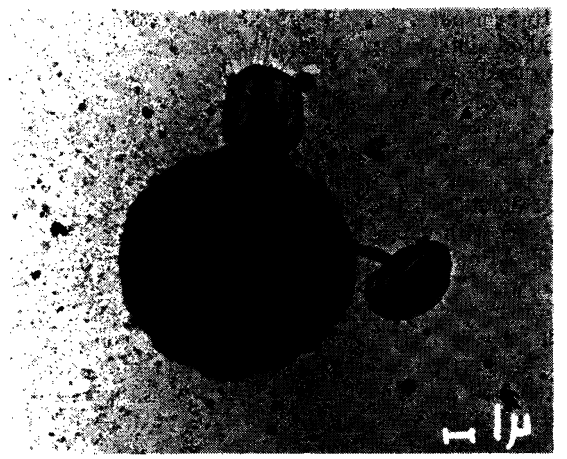

Fig. 2. Swarmspore with both flagella rolled inward from the tip. Electron micrograph, unshadowed, × 3500.

similar to those described from electron micrographs for the genus *Saprolegnia* by Manton *et al.* (*2*). Couch's (*3*) description of the flagellation of *Pythium* sp. based on staining procedures and observations with the optical microscope also fits closely the situation found in *P. infestans*.

The flagella of most of the swarmspores killed soon after their liberation from the sporangia and kept cold during the killing process are not paddle-shaped. The tip of the ciliated flagellum is slightly rounded, as is shown in Fig. 1*b*. The tip of the other flagellum often appears to be slightly tapered. In some preparations, however, a situation, such as that pictured in Fig. 1*c*, may be noted. Either one or both flagella appear to be rolled inward from the tip.

In droplets taken several hours after swarming, many swarmspores like that shown in Fig. 2 are seen. In these the flagella appear to have rolled up almost completely. Intermediate stages between those pictured in Figs. 1*c* and Fig. 2 also may be seen, and frequently a rolled-up flagellum is found detached from the body of the swarmspore. Occasionally all the stages can be found in the same droplet. In view of these findings, it seems likely that this is a way the swarmspore sheds its flagella preparatory to encystment and germination.

Further examination of living swarmspores with the phase microscope has confirmed this interpretation. Soon after swarming, the swarmspores are very active and will continue to be if they are kept cold. The flagella move rapidly and are difficult to see. However, they do not appear to be shaped like paddles at this time. As the water in the droplet begins to warm, the swarmspores begin to swim more slowly, and small paddle-like structures can be seen on some of them. The paddles soon become easier to see, partly because the paddle blades become larger, and partly because the swarmspores move more slowly. As the blade of the paddle enlarges, the handle separating it from the swarmspore body becomes shorter until often it cannot be seen. At this point, the swarmspore stops its movement. The flagella, still resembling paddles, become detached and float away.

These preliminary studies indicate that both time and temperature are factors in the formation of the paddles and their detachment. The flagellation of this organism is being studied further and will be described later in detail.

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Effect of Isonicotinic Acid Hydrazide on Several Higher Plants*

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Isonicotinic acid hydrazide (INAH) has been shown to be bacteriostatic *in vitro* in concentrations as low as 0.02 mg/ml (*1*), and it may possess some slight antifungal properties (*2*). Its effects upon the growth of higher plants and upon the enzyme chemistry of affected organisms have not been reported.

In three experiments conducted May–Oct. 1953, observations were made on vegetative, reproductive, and enzyme responses of bush beans, sugar beets, buckwheat, and spring oats treated with INAH. Each treatment, applied 21 days after sowing the seed, involved five pots of three to five plants.

The treatments were as follows: (i) aerial parts sprayed until wet with 0.1 percent Tween aqueous solutions of 0.1, 0.2, 0.4, 0.8, 1.2, or 1.6 percent INAH; (ii) one leaf immersed for 30 sec in the aforementioned solutions; (iii) one leaf, the upper epidermis of which had been removed by scraping with a sharp scalpel, immersed in 0.4, 0.8, 1.2, or 1.6 percent solutions; (iv) 50 ml of 0.4, 1.2, or 1.6 percent

Table 1. Green weights (grams per plant) of bean plant tops treated with isonicotinic acid hydrazide and harvested 51 days after treatment.

Concentration of INAH (%)	Aerial parts sprayed (g)	One leaf immersed (g)	One leaf abraded and immersed (g)	50 ml of solution on soil in pot (g)
0.4	41.9	43.6	40.7	42.4
.8	42.3	39.6	32.5	34.9
1.2	32.3	39.3	38.9	15.3
1.6	26.5	22.3	22.9	Dead

Untreated plants: 52.8 g.

* Supported by the Research Fund, University of British Columbia.

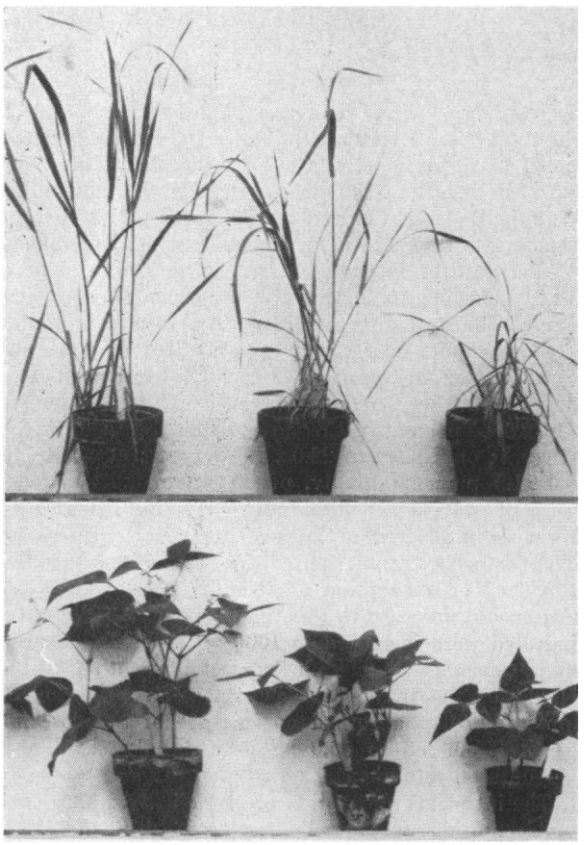

Fig. 1. Effect of 1.2 percent isonicotinic acid hydrazide solution on Victory oats (top) and Masterpiece bush bean (bottom) 24 days after treatment. From left to right: control, spray, and applied to soil.

solution of INAH applied to the soil in each 5½-in. pot.

Concentrations of 0.1 percent and 0.2 percent INAH had no visible effect on any of the plants. Solutions of 0.4 percent and higher resulted in a stunting of all plants irrespective of the method of application. The intensity of action increased with concentration of INAH. Buckwheat was most sensitive to treatment, followed by sugar beet, bush beans, and spring oats. Spraying or immersion of whole or abraded leaves did not result in absorption of sufficient INAH to cause the death of any plant, with the exception of buckwheat. Solutions of 1.2 percent and 1.6 percent, entering through abraded leaves, proved lethal to this plant. A solution of 1.6 percent INAH applied to the soil resulted in the death of all species. Buckwheat was killed by the soil application of 0.8, 1.2, and 1.6 percent INAH. Green weights of bean plant tops (Table 1) indicate growth response. This is also shown in Fig. 1.

Retardation of growth was evident 4 days after treatment. The stems of plants given a lethal dose drooped and the leaves curled and wilted within this time. These symptoms were followed by death of stem tips and necrosis of the stem just above the soil. Flowering was retarded from 3 to 7 days by the higher concentrations, but in no case where the plants survived treatment did flowering fail to occur. Photosynthesis, as indicated by the I-KI test for starch, was very considerably reduced in bean plants whose cut stems were immersed in 1.2 percent and 1.6 percent solutions of INAH. The production of adventitious roots on these stems was similarly affected. Lower concentrations had little effect on these two phenomena.

Table 2. Activity of catalase and phosphatase in oats, sugar beets, and beans not treated and treated with 1.2 percent isonicotinic acid hydrazide.

Plant	INAH	Catalase K_o	Phosphatase*
Oat	None	0.0447	76.7
	1.2% to soil	.0394	74.1
Bean	None	.0520	85.8
	1.2% to soil	.0403	81.6
Sugar beet	None	.0304	219.7
	1.2% spray	.0178	211.9

* Micrograms phenol.

Catalase activity was less in treated plants than in controls. The reduction was 42 percent in the case of sugar beets. Phosphatase activity was not significantly altered (Table 2). Enzyme activity was determined by methods given by Wort (*3*).

The effects of INAH are unlike those produced by maleic hydrazide (MH) in several respects. The inhibition of growth was not temporary; flower and vegetative buds were not completely inhibited; flowering was not delayed by the lower concentrations of INAH used; there was no local accumulation of anthocyanins; and there were no leaf and bud abscissions as have beeen obtained with MH (*4*). Moreover, INAH effects were more severe with the dicots used than with the monocot. The very considerable drop in photosynthesis and in catalase activity in the treated plants suggests that observable INAH effects stem in part from a lack of available photosynthate for cell material synthesis and available energy and in part from an inhibition of respiratory enzymatic action. Respiratory and phosphorylase studies are being continued.

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