimes occurs and causes severe damage because of high air temperature and poor transport technology. Therefore, it was examined to develop simple and low-cost improved methods to control the occurrence of soft rot after the harvest of cabbages. Consequently, drying was recognized as one of the important factors to control soft rot. The cement treatment to the cut end is being used in Indonesia at present and was an effective way of suppressing soft rot. Drying the cut end is thought to contribute to greatly improving the control effect. Furthermore, keeping cabbage indoors for more than one day after the harvest was a more simple and easy way to prevent the occurrence of soft rot.

Discipline: Postharvest technology
Additional key words: high temperature, drying, cement treatment

Introduction

The high altitude zone of West Java Indonesia, includes the metropolis suburbs of Jakarta and Bundung, etc., plays an important role as a supply base of temperate zone vegetables. Cabbages are the main vegetable crop in this area, and part of the production is exported to various neighboring countries such as Malaysia and Singapore etc[5]. However, soft rot sometimes occurs and causes severe damage during the distribution under the poor high temperature transportation system. Therefore, we expect to develop simple and low-cost improved methods to control the occurrence of soft rot after the harvest of cabbage.

Materials and methods

The author (H. H.) stayed in West Java Indonesia as a short-term researcher for two periods from August 10 to September 21, 2001 and from September 21 to October 10, 2002. In these periods, the development of management technology (dipping treatment with hot water or hypochlorous acid, and natural or artificial drying treatments) for the prevention of cabbage soft rot was conducted at the National Institute of Vegetables in Lenbang. Treatments were compared with the "cement" (the chief ingredient is calcium) treatment introduced as a common method currently used to control soft rot.

Cabbages (*Brassica oleracea* L. cv. 'Kosui') were purchased from a collecting dealer, or properly harvested in the research farm of the Indonesian Vegetables Research Institute. A random sample of 10 heads was used for one treatment.

The effect of a hot water treatment was investigated by dipping cabbages for 5–15 min in water at a temperature of about 50°C. Also, cabbage was treated with hypochlorous acid at 200, 500 and 1,000 ppm concentrations for 5–15 min. Cabbages were dipped in 30 L water or solution for the treatment time, and then dried under natural conditions. In addition, the effect of preparation was examined. The preparation was conducted by removing sick leaves from the head and cutting the cut end one more time before the dipping treatment.

Next, a preliminary drying treatment was examined to control this disease. The dryness of cabbage was managed after the harvest using the 7 following treatments: ① Storing indoors (average temperature : about 24°C) for

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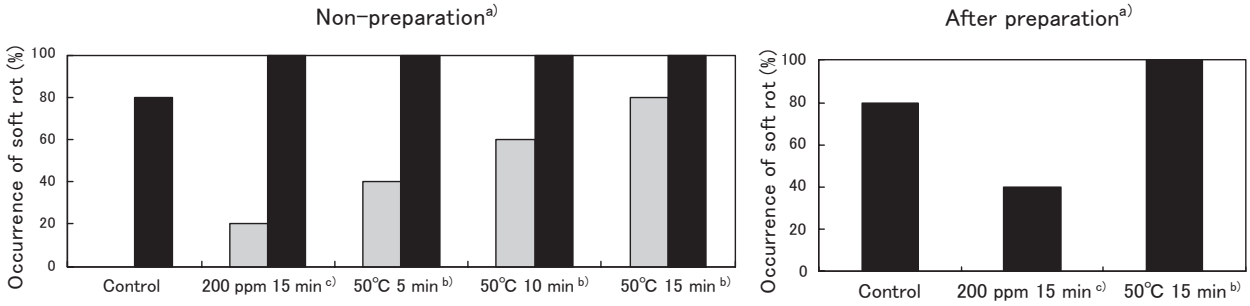

Fig. 1. Effect of dipping treatments with hot water and hypochlorous acid on the occurrence of cabbage soft rot after harvest

: 2 days, : 4 days.

a): preparation; Cabbage leaves with symptoms of soft rot were removed and the cut end was cut one more time before the treatment.

b): hot water; Cabbages were dipped in hot water (30 L) controlled at 45–50°C.

c): hypochlorous acid; Cabbages were dipped in a solution of hypochlorous acid (200 ppm).

one day after the harvest, ② Storing indoors for 6 days after the harvest, ③ Storing indoors in sealed polyethylene bags for 6 days after the harvest, ④ Storing 1 h outdoors in the field under the conditions after the harvest, ⑤ Storing 3 h outdoors in the field under the conditions after the harvest, ⑥ Storing 1 h in a drying room at 35°C, and ⑦ Storing 3 h in a drying room at 35°C.

Various calcium chemicals (calcium hydroxide, calcium carbonate, calcium sulfate dihydrate, calcium phosphate tribasic, calcium dihydrogenphosphate monohydrate, and calcium hydrogenphosohate dihydrate) on the market were examined to explain the factor effecting expression of the cement treatment control, and to look for more effective chemicals. Calcium chemicals were painted on the cut surface of the head in small amounts (about 1 g/head).

In most cases, cabbages which had air dried after treatment were packaged in polyethylene bags (thickness : 0.03 mm) individually, and held in a large drying machine controlled at 35°C. This simulated the conditions of transport. The occurrence of soft rot was judged by the existence of rot at the cut end, and the degree was the percentage of the total heads tested showing soft rot.

Results

1. Effect of dipping treatment with hot water and hypochlorous acid on the occurrence of soft rot

As shown in Fig. 1, soft rot occurred in all the treatments. There was a tendency for the occurrence of soft rot to increase with increasing treatment time in hot water. On the other hand, the rot progress was suppressed by a dipping treatment in a solution of hypochlorous acid (200 ppm, 15 min) for prepared heads (damaged leaves removed and cut again at the end of the core).

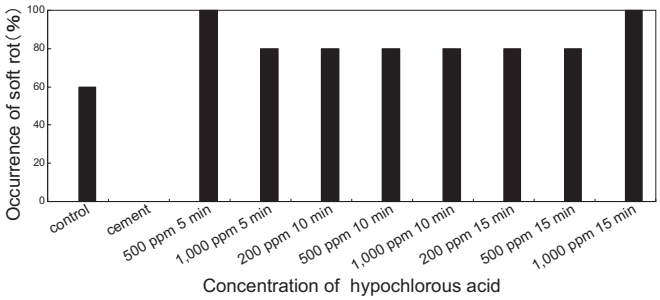

Fig. 2. Effect of pretreatment with cement or hypochlorous acid on the occurrence of cabbage soft rot after harvest

Data were obtained at 4 days after the treatment.

■ : packing.

Symptoms of soft rot were not detected in any of the non-packing cabbages.

The condition of dryness (in the case of non-packing) controlled soft rot disease remarkably, despite the decline in freshness. Conversely, the occurrence of disease was accelerated for heads sealed in polyethylene bags (Fig. 2). The suppressive effect of the hypochlorous acid solution also disappeared at high humidity conditions (in the case of packing in polyethylene bags).

The cement application to the cut end was not influenced by the humidity conditions, and the suppression effect was remarkable, compared with hypochlorous acid treatment.

2. Effect of preliminary drying on the occurrence of soft rot

As showed in Fig. 3 (only the main results of treatments are indicated) soft rot at the cut surface was suppressed only by keeping cabbages indoors for 1 and 6 days after the harvest. In addition, the effect was superior to the calcium hydroxide application (Fig. 4). The next

best result was obtained in 1 h in a drying room at 35°C. In the other treatments, soft rot occurred at a high rate with no suppressive effect apparent.

3. Effect of calcium on the occurrence of soft rot

Various calcium chemicals on the market were examined to explain the suppressive effect of the cement treatment and to look for more effective chemicals to control soft rot. Calcium hydroxide had a more suppressive effect on the occurrence of rot at the cut end of the cabbage. On the other hand, some chemicals promoted the disease in the group of calcium compounds tested (Fig. 5).

Discussion

In Japan as well, vegetable soft rot is a disease that is difficult to control. Moreover, even if products are free of rot in the field, it is known that soft rot develops during the transport to markets[6–8]. Cabbage can be grown, because the highland of West Java Indonesia has a cool climate. However, the disease occurs at high temperature and high humidity conditions of the market areas and during rough handling in transport. Then, it causes severe damage.

Hot water treatment is recognized as a simple and easy technique to control disease and insect damage, and it has already been put to practical use in various foreign countries[1,2,4]. However, in this study there was no suppressive effect and in some cases rot was promoted. We considered that the lethal temperature for the soft rot bacterium was higher than that of the hot water used in this study[6], and that the soft rot bacteria infected from the cut end, moving promptly through the vascular tissue.

On the other hand, in Japan, hypochlorous acid is the only chemical used to disinfect fresh vegetables, and is being used for the control of microorganisms in shredded vegetables[3]. In this study, a certain degree of soft rot suppression occurred after hypochlorous acid application. That effect on soft rot management greatly depended on humidity conditions after the treatment, and the effect did not occur at high humidity conditions. It was clear that the occurrence of soft rot was restrained by storing cabbages in drying conditions, from the results of this study.

We stored cabbages under various degrees of dryness after harvest. As a result, it was found that keeping them indoors for more than one day after the harvest had the most effect. It is recognized that soft rot bacteria doesn't enter plant tissue without a wound. Because of this, it is thought that the injuries to the cabbage head received at the time of harvest can be healed by storing it

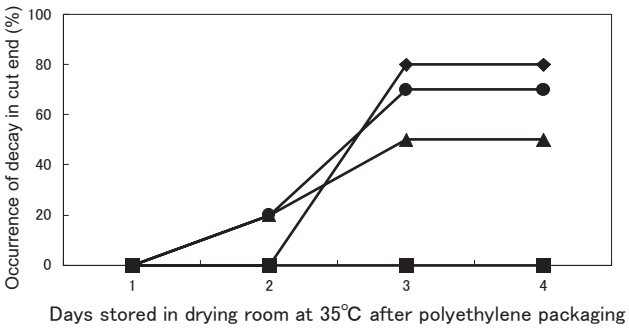

Fig. 3. Effects of various pretreatments on the occurrence of decay at the cut end of cabbages
● : control, ◆ : calcium hydroxide, ■ : 1 day stored indoors, ▲ : 1 h in 35°C drying room.

Fig. 4. Effect of calcium chemicals and indoor storage treatment on occurrence of soft rot at the cut end of cabbages

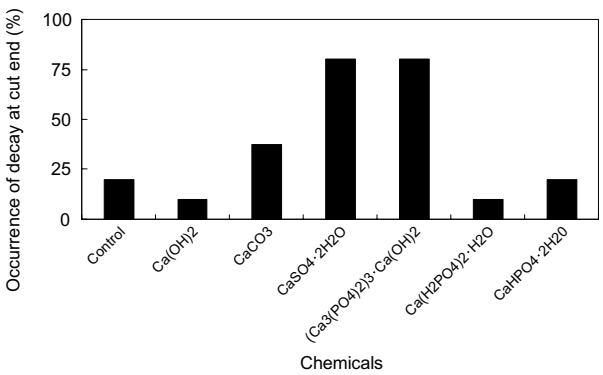

Fig. 5. Effect of calcium chemicals on the occurrence of decay at the cut end of cabbages
Data were obtained at 2 days after the treatment.

indoors after the harvest and so on, and that the bacteria cannot easily enter from the cabbage surface.

On the other hand, the cement (the main constituent was calcium hydroxide) application is a simple and easy method introduced in Indonesia at present[6], and it has been confirmed that the effect is stable as in this examination. However, some chemicals showed a tendency to promote soft rot despite being calcium compounds. Because of this, it is considered that the effect of the cement application was caused by the interception of bacteria at wounds rather than any physiological function of calcium.

According to the result of a market survey, Chinese cabbage is commonly infected with soft rot in a high ratio. It is difficult to select healthy ones from their appearance. In Indonesia, we are anxious about the damage caused by soft rot of Chinese cabbage. This disease begins from infection in the field. Needless to say, a synthetic countermeasure including chemicals and cultural control etc. is demanded for the complete protection of products from soft rot.

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