WATER STRESS INDUCED CHANGES IN PROLINE CONTENT IN VIGNA UNGUICULATA (LINN.) VAR. KONKAN SADABAHAR AT VARIOUS STAGES OF GROWTH

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Abstract: Water stress is one of the major constraints in plant growth resulting loss in crop production. Various plant parts can sustain the water stress to different degree. It was demonstrated that bayleton (Triadimefon) reduces transpiration and increases yield in water stress plant. The aim of this experiment was to investigate the responses caused by progressive water stress and bayleton treatment on the proline content of Vigna unguiculata (Linn.) var. Konkan Sadabahar at two stages of growth, viz. germination and young plant stage. The proline content in root, stem and leaf of 17 days old plants subjected to water stress with bayleton treatment [bayleton soaked seeds + bayleton spray (0.1 ppm)] was found to be less in comparison with plants subjected to water stress.

Key words: Vigna unguiculata (Linn.), Water stress, Proline.

INTRODUCTION

Water availability is considered as the climatic factor with greatest effect on agricultural productivity, being responsible to govern species distribution in the different climatic zones around the globe [1]. Plants synthesize and accumulate osmotically active low molecular weight compounds such as sugar, alcohols, proline, glycine, betaine and putrescine [2,3] under soil moisture stress. Accumulation of free proline in tissues of several plant species in response to water deficit and other stresses is well documented [4, 5]. It was demonstrated that triadimefon reduces transpiration and increases yield in water stress plants [6], which is in part mediated by a partial closure of stomata [7]. Bayleton, a triadimefon have been extensively used worldwide in agriculture as fungicide.

Cowpea (Vigna unguiculata L.) is an annual legume chiefly used as a grain crop, for animal fodder or as a vegetable world wide. Scarcity of irrigation during flowering season is a major limiting factor in case of cowpea cultivation [8]. In Konkan region, as the pulses are cultivated after rainy season; the crop is subjected to moisture stress due to receding soil moisture and raising temperature [9]. Patil [10] reported that rabi cowpea in Konkan region experience mild to severe degrees of moisture stress and exhibits reduction in grain yield in the range of 24 % to 83%. Invention of short duration (55 to 60 days) and strictly determinate genotype “Konkan sadabahar” of this crop has opened new avenues of pulse production of the region as well as nation. Therefore, the present investigation was undertaken to determine the effect of water stress and Bayleton treatment on the proline content
of *Vigna unguiculata* (L.) Var. Konkan Sadabahar at various stages of growth.

**MATERIALS AND METHODS**

Seed samples of *Vigna unguiculata* (L.) Var. Konkan Sadabahar were obtained from Konkan Krishi Vidyapeeth, Dapoli. Morphologically alike seeds were selected and washed with distilled water. These seeds were surface sterilized using 0.5% HgCl$_2$ solution for 5 mins. by continuous shaking. The seeds were then thoroughly washed several times with distilled water and blotted dry. After sterilization the seeds were soaked in distilled water and bayleton (0.1 ppm) separately for 6 hours. Two phases were selected, in order to study the effect of water stress and bayleton treatment on the growth of *Vigna unguiculata* (L.) Var. Konkan Sadabahar as follows:

**Phase I: Germination:**

The germination tests were carried out in petridishes lined with Whatman no. 1. paper. Ten seeds which had been previously sterilized and soaked in D.W were placed in each petridish. Each of the petridish was supplied with 10 ml solution of PEG-6000 of various concentrations (0.0, -0.1, -0.25, -0.5, -0.6, -0.75 and -1.0 MPa) to induce water stress of different potential. The similar set was prepared for the seeds soaked in Bayleton (0.1 ppm). The petridishes were kept at room temperature. Visible emergence of radicle was taken as the criterion for germination. The samples were obtained at 24, 48, 72 and 96 hours.

**Phase II: Young plant stage: Stage I: 17 days old plants:**

After sterilization the seeds were soaked in D.W. and Bayleton (0.1 ppm) separately for 6 hrs. These soaked seeds were then sown in 15 cm diameter plastic pots filled with equal quantity of soil as follows.

a) **Control**: The seeds soaked in D.W. were sown in pots and were watered every day.

b) **Stress**: the seeds soaked in D.W. were sown in pots and were watered every day up to 7$^\text{th}$ day and then onward every 5$^\text{th}$ day i.e. on 12$^\text{th}$ and 17$^\text{th}$ day. Thus the stress cycle of 5 days were maintained.

c) **Stress to Bayleton soaked seeds**: The seeds soaked in bayleton were sown in pots and were watered every day up to 7$^\text{th}$ day and then onward every 5$^\text{th}$ day. Thus the stress cycle of 5 days were maintained.

d) **Stress (D.W. soaked seeds) with Bayleton spray (0.1 ppm)**: The seeds soaked in D.W. were sown in pots and were watered every day up to 7$^\text{th}$ day and then onward every 5$^\text{th}$ day i.e. on 12$^\text{th}$ and 17$^\text{th}$ day along with the foliar spray of 0.1 ppm bayleton. Thus the stress cycle of 5 days was maintained.

e) **Stress (Bayleton soaked seeds) with Bayleton spray (0.1 ppm)**: The seeds soaked in Bayleton were sown in pots and were watered every day up to 7$^\text{th}$ day and then onward every 5$^\text{th}$ day i.e. on 12$^\text{th}$ and 17$^\text{th}$ day along with the foliar spray of 0.1 ppm bayleton. Thus the stress cycle of 5 days was maintained.

Whenever the pots were watered, 200 ml of water was supplied to each pot. Six seeds were sown in each pot. Three sets of each treatment were maintained. Samples were collected after 17 days. The root system was gently taken out, stem and leaves separated carefully. These plant parts were washed repeatedly with distilled water to remove surface dirt, blotted dry and were used for analysis immediately.

**Stage II: 27 days old plants:**

The plants were grown in earthen pots under water stress as described above (Stage I). After 27 days the plants were collected. Root and leaves were separated carefully and were washed several times with distilled water to remove surface dirt, blotted dry and were used for analysis immediately. The proline content was estimated by the method of Bates et al. [11].
RESULTS AND DISCUSSION

Data pertaining to the effect of water stress on proline content in seeds and the effect of Bayleton treatment on proline content in the seeds (subjected to water stress) of *Vigna unguiculata* (Linn.) Var. Konkan Sadabahar at different hours of germination are presented in Table 1.

No significant change was observed in proline content of germinating seeds subjected to water stress and in germinating seeds subjected to water stress with Bayleton treatment at 24, 48 and 72 hours of germination. However, at 96 hours of germination an increase in proline content was observed in Bayleton treated germinating seeds (subjected to water stress) in comparison to germinating seeds subjected to water stress at different levels of water stress (-0.1, -0.5, -0.6, -0.75 and -1.0 MPa).

Data pertaining to the effect of water stress and Bayleton treatment on proline content in root, stem and leaf of 17 and 27 days old plants (subjected to water stress) of *Vigna unguiculata* (Linn.) Var. Konkan Sadabahar are presented in Table 2. At 17 DAS, the proline content in root (788.73 µg/g fresh tissue) of plants subjected to water stress with bayleton treatment [bayleton spray (0.1 ppm)] showed an increase in comparison with root (489.20 µg/g fresh tissue) of plant subjected to water stress.

At 17 DAS, an increase in proline content was observed in stem (913.50 µg/g fresh tissue) and leaf (378.00 µg/g fresh tissue) of plants subjected to water stress with bayleton treatment [bayleton spray (0.1 ppm)] in comparison with stem (472.50 µg/g fresh tissue) and leaf (294.00 µg/g fresh tissue) of plants subjected to water stress. However, decreased proline content was

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<thead>
<tr>
<th>Water Potential (MPa)</th>
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<td>24 Hrs. DW</td>
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<td>96 Hrs. DW</td>
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Table 2: Effect of water stress and bayleton treatment on Proline content in root, stem and leaf of 17 and 27 days old plants of *Vigna unguiculata* (Linn.) Var. Konkan Sadabahar. A: Control, B: Stress, C: Stress to Bayleton soaked seeds, D: Stress (D.W. soaked seeds) + Bayleton spray (0.1 ppm), E: Stress (Bayleton soaked seeds) + Bayleton spray (0.1 ppm), Values expressed as µg of proline/g fresh tissue. Values expressed are average of three determinants.
observed in stem (430.50 µg/g fresh tissue) and leaf (210.00 µg/g fresh tissue) of plants subjected to water stress with bayleton treatment [bayleton soaked seeds] in comparison with stem (472.50 µg/g fresh tissue) and leaf (294.00 µg/g fresh tissue) of plants subjected to water stress.

At 17 DAS, the proline content in root (251.08 µg/g fresh tissue) stem (304.50 µg/g fresh tissue) and leaf (136.50 µg/g fresh tissue) of plant subjected to water stress with bayleton treatment {bayleton soaked seeds + bayleton spray (0.1 ppm)} decreased in comparison with root (489.20 µg/g fresh tissue), stem (472.50 µg/g fresh tissue) and leaf (294.00 µg/g fresh tissue) of plants subjected to water stress and the content was higher in comparison to control (the values being 42, 73.5, 157.5 µg/g fresh tissue in root, stem and leaf respectively).

At 27 DAS, an increase in proline content was observed in root of plants subjected to water stress with bayleton treatment {bayleton soaked seeds, bayleton soaked seeds + bayleton spray (0.1 ppm)} in comparison with root of plants subjected to water stress. However, a decline in proline was observed in root (1974.00 µg/g fresh tissue) of plants subjected to water stress with bayleton treatment {bayleton spray (0.1 ppm)} in comparison with root (2117.50 µg/g fresh tissue) of plants subjected to water stress.

An increase in proline content was observed in stem of 27 days old plants, subjected to water stress with bayleton treatment {bayleton spray (0.1 ppm), bayleton soaked seeds + bayleton spray (0.1 ppm)} in comparison with stem of plants subjected to water stress. However, decrease in proline content was observed in stem (1291.50 µg/g fresh tissue) of plants subjected to water stress with bayleton treatment [bayleton soaked seeds] in comparison with stem (1554.00 µg/g fresh tissue) of plants subjected to water stress.

Proline content in leaf of 27 days old plants subjected to water stress with bayleton treatment {bayleton soaked seeds, bayleton spray (0.1 ppm), bayleton soaked seeds + bayleton spray (0.1 ppm)} showed an increase in comparison with leaf of plant subjected to water stress.

It is widely accepted that water deficit enhances accumulation of proline in many plant species [12-14]. It has been observed that decrease in proline oxidation contribute to the proline accumulation during water stress [15,16]. Stewart [17] while discussing about the biochemical aspects of proline accumulation concluded that although stress is a single prominent trait, it is resulted due to several associated responses. The increase of free proline, is attributed to the osmotic adjustment [18], in which Vigna unguiculata, under water stress, has low hydric potential and in reply elevated the levels of proline aiming at tolerating the abnormal situation to which it is submitted [19].

REFERENCES

Patil et al.


