Indian Journal of Fundamental and Applied Life Sciences ISSN: 2231-6345 (Online)
An Online International Journal Available at http://www.cibtech.org/jls.htm
2012 Vol. 2 (2) April-June, pp.202-206/Mondal and Ghanta
Research Article

EFFECT OF SUCROSE AND BORIC ACID ON IN VITRO POLLEN GERMINATION OF *SOLANUM MACRANTHUM* DUNAL

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ABSTRACT
The present investigation reveals the effect of sucrose and boric acid on *in vitro* pollen germination of "giant potato tree" *Solanum macranthum* Dunal belonging to the family Solanaceae, having antimicrobial activity. Flowers open in the early morning (5.00 hrs.-7.30 hrs.) after which anther dehiscence take place. The maximum 98% pollen germination along with 427 μm long pollen tube developed in 15% sucrose solution supplemented with 100 ppm boric acid. Pollen grains which were collected in the morning (6.00 hrs.- 8.00 hrs.) showed best results.

Key Words*: *Pollen Germination, Pollen Viability, Pollen Tube, Solanum Macranthum

INTRODUCTION
Solanum species (family: Solanaceae) comprises of 1,700 species which are commonly found in the temperate and tropical regions of the world. Solanum macranthum Dunal (Syn. Solanum wrightii Benth.) or 'giant potato tree' is a shrubby ornamental plant and native of South America. Tolerance to many bacterial and fungal diseases has been reported. When applied to surfaces of plants, they inhibit the growth of bacteria and fungi. Solasodine and other steroidal alkaloids have been isolated and characterized from the plant (Fayez and Saleh, 1967; Hardman, 1969; Walker and Edwards, 1999). This plant also has antimicrobial activity (Olayemi *et al.*, 2011). Pollen grains, being the sexual reproductive unit and the carrier of male genetic material in higher plants, play a vital role in breeding programme and assists successful fruit-set. High crop yield generally depends on viable pollen grains. Pollen fertility and viability have a paramount importance in hybridization programme. Pollen performance in terms of germinating ability may have the relative importance upon not only fruit-set but also the flower-flower and flower-pollinator interaction. The present work is aimed to estimate the effect of sucrose and boric acid on in vitro pollen germination of Solanum macranthum belonging to the family Solanaceae.

MATERIALS AND METHODS
For the study of *in vitro* pollen germination, newly opened flowers were collected in the morning (6.00 hrs.-8.00 hrs.) and transferred to polythene bag. *In vitro* pollen germination was studied to know the effect of nutrients like sucrose and boric acid at different concentration individually as well as in combinations. The fresh pollen samples were sown on several grooved slides containing solution of sucrose and boric acid at different concentrations separately or in combinations. Slides were then kept in Petridishes lined with moist filter paper and examined under the microscope at low magnification (150X) at different time intervals to know the germination percentage and pollen tube length following the method of Shivanna and Rangaswamy (1993). A pollen grain was considered as germinated if pollen tube length atleast becomes twice greater than the diameter of the pollen grains (Gupta *et al*., 1989).

RESULTS AND DISCUSSION
Studies on *in vitro* pollen germination at different time intervals after anthesis indicated that 82% germinating pollen with a mean of 378 μm long pollen tube development observed in 20% sucrose solution (Table 1). Individually, 100 ppm boric acid showed 88% germination along with 407 μm long pollen tube (Table 2). The maximum 98% pollen germination along with 427 μm long pollen tube developed after 4 hours in 15% sucrose solution supplemented with 100 ppm boric acid (Table 3; Fig.1).

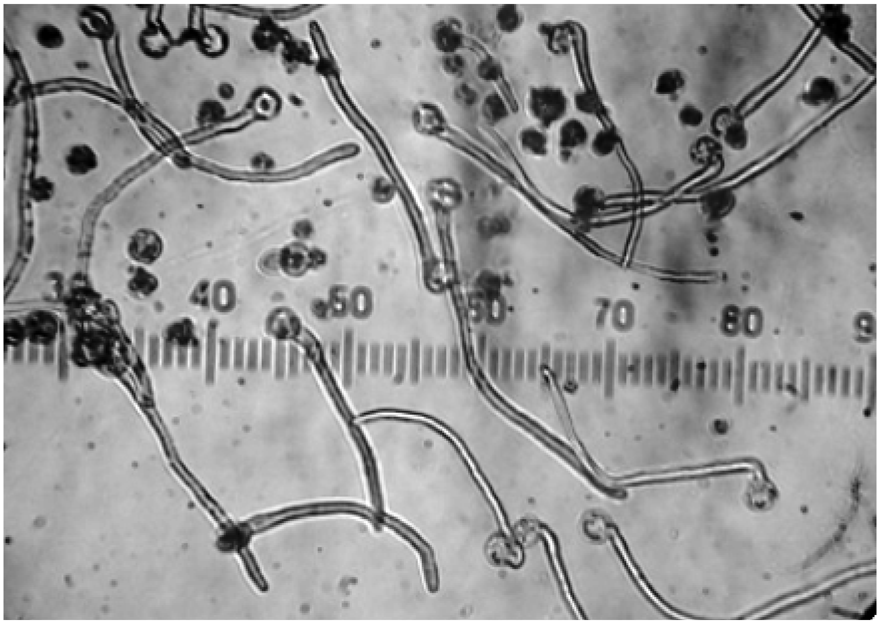

Figure 1: *In vitro* germinating pollen of *Solanum macranthum* Dunal

Though the effect of either sucrose or boric acid individually showed good results, but sucrose in combination with boric acid promoted pollen germination as well as tube development, because boron makes a complex with sugar and this sugar-borate complex is known to be capable of better translocation than non-borate, non-ionized sugar molecules (Gauch and Dugger, 1953; Sidhu and Malik, 1986).

Table 1: Effect of sucrose on *in vitro* pollen germination

Conc. (%)	After 1 hr.		After 2 hrs.		After 4 hrs.	
	Germination (%)	Mean tube length (μm)	Germination (%)	Mean tube length (μm)	Germination (%)	Mean tube length (μm)
Distilled water	--	--	--	--	--	--
1	--	--	--	--	3	52
5	3	52	4	76	5	104
10	25	58	38	83	40	130
15	26	123	40	178	45	195
20	56	165	78	243	82	378
25	42	69	53	167	66	273
30	13	48	29	79	34	104

Table 2: Effect of boric acid on *in vitro* pollen germination

Conc. (ppm)	After 1 hr.		After 2 hrs.		After 4 hrs.	
	Germination (%)	Mean tube length (μm)	Germination (%)	Mean tube length (μm)	Germination (%)	Mean tube length (μm)
25	28	78	48	198	57	295
50	37	156	73	324	78	390
100	58	167	82	376	88	407
200	57	124	75	287	82	336
300	34	112	59	256	64	312
400	32	89	51	187	56	247

Table 3: Effect of sucrose and boric acid on *in vitro* pollen germination

Conc.	After 1 hr.		After 2 hrs.		After 4 hrs.	
	Germination (%)	Mean tube length (μm)	Germination (%)	Mean tube length (μm)	Germination (%)	Mean tube length (μm)
5%+100ppm	36	132	48	213	58	234
10%+100ppm	53	176	76	284	84	364
15%+100ppm	68	211	89	345	98	427
20%+100ppm	57	187	65	321	72	390
25%+100ppm	34	156	50	243	56	299

The pronounced effect of sucrose and boric acid on increasing trend of germinating pollen might be reflected with the views of Johri and Vasil (1961) and Shivanna and Johri (1989) who stated that the externally supplied sucrose maintains the osmotic pressure and acts as a substrate for pollen metabolism.
The role of boron has been confirmed in germinating pollen and growing pollen tubes in vascular plants (Lewis, 1980; Sidhu and Malik, 1986). The studies of Stanley and Loewus (1964) indicated that boron is directly involved in pectin synthesis and thus indirectly involved in development of pollen tube membrane. Scott (1960) suggested that boron could exert a protective effect in preventing excessive polymerization of sugars at sites of sugar metabolism. In nature water, sugar, amino acids are supplied by the style to nourish the growing pollen tube. Boron is also provided by stigmas and styles, facilitates sugar uptake and has a role in pectin production in the pollen tube (Richards, 1986). Boric acid is known to be crucial for pollen germination and tube growth and it is required at concentration of 100 ppm for most species (Brewbaker and Majumder, 1961). Brewbaker and Kwack (1964) reported the induced role of Calcium and Boron on *in vitro* pollen germination. Boron plays a role in flowering and fruiting process in pistachio (Brown *et al.*, 1994) and its deficiency results in low pollen viability, poor pollen germination and reduced pollen tube growth (Nyomora and Brown, 1997). Boron takes part in pollen germination and style tube formation and therefore has a vital function in fertilization of flowering crops. Boron added in the form of boric acid, is also essential for the *in vitro* culturing of pollen from most species; for example, it is well appreciated that elimination of boric acid from the culture medium often leads to tube bursting (Holdaway-Clarke and Hepler, 2003; Acar *et al.*, 2010).Wang *et al.*, (2003) studied the effect of boron on the localization of pectins and callose in the wall of pollen tubes in *Picea meyeri*. Acar *et al*. (2010) also reported the stimulatory effect of boron on *in vitro* pollen germination of *Pistacia vera*. Thus, the present work gets supports from Vasil (1964), Gupta *et al.*, (1989), Pal *et al.*, (1989), Mondal *et al*. (1991), Bhattacharya *et al.*, (1997) and Bhattacharya and Mandal (2004), Biswas *et al*., (2008) and Acar *et al*. (2010)

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