Table 1 *Effect of concentrated cell-free culture filtrate of B. subtilis on the radial growth of vascular wilt fungi*

Organism	Control	5%			10%			20%			40%		
		2*	5	10	2	5	10	2	5	10	2	5	10
Verticillium albo-atrum	43 2	42.6	22 6	11.9	40.2	10.6	NG**	36.0	NG	NG	30 2	NG	NG
V. dahliae	51.6	49.6	16.2	8.3	47.8	NG	NG	42.3	NG	NG	36 2	NG	NG
Fusarium udum isolate 1	58 4	55.7	32.4	18 6	53.2	26 4	NG	50 4	12 6	NG	45 4	NG	NG
F. udum isolate 2	56 2	53 4	36.2	20.4	49 7	28.8	NG	45 6	18.2	NG	39 2	NG	NG
F. oxysporum f. sp. *lycopersici*	51 8	48.4	24 2	19.7	45.5	18.6	NG	42.8	11 8	NG	37 6	7.0	NG
F. oxysporum f. sp. *vasinfectum*	53.2	51.3	28 4	12.2	48 6	11.4	NG	44.5	8 3	NG	40 6	NG	NG

* Values in this row indicate the concentration folds; ** NG = No growth

B. subtilis was grown in 1 lit flasks containing 500 ml of potato dextrose broth and incubated on a reciprocating shaker (80 rev/min) at $28 \pm 2°C$ for 72 hr. Cultures were centrifuged at 15000 rpm for 15 min. The supernatant was concentrated to 2-, 5-, and 10-fold by reducing the volume in a rotary vacuum flash evaporator and passed through millipore filters (0.45 μm). The pH was adjusted to a desirable value (original pH was 5.5, 5.2 and 4.8 for 2-, 5- and 10-fold concentrated extracts, respectively). Each extract was diluted to indicate 5%, 10%, 20% and 40% in PDA. Plates without added extracts served as control. Petriplates were inoculated with actively growing test fungal cultures (5 mm plug) and incubated at appropriate temperatures of growth. The fungal growth was measured in terms of colony diameter after 7 days of inoculation. Each experiment was run in duplicate.

It was observed (table 1) that the 10-fold concentrated extract inhibited the growth of all the test fungi at > 10% concentration. With the exception of *F. oxysporum* f sp *lycopersici* no test fungus could grow in 5-fold concentrated extract at 40% concentration. There was some level of inhibition in all the cases, which increased with increase in percent concentration as well as the original concentration of the extract.

It is evident that the organism (*B. subtilis*, AF_1) produced some extracellular antibiotics, diffusible in solid agar which could inhibit the growth of test fungal wilt pathogens. Since the initial inoculum of wilt fungi appears from the debris of diseased plants and from the residual inoculum which remains viable in the soil for long periods, stable amendment of wilt sick soils with *B. subtilis* may provide a biological control for fungal wilt diseases. This could be an ideal alternative to reduce the initial inoculum in the soil.

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SELF-SOWN PLANTS FROM BACTERIAL BLIGHT-INFECTED RICE SEEDS—A POSSIBLE SOURCE OF PRIMARY INFECTION IN NORTH-WEST INDIA

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THE reports of bacterial blight-infected seeds as the source of perpetuation of the disease in north-west India mainly referred to the seed-lots stored and used for raising rice nurseries[1-4]. As information on the feasibility of survival of inoculum in seeds, lying in

the fields after crop harvest, was lacking, the fate of left-over bacterial blight-infected rice seeds was investigated.

During the second week of December 1983, infected rice seeds, harvested from a severely blighted crop consisting mixed population of Pusa 169 and a tall 'off-type', were buried in horizontal layers at three depths—5, 15, 25 cm, at 200 g per layer, in soil, belonging to non-cultivated area, filled in cement pots (45 × 45 cm) placed underground upto brim under partially tree-shaded conditions. The seeds were allowed to remain in soil for about 24 weeks under three cropping conditions *viz* (i) wheat crop, (ii) berseem (*Trifolium alexandrinum*) crop and (iii) fallow. Identical sets with healthy seeds (seeds of disease-free crop) served as checks. At maturity, the *rabi* crops were cut and the pots were left undisturbed till third week of June 1984. Large number of seedlings appeared from seeds at 5 cm depth after showers in April–May. Seeds placed at 15 and 25 cm depths, however, remained unaffected, taken out in the third week of June and allowed to germinate in respective pots. All pots thereafter received regular watering. The crops in pots were regularly observed for appearance of the disease till September when tillers were cut and stalks examined for systemic infection.

During August–September, leaf blight was detected, in traces, in crops raised from infected seeds that remained buried during *rabi* at 25 cm depth with wheat crop and at 15 cm depth under all the three cropping conditions. Microscopic examination of tiller-stalks revealed that systemically infected plants were present in all crops raised from infected seed-lots. The number of systemically infected tillers was, however, noticeably high (5–8) in crops which revealed leaf blight visually. Appearance of 'kresek'-affected ratoon tillers from stubbles further provided confirmative evidences. Examination of crops in check pots did not indicate bacterial blight infection in plants.

The results suggested that in north-west India, bacterial blight-infected rice seeds, buried upto a depth of 25 cm in soil, could retain viability and inoculum through *rabi* season under both cultivated and non-cultivated conditions. The subsoil conditions prevailing at a depth of about 15 cm during *rabi* in the region appeared to be congenial for survival of inoculum in seeds. Partially-shaded conditions, commonly occurring under trees in fields, seemed to provide ideal conditions for successful establishment of the disease in self-sown plants. The number of such foci of primary infection was obviously very low, but the source was potent enough to initiate outbreak of the disease in rice crops. With early cropping practice, the source was capable of playing very active role in rice nurseries and transplanted crops.

Abundant presence of self-sown rice seedlings, observed during April, in a sugarcane field, planted after rice (*kharif*) and pulse (*rabi*) crops, suggests that the left-over rice seeds in fields get buried in soil during *rabi* field operations and later produce self-sown plants, coming to surface again by *kharif* ploughing operations. Bacterial blight-susceptible rice with seed-shedding characteristic may be potential source of infected self-sown plants in the region.

The present findings provide clues to some baffling disease situations encountered in the region: often appearance in early transplanted crops; occurrence in crops raised from healthy seeds; out of many fields transplanted with same nursery, appearance in certain fields only, often appearance in plants under tree-shades; patchy development in fields. It is imperative that epidemiological and management aspects of the disease in north-west India should be discussed keeping in view the facts revealed herein. Evidently raising nurseries with disease-free seeds may not prove to be an absolutely effective manoeuvre to check occurrence of the disease in fields in the region.

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IN VITRO DEVELOPMENT OF *CAJANUS* × *ATYLOSIA* HYBRIDS

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FOOD legumes which have many utilitarian features, have been neglected in cultivation mainly because of their poor yields and susceptibility to various insect pests and diseases. Pigeonpea, *Cajanus cajan* (L) Mill