

silydanin (while MS media supplemented with 1.0 mg/l of 2iP gave 0.71% for silybin and 0.27 % for silydanin .On the other hand, the *in vivo*) wild) grown shoots of *S. marianum* gave 1.07 % for silybin and 0.47 % for silydanin .In studying carbon source effect on the *in vitro* multiplication and silymarin content, glucose gave the highest number (4.4) of shoots and the maximum shoot height (10.6 cm), and the largest amount 1.63 % of silymarin content.

**Key words:** *In vitro*, metabolites, milk thistle, propagation, *Silybum marianum*.

#### 4.9 Effects of Salt Stress (KCl, CaCl<sub>2</sub>) on In-Vitro Hyoscyamine Production from *Datura* Hairy Roots

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**Abstract:** Several species of *Datura* genus are cultivated for their tropane alkaloid contents. However, the hyoscyamine production in open field is limited by the environmental conditions. The culture of hairy roots obtained by inoculation of *Datura* explants with the *Agrobacterium rhizogenes* A4 strain offered promising prospects for the *in vitro* production for this molecule. After the selection of effective root lines, the objective of this study is to optimize the hyoscyamine production by applying of salt stress. Potassium chloride and calcium chloride used as elicitors with various elicitation times reveal significant effects on hyoscyamine biosynthesis. The optimal concentration of KCl is 2 g/l combined with a contact time of 10 hours for the line L<sub>DT</sub> and 24 hours for the lines L<sub>DS</sub> and L<sub>DI</sub>. For CaCl<sub>2</sub>, it is 2 g/l for the lines L<sub>DS</sub> and L<sub>DT</sub> with respectively elicitation times of 10 hours and 24 hours. For the line L<sub>DI</sub>, it is with the concentration of 1 g/l and 24 hours elicitation time of CaCl<sub>2</sub>, that the most significant result is recorded. The improvement levels of hyoscyamine content compared to the non-elicited controls are respectively 2.32, 1.99 and 1.85 fold for the lines L<sub>DS</sub>, L<sub>DT</sub> and L<sub>DI</sub> elicited with KCl and 2.08, 2.07 and 1.85 fold for L<sub>DS</sub>, L<sub>DT</sub> and L<sub>DI</sub> elicited with CaCl<sub>2</sub>. The line resulting from *D. tatula* elicited with CaCl<sub>2</sub> is most productive in hyoscyamine (16.978 mg/g DW). It is followed by the line of *D. innoxia* elicited with CaCl<sub>2</sub> then that of *D. stramonium* elicited with KCl.

**Key words:** *Agrobacterium rhizogenes*, *Datura*, hairy roots, hyoscyamine, salt stress.

#### 4.10 Effects of Chemical Fertilizers on Quantitative and Qualitative Yield of Cumin (*Cuminum cyminum* L.)

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**Abstract:** Cumin is an important medicinal plant and its cultivation in arid and semi-arid parts of Iran which water is a serious constraint to agricultural production has a high economical feasibility. Effects of nitrogen fertilizer in three levels (0, 25, 50 kg.ha<sup>-1</sup> from urea) and phosphorous fertilizer in three levels too (0, 40, 80 kg.ha<sup>-1</sup> from super phosphat triple) on the yield, yield components and essential oil yield of Cumin was investigated. The experiment was a factorial on the basis of randomized complete block design with three replications conducted at Shaded University, Tehran, Iran in 2010-2011. Results showed that there were significant differences between these two fertilizers for yield, seed yields components, biological yield, essential oil yield, and harvest index (HI) at 1% level while it was not significant for plant height. Maximum number of umbels per plant, seed per umbel, biological yield, seed yield, harvest index (HI), 1000 seeds weight and essential oil yield were related to 25 kg of N per ha. Plant height was not affected by N fertilizer significantly. Maximum number of umbels per plant, seed per umbel, biological yield, seed yield, harvest index (HI), 1000 seeds weight and essential oil yield were related to 50 kg of P per ha.