UTILIZATION OF CARBON COMPOUNDS BY
FUSARIA M SOLANI F. AURANTIFOLIAE
BHA T. AND PRASAD

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ABSTRACT

The two isolates of Fusarium solani f. aurantifoliae responsible for lime twig disease were found to utilise carbon from a wide variety of compounds. In general, monosaccharides proved to be better than other sources tested for growth and sporulation though maltose exhibited best growth.

In both the isolates mannose supported best growth among hexoses. Pentoses were less readily utilized than the hexoses. Among disaccharides, maltose proved to be the best carbon source out of all the 14 different compounds tested. As compared to dextrin, starch proved to be the better source. Alcohols did not prove to be satisfactory sources for both the isolates.

INTRODUCTION

In fungi, carbohydrates are supposed to be the best utilised sources of carbon. Among monosaccharides, glucose is preferred by majority of fungi and is reported to be well utilized by two strains of Fusarium coeruleum (Tandon and Agarwal, 1957), various isolates of cumin wilt Fusaria (Mathur, 1960) and Curvularia lunata (Mathur et al., 1960). Tochinai (1926), however, found that Fusarium lini was incapable of utilising glucose. Sucrose proved to be an excellent carbon source for the fungi studied by Fergus (1952), Wolf (1953) and Tandon (1961). Maltose is considered to be a rich source of carbon in general for many species of fungi as reported for majority of isolates

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of *Fusarium oxysporum* f. *cumini* (Mathur, 1960), *Pestalotia psidii*, *P. citri*, *P. banksiana* and many species of *Phyllosticta* (Tandon, 1961). Blank and Talley (1941) and Wolf (1953) considered lactose, maltose and sucrose to be good carbon sources while their poor utilization has been observed by Schade (1940) and Tochinai (1926) for the fungi included in their studies. Among polysaccharides starch was good carbon source for *Morchella esculenta* (Brock, 1951), *Curvularia lunata* (Shrivastava, 1951) and *Phytophthora* species (Mehrotra, 1951), whereas poor for *Ustilago zeae* (Wolf, 1953) and *Penicillium digitatum* (Fergus, 1952). Tandon (1961) stated that all the species of *Pestalotia* tested in his laboratory showed very poor liking for mannitol, sorbitol, dulcitol and glycerol. He further observed that sorbitol and dulcitol which were good for the growth of *Gloeosporium psidii*, *G. limetticolum* and *G. citricolum* was a poor source for *G. musarum*. Glycerol was fairly well utilised by various isolates of cumin wilt *Fusaria* (Mathur, 1960). It is thus evident that species of fungi differ in their ability to utilise carbon compounds for their growth and sporulation and the two isolates of *Fusarium* causing twig disease of lime (Bhatnagar and Prasad, 1966) were grown on fourteen different carbon sources to study their selectivity in utilising carbon from them and the results are reported in this paper.

**MATERIAL AND METHODS**

Substitutions with different carbon compounds in Richard’s liquid medium (*KNO₃* : 10 gm., *KH₂PO₄* : 4 gm., *MgSO₄*·*H₂O* : 2·5 gm., sucrose : 50 gm, *FeCl₃* : 0·02 gm. and distilled water to make 1,000 ml.) were made on an equivalent of available carbon (4·8 gm. per litre). Medium without any carbon compound was used as control. Pyrex glasswares, metal distilled water redistilled in a pyrex still and chemicals of Analar grade were used. pH of the medium was adjusted to 6·0 before autoclaving with N/20 sodium hydroxide or acetic acid. 100 ml. Pyrex Erlenmeyer flasks thoroughly cleaned, dried and fitted with cotton plugs were used. Twenty ml. of the medium were dispensed in each of the flasks and then autoclaved at 15 pounds pressure for 20 minutes. Each of the flasks was inoculated with single germinating conidium. The mycelial mats (10 days old) were harvested by filtering through Whatman filter-paper (No. 41), washed thrice with distilled water on the filter-paper, dried at 60°C. for 24 hours, cooled in a desiccator and weighed. The mean value of three replications has been presented. For the assessment of amount of sporulation, one ml. of the spore suspension obtained from the flask of the culture on the day of harvest was pipetted in a test-tube containing 1 ml. of distilled water. One drop of the solution was placed on the squares of haemocytometer. Number
of spores in ten squares were averaged. The following 14 carbon compounds were tested:

1. **Monosaccharides**
   
   (a) **Hexoses** .. \( d\)-glucose, \( d\)-fructose, \( d\)-mannotose and \( d\)-galactose.
   
   (b) **Pentoses** .. \( l\)-arabinose and \( d\)-xylose.

2. **Disaccharides**
   
   Maltose, lactose and sucrose.

3. **Polysaccharides**
   
   Dextrin and starch.

4. **Polyhydric alcohols**
   
   Glycerine, \( d\)-mannitol and sorbitol.

**RESULTS**

Results from Table I and Fig. 1 clearly indicate that both the isolates showed their ability to utilise all the 14 carbon compounds included in the experiment. Though maltose exhibited best growth, monosaccharides proved to be better for the growth and sporulation. Among simple sugars (monosaccharides), hexoses like mannose, \( d\)-galactose and fructose were better utilised than pentoses (\( l\)-arabinose and xylose). Amongst disaccharides, maltose supported best growth while sucrose was used fairly well and lactose poorly. Starch proved to be better than dextrin. Mannitol and sorbitol supported better growth than glycerine among alcoholic sugars. In general, monosaccharides exhibited fairly good growth; maltose was best utilised and lactose, dextrin and glycerine were poor sources of carbon for the two isolates. No relation can be established between growth and sporulation with respect to utilization of carbon compounds. Glycerine, though it supported poor mycelial growth, enhanced sporulation to a great extent in both the isolates. In isolate F2, xylose exhibited fairly good growth, yet the sporulation was poor.

**DISCUSSION**

Among hexoses, mannose supported best growth in both the isolates under study. Tandon (1961), Fergus (1952), Wolf (1953) and Agarwal (1958) also found mannose to be a good carbon source for the fungi studied.
**Table I**

Average dry mycelial weight and sporulation of the two isolates of *Fusarium solani* grown on Richard's medium supplemented with different carbon compounds (4·8 gm. of available carbon per litre)

<table>
<thead>
<tr>
<th>Carbon Compound</th>
<th>Average dry mycelial weight in mgm. (10 days old)</th>
<th>Sporulation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Isolate F₁</td>
<td>Isolate F₂</td>
</tr>
<tr>
<td>l-Arabinose</td>
<td>114</td>
<td>127</td>
</tr>
<tr>
<td>Xylose</td>
<td>104</td>
<td>105</td>
</tr>
<tr>
<td>Fructose</td>
<td>129</td>
<td>147</td>
</tr>
<tr>
<td>Glucose</td>
<td>111</td>
<td>144</td>
</tr>
<tr>
<td>d-Galactose</td>
<td>119</td>
<td>154</td>
</tr>
<tr>
<td>d-Mannose</td>
<td>137</td>
<td>168</td>
</tr>
<tr>
<td>Maltose</td>
<td>159</td>
<td>204</td>
</tr>
<tr>
<td>Lactose</td>
<td>67</td>
<td>59</td>
</tr>
<tr>
<td>Sucrose</td>
<td>122</td>
<td>131</td>
</tr>
<tr>
<td>Dextrin</td>
<td>97</td>
<td>62</td>
</tr>
<tr>
<td>Starch</td>
<td>125</td>
<td>152</td>
</tr>
<tr>
<td>Glycerine</td>
<td>70</td>
<td>89</td>
</tr>
<tr>
<td>d-Mannitol</td>
<td>122</td>
<td>143</td>
</tr>
<tr>
<td>Sorbitol</td>
<td>101</td>
<td>99</td>
</tr>
<tr>
<td>Control (No carbon)</td>
<td>..</td>
<td>..</td>
</tr>
</tbody>
</table>

+, ++, +++ = Poor, Good, Very good, Excellent.

by them. D-glucose in general is utilised well by majority of fungi and it was assimilated well by the two isolates. Tandon and Agarwal (1957), Mathur (1960) and Mathur *et al.* (1960) also found glucose to be a good source of carbon for *Fusarium coeruleum*, *F. oxysporum f. cumini* and *Curvularia lunata* respectively. As found in the present investigations, galactose exhibited fairly good growth in species of *Phyllosticta* (Tandon, 1961) and *Curvularia penniseti* (Agarwal, 1958). In comparison to hexoses, pentoses (arabinose and xylose) were less readily utilised by the two isolates of *Fusarium* under study. Sukhapure *et al.* (1957), Brock (1951) and Ramakrishnan (1942) also reported them to be poor sources of carbon for *F. oxysporum f. pisi*, *Morchella esculenta* and *Colletotrichum falcatum* respectively. Among disaccharides, behaviour of maltose, as a good source of carbon for the *Fusarium* of lime twig disease, supports the observations made by Tandon (1961) for various species of *Pestalotia* and *Phyllosticta* and Mathur (1960)
for some isolates of cumin wilt *Fusaria*. Brock (1951), Shrivastava (1951) and Mehrotra (1951) found starch to be a good carbon source for the fungi studied by them and it also supported satisfactory growth of *Fusarium* under study. Alcohols in general did not prove to be satisfactory source for the lime twig disease *Fusaria*. Similar observations were made by Tandon (1961)

![Graph showing growth on different carbon sources](image)

for all the species of *Pestalotia* tested by him which showed very poor liking for mannitol, sorbitol, dulcitol and glycerol. As reported by Agarwal (1958) and Mathur (1960), no correlation between growth and sporulation due to various carbon compounds of the two isolates could be observed in this case.

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