Short Communication

Independence of Morphactin and Gibberellin Effects Upon Higher Plants

Jay D. Mann, Henry Hield, Kung-Hing Yung, and Douglas Johnson
Department of Horticultural Science, University of California, Riverside, California 92502

Received September 26, 1966.

Two fluorene-9-carboxylic acid derivatives (fig 1, I and II) have recently been shown to be potent growth regulators in higher plants (1), and have been given the trivial name, morphactins. The structural similarity between the morphactins and gibberelic acid (fig 1, III) immediately suggested a common site of action. In fact, Ziegler et al. (4) have claimed that methyl-morphactin (I) is a competitive inhibitor of the action of gibberellin; they also showed that methyl morphactin did not inhibit biosynthesis of gibberellin by Fusarium oxyformis. Their data with regard to a competitive relationship between gibberellin and morphactin was obtained only from measurements of pea seedling height. This data can be interpreted in other ways than by assuming a common receptor site for the 2 compounds.

\[ \text{I} \quad \text{R} = \text{Me}, \quad \text{X} = \text{Cl} \\
\text{II} \quad \text{R} = \text{Bu}, \quad \text{X} = \text{H} \]

Fig. 1. Structures of 2 morphactins (I and II) and of gibberelic acid.

When embryo-free half-seeds of barley are treated with gibberellin, alpha-amylase synthesis and release follows after 15 hours (3). This system thus provides a simplified bio-assay for measurement of a gibberellin-induced response under conditions where gibberellin synthesis is unimportant. This assay was performed with 1 \( \mu \text{M} \) gibberellin, a concentration causing maximal response, since published data (4) indicated that high gibberellin levels did not overcome inhibition by morphactin. Both morphactins (I and II) were tested at concentrations ranging from 0.01 to 100 \( \text{mM} \). No antagonism between either morphactin I or II, on the one hand, and gibberelic acid, on the other, could be detected in the barley half-seed test. Nor did morphactin replace gibberellin in stimulating amylase biosynthesis.

The foregoing data suggested that the morphactin esters do not directly antagonize gibberellin, at least in the assay used. Ziegler et al. (2) had demonstrated that morphactins do not inhibit gibberellin synthesis by Fusarium, but it was possible that gibberellin synthesis by higher plants may be inhibited by morphactins. If so, then replacement of missing endogenously-made gibberellin with exogenous gibberellin, should completely overcome all morphactin effects.

Citrus seedlings respond to morphactin sprays in 2 ways. Internode shortening becomes apparent, as well as a loss of dormancy of lateral buds (fig 2). When gibberellin is also sprayed on these seedlings, the internode shortening is completely overcome, but not the loss of lateral bud dormancy (table I). The positive effect of gibberellin in promoting internode elongation suggests that penetration and translocation of gibberellin occurred, yet morphactin-induced loss of bud dormancy was not prevented. Branching, in fact, seemed to be an additive response to both compounds. Mor-
phactin may have interfered with auxin-regulated apical dominance (2).

Thus the action of morphactins appears to be at least partially independent of both gibberellin synthesis and action. Morphactin-induced shortening of internodes is readily overcome by added gibberellin, but not the morphactin-induced loss of apical dominance. Combinations of morphactin with gibberellin, used as general foliar sprays, may be useful in chemical shaping of plants when increased bushiness is desired.

[Morphactins have become popular research items in the short time since samples have been made available. During the preparation of the above manuscript, similar results were reported by Tognoni, et al. (2), and we were informed that Dr. J. E. Varner (personal communication) also found no effect of morphactins upon amylase induction.]

<table>
<thead>
<tr>
<th>Gibberellin (mM)</th>
<th>Morphactin (mM)</th>
<th>Height (cm)</th>
<th>Avg internode length (mM)</th>
<th>Branches/Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>14.2</td>
<td>13.2</td>
<td>0</td>
</tr>
<tr>
<td>1.7</td>
<td>0</td>
<td>15.2</td>
<td>33.2</td>
<td>0.7</td>
</tr>
<tr>
<td>0</td>
<td>3.7</td>
<td>8.2</td>
<td>2.4</td>
<td>4.0</td>
</tr>
<tr>
<td>1.7</td>
<td>3.7</td>
<td>16.3</td>
<td>20.6</td>
<td>4.7</td>
</tr>
<tr>
<td>3.3</td>
<td>0</td>
<td>16.6</td>
<td>17.8</td>
<td>1.0</td>
</tr>
<tr>
<td>3.3</td>
<td>3.7</td>
<td>18.1</td>
<td>25.8</td>
<td>5.0</td>
</tr>
</tbody>
</table>

**Acknowledgments**

This work was supported in part by PHS Grant 12664-02. Mr. Johnson was supported by a National Science Foundation summer training grant.

**Literature Cited**


