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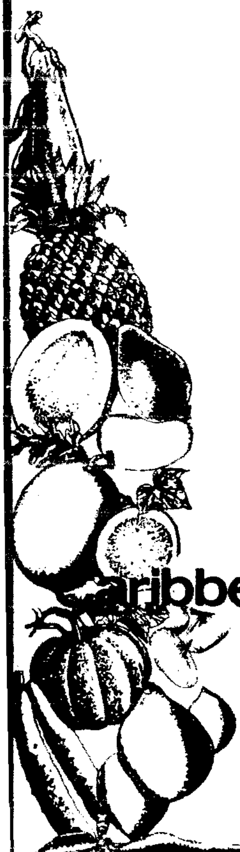

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# CABBAGE – TOMATO INTERCROPPING IN BARBADOS: THE INCIDENCE OF PLUTELLA XYLOSTELLA 1/ AND APANTALES PLUTELLA E. 2/

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## INTRODUCTION

The diamond-back moth (DBM) *Plutella xylostella* (L). (= *P. maculipennis.* Curtis.) is a widely established species which flourishes wherever crucifers occur. The earliest available record of its appearance in Barbados is 1919 and since then it has become the most serious pest of cruciferous plants, with cabbages and cauliflowers experiencing the heaviest losses.

The Braconid wasp *Apantales plutellae* (Kurdj.) introduced here from India has been established and is now the main parasite attacking *(ater* group) which is found in extremely low intensities (Badar Munir 1973).

. The protection of crucifers against the DBM in Barbados has depended exclusively on intense insecticidal treatment. Not surprisingly there is now evidence that populations of the DBM are becoming resistant to some insecticides.

If the efficacy of a number of presently effective insecticides against the DBM is to be retained, and at the same time the beneficial species preserved, it will be necessary to delay further development of insecticide resistance. To accomplish this, it will be imperative to reduce insecticidal stress by decreasing pest-pesticide interactions wherever and whenever possible.

Kogan (1976) suggests that the same glucosides in crucifers that are responsible for the oviposition behavior of *P. xylostella* also attract and elicit feeding responses in the larvaee. There are also plants with known feeding deterrents (Cantella et al 1974, Kogan 1976), but Thorsteinson (1953, 1960) and Buranday and Raros (1975) found that tomato plants exhibit a repellent which inhibits oviposition by adult female

DBM. Thus intercropping cabbage with tomato is envisaged as a possible pest management tool which might reduce dependence on pesticides.

Whereas most intercropping studies investigated the effects of crops on the pest components only it seems more valid to also investigate waht effects intercropping have on both the pest and the beneficial components of the system.

The objectives of this study were to determine the incidence of *Plutella xylostella and Apantales plutellae* in a cabbage – tomato intercrop, and in so doing, assess the repellent or disruptive influence of tomato plants on the populations of both species.

## Materials and Methods

The study was conducted at the Home Agricultural Station from March 1, 1979 to May 7, 1979. The plants (cabbage cv K-K cross and tomato cv Walter) were sown in individual peat pots (62.5 cm3) which were then transplanted 45 cm apart, thus ensuring uniformity in replacements. There were three plots measuring 6m x 3m each. Plot 'A' was planted in cabbage only while plots 'B' and 'C' contained cabbage intercropped with tomatoes in two different planting arrangements. 'B' was planted with cabbages and tomatoes in alternate rows (c t c t) while in 'C' two rows of tomatoes were planted in between two rows of cabbages (c t t c). Plots 'A', 'B' and 'C' were arranged in a randomized block design, each plot being replicated three times. The plots were sprayed with Carbaryl 85 WP (5.0g/9. 1l water) on March 23 and 27; April 6th, 12th, 20th and 27th; and May 3rd. *Ascia monuste* (L) were eliminated but DBM were not unduly influenced by the Carbaryl applications, as an earlier study had revealed that DBM were resistant to Carbaryl. Weeding, fertilization, irrigation and other cultural practices followed recommended procedures.

1 *L'epidoptera: Plitellidae*
2 *Hymenoptera: Braconidae*
3. *Entomologist (Bio-Control Section)*

The plots were sampled weekly with 24 plants in 'A' and 12 in 'B' and 'C' being examined at random. The DBM larvae were incubated in the laboratory at room temperature (ca 29$^{\circ}$C) to evaluate the parasitism by *Apantales* sp.

## Results and Discussion

The incidence of the diamond-back moth in the solid plot of cabbage and in the two cabbage – tomato intercropping plots was determined by monitoring larval and pural populations (Figs 1 and 2 and Tables 1+2). The population patterns varied very little in the three plots. The number of larvae per plant, sampled weekly, ranged from .09 to 9.05 in plot 'A', .12 to 9.62 in 'B' and .10– 13.75 in plot 'C'; with seasonal means of 1.76, 1.79 and 2.42 larvae/plant in plots 'A', 'B' and 'C' respectively (Table 1).

Pupae of DBM reached a maximun of .93/plant in plot "A" and 73 and 1.52/ plant in plots 'B' and 'C' respectively while the seasonal means were .28, .22 and .42 per plant in plots 'A', 'B' and 'C' respectively.

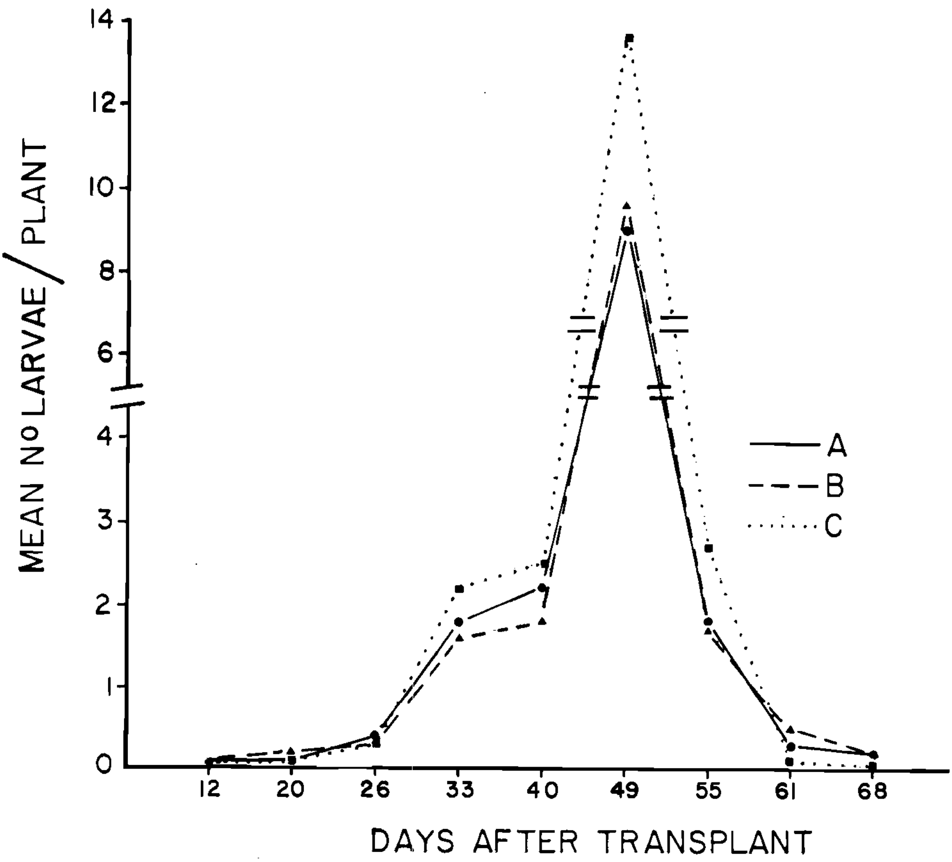


Fig. 1. Larval Plutella xylostella in 'A', cabbage alone and "B" & "C" cabbage intercropped with tomatoes (Barbados 1979).

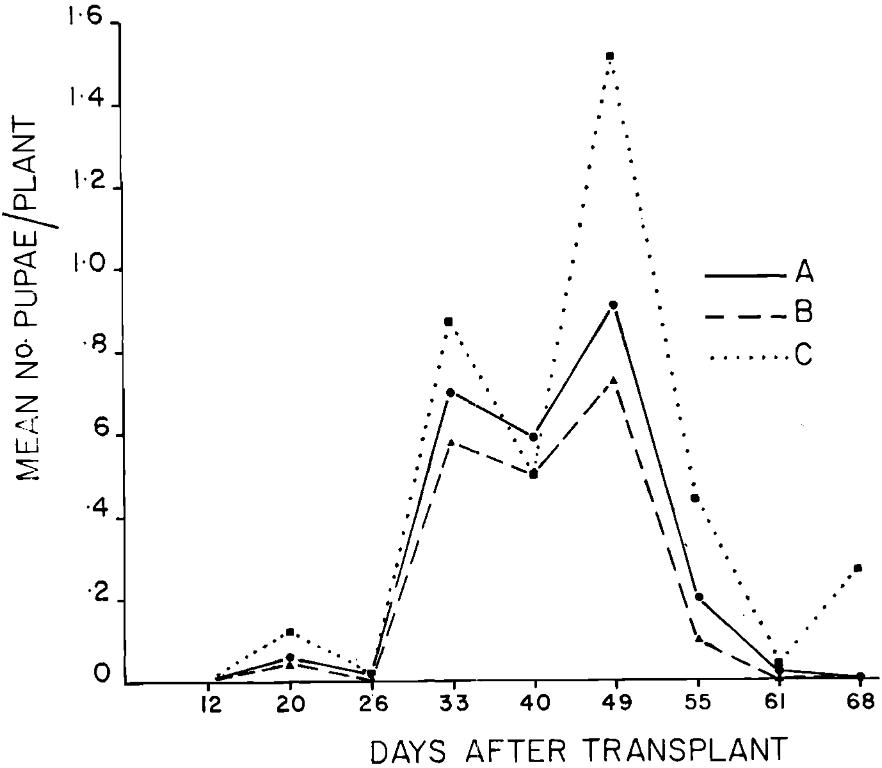


Fig. 2. Pupae of Plutella xylostella in 'A', cabbage alone and "B" & "C" cabbage intercropped with tomatoes (Barbados 1979).

TABLE 1: Population means of *Plutella xylostella* (larvae & pupae) and *Apantales plutellae* in cabbages (A) and cabbages & tomatoes (B&C) in Barbados (1979)

| Plot | Seasonal mean plant | range (per plant) | S.E. |
|---|---|---|---|
| | | LARVAE | |
| A | 1.76 | .09 –9.05 | 2.76 |
| B | 1.79 | .12 –9.62 | 2.78 |
| C | 2.42 | .10–13.75 | 4.15 |
| | | LARVAE PARASITIZED BY APANTALES | |
| A | .72 | 0 – 4.36 | .90 |
| B | .65 | 0 – 3.77 | .71 |
| C | .80 | 0 – 4.37 | 1.33 |
| | | PUPAE | |
| A | .28 | 0 – .93 | .34 |
| B | .22 | 0 – .73 | .28 |
| C | .42 | 0 – 1.52 | 47 |
| | | APANTALES COCOONS | |
| A | .66 | 0 – 3.23 | 1.12 |
| B | .49 | 0 – 2.64 | .87 |
| C | .79 | 0 – 3.64 | 1.42 |

TABLE 2: Population trends of ***Plutella xylostella*** and ***Apantales plutellae*** in cabbage (A) and cabbage & tomatoes (B,C) in Barbados (1979)

| | PLOTS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Days after transplant | A | | | | B | | | | C | | | |
| | Plutella | | | Apantales | Plutella | | | Apantales | Plutella | | | Apantales |
| | larvae | Parasit'd | pupae | cocoons | larvae | Parasit'd | pupae | cocoons | larvae | Parasit'd | pupae | cocoons |
| 12 | 13 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 7 | 0 | 0 | 0 |
| 20 | 9 | 4 | 9 | 0 | 10 | 1 | 2 | 0 | 5 | 0 | 6 | 0 |
| 26 | 38 | 18 | 2 | 1 | 14 | 12 | 0 | 0 | 14 | 7 | 1 | 0 |
| 33 | 175 | 27 | 67 | 3 | 79 | 9 | 28 | 2 | 108 | 24 | 42 | 0 |
| 40 | 209 | 85 | 57 | 27 | 86 | 37 | 24 | 7 | 118 | 54 | 24 | 7 |
| 49 | 869 | 419 | 89 | 208 | 462 | 181 | 35 | 68 | 660 | 20 | 73 | 175 |
| 55 | 173 | 63 | 19 | 310 | 80 | 31 | 6 | 127 | 128 | 50 | 21 | 156 |
| 61 | 26 | 7 | 2 | 17 | 24 | 6 | 0 | 3 | 3 | 1 | 2 | 2 |
| 68 | 16 | 7 | 0 | 3 | 12 | 6 | 0 | 4 | 2 | 2 | 13 | 2 |

A – n= 96 plants per samble
B,C–n= 48 plants per sample

*Apantales plutellae* were assessed by observing the number of coccons (Tables 1 & 2) and the number and percentage of larval DBM parasitized by this parasite (Figs. 3 & 4, Table 1). The indigenous *Apantales* sp (**ater** group) was encountered only once, 'n an insignificant number, during this study.

The number of *A. plutellae* coccons remained at a relatively low level in all the plots until 40 to 55 days after transplant when they reached the maximun of 3.22, 2.64 and 3.64 per plant in plots were calculated to be .66, .49 and .77 cocoons per plant respectively (Table 1). This revealed that there were significantly (P=0.05) higher numbers in plot 'B', than in plot 'C', both intercropping plots, whereas the numbers found in plot 'A', cabbages only were not significantly different from those in either 'B' or 'C'.

It is possible that the recorded low incidence and differences, might be due to the ,enght of time between sampling dates, as the pupal period for *A. plutellae* in Barbados is 3–5 days.

The percentage of DBM larvae which were parasitized by *A. plutellae* varied from 0 to 48.2% in plot 'A', 0,85% in plot 'B' to 0–100% in plot 'C'. 41.2, 36.6 and 33.3% of the *plutella* larvae collected in plots 'A', 'B' and 'C' respectively were parasitized by *A. plutellae.* The seasonal means were calculated to be .72, .65, and .80 parasitized larvae per plant in 'A', 'B' and 'C' respectively (Table 1). These differences were not significant at P =0.05 level. As reflected in the rate of parasitism, it thus appears tha 'Walter' tomatoes intercropped with cabbages had no adverse effect on the abundance of *Apantales* plutellae and apparently intercropping did not impair the searching capacity of the parasite as the rate of parasitism remained satisfactory even when the incidence of *Plutella* was low.

Buranday and Raros (1975) determined that a significantly higher number of *P. xylostella* adults entered the plot of solid cabbage than the plot of cabbage – tomato intercrop. A similar relationship was observed with the number of eggs on plants in the cabbage only and intercroppings plots. They therefore concluded that the presence of tomato plants in cabbage plots appeared to have influenced the reduction of adult *P. xylostella* and oviposition. They also observed that 1 to 2 cabbage rows between 2 rows of tomato was the planting pattern which reduced the adult DBM populations most. Cantello *et al* (1974) found that the fruit, leaves and glandular hairs of the tomato cultivar 'Manapal' contained chemical which strongly repelled only the females and inmature forms of two species of mites. A number of workers (Gupta & Thorsteinson, 1960 a, b; Thorsteinson, 1960; Kogan, 1976) investigated the host-finding, feeding and oviposition responses of DBM, and it is generally accepted that most cruciferae-associated species are attracted and excited to oviposit by the characteristic insothiocyanates or their parent glucosides of that plant family. If as Kogan (1976) asserts, "these same compounds attract and elicit feeding responses in larvae", then it appears as if the repellent properties of tomato might be effective only against certain stages of different species or that different tomato cultivars probably contain different quantities of the repellent chemical and therefore vary in their effectiveness.

There is no evidence from this study with larvae, to corroborate Buranday and Raros' (1975) findings with adults. The data indicate that the tomato plants exerted no repellent effects on DBM or the *Apantales* sp and the different planting patterns elicited no extra response from the species studied. The cabbage – tomato intercro-

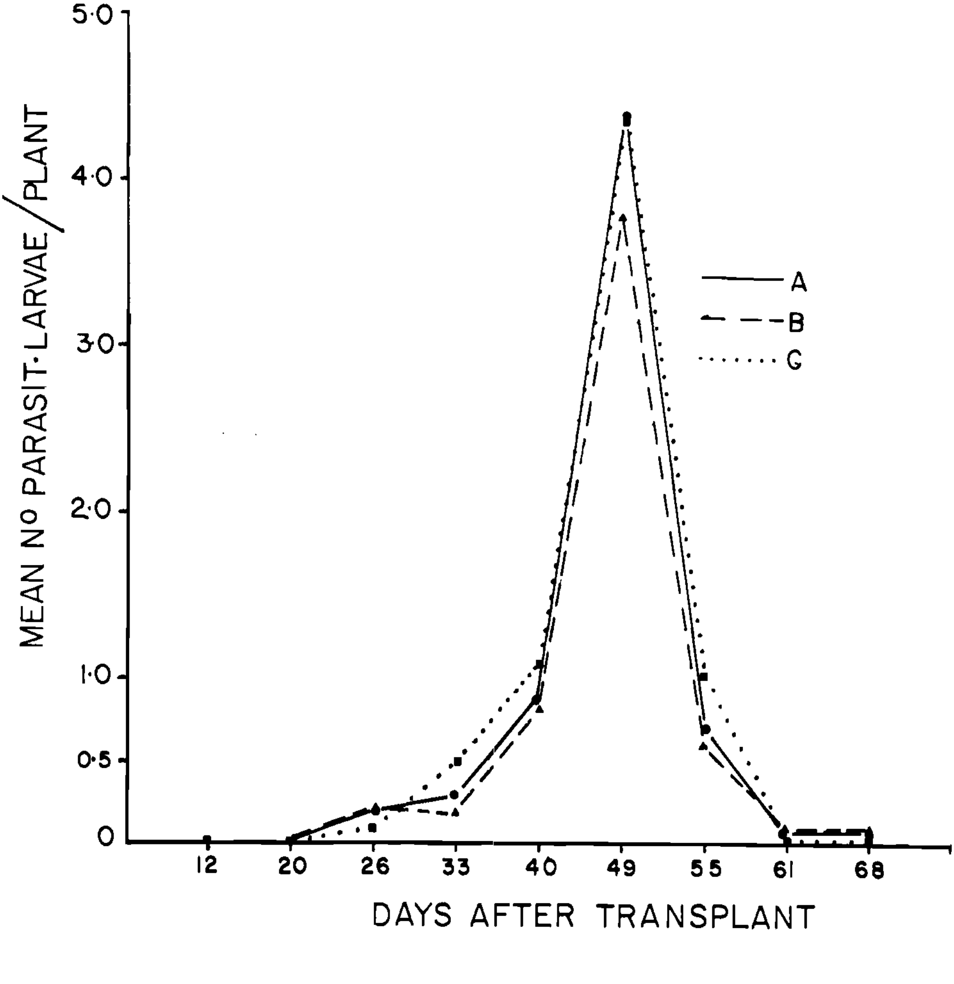


Fig. 3. The Number of Plutella xylostella larvae parasitized by Apantales plutellae in 'A', cabbage alone and "B" & "C", cabbage interoropped with tomatoes (Barbados 1979)

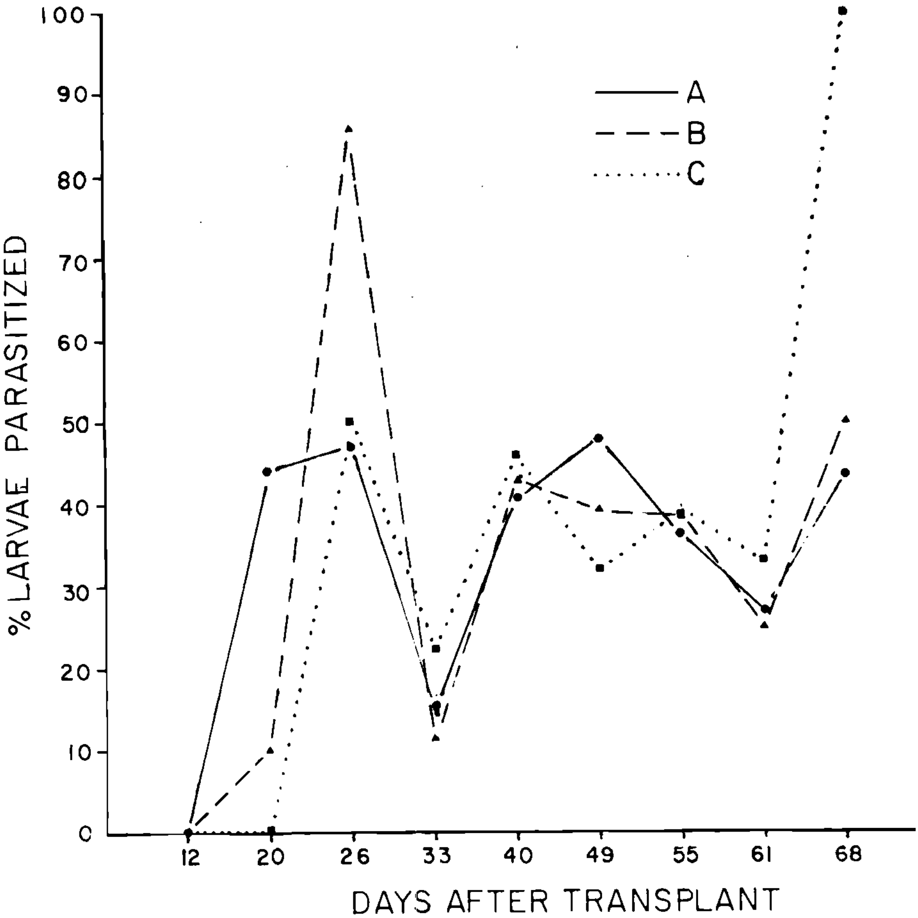


Fig. 3. The percentage of larval Plutella xylostella paracitized by Apuntales plutellae in 'A', cabbage alone and "B" & "C" cabbage intercropped with tomatoes (Barbados 1979).

pping failed to effect larval and pupal populationsof DBM or *Apantales plutellae* which were significantly less at P=0.05 level than those in the plot of solid cabbage. Indeed plot 'C' showed significantly higher numbers of pupal *Plutella* than plots 'A' or 'B' while at the same time there was no observed difference in populations between plots 'A' and 'B'.

The economic thresholds (Critical pest numberss) in cabbage in Barbado are yet to be determined but DBM were so abundant in the three plots that all of the cabbage were rendered unmarketable due to the extensive damage to the heads.

Many new approaches including intercropping are being examined by researchers seeking increased yield and/or improved pest control. The supply of effective pesticides cannot exist indefinitely and the vegetable industry must decide that alternative control strategies and pesticide reduction are vital.

The elucidation of the basis of insect-plant selection and repellency would open new avenues especially in crucifers. Future research needs to be directed towards identifying and elucidating insect/plant interactions and quantifying the interactive responses.


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