# IN-CANOPY ENVIRONMENT AS A FACTOR IN LATE BLIGHT MANAGEMENT

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With the recent increase in incidence of late blight in many potato production areas of North America there is increased interest in knowing what influence the climatic conditions within the plant canopy have on this disease. For the past several years monitoring of the environment within the canopy of potatoes in the Columbia Basin of Washington grown under center pivot irrigation indicates that conditions favoring late blight occur quite frequently.

In 1996 environmental conditions in the canopy of a pivot irrigated potato field over the 80 day period from June 3rd through August 21st show that on 74 of the 80 days (93%) conditions favorable for late blight infection and spread occurred. The factors important for infection and spread of late blight are temperature, leaf wetness and relative humidity. Temperature and relative humidity conditions favorable for sporangia production are shown in Figure 1. Conditions favorable for sporangia to germinate and penetrate plant tissue are shown in Figure 2. Note that a 20 F change in temperature (from 70 - 80 F to 50 - 60 F) results in multiple infection sites as opposed to single infection sites (a 6 to 10 fold increase in disease potential). Single penetration which occurs at 70 - 80 F results in single infection sites and isolated lesions. Multiple penetrations which occurs at the lower temperatures results in multiple lesions.

Results of monitoring temperature, leaf wetness and relative humidity within the canopy of a pivot irrigated potato field are shown in Figures 3-5. Note in Figure 3 that the temperature out side the canopy (ambient) does not reflect conditions within the canopy. Also note the occurrence of the 50 - 60 F temperature that would result in multiple infection sites. When any two of the three factors (temperature, leaf wetness and relative humidity) are favorable for late blight, a blight favorable period occurs. The days each week when conditions in two pivot irrigation circles were favorable for blight during the 80 day period from June 3rd through August 21st are shown in Figure 6. In both instances over 90% of the days were favorable for blight. Data from monitoring a pivot irrigation circle in 1993 indicated that 80% of the days found to be favorable for blight involved irrigation, the other 20% were associated with rainfall.

Although late blight has been reasonably well controlled with available fungicides when the rate, coverage and timing are correct the cost of material and application ranged from 32 to $215/A for early-to-mid season harvest potatoes and 59 to $321/A for late harvest potatoes.

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Given these high costs and the blight favorable conditions within the canopy it appears there is an opportunity to impact late blight pressure if irrigation applications and canopy growth could be managed to reduce the occurrence and duration of conditions favorable for disease development.

The environment within the canopy of a number of commercial potato circles in the Columbia Basin of Washington were monitored during the 1996 growing season by an agricultural service company. Sophisticated environmental monitoring equipment was used to obtain the information. This data shows that when irrigation occurred during the late afternoon and into the night conditions favorable to late blight occurred and were present for an extended period (Figures 7-10). When irrigation occurred early in the day and did not extend into the evening the number of times and the duration of conditions favorable for late blight was reduced. (Temperature Fig. 3, Leaf Wetness Fig. 4, Relative Humidity Fig. 5)

Given that the environment within the plant canopy is a critical factor in the occurrence of late blight it would be desirable to be able to modify the canopy to reduce the occurrence and duration of conditions favorable to the disease. If this approach is to be used one of the things that needs to be understood is how much canopy is required to obtain economical production levels. The literature indicates that a canopy that occupies no more than 3 to 4 times the amount of ground it covers is adequate. The term used to describe the relationship of ground surface covered to plant size is called Leaf Area Index (LAI). Nitrogen fertilizer a factor known to impact plant growth would influence LAI. During 1994 and 1995 potato plant, tuber growth, and petiole nitrogen profile of commercial potato cultivars and new clones were documented.

The plant and tuber growth profile of Russet Burbank was quite different each of the two years as was the petiole nitrate nitrogen profile. In 1994 the initial petiole nitrogen level was lower and remained lower throughout the season compared to that of 1995. There was less plant weight at 60 days after planting in 1994 (lower petiole nitrogen) vs. 1995 with no difference in tuber weight. Ninety days after planting there was considerably more tuber weight in 1994 (the lower petiole nitrogen year) than in 1995 while plant weight was similar. One hundred and twenty days after planting tuber weight was higher in 1994 than 1995 but plant weight was lower. In both years plant weight declined between 90 and 120 days after planting. At 145+ days after planting tuber weight was greater in 1995 (the high petiole nitrogen year) and there was still some green plant weight. In the low petiole nitrogen year (1994) plants were completely dead 145 days after planting. These results suggest that for nitrogen fertility management to be considered as a viable tool for canopy management as a potential tool in the late blight battle the impact different nitrogen programs have on plant and tuber growth must be known. With this knowledge the potential trade-offs between tuber yield and quality and late blight incidence can be critically evaluated during the decision making process. To make matters even more complicated, plant and tuber growth profile, petiole nitrogen profile and level of the other cultivars and clones included in this study were found to be distinctly different from that of Russet Burbank.

When all these factors are considered there does seem to be the potential that both irrigation and canopy management could be used in the battle against late blight, **BUT** before these management concepts can be utilized as a part of a disease control program, there will have to be a much better understanding of how these practices impact potato growth and development as well as their impact on the occurrence and severity of the late blight disease.

**Conditions Favorable to Sporangia Production:**

- 8-10 hours >90% R.H.
- 8-10 hours 60-72° F


Figure 1.

**Conditions Favorable for Sporangia Germination / Penetration:**

- 70-80°F - Single Penetration
- 50-60°F - Multiple Penetration
- 80-60°F = 6-10 Fold Increase in Infection Sites
- 2.5-5 Hours of Leaf Wetness

Figure 2.

**Plant Canopy Temperature vs. Daily High Temperature**

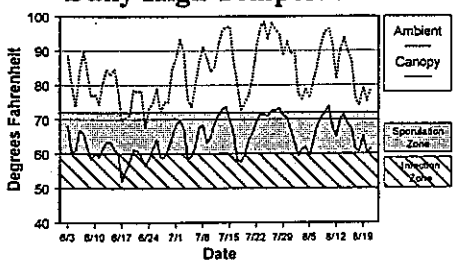


Figure 3.

**Duration of Leaf Wetness**

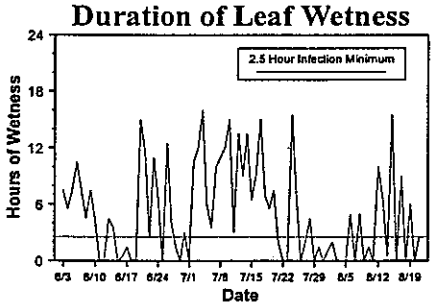


Figure 4.

**Duration of >90 % Relative Humidity**

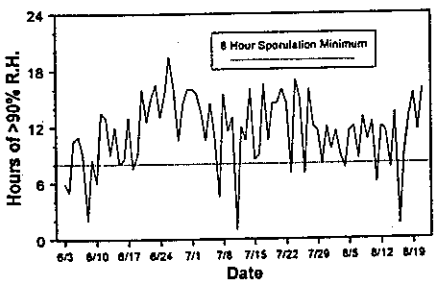


Figure 5.

**Days of Occurrence of Favorable Blight Conditions in 2 Pivot Irrigated Fields**

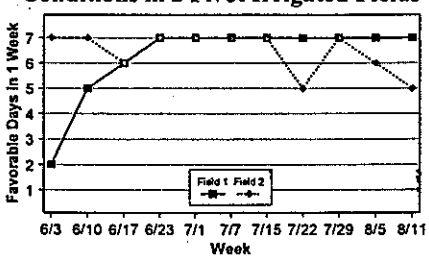


Figure 6.

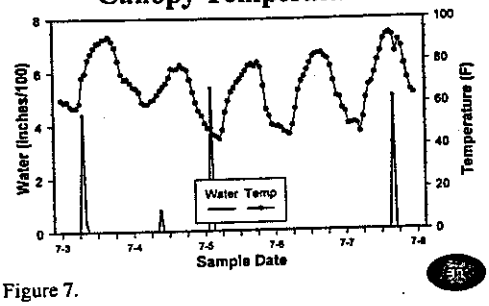


Figure 7.

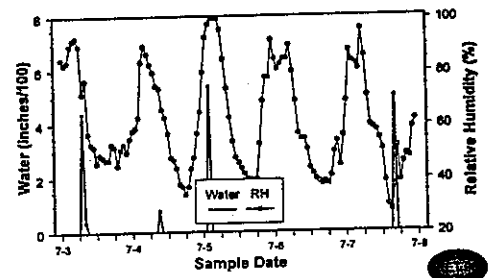


Figure 8.

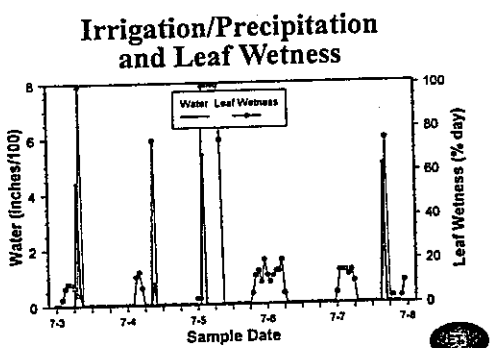


Figure 9.