MORPHOGENETIC RESPONSES OF ETHREL TREATMENTS IN MEDICINAL SOLANUMS

ABSTRACT

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Solasodine yielding Solanums (S. khasianum and S. indicum) are of economic value as a source of raw material for the manufacture of steroids. But commercial cultivation of these plants is not feasible at present as berry and alkaloid yield is not very good. Plant growth substances are known to influence plant growth and development, and secondary plant products in plant species. Ethylene, a gaseous plant hormone also influences various aspects of seed germination, plant growth, development, differentiation and sex expression and causes male sterility. 2-Chloroethanephosphonic acid (Ethrel) on decomposition in plant tissues releases ethylene and produces ethylene-induced responses in plants. As effects of ethylene on plant growth and development of S. khasianum and S. indicum have not been studied, an attempt was made here to study ethylene effects in these plants using ethrel. Ethrel was applied in two ways: seed treatment (S treatment) and S+2+4 treatment (seed treatment + foliar sprays at 2 and 4 leaf stages). The concentrations used were 100, 250, 500 and 1000 ppm of ethrel (active principle 39.2%) manufactured by M/s. Agromore Ltd., Bangalore.

Seeds of S. khasianum and S. indicum treated with ethrel germinated earlier than control, exhibited faster rate of seed germination and improved germination percentage. The optimal concentration of ethrel for S. khasianum seeds was 250 ppm while 500 ppm was best for S. indicum seeds. The present

study also suggests that removal of abscisic acid block by kinetin for ethylene action is not always a prerequisite. Similarity between ethrel and auxin effects on germination of seeds in plant species is suggested.

In the present study, ethrel-induced stimulation of plant growth (height, number of leaves, leaf area and petiole length) in S-treated plants was evident. The treatment was less effective in S. indicum as only height and number of leaves were altered significantly. Repeated treatments also stimulated plant growth in S. khasianum while in S. indicum leaf area and petiole length were inhibited. Branching was stimulated by repeated treatment in both the species which confirms that ethylene breaks apical dominance. Ethylene-induced stimulation of plant growth is not common amongst di-cotyledonous plants. Thus S.,khasianum and S. indicum may be exceptions. The lamina and petiole of the leaves produced on treated S. khasianum plants were less spiny, compared to control. The spine intensity of the lamina and petiole in S. indicum was, however, not influenced. In treated S. khasianum the reduction of spine intensity was due to increase of lamina and petiole size. The spine number was not affected by ethrel concentrations except 1000 ppm, when used repeatedly. However, in S. indicum repeated treatments of ethrel reduced the number of spines on lamina (250 - 1000 ppm) and petiole (1000 ppm). Thus compared to S treatment, repeated treatment is more

effective in reducing the spine number. Spine size was also inhibited by repeated treatments in both the species whilst S treatment was not very effective in reducing the size of the spines.

Berry yield in the treated plants did not differ from the control. But berries of the treated plants had more fresh and dry weight compared to control. The effect was more evident in S. indicum compared to S. khasianum. Berry size in the ethrel treated plants of S. khasianum was not different from control but treated plants of S. indicum bore smaller berries than control. Alkaloid content of the berries was altered significantly. Alkaloid content of S. khasianum berries in ethrel treated S-plants increased at 100 - 500 ppm concentrations but decreased at 1000 ppm. Repeated treatments, however, reduced the alkaloid content of the berries in this species. On the other hand, in S. indicum the alkaloid content was more than control in the berries of both S (250 and 500 ppm) and S+2+4 (250 ppm) treated plants. Thus alkaloid content of the berries can be increased with appropriate concentation which varies from species to species. Compared to repeated treatments, seed treatment was more effective for the improvement of alkaloid content in the berries of treated plants.

In both the species flowering was usually delayed in plants given repeated treatments; the more the ethrel concentration the more the delay. Ethrel-induced floral abnormalities

by increasing or decreasing stamen and aborting pistils at primordial level.

Ethrel treatments although could not induce full male sterility, the production of non-viable pollen was more in the treated plants. Compared to S treatment, repeated treatments were more effective in inducing sterility. Non-viable pollen production usually increased with increase in ethrel concentration. However, 100 ppm of ethrel given as S treatment improved pollen viability, as was evident from pollen germination, in S. indicum. Thus ethrel concentrations only above the threshold level can cause male sterility. If used below the threshold level, the pollen viability may be enhanced. Further, the threshold concentration varied with the species. Ethrel concentrations inhibited pollen tube elongation. The present study thus indicates that the mechanism of pollen germination and pollen tube elongation may not necessarily be different always as suggested for Arachis hypogea. It also brings out the fact that inhibition of pollen germination due to direct incorporation of ethrel in the germinating medium is not a result of increased acidity of the medium, rather it is an effect of the released ethylene.

Ethrel treatments did not influence heterostyly (production of long and short styled flowers), in S. khasianum though the number of short style flowers increased in the treated plants. The present study also provides indirect evidence that the

kinetin level may determine production of long and short styles. Ethrel treated apical meristems usually had a better developed corpus compared to control. The effect of ethrel treatment on cell shape, cell size and expansion generally revealed a reduction of length, an increase in radial expansion and a decrease in cell area. This is a reflection of inhibition of cell growth and modification of cell wall structure due to reorientation of cellulose microfibrils, in the treated cells.

Although pattern of differentiation and organization of the axillary bud meristems was not influenced in the treated plants, the growth of axillary buds by cell division was inhibited in S-treated bud meristems while it was stimulated by repeated treatments. The stimulation of bud growth in the repeatedly treated plants rather than a direct effect is considered to be an indirect effect of the loosening of apical dominance due to ethrel application. Shell zone in treated bud meristems was not influenced much.