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MAGNETIC STIMULUS: A NOVEL TOOL TO PROMOTE PAPAYA POLLEN GERMINATION

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Electromagnetic flux produced linear increase 'in vitro' *germination and reduced the incubation period of 'mounts' of quiescent papaya* (Carica papaya *L. cv. 'Washington') pollen. The linear trend for germination began at 18 oersted and continued progressively upto 108 oersted (when the percent increase over control was calculated). At 18 oersteads the per cent increase over control was 6.1 and at 108 oersteads it was 81.8. The best operating strengths were 72 (46.2**), 90 (79.4**) and 108 (81.8**) oersteds. Also, the incubation period of pollen mounts for both germination and tube growth was halved, with germination being more responsive to the treatment than tube growth. Moreover, tube growth did not follow a linear pattern. In tube growth significant increase over control was produced at 90 oersteds (41.9**) and at 108 oersteds (45.2**). At present, possible errors in handling techniques of 'in vitro' viability tests result in valuable and viable germplasm being discarded. This method of magnetic stimulation could be used to break the quiescence of pollen in order to successfully evaluate inherent genetic potential of pollen.*

Sustained substantive success of *in vitro* pollen viability test depends upon many factors; whether pollen be newly collected or conserved (short, medium and long term). Among many interdependent components, genetic potential, nutrient medium, technical manipulation of 'pollen mount', and prevailing conditions of incubation play major roles. If the contributive parameters are not properly controlled a genetically potential germplasm may likely be discarded and lost forever. This is due to the fact that most of the pollen cryobanks base their decision to discard or conserve material, on the basis of viability test.

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**Per cent increase over control

Exposure to magnetic fields has been shown to influence germination of quiescent seeds of sporophytes (Pittman and Ormord 1970). Recently Alexander and Ganeshan (1990) have extended these results to gametophytes. Quiescence of *Carica papaya* L. cv 'Washington' pollen was broken by applying magnetic stimulus, enabling it to express the inherent genetic potential. The experiments on magnetic stimulation of papaya pollen were continued and this report deals with application of magnetic flux varying from 18 to 108 oersteds in order to fix the optimum strength for boosting germination and tube length.

MATERIALS AND METHODS

Two identical bar electromagnets were used as the source of the magnetic pulsing. The magnetic set-up and the electrical and electronic hook-ups used in this experiment were similar as used earlier (Alexander and Ganeshan, 1990). In this experiment one variation was introduced. The alternation consisted in varying the strength from 0 to 108 oersteds, with an 18 oersted increment keeping the exposure time 10 minutes in all treatments.

It was not possible to use other intermediate values due to arrangements of tappings in the step-down transformer. The experimental material was papaya pollen (*Carica papaya* L. cv. 'Washington'). Experimental methods were similar to those followed by Alexander and Ganeshan (1990). In the statistical analysis treatments were compared based on analysis of variance technique using L.S.D. (P = 0.05) and per cent change in germination and tube length over control was also calculated.

RESULTS AND DISCUSSION

Table 1 shows the percentage pollen germination and tube length in different treatments. The treatment at 18 and 36 oersteds was at par with the control (zero oersted, ignoring earth's magnetic strength). Maximum germination and tube length were recorded at 108 oersteds. A linear trend with increase in magnetic field strength was evident, which was broken at 72 giving a 'staircase pattern'.

Alexander and Ganeshan (1990) energised papaya pollen at 96 oersted and obtained increased germination and tube length for a 2 hour incubation period. The pollen germination and tube length recorded in the present study for a corresponding magnetic flux are in close agreement with the previous results.

The influence of the magnetic stimulus on pollen tube growth is more critical requiring precise operative methodology more familiar to biophysicists than agro-biologists. *In vitro* germination is a useful tool for pollen viability assessment. The stimulus operates over a wide range of strength for

Table 1. Effects of varying electromagnetic field on *in vitro* germination and tube length of *Carica papaya* L. cv. 'Washington' pollen

Magnetic flux (in oersteds)	Mean germination (%)	Per cent increase over control	Mean tube length (μ)	Per cent increase over control
0 (Control)	27.75 a	–	237.89 a	–
19	29.43 a	6.1	233.50 a	– 1.8
36	31.86 a	14.8	277.00 a	+ 16.4
54	45.00 bc	62.2	318.50 bc	+ 33.9
72	40.58 b	46.2	308.00 b	+ 29.5
90	49.77 c	79.4	337.50 c	+ 41.9
108	50.46 c	81.8	345.50 c	+ 45.2
SE_d	14.42		3.21	

Treatments followed by same alphabets are not significantly different with respect to mean % values of germination and tube length.

germination. So it could be adopted in viability evaluations. Application of magnetic stimulus in bioscience is only three decades old. Scientific interests in this filed started late in the 1950s and continued till 1970.

Magnetic stimulus is responsive to magnetically receptive materials. Biological systems are paramagnetic, hence the response is not clearly understood. Pittman and Anstey (1967), Pittman and Ormrod (1970) and Commoner *et al.*, (1957) explained the action of the stimulus on biological systems. Commoner *et al.*, (1957) attributed influence of magnetism on reaction rate of enzymes to paramagnetic molecules and free radicals in the system. He concluded that for a given magnetic stimulus the processes that normally occur before DNA duplication are influenced.

Stimulation of pollen under magnetic field is suggested as a new tool for *in vitro* pollen germination. This stimulation is useful in expressing the inherent genetic potential of germplasm in terms of *in vitro* viability. In addition to this the incubation period is halved (papaya takes 4 hrs to register 51.5% germination; Ganeshan, 1985). Thus more samples could be evaluated.

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