Proceedings of the 16th International Pepper Conference
Tampico, Tamaulipas, Mexico. November 10 – 12, 2002

CONTROL OF THE DISEASE INCIDENCE OF PLANT ROOT ON RED CHILE, BY PRACTICES OF DRIP IRRIGATION

Dr. Francisco MOJARRO DAVILA[1]
Dr. Rodolfo VELAZQUEZ VALLE[2]
[1]Investigador of the Cecal-Zac.
[2]Investigador of Pabellón Ags.

INTRODUCTION. Zacatecas Mexico is the leading state in the production of red chile, where the rain is infrequent during the growing season and the farmers use meanly furrows and few drip irrigation systems. Most of the production is carried out with pumping irrigation, and the mean production is about 1.6 ton/ha. In the last 5 years the lost of crops were increased by the root rot, either furrows and drip irrigation; caused by a group of fungal pathogens. Only In 1999, the lost ones ascended to 400 million pesos. The principal causal agent of chile root rot disease has not been well defined. Rincon (1999) found, under field condition, greater activity of Phytopthora spp in red chile plants, but he found the presence of Rhizoctonia spp and Fusarium spp, too. In general, high frequenty irrigation with drip and furrow irrigation systems enhanced root rot in bell pepper (Ristiano 1991, and Cafe-Filho and Duniway 1996). Moreover, long periods of saturated soil are well known to increase the incidence and severity of plant chile diseases (Bowers and Mitchell 1990). Besides yield of green peppers from plots given alternate-row irrigation was significantly higher than plots given every-row irrigation, besides the disease progress of root rot appears to correlate with the first rains of the growing season (Biles et al 1992). And it is likely that the placement of drip emitter near plant stems allow more numero infections at vital part of the root; consecuently control of the disease in the field is achieved, at least partially, by the maintenance of low soil moisture (Cafe-Filho and Duniway 1996). Stolzy et al. (1985) suggested that the zoospores of Phytophthora spp. require water-filled pores to move through soil.

While soil moisture is certainly important, there have been no attempts to examine, under field condition, the effects of different soil moisture levels and the incidence of root rot. The main objective this study was to compare soil moisture content in regard to disease incidence of root rot and yield of red chile, under field condition. And generate some practice for drip irrigation.

MATERIALS AND METHODS. In this study the symptoms of disease incidence of plant root of red chile are similar to Phytophthora root rot. A field experiment was conducted out in the CEZAC-INIFAP in the 2000, in a soil with antecedents of contamination for fungal pathogens responsible of the disease of red chile plants. And a Criollo plant of red chile (Ancho Zacatecas) was used which is very susceptible to the root rot disease. It was planted April 27. Experimental design was randomized complete block with three replicates and four treatments. Each treatment had 72 plants of red chile. The amount of water to each drip treatment was varying from 60, 80, 100 y 120 % of the pan evaporation, obtained from a climatologic station. Drip irrigation was used with a emitter spacing of 30 cm and a rate of 3.0 l/h/m. The amount of water applied was measured by a flow meter. Soil water status was measured with TDR (Model) weekly. Fertilization was as followed 220 kg/ha (N), 100 kg/ha (P_2O_5) and 150 kg/ha (K_2O_5). The numbers of diseased plants per plot were counted weekly and yields of red chile were measured at harvest.

RESULTS. The red chile plants were infested by the fungal pathogens, as a result of the high regimens of residual soil moisture during the growing season . For instance, the plots given 120% pan evaporation the residual soil moisture on July 28 was higher than field capacity point 21 cm^3/cm^3 (Figure 1) . At the end of the season, red chile plots given 60 y 80% of the pan evaporation had significantly fewer plant diseases than plots given 100 and 120% (Table 1). The incidence of the disease in plots given 60% was 26.7, in 80% 27.2, in 100% 28.2 and in 120% 37.5 (Table 1). Yield of dry red chile was highest in plots given 80 and 100% of pan evaporation than plots given 60 and 120% (Table 1). On the other hand, eleven times were collected the number of plant diseases, during the season, of each treatment, in Figure 2 are shown the number of plant diseases and the 60, 80, 100 and 120% of pan evaporation. In this figure the time variable was replaced for the Heat Degree Days, which was calculated as followed:

$$GDC = \sum_{n=1}^{n} \left(\frac{Tmax - Tmin}{2} \right) \text{-Tb}$$

where Tmax is maximum temperature, Tmin is minimum temperature and Tb is base temperature in this case 5°C. Disease incidence was compared statistically using an analysis of variance procedure. Repeated analysis of variance was used for data collected sequentially. Significant statistical differences were found for 8 data collected for comparing the effect of four rates of pan evaporation on disease incidences, whereas insignificant differences on disease incidences were found for the rest of data collected.

DISCUSSION. The data of the effects of the soil moisture conditions on the disease incidence are very clear. The number of plant diseases was influenced by the different rates of pan evaporation. Others investigators also have shown an increase in disease with high frequent irrigation (Bowers and Mitchell 1990, Cafe-Filho and Duniway 1996 and Biles et al 1992). For instance, plots given 120% of the pan evaporation the residual soil moisture was very high (saturation point) during the growing season, evidently in these plots the soil pores were full (Figure 1) of water, allowed the pathogens to promote root infection as high as 52% of sick plants at the end of the season. As Stolsy et al (1965) was observed, more over Bowers and Mitchell (1990) showed that periodic saturation of soil increased disease incidence of bell pepper. On the other hand, the plots that received less water during the season reduced their numbers of sick plants. This is very important, for example if we consider the density of plants of a hectare (45,000 plants) and if we apply the irrigation with the approach of 120% of the pan evaporation, we will have that a decreased of unproductive plants of 23,850. This data suggest that low soil moisture levels, applying 60 o 80% of pan evaporation, may be effective technique for management of root rot of red chile.

It is observed in this figure 2 that the biggest incidence of plant diseases were registered between 400 to 900 units of heat (Figure 2) (40 to 50 days after planting), this is due to the conditions of soil moisture, like it was discussed up and also to the precipitation conditions that prevailed mainly at the beginning of the season. During this same period of time were registered 152.4 mm of precipitation of a total of 239.7. These two conditions caused that the levels of residual soil moisture registered were very superior to the value of the field capacity (Figure 1). It is in this period where the biggest disease incidence of plants is presented, with a total of 17, for the treatment 120% pan evaporation, that is to say 42% of the total of sick plants.

The results found in this work, support the asseveration that high soil moisture increases plant disease incidence. Also and very important, the speed of the incidence of plant diseases is seriously increased with the presence of precipitations. The number of plant diseases can be diminished applying only volumes of water to restore to soil field capacity. In soils contaminated by these fungals, with drip irrigation it is recommended to apply volumes of water with t60% of pan evaporation.

BIBLIOGRAFIA

Biles, C.L. et al. 1992. Control of Phytopthora root rot of chile peppers by irrigation practices and fungicides. Crop Protection vol. 11 June 1992.

Bowers, J. H and Mitchell, J. J. 1990. Effect of soil-water matric potential and periodic flooding on mortality of pepper caused by Phytophthora capsici. The American Phytopathological Society. Vol 80, No. 12. 1447-1450.

Ristaino, J. B. 1985. Influence of rainfall, drip irrigation, and inoculum density on the development of Phytophthora root rot and crown rot epidemics and yield in bell pepper. Phytopathology 81. 922-929.

Cafe- Filho, A. C. And Duniway, J. M. 1996. Effect of location of drip irrigation emitters and position of Phytophthora capsici infections in root on Phytophthora root rot of pepper. Phytopathology vol. 86, No. 12. 1364-1369.

Stolzy, L. H. et al 1965. Water and aeration as factors in root decay of Citrus sinensis. Phytopathology 55: 1451-1455.

Rincón, V. J. 1999. Optimización de la marchitez del Chile, Phytophthora capsic. Informe anual CECAL-INIFAP.

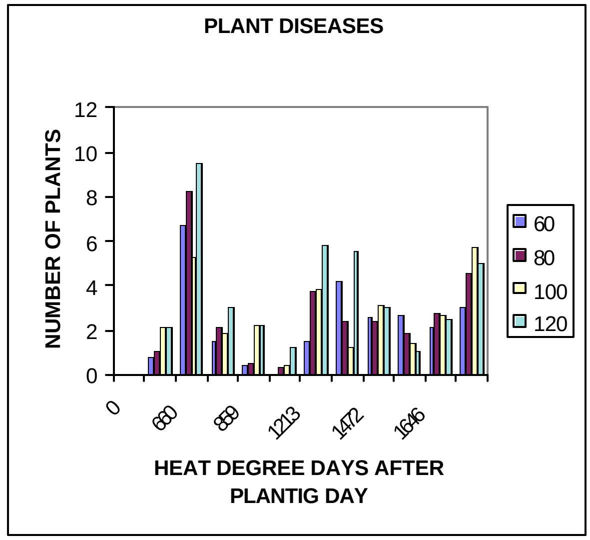

Figure 2. Disease incidence of root rot of red chile in rates of pan evaporation.

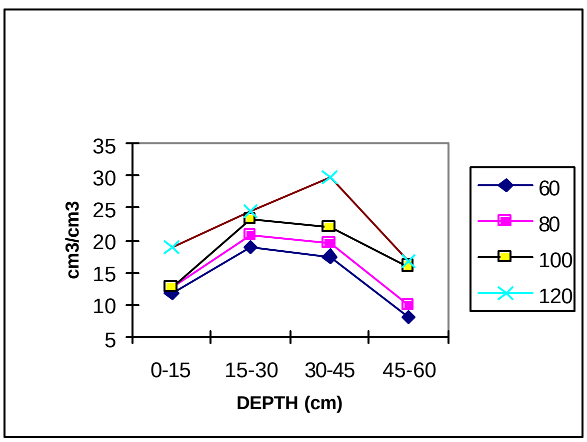

Figure 1. Soil moisture content cm^3/cm^3, measured with TDR, on July 28 for the different treatments.

Table 1. Means of disease incidence of root rot on red chile and yield, in the field.

Treatment (%)	Number of plant diseases	Yield (T/ha)
60	26.7 a	2.030 a
80	27.2 a	2.443 b
100	28.2 a	2.671 b
120	37.5 ab	2.164 a

Numbers in the same column followed by the same letter are not significantly different (p=0.05) according to the Duncan test.