

## **Application of Sprinkler System for Control of Cone Insects in a Conal Seed Orchard of *Pinus koraiensis***

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The cone insects decreased cone growth and seed production by feeding flesh fruits and by obstructing seed formation. As seed orchards are established as pure forests, there is more damage by insects than in a mixed forest. As Carbofuran (Furadan 3% granule) has been buried around trees to control cone insects, it causes environment problem due to a long stay in the soil. As a replacement for this problem, the need to apply the pesticides, such as Diflubenzuron and Cyfluthrin that cause little pollution and toxicity, was suggested. However, the information on spray periods and spray frequency of the above pesticides is lacking in seed orchards. Therefore the sprinkler system was installed in a Korean pine (*Pinus koraiensis*) seed orchard, which was managing by the Korea Forest Seed Research Center. The purpose of study was to investigate the effect of sprinkler system and pesticides on the control of cone, and effect on the labor reduction for seed orchard management.

### **METHODS AND MATERIALS**

Korean pine (*Pinus koraiensis*) is mainly attacked by cone insects such as pine twig moth (*Gravitarmata margarotana*) and pine shoot borer (*Dioryctria abietella*). Two kinds of pesticides, Diflubenzuron (25% wettable powder) and Cyfluthrin (2% Emecifiable concentrate) were selected for this study, because they were known to be less harmful compared to Carbofuran, which had been used in seed orchard in Korea. The chemicals were applied for 15 day or 20 day intervals from early June to early August. The sprinkler system was consisted of a water tank, a pesticides tank, a water pump, a pressure pump and the self-generator that supplies the power and the connecting hose and sprinkler nozzle, which carry pesticides to each tree. The spraying nozzles were fixed above the crown as to insecticides dropped onto the cones. Cones from each of the treated groups were collected every month after spraying pesticides to examine cone insect control by sprinkler system.

### **RESULTS AND DISCUSSION**

#### **1. Cone insect control effects by pesticides and spraying intervals**

While the damaged cone rate was 67.5% in control group, the cone damage was reduced to 14.8% and 9.1% after spraying Diflubenzuron and Cyfluthrin, respectively. The insect control effects of each pesticide were 86.5% for Cyfluthrin and 78.1% for Diflubenzuron. There were no clear difference between 15 day intervals and 20 day intervals. So it would be more effective to spray 20 days intervals to reduce the costs.

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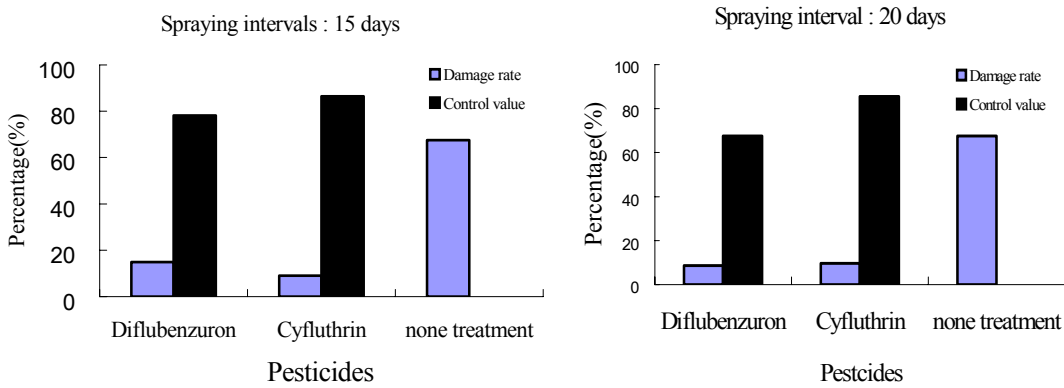


Figure 1. The control effects of cone insects by pesticides and spraying intervals

## 2. The control effects by the spraying periods

As shown in Figure 2, the cone insect control effects of pesticide by spraying periods for Korean pine cone insect pests were 93.0% and 94.9% during June and July, however, the control effects reduced a little on September. As the pesticides were applied until early August, the activities of larvae were more increased after that time. So it was suggested that if the effective control would be expected, the application of pesticides should be continued by September.

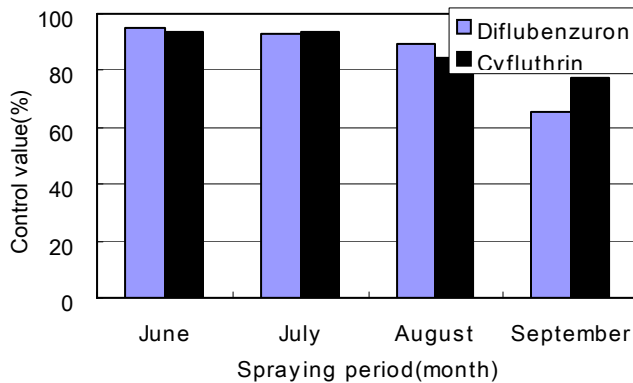


Figure 2. The control effects of cone insects by pesticide spraying periods

## 3. The effective cone insect control management

The present cone insect control in the seed orchard is to bury Carbofuran (3% granule) around individual tree. However due to the lack of labor by the concentration of population to the urban area, it became difficult to manage cone insect by manpower. So the sprinkler system was introduced to the seed orchard.

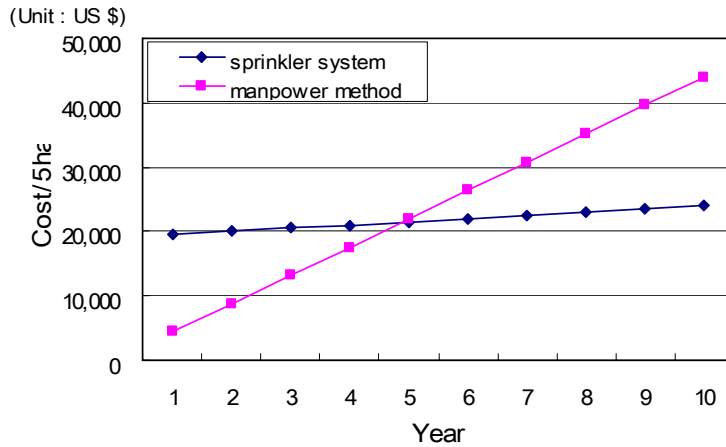


Figure 3. The comparison of cost for the cone insect control by sprinkler system and manpower

Even though the cost of insect pest control seemed to be higher at the beginning compared to the burying method due to the expense of initial installing system, the gap was reduced gradually as time went by. Five years after installing, the costs for two cone insect control methods became almost the same (Figure 3). In addition, the sprinkler system had advantages to reduce the labor and time because it could spray pesticides large areas in a few minutes. The amounts of pesticides needed for each hectare by the sprinkler system were 200g for Diflubenzuron and 8,000ml for Cyfluthrin, while the burying method for Carbofuran was 501kg (Table 1). The sprinkler system used less pesticide than the burying method, however, its insect control effect was much more increased. Furthermore it was expected that effect on the soil environment would be decreased.

Table 1. The amount of spraying insecticides by treatment each hectare

Applying method	Insecticide	Sprayed amount/ha
Sprinkler	Diflubenzuron	3,200 g
	Cyfluthrin	8,000 Mℓ
Burying in soil	Carbofuran	501 kg