on the reproductive physiology of common beans (Phaseolus vulgaris): I. On the differ-
8. Ojehomon, O.O., A.S. Rathjen and D.G. Morgan. 1968. Effects of day length on the
morphology and flowering of five determinate varieties of Phaseolus vulgaris L. J.
fruits in Phaseolus vulgaris L.: I. Cultivar differences in flowering pattern and absces-
on abortion and abscisic acid concentration of younger fruits of Phaseolus vulgaris L.
Plant Physiol. 64:620-622.


Efficacy of a Hydrophilic Gel as a Transplant Aid
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Abstract. Studies were conducted to determine the effect of a hydrophilic gel used as
a medium amendment or root dip on plant response to moisture deficits. Tomato
(Lycopersicon esculentum Mill.) seedling roots were dipped in water or hydrophilic gel
solution (7.4 g liter−1) and planted in sand or a 1 sand : 1 very fine sandy loam mixture
(v/v). Seedlings were also planted in the same medium amended with 3 kg-m3 hydro-
philic gel. Leaf water potentials and stomatal resistances were determined at various
times after a final irrigation. Significantly greater leaf water potentials occurred in
new transplants in sand amended with gel than in control or root-dipped plants. No
treatment effects on plants exposed to the
environment. The use of these and similar
 compounds, usually starch-hydrolyzed polyacrylonitrile copolymers or acry-
lamide and acrylic acid salt copolymers,
absorb water and potentially release it to the
environment. The use of these and similar
materials has improved the water status of
plants during production (2, 9), and they have
been recommended for use as container me-
dia amendments (3), seed amendments (8),
and transplant aids (10).

The purpose of these studies was to de-
termine the influence of a hydrophilic gel on
plant response to moisture deficits following
transplanting.

Washed root systems of ‘Marglobe Large
Red’ tomato seedlings with 4 true leaves were
dipped in a solution of 7.4 g of hydrogel per
1 liter of water or in water and were planted
in 15-cm plastic pots containing washed river
sand of medium coarse texture or a 1:1 mix-
ture (v/v) of sand and very fine sandy loam.
The hydrogel was a starch-hydrolyzed poly-
acrylonitrile graft copolymer using KOH.
Plants also were planted in the same media
amended with 3 kg hydrogel m−3. All treat-
ments were well-watered immediately after
transplanting but received no additional water
thereafter. Each treatment was replicated 4
times.

Leaf water potentials were determined us-
ing a pressure chamber (PMS Instruments,
Corvallis, Ore.), and stomatal resistance was
determined with an LI65 Autoporometer
(Lambda Instruments, Lincoln, Neb.) during
midafternoon for several days immediately
following planting.

In another study, similar-sized tomato
plants were planted in medium coarse texture
sand using the treatments described above.
Treatments were replicated 4 times. Plants
were watered and fertilized as necessary to
promote growth for 12 days. Leaf water po-
tentials and stomatal resistances were deter-
mined periodically beginning 24 hr after the
final irrigation. Two-way analysis of vari-
ance and linear regression procedures were
used to compare the data.

Plants placed in sand began to wilt within
48 hr regardless of the presence or absence
of hydrophilic gel. Leaf water potentials sig-
ificantly greater in sand amended with gel
than in sand and in sand dipped in water.

Table 1. Effects of hydrogel root dip and media
amendment on leaf water potentials 24, 48, and
72 hr after transplanting and irrigating tomato
plants in sand.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Leaf water potential (−MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>1.29 b</td>
</tr>
<tr>
<td>Media</td>
<td>1.03 c</td>
</tr>
<tr>
<td>Dip</td>
<td>1.44 a</td>
</tr>
<tr>
<td>Hours after</td>
<td></td>
</tr>
<tr>
<td>transplanting</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>0.98 b</td>
</tr>
<tr>
<td>48</td>
<td>1.40 a</td>
</tr>
<tr>
<td>72</td>
<td>1.38 a</td>
</tr>
</tbody>
</table>

The medians separation within each main effect column
by Tukey’s HSD procedure (5% level).

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nificantly decreased between 24 and 48 hr, but little change occurred between 48 and 72 hr (Table 1). Leaf water potentials of plants in the hydrophilic gel-amended sand were significantly greater than those of control or root-dipped plants. There were no treatment x time interactions, however.

Plants in the sand: sandy loam mixture began wilting later (within 72 hr) than those in sand alone due to the increased water holding capacity of the medium. Leaf water potentials decreased ($r = 1.00$) and stomatal resistance increased ($r = 0.99$) linearly with time regardless of hydrophilic gel treatment (Table 2). There were no significant differences in either leaf water potential or stomatal resistance due to gel addition to the media or as a root dip. There were also no interactions between the main effects.

The high correlation between leaf water potential and stomatal resistance reflects reduced soil moisture availability for plant use. Duniway (1) found, as leaf water potential decreased, that stomatal resistance sharply increased (at about -1.0 MPa). This same correlation can be seen in this data.

This correlation was not as pronounced when plants were allowed to establish for 2 weeks prior to initiation of drought stress (Table 3). Neither leaf water potentials nor stomatal resistance showed a significant linear correlation with time in this study. There was a significant change in leaf water potential between 72 and 96 hr and in stomatal resistance after 72 hr. The presence of gel as a root dip or media amendment affected neither leaf water potential nor stomatal resistance, and there were again no interactions between gel treatments and time.

The delay in response of established plants to reduced moisture levels might be expected, since they regenerated roots for more extensive moisture uptake prior to imposition of drought. Most moisture uptake occurs primarily in the root hair zone (7). Root hairs often are lost in transplanting, so moisture uptake may be reduced. If plants regenerated roots prior to the onset of drought conditions, moisture uptake would occur more readily despite reduced water availability.

It is commonly accepted that stomata close in response to moisture stress. There is, evidently, a leaf water potential above which leaf resistance and stomatal opening remains constant (6). Once this leaf water potential is reached during drought stress, stomatal resistance increases sharply. This relationship between leaf water potential and stomatal resistance has been shown for tomatoes, where stomatal resistance sharply increased at about -1.1 MPa (1). This level corresponds with the findings of this study in which stomatal resistance of established plants increased sharply beginning at about -1.0 MPa. Stomatal resistance of new transplants, however, was greater at -0.99 MPa and did not increase sharply until exposed to -1.3 to -1.4 MPa of pressure (Table 2).

Hydrophilic gels have improved moisture retention of sandy loam and loamy sand soils (4), possibly enhancing the soil’s ability to store plant-available water. This improved moisture use may account for the increased leaf water potential of plants exposed to gel-amended sand in the initial study.

The results of these studies agree with those of other studies in which hydrophilic gels were incorporated into the medium of container-grown plants. The time required for wilting of marigold (Tagetes erecta L.) and zinnia (Zinnia elegans Jacq.) was increased and moisture stress decreased with the incorporation of a hydrophilic gel into Jiffy Mix, a commercial medium (2). Hydrophilic gel also reduced the number of irrigations necessary for growth of chrysanthemum (Chrysanthemum morifolium Ramat.) in hardwood bark media (9).