THE EFFECT OF WEATHER ON YIELD OF TOMATO PLANTS INFECTED WITH TOMV, AS COMPARED WITH HEALTHY PLANTS

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Tomato yield is different in various years, in a great measure owing to differences in weather conditions. Studies of the relationships between the yield of healthy tomatoes and weather conditions are very scarce. Tomato mosaic virus (ToMV) causes big losses of tomato crops in Poland and other countries [5-8, 14]. There is much information about the effect of cultivar, agricultural treatments, virus strains and their isolates, as well as of the time of infection on yield reduction of ToMV-infected plants [2, 12]. In contrast, only single observations concern the relationships between the yield of ToMV-infected tomato plants and weather conditions. In this paper, the relationships between the yield of healthy and ToMV-infected tomato plants, on one hand, and weather factors were analysed on the basis of own studies performed in years 1971-1980.

REVIEW OF LITERATURE

According to the so far performed studies, tomato plants display high requirements concerning temperature, air humidity and light. Optimal temperature for growth and yield amounts to 20-25°C. The major part of cultivars exhibit at 30°C inhibition of plant growth, and at 35°C - its complete arrest. Minimal temperature for growth amounts to 10-14°C. At temperatures lower than 15°C tomato plants neither bloom nor set fruits [12, 13, 15]. This plant is characterized by high efficiency of photosynthesis, corresponding to 2.6-3.4 million kcal/ha. About 55% of the accumulated energy are utilized for fructi-
Light intensity required for maximal yield is about 10-20 thous. lux [5]. Light requirements of tomato plants depend on temperature conditions, and vice versa. Moreover, these plants have high requirements with respect to soil humidity. An 1-ha culture area needs 5800-9600 m$^3$ of water, and production of 1 t of plant matter = 60-80 m$^3$. Tomato plants require air humidity not lower than 45% and not higher than 70% [9]. During the vegetation period, in field culture the temperature and humidity are mostly inadequate, whereas light intensity exceeds the optimum.

METHODS

The methods used in the experiments, whose results concerning the yield of tomato cv. Fireball and cv. VF-145 were utilized for the present analysis, have earlier been described by this author et al. [6]. The data on weather factors were obtained from a Meteorological Station adjacent to the experimental plot of the Institute of Vegetable Growing. The maximal distance from the Meteorological Station did not exceed 1.5 km.

The relationships between the yield of healthy and ToMV-infected tomato plants and weather were evaluated by Spearman's test of rank correlation - $r_s$ [3]. Search was made for the relationships between total and commercial yield, number of fruits per plant and mean weight of 1 fruit, as found for healthy and infected plants (elements of yield), and air temperature, rainfall, air humidity, wind and insolation (elements of weather). The values of total yield, commercial yield, number of fruits per plant and mean weight of 1 fruit, obtained for healthy plants, were accepted as 100%. The differences in the values of these properties between healthy and infected plants, expressed as percentages against the value obtained for healthy plants, were analysed in a search for relationships between the elements of yield of infected tomato plants and elements of weather. In case of air temperature, the mean 24 h temperature as well as the maximal and minimal one were taken into account. For characterization of rainfall, from the sum of rainfall and number of days with rainfall calculation was made of the mean daily rainfall and mean rainfall depth as well as of the coefficient of variation of rainfall depth and coefficient of variation of the number of days between rainfall. To obtain these coefficients, the variances of
rainfall depth and number of days between rainfall were calculated. These coefficients consisted of the above calculated variances referred to their mean values and expressed as percentages. Air humidity was characterized by the mean 24 h value and by the values at 7 a.m., 1 p.m. and 7 p.m. Wind intensity was described by the mean 24 h wind velocity and by its values at 7 a.m. and 1 p.m. Lighting conditions were determined by measurements of cloudiness (expressed using a 10-score scale) and insolation (measured by the number of hours of the action of sun).

The vegetation period was arbitrarily divided into three parts:
I - from planting till the end of June (vegetative growth);
II - from July till mid-August (phase of fruit setting and growth);
III - from mid-August till mid-September (ripening and harvest of tomato fruits).

The investigated correlations were calculated for the whole vegetation period and for its three parts.

RESULTS

Characteristics of yield

Fireball. As concerns healthy plants, in the investigated period the differences between years in all elements of yield (total and commercial yield, mean number of fruits per plant and mean weight of 1 fruit) exceeded 20 times their lowest values. Total yield was highest in 1973 and lowest in 1978, amounting to 840 and 32.2 q/ha, respectively. In years 1977-1978 and in 1980, tomato crops were exceptionally small. Commercial yield was highest in 1973 and lowest in 1977, amounting to 549.5 and 13.9 q/ha, respectively. The mean number of fruits per plant was highest in 1975 (66 tomatoes) and lowest in 1978 (7 tomatoes); the differences between years in the values of the latter property were big, whereas the differences in weight of 1 fruit were smaller. The mean weight of 1 fruit was highest in 1972 and lowest in 1978.

In case of the ToMV-infected plants, their total yield - as compared with that of healthy plants - was lower in 1974 and in 1978 by 60.8 and 57.5%, respectively. It was slightly lower in 1971 and 1976. Commercial yield most differed from that of healthy plants in 1974
Table 1

Effect of tomato mosaic virus infection on yield of tomato plants

<table>
<thead>
<tr>
<th>Year</th>
<th>Commercial yield (g ha)</th>
<th>No. of fruits per plant</th>
<th>Mean weight of 1 commercial fruit (g)</th>
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<tr>
<td></td>
<td>1</td>
<td>2</td>
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<tr>
<td>1971</td>
<td>255.9</td>
<td>23.2</td>
<td>56</td>
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<tr>
<td>1972</td>
<td>428.2</td>
<td>33.0</td>
<td>52</td>
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<tr>
<td>1973</td>
<td>549.5</td>
<td>29.7</td>
<td>63</td>
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<td>1974</td>
<td>249.5</td>
<td>59.7</td>
<td>44.9</td>
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<tr>
<td>1975</td>
<td>375.8</td>
<td>25.0</td>
<td>66.0</td>
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<tr>
<td>1976</td>
<td>367.1</td>
<td>4.4</td>
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<td>1977</td>
<td>13.9</td>
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<td>1978</td>
<td>17.1</td>
<td>57.9</td>
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<td>1979</td>
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<tr>
<td>1980</td>
<td>25.2</td>
<td>36.8</td>
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Fireball

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<thead>
<tr>
<th>Year</th>
<th>Commercial yield (g ha)</th>
<th>No. of fruits per plant</th>
<th>Mean weight of 1 commercial fruit (g)</th>
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<td>1979</td>
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<tr>
<td>1980</td>
<td>107.5</td>
<td>33.0</td>
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VF-145

1 - Healthy plants,

2 - ToMV - Infected plants; percentage of the decrease in the property, as compared with healthy plants.
and 1979, being lower by 59.7 and 70.2%, respectively; the difference was smallest in 1976 (4.4%). For the mean number of fruits per plant, the greatest decrease (by 57%) was found in 1974, whereas there was no difference between the diseased and healthy plants in 1971. The infected plants were characterized by considerable differences between years in the reduction of this property. The drop in mean weight of 1 fruit was - as compared with healthy plants - biggest in 1979 (by 25.1%) and smallest in 1972 (by 1.9%). In the diseased plants, the weight of 1 fruit, compared to other yield elements (total yield, commercial yield, mean number of fruits per plant) exhibited the smallest weather-dependent changes in different years.

VF-145. In healthy plants the total yield was highest in 1973 and lowest in 1977 (673 and 58.2 q/ha, respectively. Although the fluctuations of total yield over years were big, they were smaller than those in cv. Fireball. Commercial yield was highest in 1975 and lowest in 1977 (527.2 and 43.2 q/ha, respectively. In this cultivar, as compared with cv. Fireball, the differences between the maximal and minimal total yield in the investigated period were smaller, and the total yield in years of particularly bad crops (1977, 1978, 1980) was higher. The number of fruits per plant was biggest in 1975 and smallest in 1978. The mean weight of 1 fruit was during the investigated 7 years biggest in 1975 (20.5 g) and smallest in 1978 (10.2 g). This property, as compared with the yield and number of fruits per plant, was more stable and less dependent on weather changes.

In the ToMV-infected plants, as compared with healthy plants, the total yield was most reduced in 1978, and least - in 1971 (by 69.8 and 9.1%, respectively). In this cultivar, as compared with cv. Fireball, the total yield of the infected plants was more reduced and the distribution of the total yield values over years was different. Commercial yield of the infected plants, as compared with healthy ones, was most decreased in 1974, whereas it was similar in both kinds of plants in 1973. The reduction of the mean number of fruits per plant, as compared with healthy plants, was biggest in 1977 (by 62.3%) and smallest in 1973 (by 12.3%). The infected plants of this cultivar, as compared with cv. Fireball, reacted differently to weather; this was testified to by a different schedule of fruit setting in various years. In the infected plants, as compared with healthy ones, the reduction of weight of 1 fruit was greatest in 1973 (by 30.8%), whereas in 1976 no such differences were found.
Characteristics of weather

Weather conditions during the vegetation period of tomato in years 1971-1980 are characterized in Figs 1-6. In general, the values of various weather elements exhibited big annual variation. The maximal value of some weather elements exceeded 7 times their minimal value. During the first half of the 10-year period, the weather to a greater extent promoted a good yield of tomatoes. On account of the high yield of tomatoes in years 1973 (Fireball) and 1975 (VF-145) and in view of the particularly bad crops in 1977 and 1978, it is of interest to consider the weather particularly in these years.

Year 1973 was characterized by very warm June, high temperature in the II and III part of the vegetation period, moderately high maximal and minimal temperature, medium (for the 10-year period) sum of rainfall in June and a low one in the remaining parts of the vegetation period, low number of rainfall in June and during harvest, and its medium number in the II part of the vegetation period, low mean rainfall depth in the I and II part of this period, moderate air humidity in the I and III part of this period, and windy weather only in the I part of this period. Year 1975 differed from 1973 by lower temperature in June, bigger sum of rainfall and its smaller number in the II part of the vegetation period, mean rainfall depth being lower in the I and III part as well as higher in the II part, and lower air humidity in the II part of the vegetation period.

Year 1974 in which yield of the infected plants was most reduced was characterized by low temperature in the I and II part of the vegetation period, and by a high one in the III part, low minimal and maximal temperature, big sum of rainfall in the II part and a low one in the III part, big number of rainfall in all parts of the vegetation season, medium rainfall depth, small number of days between rainfall, high air humidity in the I and II part, low wind velocity and marked cloudiness.

Year 1977 was characterized by low mean temperature of the whole vegetation period, big sum of rainfall and its high frequency in the II and III part of this period, low mean rainfall depth, medium number of days between rainfall, high air humidity and windy weather in the II and III part of the vegetation period, substantial cloudiness and low insolation.
Year 1979 differed from 1974 by a higher mean maximal and minimal temperature in the I part and a lower one in the III part of the vegetation period, smaller sum of rainfall in the II part, lower air humidity in the I and II part, more windy weather in the II part, lesser cloudiness in the I part and a greater one in the III part of the vegetation period.

Correlations between yield and weather

Marked annual differentiation of the elements of weather and of yield permitted demonstration of many correlations. The significant correlations between the elements of yield of the healthy and infected plants, on one hand, and elements of weather are presented in Figs 1-6.

Correlations between temperature and yield

In case of the healthy plants, there were significant correlations between total yield, commercial yield, mean number of fruits per plant and mean weight of 1 fruit, on one hand, and mean 24 h temperature in July till mid-August (II part of the vegetation period) and during this total period. Moreover, a significant positive correlation was found between the mean 24 h temperature during fruit harvest (III part of the vegetation period - from 15 August till 15 September), on one hand, and total yield and commercial yield of both cultivars, as well as mean weight of 1 fruit in cv. VF-145. Maximal 24 h temperature for the total vegetation period was positively correlated with the yield. There was a positive correlation between the maximal 24 h temperature of the total vegetation period, on one hand, and total yield, commercial yield, number of fruits per plant and mean weight of 1 fruit in both cultivars. Minimal temperature of the II part of the vegetation period was positively correlated with the yield except for the mean weight of 1 fruit in cv. VF-145 (Fig. 1).

As concerns the ToMV-infected plants, in cv. VF-145 the mean 24 h temperature of the total vegetation period was negatively correlated with commercial yield and number of fruits per plant. In cv. Fireball plants, the reduction of commercial yield was negatively correlated with the mean 24 h temperature and maximal temperature of
Fig. 1. Spearman's coefficients of rank correlation ($r_s$) between yield of healthy and ToMV-infected tomato plants, on one hand, and temperature; $\circ$ - cv. Fireball, $\triangle$ - cv. VF-145, $A$ - total yield, $B$ - commercial yield, $C$ - no. of fruits per plant, $D$ - weight of 1 fruit, $a$ - healthy plants, $b$ - ToMV-infected plants, I - 16.IV-15.VIII, II - 1.VII-15.VIII, III - 16.VIII-15.IX, IV - 15.V till end of vegetation period, $\circ\Delta$ - significant, with 5% error probability, $\circ\triangle$ - significant, with 1% error probability; signs above the curve - positive correlation, signs below the curve - negative correlation.
only the II part of the vegetation period. In VF-145 plants, a reduc-
tion of the mean number of fruits per plant was negatively correla-
ted with the maximal temperature of the total vegetation period. In
cv. Fireball plants, the minimal temperature of the III part of the
vegetation period was negatively correlated with commercial yield
(Fig. 1).

Correlation between rainfall and yield

In healthy plants there was no correlation between the sum of
rainfall and yield of both cultivars (Fig. 2). The number of days
with rainfall during the total vegetation period and that in its II
part were negatively correlated with total and commercial yield of
both cultivars. In cv. Fireball, the mean number of fruits per plant
was negatively correlated with the numbers of days with rainfall in
the total vegetation period and in its II and III part; in cv. VF-
-145, a similar negative correlation was found only for the number
of days with rainfall in the total vegetation period. The mean wei-
ght of 1 fruit was negatively correlated with the number of days
with rainfall in the II part of the vegetation period for both cul-
tivars, as well as with that in this total period and in its I part
for cv. VF-145 (Fig. 2). The mean depth of rainfall in the total ve-
getation period was positively correlated with the number of fruits
per plant in cv. VF-145 (Fig. 3). The numbers of days between rain-
fall in the total vegetation period as well as in its II and III
part were positively correlated with total and commercial yield in
both cultivars. In cv. Fireball the mean number of fruits per plant
was positively correlated with the numbers of days between rainfall
in the total vegetation period and in its II and III part; in cv.
VF-145, a similar correlation occurred only for the numbers of days
between rainfall in the total vegetation period and in its III part.
In both cultivars, the mean weight of 1 fruit was positively corre-
lated with the number of days between rainfall in the II part of the
vegetation period (Fig. 3). In both cultivars, the coefficient of va-
riation of the number of days between rainfall was negatively corre-
lated with total and commercial yield; moreover, in cv. Fireball
this coefficient was positively correlated with the mean number of
fruits per plant. The coefficient of variation of rainfall depth was
negatively correlated with total and commercial yield only in cv.
VF-145 (Fig. 3).
Fig. 2. Spearman's coefficients of rank correlation ($r_s$) between yield of healthy and ToMV-infected tomato plants, on one hand, and rainfall; explanations as in Fig. 1.
Fig. 3. Spearman's coefficients of rank variation ($r_s$) between yield of healthy and ToMV-infected tomato plants, on one hand, and rainfall; explanations as in Fig. 1.
In the ToMV-infected plants, the number of days with rainfall in the II part of the vegetation period was positively correlated with the reduction of total yield in both cultivars; in cv. Fireball, it was also positively correlated with the decrease in commercial yield, mean number of fruits per plant and mean weight of 1 fruit. The number of days with rainfall in the total vegetation period was positively correlated with the drop in commercial yield in both cultivars; in cv. VF-145, it was also positively correlated with the reduction of total yield and number of fruits per plant (Fig. 2). The mean rainfall depth in June was negatively correlated with total yield in both cultivars, as well as with commercial yield in cv. VF-145 and with the number of fruits per plant in cv. Fireball. The mean number of days between rainfall in the II part of the vegetation period was negatively correlated with commercial yield in both cultivars and with the number of fruits per plant in cv. VF-145. The mean number of days between rainfall in the III part of the vegetation period was negatively correlated with the reduction of total and commercial yield as well as of the number of fruits per plant only in cv. VF-145. The mean number of days between rainfall in the total vegetation period was negatively correlated with total and commercial yield as well as with the number of fruits per plant only in cv. VF-145 (Fig. 3). The coefficient of variation of the number of days between rainfall was negatively correlated with the decrease in total and commercial yield in both cultivars, as well as with the drop in the number of fruits per plant in cv. Fireball (Fig. 2).

Correlation between air humidity and yield

In the healthy plants, relative air humidity at 7 a.m., 1 p.m., and 7 p.m. as well as its mean 24 h value were in several cases correlated with the yield (Fig. 4). In cv. Fireball, the total and commercial yield were negatively correlated with relative air humidity at 1 p.m. at the III part of the vegetation period. In cv. VF-145, air humidity at 7 a.m. was positively correlated with total yield; in this cultivar, the commercial yield was negatively correlated with air humidity at 7 a.m. in the II part of the vegetation period. In both cultivars, the mean weight of 1 fruit was positively correlated with relative air humidity at 7 a.m. and 7 p.m. as well as with its mean 24 h value in the I part of the vegetation period (Fig. 4).
Fig. 4. Spearman's coefficients of rank correlation $r_s$ between yield of healthy and ToMV-infected tomato plants, on one hand, and air humidity; explanations as in Fig. 1.
In case of the ToMV-infected plants, relative air humidity at 7 a.m. in the II part of the vegetation period, as well as that at 1 p.m. and 7 p.m. and its mean 24 h value in the III part of this period were positively correlated with total yield in cv. VF-145. Commercial yield of this cultivar was likewise positively correlated with air humidity at 7 a.m. and 1 p.m., and with its mean 24 h value in the III part of the vegetation period, as well as with its values at 7 p.m. in the II and III part of this period. In cv. Fireball, commercial yield was positively correlated with air humidity at 1 p.m. and 7 p.m. and with its mean 24 h value in the II and III part of the vegetation period. In this cultivar, the reduction of the number of fruits per plant was positively correlated with air humidity at 1 p.m. and with its mean 24 h value in the II part of the vegetation period (Fig. 4).

Correlation between wind velocity and yield

In healthy plants, wind velocity at 7 a.m. in the II part of the vegetation period was negatively correlated with total and commercial yield in cv. Fireball. Wind intensity at 7 a.m. in the III part of the vegetation period was negatively correlated with total and commercial yield in both cultivars. Mean wind velocity at 7 a.m. for the total vegetation period was negatively correlated with total and commercial yield in cv. Fireball and with the number of fruits per plant in cv. VF-145. Wind velocity at 1 p.m. (i.e. at time of the day, playing an important part in pollination) in the III part of the vegetation period was negatively correlated with total and commercial weight, and with the number of fruits per plant in both cultivars, as well as with the mean weight of 1 fruit in cv. VF-145. Mean wind velocity at 1 p.m. in the total vegetation period was negatively correlated with total yield in cv. Fireball, commercial yield in both cultivars, and number of fruits per plant in cv. VF-145. Wind velocity at 7 p.m. in the III part of the vegetation period and in this total period were negatively correlated with total and commercial yield in both cultivars. Mean wind velocity at 7 p.m. in the total vegetation period was negatively correlated with total and commercial yield in cv. Fireball, and with the mean weight of 1 fruit in cv. VF-145. Mean 24 h wind velocity in the I part of the vegetation period was positively correlated with the number of fruits
Fig. 5. Spearman's coefficients of rank correlation $r_s$ between yield of healthy and ToMV-infected tomato plants, on one hand, and air humidity; explanations as in Fig. 1.
per plant in cv. Fireball, whereas that in the II part of this period was negatively correlated with total and commercial yield, and with the mean weight of 1 fruit of this cultivar. Mean 24 h wind velocity in the III part of the vegetation period was negatively correlated with total and commercial yield, and with the number of fruits per plant in both cultivars, as well as with the weight of 1 fruit in cv. VF-145. Mean 24 h wind velocity in the total vegetation period was negatively correlated with total yield in cv. Fireball, with commercial yield in both cultivars, as well as with the number of fruits per plant in cv. VF-145.

In case of the ToMV-infected plants, wind velocity was correlated with the decrease in the values of yield elements. Wind intensity at 7 a.m. in the II and III part of the vegetation period was positively correlated with the reduction of the number of fruits per plant in cv. VF-145. Wind velocity at 1 p.m. in the III part of the vegetation period and in this total period was positively correlated with the decrease in the number of fruits per plant in cv. VF-145. Wind velocity at 7 p.m. in the I part of the vegetation period was negatively correlated with the drop in total and commercial yield in cv. Fireball, and positively correlated with the reduction of the number of fruits per plant in cv. VF-145. Mean 24 h velocity was positively correlated with the drop in commercial yield and number of fruits per plant only in cv. VF-145 and solely in the III part of the vegetation period (Fig. 5).

Correlation between light conditions and yield

In healthy plants, cloudiness in the III part of the vegetation period was negatively correlated with total yield in both cultivars, as well as with the number of fruits per plant in cv. Fireball. Mean cloudiness in the total vegetation period was negatively correlated with total yield in cv. Fireball (Fig. 6).

The ToMV-infected plants were very sensitive to cloudiness. The reduction of total yield in cv. VF-145 was positively correlated with mean cloudiness in the total vegetation period. The decrease in commercial yield was positively correlated with cloudiness in the II part of the vegetation period and in this total period in both cultivars, and that in the III part—only in cv. VF-145. The drop in the number of fruits per plant was positively correlated with clou-
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Fig. 6. Spearman’s coefficients of rank correlation ($r_s$) between yield of healthy and ToMV-infected tomato plants, on one hand, and light conditions; explanations as in Fig. 1.
diness in the II part of the vegetation period and in this total period in cv. Fireball (Fig. 6). There were no correlations between the elements of yield and insolation in both - healthy and infected plants.

DISCUSSION OF RESULTS

The present results testify to a great and diversified effect of weather on the yield of healthy and ToMV-infected tomato plants. They are consistent with studies of the climatic requirements of tomato plants [1, 5, 10, 11, 16]. As concerns the healthy plants, the correlations found in the present studies confirm the findings reported by Fajkowska [4]. Only the correlation between insolation and yield (considered by Fajkowska to be doubtful) was not confirmed. On the other hand, in contrast to Fajkowska, we found a correlation between yield and cloudiness. The occurrence of this correlation seems probable in the light of the results of Patron [10] showing that UV radiation significantly influences ripening of tomato fruits. Moreover, according to Fletcher and Mac Neil [5], the optimal light intensity is between 10-20 thou. lux. During the vegetation season, in field cultivation the light intensity is much higher. Plants utilize about 2-3% of the energy supplied by the sun. The calculated correlations between the elements of weather and yield of healthy plants provide a comparative basis for an analysis of the effect of weather on yield of the ToMV-infected plants. The present results suggest that the mean air temperature is usually too low to provide maximal yield, whereas the number of rainfall is too big, and its distribution over time is rather unfavourable; winds are usually too intense.

Among both main elements of yield: number of fruits per plant and mean weight of 1 fruit, the former seems to be more sensible to weather. The same applies to commercial yield. Moreover, there are differences between the sensitivity of cultivars to different elements of weather. It seems that cv. Fireball react stronger to temperature and wind, and cv. VF-145 to soil humidity (since it reacts more intensely to the number and distribution of rainfall as well as to air humidity). There are differences between the various parts of the vegetation season in plant sensitivity to weather factors. It seems that favourable weather in July till mid-August is decisive of
a good crop of tomatoes, whereas the weather during harvest is less essential; the weather in the I part of the vegetation period exerts the slightest effect. Furthermore, each individual element of yield (number of fruits per plant, mean weight of 1 fruit, total yield, commercial yield) exhibits its own critical period of sensitivity to weather conditions. ToMV-infected plants are more weather-dependent than the healthy ones. Therefore, it seems difficult to find a multiple correlation. The present results seem to be in agreement with the hypothesis of Macias [7], claiming that the clear-cut deterioration of the yield of the infected plants is related to the stress suffered by the plant and caused - in this case - by weather.

The negative reaction of the infected plants to weather elements reveals - therefore - the special sensitivity of cultivar to some weather factors; for example, cv. Fireball is sensitive to temperature, and cv. VF-145 - to rainfall. Moreover, as concerns temperature, the reaction of the infected plants to this weather factor depends on the period elapsed from infection; Macias [7] has shown that the second decade after infection is the critical period. According to the present results, after this period the reaction of the healthy and infected plants to temperature is fairly similar. The present results testifying to a poor yield of the ToMV-infected plants at low temperature are consistent with those of Moskovets and Niktina [8]. No reports on the effect of the remaining weather elements on yield of the ToMV-infected plants were found in the available literature.

CONCLUSIONS

1. Cultivars differ in sensitivity to various weather elements; for example, cv. Fireball is sensitive to temperature and cv. VF-145 - to the number of rainfall.

2. There are differences between various parts of the vegetation period in the reaction of tomato plants to weather. The effect of weather on tomato yield is greatest from the beginning of July till mid-August, whereas it is slight in May and June.

3. Among the investigated weather elements, the greatest effect on tomato yield is exerted by: mean 24 h temperature, number of rainfall and number of days between rainfall (and their variation), mean depth of rainfall, wind intensity. The sum of rainfall, daily depth of rainfall and insolation do not influence tomato yield.
4. The weather dependence is greatest for commercial and total yield, whereas it is least for the weight of 1 fruit.

5. The sensitivity to adverse weather is higher in the ToMV-infected than in healthy plants. The reaction of the infected plants is the stronger, the higher the sensitivity to the given weather factor.

6. In healthy plants, a high total and commercial yield can be expected at a high mean 24 h air temperature, at unfrequent rainfall of uniform frequency (every 3-5 days) and depth, and at only slightly windy weather. In the ToMV-infected plants, a strong negative reaction can be expected at low air temperature, frequent and nonuniformly distributed rainfall, strong winds (particularly at night) and high air humidity. In the warm-weather cv. Fireball, the yield of the infected plants decreases at a drop in temperature during florescence and fruit growth.

7. In the healthy plants, a big number of fruits per plant can be expected at high 24 h temperature from July till mid-August, at a small number of uniformly distributed rainfall, and in the absence of strong winds. In the ToMV-infected plants, a strong reaction can be expected at cold weather, big number of nonuniformly distributed rainfall, high air humidity (cv. Fireball) and strong winds (cv. VF-145).

8. In healthy plants, a big mean weight of 1 fruit can be expected in warm summers with a small number of uniformly distributed rainfall (beginning from July), high air humidity, slight cloudiness, and absence of strong winds. In ToMV-infected plants, the weight of 1 fruit greatly decreases in years with excessively rainfall (cv. Fireball).

REFERENCES


Badano korelację między warunkami pogody a plonowaniem pomidorów. Wykazano, że:

1. Odmiany wykazują różnicę wrażliwość na poszczególne elementy pogody, np. odmiana Fireball wrażliwa jest na temperaturę, a odmiana VF-145 na liczbę opadów.

2. Pomidory wykazują zróżnicowaną reakcję na pogodę w poszczególnych częściach okresu wegetacyjnego. Największy wpływ na plonowanie ma pogoda w okresie od początku lipca do połowy sierpnia, niewielki zaś w okresie maja aż do końca czerwca.


4. Największą zależność od pogody wykazuje plon handlowy i plon ogólny, najmniejszą zaś wykazuje masa jednego owocu.

5. Rośliny chore wykazują większą wrażliwość na niekorzystny przebieg pogody niż rośliny zdrowe. Reakcja jest tym silniejsza, im większa jest wrażliwość na dany czynnik pogody.

6. Wysokiego plonu ogólnego i handlowego z roślin zdrowych osiągnąć należy przy wysokiej średniej temperaturze dobowej, opadach nielicznych i równomiernych co do częstotliwości (co 3-5 dni) i wysokości, o pogodzie słabo wietrznej. Dużej reakcji pomidorów porażonych wirusem mozaiki spodziewać się należy przy niskich temperaturach, częstych nierównomiernie rozłożonych opadach, silnych wiatrach, zwłaszcza nocą, dużej wilgotności powietrza. Odmiana Fireball – ciepłolubna daje mniejszy plon z chorych roślin przy spadku temperatury w okresie kwitnienia i dorastania owoców.

7. Duża liczba owoców z rośliny uzależniona jest od temperatury dobowej w lipcu – do połowy sierpnia, małej liczby opadów równomiernie rozłożonych, przy braku silnych wiatrów. Dużej reakcji roślin porażonych wirusem mozaiki spodziewać się można przy pogodzie
chłodnej o dużej liczbie opadów, nierównomiernie rozłożonych, ponadto przy dużej wilgotności powietrza (Fireball) i silnych wiatrach (VF-145).

8. Dużej średniej masy jednego owocu należy się spodziewać w latach ciepłych, o małej liczbie równomiernie rozłożonych opadów (począwszy od lipca), wysokiej wilgotności powietrza i małym zachmurzeniu, braku silnych wiatrów. Znaczne zmniejszenie masy jednego owocu u roślin chorych występuje w latach nadmiernie deszczowych (Fireball).

В. Мацисак

ВЛИЯНИЕ ПОГОДЫ НА ПЛОДОНОШЕНИЕ РАСТЕНИЙ ПОМИДОРОВ ПОРАЖЁННЫХ ВИРУСОМ МОЗАИКИ НА ОСНОВАНИИ ПЛОДОНОШЕНИЯ ЗДОРОВЫХ РАСТЕНИЙ

Резюме

Исследовалось соотношение между условиями погоды и плодоношением помидоров. Данные указывают на:

1. Сорта проявляют разную чувствительность к отдельным элементам погоды, например, сорт Fireball восприимчив к температуре, а сорт VF-145 к сумме осадков.

2. Помидоры по-разному реагируют на погоду в отдельные периоды вегетации. Наиболее сильно влияет на плодоношение погода в период от начала июля до половины августа.

3. Из исследуемых элементов погоды самое большое влияние оказывали: среднесуточная температура, сумма осадков и число дней между осадками и их показателями изменчивости, средняя величина осадков, сила ветра. Не оказывали влияния на плодоношение: сумма осадков, суточная величина осадков, инсоляция.

4. Самую высокую зависимость проявляют реализуемый урожай и валовой урожай, а самую низкую же — масса одного плода.

5. Больные растения проявляют большую чувствительность к неблагоприятным условиям погоды, чем здоровые растения. Реакция тем сильнее, чем выше чувствительность к данному фактору погоды.

6. Высокий валовой и реализуемый урожай от здоровых растений можем получать при высокой среднесуточной температуре, незначительных и равномерных осадках (через каждые 3–5 дней) и слабоветренной погоде. Сильной реакции помидоров, пораженных вирусом мозаики, следу-
ет ждать при низких температурах, частых и неравномерных осадках, сильных ветрах особенно ночью, высокой влажности воздуха. Сорт Fireball теплолюбивый, понижает урожай больных растений при понижении температуры в период цветения и подрастания плодов.

7. Высокое количество плодов от растения зависит от суточной температуры в течение июня и до половины августа, малого числа равномерных осадков, отсутствия сильных ветров. Сильной реакции растений поражённых вирусом мозаики можно ждать во время холодной и дождливой погоды, высокой влажности воздуха (Fireball) и сильных ветрах (VF-145).

8. Высокой средней массы одного плода можно ждать в тёплое лето, с малым числом равномерных осадков, начиная с июля, высокой влажностью воздуха и небольшой облачностью и отсутствием сильных ветров. Заметное понижение массы одного плода у больных растений выступает в чрезмерно дождливое лето (Fireball).