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INSTITUTE OF AGRICULTURAL RESEARCH

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Part II

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* Evaluation of Varietal Resistance of Potato to Potato Tuber Moth (PTM) Phthorimaea operculella.

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As in any other insect host relationships, interaction between the potato plant and its insect pest, the potato tuber moth, varies from one cultivar to another. The relationship sometimes favours the host plant resulting in a tolerant or resistant cultivar or a susceptible plant if otherwise. This offers an opportunity to screen a variety with a degree of resistance or tolerance to the pest attack. No study on the selection of resistant varieties of the potato to the insect has been carried out in this country. However, the worldwide distribution of the potato and its insect pest, Phthorimaea operculella, has given to an emple source of research information. Differences in the development of the moth have been observed on different varieties of potato on the field and tubers in store (Haines 1977). Comparison based on the proportion of damaged tubers in 20 cultivars tested in one study showed a variation ranging from 28.7 to 61.56% (Guglehmetti, 1978). Ohter trials involving 20 cultivars of potato were tested in the field for relative levels of leaf and tuber infestation (Foot, 1976). None showed evidence of resistance except those varieties with prolonged upright growth habit and fewer leaves close to the soil surface sustained lower leaf mine injury, and varieties with deeper tuber settings showed lighter tuber infestation at harvest. Three clones out of 100 tested showed resistance to tuber moth at CIP (1979) under laboratory condition.

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Larvae penetrated either through the eyes of tubers or through the skin and fed inside susceptible tubers whereas in the resistant varieties there were fewer tuber eyes or skin injury due to antibiosis, produced in those parts (CIP, 1979).

Therefore the objective of this study was to evaluate varieties which show potential resistance to potato tuber moth as growing plants in the field.

Materials and Methods

A trial was carried out at Melkassa, Institute of Agricultural Research (I.A.R.) Nazret in 1980 - 81. An area of 0.08 hectare field was divided into 44 plots, each 2.1 meters (3 rows) wide and 4.5 meters long with hills 30 cms apart and 70 cms between rows and was planted with eleven varieties of potato. All other usual cultural practices were followed and the source of moisture was rain supplemented by irrigation water The trial was arranged in a completely randomized block design replicated four times. The varieties tested were eleven in number.

Nine plants from each plot replicated four times per variety (a total of 36 plants) were selected at random and assessed for number of mines and larvae every two weeks beginning one month after planting through harvest. Height, lateral growth and distance of lower leaves above the soil surface of the same number of plants as above were measured Depth of tuber settings of each variety was also measured at harvest. Ten samples of 20 tubers were selected at random from all the three rows of each variety of the four replicates (800 tubers from each variety) and examined for tuber worm injury. The tubers were graded into categories according to degree of infestation. Tubers with 1 to 2 larval burrows were classed as lightly infested; those with 3 to 5 burrows were designated medium and those with 6 or more burrows per tuber were classified as heavily infested.

In the 1981-82 and 1982-83 trials varieties were planted into a single row replicated three times. However, the data taken for both years was the same as the 1980-81 trials.

Results and Discussion

Of the eleven varieties of potato tested in the field, in Nazret, Melkassa, 1980-81, for relative levels of leaf and tuber infestation by larvae of Phthorimaea operculella (Zeller) none showed any evidence of resistance, but a few of the varieties showed some difference in foliage attack and tuber burrowings.

Comparison among the mean number of mines (Table 1) showed significant difference among the mean number of larvae between varieties. The activities of the potato tuber worms (leaf miners) were shown to be more important than their numbers because an insect larva could cause more than one mine during its life time if conditions are favourable. This has also been observed by El-Hemassy et.al., (1974). AL-253 with smaller number of mines was significantly different from AL-562, Al-257, and AL-560. AL-517 had smaller mean number of mines which was significantly different from those of AL-257 and AL-560. The mean number of mines for variety, AL-200 was smaller and significantly different from that of variety AL-560. No statistical differences in mean number of mines were observed among the other varieties. This could be attributed to the susceptibility of the cultivars to PTM attack as has also been observed by fFoot (1979). An examination of cultivars for relative degree of damages (Table 2) showed significant differences in the percentage of damaged tubers at harves (30.89 - 74-63). Differences in infestation appear to be attributed to tolerance of attack of the varieties to PTM. Varieties with lower percentage infestation (Table 3), about two thirds of the infested tubers, were in the lightly infested category (1 - 2 larval holes) and those with higher percentage infestation, the majority of the infested tubers, were in the more heavily infested category, 3 - 6 larval holes per tuber).

Varieties with higher leaf attack were also observed to be prone to higher tuber attack. Enough number of larvae and moths present within each cultivar may leave the dying foliage and enter soil openings to infest tubers of their respective varieties. Larvae present within each cultivar also have funneled through the stems to reach tubers as has also been observed by Bacon (1960) and Richardson (1966).

Out of the twenty varieties of potato tested in the field in Nazret, Melkassa, 1981-82 for relative levels of leaf and tuber infestation by PTM, none showed evidence of resistance, but a few of the varieties showed some difference in foliage attack and tuber burrowings as shown in Table 4 and 5. However, there was no statistical difference among the mean number of larvae between varieties. This could be attributed to the fact that activities of the potato tuber worms were shown to be more important than their numbers because an insect larva could cause more than one mine during its life time if conditions are favourable. AL-563 with smaller number of mines was significantly different from AL-556 and AL-646. No statistical differences in mean number of mines observed among the other varieties. An examination of cultivars for relative degree of damage (Table 5) showed no significant differences in the percentage of damaged tubers of harvest though the mean damage ranges from 31.10 to 73.88 percent.

Out of the seventeen varieties of potato tested in the field in Nazret, Melkassa, 1982-83 for relative levels of leaf and tuber infestation by PTM, none showed evidence of resistance, but a few of the varieties showed some difference in foliage attack and tuber burrowings. Comparison among the mean number of mines and mean number of larvae between varieties showed no significant difference as it is shown in Table 7. However, mean percentage infestation of tubers among varieties showed statistical difference as indicated in Table 8. AL-563, AL-517, AL-634 and AL-568 showed lower mean percentage infestation of tubers than the remaining varieties.

Table 1. The effect of varietal difference on mining injury and larval count. 1980-81.

Variety	Mean number of mines and larvae on leaves and stems.	
	Mines	Larvae
1. AL - 253	* 27.25 a	21.00 a
2. AL - 517	28.75 ab	23.75 a
3. AL - 200	31.57 abc	25.25 a
4. AL - 615	32.75 abc	24.75 a
5. AL - 563	36.25 abcd	21.75 a
6. AL - 575	43.25 abcd	30.25 a
7. AL - 578	43.50 abcd	35.00 a
8. AL - 580	46.00 abcd	32.50 a
9. AL - 562	56.75 bcd	36.00 a
10. AL - 257	51.25 cd	21.00 a
11. AL - 560	57.75 d	39.75 a
Mean	41.02	28.27
S.E.	5.01	5.89
L.S.D. at 1% level	19.50	-

* Means followed by the same letters are not statistically different at 1% level (Duncan's New Multiple Range Test).

Table 2.

The effect of varietal differences on mean percentage infestation of tubers by Potato Tubers Moth. 1980 - 81.

Variety	Mean percentage infestation of tubers.
1. AL - 517	* 30.89 a
2. AL - 578	40.25 b
3. AL - 563	42.88 b
4. AL - 253	44.50 b
5. AL - 562	46.63 b
6. AL - 575	47.38 bc
7. AL - 257	47.88 bc
8. AL - 560	56.75 c
9. AL - 200	58.00 dc
10. AL - 615	67.13 de
11. AL - 580	74.63 e
Mean	50.63
S.E.	2.26
L.S.D. at 1% level	8.80

a/ 200 tuber samples taken from each of four replicated in each cultivar on Sept. 20, 1980.

* Means followed by the same letters are not statistically different at 1% level (Duncan's New Multiple Range Test).

Table 3.

The influence of varietal difference on the degree of tuber injury by PTM.

1980 - 81

Variety	No. of infested tubers with			Total infested	b/ tubers
	1 - 2 Holes	3 - 5 Holes	6+ a/ Holes		
1. AL - 517	145	77	25	247	
2. AL - 578	155	122	45	322	
3. AL - 563	115	163	65	343	
4. AL - 253	177	125	54	356	
5. AL - 562	145	147	81	373	
6. AL - 575	199	120	60	379	
7. AL - 257	220	108	55	383	
8. AL - 560	153	196	105	454	
9. AL - 200	189	186	89	464	
10. AL - 615	185	301	51	537	
11. AL - 580	247	220	130	597	

a/ Tubers classified as lightly infested (1 - 2 holes); medium infested tubers with (3 - 5 holes); heavily infested (6^+ holes) per tuber.

b/ 200 tubers samples taken from each of four replicates in each cultivar on Sept. 29, 1980.

Table 4.

The effect of varietal differences on mining injury and larval count. 1981 - 82.

Variety	Mean number of mines and larval on leaves and stems	
	Mines	Larvae
1. AL - 563	* 6.06 a	1.93
2. Local	6.33 a	2.30
3. AL - 204	6.46 a	1.86
4. AL - 253	6.93 a	2.53
5. AL - 568	7.33 a	2.40
6. AL - 569	7.33 a	4.80
7. AL - 108	7.46 a	3.20
8. AL - 148	8.06 a	3.46
9. AL - 570	8.20 a	2.06
10. AL - 578	8.33 a	3.20
11. AL - 575	8.46 a	2.26
12. AL - 615	9.13 a	3.66
13. AL - 601	9.80 abc	3.33
14. AL - 624	10.40 abc	5.26
15. AL - 580	10.80 abc	4.26
16. AL - 567	10.86 abc	4.60
17. AL - 634	11.33 abc	4.06
18. AL - 517	12.40 abc	5.66
19. AL - 556	14.86 bc	3.06
20. AL - 646	16.46 c	4.20
Mean	9.35	3.41
S.E.	1.93	1.04
L.S.D at 5% level	5.53	N.S

* Means followed by the same letters are not statistically different at 5% level (Duncan's New Multiple Range Test).

Table 5. The effect of varietal differences on mean percentage infestation of tubers by PTM.

1981 - 82.

V	Variety	Mean percentage infestation of tubers
1.	AL - 634	31.10
2.	AL - 575	34.99
3.	AL - 517	39.99
4.	AL - 108	43.33
5.	AL - 615	45.55
6.	Local	47.77
7.	AL - 556	47.77
8.	AL - 148	48.33
9.	AL - 580	48.33
10.	AL - 253	50.55
11.	AL - 601	51.66
12.	AL - 569	53.33
13.	AL - 563	56.11
14.	AL - 204	51.66
16.	AL - 578	59.44
16.	AL - 567	60.00
17.	AL - 646	62.66
18.	AL - 568	66.66
19.	AL - 624	66.66
20.	AL - 570	73.88
	Mean	51.98
	S.E.	12.19
	L.S.D at 5%	N.S.

Table 6.

The influence of varietal differences on the degree of tuber injury by PTM. 1981 - 82

Variety	No.of infested tubers with 1 - 2 holes	3 - 5 holes	6+ holes a/	Total infested tubers b/
1. AL - 634	57	7	12	76
2. AL - 575	36	12	15	63
3. AL - 517	47	17	8	72
4. AL - 108	29	32	17	78
5. AL - 615	47	25	10	82
6. Local	51	34	11	86
7. AL - 556	42	33	11	86
8. AL - 178	41	31	15	87
9. AL - 580	45	29	17	91
10. AL - 253	42	26	21	89
11. AL - 601	35	38	15	88
12. AL - 569	39	30	27	96
13. AL - 563	39	45	17	101
14. AL - 204	37	44	26	107
15. AL - 578	60	34	13	107
16. AL - 567	45	39	34	118
17. AL - 606	58	33	22	113
18. AL - 568	54	49	17	120
19. AL - 626	50	41	19	110
20. AL - 570	63	57	14	134

a/ Tubers classified as lightly infested (1 - 2 holes); medium infested 3 - 5 holes; heavily infested (6+ holes) per tuber.

b/ 60 tuber samples taken from each of three replicates in each cultivar.

Table 7. The effect of varietal differences on mining injury and larval count, 1982-83

Variety	Mean number of mines and larvae on leaves and stems	
	Mines	Larvae
1. AL - 575	15.27	7.73
2. AL - 568	16.07	13.20
3. AL - 253	16.93	10.67
4. AL - 578	17.20	11.07
5. AL - 108	19.20	14.53
6. AL - 624	20.20	13.07
7. AL - 646	20.73	11.08
8. AL - 580	22.47	11.53
9. AL - 204	24.27	11.13
10. AL - 517	25.07	12.80
11. AL - 567	25.67	14.93
12. AL - 634	29.60	21.40
13. AL - 563	30.00	17.07
14. AL - 148	34.27	13.73
15. AL - 615	36.13	15.33
16. AL - 556	36.47	12.67
17. AL - 601	40.87	23.80
Mean	25.32	13.91
S.E.	6.94	4.62
L.S.D. at 5%	N.S	N.S

Table 8. The effect of varietal differences on mean percentage infestation of tubers by PTM.

Variety	Mean percentage infestation a/ of tubers
1. AL - 563	2.21 a *
2. AL - 517	2.77 a
3. AL - 634	5.81 a
4. AL - 568	5.11 a
5. AL - 624	5.92 b
6. AL - 108	6.00 b
7. AL - 601	6.57 b
8. AL - 556	6.85 b
9. AL - 575	6.96 b
10. AL - 578	7.40 b
11. AL - 615	8.32 b
12. AL - 204	8.92 b
13. AL - 580	10.28 b
14. AL - 646	11.49 b
15. AL - 567	12.43 b
16. AL - 253	19.74 b
17. AL - 148	19.83 b
Mean	8.60
S.E.	4.11
L.S.D. 5% level	11.86

a/ 180 tuber samples taken from each of three replicates in each cultivar.

* Means followed by the same letters are not statistically different at 5% level (Duncan's New Multiple Range Test).

Table 9.

The influence of varietal difference on the degree of tuber injury by PTM.

	Variety	No of infested tubers with 1 - 2 holes	3 - 5 holes	6^{+} holes	Total infested Tubers.
1.	AL - 563	38	8	7	53
2.	AL - 517	23	8	4	35
3.	AL - 634	16	6	2	24
4.	AL - 568	47	13	11	71
5.	AL - 624	26	5	6	37
6.	AL - 108	51	2	2	55
7.	AL - 601	6	9	2	17
8.	AL - 556	20	2	1	23
9.	AL - 575	11	2	0	13
10.	AL - 578	10	0	0	10
11.	AL - 615	40	1	1	42
12.	AL - 204	18	0	0	18
13.	AL - 580	18	12	6	36
14.	AL - 646	23	6	1	30
15.	AL - 567	29	19	0	48
16.	AL - 253	12	1	1	14
17.	AL - 148	27	6	3	36

a) Tubers classified as lightly infested (1-2 holes) medium infested (3-5 holes); heavily infested 6^{+} holes per tuber

b) Maximum 180 tuber samples taken from each of three replicates in each cultivar, but there were deficient cultivars in tuber production.

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