Test about transmittance and optical properties of a plastic film for simulating the haze effect on crop growth

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Outline

- Introduction
- Objectives
- Methods
- Results
- Summary

1. Introduction

- Solar radiation received on the ground surface impacts crop productivity.

- Changes in cloudiness and aerosol content in the atmosphere can influence solar radiation received on the ground surface, balance of direct and diffuse components of the solar radiation received on the ground surface (*Gu et al., 2003; Urban et al., 2007; Matsui et al., 2008; Doughty et al., 2010*).

1. Introduction

- Many studies have shown that increased diffuse radiation can enhance productivity for the terrestrial ecosystem with higher and complex canopy, when sky become cloudy or aerosol content in the atmosphere increase (*Gu et al., 2003; Olivera et al., 2007*).

- However, how the increased diffuse radiation affect the crop growth and production is still a question, especially under the heavy haze weather which often influence Eastern China nowadays.

1. Introduction

- Thereby, whether the haze can affect crop growth and reduce the crop productivity need to be verified in open field.

- A plastic film can simulate the haze effect on crop production in open field.

2. Objectives

- The two treatments were chosen in the plastic film simulation experiment.

- One treatment is simulate the light and moderate pollution, that is global solar radiation decrease by about 10%, the ratio of diffuse radiation to global radiation increase by about 7%.

- The other is simulation the heavy pollution, that is global solar radiation decrease by 20%, the ratio of diffuse radiation to global radiation increase by about 20%.

2. Objectives

- In order to get a good simulation, we need to test the transmittance and optical properties of the chosen plastic film.

3. Methods

3.1 Materials and instruments

- No. 8, No. 10, and No. 12 plastic film are chosen to be test.

- Sun Spectroradiometer Model S-2440C is applied to observe the solar radiation spectrum.

- Sunshine Pyranometer type SPN1-MS1 is applied to observe the global solar radiation (S) and diffuse radiation (S_{dif}).

3.2 Observation

- The observation should be done under clear sky condition.

- We chose 2 Mar, 2014 (cloud sky), 3 Mar, 2014, and 5 Mar, 2014 (clear sky with light cloud).

- We observed S, S_{dif}, and Solar radiation spectrum under natural environment and one layer, two layers, and three layers of the three types plastic film cover.

3.2 Observation

4. Results

4.1 Sky condition

Table 1 The sky conditions on 2, 3, and 5 Mar, 2014.

	Clearness Index	Air Quality Index
2014-03-02	0.47	107
2013-03-03	0.76	100
2013-03-05	0.75	70

4.2 The transmittance of plastic film

Table 2 The transmittance of plastic film and the ratio of diffuse radiation to global solar radiation under plastic film

	No. 8			No. 10			No. 12		
	1 layer	2 layers	3 layers	1 layer	2 layers	3 layers	1 layer	2 layers	3 layers
Transmittance[a]	90%	77%	62%	91%	82%	70%	91%	79%	69%
S_{dif}/S (NE)[b]	31%	30%	29%	35%	35%	35%	34%	36%	32%
S_{dif}/S^{c}	42%	49%	60%	45%	48%	61%	46%	57%	58%

a: Transmittance is the ratio of global solar radiation covered by plastic film to that under natural environment.

b: The ratio of diffuse radiation to global solar radiation under natural environment.

c: The ratio of diffuse radiation to global solar radiation under plastic film

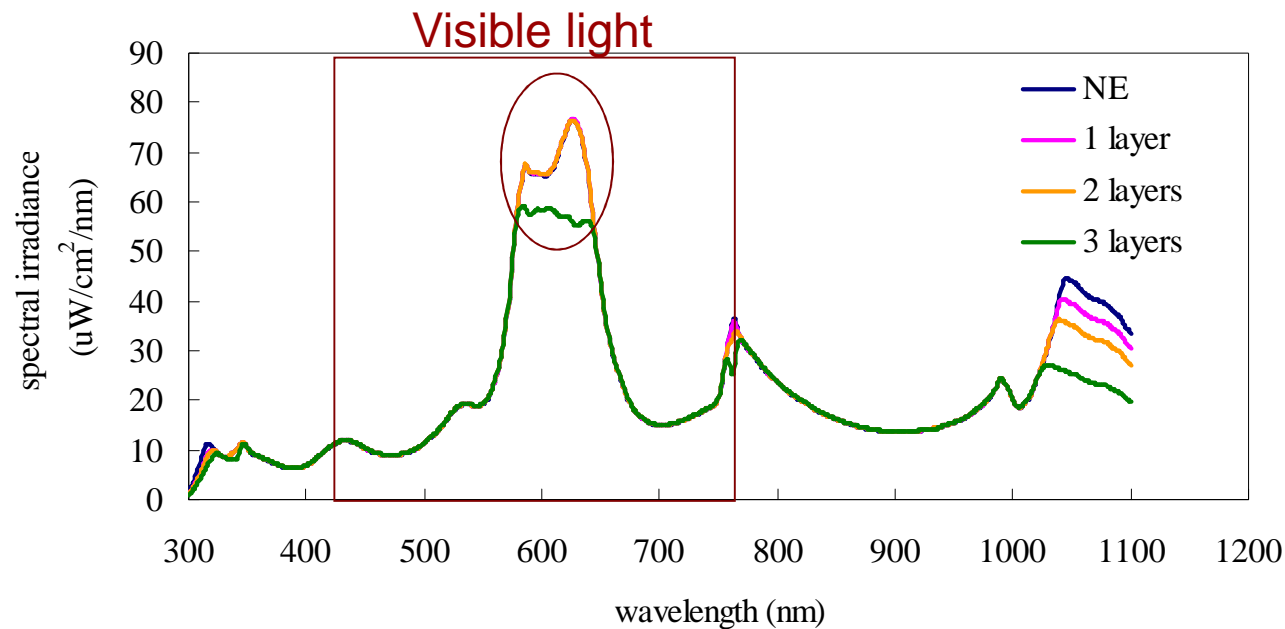# 4.3 The solar radiation spectrum under plastic film

Figure 1 The spectrum irradiance of Sun under No. 8 plastic film

4.3 The solar radiation spectrum under plastic film

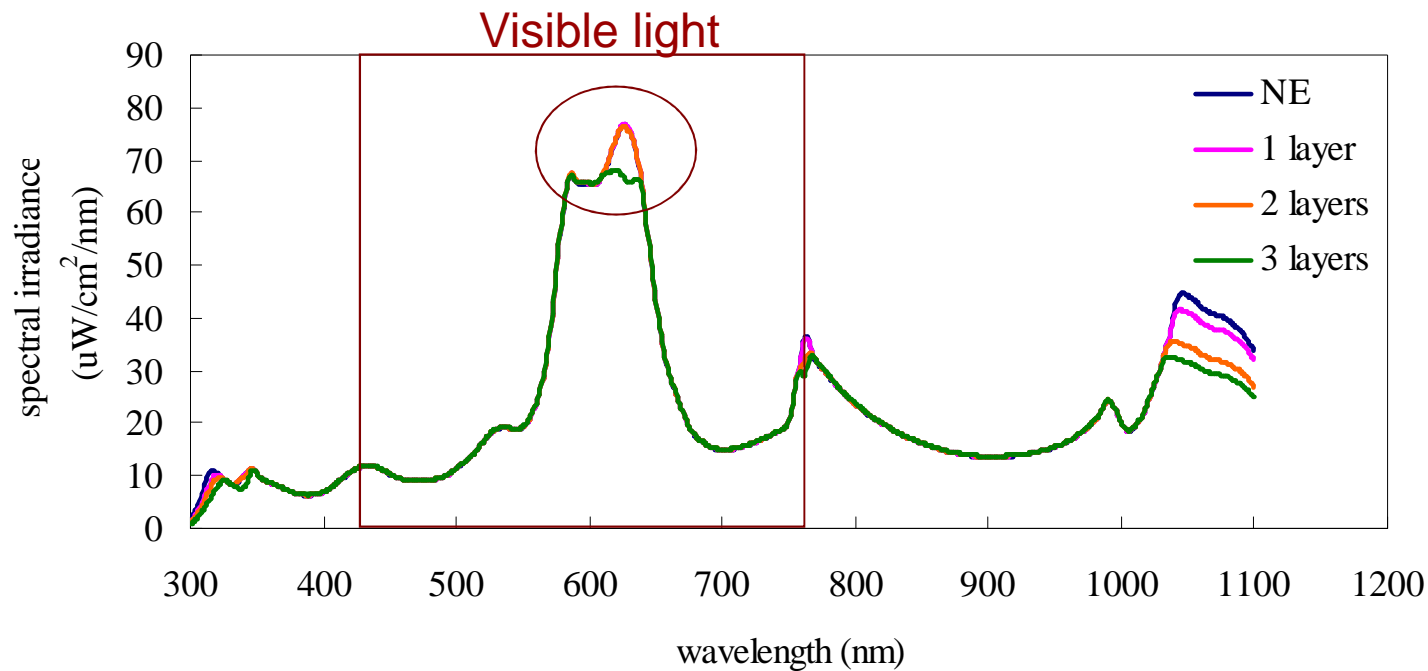
Figure 2 The spectrum irradiance of Sun under No. 10 plastic film
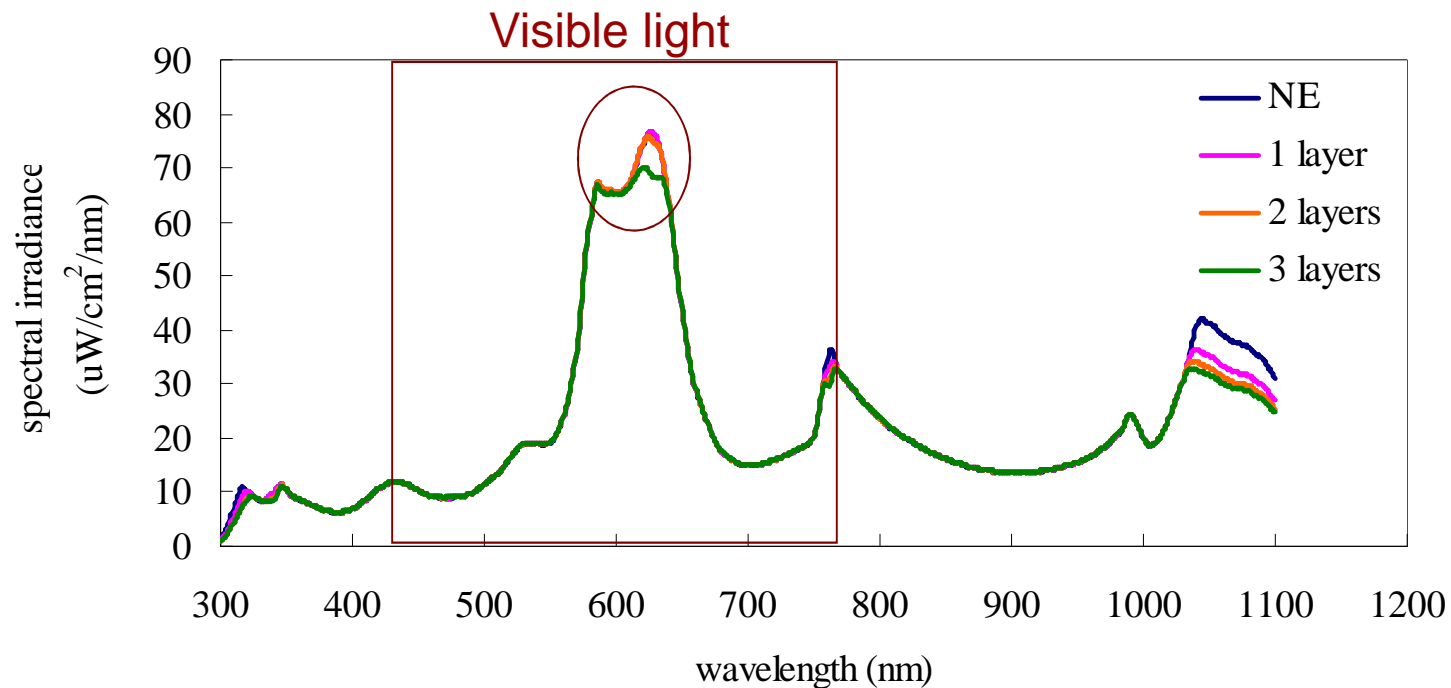
4.3 The solar radiation spectrum under plastic film

Figure 3 The spectrum irradiance of Sun under No. 12 plastic film

5. Summary

- According to the test results, we advice that we can choose No. 12 one layer to simulate light and moderate pollution, and choose No. 12 two layers to simulate heavy pollution.

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