
**INTRAMOLECULAR DECARBOXYLATION OF 3-(4'-ETHOXYPHENYL)-GLUTACONIC ANHYDRIDE: FORMATION OF A KETENE DIMER**

The condensation of phthalic anhydride with acetic anhydride in presence of potassium acetate has been reported to give phthalylacetic acid\(^1\), 3-(4'-Ethoxyphenyl)-glutaconic anhydride, under similar conditions behaved in an analogous manner and furnished 3-(4'-ethoxyphenyl)-glutaconylacetic acid\(^2\)-\(^3\). Perkin-type reaction between phthalic anhydride and phenylacetic acid in presence of sodium acetate gave benzalphenylide\(^4\)-\(^6\). Similar extension of the reaction to 3-(4'-ethoxyphenyl)-glutaconic anhydride (I), however, afforded a product, namely, 4-(4'-ethoxyphenyl)-6-[[β-(4'-ethoxyphenyl)-propenyl]-2-pyrene (IV) to the exclusion of expected (V). The formation of (IV) was confirmed on the basis of elemental analysis, oxidation studies and IR spectral determination.

The elemental analysis of the compound was in agreement with structure (IV). Alkaline permanganate oxidation of the product yielded p-ethoxybenzoic acid (m.p. 193-95\(^°\)) and oxalic acid. The IR spectrum of the product exhibited bands at 1718, 1610, 1530, 1512, 1180, 1030 and 840 cm\(^{-1}\) characteristic of compounds of type (IV)\(^6\)-\(^7\). The formation of (IV), therefore, suggests that anhydride (I) in presence of a base like sodium acetate undergoes intramolecular decarboxylation and the resulting ketene (II) dimerizes to (III) which subsequently yields pyrone (IV)\(^8\). The plausible mechanism entailing the formation of (IV) is represented in Chart 1.

**Experimental**

4-(4'-Ethoxyphenyl)-6-[[β-(4'-ethoxyphenyl)-propenyl]-2-pyrene (IV) : A mixture of 3-(4'-ethoxyphenyl)-glutaconic anhydride (1, 2\(^.\)32 g), phenylacetic acid (1\(^.\)36 g) and fused sodium acetate (1\(^.\)64 g) was heated in an oil bath at 140-150\(^°\) for 4 hr. Initially the mixture liquefied and then rapid evolution of carbon dioxide occurred giving reddish brown coloured viscous liquid. The mixture was then cooled to room temperature and treated with aqueous bicarbonate. The residue thus left was thoroughly washed with water and crystallized from 50% ethanol, yielding pale yellow coloured crystals, m.p. 150-52\(^°\) (Anal. Calcd. for C\(_{24}\)H\(_{24}\)O\(_4\) : C, 76.59; H, 6.38%. Found : C, 76.48, H, 6.44%).

![Chart 1](image)

We wish to thank Dr. S. S. Karmarkar, Bombay, for his interest in the work and to Professor S. C. Bhattacharya, Indian Institute of Technology, Bombay, for IR spectral determination.


CONTROL OF Fusarium WILT OF PIGEON PEA WITH BAVISTIN, A SYSTEMIC FUNGICIDE

Until recently, no good chemical control measure was known for most of the vascular wilt diseases. However, with the advent of systemic fungicides, particularly those of the benzimidazole group, successful chemical control of vascular wilt diseases of some plants has been achieved in the recent years. Wilt disease due to Fusarium oxysporum f. sp. udum (Butler) Snyder and Hansen causes considerable damage to the pigeon pea crop. Only recently, some success in control has been reported from this laboratory with the use of Benlate, a systemic fungicide of benzimidazole group(1). Results of some further studies on the control of pigeon pea wilt by using Bavistin (2 Methyl-2-benzimidazole carbamate, 50% w/w), a broad spectrum systemic fungicide of the same group, are briefly reported here.

Plants raised in garden soil mixed with farmyard manure in 6 in. pots were inoculated when 3 weeks old. Inoculum was prepared by mixing 10–12 days old culture grown on sand maize-meal medium at 28° C with equal amount of dry, sterilized soil. Top soil in each pot to be inoculated was replaced with 100 g of inoculum which was then covered with a thin layer of removed top soil. Treatments with the fungicide, used always as a suspension in water, were given mostly as soil drench, rarely as spray, on different dates in relation to the time of inoculation. For each treatment, there were 4 pots, each with 3–5 plants. At different intervals after inoculation, the number of plants showing wilt symptoms were recorded and the degree of wilting shown by the individual leaves was assessed on a 0–4 scale. The total of these values for a plant, when divided by its number of leaves, gave the disease index on leaf basis.

In the first experiment, there were four treatments in addition to the uninoculated control and inoculated control series. The fungicide was applied at different concentrations, in 50 ml portions to each pot as soil drench, 10 days before, and 5 and 22 days after inoculation, that is well ahead of, soon after and at a late stage of infection. While the concentration of 4,000 ppm was used on all the three occasions, a lower concentration of 2,000 ppm was also used when the treatment was given soon after inoculation.

It appears from the summarized results (Table 1) that half of the 20 plants in the inoculated control series developed symptoms within 3 weeks and 7 more within the next 3 weeks and all these plants died within the experimental period (11 weeks). The remaining 3 plants did not develop any symptoms. In contrast to this, soil drench with 4,000 ppm Bavistin 10 days before inoculation gave the treated plants total protection against the disease. None

<table>
<thead>
<tr>
<th>Treatment</th>
<th>No. of plants</th>
<th>Disease incidence (% of plants affected)</th>
<th>Mean wilt index per leaf</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>21</td>
<td>42</td>
</tr>
<tr>
<td>Uninoculated</td>
<td>16</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Inoculated (control)</td>
<td>20</td>
<td>50.0</td>
<td>85.0</td>
</tr>
<tr>
<td>Inoculated + 4,000 ppm Bavistin (22 days after inoculation)</td>
<td>17</td>
<td>23.5</td>
<td>29.4</td>
</tr>
<tr>
<td>Inoculated + 2,000 ppm Bavistin (5 days after inoculation)</td>
<td>16</td>
<td>6.3</td>
<td>6.3</td>
</tr>
<tr>
<td>Inoculated + 4,000 ppm Bavistin (5 days after inoculation)</td>
<td>16</td>
<td>6.3</td>
<td>6.3</td>
</tr>
<tr>
<td>Inoculated + 4,000 ppm Bavistin (10 days before inoculation)</td>
<td>17</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>C.D. (5%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.D. (1%)</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Table I
Effect of Bavistin, applied as soil drench, on the incidence and severity of Fusarium wilt in pigeon pea plants.