



AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
<http://ageconsearch.umn.edu>
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

Analysis on Pollution Factors in Asparagus Production and Research on Safety Production Technology

Liping MA*, Bianqing HAO, Xiongwu QIAO

Shanxi Key Laboratory of Pesticide Science, Taiyuan 030031, China

Abstract Based on the analysis on the infection degree, infection law and influencing factors of the main diseases on asparagus and the analysis on the pollution factors in asparagus production such as blind pesticide use, atmospheric pollution and acid rain, the pollution of soil and fertilizer, this article proposes asparagus safety production technologies which include the selection of disease-resistant variety and suitable planting field, scientific and reasonable disease control, balanced fertilization, rational irrigation, making a good job of field management, *etc.*, to reduce pathogenic factors.

Key words Asparagus disease, Pollution factors, Pesticide residue, Safety production

1 Introduction

Asparagus is one of the world's top ten famous vegetables planted in many provinces and regions in China which has high nutritive value and economic value. It is perennial root herb plant with long growth period and great disease incidence. Stem wilt, fusarium wilt and root rot-based asparagus diseases have become the prominent problems influencing the production currently. The control of asparagus disease mainly depends on chemical pesticide currently, but the misuse and excessive input of chemical pesticides may exert serious effects on asparagus safety production and foreign exchange earnings. With the acceleration of globalization pace of agricultural products trade, the international and domestic market for asparagus will be more expansive and the quality requirements on asparagus products will be improved increasingly. As a member of WTO, China has taken the safety and quality of vegetable products (such as asparagus) as the key factors for its vegetable products participating in the competition in the international market. Therefore, to ensure the quality safety of agricultural products, it is required to put the minimization of pre-production, in-production and post-production pollution, especially the minimization of residue and pollution of chemical pesticides in production, on the important agenda. This article analyzes the pollution factors of asparagus and puts forward some suggestions on its safety production technology for reference.

2 Main diseases of asparagus and current infection situation

The main diseases of asparagus are stem wilt, fusarium wilt (damping off) and root rot in China, followed by brown spot, die-back, *etc.* The disease causing the damage of overground part is

mainly stem wilt, and the diseases causing the necrosis of underground roots and rotten root are mainly fusarium wilt and root rot. The circumstances are as follows: the disease of old asparagus field is more serious than new asparagus field; the wet land in the hollow is more serious than sandy field; the field under improper management is more serious than the field in good management; and the out-of-management or pesticide-abuse field is more serious than the field under reasonable control. For the same field, the disease in later period is more serious than that in early period, and the disease in the year with frequent rain is more serious than that in ordinary year. According to the investigation conducted by the researchers in our laboratory in Shanxi, the incidences of the disease in 2006 with less rain were as follows: 19.4% for stem wilt, 11.5% for fusarium wilt, 11.0% for root rot, 10.7% for brown spot and 6.0% for die-back. However, the incidences of the diseases such as stem wilt and fusarium wilt could rise to 40% to 50% in general and 60% to 70% or even 100% in individual fields in 2007 due to its frequent rain, especially, the continuous rain in September and October made the asparagus suffer from infection in general.

3 Analysis on infection law and influencing factors of main diseases on asparagus

3.1 Infection law of the pathogen of asparagus stem blight

The pathogen of asparagus stem blight lives through the winter in the diseased plant mainly in the form of resting mycelia and pycnidium. Upon examination, the resting mycelia, hosting on the overwintering disease stem and tissue which are located on soil surface and under 5 to 20 cm from the soil, survived 100%. The overwintering pathogen will pour out conidium from the pycnidium, thus leading primary infection. The pycnidium produced from scab is the secondary source of infection in the field, and the high humidity caused by rain, fog, dew and booming branches and leaves will make mature conidium release from the pycnidium, so as to spread and make secondary infection on healthy tissue. In

Received: March 29, 2013 Accepted: July 16, 2013

Supported by Antagonistic Bacteria Control and Basic Research Foundation on Asparagus Disease of Shanxi Province (200603021).

* Corresponding author. E-mail: maliping808@126.com

dry weather, the conidium will fly upward and spread with the air^[1]. The infection laws of stem blight pathogen are not the same in harvested asparagus field and un-harvested asparagus field, so are they on white asparagus and green asparagus. According to the biological characteristics research conducted by project team of Shanxi Key Laboratory of Pesticide Science, the pathogen of asparagus stem blight can grow in the temperature of 13 °C to 38 °C, and the optimum temperature is between 23 °C and 28 °C. Within this temperature range, the mycelia grow fast and produce a large amount of spore.

3.2 Infection law of the pathogen of fusarium wilt of asparagus Asparagus fusarium wilt is a kind of soil-borne disease caused by the asparagus specialized form fusarium oxysporum. The pathogen is a kind of soil inhabitant which lives through the winter with the diseased plant in the soil in the form of chlamydo-spore. The primary sources of infection of the pathogen include chlamydo-spore and conidium. The enabling of secondary infections mainly led by conidium with the help of rain and irrigation water. The pathogen invades into the plant from the wound, enters into vascular tissue from host parenchymal cell and reproduces in the tissue, then breaks host transfusion tissue by blocking the vessel and producing toxin, thus leading the plant wither and dead. The pathogen can survive in the soil for decades, so it is easy to induce fusarium wilt in continuous cropping plant or under the condition of applying immature organic fertilizer. The disease is most susceptible with heavy soil and impeded drainage. The pathogen of fusarium wilt of asparagus can grow in the temperature of 13 °C to 38 °C, and the optimum temperature is 28 °C. Within this temperature range, the mycelia can grow fast with the average rate at 1.21 cm/d; and the output of big or small conidium is great. However, when the temperature is below 13 °C and above 38 °C, the mycelia will grow at a slow rate which decreases 27.3% to 33.1% compared with the temperature of 28 °C, and the conidium output also has a significant reduction.

3.3 Infection law of the pathogen asparagus root rot The pathogenic bacteria of asparagus root rot is mainly caused by helicobasidium mompa tanaka and fusarium. The pathogen makes the xylem and phloem of root rot gradually after infecting the root system, resulting only skin and vascular bundle left as well as amaranth root surface. For the root system is corrupt, the growth of plant over the ground is poor, stalk is dwarf and the stem branch and needle turn yellow, thus causing the death of the whole plant finally. The pathogen reproduces and lives through the winter in the soil, spreads in the form of mycelium and sporangium and infects the plant by the methods of irrigation and farm operation repeatedly^[2]. In general, the incidence of a disease in old asparagus region where the asparagus has been harvested for many years is above 60% and more serious than that in new asparagus region. The attack of root rot is more popular and synchronizes with stem wilt usually.

3.4 Analysis on influencing factors of asparagus diseases (1) Atmospheric humidity. Under the mild temperature, atmospheric

humidity becomes the key factor influencing the popular occurrence of disease. In the temperature range of 23 °C to 28 °C, the asparagus grows fast and the pathogenic bacteria also reproduces fast. Within this temperature range, disease will get more serious with more rainfalls. (2) Soil moisture. The diseased plant in the soil is the main habitat for pathogenic bacteria. Under the mild temperature, the reproduction speed of pathogenic will grow faster and the disease will get more serious with the greater soil moisture^[3]. (3) Planting period. Asparagus is a kind of perennial root herb plant. When planted in the field without proper control, the longer the planting period, the larger the base number of pathogenic and the more serious the disease, otherwise lighter. (4) Variety. The strong disease-resistant varieties with high yield have higher disease resistance and tolerance to diseases due to their genetic factors, and the ordinary varieties can not be compared with them. Above 20% of asparagus suffered stem wilt in Yongji City of Shanxi Province in 1998, which was caused by the planting of old varieties without disease-resistance, such as UC15, etc. (5) Scientific management. When planted in out-of-management field, the asparagus may have the features of high incidence of a disease, low yield, short harvesting time and short asparagus life which is 3 to 5 years in general; but when planted in the field under precision management, the asparagus will suffer slight pest and disease damage with a longer harvesting time and 8 – 10 – year life.

4 Analysis on pollution factors in asparagus production

4.1 The pollution due to blind pesticide use (1) Direct pollution on asparagus by pesticide. The pesticide will adhere to the surface of asparagus plant or penetrate into the plant to cause pollution with its residue after applying. (2) Indirect pollution on asparagus by pesticide. The pesticide will spread in the air, water and soil, thus pollution asparagus indirectly. Meanwhile, the blind use and abuse of pesticide aggravate the degree of direct pollution and indirect pollution. The research conducted by Shanxi Key Laboratory of Pesticide Science shows that safety, reasonable and scientific use of pesticide (the use frequency is 3 to 4 times during key periods of each year) can reduce field inputs of pesticide and lower the asparagus pollution degree effectively.

4.2 Fertilizer pollution China has become one of the countries which use the most fertilizer and pesticide in the world. But the utilizations of fertilizer in China are generally low, with 30% to 35% for nitrogen fertilizer, 10% to 20% for phosphate fertilizer and 35% to 55% for potash fertilizer. A large amount of fertilizer nutrients failing to be absorbed and utilized by crops will pollute agricultural products, soil, environment and the air by the methods of retention, adsorption, runoff with the water, anti-digesting, etc.

4.3 Water pollution Numerous water sources are polluted by a large amount of production and domestic water which is drained into rivers and lakes and penetrated into the ground. Therefore,

ammonia nitrogen and oxygen – consumption organic matter in the water are out of limits seriously, and the polluted water contains many chemical elements such as pesticide, polychlorinated biphenyl, polycyclic aromatic hydrocarbon, phenol, mercury, chromium, lead, cadmium, arsenic and cyanogen as well as harmful matters such as pathogenic bacteria.

4.4 Atmospheric pollution and acid rain pollution The formation of acid rain is related to atmospheric pollutants which mainly consist of sulfur dioxide and oxynitride. The annual discharge of sulfur dioxide reached 18 million tons in China currently, and the area of acid rain region is enlarging sharply, accounting for 29% of the national land area. Southwest and southern areas have become world's third acid rain area. And it has the trend to spread to the central, eastern and northern parts of the country.

4.5 Soil pollution When the soil takes in too many wastes and some pollutants failing to be degraded and accumulating in the soil influence or exceed the self cleaning capacity of the soil, the soil pollution will be caused. Soil pollution can be divided into three classes. The first one is pathogenic bacteria (including pathogenic enterobacteria, virus, *etc.*), which is mainly from human and animal excreta, rubbish, sanitary sewage, *etc.* The second one is toxic chemical matters (including heavy metals such as cadmium and lead, organochlorine pesticide, *etc.*) which mainly come from emissions of industrial production and a large amount of pesticide and fertilizer applied in agriculture. The third one is liquid and solid radioactive substance wastes produced from industry and medical institutions. The increase of soil pollution and the enlargement of influence surface should be paid high attention in asparagus safety production.

5 Safety production technology of asparagus

A great deal of factors will influence the safety production of asparagus. For asparagus farmers, taking main considerations on the following factors is practical.

5.1 Selecting disease-resistant variety Asparagus is perennial herb. Once planted, it will generally keep on growing for many years. The selection of disease-resistant variety mitigates the disease significantly at the source, and the dramatical reduction of pesticide inputs in production results the decline of asparagus pollution. When selecting asparagus variety, all regions must be subject to their local conditions and select disease-resistant varieties with high yield.

5.2 Seed disinfection The control of seed quality is an important part of safety production. Sand pathogenic bacteria can propagate for a long distance by adhering to the surface of seed. The seeds imported from other places must be conducted plant quarantine, and should be made seed disinfection when planting. Seed dressing or seed soaking under high temperature can be applied: (1) Seed disinfection under high temperature: flush dry seeds with the water of 50°C to 60°C and stir them for 30 minutes, preserve them in the water of 25°C to 30°C for 36 hours, then accelerate germination^[2]. (2) Soak the seed in 10% of potassium

permanganate solution, preserve them in the water of 25°C to 30°C for 36 hours, then accelerate germination after scrubbing. (3) Disinfection by fungicide: use 5 to 10 g 50% of carbendazim or 4 to 5 g thiophanate methyl to disinfect 1 kg seeds, soak the seed for 36 hours, and then accelerate germination.

5.3 Selecting suitable planting field In the place far away from pollution sources, select a planting field with high and dry terrain, the convenience for drainage and loose and fertile soil texture. Avoid to plant in old field, to prevent fusarium wilt.

5.4 Conducting scientific and reasonable disease control

The asparagus has a long growth period which may suffer damage from complex kinds of diseases and pests. So conducting control in critical moment based on occurrence characteristics of main diseases and pests can get twofold results with half the effort. (1) The selection of control time. Using pesticide outside asparagus harvesting time can reduce pollution possibility greatly. In general, the control periods are from the last third of March to the middle third of April before asparagus harvesting and August to September after asparagus harvesting. Pre-harvesting control mainly aims to cut off primary infection sources of bacteria, so as to nip them in the blossom. Post-harvesting control mainly aims to block and reduce secondary infection pathogenic bacteria. (2) The selection of control method. Soil disinfection is an effective measure to control stem wilt, fusarium wilt and root rot. Though the symptoms of stem wilt and fusarium wilt mainly show on the stalk, the habitat and overwintering place of pathogenic bacteria are mainly located in the surface of ground and underground. Soil disinfection in spring can inhibit the pathogenic bacteria in the blossom effectively and play a critical role in reducing bacteria sources of current year. In addition, compared with foliar spray, root-irrigation can reduce the drift of pesticide, thus decreasing environment pollution. It is recommended to conduct the first soil disinfection, *i. e.* root-irrigation treatment, before banking up; then after stopping harvesting and laying down the ridge, remove the earthing and stubble on asparagus plate and conduct the second root-irrigation treatment. Irrigate the liquid pesticide on asparagus plate evenly and thoroughly. The overground part of asparagus grows vigorously in July to September, so we should pay attention to preventing and curing disease under frequent rain by a combination of root-irrigation and foliar spray. And the pesticide spraying of central infected plant should be paid particular attention, to reduce secondary infection and spread of diseases. (3) The selection of insecticides. To reduce the pollution on asparagus by chemical pesticide, c382 should first select biological pesticide which can inhibit pathogenic bacteria directly and continuously. For example, the broad spectrum growth-promoting microbial fungicide – fermentation broth for bacillus B96 – II, which is filtered and developed by Shanxi Key Laboratory of Pesticide Science, not only has significant inhibition effects on various pathogenic bacteria, but also has more continuous bacteriostat action compared with chemical pesticide. In addition, the biological pesticides such as TF 120, Caifengning (*bacillus subtilis*) and zhongshengmycin, which have

