Dahlia Virus Test Results

Fall, 2015

Summary

The American Dahlia Society has been able to substantially increase the level of effort involved in virus research through the generosity of Jim Chuey and the Scheetz-Chuey Foundation. This article reports on a study that grew out of that donation. It evaluates the presence of virus in several gardens in NE Ohio. Each of the six viruses that are of concern in our dahlia gardens were analyzed in about 200 dahlia leaf samples gathered in the fall of 2015. The two key results of the research project were 1) that the majority of the samples taken from each of the gardens were virus-free and 2) that the appearance of abnormal leaf color and structure were a good indication of the presence of virus in the plants. That is, the strategy described in the brochure distributed with the June, 2015, Bulletin ("If in doubt, throw it out!") is supported by laboratory tests on dahlia plants with varying levels of virus symptoms. Further, the fact that the majority of plants were virus-free suggests that rigorous adherence to the "If in doubt, …" strategy should substantially reduce the incidence of virus in our gardens in just a few years.

Introduction

The American Dahlia Society (ADS) has taken the leadership role in tackling the problem of virus in dahlias. The early stages of that project came as a result of a donation to Washington State University from the estate of Evie Gullikson and matching funds from ADS member societies in the mid 1990's. The early observations in the academic work led to the suggestion that all dahlias have virus. That led many ADS members to conclude that there was little hope for virus-free dahlia gardens. That also led to lower enthusiasm for support of the research project at WSU. Professor Hanu Pappu became the leader of the project in 2003. In contrast to those early observations, Professor Pappu found that some dahlia plants do not have virus! While many of us missed that conclusion, Professor Carl Chuey, Professor of Biology at Youngstown State University and dahlia enthusiast, recognized the significance of that change. Fortunately for the ADS, Prof. Chuey's commitment to the WSU project led his brother, Jim Chuey, to make a large donation to WSU from their Scheetz-Chuey Foundation. That donation has reinvigorated interest in the project.

One of the first practical consequences of the work evolving from the Chuey donation was the publication of a brochure that was distributed with the June, 2015, ADS Bulletin. The brochure provided pictures of foliage on dahlia plants with virus. The working premise in the brochure was straightforward. If not all dahlias have virus and if growers systematically remove plants with virus from their gardens, then the incidence of virus in those gardens will steadily decrease in following years. The bottom line was "If in doubt, throw it out."

The next logical step was to test actual home dahlia garden(s) for virus. This article presents the results of a testing program that examined the presence of virus in a number of dahlia gardens in Northeast Ohio. In general, each of the five gardens involved in the tests followed the "If in doubt, …" guidelines presented in the brochure. That is, if the foliage on the plants in the garden exhibited the characteristics identified in the brochure, the plants were removed from the garden and destroyed early in the year. In some cases, that recommended approach was ignored. For example, the last known plant of an introduction was left in place even though it looked bad. In other cases, replacement plants were exhausted before all the bad plants were removed. Thus, some plants with poor foliage were left in the gardens. Consequently, when the leaf samples were finally removed from the plants for the tests in September, there was a large range in the appearance of the leaves on the plants in the garden. Most were very clean but a few exhibited foliage almost as bad as the leaves in the brochure.

Procedure

In order to capture the condition of the samples as reliably and accurately as possible, they were gathered from the various gardens on the same day and shipped to Professor Pappu by overnight mail to arrive the next day. Each set of leaves was placed in a Zip-Loc® bag and sealed with a sheet of paper towel and a sample label showing the garden, sample location in the garden, and the name of the cultivar. One individual gathered and shipped the samples from four of the gardens. A second individual gathered and shipped the samples from the fifth garden. Photographs were taken of each sample gathered in each of the four gardens. In at least one garden, the sample identification was carried over to the tubers when the plants were dug and divided. That will allow us to use the tubers if the virus result is negative, destroy them if the virus result is positive, and/or submit them for virus testing as tubers.

A small scale test is being considered on tubers where the leaf results have already been determined. There would be a lot of merit in being able to specify that a given clump of tubers is free of virus. A fourth option being considered would be to isolate and grow the plants with virus next year to determine if the virus continues into the second year.

Figure 1: Samples of Thomas A Edison gathered from plant number 23 in the eastern half of row 2 in the back garden location (b) of garden c (sample 10 from that garden).

Figure 1 shows a typical sample. The results of the virus testing on that sample was negative and the author was pleased to have a healthy plant of this classic cultivar! The foliage was very clean with a rating of 10; so no virus was anticipated. More on that later.

CMV	Cucumber Mosaic Virus
INSV	Impatiens Necrotic Spot Virus
TSWV	Tomato Spotted Wilt Virus
TSV	Tobacco Streak Virus
DMV	Dahlia Mosaic Virus
DCMV	Dahlia Common Mosaic Virus

Table A: The set of six viruses for which the leaves were tested in this study. They are the viruses that are known to infect dahlias in nature.

When Professor Pappu received the shipments of leaves, he, his students, and laboratory staff immediately processed them in order to produce stable sample material in the form required for subsequent virus testing. Each leaf sample was tested for the presence of the six viruses Prof. Pappu feels are most important in typical home dahlia gardens (Table A, left). These are the six viruses that are known to infect dahlias in nature. Other viruses can be introduced into dahlias, but these six are the ones that we need to be concerned about affecting our gardens.

It became clear that a quantitative characterization of the quality of the appearance of the foliage would be a very useful tool in analyzing the results of the virus tests. An arbitrary scale of rating was created that treated leaves with no

Figure 2: Photographs of the foliage of the three lowest rated samples analyzed. Although each of the samples was rated as 2, the problems with the foliage are not easy to see in a photograph.

appearance of yellowed streaks or spots as a value of ten (10) and highly mottled and/or necrotic (yellowed) leaves as a value of zero (0). Most of the plants tested were rated as 10. The worst-appearing plants in this study were rated as 2. None of the plants seemed to be as bad in appearance as the worst of the samples shown in the brochure. Those would have been rated as 0.

The pictures in Figure 2, on the previous page, were taken of leaves from the three plants with the lowest visual quality ratings (2). Unfortunately, the pictures do not very effectively illustrate the problems that could readily be seen in the leaves when we were able to observe them directly. The substantial yellowing of most of the leaf in the rightmost picture can be seen. That was the basis for its rating. The other two samples exhibited substantial yellowing along the veins in the leaves. That yellowing was the basis for their rating and unfortunately that feature does not show up in the pictures. The visual rating system was nevertheless useful for characterizing the foliage and comparing the results among samples. It is clear that the ratings of 2 or 4, for example, characterized foliage that was significantly different than foliage rated at 9 or 10. However, differentiation between foliage of 6 and foliage of 8 would be pretty unreliable and dependent on lots of variables, including, for example, the lighting of the foliage, the angle of observation, and the observer. In hindsight, it might have been more appropriate to use a coarser scale in the analysis—like good, bad, and in between.

Results

Figure 3 shows the numbers of samples testing positive for each of the six viruses examined. Table B, appended at the end of the report, provides the results of the tests on each of the samples studied. The data in that table are sorted by increasing foliage quality and then by cultivar name within the foliage rating. It is immediately clear in the table that the great majority of samples had high foliage ratings, say 8 and above. It is also clear that most of the samples with poor ratings also tested positive for one or more viruses. The amount of data is insufficient to draw any firm conclusions about the relative importance of any of the individual viruses on plant appearance. It is interesting, nevertheless, that Dahlia Mosaic Virus (DMV) and Dahlia Common Mosaic Virus (DCMV) were found in 8 of the 10 samples rated at 6 and below. Further, no DCMV was found in samples rated at 7 or above.

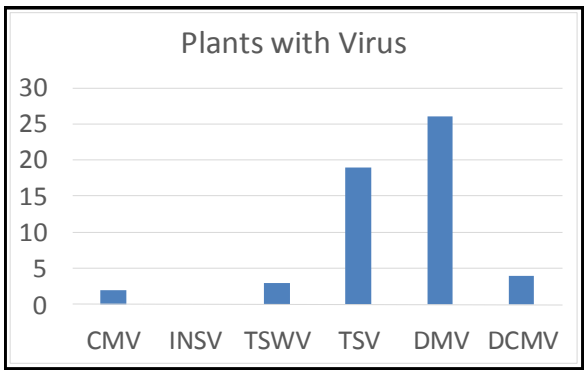

Figure 3: Distribution of viruses detected over the six viruses investigated.

Virus was detected in 48 of the 186 samples submitted for analysis. No impatiens necrotic spot virus (INSV) was detected. DMV was the most commonly observed virus. It was discovered in 26 of the samples studied. Tomato streak virus (TSV) was the second most commonly observed virus and it is interesting that all but one of the 19 occurrences of the virus were found in just one of the five gardens. The disparity from one garden to the next argues that generalizations from one garden to the next (or one region to the next!) may not be possible.

There was no systematic evaluation of specific cultivars in the study. It is interesting, however, that there was no indication in the results that certain cultivars always tested positive for

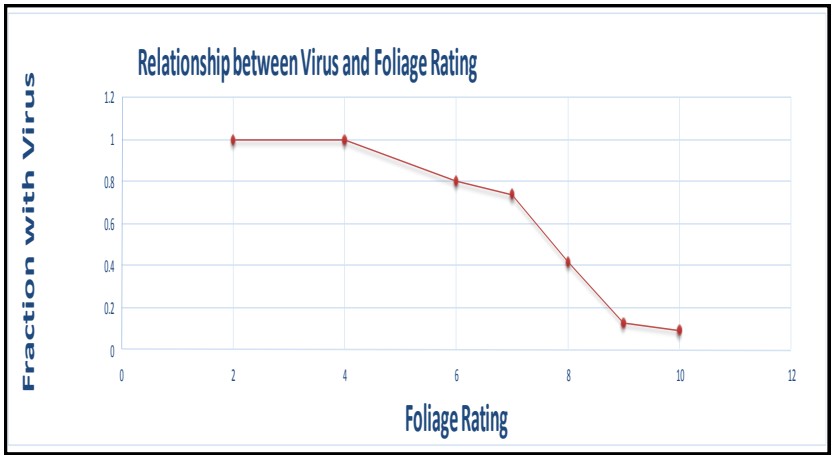

Figure 4: The fraction of samples that tested positive for virus is dramatically higher at the low end of the foliage rating scale than it is at the high end of the rating scale.

virus. Embrace may be a good example; three of the nine samples evaluated tested positive for virus and had lower leaf quality ratings. The other six samples showed high leaf quality ratings and no virus. Similar results can be found on other cultivars where multiple tests were performed. An interesting followup item here will be to track the occurrence of virus in the same cultivar taken from stock where virus was detected and from stock where no virus was detected.

One key objective of this investigation was to determine to what extent poor appearance of foliage would correlate to a high incidence of virus. Figure 4, above, demonstrates that the correlation is very high. In particular, **all** of the samples with ratings of 4 or less tested positive for virus. That result is very consistent with the "If in doubt, throw it out" strategy described in the virus brochure distributed in June.

At the other end of the scale, about 10% of the samples rated 9 or 10 tested positive for virus. It is not clear why that is the case. The virus may be present in small enough amounts that the foliage is not yet affected. It is a little disappointing that plants with excellent foliage can still have a (small) chance of having virus.

Discussion and Conclusions

Perhaps the most important result of this work is that we can be confident that the appearance of the foliage of the dahlias in our garden is a good indicator of the presence or absence of a virus in the plants. That is particularly true on the low end of the scale. That is, poor foliage, like that illustrated in the brochure distributed in June, is a very strong indicator of the presence of virus in the plant. Similarly, very clean foliage is a good indicator of the absence of virus in the plant. Unfortunately, that expectation is only about 90% accurate. Plants with good foliage will have virus about 10% of the time.

It is similarly important that almost **two thirds** of the plants tested were negative for any of the most commonly and naturally occurring viruses. The consequence of that result is that we can feel confident that removing the plants with virus every year will move us toward our goal of reducing virus in our gardens fairly quickly.

Finally, this work , made possible by Jim Chuey and the Scheetz-Chuey Foundation, suggests that Carl Chuey's vision of a virus-free dahlia garden may be a real probability.

Acknowledgements

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Appendix

Table B