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EFFECT OF GA_{4+7} ON GERMINATION AND EARLY SEEDLING GROWTH OF MAIZE UNDER WATER STRESS

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IMPROVING seed performance of plants under stressing regimes is of increasing economic importance. Recent research interest in pre-sowing seed treatments for improving field emergence under stress has shown considerable benefits[1,2]. The effects of water stress on germination and seedling growth of maize have been reported[3,4] but studies pertaining to stress alleviation by seed pre-treatments are scarce. Poor seed performance under water stress might be associated with alteration in the endogenous levels of phytohormones and it is thus probable that an exogenous supplementation might help in the alleviation. In the present communication, the effects of GA_{4+7} on the germination and early seedling growth of maize were investigated under simulated water stress conditions.

Seeds of *Zea mays* L. cv. Partap were obtained from the Department of Plant Breeding, Punjab Agricultural University, Ludhiana. Seeds were germinated in petri dishes (9 cm) over two layers of filter paper moistened with 5 ml of water or test solution. Solutions of polyethylene glycol 6000 (PEG) at -0.3 and -0.6 MPa were used[5]. Solutions of GA_{4+7} (25, 50, 75 and 100 ppm) were prepared. Seeds were pre-soaked for 24 h in water and various concentrations of GA_{4+7} at 30 ± 1°C. Seeds were incubated in dark for germination at the same temperature. A seed was credited with germination when its radicle protrudes about 2 mm. Germination counts were taken daily. The coefficient of rate of germination (CRG) was calculated as $[100\ \sum N/\sum(DN)]$ where, D is the number of days counted from the beginning of germination test, and N is the number of seeds which germinate on day D. Higher the CRG value, greater is the rate of germination. Observations on primary root length, shoot length and seedling dry weight (roots + shoot) were recorded after 5 days. The data were statistically computed using analysis of variance.

The rate of germination of stressed seeds was markedly lowered compared with the unstressed ones (table 1). The decrease was greater at

Table 1 *Effect of seed pre-soaking on germination and early seedling growth of maize under water stress*

Pre-soaking treatment	Coefficient of rate of germination at osmotic potential (MPa)			Primary root length (mm) at osmotic potential (MPa)			Shoot length (mm) at osmotic potential (MPa)			Seedling dry weight (roots + shoot) (mg) at osmotic potential (MPa)		
	0	−0.3	−0.6	0	−0.3	−0.6	0	−0.3	−0.6	0	−0.3	−0.6
None	45.5a	34.3a	30.8a	107.2a	50.4a	31.1a	82.8a	5 6a	4.1a	59.5a	43.6a	37.7a
Water	79.4b	61.0b	49.1b	134.5b	69.0b	38.9b	91.7b	33.3b	7.8b	62.6b	52.0b	40.6b
GA_{4+7} 25 ppm	79.4b	67.0c	63.8c	156.7c	65.6b	40.1b	122.2c	30.7b	10.0c	68.4bc	52.7b	45.6c
GA_{4+7} 50 ppm	80.0b	69.3c	62.3c	155.6c	66.2b	43.6b	122.8c	31.7b	11.2c	72.2c	52.5b	47.1c
GA_{4+7} 75 ppm	81.0b	68.4c	63.4c	155.2c	79.2c	62.8c	121.8c	32.3b	12.3c	72.8c	53.2b	50.5d
GA_{4+7} 100 ppm	76.5b	70.0c	62.2c	168.9c	76.5c	63.2c	133.3c	31.7b	16.0d	86.7d	53.6b	51.1d

Mean values in a column with similar suffixes do not differ significantly at $P = 0.05$.

−0.6 MPa than at −0.3 MPa. However, germination was not affected and the seeds attained 100% germination even under water stress conditions. Seed pre-soaking in water as well as solutions of GA_{4+7} significantly accelerated the rate of germination of unstressed seeds to a similar extent, but under stressing regimes GA_{4+7} proved to be effective (table 1).

Both root and shoot growth were reduced under water stress but shoot growth was more severely affected (table 1). Growth inhibition due to water stress is attributed to inhibition of cell elongation, cell division or both[6]. Seeds pre-soaked in water and GA_{4+7} showed improved growth under control as well as stress conditions. Higher concentrations of GA_{4+7} (75 and 100 ppm) proved generally better for improved root and shoot lengths (table 1). An increase in dry weight was also recorded in seedlings raised from soaked seeds than from unsoaked seeds. At a milder stress (−0.3 MPa), the dry weight of seedlings (roots + shoot) raised from water and GA_{4+7}-soaked seeds increased to a comparable extent but at −0.6 MPa and in control the higher concentrations of GA_{4+7} showed a better response.

The increased tolerance of germinating seeds and seedlings to water stress by gibberellic acid has also been shown for other plants[7,8]. Increased sensitivity to gibberellin may be connected with its decreased endogenous levels or an increased content of abscisic acid or other inhibitors in stressed seeds. Some growth stimulators can reduce inhibition of seed germination due to the presence of PEG and abscisic acid, and they can alleviate the effect of water stress[9,10]. Studies on endogenous levels of phytohormones, therefore, need to be undertaken.

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CASES OF POLYEMBRYONY IN COCOSOID PALMS

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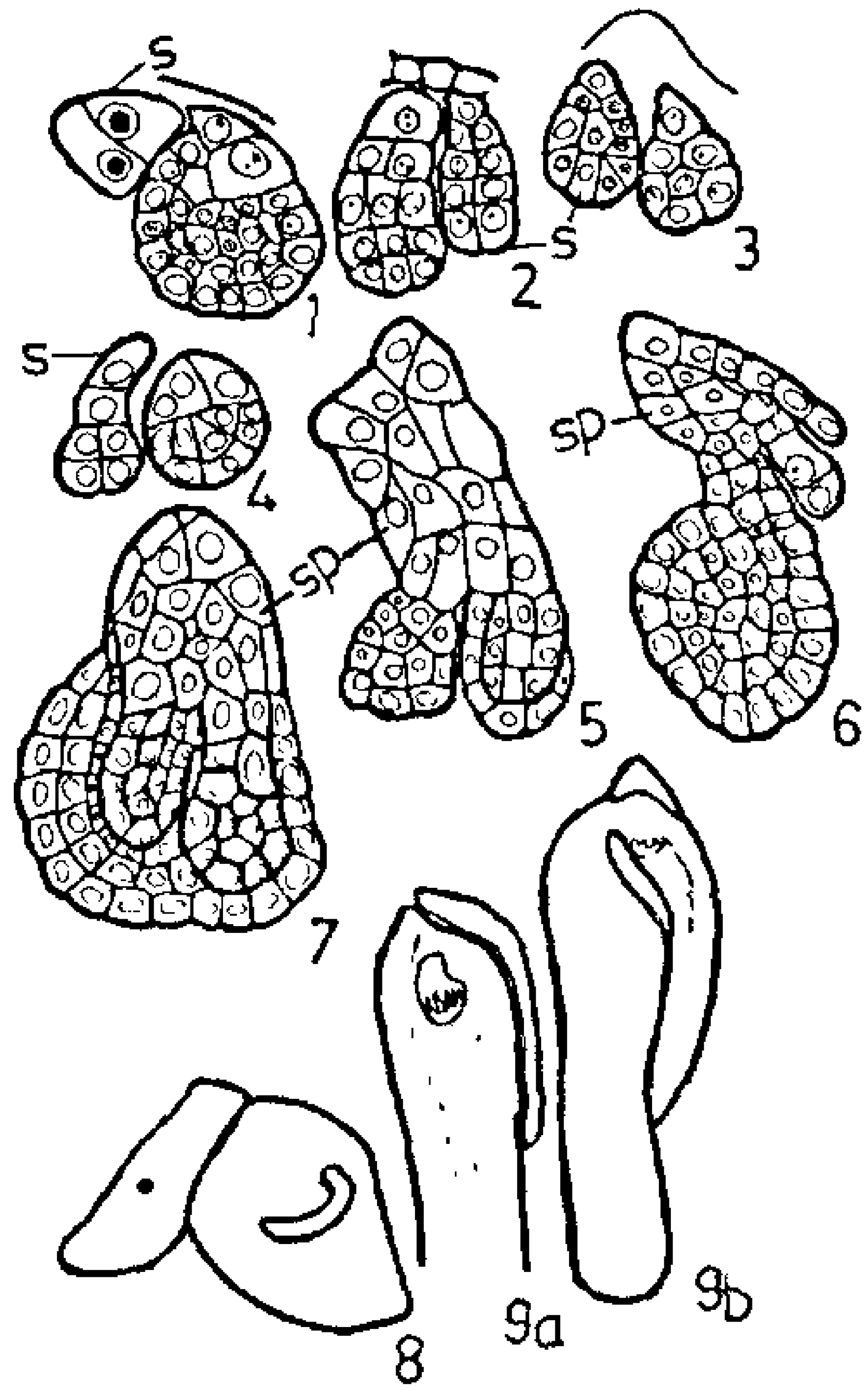
POLYEMBRYONY occurs rarely in Arecaceae. So far it has been reported in *Cocos nucifera*[1–4] and *Phoenix dactylifera*[5]. The present communication describes cases met with in *Syagrus coronata* Becc., *Arecastrum romanzoffiana* Cham. and *Arikuryroba schizophylla* Becc. during embryogenetic studies.



Figures 1–9. 1–3. *Syagrus coronata*, **1.** Two-celled synergid embryo(s) and globular zygotic embryo; **2,3.** Twin embryos below the micripyle; **4.** *A. schizophylla*. A filamentous synergid embryo by the side of globular zygotic embryo; **5–9.** *A. romanzoffiana*, **5–7.** Accessory embryos proliferating from massive suspensor (SP) of globular zygotic embryo; **8 and 9a,b.** Mature twin embryos attached at the radicular end.