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THE EFFECT OF THREE INSECTICIDES AND FOUR BAIT-BASE COMBINATIONS FOR THE CONTROL OF CUTWORM CATERPILLARS ON POTATO IN JAMAICA

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Three insecticides were mixed in four bait-base combinations and applied to a potato field with high cutworm infestation. Population and mortality counts were taken 5 days before bait application and 2 and 4 days after. At 4 days after the baits were applied, those with Basudin and Phosvel gave better kills than Sevin, there were no differences between the bases pig meal, citrus pulp, saw dust and coir dust, but Phosvel in pig meal and citrus pulp gave the highest mortality.

INTRODUCTION

In Jamaica various pests attack the potato Solanum tuberosum crop from the seeds are planted to reaping of the tubers. Among these cutworm caterpillars especially the species Anicta infecta, Prodenia ornithogalli and Xylomiges sunia have been considered most serious for many years damaging the new sprouts (haulms) and the matured tubers. Losses of up to 60% of the tubers have been recorded (Suah 1974) and damage has been most severe on tubers nearest the soil surface. Several methods of control were examined over the years.

Soon after the establishment of potato as a viable crop here and assessment of the pests, Edwards (1936) recommended the use of poison baits containing paris green or white arsenic. In Australia, Hawaii and the Phillipines, a Toxaphene bait was used effectively against Prodenia spp. (1 to 1970). Peregrine (1973) stated that prior to 1943, the use of toxic baits was a popular method of pest control worlwide. He claimed that the subsequent reduction in use of this method coincided with the discovery of DDT and its use as a dust or spray.

Since 1936 several insecticides and methods of application have been tested in Jamaica (Payne et al 1970), Suah 1974), but none provided lasting effective economic control. This paper describes a test conducted with 12 baits for the control of cutworm caterpillars. It was influenced by considerations such as the nocturnal and crawling habit of the insects, shortage of water for insecticide sprays in the main potato growing areas, the need for rapid kill of the pests to prevent or minimize tuber damage, the desire to reduce environmental pollution by the use of pesticides, and the economics of applying this method of pest control. The baits, time of application and method of assessment were based on preliminary data derived from a small observation trial conducted during the preceding potato crop.

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EXPERIMENTAL PROCEDURE

The tiral was conducted with spring potato on Chudleigh clay loam soil (Map No. 73) at an elevation of 900M. The area used was planted with potato the preceding fall season to help ensure a high natural population of cutworms. The field was prepared by the owner-farmer in the customary methods of clearing, land preparation, furrowing and planting. Potato cv Kennebec was used as the host plant. The 12 bait treatments comprised of the insecticides Basudin 40% WP (0,0-diethyl-(2-isopropyl-4-methyl-6 prymidinyl) Sevin 85% WP (1-naphthyl N-methylcarbamate) and Phosvel 50% WP (0-(4-bromo-2, 5-dichlorophenyl) 0-methyl phenyl phosphonothiote) mixed in four bases, commercial pig meal (sowchow), dried citrus pulp, coir dust, and pine timber saw dust. There were also two treatments of bait bases alone (pig meal and citrus pulp) and one untreated plot per experimental block (see Tables 1 and 5). All the toxic baits were comprised of 1% active ingredient of the insecticides and 99% of the bases. Two pounds of the mixtures were applied per plot in one ounce heaps evenly distributed.

Treatment plots were arranged in a randomized complete block design with four replications. Each experimental plot was 8m long by 2.2m wide with 10 cross rows 80cm apart. The uncut seeds were planted 20cm apart in furrows about 20m deep. There were 36 experimental plants per treatment plot.

Spraying for the control of early blight Alternaria solani and late blight Phytophthora infestans was done weekly from weeks 4 to 10 using Dithane M-45 WP (combination of zinc ions and manganese ethylene bis-dithiocarbomate) at 2 pounds per 100 gallons of water. The furrows were moulded over or earthed up at week 6, and the initial cutworm population counts were made at week 12 (see Table 1). Five days after this the baits were applied and counts were again taken 2 and 4 days after application (see Tables 2 and 3). Samples were taken at random by tossing a square centimetre steel frame from the edge of each plot. All the caterpillars in the frame, taken from the soil surface or within 5 cm of it were counted and released. The experimental plants were reaped at week 14 and the tubers assessed for cutworm damage.

RESULTS AND DISCUSSION

At 5 days before the baits were applied population counts of cutworm caterpillars varied from 10 to 41 among the treatment plots (see Table 1). There were no marked trends in distribution. Table 2 shows cutworm per treatment plot at 2 days after the baits were applied and Table 3 shows this at 4 days.

Counts of cutworm caterpillar in the experimental plots at 5 days before and 2 days after the bait application were closely related (the estimated correlation coefficient being 0.85). The population level

TABLE 1. Cutworm caterpillar population counts at 5 days before toxic baits were applied

Treatment	Experimental Block 1		2		3		4		Average of 4 blocks	
	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead
A Basudin in saw dust	14	0	34	1	14	0	91	0	45.0	0.2
B Basudin in coir dust	43	1	26	0	63	2	42	0	43.5	0.7
C Basudin in pig meal	40	2	24	0	57	1	74	2	48.7	1.2
D Basudin in citrus pulp	41	6	86	2	69	4	21	1	54.2	3.2
E Sevin in coir dust	26	0	28	0	50	1	26	2	32.5	0.7
F Sevin in pig meal	48	1	42	0	44	3	10	0	36.0	1.0
G Sevin in saw dust	29	0	64	2	11	4	27	0	32.7	1.5
H Sevin in citrus pulp	24	1	14	1	22	1	18	1	19.5	1.0
I Phosvel in pig meal	40	3	31	1	71	6	62	3	51.0	4.2
J Phosvel in saw dust	48	1	27	0	26	3	34	3	33.7	1.7
K Phosvel in coir dust	56	4	16	0	43	0	68	1	45.7	1.2
L Phosvel in citrus pulp	21	1	28	2	72	4	53	3	44.0	2.5
M Control, pig meal alone	28	4	31	1	16	1	28	0	25.7	1.5
N No treatment	33	0	26	1	40	0	24	2	30.7	0.7
P Control, citrus pulp alone	14	1	18	3	37	0	17	0	21.5	1.0

TABLE 2. Cutworm caterpillar population 2 days after toxic baits were applied

Treatment	Experimental Blocks 1		2		3		4		Average of 4 blocks	
	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead
A Basudin in saw dust	11	24	12	19	3	12	8	73	8.5	32.0
B Basudin in coir dust	11	36	5	17	7	76	10	39	8.2	42.0
C Basudin in pig meal	7	25	16	29	8	60	11	58	10.5	43.0
D Basudin in citrus pulp	8	34	16	74	12	41	4	12	10.0	40.2
E Sevin in coir dust	14	17	7	16	25	16	13	11	14.7	15.0
F Sevin in pig meal	23	20	15	12	25	9	2	9	16.2	12.5
G Sevin in saw dust	19	8	35	23	8	9	21	16	20.7	14.0
H Sevin in citrus pulp;	16	11	0	19	14	1	7	12	9.2	10.7
I Phosvel in pig meal	12	30	4	23	10	75	6	49	8.0	44.2
J Phosvel in saw dust	14	28	16	19	4	35	12	20	11.5	25.2
K Phosvel in coir dust	22	30	3	9	13	23	9	53	11.7	28.7
L Phosvel in citrus pulp	4	11	7	26	8	57	10	44	7.2	34.5
M Control pig meal alone	18	8	28	0	24	1	27	0	24.2	2.2
N No treatment	19	0	25	0	36	0	27	2	26.7	0.5
P Control, Citrus pulp alone	17	0	23	2	33	0	18	0	22.7	0.5

TABLE 3. Cutworm caterpillar population at 4 days after baits were applied

Treatment	Experimental Blocks 1		2		3		4		Average of 4 blocks	
	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead
A Basudin in saw dust	6	49	13	34	8	21	16	18	10.7	30.5
B Basudin in coir dust	10	47	18	71	5	32	10	28	10.7	44.5
C Basudin in pig meal	11	47	5	67	9	79	2	45	6.7	59.5
D Basudin in citrus pulp	14	55	10	24	2	83	7	26	8.2	47.0
E Sevin in coir dust	29	60	11	1	49	17	19	18	27.0	24.0
F Sevin in pig meal	10	37	24	7	6	20	6	27	11.5	22.7
G Sevin in saw dust	43	15	23	3	40	11	12	13	29.5	10.5
H Sevin in citrus pulp	27	14	16	19	6	10	9	40	14.5	20.7
I Phosvel in pig meal	3	59	4	96	0	121	0	40	1.7	79.0
J Phosvel in saw dust	13	36	4	43	1	29	0	57	4.5	41.2
K Phosvel in coir dust	13	83	5	29	8	14	10	40	9.0	41.5
L Phosvel in citrus pulp	3	59	13	75	2	77	2	23	5.0	58.5
M Control, pig meal alone	135	0	145	0	125	0	78	2	120.7	0.5
N No treatment	50	0	38	3	26	0	57	0	42.7	0.7
P Control, citrus pulp alone	49	10	27	4	62	1	18	1	39.0	4.0

on these 2 days was also similar. However, on the 4th day after treatment the distribution pattern changed, and the population level (dead caterpillars included) was raised. There was a marked increase in the control plots with pig meal (PM) only (treatment M). Otherwise there were no apparent trends in population distribution change which could be attributed to the treatments.

Mortality rates for each plot at each count were estimated as the percentage number of dead caterpillars among the total number of caterpillars in the same area. At 5 days before bait application, mortality was less than 10% in all but 2 of the 60 plots with an overall average of 3.94%. There was no evidence or marked differences or trends in mortality rates among the plots.

Two days after application of the baits, the average mortality in the control plots (treatments MNP) was 4.14% compared to 67.66% in the pesticide treated plots (A-L). In order to detect differences between the pesticides and bait bases, percent mortality of treatments A to L was analyzed, and this showed that Phosvel and Basudin (average mortality rates of 75.60% and 79.61% respectively) were both significantly more effective than Sevin (average mortality rate 47.71%). The difference between Phosvel and Basudin was not significant. There was no difference between the bait bases pigmeal (PM) citrus pulp (CP) coir dust (CD) and saw dust (SD). There was also no evidence of pesticide by bait base interaction.

At 4 days after baiting, mortality was distinctly higher in the toxic bait treated plots than in the controls with average rates of 72.65% for the former and 3.88% for the latter. Analysis of mortality rates for treatments A to L showed that Basudin and Phosvel were both significantly more effective than Sevin ($P > 0.01$) but not significantly different from each other. However, at this stage there were significant differences between the bait bases. With an average mortality of 84.23% pigmeal was significantly more effective than coir dust at 65.66% and saw dust at 63.28% (see Table 4). Also citrus pulp with the second highest average mortality of 77.43% was significantly more effective that saw dust only. There was no evidence of pesticide by base interaction. Comparing this with the results at 2 days after bait application, the average mortality was similar for both times for Sevin (47-48%) and Basudin (80-81%) but was substantially lower for Phosvel on day 4 than day 2 (90% vs 76%).

Analysis of tuber yield data was also done. Damage for each plot was assessed as the percentage number of damaged tubers of the total number reaped. The resulting values of percentage damage were then analyzed. Damage was significantly lower ($P < 0.01$) in the toxic bait treated plots (A to L) than the others (M to P). Differences between these plots were not significant. Of the 3 pesticides, percentage damage was least for Phosvel. The average for that pesticide of 3.90% was significantly lower ($P < 0.01$) than for Basudin (9.08%) and Sevin (10.10%).

Table 4.--Percentage cutworm caterpillar mortality 4 days after toxic bait application - Pesticide by base totals

Pesticide	SD	Base CD	PM	CP	Average %
Basudin	286.79	322.40	359.61	326.73	89.88
Sevin	110.97	150.16	260.05	232.57	80.97
Phosvel	361.63	315.39	391.16	369.86	47.11
Average %	63.29	65.66	84.23	77.43	

For the bait bases, damage per plot for pigmeal (5.25%) and citrus pulp (5.43%) was significantly lower than coir dust (9.33%) and saw dust (10.76%). There was no significant difference between pigmeal and citrus pulp, or between saw dust and coir dust. There was no pesticide by bait base interaction. These results agreed with those based on cutworm mortality rates for the 4th day after bait application, with the exception of the relative differences between Basudin and Sevin.

CONCLUSION

The need for a more efficient method of cutworm caterpillar control in potato production led to the investigation of the use of toxic baits. Population counts 5 days before toxic baits were applied showed three species of cutworms involved evenly distributed in the treatment plots. The population counted 2 days after the baits were applied remained closely related to the pre-treatment populations. Caterpillar mortality data showed that at 4 days after the baits were applied the insecticides Phosvel and Basudin gave better kills than Sevin, but there were no differences in interaction between the bait bases pigmeal, citrus pulp, saw dust and coir dust. The data on tuber damage showed that the most effective baits in terms of losses appeared to be Phosvel in either pigmeal or citrus pulp.

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TABLE 5. Number[a] of cutworm damaged and undamaged potato tubers in relationship to the bait used

Treatments	Damaged Tubers	Undamaged Tubers	Total
A Basudin in saw dust	50	403	453
B Basudin in coir dust	56	367	423
C Basudin in pig meal	25	402	427
D Basudin in citrus pulp	29	424	453
E Sevin in coir dust	45	392	437
F Sevin in pig meal	39	424	463
G Sevin in saw dust	55	336	391
H Sevin in citrus pulp	30	453	483
I Phosvel in pig meal	6	477	483
J Phosvel in saw dust	26	388	414
K Phosvel in coir dust	20	453	473
L Phosvel in citrus pulp	16	391	407
M Control pig meal alone	147	413	560
N No treatment	100	401	501
P Control citrus pulp alone	134	424	558

a = Total of 4 replications

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