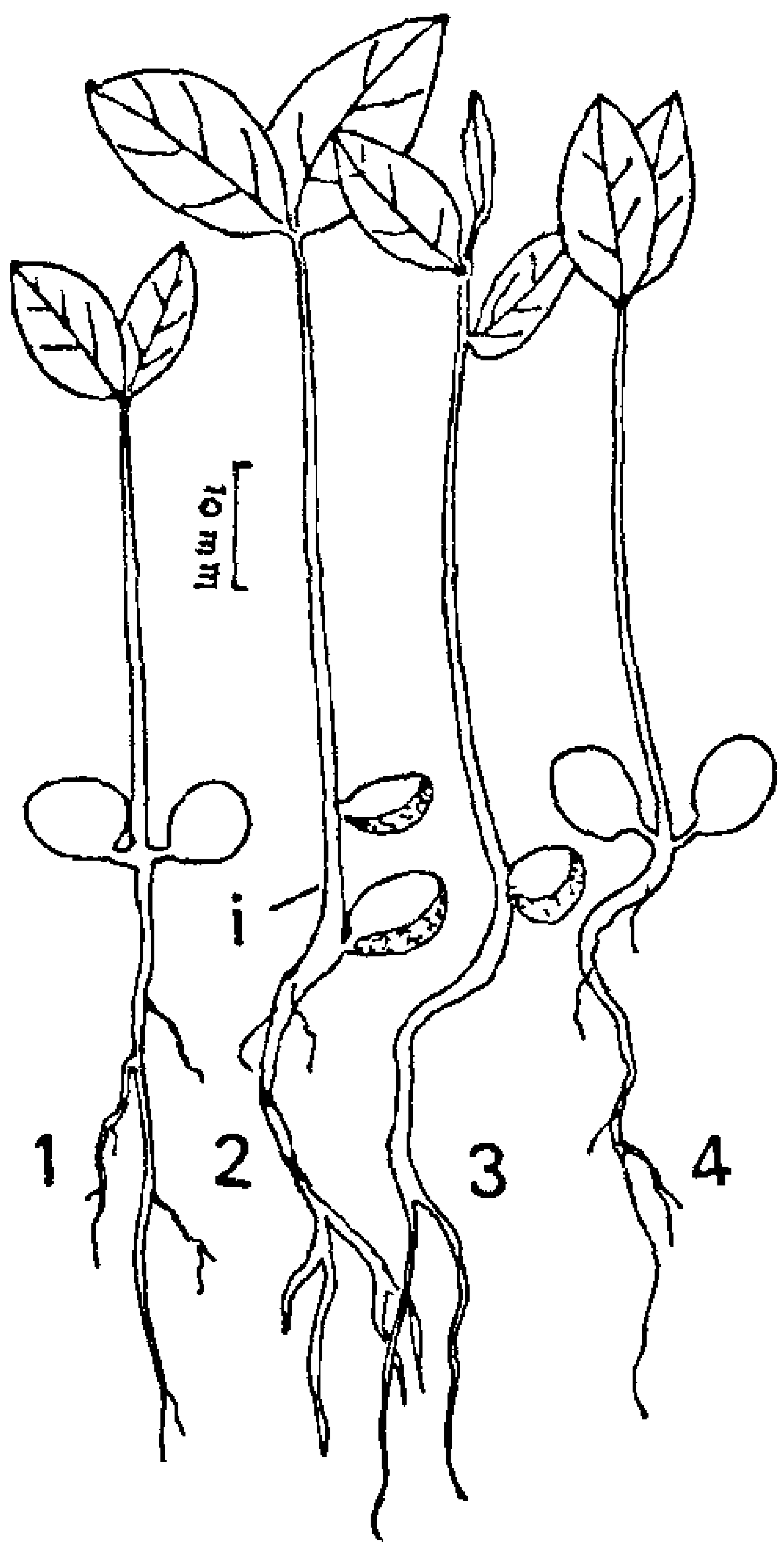

Figures 1–4. Seedlings of *Citrus medica*. **1.** Seedling of zygotic origin; **2–4.** Seedlings of non-zygotic origin; **3.** Seedling with a single cotyledon; **4.** Seedling with sub-opposite cotyledons. i- intercotyledonary internode.

(both are of vegetative origin) tend to differ from typical seedlings of zygotic origin in morphology. A fresh look at the factors which cause this variation would be rewarding.

30 November 1984; Revised 31 January 1985

1. Padmanabhan, D. and Muneeswaran, A., *Curr. Sci.*, 1975, **44**, 402.
2. Nair, N. C. and Kanta, K., *J. Indian Bot. Soc.*, 1961, **40**, 382.

EVOLUTION OF CO_2 IN SOIL INFESTED WITH FOUR SOIL-BORNE PATHOGENS OF SUGARBEET SEEDLINGS

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FACULTATIVE parasites often lead a saprophytic life in soil[1-3]. Although several parameters have been used for recording saprophytic activity of an organism, evolution of CO_2 provides a rapid and reasonably good information[4]. Using this parameter, saprophytic activity of four important soil-borne pathogens of sugarbeet seedlings, (*Sclerotium rolfsii*, *Rhizoctonia bataticola*, *R. solani* and *Pythium ultimum*) was studied under controlled conditions in the laboratory. This information will help in understanding the ecological behaviour of these pathogens in soil.

The apparatus designed by Peterson[5] was used for studying soil respiration. The soil used had the following characteristics: 100 g of soil. inoculum (1, 5 and 10%; grown on sand maize meal) was taken in brass wire basket (10 × 3 cm) and hung in 1 litre conical flask containing 25 ml of 0.1N NaOH. The evolved CO_2 was estimated by the method of Pramer and Schmidt[6]. The data on CO_2 produced were recorded at an interval of 4 days and each treatment was replicated thrice. The results were statistically analysed.

Data in table 1 indicate that the quantum of CO_2 produced by all the four pathogens was related to the level of inoculum applied initially, *i.e.* the CO_2 production increased as the level of inoculum increased and this trend persisted throughout the experimental period. Of the four facultative parasites used, the saprophytic growth/activity of *R. bataticola* and *S. rolfsii* was more than *R. solani* and *P. ultimum*, as judged by the amount of CO_2 produced. In *R. bataticola* and *S. rolfsii* the maximum CO_2 was produced by the 4th day, while *P. ultimum* and *R. solani* did so by the 8th day. This suggests (but does not prove) that the former fungi have higher saprophytic growth/activity than the latter ones. Similar results for *Pythium* species have been earlier reported[7-9].

The decrease in CO_2 production, after attaining the peak, may be correlated with the suppression of fungal growth/activity or may be due to the paucity of food material in the soil, as suggested by Papavizas and Davey[10].

This note is a part of Ph.D thesis awarded from Kanpur University.

Table 1 *Evolution of CO_2 at different inoculum levels by four seedling pathogens of sugarbeet*

Fungus	Inoculum	Incubation period (in days) 4	8	12	16	20	24	Total
S. rolfsii	Control	1.43	0.23	0.13	0.0	0.63	0.13	2.55
	1%	13.46	11.73	10.10	8.70	6.56	4.33	54.88
	5%	16.56	14.90	13.10	11.90	9.53	7.26	73.25
	10%	18.93	17.33	16.46	14.40	13.20	12.40	92.72
P. ultimum	Control	1.90	1.23	0.70	0.63	0.40	0.10	5.96
	1%	4.70	12.23	9.00	6.60	3.66	3.66	39.55
	5%	10.70	17.16	12.26	10.30	5.93	5.76	62.11
	10%	15.70	18.40	14.46	14.73	10.33	10.06	83.68
R. bataticola	Control	1.43	0.13	0.13	0.0	0.63	0.13	2.45
	1%	9.40	6.53	3.96	2.36	3.83	1.23	27.31
	5%	11.60	6.86	7.53	4.40	4.53	2.43	27.35
	10%	12.50	7.26	7.80	4.46	7.86	3.13	43.01
R. solani	Control	1.90	1.23	0.76	0.63	0.40	1.10	6.02
	1%	6.93	11.40	6.50	4.93	2.96	3.30	36.02
	5%	11.50	16.70	9.63	8.70	5.76	5.53	57.82
	10%	16.26	18.96	18.30	10.36	12.80	13.60	90.28

Statistical analysis: D—Days; T—treatment; Int = interaction
S. rolfsii C D (D) = 0.50, CD (T) = 0.40, C D (Int.) = 1.01; *P. ultimum* C D (D) = 1.13, CD (T) = 0.93, C D (Int.) = 2.27; *R. bataticola* C D (D) = 0.78, CD (T) = 0.64, C D (Int.) = 1.56; *R. solani* C D (D) = 0.59, CD (T) = 0.48, C D (Int.) = 1.18

4 December 1984; Revised 2 February 1985

1. Garrett, S. D., *Biol. Rev.*, 1950, **25**, 220.
2. Garrett, S. D., *Biology of root infecting fungi*, Cambridge University Press, London, 1956.
3. Louvet, J., *Root diseases and soil-borne pathogens* (ed.) Tonssonn, Bega and Nelson. 1970, p. 89.
4. Waksman, S. A. and Starkey, R. L., *Soil Sci.*, 1924, **17**, 141.
5. Peterson, E. J., *Tidoskr. Fur planteual.*, 1962, **32**, 625.
6. Pramer, D. and Schmidt, E. L. *Exp. Soil Microbiol.*, Burgess Publication Co., Minneapolis, M. U.S.A. 1964.
7. Barton, R., *Trans. Brit. Mycol. Soc.*, 1958, **41**, 207.
8. Barton, R., *Trans. Brit. Mycol. Soc.*, 1960, **43**, 529.
9. Luna, L. V. and Hine, R. B. *Phytopathology*, 1964, **54**, 955.
10. Papavizas, G. C. and Davey, C. B., *Phytopathology*, 1962, **52**, 759.

COMPARATIVE TOXICITY OF *BACILLUS THURINGIENSIS* SUBSPECIES TO *SPODOPTERA LITURA* (F.)

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Spodoptera litura(F) is presently considered as one of the resistant, polyphagous pest species of field crops of economic importance in India. *S. litura*, commonly known as the tobacco caterpillar, is also one of the major tobacco pests. These caterpillars feed on the foliage in the nursery and in fields and often cause serious crop damages. This pest also attacks banana, safflower, sweet potato, Marsilla, cabbage, cauliflower, *Sesbania grandiflora*, cotton, tomato, castor, groundnut and soybean[1].

It is generally a well known fact that a majority of the crystalliferous bacilli which encompass *Bacillus thuringiensis* subspecies are toxic to Lepidoptera. However, some of the workers in the field[2,3] have stated that the subspecies of the same serotype differ in their toxicity, while others[4,6] have attempted fractionation of the crystal protein (δ-endotoxin) of *B.thuringiensis* var *Kurstaki* (HD-1) subspecies and have shown that these fractions exhibit differential toxicities to Lepidoptera and Diptera.