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Effect of Na^+ and Ca^{2+} ions on germination of Saint-Paulia pollen

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The germination and tube growth of pollen of various plant species have been widely studied including the cytoskeleton [1] and the role of calcium in the tube growth [2–4]. Continuous gradient of this ion within growing pollen tubes has been reported [4].

As far as we know no data are available on the role of monovalent cations in germination of pollen although the role of sodium and potassium channels in various processes occurring in plants are known [5–8].

In this report we present the results concerning the effect of monensin, a carboxylic ionophore which selectively binds Na^+, K^+ and H^+, caffeine which increases calcium concentration in cytosol, and Co^{2+} which is reported to inhibit Ca^{2+}-dependent phospholipase C activity involved in transmembrane signaling systems, on the germination of Saint-Paulia pollen.

The pollen of 2–3-day-old flowers of Saint-Paulia sp. was germinated in a liquid medium containing in 100 ml of bidistilled water: 10 g of sucrose, 10 mg of H_3BO_3, and 0.05 mM of $NaH_2PO_4 \cdot H_2O$. To this control medium caffeine, monensin or $CoCl_2$ were added at the concentrations 5 mM, 10 µM, 10 mM, respectively. The medium was adjusted to pH 7.0. The number of germinating pollen was determined 2 h after sowing.

Reversibility of the studied effect was examined by washing of the pollen exposed to the chemicals for 0.5, 1, 2, or 4 h. Germination was checked after 2 h. All the experiments were carried out at $25 \pm 1^{\circ}C$.

Monensin and $CoCl_2$ at the concentrations studied completely inhibited germination of Saint-Paulia pollen (Table 1). In treatment with caffeine the percentage of germinating pollen

Table 1

Germination of Saint-Paulia pollen in liquid nutrient media supplemented with caffeine (5 mM), or monensin (10 µM), or $CoCl_2$ (10 mM).

Percent of germinating pollen was determined 2 h after immersion of pollen in the nutrient medium.

Nutrient medium	Germinating pollen (%)		
	Experiment No.		
	1	2	3
Control	51	53	56
+ caffeine	2	3	2
Control	32	43	32
+ monensin	0	0	0
Control	34	35	36
+ $CoCl_2$	0	0	0

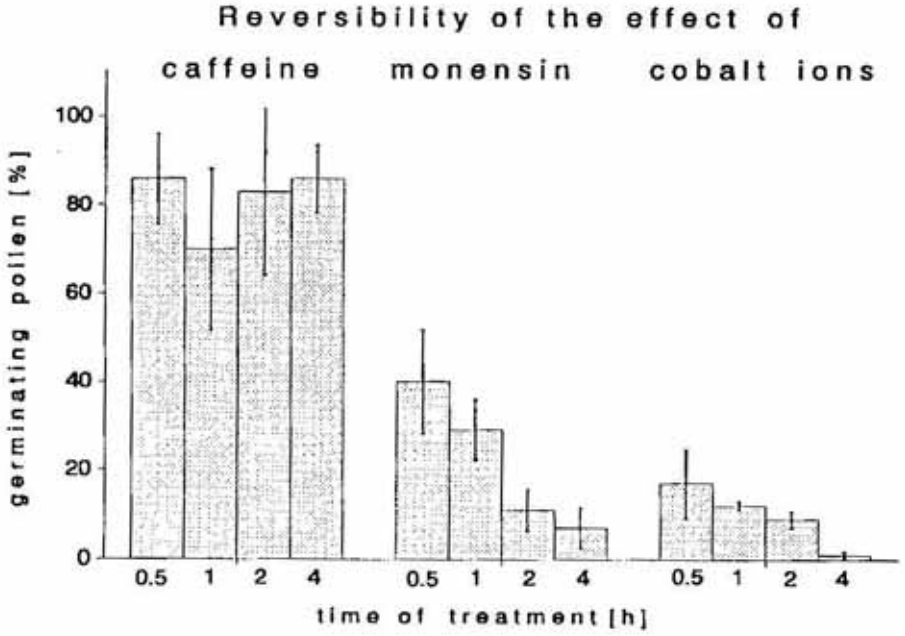

Fig. 1. The reversibility of the effects of caffeine (5 mM), monensin (10 μM) and $CoCl_2$ (10 mM) on the germination of Saint-Paulia pollen.
Pollen was treated for the time indicated, washed three times with the control medium and germinated for another 2 h. The experiments were carried out at 25 ± 1°C. The data represent the average of three experiments ± S.D.

treated with caffeine solution did not exceed 3% while in control medium germination of pollen exceeded 50%. The effect of caffeine was reversible in 70%–86% irrespectively of duration of the treatment (Fig. 1). On the contrary reversibility of the monensin and cobalt effect on pollen germination was much lower, especially that of cobalt ions, and depended on the time of treatment (Fig. 1).

The results presented point to the importance of the transport processes of monovalent cations (Na^+, K^+ and H^+) in germination process of pollen and confirm the importance of non-disturbed calcium concentration [9, 10].

Monensin was shown by other authors to cause dose dependent (2 to 40 μM) fluxes of Na^+, K^+ and H^+ across the muscle fiber membrane [11]. Sanders & Chokka (1987) reported that monensin inhibited hyaluronic acid secretion by blocking the transport of secretory vesicles to the cell surface, and leading to a distension of the cisternae of the Golgi apparatus. It would be interesting to see whether monensin affects the pollen tube growth by blocking secretory vacuoles coalescence with plasmalemma.

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