EFFECT OF ROW COVER TREATMENT ON THE PREVENTION OF TYPHOON DAMAGE IN VEGETABLE PRODUCTION

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ABSTRACT

Experiments aimed at developing effective methods to minimize typhoon damage in vegetable production were started in 1983, in Ogasawara islands.

Creeping melon was cultivated with or without row cover during the typhoon 8422 with a maximum wind speed of 47.0 m/sec. The fruits were harvested 30 to 45 days after the typhoon hit the islands. No marketable fruits were produced without row cover while 12.5 t/ha of marketable fruits were produced with the row cover.

Typhoon 8512 with a maximum wind speed of 34.6 m/sec hit fields planted to Santousai (a leafy vegetable, *Brassica campestris*) at harvest time. A higher marketable yield was obtained with the use of row cover than without the treatment. However, continuous row cover treatments throughout the cultivation period resulted in a significant yield loss.

The row cover technique was found to be very effective in reducing typhoon damage, but the mechanism whereby the row cover could alleviate the damage remains to be elucidated.

Introduction

The Ogasawara islands were occupied by the U. S. A. from the end of World War II until 1968. After the islands were returned to Japan, the farmers had started to grow winter pumpkins for consumption in the city of Tokyo. However, the increase in imports of pumpkins from New Zealand and Mexico, resulted in a sharp decrease in price. Then, the combined cultivation of melon (cultivar 'Princemelon') with sweetcorn became popular. However, yield loss due to typhoon damage has been the major constraint on melon production (Fig. 1).

The Ogasawara islands are located in the sub-tropics, where typhoons occur frequently. Based on meteorological statistics compiled from 1971 over 1982, an annual average frequency of 0.8 typhoon hits areas as close as 100 km, while in areas as close as 300 km to Chichijima (Bonin) island, the main island of the Ogasawara islands, the frequency was 2.3. The summer typhoons generally move up to the Ogasawara islands slowly in zigzags, while the autumn typhoons are strong and hit the island directly, bringing about the destruction of melons (Fig. 2).

Recently, the 'row cover technique' whereby cultivation beds with vegetables are directly covered with either a net, unwoven fabric or cheesecloth has been spreading rapidly in Japan. Based on the survey conducted in 1987 by the Japan Institute of Agricultural and Horticultural Materials, the acreage expanded to 5,320 hectares. This technique is used for various purposes : alleviation of chilling injury (Igarashi and Okada, 1987) ; high radiation damage (Nakamura and Igarashi, 1983 ; Noguchi and Nakamura, 1984 ; Hanada, 1987) ; protection from hail (Takahashi *et al.*, 1987) and insects (Seko *et al.*, 1962 ; Watanabe, 1962 ; Kawai, 1983) ; alleviation of wind damage (Ozawa, 1984) ; etc.

In this paper, the effects of row cover treatment on the protection of prostrate crops

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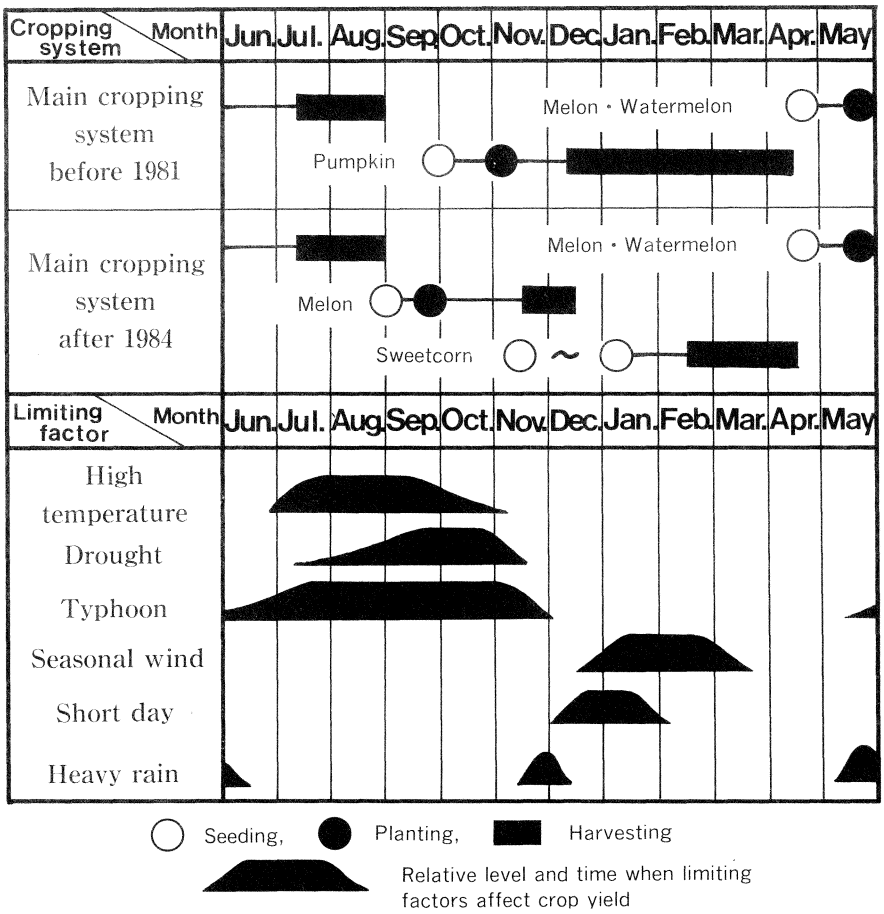

Fig. 1 Changes in main cropping systems in relation to meteorological limiting factors in the Ogasawara islands

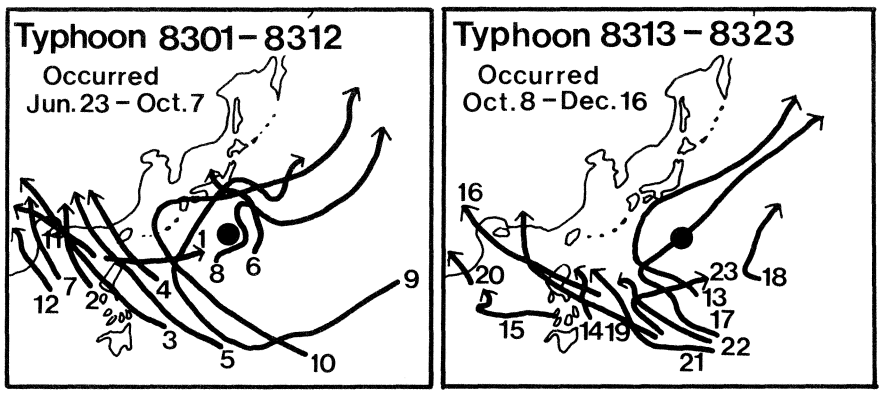

Fig. 2 Record of typhoon routes in 1983
Source : Japan Meteorological Agency
● ; The Ogasawara islands.

and leafy crops from typhoon damage are analysed.

Results and discussion

1 Effect of row cover on melon production

Typhoon 8422 hit the Ogasawara islands on October 30, 1984, and the maximum wind speed (MWS) was 47.0 m/sec. The effect of row cover on the prevention of typhoon damage was tested on the melon cultivar 'Princemelon PF No 6', sown on September 3 (seedlings were transplanted on 1.4 m beds, with a distance of 1.0 m between hills). Three plants were not subjected to the row cover treatment and six plants were covered with a blue *Raschel* net for a whole day a few hours before the strong wind started to blow (Fig. 3). The leaf-covering degree, the covering ratio of the soil surface by the plants, was measured before and after the typhoon. Harvested fruits were classified into marketable and unmarketable ones, according to the shape, weight (>300 g), and brix value (>14.0).

The leaf-covering degree after the typhoon was much lower in the check plot than in the row cover plot (Fig. 4). No marketable yields were obtained in the check plot, while nearly 12.5 t/ha of marketable yield was attained in the row cover plot (Table 1).

A similar experiment has been carried out continuously up to date since 1983. More

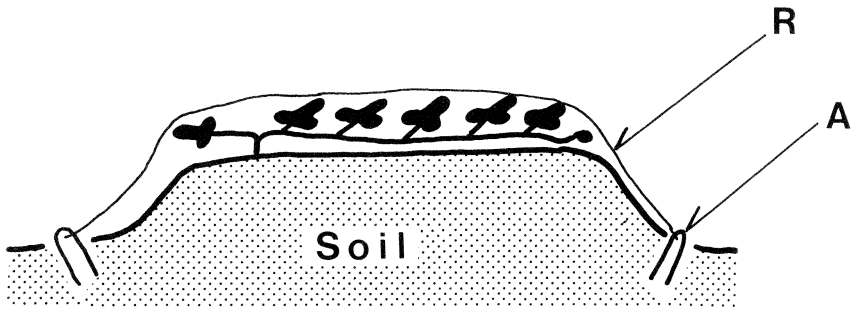

Fig. 3 Diagrammatic representation of row cover on melon
A ; Anchor, U-shaped iron # 7 wire about 30 cm long is inserted obliquely in soil at intervals of 4 m on both sides of *Raschel* net.
R ; *Raschel* net, blue in color 4 mm mesh and 1.8 m wide.

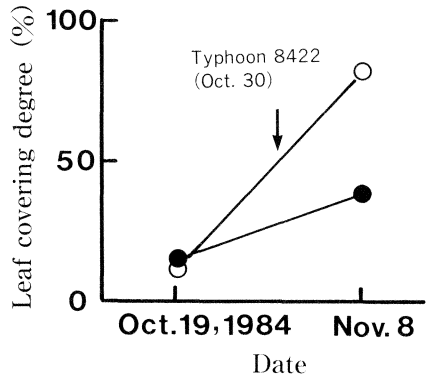

Fig. 4 Effect of row cover on leaf covering degree of melon
● ; Without row cover ○ ; Row cover.

Table 1 Effect of row cover on melon yield

Treatment	Marketable yield	Non-marketable yield
	(t/ha)	
Without row cover	0	4.5
Row cover	12.5	4.6

than 16 t/ha of marketable yield was obtained with the row cover technique during the typhoon 8617 (MWS, 59.6 m/sec).

When the row cover technique is applied to vegetable cultivation, it is most important to prevent the nets from flapping. The beds have to be raised up to 10 cm from the soil surface, and the nets have to be stretched tight. Iron wire is the best material to use as anchors.

Two persons can cover 0.1 hectare of field within one hour, and the cost is almost the same as that of polyethylene mulch. Thus, the results from the experiments indicate that the row cover technique is extremely effective in protecting vegetables from wind damage. Actually, in 1986, no serious wind damage was reported after the occurrence of typhoon 8617 (MWS, 59.6 m/sec) throughout the islands because this technique has been widely adopted by the farmers.

2 Effect of row cover on Santousai production

In the sub-tropical region of Japan, vegetable shortage during summer time is a very serious problem (Nakamura and Igarashi, 1983 ; Ozawa, 1987). Although Santousai (a leafy vegetable, *Brassica campestris*) can grow easily and give a high yield even in summer in the sub-tropics, adequate cultural practices to avoid typhoon damage are required for stable production.

Seeds of the Santousai cultivar 'Ohimaruba-santousai' were broadcasted on beds 1.4 m in width on July 23, 1985. Plants were cultivated with or without row cover over a surface of 7 m^2 each. A blue 4 mm mesh *Raschel* net was used as row cover net. The netting was commenced from sowing and continued up to harvesting. As summer typhoons occur erratically and more slowly, it is generally difficult to predict when and/or where they are likely to hit.

On August 26, typhoon 8512 (MWS, 36.4 m/sec) hit the islands. Plants in both plots (0.15 m^2) were harvested immediately before and after the typhoon. Immediately before the typhoon, both total yields and marketable yields in the row cover plot decreased by 25% compared to the yields in the plot without cover. However, immediately after the typhoon, the marketable yield in the plot without cover decreased to 30% of that of the plot with cover (Table 2).

Thus, although row cover protected Santousai from wind damage, long-term covering caused a decrease in potential yield. The same phenomenon was observed for melon and other leafy crops (Ozawa and Wada, 1986). Further studies are required to analyse the environmental effects of row cover on vegetable production.

Table 2 Effect of row cover on Santousai yield

Treatment	Immediately before typhoon (Aug. 26)		Immediately after typhoon (Aug. 27)	
	Total yield	Marketable yield	Total yield	Marketable yield
		(t/ha)		
Without row cover	113	84	143	22
Row cover	83	66	93	73

3 Advantage of row cover technique in vegetable production

To determine the mechanism of alleviation of wind damage, the wind velocity was measured, on October, 2, 1987 in plots planted to melon cultivated with and without row cover by hotwire anemometers. Sensors were set at 5 cm above the soil surface in both experimental plots, and at 100 cm above as a reference. The wind velocity in the case of row cover was not significantly different from that without cover (Fig. 5). Therefore, it appears that the decrease in the wind velocity is not the major factor which reduces the wind damage when the row cover technique is applied.

In another experiment, pumpkins which fixed themselves on the nets by vein coiling, did not experience wind damage, and the marketable yield increased by 60% (Ozawa, 1978). These observations indicate that the flapping of vegetable leaves associated with strong wind may be responsible for the yield decrease rather than the direct effect of wind pressure.

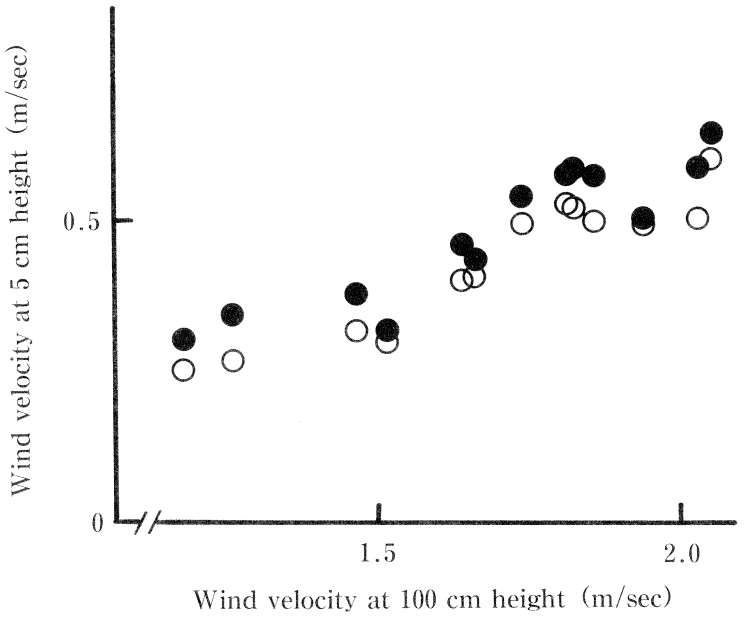

Fig. 5 Effect of row cover on wind velocity in melon canopy
● ; Without row cover. ○ ; Row cover.

Conclusion

The row cover technique was found to be highly effective in protecting vegetables from typhoon damage. However, long-term covering caused a decrease in potential yield. These facts suggested that the alleviation of wind damage by row cover may be associated with the prevention of leaf-flapping.

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