COMPARATIVE STUDIES ON THE INTRODUCTION AND PERFORMANCE OF *SOLANUM KHASIANUM* CLARKE AND *SOLANUM MAMMOSUM* L. AT MEDICINAL PLANTS FARM PESHAWAR

Anwar Ahmad Khan & Shakeel Haider Zaidi*

Abstract

Solanum khasianum and *Solanum mammosum* are well-known for their solasodine content, which is the precursor for the preparation of cortisone. To assess the possiblities of their acclimatization and cultivation, yield trials with various spacings were conducted for three consecutive years i.e., from 1982 to 1984 at Peshawar. *S. mammosum* though gave higher yield of fresh berries (1033 kg/ha) as compared to *S. khasianum* (746 kg/ha) but *S. mammosum* was found to be highly susceptible to black shank disease caused by Phytophthora spp. during 1984, whereas *S. khasianum* was resistant. Chemical analysis of berries depicted higher percentage of solasodine content (2.65%) in *S. khasianum* as compared to *S. mammosum* (1.5%). The result of chemical analysis are in confirmity with Atal and Kapoor 1977. Spacing of 75 X 75 cm was found to be suitable in both the species. *S. khasianum* on the basis of better performance and resistance to black shank disease could be recommended for cultivation by pharmaceutical concerns under Peshawar climatic conditions.

Introduction

Glycoside (solasodine) rich Solanum species have gained commercial importance through out the world for the preparation of steroid drugs such as steroidal hormone and cortisone.

Screeing of a number of Solanum species throughout the world resulted in the selection of *Solanum mammosum, S. khasianum,* and *S. aviculare* based on higher solasodine content ranging from 1 to 3% (4, 2). Inspite of the fact that most of the Diosgenin in the world (400–600 tonnes per annum) is extracted from sapogenin bearing Dioscorea species, there is a dire necessity to look at other alternate sources (i.e., Solanum and other plant species), because of long-time (3–6 years) taken by Dioscorea species for attaining 3 –4% level of Diosgenin and also higher cost of cultivation. Solanum species in this respect are a potential raw material which can be cultivated under a wide range of climatic conditions(2).

Pakistan due to its varied climate could be quite suitable region for cultivation of glycoside rich Solanum spps. Keeping in view, their economic importance and potential for development as an industrial crop, introduction and cultivation trials were conducted for three conscutive years (1982 to 1984) at the Medicinal Plants Farm, Peshawar; climatic conditions of which are very congenial and comparable to the sub-tropical conditions of native habitats of both exotic species.

*The authors are Medicinal Plant Botanist and Assistant Economic Botanist at Pakistan Forest Institute, Peshawar respectively.

Review of literature

Solasodine was first reported by Oddo in 1905 (6) to occur in the berries of *Solanum sodomeum*. Subsequently its presence has been reported in various Solanum spps. by various workers in Hungary, Russia, Bulgaria, Czechoslovakia, Yogosalvia, Poland, Romania, China and India. These workers after screening isolated three solasodine rich species namely *Solanum khasianum, S. aviculare* and *S. laciniatum,* which are native of India, Australia and Newzealand respectively (7). Sharma *et al* in 1979 (8) found that solasodine content in *S. kahasianum* increased with age of berry, reaching its maximum level 80 days after fertilization when berry started turning yellow. Breadley *et al* (3) conducted extensive work on chemical analysis of 85 indigenous and exotic Solanum, spp. in Australia. They isolated three species; *Solanum aviculare, S. mammosum* and *S. laciniatum* having highest content of solasodine. Marti *et al* in 1979 (4) cultivated 31 species of Solanum in India. They analysed leaves and fruits of these species for total alkaloid content and solasodine percentage Later they found that three species namely *S. khasianum, S. aviculare* and *S. giganateum* contained sufficient quantity of total alkaloids.

Materials and methods

Seeds of *S. mammosum* and *S. khasianum* were procured from Peru (South America) and India. Seeds viability of two exotic species were tested in laboratory, which was 94% in *S. khasianum* and 88% in case of *S. mammosum* respectively at Peshawar. Later seeds of each species after soaking in water for two hours were sown in 2000 polythene tubes (size 5 x 12 cm) containing a mixture of sand, manure and soil (33% each) during last week of January every year. Watering was provided immediately after sowing with water-cane fixed with a rose sprinkler. Subsequent waterings were given twice a day (i.e. morning and evening). *S. khasianum* seeds started germination after 12 days and continued to germinate upto 35 days, whereas seeds of *S. mammosum* germinated after 18 days and it took 44 days for complete germination. The seedlings were looked after properly for 3 months in the nursery. An experiment was set up in split plot design having three replicatons with two species as major treatment and four spacings were minor treatments. Size of the sub-plot was kept as 30 m^2. 90 seedlings were planted in 50 x 50 cm spacing, 60 seedlings in 75 x 75 cm, 25 seedlings in 100 x 100 cm and 16 m 125 x 125 cms. respectively during the second week of April every year as per experimental design. First irrigation (10 cm) was provided immediately after planting and ten subsequent irrigations, at fortnight interval, were given to the crop upto the end of November, providing a total depth of 90 cm. In addition, 400 mm. average annual rain was received. Survival percentage of both under-trial species recorded in early stage of growth, ranged from 85 to 90%. Mortality gaps of young plants in each treatment was kept constant. Weeding and hoeing were given to the corp during the month of May and July and after each hoeing a uniform dose of 50 kg N/ha in the form of urea was applied as side dressing to the crop. Experimental plots were irrigated immediately after fertilizer application. Two plucking of leaves from each specie was obtained in August and November. The crop was harvested when the berries (fruits) assumed a light yellowish green colour. Survival percentage observed at tht time of maturity was 98% in *S. khasianum* while it was 95% in case of *S. mammosum*. The

berries were harvested in October and December every year and yield of fresh berries of two under-trial species were recorded in kg/plot.

Results and Discussion

Comparative mean yield of fresh berries in kg/plot (30 cm^2) of two Solanum spps. as affected by various spacing treatments.

Spacing (cm)	Species		Mean	Pooled mean for spacing
	S. khasianum	*S. mammosum*		
		1982		
50 x 50	2.40	3.43	2.92	–
75 x 75	2.80	4.13	3.47	–
100 x 100	1.85	2.80	2.33	–
125 x 125	1.49	2.68	2.09	–
Mean	2.13	3.26	–	–
		1983		
50 x 50	2.62	3.57	3.10	–
75 x 75	2.67	3.53	3.10	–
100 x 100	1.82	2.58	2.20	–
125 x 125	1.89	2.07	1.98	–
Mean	2.25	2.94	–	–
		1984		
50 x 50	2.72	2.91	Since the crop was heavily	
75 x 75	2.75	3.10	attacked by black shank	
100 x 100	1.96	2.16	disease (Phytophthora spp).	
125 x 125	1.91	1.99	Therefore the results	
Mean	2.34		were not accounted for.	
Pooled mean for species	2.24	3.10	(two year average)	
LSD at 5% for:	1982	1983	1984	Pooled
species	0.989	0.662	–	0.882
Spacing	0.411	0.671	0.488	0.658
Species x spacing	NS	NS	–	NS

The results indicated that *S. mammosum* though gave significantly higher yield of fresh berries (1033 kg/ha) as compared to *S. khasianum* (720 kg/ha) in two consecutive years. But during third year of trial it was damaged as a result of severe attack of black shank disease caused by Phytophthora spp. whereas *S. khasianum* was found to be resistant to the disease.

It was further observed that plants of both species when spaced at 75 x 75 cm. gave a significant increase in the yield of fresh berries (1095 kg/ha) as compared to other spacings viz. 100 x 100 and 125 x 125 cm. (744 and 650 kg/ha) respectively. No significant difference was observed in the mean fruit yield of 50 x 50 and 75 x 75 cm spacing treatments. The 75 x 75 cm spacing was suitable as it utilized 20% less of planting material and saved labour expenditure incurred during planting operation. More over, as the plants are spiney, interculture and fruit plucking operations become easier to perform at 75 x 75 cm spacing.

Leaf and fruit samples of two Solanum spps were analysed at the Chemistry Branch for solasodine contents.

Solasodine content of Solanum spp.

Name of spacies	Solasodine percentage	
	Leaves	Berries
S. khasianum	0.41	2.65
S. mammosum	0.55	1.50

S. khasianum appears to have a fair amount of solasodine (2.65%) as compared to *S. mammosum* (1.50%). On comparasion the solasodine content present in Indian species ranged from 2 to 3% while it varied from 1 to 2% in the berries of *S. mammosum* (2, 3).

Yield of fresh berries of two Solanum spp. under optimum spacing were calculated on one hectare basis to determine the expected net income from crop as follows:

Economic aspect of growing Solanum species

Name of species	Leaves* yield kg/ha	Fruits yield in kg/ha	Cost of cultivation	Gross income from yield of leaves & berries	Net income
S. khasianum	838	915	3450	6328	2878
S. mammosum	784	1116	3450	5248	1798

* Considering the rate of leaves as Rs. 1/kg, while rate of fresh berries of *S. khasiamum* and *S. mammosum* as Rs. 6/kg and Rs. 4/kg respectively, calculated on solasodine content basis.

Solanum khasianum though gave lower yield of fresh berries but the solasodine content (2.65%) was high as compared to *S. mammosum* (1.50%). It was also found to be resistant to (Phytophthora sp) root-rot disease, whereas *S. mammosum* was susceptible to the disease at later stages of development in the third year of growth and therefore *S. mammosum* is not considered suitable for cultivation under Peshawar climatic conditions.

Conclusions

Solanum khasianum was found to be more suitable for cultivation under irrigated and climatic conditions of Peshawar due to its resistance to diseases and higher solasodine content as compared to *Solanum mammosum.* The crop is a promising potential raw material for the production of steroids at comparatively low cost of cultivation.

It is, therefore suggested that pilot-scale cultivation of *S. khasianum* may be tried as a specialised crop by interested pharmaceutical firm intending to make end products from the crop as is being done in developed countries.

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