studying partial regression coefficient of different characters.

In this study, investigations were conducted on chlorosis, chlorophyll, leaf number, shoot growth, dry matter, nitrogen and potassium of four trees each of Excelsior and Foster grape fruit, Kinnow mandarin, Ruby orange and Sampson Tangelo in March, June and September flushes during the year 1973 and 1974. The intensity of die-back of the individual trees of the different species used in this investigation were graded from 1 to 6 on the basis of visual observations.

Correlation coefficients between die-back and other characteristics and the regression coefficients of die-back on these characters were calculated by multiple regression techniques. Among the nutrients only nitrogen and potassium were included in the study as these were less than the optimum. The predictability of die-back with the help of different characters was estimated by calculating $R^2$, the coefficient of determination. The correlation coefficients of die-back with all the eight characters were highly significant. However, $R^2$ values indicated that only three characters, viz., nitrogen, chlorosis and chlorophyll were important in predicting the die-back, as their values, ranged from 66% to 94%. For other characters, the $R^2$ values were comparatively low, their values ranging from 44 to 64%.

An attempt was also made to examine the predictability of die-back (as judged by $R^2$) when nitrogen, chlorophyll and chlorosis were not available. The regression equations for different combinations of the remaining characters and their $R^2$ values were calculated. The number of leaves when combined with shoot growth gave a $R^2$ value of 55% which rose to 57% when shoot growth was replaced by leaf area. When all the three characters, leaf area, leaf number, and shoot growth, are taken into consideration for estimation, the $R^2$ value rose to 66%. It is interesting to note that $R^2$ values of these characters when taken individually ranged from 44% to 49% only.

It is clear from above discussion that die-back can be estimated efficiently either by taking into account characters like chlorosis, chlorophyll and nitrogen or by considering characters like leaf area, leaf number and shoot growth together. However, it may be noted that while the maximum value of $R^2$ was 94% in the first set of characters, it was only 66% in the second set of characters.

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THE INFLUENCE OF SMUT ON THE PRODUCTIVITY OF ISELEMA LAXUM HACK

Iselema laxum Hack is a prominent and promising fodder grass in Ujjain. In a survey of smut diseases of graminaceous plants, a majority of flowering stalks of I. laxum was found to be infected by a fungal disease. Preliminary observations showed that the causal organism was a smut, Spathelotheca anayati. The infected spikelets start appearing in the last week of September. Ovaries of the infected spikelets transform into oval dark brown sacs full of spores. The present study was undertaken to analyse the effects of smut disease on the primary productivity and the energy content of the host.

Healthy and infected plants were collected and analysed during late October to assess the above parameters. The disc method was used to evaluate net primary production. The calcific values were determined with an oxygen bomb calorimeter, and the estimates were made by the formula proposed by Lieth.

It is seen that the production rate of infected plants was reduced significantly (Table I). The reduction in the net primary productivity (NPP) of leaves may be due to the reduction in photosynthetic efficiency or due to increased breakdown due to high respiration.

<table>
<thead>
<tr>
<th>Productivity of healthy and infected leaf mg/h</th>
<th>Healthy</th>
<th>Infected</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiration (R)</td>
<td>0.175</td>
<td>1.00</td>
<td>5%</td>
</tr>
<tr>
<td>Net primary production (NPP)</td>
<td>2.445</td>
<td>0.610</td>
<td></td>
</tr>
<tr>
<td>Gross production (GP)</td>
<td>2.620</td>
<td>1.610</td>
<td>1%</td>
</tr>
<tr>
<td>GP = NPP + R</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The reduction in gross production (GP) of infected plant was 61.5%. Further, from Table I, it is evident that there is a proportional increase in the respiration with a decrease in the net production in the infected leaves. It appears that the infected plant was photosynthetically inefficient and at the same time catabolically overactive, leading to the significant reduction in NPP and GP of the infected plants. Lower energy content of the diseased plant parts indicate the nature of the pathogen as a consumer (Table II).
This reduction was 74% in the stem, 55% in the leaf and 54% in inflorescence, which was highly significant.

**TABLE II**

<table>
<thead>
<tr>
<th>Plant part</th>
<th>Healthy</th>
<th>Infected</th>
<th>Statistical level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stem</td>
<td>3183</td>
<td>2383</td>
<td>5%</td>
</tr>
<tr>
<td>Leaf</td>
<td>3655</td>
<td>2011</td>
<td>5%</td>
</tr>
<tr>
<td>Inflorescence</td>
<td>4915</td>
<td>2782</td>
<td>1%</td>
</tr>
</tbody>
</table>

Thus the overall ecopathological effects of smut of *Isellema* grass reveal reduction in the rate of photosynthesis and lower energy status of host plant parts. However, these metabolic losses occurred without any significant changes in the morphology of the host.

Our sincere thanks are due to Prof. L. P. Mall for providing necessary facilities for the work.

School of Studies in Botany, Vikram University, Ujjain, V. P. SINGH. February 19, 1975.


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**SHORT SCIENTIFIC NOTES**

Antifungal Activity of Some C₉₈ Steroidal Lac tones

Withanolides¹ and physalin², a new group of C₂₈ steroidal lactones from family Solanaceae have been found to possess anti-tumour, anti-inflammatory and antibacterial activity³. In continuation of our work on the antifungal activity of Withaferin A⁴, we now report on the activity of other related compounds with different substitution patterns to establish the structure-activity relationship.

The compounds* (Withaferin A, Withanolide E, Withanicandrin, and Physalin B) dissolved in ethanol were incorporated in Czepek's agar medium to obtain different concentrations and the antifungal activity of the compounds was seen against *Aspergillus flavus*, *Epidermophyton floccosum*, and *Cladosporium herbarum*.

Withaferin A inhibited the growth of fungi in concentrations varying from 250 to 500 μg/ml whereas other compounds were inactive at concentrations of even 1 mg/ml.

The presence of 4β-OH; 27-OH; 17β-side chain; 5β, 6β-epoxide, as seen in Withaferin A, seems to be significant for the biological activity. Withanolide E lacks 4β-OH, 27-OH and has 17β-sidechain, whereas, Withanicandrin has 5α-OH, 6α-, 7α-epoxide, both these compounds being inactive. It is interesting to observe that physalins are almost biologically inactive possibly due to their highly oxygenated nature.

Department of Medicinal Chemistry, Institute of Medical Sciences, Banaras Hindu University, Varanasi 221 005, July 21, 1975.

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* Withaferin A (4β, 27-dihydroxy-5β, 6β-epoxy-1-oxo-22-R-witha-2, 24-dienolide);
  Withanolide E (14α, 17α, 20α-trihydroxy-5β, 6β-epoxy-1-oxo-17S, 20S-22 R-witha-2, 24-dienolide);
  Withanicandrin (5α-hydroxy-1, 12-dioxo-6 α, 7 α-epoxy-22-R-witha-2, 24-dienolide);


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Screening for Genetic Host Resistance Against the Bacterial Leaf Spot Disease in Tomato Incited by *Xanthomonas vesicatoria* (Dodge) Dowson* ⁵

Bacterial leaf spot disease in tomato incited by *Xanthomonas vesicatoria* is not so very serious in India at present. Field observations have, however, revealed that the disease can occasionally flare up in epiphytic proportions. Locating genetic resistance and breeding resistant varieties will be the most effective method of controlling this disease. Alexander and Lincoln (1942) reported *Lycopersicum peruvianum* Linna to be the most valuable source of resistance in tomato against the disease. Avezdezhnova (1967) detected varietal differences.