Effect of morphactin on the heteroblastic development and the floral morphogenesis in *Lycopersicon esculentum*

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MS received 4 February 1978

Abstract. The growth pattern, leaf morphology and flower development were studied in *Lycopersicon esculentum* Mill. With the increase in concentration of morphactin the height of the plants and the length of the petiole reduced and leaflets of young primordial leaves gradually fused to form simple leaves. The length of the inflorescence axis gets reduced and leads to the formation of composite flowers due to a gradual condensation with the increase in the concentration of this growth regulator. The shedding of flowers, a common phenomenon in tomato plants during first flowering was checked and considerable increase in the number of fruits was observed by lower concentration of morphactin treatment.

Keywords. Morphactin; heteroblastic development; *Lycopersicon esculentum*; floral morphogenesis.

1. Introduction

Morphactins represent a new class of synthetic bio-regulants with a very high morphogenetic potency, i.e., which affect almost every phase of plant growth and development (Schneider 1964, 1970; Ziegler 1970). In the present investigation the effect of different concentration of morphactin on the growth pattern, morphogenesis of leaves and flowers, shedding phenomenon of flowers and fruit development were studied in tomato plants.

2. Materials and methods

Seeds of *L. esculentum* Mill var. Pusa Ruby were obtained from Sutton Seeds (India) Private Limited, and were raised into seedling in the University Botanical Garden in October. In all, 50 seedlings of uniform size were transferred to 5 beds of 1 x 2 m; 10 seedlings were placed in each bed. Plants were uniformly watered. When the plants were 50 days old, they were sprayed with 1-0, 2-5, 5-0 and 7-5 ppm concentration of morphactin CME 74050. Tween — 20 0-03 % was used as surfactant in beds number 1, 2, 3, and 4 respectively. The plants in bed number 5 were kept as control. Foliar spray was made with a hand atomiser and on the control plants 0-03 % tween-20 was sprayed. The second and third spray were made at an interval of one week each and the fourth and fifth spray were made at an interval of one month duration. The results were based upon two replicates.
3. Results

It is seen in figure 1 that plant growth was gradually checked with the increase in the concentration of morphactin. Control plants on the average were of 29 cm in height after a period of 50 days, and when treated with different concentrations of morphactin they showed reduced growth. The growth rate between 1.0 and 2.5 ppm, 5.0 and 7.5 ppm morphactin treated tomato plants were almost similar.

The height of 7.5 ppm morphactin-treated plants after 50 days was almost half as compared to the control plants. It was interesting to note the change in the leaf morphology of morphactin-treated tomato plants. These plants, initially, showed the presence of imperipinnate compound leaf but after the third treatment with morphactin the treated plants exhibited a tendency of fusion of the leaflets. The fusion of the leaflets could be seen only in the young leaves resulted in the formation of simple leaves. The number of leaflets fused in a leaf was increased with the increase in morphactin concentration and plants treated with 7.5 ppm morphactin shows complete fusion of leaflets (figure 2). Mature leaflets, however, exhibited enrolling of the margins, and there was no fusion of leaflets.

It was interesting to note that flower initiation was also checked by morphactin (figure 1). In control plants, on an average, 135 flowers were formed in 50 days while in morphactin-treated plants the number varied from 8 to 65 depending upon the concentration applied. There was almost a gradual decline in the number of flower produced with the increase in the concentration of this growth regulator. Figure 2 clearly reveals the effect of different concentrations of morphactin on the

![Figure 1. Effect of different concentrations of morphactin on height, number of flowers and fruits of *L. esculentum*](image-url)
Figure 2. *L. esculentum* showing morphological changes in the leaf and flower as caused by different concentrations of morphaactin.
floral morphogenesis. A gradual reduction in the length of inflorescence was accompanied by the increase in the number of sepals, petals, stamens and carpels. The tendency of fusion of flower buds gradually increased with the increase in the morphactin concentration from 1.0 to 7.5 ppm resulting in the formation of composite flowers (table 1). Stamens were sterile as they gave negative test with acetocarmine. It was also observed that only 2 fruits were formed in the control plants whereas 15 to 40 fruits could be seen in treated plants. Maximum fruit formation and maturation could be noticed in 1.0 ppm treated plants, and a reduction in their number was observed with the increase in the concentration of morphactin (figure 1).

4. Discussion

From the overall observations, it is evident that the height of the tomato plants is gradually reduced with the increase in morphactin concentration. The reduced internodal growth indicates the inhibition of cell division and cell elongation by morphactin. This regulator also causes the change in the leaf morphology. In tomato, a series of single recessive gene factors control the leaf shape. Gene control is presumably expressed through the control of one or more enzymatic activities which in turn control cell division and/or cell enlargement in the leaf (Torrey 1967). In the case of dissected leaves the individual units originate from separate localised growth centres (Esau 1969) and the marginal meristem is functional only at those points. In the present study, the appearance of simple leaves with the increase in morphactin concentration may indicate that the gene responsible for dissected nature of the leaflets has become inactive gradually, thereby increasing the number of growth centres and making the entire marginal meristem in the active state. It was clearly revealed how variation in the fusion of leaflets could be achieved by changing the concentration, the production of leaves of varied shapes and complexities on the same plant. In Centaurea solstitialis, it was reported that GA<sub>3</sub> treatment could change the dissected leaves into simple unlobed leaves and different forms of leaves were partly regulated by the endogenous levels of gibberellins (Feldman 1970a, b). Similar observations were also made by Maksymowych et al (1976) while studying the morphological changes in the leaves of Xanthium pennsylvanicum influenced by GA<sub>3</sub>. Instead of typical deltoid leaves, GA<sub>3</sub> induced the development of lanceolate leaves. The leaves of the treated plants became smaller, their length and width were reduced, and the leaf margins became more acute.

### Table 1. Effect of morphactin on the different morphological changes in leaves and flowers of L. esculentum.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Average*</th>
<th>No. of Leaflets/leaf</th>
<th>No. of Leaflets fused/leaf</th>
<th>Length of the petiole</th>
<th>No. of flowers/cluster</th>
<th>No. of stamen/flower</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>14·6</td>
<td>0·0</td>
<td>3·24</td>
<td>4·9</td>
<td>5·6</td>
<td></td>
</tr>
<tr>
<td>1·0 ppm</td>
<td>12·3</td>
<td>1·4</td>
<td>2·31</td>
<td>2·7</td>
<td>6·9</td>
<td></td>
</tr>
<tr>
<td>2·5 ppm</td>
<td>8·5</td>
<td>2·4</td>
<td>2·31</td>
<td>2·7</td>
<td>7·6</td>
<td></td>
</tr>
<tr>
<td>5·0 ppm</td>
<td>6·6</td>
<td>2·9</td>
<td>2·24</td>
<td>1·7</td>
<td>14·4</td>
<td></td>
</tr>
<tr>
<td>7·5 ppm</td>
<td>3·5</td>
<td>3·8</td>
<td>2·27</td>
<td>0·3</td>
<td>**</td>
<td></td>
</tr>
</tbody>
</table>

* Observations are based upon 50 replicates.
**Staminodes.
leaves in this plant. Although the heteroblastic development takes place in tomato in the first few leaves (Coleman and Greyson 1976), the change in leaf form in general by morphactin treatment clearly indicates its regulatory effect like gibberellins. It was also noticed that the formation of simple leaves or the fusion of leaflets could be initiated by morphactin if the application was made during the appearance of leaf primordia and not at a later stage. Fusion of leaflets were reported earlier in the case of Momordica charantia Linn. and Vigna sinensis L. (Sankhla 1971; Bhora and Sankhla 1973), but this was by a different morphactin and use of a single concentration only. We have observed a gradual change in the shape of leaflets with the increase in morphactin concentration, ultimately resulting in the complete fusion and formation of simple leaves. The decrease in the length of petiole of tomato leaves with morphactin treatment resembles to that of GA<sub>3</sub> treatment in X. pennsylvaniaicum leaves recorded earlier. Both the plants show the inhibition of the petiole growth. The development pattern of flowers and leaves resemble each other in the plants treated with morphactin. While leaves exhibit a gradual fusion of leaflets, a gradual condensation could be observed in the case of flowers indicating a similar pattern which they follow during their development. Abscission is said to be the result of a complex interaction of hormones (Galston and Davis 1969). The shedding of a large number of flowers and the reduction in the number of fruits in control tomato plants during first flowering may be due to the accumulation of growth inhibitors. It was indeed checked by the morphactin treatment and it was found that the lower concentration of morphactin could markedly resist the floral abscission.

Acknowledgements

Grateful thanks are due to Prof. G Schneider of Merck (Dramstadt), West Germany, for generous gift of morphactins and Prof. K S Bhargava for laboratory facilities. The first author (VKJ) thanks the UGC for providing a fellowship.

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