TRANSLOCATION OF BETAIN LEVELS DURING STRESS AND REWATERING IN LENTIL (LEN S ESCULENTA MOENCH)

Magendra Pal Singh & K.A. Varshney
P.G. Department of Botany, B.R.S.-B.S.M. (P.G.) College Babrala, Sambhal (U.P.) India
Plant Physiology and Bio-chemistry Section, P.G. Department of Botany, Bareilly College, Bareilly

Abstract : Lentil var. PL-639 and PL-406 may be recommended to exploit on field scale because their satisfactory growth and performance in terms of biochemical parameters at 4 m$cm^{-1}$ electrical conductivity level. The accumulation of betaine and choline cumulative index for inducing salt tolerance in lentil plants besides osmotic effects and specific effects. Betaine levels increased during imposition of salt stress and decreased during rewatering of Plants. This decline in the betaine concentration upon rewatering was found mass because of its transport to the actively growing shoots through phloem than its degradation. The excessive accumulation of betaine and choline in lentil plants, might be playing a pivotal role in salt tolerance inducing osmotic adjustment or osmoregulation which causes a drop in water potential.

Key Words – Salt Stress, Betaine, Lentil.

INTRODUCTION

LENTIL (LEN S ESCULENTA MOENCH) family fabaceae is a leguminous land crop. It mainly grown low lying in undated and marginal land and also grown as utera. It is a native south west asia and cultivated as a pulse crop mainly in north india. The accumulation of this compatible solute betaine plays a role in the adaptation of many organisms, such as Bacteria, Landfald and Strom, 1986 and higher plants Rhodes and Hanson, 1993 to high salinity. It has been shown by Arakawa et al 1990, 1992 that the level of betaine aldehyde dehydrogenase increases several fold in whole leaves in response to salt stress, glycine betaine is the most well known quaternary ammonium compounds in higher plants, that induced and endogenously synthesized in the chloroplasts in response to various abiotic stress, such as drought Silva et al, 2011 high salinity Kern and Dyer, 2004 low temperature Zhang et al, 2010 and its concentration correlated with the level of tolerance. Proline accumulation in leaves of drought stress plants and its role as an osmolyte or osmoproctant has been the theme of a long standing Seki M et al 2007, Szbadss I et al 2010 Lentil serves as an excellent sources of readily digestible seed proteins and carbohydrates, vitamins A and B, fibre, potassium, and iron, making it a favorite for people on meat free diets.

Betaine accumulation during field stress conditions is infact, and adaptive response to stress, and if there is useful genetic variation for betaine accumulating potential, then the betaine accumulation can be considered a valuable metabolic criterion in breading for salt resistance, the over all aims of this work were to assess, to the extent possible physiological experiments, the adaptive value of betaine accumulation under field conditions. To emphasize the successful cultivation of the proposed lentil plants in barren lands.

MATERIAL AND METHODS

Lentil (Len s esculent a Moench) var. PL-639 and PL -406 seeds obtained from G.B. Pant University of Agriculture and Technology, Pantnagar (India) were surfaced sterilized with 0.1% sodium hypo chloride solution for 15 minutes and washed in running tap water. The seeds were then sown in earthen-ware pots. A preliminary experiment of follow translocation of betaine from sources young leaves to sinks mature leaves was designed in order to understand the actual sight where betaine / allied compounds involve in inducing salt tolerance. The method was based on

Imperial Journal of Interdisciplinary Research (IJIR)  
Vol-3, Issue-4, 2017  
ISSN: 2454-1362, http://www.onlinejournal.in
technique develops for studying translocation of sugars and amino acids by housley et al 1977, well watered, stressed and stressed rewatered plants were analyzed for betaine contents using the Thin Layer Chromatography (TLC) method. This also provided a means of assessing the specification of the periodide assay for betaine. To achieve a satisfactory separation of these compounds by thin layer chromatography it the betaine concentration was greater than 10 micron mol. g. fr. Wt. A 10x3 cm column of Zeo-Kort 225 SRC 14 (Standard resin, 52-100 mesh was prepared washed with NaOH and HCl 6M thrice. Betaine and choline were determined by direct reflectance densitometry in the visible range after TLC as described by Radecka et al, 1971. This method was rapid as well as highly specific but lacked the precision of the periodide colorimetric assay.

RESULTS AND DISCUSSION

The betaine concentration in shoot tissue rose during the first and second stress episodes and decreased during the rewatering period (Fig.1). The declines in betaine concentration upon rewatering were consequence of dilution by dry weight added as growth resumed, not of net degradation of betaine. This is because the total betaine content per shoot did not decrease during the first rewatering period (Fig.-2). The data given in table-1 confirm that the total quantity of betaine per shoot did not fall upon rewatering and shows further that the distribution of betaine among shoot organs changed markedly upon stress relief. At the end of the stress period, most of the betaine was present in the mature leaves 1, 2 and 3. After 4 days period, at each four days of rewatering, the amount was found reduced in leaves, while the betaine contents of the expanding leaves had risen markedly. Sample of these leaves were taken from well-watered plants which were two days younger than the rewatered plants.

Table-1

<table>
<thead>
<tr>
<th>Days</th>
<th>Betaine content (µmol g⁻¹ dry wt.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Well watered Plants</td>
</tr>
<tr>
<td>0</td>
<td>13.8</td>
</tr>
<tr>
<td>2</td>
<td>13.8</td>
</tr>
<tr>
<td>4</td>
<td>13.8</td>
</tr>
<tr>
<td>6</td>
<td>13.8</td>
</tr>
<tr>
<td>8</td>
<td>13.8</td>
</tr>
<tr>
<td>10</td>
<td>13.8</td>
</tr>
<tr>
<td>12</td>
<td>13.8</td>
</tr>
</tbody>
</table>

Table 1 : A comparison of betaine contents in control well Watered plants and stressed rewatered plants of lentil

The result form the above experiment indicates that upon rewatering betaine is not retained by the mature leaves in which it accumulated betaine could either be transported to the actively growing regions of the shoot without, being destroyed or it could be simultaneously degraded in mature leaves and synthesize in growing tissues upon stress relief. During episodes of salt stress betaine accumulates in expanded leaves of the lentil but not appreciably degraded by these or any other organs before, during or upon relief of stress. After relief of the stress the betaine is exported from the expanded leaves to the young, actively growing region of the shoot. This export most probably occurs in the phloem. That betaine is both metabolically inert in the phloem mobile lands supports to its promise as a cumulative indicator of salt stress in lentil as has already been experienced by barley crop, Hanson and Nelson 1978. The most appropriate organs to sample for analyses in further test of this concept to be the youngest leaves. Two additional point emerge from our result regarding the site of syntheses and the translocation of betaine in well-watered plants.
The betaine concentration in shoots of well-watered plants remained quite steady (at about 15 μmol/g dry weight) as dry weight increased about 3-fold (fig. 1).

![Fig. 1: Betaine levels in shoot of soil-grown lentil plants subjected to two cycles of stress-rewatering. It shows betaine concentration of stressed-rewatered and well-watered control plants.]

Betaine must therefore be synthesized continuously during growth. The syntheses probably occurs at least in part in the mature leaves because mature leaves of well-watered plants can convert various 14c-precursors to betaine at low rates of chik pea (Hanson and Nelson, 1978; Hanson and Scott, Varshney et al., 1992). When G Betaine was applied to single mature leaves of tomato plants, a large fraction of the incorporated GB was translocated to meristem containing tissues, which included flower bud and shoot apices Park and Chen 2006. In addition, since the betaine content of individual mature leaves remains fairly constants (Hanson and Nelson, 1978), any betaine synthesized in such leaves of plants.

![Fig. 2: Betaine content of stressed rewatered shoots (per shoot basis).]
CONCLUSION

Lentil is considered a very sensitive species to salinity, much more than other legumes such as broad bean, chickpea and soyabean. Thus, it may concluded that the accumulation of betaine least adverse impact on protein turnover, a probable cumulative index for inducing salt tolerance in lentil plants besides osmotic effects and specific ion effects. Our present result contain some direct experimental support for such a continuos export betaine from mature leaves of unstressed plants.

REFERENCES

8- Radecka,C., Genest,K. and Hughes, D. W. 1971: