Table 1. Nitrogen characteristics of sewage before application to soil, sewage pond, and of sewage applied soil

Habitat	Total-N*	Ammonium-N*	Nitrate-N*
Sewage before soil application (mg/l)			
	100 0	52 0	1 8
Sewage pond water (mg/l)			
With vegetation (*Typha* and *Lemna*)	16 4	10 6	0 4
Without vegetation	5 7	3 5	0 1
Sewage irrigated soil (mg N/100 g oven dry soil)**			
With vegetation (*L. vulgaris*)	194 0	5 8	16 1
Without vegetation	157 0	7 2	24 4

*Determined by digestion and distillation (Bremner[3])
**Soil moisture status 55% (soil with vegetation) and 48% (soil without vegetation) on oven dry basis after 2 h of irrigation

Table 2. Ammonia loss (mg ammonia/m^2 surface area basis) in sewage pond and sewage-irrigated soil with and without vegetation in 5-days measurement during summer '91

	Ammonia flux (mg/m^2 surface)	
Habitat	Per day*	In 5 days
Sewage pond water		
With vegetation (*Typha* and *Lemna*)	113[a] (55)	564
Without vegetation	40[b] (20)	201
Sewage-irrigated soil		
With vegetation (*L. vulgaris*)	57[b] (25)	283
Without vegetation	89[a] (41)	444

*Mean (standard deviation in parentheses) The means were tested by Students' *t* test Values followed by the same letter are not significantly different at 0 05 level

Table 1 reveals that the raw sewage before land application had more total N than ammonium-N and nitrate-N, showing thereby the presence of sizeable amount of nitrogen in organic form. The observations further revealed that the nitrogen fractions [total N and inorganic N (ammonium-N and nitrate-N)] of sewage pond under the vegetation zone were relatively higher than of those without vegetation, obviously due to the presence of rhizosphere and its ammonifying activity. Secondly, the nitrate-N was much less compared to ammonium-N irrespective of the aquatic site, suggesting low rates of nitrification due to the anaerobic nature of the system. These patterns were in contrast to sewage-irrigated terrestrial system where all the nitrogen fractions (except total N) in crop-sown soil were lower than in the soil without vegetation because of uptake of nitrogen by the crop. The nitrate-N concentration in soil was about three times higher than the ammonium-N due to active nitrification (aerobic process) in both the terrestrial sites (Table 1).

The results of field measurements of ammonia loss from the pond water and sewage-irrigated soil supporting vegetation and without vegetation are shown in Table 2. It was significantly higher (× 2.8) in pond water with macrophytes (*Typha* and *Lemna*) compared to the area without any macrophytes because of the higher flood water ammonium-N concentration in the former, resulting from the ammonifying activity of rhizosphere microorganisms. Higher ammonium-N results into more ammonia loss due to the direct relation of flood water ammonium-N concentration to ammonia losses[5, 6].

The amount of ammonia loss and the nitrate N status in the soil without any crop was 1.5 times higher than the soil with crop. The latter site had faster rate of nitrification due to the rhizosphere effect, hence less level of steady state ammonium-N, unlike the former site (Table 1), thus leading to low N losses as ammonia (Table 2). Likewise because of no crop uptake, the amount of nitrate-N in soil without crop was higher (× 1.5) than the soil with crop (Table 1).

The study showed that a vegetated aquatic system provides a treatment avenue for the reduction of excess nitrogen contained in the domestic sewage through ammonia volatilization before it can be reutilized in land irrigation for plant growth.

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ACKNOWLEDGEMENTS We are thankful to University Grants Commission, New Delhi for financial support, and an anonymous reviewer for helpful suggestions on this MS

Received 20 March 1993, revised accepted 16 August 1993

Occurrence of direct somatic embryogenesis on the sword leaf of *in vitro* plantlets of *Phoenix dactylifera* L. cultivar barhee

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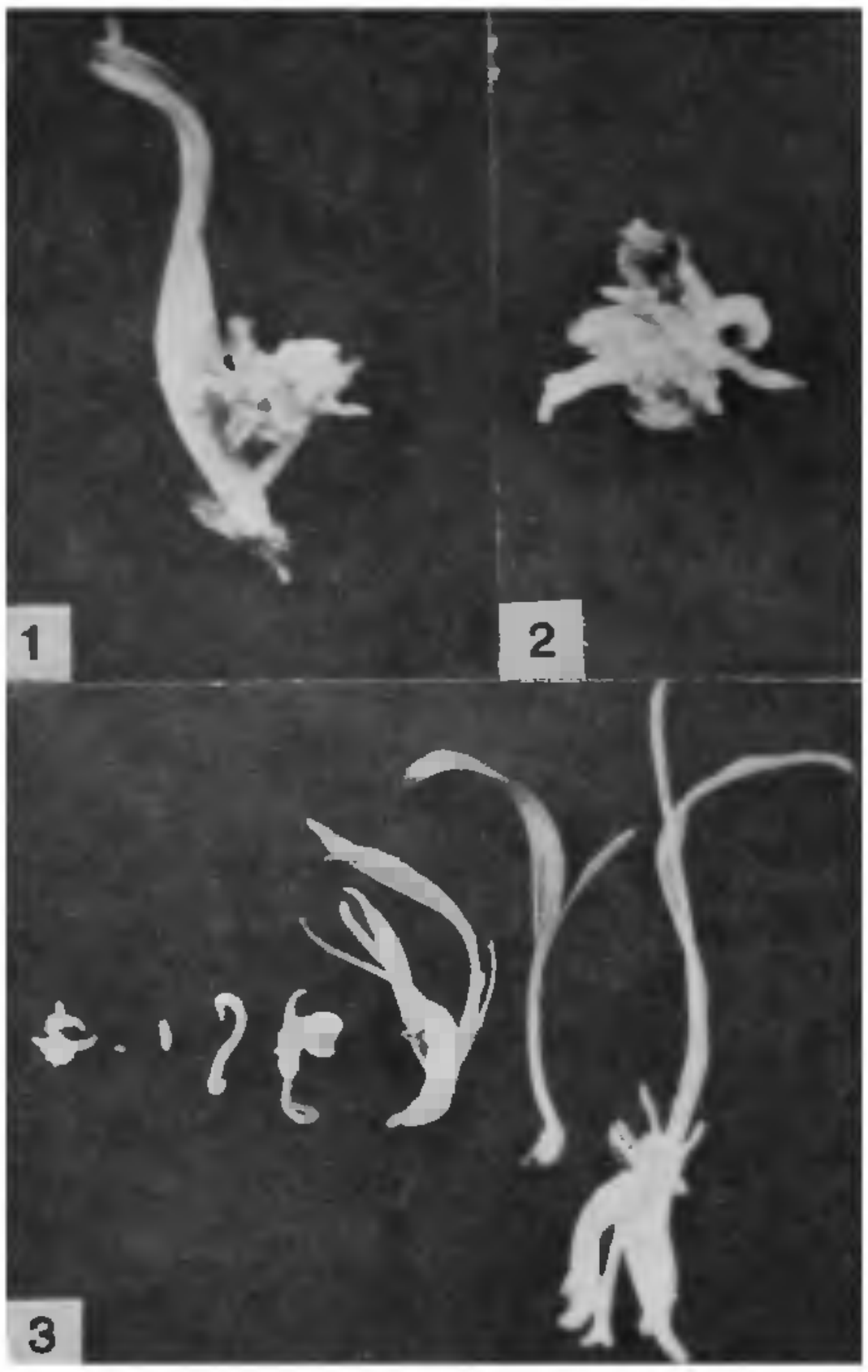
Date palm (*Phoenix dactylifera* L.) can be propagated clonally by somatic embryogenesis method. Success-

ful regeneration of plantlets from the young leaf lamina of the *in vitro* plants has been reported. Somatic embryos developed directly on the leaf lamina of the *in vitro* plants when transferred from media containing NAA, 2iP and K to hormone-free media. Plantlets were obtained from somatic embryos transferring to hormone-free MS media. Adventitious roots were induced in media containing 0.1 mg/l NAA. Rooted plants were successfully transferred to soil. This method holds good chances for the production of true-to-type plants since the callus stage is avoided.

PROPAGATION of most species in the palm family (Arecaceae) is dependent on seed germination and development, but seed germination in date palm (*Phoenix dactylifera* L.) is very limited due to their high degree of genetic heterozygosity and dioecious nature. The old conventional method of vegetative propagation of offshoots is slow and expensive. About a decade back, scientists succeeded in propagating date palm through somatic embryogenesis via callus and axillary bud multiplication methods[1,2] of tissue culture. Since 1989, fifteen locally available good cultivars of date palm have been successfully cloned in our laboratory at Riyadh. We observed the production of somatic embryos directly on the leaf lamina of the *in vitro* plantlets when the small plantlets were transferred from MS[3] media with different combinations of growth hormones to a hormone-free medium. This study reports in detail a direct somatic embryogenic pathway which avoids the intervening callus stage in *P. dactylifera* L. cultivar barhee.

Phoenix dactylifera L. cultivar barhee offshoots were dissected out and surface-sterilized using 25% Chlorox with one drop of Tween 20 for 20 min, 1% mercuric chloride solution for 3 min and 95% ethanol for 1 s. The last nine young leaf primordias and the scooped out meristem from the surface-sterilized material were cultured on MS media containing NAA, NOA, 2iP, K, citric acid, ascorbic acid and glutamine, and with pH adjusted to 5.6. The cultures were incubated in dark at 25 ± 1°C for callusing. After three to four subcultures in the same medium, the embryogenic calli were transferred to a medium containing 1 mg/l NAA, 3 mg/l 2iP and 3 mg/l K and incubated under fluorescent illumination (3000 lux) for 16 h at 25 ± 1°C for embryogenesis. Within 3 months numerous embryos and small plantlets were produced.

The embryos and small plantlets with one or two small leaves were transferred to the hormone and charcoal-free medium for germination, growth and development. In about 10% of the cultures basal part of the plantlet swelled after two weeks, and after another 30 days the new leaf with a cluster of somatic embryos on the adaxial surface of the lamina emerged out piercing the sheath of the old leaves (Figure 1). In some plantlets the young leaf came out normally, with a few small round pro-



Figures 1–3. 1, *Phoenix dactylifera* L. plantlet showing somatic embryos on its leaf lamina. **2**, Leaf lamina showing somatic embryos. **3**, Stages of somatic embryo germination and plantlet development

embryoids on the adaxial surface or margin of the lamina, which multiplied further into a cluster of embryos by adventive embryony method[4]. A few embryos germinated into plantlets even on the leaf itself (Figure 2) when kept for a long time in culture. These somatic embryos when isolated and cultured on fresh media produced numerous embryos and plantlets. The small embryos germinated into plantlets which produced adventitious roots (Figure 3) in MS media containing 0.1 mg/l NAA. The healthy rooted plantlets were transferred to soil through a series of acclimatization procedures.

Direct somatic embryogenesis from leaf explants has been reported in a few species[5–7]. However, there is no report about direct somatic embryogenesis on the date palm leaf in culture. Williams and Maheswaran[5] pointed out the role of hormones in induction of somatic embryogenesis. The somatic embryos were directly

produced from the hypocotyl epidermis of immature sexual embryos of *Trifolium repens* in the presence of the cytokinin BAP (6-benzyl aminopurine). In the present study, a few epidermal cells of the young leaf lamina were induced as embryogenic cells by the growth hormones. These embryogenically determined cells produced somatic embryos when transferred to hormone-free media. Production of plantlets through direct somatic embryogenesis, avoiding the intervening callus stage, holds the potential for 100% true-to-type progeny.

This perhaps is the first report on direct somatic embryogenesis on the leaf lamina of the date palm. Further research work on induction of a direct somatic embryogenesis pathway on various tissue explants of *Phoenix dactylifera* L. is in progress.

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ACKNOWLEDGEMENTS The senior author is thankful to Dr S W Adkins, Department of Agriculture, The University of Queensland, Brisbane Qld 4072, Australia, for critical evaluation of the manuscript

Received 17 July 1993, accepted 4 September 1993

PERSONAL NEWS

Debiprasad Chattopadhyaya – The modern Indian sage

An obituary by S. K. Biswas

In the demise of Professor Debiprasad Chattopadhyaya on the eighth of May 1993 in Calcutta (born 19 November 1918) science in India has lost one of its staunchest supporters and ideologues. He was not a practitioner of science in the conventional sense but an ardent champion of the scientific method. He spent most of his life establishing that science in India has roots which go back to the dawn of civilization. He was neither a chauvinist nor a romantic. In his mission to explore the roots of science in India he never once moved out of the then contemporary cultural and technological framework. He looked for what was practically possible and what was actually there without any trimmings and romance. But again he was not just a chronicler of facts. He searched the records of societies to establish what was the motivation and need for a specific development of science and technology and what indeed were the social forces which, while reaping the material benefits, found the ideological implications of such development too dangerous for their own class hegemony. What indeed were the

social forces which encouraged or discouraged science and for what material, political and ideological ends – form the central core of Debiprasad's thesis.

Debiprasad Chattopadhyaya was a trained philosopher. His academic training in Calcutta was rigorous. He studied under able teachers such as Sarvapalli Radhakrishnan and S. N. Dasgupta. He stood first in philosophy of the Calcutta University both in B. A (1939) and M. A. (1942) and went on to do post-graduate research work under the supervision of S. N. Dasgupta. Subsequently he taught philosophy in Calcutta for about twenty years before being appointed as UGC Visiting Professor of the universities of Andhra Pradesh, Calcutta and Poona. He developed wide interactions with serious intellectuals and especially the social science community of India. He had formal associations with the Indian Council of Historical Research (ICHR), Indian Council of Philosophical Research (ICPHR) and the National Institute of Science, Technology and Development Studies (NISTADS) of the