

OCCURRENCE OF HOPPERBURN RESISTANCE AND SUSCEPTIBILITY IN THE POTATO¹

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Preliminary studies of hopperburn, a disease of potatoes caused by the potato leafhopper, *Empoasca fabae*, Huber., have been made during the past two seasons in Southern Wisconsin. Previous observations of experimental potato plantings containing large numbers of potato varieties show that potatoes definitely exhibit variability in susceptibility to the hopperburn disease. The present report includes methods employed in measuring hopperburn resistance and susceptibility, and the results obtained when using this method in determining the behavior of potato varieties and potato seedlings to the incidence of the disease.

The method used in measuring the relative degree of hopperburn occurring in various varieties of potatoes was based upon the ratio of hopperburn tissue to green tissue in leaves of the potato plant. This was accomplished by taking samples of potato foliage at different intervals throughout the season and by making consequent determinations of the percentage of hopperburn foliage. In following this procedure, the third and sixth leaves from the terminal growth of the vine were removed from each hill of potatoes. Ten randomized hills were chosen from which samples were obtained in each varietal planting. The leaves were then taken to the laboratory for segregation of hopperburn tissue.

Separation of the hopperburn and healthy potato tissue was made from the leaflets located at the terminal end of each leaf. The leaflets chosen for this purpose were the apical and the first two adjacent lateral ones of each leaf. The segregates were dried, weighed, and the relative percentage of hopperburn and green tissue was calculated on a dry weight basis. In separating the diseased hopperburn foliage from the healthy green tissue, considerable aid was obtained by the use of a scissors.

¹Approved by the Director of the Wisconsin Agricultural Experiment Station. Aid was received from the National Science Division of W.P.A. in the collection and determination of potato foliage segregates.

BEHAVIOR OF POTATO VARIETIES TO HOPPERBURN

The 1937 plot employed for the study of hopperburn resistance contained 8 standard varieties and 7 recently introduced varieties of potatoes. The varieties were planted in peat soil at random in 4 replicate blocks 15 rows wide. Each block contained 25 hills making a total of 100 hills for each variety of potatoes planted. The maximum nymphal leafhopper population infesting the Triumph potato foliage during this season was 10.0 insects on each leaf. Leaf-feeding insects, such as the potato beetles and flea beetles were controlled by two applications of an arsenical spray early in the season.

The determination of percentage hopperburn showed that the earlier varieties were most susceptible to hopperburn development as shown in table 1. Among these varieties, Triumph, Warba, Earlaine, and White Blossom Cobbler showed a very high level of susceptibility to hopperburn. The late varieties were, in general, more resistant to hopperburn. Among the most resistant varieties were Pioneer Rural, Houma, Katahdin and Russet Rural.

The 1938 plot was located on sandy silt loam soil and was a replicate of the plot employed in 1937. Seventeen varieties were planted in the plot and determination of hopperburn tissue was accomplished as previously described. The maximum nymphal leafhopper population infesting the Triumph potato foliage during this season was 18.03 insects to the leaf. The results in table 1 show relative percentage hopperburn quite similar to that found during the previous season.

TABLE 1—*Percentage hopperburn leaf tissue obtained from potato varieties grown in 1937 and 1938*

| Potato Variety | Percentage Total Hopperburn Leaf Tissue | |
|-----------------------------|---|-----------|
| | 1937 Plot | 1938 Plot |
| Pioneer Rural | 25.38 | 14.67 |
| Houma | 27.44 | 14.91 |
| Katahdin | 25.44 | 16.80 |
| Russet Rural | 26.12 | 17.42 |
| Rural New Yorker | 28.28 | 18.35 |
| Sebago | | 19.68 |
| Russet Burbank | 31.56 | 26.32 |
| Chippewa | 32.14 | 38.82 |
| 100-Day Cobbler | 34.62 | 37.21 |
| Green Mountain | 35.62 | 35.18 |
| Columbia Russet | 38.11 | 48.52 |
| Mesaba | | 70.96 |
| Irish Cobbler | 48.05 | 72.18 |
| Earlaine | 48.67 | 77.72 |
| White Blossom Cobbler | 50.81 | 74.50 |
| Warba..... | 51.03 | 80.07 |
| Triumph | 58.07 | 87.85 |

BEHAVIOR OF POTATO SEEDLINGS TO HOPPERBURN

In 1937, observations were made of a potato breeding plot in Northern Wisconsin for the selection of possible hopperburn resistant stock. This plot was located at Port Wing, Wisconsin, and contained approximately 2300 potato seedlings obtained from 30 to 40 crosses furnished by the United States Department of Agriculture and the Minnesota Agricultural Experiment Station. Observations throughout this planting distinctly showed wide variations in hopperburn susceptibility. In many of the segregating populations, individual resistant-appearing potato hills occurred adjacent to hills showing extreme susceptibility to the disease. As the planting contained a wide range in types of plants and foliage development, 20 samples of the most susceptible appearing plants, and approximately 40 samples of the most resistant appearing plants were designated as stock for further study in 1938.

A randomized planting of the hopperburn resistant and susceptible

TABLE 2—*Relative percentage hopperburn leaf tissue obtained from selections of hopperburn resistant and hopperburn susceptible potato seed stock*

| Resistant Selections | | | | Susceptible Selections | |
|----------------------|-----------------------|-------|-----------------------|------------------------|-----------------------|
| Stock | Percentage Hopperburn | Stock | Percentage Hopperburn | Stock | Percentage Hopperburn |
| HR-24 | 1.13 | HR-28 | 7.87 | HS-40 | 13.42 |
| HR-17 | 1.29 | HR-34 | 8.04 | HS-57 | 14.95 |
| HR-16 | 1.65 | HR-20 | 8.28 | HS-53 | 15.18 |
| HR-10 | 1.78 | IC-1 | 85.29 | IC-5 | 65.80 |
| IC-4 | 48.02 | HR-21 | 9.26 | HS-59 | 18.50 |
| HR-13 | 1.04 | HR-3 | 9.34 | HS-49 | 18.88 |
| HR-23 | 2.00 | HR-30 | 10.05 | IC-6 | 53.06 |
| HR-14 | 2.09 | HR-25 | 11.14 | HS-48 | 20.82 |
| HR-11 | 2.51 | HR-12 | 11.85 | HS-45 | 20.87 |
| HR-4 | 3.43 | HR-32 | 12.18 | HS-44 | 25.07 |
| HR-5 | 3.98 | HR-26 | 13.95 | HS-54 | 31.80 |
| HR-37 | 4.07 | HR-38 | 15.29 | HS-47 | 32.92 |
| HR-19 | 4.12 | HR-6 | 18.95 | IC-3 | 68.90 |
| HR-9 | 4.21 | HR-35 | 24.24 | HS-55 | 33.52 |
| HR-22 | 4.43 | HR-15 | 27.91 | HS-50 | 47.59 |
| HR-27 | 5.85 | HR-8 | 32.28 | HS-46 | 49.50 |
| HR-2 | 7.27 | HR-39 | 38.09 | HS-58 | 52.28 |
| HR-7 | 7.44 | HR-1 | 49.92 | HS-42 | 64.05 |
| HR-18 | 7.83 | HR-31 | 55.41 | HS-43 | 67.93 |
| IC-2 | 87.41 | | | HS-52 | 90.89 |
| | | | | HS-51 | 94.91 |

(HR) Hopperburn Resistant
 (HS) Hopperburn Susceptible
 (IC) Irish Cobbler check

selections were made at Kenosha in 1938. The Irish Cobbler was distributed among the planting to serve as checks. As hopperburn symptoms developed, foliage samples were removed from the vines and the percentage of hopperburn tissue calculated as described above. Data obtained from these calculations as shown in table 2 reveal that a large proportion of the hopperburn-resistant selections developed less hopperburn tissue than any of the most resistant varieties tested to date. Among the susceptible selections, some developed more hopperburn tissue than any of the most susceptible varieties tested.

SURVEY OF ADDITIONAL POTATO CULTURES FOR HOPPERBURN TOLERANCE

During the past season, observations in a planting of 160 new seedlings for possible selection of tolerant potato varieties to hopperburn revealed several selections of potatoes which showed outstanding resistance to hopperburn. Of the 85 cultures of South American origin observed, 13 promising lines have been selected for future detailed study. Of 117 miscellaneous varieties and strains collected from various seed growers and potato breeders and grown during the past season, 18 stocks have been selected for future study.

SUMMARY

In making a study of the behavior of new and old potato varieties to hopperburn injury, it has been found that, in general, the early-maturing varieties are more susceptible than the late-maturing varieties. The hopperburn tolerance exhibited by the two recently introduced varieties, Houma and Katahdin may readily account, in part, for the heat and drought resistance attributed by various investigators to these two new varieties.

By selecting hopperburn-free and hopperburn-injured individuals in segregating seedling populations grown under epidemic conditions in the field, it has been possible to separate segregates into two distinct levels of hopperburn tolerance. A number of seedling cultures have been isolated which show a greater degree of resistance and of susceptibility to hopperburn than any of the new or old varieties tested.

Relative percentage hopperburn resistance and susceptibility have been based on the ratio of necrotic hopperburn tissue to healthy green tissue which occurred in the various potato leaf tissues under consideration.