Control of Potato Tubermoth (Phthorimaea operculella) Through Crop Association

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ABSTRACT

In studies on effects on crop association on potato tubermoth, leaf and tuber infestations were consistently less in the association plots compared with the sole potato plots. Least damage was found among potato-native tomato and potato-onion associations. Notable differences were found in predator/parasite populations, as well as yields among and between associations and sole potato plots although these were not significant.

The implications of these results and their relevance to overcome threatening pests in lowland tropical (non-traditional) potato environments are offered.

Several investigators have found that certain crop combinations or mixtures affect pest incidence and subsequent damage. In intercropping trials, for instance, it was observed that significantly more diamond backmoth (Plutella xylostella), adults were found on cabbage-tomato intercrop (Buranday and Raros, 1975). Unsprayed cowpeas were observed to be less subject to insect damage when intercropped with sorghum rather than sole cropped (Raheja, 1973). Surayatna and Hardwood (1976) reported significant reduction in corn borer on corn-peanut intercrop compared with plots of pure corn. Potato-sorghum intercrop was found to be more vigorous and less damaged by late blight, Phytophthora infestans compared with sole potato plots (Raymundo and Alcazar, 1982). On the otherhand the disease was very severe in potato-sweet potato plots.

No known published work is known on the effect of crop association on pest infestation on potatoes. This study was undertaken to determine the influence of crop association on the incidence and damage by tubermoth. It is envisaged that results of this study will help identify crop species to be planted along with potato to reduce losses from damaging pests. Data collected could have immense relevance for the lowland humid tropics (non-traditional climates), where mix cropping or polyculture, is popular particularly among small-scale crop growers.

Materials and Methods

The study was in the summer of 1982 at the Centro Internacional de la Papa (CIP) Experimental Farm, La Molina, Peru. Potato (main crop) was planted in alternate rows with each associated crop. A check plot of sole potato was used for comparison. The potato as well as the associated crops were planted at the same time. The experimental design was randomize block with four replications.

Tubermoth is the most damaging pest of summer-planted potato at the experimental site, hence there was no need for artificial infestation. Various parameters including larva, predator and parasite populations were obtained from time to time. At harvest, data on percent damaged tubers and yields were recorded.

Results and Discussion

Leaf infestation

The effects of the various treatments on leaf infestation are shown in Figure 1. Infestation levels were about the same during the first observation (35 days after planting). However, as the season progressed significant differences were found between infestation on sole potato plot compared with some association plots. The potato-native tomato and potato-onion associations consistently registered the lowest infestation level.

Percent damaged tubers

It is evident that planting potato in association with the crops used significantly reduced pest damage on the tubers (Figure 2). The associated crops are listed in their order of effectiveness: native tomato, onion, Rutjers tomato, Phaseolus beans, soybean and corn.

Predator and Parasite Populations

The associations varied in their effectiveness to attract the predominant parasite, Apanteles sp. Similarly, there were differences in their attractiveness to the predominant predatory species, Chrysopa sp. (Table 1). Potato-corn and potato-Phaseoulus bean plots had more predators per potato plant compared with sole potato plot. Potato-corn registered more parasites per plant compared with sole potato plot. For both predator and parasite population counts, no significant difference between any of the treatments was found.

Table 1. Comparison of predator and parasite population per potato plant on sole-potato plot and in association with other crops.

	Average predator per plant**	Average parasite per plant*
Potato alone	1.4	1.9
Potato corn	1.6	2.0
Potato-Phaseolus	1.5	1.5
Potato-onion	1.4	1.9
Potato-soybean	1.3	1.9
Potato-tomato (Rutjers)	1.1	1.8
Potato-tomato (native)	0.9	1.5

*Predominantly Apanteles sp. (Braconidae)

**Predominantly Chrysopa sp. (Chrysopidae)

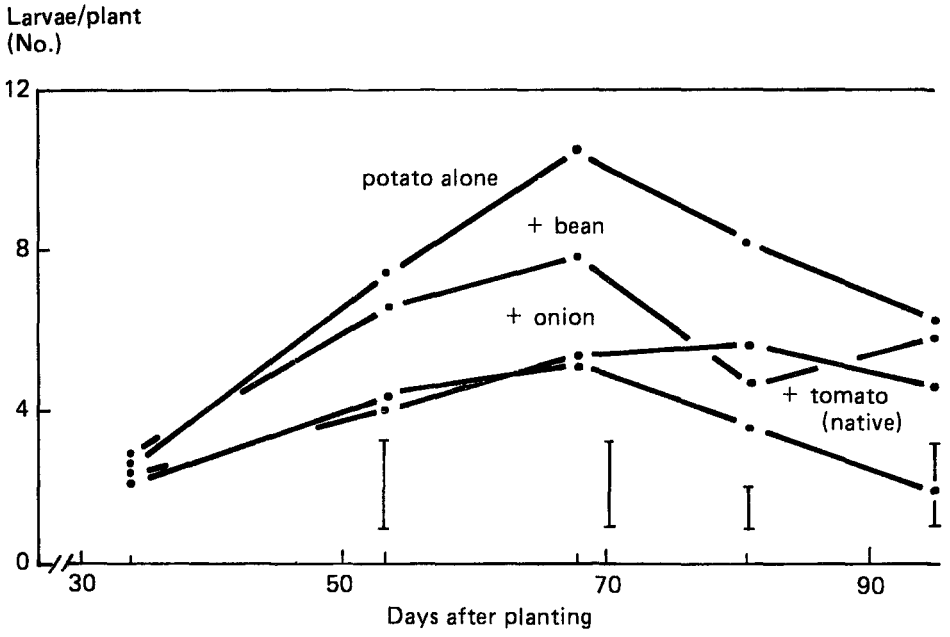

Figure 1. Phthorimaea operculella leaf infestation on potatoes grown in different crop associations. (In total 7 treatments). La Molina, January 1982.

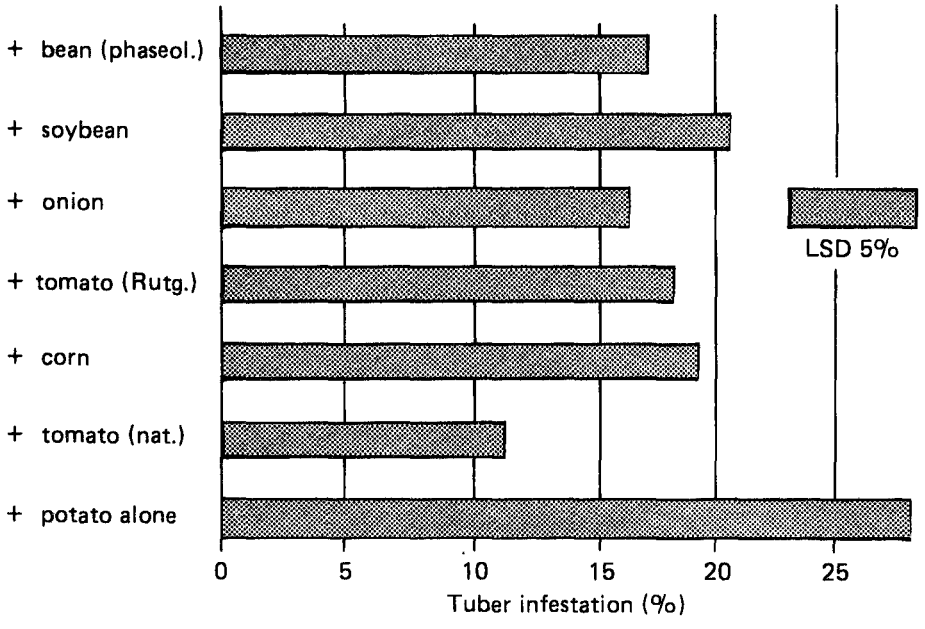

Figure 2. Phthorimaea operculella tuber infestation on potatoes grown in different crop associations. La Molina, January 1982.

Yields

As shown in yield data (Table 2) potato-soybean, potato-corn and potato-tomato (Rutjers) had higher yields than the sole potato plot; conversely, the potato-native tomato plot gave the lowest yield. No significant difference, however, was found between any of the treatments.

Reduced pest damage in polyculture as opposed to monoculture has been attributed to various factors. The odor of non-hosts in crop mixtures has been found to inhibit pests from feeding on host species (Tahvanaienen and Boot, 1972). Pests sometimes colonize one particular crop in mixtures which then serves as a diversionary host, protecting other possibly more susceptible species (McBeth and Taylor, 1944). One crop may represent a purely physical barrier to the successful establishment of a pest (Pimentel, 1951). Pest control in crop mixtures as influenced by visual effects were reported by Kennedy et al., 1961.

In the foregoing study no attempt was made to identify the mechanism(s) which may explain the pest-reducing effect of the associated crops used. Studies along this line have been initiated.

To be effective as a component of natural control, it is a requisite that predators and parasites be successfully established in the ecosystem where they operate. It is unlikely that a single season was sufficient for the observed predators and parasites to multiply sufficiently and establish themselves. Consequently, no marked differences were found in predator/parasite populations.

Table 2. Yield of potatoes in sole potato plot and in association with other crops.

	Yield (grams/plant)
Potato alone	495
Potato-soybean	512
Potato-corn	506
Potato-tomato (Rutjers)	499
Potato-onion	434
Potato-Phaseolus	383
Potato-tomato (native)	250

Physiological factors, such as light and nutrient competition, soil and ambient temperatures, humidity, are likely to explain the differences in yields. For example, it was observed that in the potato-native tomato plot, the potatoes were virtually covered by the creeping stems and branches, and lush foliage of the associated crop (native tomato). Such a situation is certain to have markedly contributed to the resultant low yields. It is extremely important that for meaningful interpretation of yield data and profitability of certain crop associations agronomic requisites such as optimum spacing, time of planting, and other recommended agronomic practices should be taken into account.

The results presented give evidence that planting potato in association with other crops could prove beneficial in reducing tubermoth, a threatening potato pest under warmer environments. In the continuing pursuit of expanding potato cultivation, particularly into the lowland humid tropics, it seems that crop association could have a suitable place in the formulation of uni- or multi-component, sound and viable pest management technologies.

References

Buranday, R.P. and Raros, R.S. 1975. Effects of cabbage-tomato intercropping on the incidence and oviposition of the diamond backmoth, Plutella xylostella (L.) Philipp. Entomol. 2:369-374.

Kennedy, J.S., Booth, C.O., and Kershaw, W.J.S. 1961. Host finding by aphids in the field. III. Visual attraction. Ann. Appl. Biol. 49:1-21.

McBeth, C.W. and Taylor, A.L. 1944. Immune and resistant cover crops valuable in root infested orchards. Proc. Am. Soc. Hort. Sci. 45:158-166.

Pimentel, D. 1931. The influence of plant spatial patterns in insect populations. Ann. Entomol. Soc. Am., 54:61-69.

Raheja, A.K. 1973. A report on the insect pest complex of grain legumes in Northern Nigeria. Proc. 1st. IITA Grain Legume Improvement Workshop, Ibadan, pp. 295-301.

Raymundo, S.A. and J. Alcazar. 1982. Development and spread of late blight, Phytophthora infestans (Mont.) de Bary in sole and intercrop plots. Phytopath. 72(7):962 (Abstr.).

Surayatna, E.S. and Hardwood, R.R. 1976. Nutrient uptake of two traditional intercrop combinations and insect and disease incidence in three intercrop combinations. IRRI Saturday Seminar, Los Baños, Philippines, 28 February, 18 pp.

Tahvanaienen, J.O. and Root, R.B. 1972. The influence of vegetational diversity on the population ecology of specialized herbivore, Phyllotreta cruciferae. Ann. Rev. Entomol. 19:455-476.