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EFFECT OF PHLORIDZIN ON THE GROWTH, DEVELOPMENT AND GLYCOALKALOID CONTENTS OF *SOLANUM VIARUM* DUNAL

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ABSTRACT

Phloridzin, a chalcone derivative possessing plant growth regulating properties was applied as foliar sprays at fortnightly intervals on *Solanum viarum* Dunal plants grown under pot culture conditions starting from early seedling to the flowering and fruiting of the plants. The treatments consisted of 0 (control), 1, 10, 100 and 1000 mg/l of phloridzin.

The physiological effects of phloridzin at different concentrations on the vegetative growth and development and the glycoalkaloid contents of the berries were studied.

It was concluded that phloridzin at the highest concentration stimulated plant height, leaf number and yield of berries, whereas the lowest concentration increased the yield of solasodine only.

INTRODUCTION

It is well established that phloridzin, the phenolic glycoside induces glycosuria in experimental animals and man by increasing blood sugar level (Geissman, 1955; Skinner, 1955). In plants, Marré (1950) and Marré and Servettaz (1955) have detected that phloridzin doubles the photosynthetic rate in *Elodea* while Raven (1968) has recorded 30 per cent stimulation of photosynthesis using isolated chloroplasts of *Hydrodictyon africanum*. These observations lead to the assumption that phloridzin may have the capacity of increasing sugar content in other plants also. Since sugar is one of the basic precursors or building materials for the biosynthesis of various secondary plant metabolites (Neish, 1960; Pridham, 1965), it is likely that increase of sugar content by application of phloridzin in steroid yielding plants may lead to the formation in them of greater quantity of metabolites as glycoalkaloids or steroids, since alkaloids are formed in competition with other demands upon the nitrogen and carbohydrate stocks of the plant (James, 1946) and since most of the glycoalkaloids or steroidal sapogenins are nothing but aglycones with sugar moiety and are synthesized *in vivo* as glycosides (Heftmann, 1963; Guseva *et al.*, 1963). Heftmann (1967) quoting Marker and Lopez's (1947) view, further stresses the hypothesis that sapogenins are synthesized in the plants from sugars. The critical dosage of phloridzin by which greater yield of alkaloids or sapogenins from a particular drug yielding plant may be obtained through the regulation of carbon assimilation, is, of course, a matter of trial and observations.

The present investigation was undertaken on the effect of phloridzin on *Solanum viarum* Dunal (*S. khasianum* Clarke var. *chatterjeeanum*), the plant yielding the alkaloid, solasodine with the object that the chemical by stimulating photosynthetic efficiency and thereby increasing the sugar accumulation in plants may affect and accelerate the metabolic pathways leading to the formation of greater quantity of alkaloids.

MATERIAL AND METHODS

The seedlings raised in nursery beds were transplanted at three leaf stage to 25 cm earthenware pots filled with soil and farmyard manure mixed in the ratio of 3: 1. Each pot contained one healthy seedling.

Freshly prepared aqueous solutions of phloridzin in the concentrations of 0, 1, 10, 100 and 1000 mg/l were applied as foliar sprays at fortnightly intervals throughout the crop growth period beginning with 3-leaf stage of the seedlings. Tween 80 (polyoxyethylene sorbitan monooleate) in a concentration of 0.1 per cent was added to all the spraying solutions as wetting agent. For each treatment, 20 pots were taken as replicates and 250 ml of the test solution of a particular concentration was sprayed uniformly upon the replicated plants preferably at the apical regions.

Plants were raised under optimum cultural conditions.

Plant height, leaf number and fruit number were recorded regularly. Berries were harvested when they assumed yellowish green to pale yellow colour. 5th, 10th and 15th leaves from each plant were plucked at maturity for measuring leaf area, fresh and dry weights and percentage of moisture content. The fresh weight, dry weight and diameter of berries were recorded after harvesting.

Solasodine content of the berries were estimated either from the fresh or dry samples and was always expressed as percentage of dry weight.

The method of estimation of alkaloid was essentially the same as followed by Chaudhury and Hazarika (1966) with some modifications. The solasodine obtained through the given procedures was finally purified with activated charcoal by the conventional charcoal purification method.

RESULTS AND DISCUSSION

The effect of phloridzin on *S. viarum* was significant in case of plant height (Table 1) and number of leaves (Table 2). The effects were marked during the middle of growth and development of the plant. With regard to plant height and leaf emergence phloridzin at 1000 mg/l concentration played almost always a stimulating role, whereas at 100, 10 and 1 mg/l, it either seemed to have no effect or was slightly inhibitory. The chemical at 100 mg/l concentration significantly retarded leaf emergence as compared to other treatments as well as the untreated controls. Neither the leaf area nor the nature of spines was altered by any of the phloridzin treatments. Fruit size, fresh and dry weight was also not effected (Table 3). In case of fruit yield,

TABLE - 1

Height (cm) of *Solanum viarum* Dunal plants as affected by different concentrations of phloridzin

Treatments (mg/l)	Age of the plants in days						
	30	45	60	75	90	105	135
1000	3.26	4.98	8.75	13.11	23.75	33.15	52.05
100	2.90	4.50	7.56	11.35	19.75	30.12	48.15
10	3.05	4.59	7.56	11.05	19.90	30.55	48.47
1	3.08	4.72	7.25	11.20	20.02	31.75	49.05
Control	2.95	4.66	7.45	11.85	21.97	32.94	49.57
S.E. ±	0.184	0.195	0.264	0.458	0.772	0.843	1.138
C.D. at 5% P	N.S.	N.S.	0.740	1.283	2.164	2.363	N.S.

N.S.=Not significant.

TABLE-2

Number of leaves of *Solanum viarum* Dunal treated with different concentrations of phloridzin

Treatments (mg/l)	Age of the plants in days							
	30	45	60	75	90	105	120	135
1000	4.25	7.60	8.95	12.55	35.15	65.00	96.10	122.60
100	4.45	7.30	8.45	11.90	26.00	55.00	81.85	117.40
10	4.05	6.75	8.00	11.45	28.30	59.10	94.10	124.00
1	4.20	6.55	7.60	10.70	30.20	62.50	92.45	121.40
Control	4.55	6.65	8.00	11.80	31.65	62.95	95.05	124.00
S.E. ±	0.155	0.152	0.211	0.182	0.351	0.400	0.427	0.672
C.D. at 5% P	N.S.	0.426	0.591	0.510	0.983	0.117	1.196	N.S.

N.S.=Not significant.

TABLE-3

Diameter (cm), fresh weight (gm) and dry weight (gm) per berry, total yields of berries per treatment and solasodine content (as per cent dry weight).

Treatments (mg/l)	Diameter	Fresh weight	Dry weight	Total yield of berries (per 20 plants)	Solasodine content
1000	2.43	6.01	1.060	543	1.211
100	2.45	6.06	1.125	435	1.340
10	2.38	5.75	1.006	391	1.600
1	2.35	5.44	0.945	406	2.049
Control	2.35	5.77	0.926	435	1.457
S.E. ±	0.058	0.550	0.166	15.639	
C.D. at 5% P	N.S.	N.S.	N.S.	43.319	

N.S.=Not significant.

phloridzin at 1000 mg/l played a significant role; the total yield of berries was increased by 24.82 per cent over the untreated control (Table 3). The regression coefficient between the berry yields and the concentration of phloridzin was significant (>0.9) indicating a high degree of goodness of fit and the results computed are given in the regression curve (Fig. 1).

The solasodine content of the berries from different treatments is given in Table 3. It shows that phloridzin at the lowest concentration accelerated greater accumulation of solasodine in the berries. The chemical at 10 mg/l also increased the steroid content slightly. But in high dosages the solasodine content was considerably reduced.

It is interesting to note that while phloridzin in high concentration stimulated vegetative growth and development of *S. viarum* but in low dosages although apparently did not stimulate any vegetative function, it increased production of steroid alkaloid.

Although there are inconsistencies as

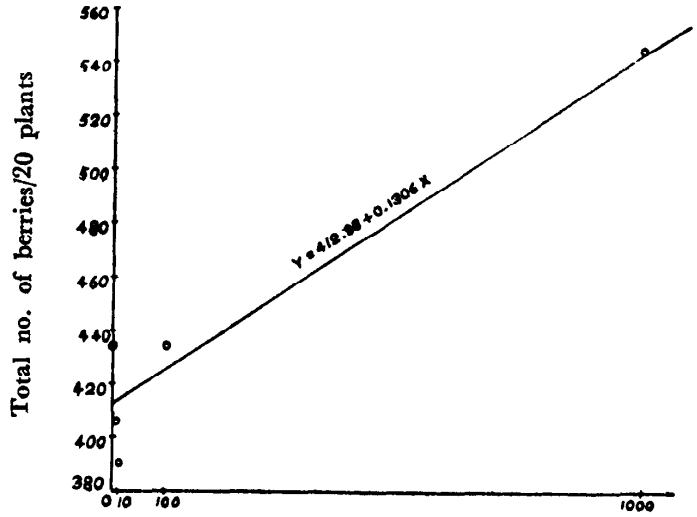

Fig. 1 : Relationship between the effect of different concentrations of Phloridzin and the yield of berries per 20 plants ($R^2 \times y=0.9183$, $R \times y=0.9582$)

regards the yield of solasodine from the plants studied by different authors (Chaudhury and Hazarika, 1966; Choudhury and Rao, 1964; Janaki Ammal and Bhatt, 1971; Maiti, 1964; Maiti *et al.*, 1964; Maiti, 1968; Saini *et al.*, 1965; Saini, 1966; Saini and Biswas, 1967), the present investigation on the influence of phloridzin on increased production of solasodine seems to be rewarding; since the results show that phloridzin at 1 mg/l increased solasodine content by 0.592 per cent and at 10 mg/l by 0.143 per cent over control. The rest two concentrations slightly reduced solasodine production, but the greater yield of berries per plant in 1000 mg/l appeared to increase the total solasodine production and thus interesting from the view point of commercial exploitation.

It seems clear from the results that the solasodine yield from *S. viarum* maintained a clear congruity with phloridzin concentrations in inverse sequence. Phloridzin in lowest concentration gave highest solasodine yield, in next higher concentration it yielded solasodine in next lower quantity and so on in this order. This variation of solasodine content probably depends on the variation in the synthesis of sugar by the differential photosynthetic efficiency under the influence of phloridzin. Sugar being one of the important basic precursors involved in the metabolic functions for the synthesis of alkaloid (Heftmann, 1967).

From the above experimentations, it may be concluded that phloridzin has got some beneficial effects on the growth, development and glycoalkaloid production in *Solanum viarum*. More investigations need to be undertaken to trace the mechanism of action of phloridzin in the regulatory pathways of this potent medicinal plant.

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