

GEOGRAPHICAL DISTRIBUTION OF SUNFLOWER DISEASES IN CHINA

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ABSTRACT

In various areas of China, the fourth largest sunflower producer in the world, 25 sunflower diseases have been reported: 19 fungi, 1 virosis and 5 species of broomrape. Their geographical distribution and economic significance are studied in details. The distribution is divided into Northern China and Southern China and further into 6 regions. Fungi are dominant in every region. More species of broomrape have been reported in China than in the world. Orobanche coerulescens has not been found to attack sunflower in any other countries but a very important sunflower disease here. The diseases differ in number among the regions with 14 in Northeast, 11 in North China, Northwest and Southwest respectively, 10 in East China and 6 in Central & South China, which corresponds largely to the distribution of the sunflower production. While 64 per cent of the diseases are found in only 1 or 2 regions, only Puccinia helianthi and Septoria helianthi are reported in all the regions. Alternaria helianthi, Septoria helianthi, Sclerotinia sclerotiorum and Orobanche coerulescens are evaluated as very important diseases, which cause 10-50 per cent loss in yield and even crop failure in some areas in some years. Much work remains to be done to control the diseases to promote the development of sunflower production in China.

INTRODUCTION

Sunflower is one of the four principal oil crops in China which is the fourth largest sunflower producer in the world. The country planted 733,000 ha of the crop and produced 1,340,400 tons of the seed in 1983 (ECYAC, 1984). However, the average yield was only 1,828 kg/ha and seed oil content 25-32%, both much lower than the biological potential of the existing cultivars, and this could be noticeably ascribed to diseases. From germination to harvest, sunflower is attacked by many diseases have been found in China, the same as in Yugoslavia where the highest number in one country was registered (Aćimović, 1983). It has been estimated that diseases cause an average annual loss of 12% in yield from nearly 12 million ha of sunflower in the world (Zimmer et al., 1978). Therefore, ways must be worked out to control them and in the long, geographical distribution research on diseases may prove to be a major tool in modern plant disease management (H.C. Weltzien, 1981) and should supply answers which diseases should be controlled chemically. Thus, we should not consider the research as a mere technical job but rather a scientific project of profound significance. As the diseases recognize neither state borders nor continents, a synchronized vigilance in several countries would bring invaluable benefits to the sunflower production (Aćimović, 1984). Aćimović (1984) has given a report on the distribution of sunflower diseases in Europe, the United States and Australia. However, there has been no report on the geographical distribution of sunflower diseases in China. We hope to fill in the gap by this paper, based on 3 years of observation and investigation and research and study of all the related reports from 1919 to 1986.

The present situation of the distribution

Referring to the administrative divisions and sunflower production geography of China, we divide the distribution of sunflower diseases in China into two parts: Northern China and Southern China, according to their economic significance. Table 1 shows the disease distribution and importance in each region and province.

Table 1. Distribution of sunflower diseases and their importance in China¹

No.	Diseases	Northeast			North China			Northwest			East China			Central & South			Southweas									
		Heilongjiang	Jilin	Liaoning	Beijing	Hebei	Shanxi	Inner Mongolia	Shaanxi	Gansu	Qinghai	Xinjiang	Shandong	Jiangsu	Anhui	Zhejiang		Jiangxi	Fujian	Tianwan	Henan	Hubei	Guangxi	Sichuan	Yunnan	
1	<i>Alternaria alternata</i>	*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
2	<i>Alternaria helianthi</i>	-	***	***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	<i>Alternaria leucanthemic</i>	-	*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	<i>Alternaria zinniae</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	<i>Ascochyta compositarum</i>	-	*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	<i>Botrytis cinerea</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	<i>Cercospora pachypus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	<i>Corticium centrifugum</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	Cucumber mosaic virus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	<i>Erysiphe cichoracearum</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	<i>Macrophomina phaseoli</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	<i>Orobanche aegyptiaca</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	<i>Orobanche brassicae</i>	-	*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	<i>Orobanche cernua</i>	-	*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	<i>Orobanche coerulescens</i>	-	***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	<i>Orobanche cumana</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	<i>Plasmodiopsis helianthi</i>	***	**	*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	<i>Puccinia helianthi</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	<i>Puccinia helianthi</i>	***	**	***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	<i>Sclerotinia sclerotiorum</i>	***	***	*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	<i>Sclerotium rolfsii</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	<i>Septoria helianthi</i>	***	***	***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	<i>Sphaerotheca fuliginea</i>	-	*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	<i>Verticillium albo-atrum</i>	-	**	*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	<i>Verticillium dahliae</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

* Less important; Infrequent occurrence. ** Medium important; Frequent occurrence with little damage to yield.

*** Very important; Frequent occurrence with huge damage to yield. -: No occurrence.

1. Provinces with no diseases reported are not listed here.

SOUTHERN CHINA

It includes East China, Central & South, and Southwest regions. As its sunflower production is not important in the country sunflower diseases here are of little economic significance. But they have important theoretical value in the geographical distribution research on sunflower diseases.

4. East China

It includes Shanghai, Shandong, Jiangsu, Anhui, Jiangxi, Zhejiang, Fujian and Taiwan. Ten diseases have been found here, 9 fungi and 1 species of broomrape, with 4 in Shandong, Jiangsu and Jiangxi respectively and 0 in Shanghai. Erysiphe cichoracearum is spread over 5 provinces while other diseases are reported in only 1 - 3 provinces. Botrytis cinerea is nationally specific for Taiwan. Except 1 species of broomrape in Shandong, all the diseases in this region are of fungi (Table 1).

5. Central & South

This region includes Henan, Hubei, Hunan, Guangdong and Guangxi. So far 6 sunflower diseases have been reported, all fungi, with 3 in Hubei and Guangxi respectively, 2 in Henan and 0 in Hunan and Guangdong. Erysiphe cichoracearum is distributed in Hubei and Guangxi, and Puccinia helianthi in Henan and Hubei. The rest diseases have been reported in only one province (Table 1).

6. Southwest

It includes Sichuan, Guizhou, Yunnan and Xizang (Tibet). Ten diseases have been reported here, 9 fungi and 1 species of broomrape, with 8 fungi and 1 species of broomrape in Sichuan, 6 fungi in Yunnan and 0 in Guizhou and Xizang. Puccinia haleniae and Sclerotium rolfsii are nationally specific for Sichuan (Table 1).

Characteristics of the distribution

Up to now, 90 sunflower diseases have been reported in the world (Bai et al., 1987) and 45 in Europe, the United States and Australia (Aćimović, 1984). The number of diseases in China is 28% and 56% of them respectively. However, the geographical distribution of the diseases in China has its own characteristics besides the generality.

Fungi are dominant in every region. There are 19 fungi, 5 species of broomrape and 1 virosis, 76%, 20%, and 4% of the diseases in China respectively. It indicates that it is correct to have put stress on fungi in the sunflower disease research in China and this should be continued hereafter.

More species of broomrape as sunflower diseases have been reported in China than in the world. They are widespread in the country and dominant in occurrence in North and Northwest China. One of the species, Orobanche coerulescens has not been reported to attack sunflower in any other countries in the world but a very important disease in Jilin and spread over 5 regions (Zhao et al., 1983; Table 1).

The number of the sunflower diseases differs in the 6 regions. Fourteen diseases, the highest number, are registered in Northeast, 11 diseases in North China, Northwest and Southwest respectively, 10 in Southeast and 6, the lowest number, in Central & South China. The distribution of the number of diseases corresponds mainly to the distribution of the sunflower production, which indicates that the stress of sunflower disease observation has been put on the major production region, and this should be continued in future.

The incidence of diseases is quite different and small for the majority. Ten diseases, 40% of the total, are found in only one region, 6 diseases, 24% of the total, found in only 2 regions, 2 diseases, 8%, in 3-4 regions, 3 diseases, 12%

NORTHERN CHINA

It includes 3 regions: Northeast, North China and Northwest. As it usually plants about 98% and produces 99% of the total China acreage and yield, diseases here have a great economic significance.

1. Northeast

It includes Heilongjiang, Jilin and Liaoning provinces. It is the most important sunflower producer as it usually produces over 50% of the total China crop. The problem of diseases here is of equal importance. So far, 14 diseases have been reported, 11 fungi and 3 species of broomrape. They are unevenly distributed in the region with 12 in Jilin, 7 in Liaoning and 5 in Heilongjiang (Table 1). So are the kinds of diseases. Those in Heilongjiang and Liaoning are all fungi while in Jilin there are 3 species of broomrape in addition to 9 fungi. Diseases which spread all over the region are: Plasmopara helianthi, Puccinia helianthi, Sclerotinia sclerotiorum and Septoria helianthi. Alternaria helianthi and Verticillium albo-atrum have been reported both in Jilin and Liaoning. Alternaria alternata is regionally specific for Heilongjiang as Cercospora pachypus for Liaoning. Alternaria leucanthemic and Ascochyta compositarum are nationally specific and Orobanche brassicae, O. ceruna, O. coerulea and Sphaerotheca filiginea regionally specific for Jilin. We may see that diseases in Jilin have both their own characteristics and the generality of the diseases in the region. The number of the very important diseases is almost the same for the 3 provinces with 4 for Heilongjiang and Jilin and 3 for Liaoning. Yet the kinds of those diseases have a significantly uneven distribution. Septoria helianthi distributes in the whole region, Puccinia helianthi in Heilongjiang and O. coerulea in Jilin. Alternaria helianthi is nationally specific for Jilin and Liaoning (Table 1). Thus, each of 3 provinces should have a different tactics against diseases. And S. helianthi should be dealt with as the regional focal point.

2. North China

It includes Beijing, Tianjin, Hebei, Shanxi and Nei Monggol and is a second important sunflower producing region in China with about 35% and 39% of the total China sunflower acreage and yield. Therefore great attention should also be paid to sunflower diseases here, 11 of which have been found so far, 5 fungi, 1 virosis and 5 species of broomrape. They are unevenly distributed with 8 in Shanxi and Nei Monggol respectively, 6 in Hebei, 2 in Beijing and 0 in Tianjin (Table 1). Puccinia helianthi is a medium important disease common in Hebei, Shanxi and Nei Monggol. Sclerotinia sclerotiorum is a very important disease in Shanxi and Nei Monggol as P. helianthi is in Hebei and Nei Monggol. Five species of broomrape have been found in Shanxi and Nei Monggol, 4 in Hebei and 1 in Beijing, showing that broomrape is very widely spread in the region. Therefore it should be a focal point of disease control here. The geographical distribution of the diseases is quite similar among Shanxi, Nei Monggol and Hebei. A virosis, Cucumber mosaic virus is nationally specific for Beijing (Table 1).

3. Northwest

This region includes Shaanxi, Ningxia, Gansu, Qinghai and Xinjiang. It usually plants 12% and produces 9% of the total China crop. Diseases here should also be dealt with seriously. So far, 11 of them have been reported, 6 fungi and 5 species of broomrape. They are unevenly spread over the region with 9 in Gansu, 8 in Xinjiang, 4 in Shaanxi, 3 in Qinghai and 0 in Ningxia (Table 1). Those in Shaanxi and Qinghai are all of broomrape. No fungi has been found there. In Gansu and Xinjiang, there are 4 and 3 fungi respectively in addition to 5 species of broomrape. Obviously, species of broomrape take 45% of the number of diseases and spread all over the region. However, in the region, only Plasmopara helianthi is a very important disease, which is nationally specific for Xinjiang. The rest are all of less important (Table 1).

in 5 regions. Only 2 diseases, Puccinia helianthi and Septoria helianthi, 8% of the total, are reported in all regions.

The very important diseases are small in number but cause great loss in yield in some areas. Only 4 out of the 25 diseases in China can be evaluated as very important: Alternaria helianthi, Septoria helianthi, Sclerotinia sclerotiorum and Orobanche coerulescens (Table 1). A. helianthi occurs mainly in Northeast. Observations conducted in Shenyang, Liaoning, showed that it attacked sunflower and caused early droop and death of the leaf of the plant and reduced yield and oil content significantly, usually by 10-20% and sometimes over 50% in yield or even caused crop failure (Zheng et al., 1986). S. helianthi often accompanied by A. helianthi, occurs in all regions. It was responsible for a loss of over 30% in the sunflower seed yield in the whole province of Liaoning in 1975 and 1978 (Chen, 1983). S. sclerotiorum has become more and more important in recent years, especially in Northeast and North China. In some countries in central and west Jilin, its incidence can usually be 10 - 30%, and sometimes over 50%. In Ulan Hot, Nei Monggol, its incidence is usually 10 - 30%, but can reach over 60% in some places in some years. In a few countries the incidence is so great that sunflower has to be replaced by other crops. In recent years O. coerulescens caused heavy damages to the crop in west Jilin. It could cause a loss of 38.3 - 70.3% in yield and 3.3 - 17.9% in oil content so that sunflower could not be planted in some countries (Zhao et al., 1983). One of the reasons that those diseases can cause such great damages has been that the farmers have no effective ways to control them. Much more efforts should be made to breed resistant hybrids and develop integrated control methods to control the diseases.

DISCUSSION

The research work on geographical distribution of sunflower diseases in China is just at its preliminary stage. Much work remains to be done to meet the demand of the development of the sunflower production. For China is a country with a vast territory and extreme variety of physical conditions, much more diseases must exist than the 25 species. Hereafter, more observations and investigations should be carried out on every part of the country while North China is kept as the focal point. Stress should be put on bacteriosis, variosis, as well as fungi and broomrape. A timely observed occurrence of a disease and a correct assessment of its important mean half of the work done in the research of geographical distribution of sunflower diseases, which will in turn provide scientific basis for the integrated control of the diseases to promote the development of sunflower production.

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