

Integrated control on potato late blight in China

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Abstract : Potato late blight becomes a major obstacle of potato production in China. The main controlling method of potato late blight is to combine resistant varieties breeding with agricultural measures such as establishing late blight-free seed potato base , chemical spray and cultivated measure etc There were at least 37 clones of germplasm had been identified to be resistant to both late blight and bacterial wilt. One of those clones, namely 388192.12, showed not only highly resistance to LB and BW, but also highly resistance to PVX, PVY .Tests in both lab and fields indicated that the presence of metalaxyl -resistant isolates and the effectiveness of metalaxyl on late blight disease were lowered. However, the Ridomil MZ 58 WP still holds high control effect. A new fungicide named Flumorph was synthesized in recent years in China. It shows very good systemic and protective control effect on late blight. Some suggestion presented is related aspects of research as below: eradication of pathogen in diseased tubers and oospores in the soil; monitoring the chemical resistant isolates; short-term disease forecast and popularization of cultivated practices

Key Words potato late blight, resistant cultivars;,seed tuber, chemical spray, forecast; integrated control

1. Introduction

Potato takes the fourth largest food in the world and It is also important food and vegetable crop in China. Nowadays China has become the top potato production country in the world with a total planting area of 4.4177 million hectares and total output of 56.0965 million tons recorded in 1999. While the north part of China takes up 57.3% in total area and 51,8 % in total production. There are 12 provinces with planting area over 100,000 ha, including 7 provinces in north and 5 in south part of China. Inner Mongolia is the biggest potato production province with planting area 576,800 hectares.(Zhang, Zh. M and Wang,R.G. 2001)

Potato late blight caused by *Phytophthora infestans* (Mont.) de Bary is one of the most devastating potato diseases worldwide. Epidemic frequency and severity of potato late blight has become more and more remarkably since 1980s. So, it has become an important obstacle of potato production in China.(Kong,F.D.,1998;Li,B.Q.,1994)

The epidemic of late blight is more often and severe in the south part of China because of heavy rainfall and long rain season. Although the total rainfall is less in the north, the rain season mainly focus on the July and August happen to be productive phase of potato . So, reduction of potato production is still very severe once potato late blight epidemic. In addition ,because many production areas of potato in the north are seed potato base of the country, if the disease occurrences, the high percentage of infected seed tuber may become a potential source for late blight epidemic in the south too. (He,W.and Paul,C.S.;Liang, Y.F.,1998;)

2. Integrated control of potato late blight

2.1 Spreading resistant cultivars to late blight

Most main potato production areas in China locate in remote mountain areas. One family plant a part of potato field. Production condition is bad. It is difficult to spread chemical control in large acreage. Using resistance cultivars is the most economic method which is used usually.During the periods of 1984 to 1994, according to the germplasm evaluation conducted by the International Potato Center (CIP) on disease resistance, there were at least 37 clones of germplasm had been identified to be resistant to both late blight and bacterial wilt. One of those clones, namely 388192.12, showed not only highly resistance to LB and BW, but also highly resistance to PVX,

PVY, Its yield reached as high as 26.4 tons per ha. It is one of the clones, which is not only disease resistance, but also has high yield potential. (Ding, M.Y. et al, 1999; He, W. et al, 1999; Song, B.F., 2001)

There are two types of disease resistance: vertical and horizontal resistance. The vertical resistance is controlled by R gene. Horizontal resistance, which is also called field resistance, is inherited by multi-gene. For many years, most of the researchers on seed breeding have been using the vertical resistance varieties to control the occurrence of potato late blight. It is an effective way in short term. However, it can not last long since the pathogen of late blight is extremely easy to vary and to cause the resistance cultivars losing the resistance in short period of time. While cultivars with horizontal resistance are fairly stable. So, it is our emphasis to cultivate horizontal resistance cultivars. In Hebei and Inner Mongolia, some major cultivars in production Tiger head, Bashu#10, Dongshu#8, Kexin#1 and Kexin#4 contain horizontal resistance to late blight has been verified by measuring number, latent period, size and sporulation of diseased lesion. (Pang, W.F., et al) Different disease-resistant cultivars should be used based on epidemic degree of late blight.

2.2 Founding late blight-free seed potato base and eliminating source of primary infection

The main source of primary infection is mainly come from the seed potato with disease. So it may reduce source of pathogen by setting up late blight-free seed potato base. Control measures should be taken to control disease. There should be a distance of more than 5 km between commercial field and seed field. if condition is good. It is more important to plant late blight-free seed potato in potato new planting area. (Huang, H. and Ling, Ch.G., 1961)

It may reduce source of primary infection to select non-disease seed potato. Diseased seed potato could not be eliminated even if seed potato is cut to check. So, seed potato treating should be done.

Seed soaking with fungicide may kill part pathogen in seed potato. It may delay late blight occurrence for 20 days and reduce disease index about 50%.

Ridomil 25 WP of 100g with little water may enough for treated 100kg seed pieces. (Ding, M.Y. et al, 1996). Other fungicides may be used.

2.3 Chemical control

Chemical control is main measure to control epidemic of potato late blight because it is lack of high resistance cultivars. Effect of controlling disease and increasing production is very good if fungicide is used suitably.

Species and use concentration of fungicides

Ridomil 25 WP with 500×; Ridomil-MZ 58 WP with 500~600×; Bordeaux mixture 100 X, Dithane M-45 80 WP with 800×; Daconil 75 WP with 600~800×; fosety-A1 MZ 70 WP with 300×; curzate M-8 72 WP with 600~800× and Flumorph MZ 60 WP with 500~1000 X. It is sprayed once every 7~10 days. It has good effect of controlling disease to spray 2~3 times in the north part of China.

Usage method

Spraying on the leaf

First spraying fungicide should be before disease occurrence or in initial stage. It is sprayed once every 7~10 days then. Protectant fungicides may be used before disease occurrence. Systemic fungicides or mixture fungicides with protectant fungicide and systemic fungicide should be used after disease occurrence. It is better to apply fungicide alternately in order to reduce fungicide resistance. Ridomil MZ 58 WP, curzate M-8 72 WP or Flumorph MZ 60 WP may be used in the area of resistance to Ridomil. (Ai, R.X. et al, 1998; Liu, W.Ch., et al; Wang, Y.Ch. et al, 1997)

Pouring root with Ridomil solution or coarse granule
3000~3750g Ridomil 25 WP coarse granule is used per ha after core disease plants or from squaring stage to blooming stage. (Liu, J.M. et al, 1994)

2.4 Strengthening forecast of disease and directing chemical control

Effect of chemical control lies on short disease forecast. Field observation for on disease occurrence core should be founded where disease often occurs. Detailed investigation should be taken before late blight occurs in local region. Investigation should be taken every day especially when whether is in favor of late blight occurrence.

Core disease plant should be pulled out or buried deeply in the soil out the field when it was found. At the same time, chemical fungicide should be sprayed in the whole field.

In Weichang county ,observation fields of disease occurrence core from south to north were found. Commercial fields ought to be also checked since the last ten-day of June. Forecast of controlling late blight was sent off and first spraying was done when relative humidity was higher than 75% and temperature was lower than 20°C in continuous 72 hrs and sunlight was less than 4 hrs.

PhytoPRE program is a decision support system to guide farmers how to use the chemical at crucial time. The program that is used in Swiss and other European countries has been planed to be trailed next year in potato production areas in China. (Cao,K.Q.et al, 1997)

2.5 Control measures before harvest

Stems and leaves may be resected or killed by spraying 1~2% Cu_2SO_4 solution or herbicide in maturity stage or 10~15 days before harvest in order to reduce tuber infected by *P. infestans* in late blight epidemic year. (Ding,M.Y.ert al,1996)

2.6 Cultivated measure

Rational fertilization may increase disease-resistance of plant. Sowing into an appropriate depth, i.e. more than 15 cm underground, and increasing the depth of plough may reduce every possibility of disease infection on tuber. Increasing the row spacing and reducing plant spacing or spraying Bonzi with 90 ppm in flower bud stage to have better ventilation and sunlight penetration. All above may reduce disease occurrence.(Ding,M.Y.ert al,1996;Song,B.F.,2001)

3 Problems and suggestion

3.1. Research on control of primary infection source

Diseased seed tuber is the major primary infection source in the epidemics; eradication of diseased tubers could effectively control the epidemic, so use of disease free seed tubers appear to be more important. But recently there is no efficient way to eradicate the pathogens in the tuber.

Our test showed that seed treatment with the currently used systemic fungicides could not eradicate the pathogen deeply inside the tubers. It may succeed in prevention of the pathogen activity in the tuber if the seed are coated with mixture of the fungicide and agent as the coating would prolong the effectiveness of the fungicides.

Oospores in soil is another major primary infection source in the epidemics .The role of oospores in disease epidemics needs to be studied in order to provide a theoretical support for controlling infection source of oospores . (Zhang,Zh.M.et al,1996,2001;Zhao,Zh.J.,1999;Zhu,J.H.et al,2000)

3.2. Monitoring fungicides resistant isolates

Chemical control has been concentrated largely in seed production, research trial and processing potato fields; most commercial production has not used fungicides for late blight control yet. The monitoring of chemical resistant isolates is the importance step to success of chemical control of disease.

Up to now, there are potato-planting areas in some provinces where monitoring have not yet been conducted on resistance of Ridomil. Because the changing of strength and occurrence frequency of chemical resistant isolates, it is also necessary to make investigation annually to study its status. Furthermore, the same work should be done to get to know whether pathogen has resistance to other fungicides. (Wang,W.Q.and Liu,G.R.,1996)

3.3.Short-term disease forecast

.Short-term disease forecast, especially the timing of primary infection plant and the possibility of the outbreak within 1-2 weeks, should not be neglected in the chemical control program. Since complexity of environment across potato growing regions in China and variation of host resistance and existence of pathogen virulence , the rules may be no difference between one forecast model and another but the actual parameters used in the model must be confirmed in utilization. The short term forecast method available could be recommended to various regions with proper modifications as it is applied.

3.4. Research and popularization of disease cultivated practices

In China, most of potato planting areas locate in remote mountain regions or cold regions, where planting is individualized to separate farmer families. Owing to the bad economic condition there, general and large area chemical control is a big difficulty. Cultivated practices can change the microclimate in the fields, and prevent pathogen's spreading without any extra cost. Though the method cannot eradicate late blight, it is a favorable to lots of farmers because not only does it lighten the disease but also reduce the loss. Moreover, because more manufacturers of starch claim potato production without pesticides, the popularization of cultural practices is imperative under the situation.

It should be noticed according to cultivated practices that wide row planting, hilling up in time, fertilizing properly, cutting the stems and leaves above the ground 10-15 days ahead of harvest and so on can lighten disease. But the detail need further study.

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