

Letter to the Editor



The Relationship between Working Conditions and Adverse Health Symptoms of Employee in Solar Greenhouse*

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To determine the correlation between the working environment and the health status of employees in solar greenhouse, 1171 employees were surveyed. The results show the 'Greenhouse diseases' are affected by many factors. Among general uncomfords, the morbidity of the bone and joint damage is the highest and closely related to labor time and age. Planting summer squash and wax gourd more easily cause skin pruritus. Asthma-related cough, eye disease, and skin pruritus are significantly correlated with the cultivation of wax gourd. The application of inorganic fertilizer and fertigation dramatically induce the bone and joint damage. The smell of covering film greatly influence skin pruritus. Personal protection is badly scanty and normative occupational health and safety need to be completed.

Solar greenhouses are the main facilities for winter vegetable production in the northern area of China. However the workspace is closed, narrow, high temperature, and humidity. Greenhouses also produce deleterious substances that are difficult to remove promptly during the productive process. As the aging of greenhouse employees, such symptoms as bone and joint pain, skin pruritus, asthma-related cough, sneezing and gastritis occur, usually called 'Greenhouse diseases'^[1-3]. This study aims to investigate the working conditions related to those discomforts and determine which factors contribute to the morbidity.

1171 employees from 97 natural villages were interviewed. All participants are over 25 years old, with over one year of vegetable planting experience in greenhouse. By the investigation method of 'door to door', both suggested-answers and open-ended questions were involved. The employee's conditions include age, gender, medical history, and educational level etc. Pathological signs include asthma-related cough, eye discomfort, skin pruritus, bone, and joint

pain and gastritis etc. In addition, working time, vegetable species, fertilizer types and the sources of peculiar smells in greenhouse are also surveyed. The data were analyzed by SPSS software 16.0.

Of 1171 questionnaires, 74 people were excluded for medical histories. Among the remaining 1097 respondents, 650 farmers including 368 men and 282 women suffered from 'Greenhouse diseases'. The morbidity of bone and joint pain (like neck and low back pain) is 49.95%. The morbidities of eye discomfort, skin pruritus, gastritis, nasal discomfort and asthma-related cough are 8.02%, 7.38%, 7.11%, 6.56%, and 5.56% respectively. The morbidity of asthma-related cough among employees with a history of smoking is higher than that of those never smoking.

Table 1 illustrates that the morbidity differences of bone and joint pain in each age group are obvious among different working years. With the increase of working years, the morbidity of bone and joint pain tends to rise. For the employees over age 55, 4-6 year of working experience is the keypoint of the morbidity of bone and joint pain ($\chi^2=9.75$, $P<0.05$). The employees age 45-54 with over 10 years of working experience show the highest morbidity (84.62%). The morbidity of employees age 35-44 peak at 64.52% when working for 7-9 years.

Seen from Table 2, the longer working hours, the more likely to suffer from bone and joint pain, the morbidity of which among employees working 8 hours or more reached 55.89%. 8 h working time is a turning point of joint pain ($\chi^2=7.09$, $P<0.05$). The influence of working hours on asthma-related cough, eyes discomfort, nasal discomfort, and skin pruritus is very little. The type of fertilizer is significantly correlated with specific symptoms ($\chi^2=17.23$, $P<0.05$). The influence of inorganic fertilizer is the largest to 'Greenhouse diseases' except nasal discomfort, which is related mostly to organic fertilizer. The morbidity related to biological fertilizer and

doi: 10.3967/bes2015.018

*This work was supported by the Profession Expert Group of Facility Cultivation and Engineering (CARS-25-D-03).

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controlled-release fertilizer is lower than that of other fertilizers. Different fertilizing ways are significantly correlated with each symptom ($\chi^2=29.09$, $P<0.05$). Fertigation is the most adverse way on bone and joint pain (60.77%). Spraying way most affect

the morbidity of asthma-related cough, skin pruritus. Broadcasting way has a higher impact on morbidity of eye and nasal discomfort. Compared with other fertilization way, spotting is the safest. The morbidity differences due to different species of greenhouse

Table 1. Morbidity of Bone and Joint Pain Among Employees by Age and Working Years

| Working Years | Age Range (y) | | | | | | | |
|---------------|---------------|---------------------------------|-------|---------------------------------|-------|---------------------------------|-----|---------------------------------|
| | 25-34 | | 35-44 | | 45-54 | | ≥55 | |
| | n | Positive No. (Positive rate, %) | n | Positive No. (Positive rate, %) | n | Positive No. (Positive rate, %) | n | Positive No. (Positive rate, %) |
| 1-3 | 24 | 6 (25.00) | 30 | 7 (23.33) | 27 | 10 (37.04) | 22 | 5 (22.72) |
| 4-6 | 17 | 2 (11.76) | 65 | 24 (36.92) | 85 | 30 (35.29) | 254 | 142 (55.91) |
| 7-9 | 18 | 8 (44.44) | 31 | 20 (64.52) | 62 | 29 (46.77) | 327 | 185 (56.57) |
| ≥10 | 3 | 0 (0) | 17 | 8 (47.06) | 13 | 11 (84.62) | 176 | 108 (61.36) |

Table 2. Morbidity of Selected Symptoms Among Employees in Different Situation

| Deferent Situation | Bone and Joint Pain (%) | Asthma-related Cough (%) | Eyes Discomfort (%) | Nasal Discomfort (%) | Skin Pruritus (%) | Gastric Discomfort (%) |
|-------------------------------|-------------------------|--------------------------|---------------------|----------------------|-------------------|------------------------|
| Working hours | | | | | | |
| <4 | 48.48 | 5.45 | 9.09 | 1.82 | 5.45 | - |
| 4-7 | 47.77 | 5.39 | 8.40 | 6.50 | 6.81 | - |
| ≥8 | 55.89 | 7.30 | 7.30 | 7.30 | 8.52 | - |
| Types of fertilizers | | | | | | |
| Inorganic fertilizer | 40.15 | 11.41 | 18.11 | 9.45 | 14.17 | 13.39 |
| Organic fertilizer | 9.94 | 9.29 | 7.69 | 14.74 | 7.37 | 8.33 |
| Biological fertilizer | 9.28 | 4.22 | 5.91 | 4.22 | 6.33 | 7.59 |
| Controlled-release fertilizer | 1.70 | 4.08 | 4.08 | 4.08 | 8.16 | 0 |
| Fertilization way | | | | | | |
| Broadcasting | 1.82 | 4.90 | 16.08 | 11.19 | 9.79 | 9.87 |
| Spotting | 1.64 | 5.80 | 3.62 | 5.07 | 3.71 | 2.1 |
| Spraying | 24.27 | 15.79 | 10.53 | 5.26 | 21.05 | 9.52 |
| Fertigation | 60.77 | 6.98 | 8.04 | 6.22 | 6.37 | 7.50 |
| Cultivated crops | | | | | | |
| Tomato | - | 10.49 | 8.39 | 9.79 | 6.99 | 2.10 |
| Cucumber | - | 7.10 | 10.32 | 8.39 | 7.10 | 1.29 |
| Pepper | - | 2.48 | 9.09 | 2.48 | 6.61 | 0.83 |
| Summer squash | - | 1.90 | 8.57 | 2.86 | 19.05 | 0 |
| Tower gourd | - | 2.65 | 2.65 | 0.66 | 3.31 | 1.32 |
| Wax gourd | - | 18.89 | 17.48 | 4.90 | 23.78 | 0.70 |
| Watermelon | - | 7.33 | 3.67 | 3.67 | 0 | 0.92 |
| Kidney bean | - | 0 | 0 | 0 | 19.63 | 0 |
| Source of odor | | | | | | |
| Fertilizer | - | 9.48 | 13.79 | 11.21 | 11.21 | 4.43 |
| Pesticide | - | 11.21 | 13.79 | 13.79 | 9.48 | 10.51 |
| Covering film | - | 0 | 0 | 8.33 | 33.33 | 0 |
| Vegetable | - | 12.40 | 5.43 | 12.40 | 9.33 | 2.84 |

Note. ‘-’ stand for the mutual relations between symptoms and situation is unknown.

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