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Irradiated-Chitosan and Methyl Jasmonate Modulate the Growth, Physiology and Alkaloids Production in Catharanthus roseus (l.) G. Don.

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Abstract : Oligomers, obtained by exposing the natural polysaccharides (alginate, carrageenan, chitosan, etc.) to cobalt-60 generated gamma radiation may prove as potent plant growth promoters when applied as foliar sprays to the plants. They function as endogenous growth elicitors, triggering the synthesis of different enzymes and modulating various plant responses by exploiting the gene expression. Exogenous application of Jasmonic acid or of its methyl ester, methyl jasmonate (MeJ) has been reported to increase the secondary metabolites production in medicinal and aromatic plants. Keeping this in mind, three pot experiments were conducted to test whether the foliar application of irradiated-chitosan (IC) and MeJ, applied alone or in combination, could augment the active constituents as well as growth, physiological and yield attributes of Catharanthus roseus, which carries anticancer alkaloids, viz. vincristine and vinblastine, in its leaves in addition to various other useful alkaloids. Totally, 5 spray treatments, comprising various aqueous solutions of IC [20, 40, 80 and 160 mg L-1 (Experiment 1)], MeJ (10, 20, 30 and 40 mg L-1 (Experiment 2)] and those of IC+MeJ [40+20, 40+30, 80+20, 80+30, 160+20 and 160+30 mg L-1 (Experiment 3)], were applied at seven days interval. Total leaf-alkaloids content as well as growth, physiological and yield parameters, evaluated at 120 days after sowing, were significantly enhanced by IC application. IC application could not increase the leaf-content of vincristine and vinblastine; nonetheless, it significantly augmented the yield of these alkaloids owing to enhancing the dry mass of leaves per plant. MeJ application, particularly at 30 mg L-1, increased both content (17%) and yield (48%) of total leaf-alkaloids as well as the content and yield of vincristine (29 and 63%, respectively) and vinblastine (14 and 44%, respectively) alkaloids, though it significantly decreased most other parameters studied, particularly at higher concentrations (30 and 40 mg L-1 of MeJ). As compared to the control (water-spray treatment), collective application of IC (80 mg L-1) and MeJ (20 mg L-1) resulted in the highest values of most of the parameters studied. However, 80 mg L-1 of IC applied with 30 mg L-1 of MeJ gave the best results for the content and yield of total as well as anticancer leaf-alkaloids (vincristine and vinblastine). Comparing the control, it increased the content and yield of total leaf-alkaloids (37 and 118%, respectively) and those of vincristine (65 and 163%, respectively) and vinblastine (31 and 107%, respectively). Conclusively, the applied technique significantly enhanced the production of total as well as anticancer alkaloids of Catharanthus roseus.

Keywords : anticancer alkaloids (vincristine and vinblastine), catharanthus roseus, irradiated chitosan, methyl jasmonate
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