

Effect of herbicide (sodium penta chloro phanate) on pollen germination and tube length of stored pollen of Apocynaceae: Further evidence of a criticism of Banerji and Gangulee (1937), Brewbaker and Kwack (1963), Sudhakaran (1967- Ph.D.Thesis), Dharurkar (1971- Ph.D. Thesis), Nair, Nambudiri and Thomas (1973), Berg (1973), Brandt (1974), Vick and Bevan (1976), Rasmussen (1977), Navara, Horvath and Kaleta (1978), Mhatre (1980- Ph.D. Thesis), Mhatre, Chaphekar, Ramani Rao, Patil and Haldar (1980), Shetye (1982- Ph.D. Thesis) and Giridhar (1984- Ph.D. Thesis)– A critical review

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Abstract

Even the lowest concentration (10^{-17} mg/ml) of sodium penta chloro phanate tried suppressed the germination of pollen of F and F-24 series of red-flowered cultivar of *Nerium odorum* and F-48 and F-72 series of pink-flowered cultivar of *Catharanthus roseus*. The herbicide stimulated the germination of pollen of successive flowers of all the cultivars of the Apocynaceae throughout the experiment. However, it stimulated the tube growth of only 3 out of 10 series.

Keywords:- Palynology, Toxicology, Environmental Sciences, Herbicides

Introduction

Herbicides drastically reduced pollen germination as well as tube growth. It was therefore important to study the effect of such chemicals on germination as well as tube growth since inhibitory effects of these chemicals eventually reduce fruit and seed-set.

Materials and Method

Pollen of successive flowers (viz. F, F-24, F-48, F-72 series i.e. open flowers and the flower buds which require 24, 48, 72 hours to open respectively) of 5 cultivars of Apocynaceae e.g. red-, pink- and white-flowered cultivars of *Nerium odorum* Soland. and pink- and white-flowered cultivars of *Catharanthus roseus* (L.) G. Don. were collected soon after the

dehiscence of anthers in the open flowers and stored at room temperature (22-31.8°C) having RH 57% and in diffuse laboratory light at the Department of Botany, Govt. Institute of Science, Mumbai. Germination of stored pollen grains of successive flowers was made soon after the dehiscence of anthers and with 2 hours intervals for the first 10 hours in the optimum concentrations of sucrose (acts as control) as well as in the optimum concentrations of sucrose supplemented with the optimum concentrations of sodium penta chloro phanate (Table 1). Observations were recorded 24 hours after incubation. For each experiment a random count of 200 grains was made to determine the percentage of pollen germination. For measurement of length of pollen tubes, 50 tubes were selected randomly and measured at a magnification of 100x.

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Table 1: Effect of sodium penta chloro phenate on stored pollen on their germination and tube length of five cultivars of Apocynaceae

					PG & TLSADA				TRADAFMPGTAL							
					%PG		TL in mm		C				T			
Cultivars	SF	PV	SC	HC	C	T	C	T	H	PG	H	TL	H	PG	H	TL
<i>N. odorum</i> pink-flowered	F	80	50	10 ⁻¹⁷	35	37	1485	745	8	52	0	1485	4	45	4	836
<i>N. odorum</i> red-flowered	F	74	20	Ng	20	Ng	1250	Ng	6	36	0	1250	Ng	Ng	Ng	Ng
<i>N. odorum</i> white-flowered	F	62	50	10 ⁻¹⁷	20	40	675	148	4	24	0	728	2	45	4	210
<i>C. roseus</i> pink-flowered	F	90	20	10 ⁻¹⁷	60	74	1575	1800	6	72	0	1575	0	74	0	1800
<i>C. roseus</i> white-flowered	F	88	20	10 ⁻¹⁷	40	64	1256	1220	8	75	0	1256	4	75	0	1220
<i>N. odorum</i> red-flowered	F-24	74	20	Ng	06	Ng	485	Ng	6	8	0	485	Ng	Ng	Ng	Ng
<i>C. roseus</i> pink-flowered	F-24	90	50	10 ⁻¹⁷	28	29	240	425	6	36	4	300	0	29	0	425
<i>C. roseus</i> white-flowered	F-24	88	50	10 ⁻¹⁷	16	56	248	786	6	50	6	264	2	60	0	789
<i>C. roseus</i> pink-flowered	F-48	90	50	Ng	14	Ng	95	Ng	4	16	0	95	Ng	Ng	Ng	Ng
<i>C. roseus</i> pink-flowered	F-72	90	80	Ng	10	Ng	65	Ng	0	10	0	65	Ng	Ng	Ng	Ng

C, in control; HC, herbicide concentrations in mg/ml; Ng, no germination of pollen even 24 hours of their sowing; PG, pollen germination; PG&TLSADA, Pollen germination & tube length in the sets which were set soon after dehiscence of anthers; PV, pollen viability in %; SC, sucrose concentrations in %; SF, successive flowers; TL, tube length; TRADAFMPGTAL, Time required after dehiscence of anthers for maximum pollen germination & tube length.

Results and Discussion

Pollen viability is a subject that has a great deal of practical as well as theoretical interest. In the present investigation even the different cultivars of the same species showed the variations in the percentage of their pollen viability (Table 1). Reduced pollen viability has been interpreted as an indication of suspected hybridity in wild populations. Nevertheless, variations in pollen viability may affect the breeding systems of the species concerned, and if the pollen viability can be altered by the environment, then the breeding system itself may be under some degree of environmental control.

Potentiality of pollen germinability was recorded in F series of all the 5 cultivars of the Apocynaceae studied. It was the pollen of F-24 series of red-flowered cultivar of *Nerium odorum* and both the cultivars of *Catharanthus roseus* found germinated in the optimum concentrations of sucrose. It should be pointed out that the pollen of F-48 and F-72 series of pink-flowered cultivar of *C. roseus* showed their germination in the optimum concentrations of

sucrose. Thus the potentiality of pollen germinability in Apocynaceae was observed in 10 out of 20 series investigated (Table 1).

As a rule the percentage of pollen germination is always less than the pollen viability (Table 1). However, Banerji and Gangulee (1937) and Dharurkar (1971) reported higher percentage of pollen germination than the pollen viability in *Eichhornia crassipes*. The claim of Banerji and Gangulee (1937) and Dharurkar (1971) is challenged by Salgare (1986c, 1995, 2000b, 2006a, 2006j, 2006m, 2006q, 2006s, 2007b-2007c, 2007e, 2007f, 2007g, 2007i and 2007j) who stated that the observations of Banerji and Gangulee (1937) and Dharurkar (1971) are exaggerating.

Germination of pollen of F-72 series of pink-flowered cultivar of *Catharanthus roseus* in vitro culture of sucrose was noted in the present investigation. However, Palathingal (1990) failed to germinate the pollen of F-72 series of pink-flowered cultivar of *C. roseus* in Brewbaker and Kwack's (1963) culture medium. This proves that the culture medium is also having the bearing on the germination of pollen.



This also confirms that Brewbaker and Kwack's (1963) culture medium is not ideal for pollen cultures. This was also pointed out earlier by Salgare (2006a, 2006j, 2006q, 2006s, 2006u, 2007e, 2007f and 2007h). Even the lowest concentration (10^{-17} mg/ml) of sodium penta chloro phanate tried suppressed the germination of pollen of F and F-24 series of red-flowered cultivar of *Nerium odorum* and F-48 and F-72 series of pink-flowered cultivar of *Catharanthus roseus* (Table 1). Sharma (1984) stated that even the lowest concentration (10^{-17} mg/ml) of sodium penta chloro phanate tried prevented the germination of pollen of F series of white cascade, sonata, F-24 series of white cascade, duet, sonata and F-48 series of red as well as white cascade. All these are the cultivars of *Petunia grandiflora*. This proves that the pollen of the said series are highly sensitive and acts as an ideal indicators of pollution. Thus it is confirmed that the pollen development and activity are more sensitive indicators of adverse factors in the botanical environment and the use of an entire vascular plant (Berg, 1973; Brandt, 1974; Vick and Bevan, 1976; Rasmussen, 1977; Navara *et al.* 1978; Mhatre, 1980; Mhatre *et al.* 1980; Shetye, 1982 and Giridhar, 1984) as an indicator of pollution is a very crude method and rather a wrong choice. There is no evidence of any entire vascular plant exhibiting this much degree of sensitivity. This is confirmed in the present critical review (Table 1) as well as by the previous extensive work of Salgare (1983, 1984, 1985a, 1985b, 1985c, 1986a, 1986e, 1986f, 2000a, 2001a, 2001b, 2005b, 2005d, 2005e, 2006a, 2006f, 2006j, 2006l, 2006o, 2006q, 2006u, 2007b, 2007c, 2007d, 2007e, 2007f, 2007g, 2007h, 2007i, 2007j, 2007k, 2007l), Salgare and Theresa Sebastian (1986), Salgare and Phunguskar (2002), Salgare and Singh (2002, 2006a, 2006b), Salgare and Pathak (2005) and Sharma (1984).

Sodium penta chloro phanate stimulated the germination of pollen of successive flowers of all the cultivars of the apocynaceae throughout the

experiment. However, it stimulated the tube growth of only 3 out of 10 series (Table 1). Maximum pollen germination was noted in all the 10 series except for F-72 series of pink-flowered cultivar of *Catharanthus roseus* with the stored pollen *in vitro* culture of sucrose. Pollen of F-72 series of pink-flowered cultivar of *C. roseus* showed an equal percentage of germination of pollen with that stored pollen. The time interval of the period of storage ranges right from 4 to 8 hours. However, the pollen of F-72 series of pink-flowered cultivar of *C. roseus* showed the highest germination in the sets which were set soon after the dehiscence of the anthers (Table 1). The herbicide stimulated the germination of stored pollen in 4 out of 10 series, while the tube growth was stimulated in 2 out of 10 series of the Apocynaceae. *In vitro* culture of sucrose the longest pollen tubes were noted in 5 out of 10 series in the sets which were set soon after the dehiscence of the anthers. *In vitro* culture of sucrose supplemented with the herbicide the maximum germination of pollen was noted in 6 out of 7 series in the sets which were set soon after the dehiscence of the anthers. However, the longest pollen tubes were noted in 3 out of 7 series in the sets set soon after the dehiscence of anther (Table 1). Thus it is confirmed that the pollen germination and tube elongation are two distinct processes. However, Nair *et al.* (1973) stated that the pollen germination and tube elongation is one and the same process. Present work (Table 1) as well as previous extensive work of Salgare (1979, 1983, 1986d, 2004, 05a, 2005c, 2006e, 2006j, 2006k, 2001, 2006s, 2007i, 2007j), Salgare and Bindu (2002, 2005) and Salgare and Tessy Mol Antony (2005a, 2005b) it could be concluded that the observations of Nair *et al.* (1973) are superficial and misleading.

In this connection it should be pointed out that Sudhakaran (1967) stated that in *Vinca rosea* L. {*Catharanthus roseus* (L.) G. Don.} besides pollen grains which produced single pollen tube, it has also been noticed that tetraploid grains frequently produce more than one pollen tube. Pollen tubes



are branched quite frequently. Aberrations of this type in the pollen tube development are not observed in diploid pollen tubes, but quite frequently met with the pollen grains of irradiated plants. Salgare (1983) made it very clear that Sudhakaran (1967) had failed to trace out the branched pollen tubes and polysiphonous condition which is fairly common even in diploid pollen grains. Apart from this Sudhakaran (1967) was not able to report the various types of pollen tube deformities either with diploid or tetraploid grains. Present investigation as well as the extensive work of Salgare (1983, 1986b, 2006b, 2006c, 2006d, 2006h, 2006j, 2006n, 2006p, 2006q, 2006s, 2006t, 2007a, 2007b, 2007c, 2007e, 2007f, 2007h, 2007i) also proved that Sudhakaran's (1967) observations are superficial and misleading.

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