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Wind tunnel test for drag coefficient estimation of insect-net

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ABSTRACT

Fruit bagging is a traditional way to produce high quality fruit and to prevent damage from insects in South Korea. If insect-net is installed instead of bagging at the orchard, cost competitiveness can be improved by manpower reduction. In this regard, insect-net facility for non-bagging cultivation was developed. However, damage caused by strong wind is frequently occurring in the rural regions. Therefore wind load should be considered designing insect-net facility. So, wind tunnel test was performed to measure wind load of insect-net. As a result of test, drag coefficients for the insect-net were found to be about 0.5~0.6.

1. INTRODUCTION

Bagging for fruit is traditional way to produce high quality fruit and to prevent damage from insects. During the process of pear production, the number of hours spent bagging is 28 hours per 10 are, accounting for about 16% of the total working time. However, installing insect-net facility instead of bagging for pear can improve price competitiveness by manpower reduction.

As damage caused by abnormal weather such as heavy snow and typhoons has occurred frequently in recent years, snow and wind load must be considered for installation of insect-net. However, as the pear insect-net opens its ceiling in winter, it does not need to consider snow cover loads, so only the wind load needs to be calculated in the facility, except for the lower body weight. In this study, wind loads on the insect screen were measured by wind tunnel test.

2. MATERIALS AND METHODS

2.1 Insect-net

The insect-net used is a commonly referred to as 4 mm mesh and its shape and size can be seen in the following Fig. 1.

[1)] Post-doctoral researcher
[2)] Agricultural researcher

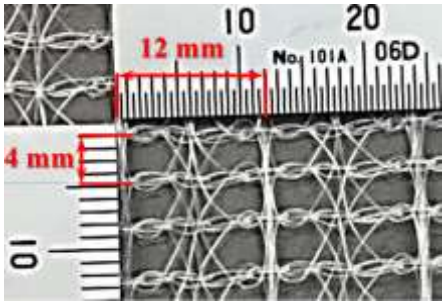

Fig. 1 Insect-net

2.2 Wind tunnel test

Wind load P is proportional to the square of the wind speed V and the swept area A as shown Eq. (1). Using the result of wind tunnel test, drag coefficient C_D of the insect-net can be determined. Where, ρ is density of air.

$$\mathrm{P} = \frac{1}{2} \cdot \rho \cdot V^2 \cdot A \cdot C_D \tag{1}$$

Wind tunnel of National Institute Agricultural Sciences was used to measure the wind load on the insect-net. The size of test section is 3.0 m(W) x 2.0 m(H), and six load cells(capacity 100 N) are used to measure wind load for insect-net. Wind speed ranges is from 0.5 to 22 m/s and the size of the net was 1 m(W) and 0.6~1.35 m(H).

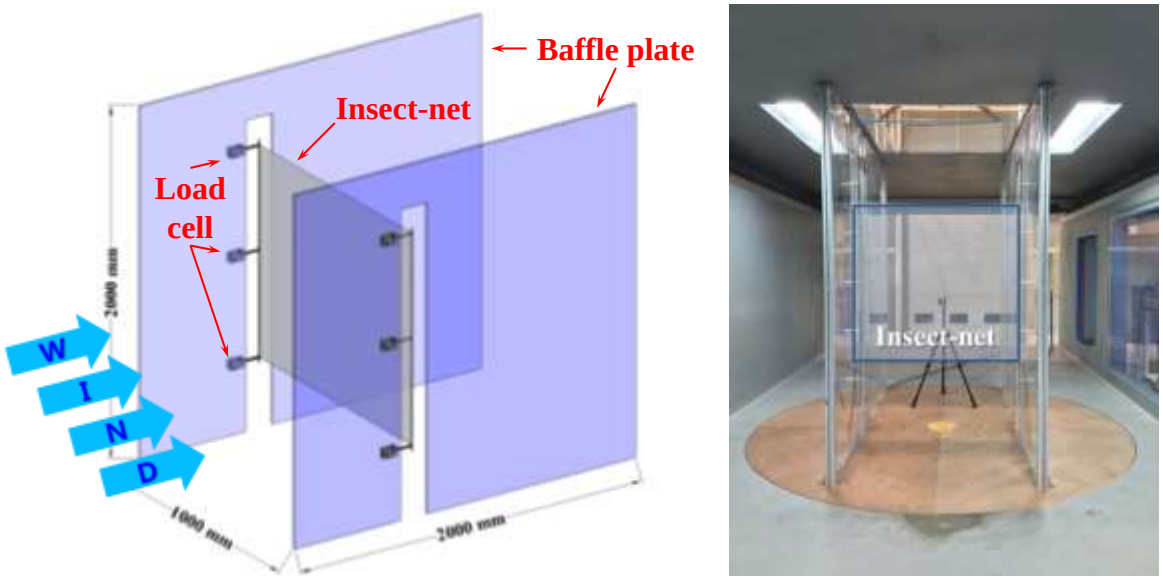

Fig. 2 Wind tunnel test model

2.3 Result of test

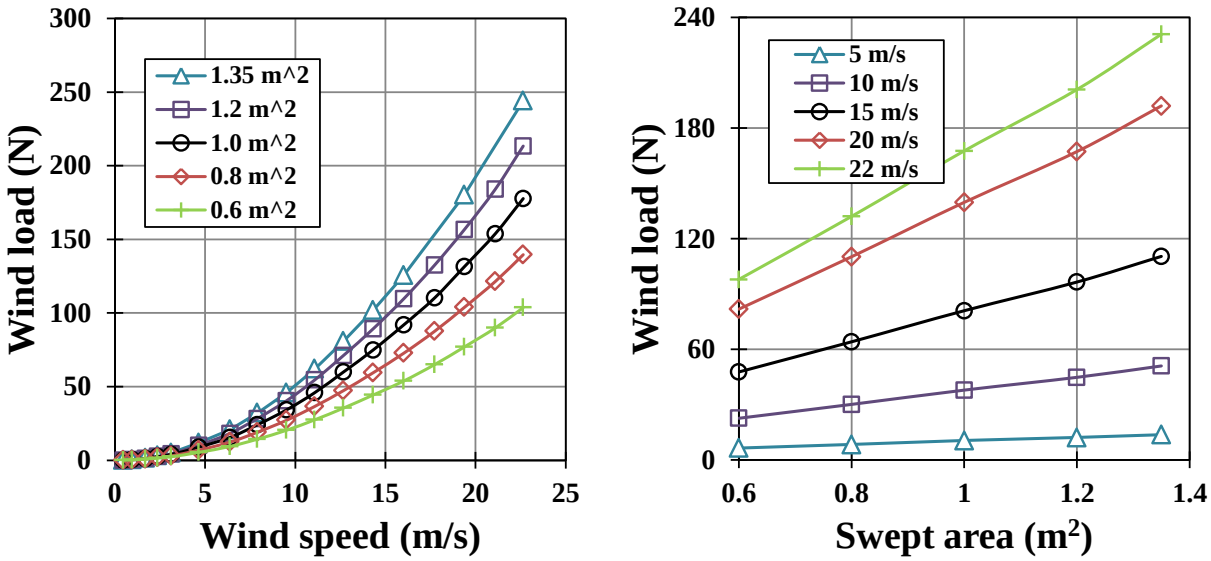

Fig. 3 Wind load by wind speed and swept area of insect-net

As a result of the wind tunnel test, the wind load acting on the insect-net was proportional to the square of wind speed and the swept area of the net.(Fig. 3) Using these results and Eq.(1), drag coefficient for insect-net could be determined as follows Fig. 4. Drag coefficient for insect-net is estimated to be in the range of approximately 0.55 to 0.65.

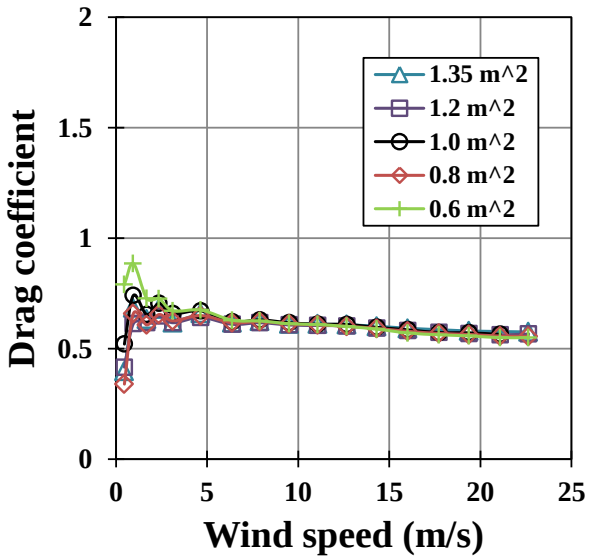

Fig. 4 Drag coefficient by wind speed

3. CONCLUSIONS

In this study, wind tunnel test were conducted to calculate drag coefficient, the basis data for the design of insect-net facilities to apply non-bagging techniques to pear orchard. As a result of test, drag coefficient for the insect-net was estimated to be between about 0.55 and 0.65. This result is expected to be used as a basis for design of insect-net facilities.

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