POTATO SCAB CONTROL ON ORGANIC SOILS. I. INITIAL RESPONSE TO PCNB[1]

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INTRODUCTION

Common potato scab, caused by *Streptomyces scabies*, is a disease of major economic importance, especially on muck soils of the midwest. Unlike infections in most mineral soils, severe scab on muck often occurs at soil reactions as low as pH 5.1 or 5.2 and sometimes lower. Control through lowering the soil pH, therefore, is usually impractical. Some control has been effected by early planting (5). Control of this type is associated with higher soil moisture at time of tuberization, which appears to be a critical factor in reducing inroads of scab. .

PCNB (pentachloronitrobenzene)[3] has been reported to reduce scab on organic (1) and on mineral soils (2). Application studies have indicated that broadcasting followed by a thorough mixing with disc or roto-tiller gives best results (4).

Twenty-five to 150 pounds of PCNB has controlled scab on mineral soils, with some phytotoxicity at higher rates. Residual scab control on mineral soil for one year after treatment has been reported (3). It was much less effective than the original application..

MATERIALS AND METHODS

Twenty per cent PCNB dust was used throughout these experiments. An area on the Purdue Muck Crops Farm, pH 5.3, known to have a high incidence of scab was selected. The soil contained 85 per cent organic matter in a highly oxidized, finely divided state, with a base exchange capacity of 235 m.e. per 100 gr.

In 1956, four treatments, 0, 100, 200, and 300 pounds active ingredient were applied in a randomized block design with treatments replicated four times. The material was broadcast and disced in to a depth of six to eight inches, being thoroughly incorporated with the soil. Katahdin potatoes, used throughout, were planted the following day, May 30. This date, about three weeks later than normal for the area, was selected in the hope of securing maximum scab infection. On October 16, paired rows, each 25 feet long, were harvested, the tubers weighed and 50-tuber samples were examined for scab. The standard "area" and "type" scab classification was used. An area of 1 indicates scab lesions affecting not more than 20 per cent of the surface area; 2, 3, 4, and 5 have upper limits of 40, 60, 80 and 100 per cent surface coverage respectively. Type one is an innocuous surface scab; 2, 3, 4, and 5 increase in severity from a slightly more prominent surface scab, though superficial, through rough pustules to

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[3]Twenty per cent PCNB dust (Terrachlor) furnished by the Olin Mathieson Company.

pitted and deeply pitted lesions respectively. A "Scab Index" was calculated as:

$$\text{Scab index} = \frac{\text{average (area x type) x per cent scabby tubers x 4}}{100}$$

The highest value possible for the index as calculated is 100; however, an index of 50 could represent nearly 100 per cent culls. All scab readings were made by the same person. Although other scab indices have been devised (6) the one employed here utilizes a scoring method that has been used at this station for several years.

In 1957, one half of each plot was given an application of PCNB similar to that applied the previous year, while the other half was not treated in 1957 and served as a residual check. Half of each 1956 "control" plot was treated in 1957 with a 200 pound application of PCNB, the other half being maintained as a control both years. The potatoes were planted on May 19 and harvested October 15. Data on scab were taken as before.

Results

Yield: Yield differences were non-significant in both years. (Table 1). Tuber size and specific gravity were similarly unaffected.

Scab Incidence: Severity of scab lesions and the number of scabby tubers were reduced by PCNB. Table 2 gives results for the initial application.

Table 1.—*Total yield and per cent "B" size tubers for seven PCNB treatments and control. 1956 and 1957. Katahdin variety.*

Pounds Actual PCNB Per Acre		Total Yield Per Acre		Yield of "B" Size Tubers	
1956	1957	1956	1957	1956	1957
		Bus.	Bus.	Per cent	Per cent
200	200		626		7.8
200	0	553	614	4.5	7.0
0	200		611		5.4
0	0	528	603	4.7	6.9
300	300		602		8.6
300	0	579	575	4.8	8.1
100	0	572	567	5.4	7.6
100	100		526		8.9
		N.S.	N.S.	N.S.	N.S.

Table 2.—*Incidence of scab-free tubers. PCNB treated plots and control. Katahdin variety. 1956.*

Pounds of PCNB Per Acre	Scab-free Tubers (Per cent)
0	9
100	34
200	49
300	55
LSD .05	17

Scab was less prevalent in 1957, perhaps due in part to the earlier planting date. Nevertheless, a definite treatment response is shown in table 3. Substantial residual control is evident at higher rates, intensified by the 1957 application, giving a cumulative response.

Percentage of scab-free tubers, although a meaningful statistic in itself, does not thoroughly describe the beneficial effects of PCNB Milder scab lesions appeared on tubers grown in treated soils, as is shown in table 4. These differences were much less pronounced in 1957, when scab was generally milder.

Inherent absorptive capacities of muck soils probably account for the high PCNB rates required. At 300 pounds per acre, excellent scab control was obtained the first year and plots receiving 600 pounds over a two year span also showed excellent control with the least scab.

In accordance with findings elsewhere (4) and unpublished results at this station, broadcast applications thoroughly incorporated with the soil were most effective. Apparently the chemical exhibits very slight mobility within the soil.

Residual activity at 200 and 300 pounds proved considerable. A direct comparison, at the 200 pound rate, of residual and current season applications revealed very slight, non-significant differences in scab incidence. (Table 3). Whether this residual effect is evidence of prolonged activity within the soil or is, instead, a manifestation of reduced inoculum level from the treatment applied the previous season is a matter of some interest. A report of phytotoxicity the year following treatment with PCNB (3) lends support to the former hypothesis.

Despite appreciable residual control at the higher PCNB levels significant improvement in scab control through current season application was apparent in every instance. Moderate yearly doses are indicated as superior to an initial massive one for best control over a period of years. Economic aspects, however, affect the practicability of general commercial usage, a matter beyond the scope of this study.

Percentage of "B" size tubers and total yield remained unaffected at the rates used. There was no evidence of toxicity, such as delayed emergence, as has been reported elsewhere (3). Howeevr, some phytotoxicity was indicated by reduced weed populations in the treated areas. No quantitative data on this effect were taken. On mineral soils of low exchange capacity, definite yield reduction has occurred at rates in excess of 150 pounds per acre. For mucks with high base exchange capacities, the safe toxic level for mineral soils should be multiplied by a factor of at least three to compensate for the added absorption capacity, assuming data from other chemically related soil amendments can be extrapolated to include PCNB. This would account for the absence of yield depression at the high rates used on muck.

Yearly differences in scab incidence were apparent as the "control" indicate. The later planting date in 1956 may have contributed to more extensive scab that year.

Tubers from plots treated with high PCNB rates were uniformly attractive. Tubers free of Rhizoctonia (black scurf) appeared in most PCNB treatments. Control of this important disease is an added possibility of PCNB (1).

TABLE 3.—*Incidence of scab-free tubers. PCNB treated plots and control. 1957.*

Rate Pounds Actual PCNB Per Acre	Per cent Scab-free Tubers	
	PCNB Applied	
	1956 only	1956 & 1957
0	28.5	58.5*
100	44.0	71.0
200	50.5	71.0
300	60.5	85.0
LSD .05 within rates	16.1	
LSD .01 within rates	22.6	
LSD .05 all other comparisons	21.5	
LSD .01 all other comparisons	30.6	

*200 pounds in 1957.

TABLE 4.—*Scab index and average classification among infected tubers for given treatments. Katahdin variety. 1956 and 1957.*

1956

Pounds Actual PCNB Per Acre	Scab		
	Area	Type	Index
0	4	3	37.0
100	3	2	12.5
200	3	2	11.0
300	3	1	7.3
	LSD .05		12.7
	LSD .01		18.6

1957

Pounds Actual PCNB Per Acre		Area	Type	Index
1956	1957			
0	0	2	3	20.8
0	200	2	3	10.0
100	0	3	3	16.5
100	100	2	2	5.0
200	0	1	4	9.0
200	200	1	3	3.5
300	0	2	2	4.0
300	300	2	2	2.0
		LSD .05		4.8
		LSD .01		6.5

Summary

Incidence of potato scab was significantly reduced on a muck soil of high exchange capacity by PCNB with no reduction in tuber yield at rates up to 300 pounds per acre. Rates of 100, 200, and 300 pounds actual fungicide were used. Broadcast application followed by thorough mixing with the soil to a 6-8 inch depth proved satisfactory. Row application was not used in these tests.

At the higher rates residual activity was apparent the year following application. Repeated treatments the second year caused further significant scab decline. Accumulative reduction in scab incidence from a series of moderate yearly doses appears to be the most efficient use of PCNB on muck soil. This practice would be inconsistent with standard cropping methods used on muck, however, since potatoes are not ordinarily raised on the same muck soil in successive seasons. Economic considerations will be important in determining the exten of PCNB use and its acceptability among potato growers.

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