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Physiology of Systemic Insecticide - induced Susceptibility of Bhendi Plants to *Aphis gossypii* G. and *Amrasca devastans* (D.)

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ABSTRACT

The application of phorate through soil resulted in the resurgence of aphids and jassids when the toxicity of the chemical vanished. Aphid resurgence was noticed from seventh week and the maximum reached during the eighth week after sowing and the jassid resurgence was delayed by a week. The aphid size was increased on treated plants when the toxicity was over and the size could be related to population build-up. The pest flare-up was due to alteration in the physiology of plants by the enhanced supply of phosphorus from the insecticide. This was associated with increase in ammoniacal nitrogen, potassium and decrease in carbohydrates and calcium contents which seemed to be favourable for aphids and jassids.

INTRODUCTION

From the arrival of the initially infesting alatae to the breakdown of of infestation, the host plant plays a key role in influencing the buildup of aphid population. The reproduction in aphid is primarily controlled by the kind of nutrition provided by the host plant. The change in host condition is brought about by various factors including application of insecticides. The systemic insecticides as a group of endotherapeutic chemicals, which have been found to serve as "insurance application" against the upsurge of pest populations have brought unforeseen problems by inducing the susceptibility of the plants after the toxic effect vanishes.

Instances of increased pest infestations, when the chemicals lost their toxic effects have been reported by Pradhan, *et all.* (1960), Jotwani *et al.* (1966), Shanks (1966) and Sithanantham (1968). Ripper (1956) also cited examples of organic insecticides causing increases in arthropod populations. In the present paper, influence of the systemic insecticide, phorate in altering the physiology of bhendi plants favourable to the development of *Aphis gossypii G.* and *Amrasca devastans (D)* is reported.

MATERIALS AND METHODS

Phorate granules were applied to soil at 0.5 and 1.0 lb. a. i./acre concentrations to bhendi plants in field.

Leaf samples of 50 days old plants were taken to assess the nutrient status of the plant for the insects induced by insecticide treatment. Moisture content was estimated by drying the leaf

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TABLE 1. Influence of phorate treatment on the contents of moisture, carbohydrates and minerals in bhendi

	Untreated control	Phorate			
		0.5 lb		1.0 lb	
		Percent	Percentage (+ or −) Increase or decrease over control	Per cent	Percentage (+ or −) Increase or decrease over control
Moisture	82.6%	85.4	3.39	84.3	2.05
Carbohydrates	16.53	15.75	−4.72	14.50	−12.28
Total nitrogen	3.11	3.35	7.72	2.19	−29.58
Ammoniacal nitrogen	0.065	0·079	21.54	0.078	20.00
Phosphorus	0.86	0.83	−3.49	0.83	−3.49
Calcium	3.88	2.90	−25.26	3.39	−1263
Magnesium	2.00	1.74	−13.0	1.07	−46.5
Potassium	3.26	4.14	26.99	4.28	31.29

samples at 105°C. Estimations of carbohydrates, phosphorus, calcium and magnesium were made by colorimetry (Somogyi, 1952; Jackson, 1967) and potassium by flame photometry. Total nitrogen was estimated by the method described by Humphries (1956) and ammoniacal nitrogen by the method suggested by Pregl (1945).

RESULTS AND DISCUSSION

1. Resurgence of pest populations:

In the treated plants resurgence of aphid population could be noticed from the seventh week after sowing, the maximum reaching during the eighth week. When the dose was increased to 1.0 lb/acre, significant increase in the population of aphids could be seen and the trend of resurgence was maintained throughout the crop, though the population dwindled gradually due to maturity of crop. Increase in the number of jassid nymphs on plants treated with phorate was observed from the eighth week stage, and considerable increase in the resurgence of population was seen during the ninth and tenth weeks.

The increase in population of insects on plants treated with systemic

insecticides after loosing their toxicity has also been reported in *Liaphis erysimi* (Pradhan, Jotwani and Sarup, 1960), *Aphis gossypii* (Sithanantham, 1968) and *Amrasca devastans* (Jotwani *et al.*, 1966; Sithanantham, 1968). The break-down products after losing toxic effects apparently after the physiological conditions of the plant more favourable for insects. This is due to the indirect influence of the insecticides through the host plant (Ripper, 1956) and is not certainly due to the direct effect on their predators, because the predator movement was not restricted.

ii) **Size of Insects:**

The aphids collected at random from the treated and untreated plants were measured for their size in order to relate the influence of altered physiology of plant on aphid size and resurgence. The length of the insect measured from the vertex to the caudal end and its maximum breadth at abdominal region were markedly higher with the aphids collected from treated plants in contrast to those on untreated plants. The aphids measured on an average 1.22 x 0.69 and 1.17 x 0.68 mm in phorate treated plants at the dosage of 0.5 and 1 1b /acre respectively, as against 1.20 x 0.59 mm in the case of control.

Aphids which were robust and heavy in weight have been observed by Sithanantham (1968) on cotton plants treated with systemic insecticides. The aphid growth varied with the vigour of the host plants (Auclair, 1967). The systemic insecticide-treated plants were observed to be more vigorous and nutritionally favourable and hence the increased population of aphids may be due to enhanced reproduction of aphids of greater size. The association between size of aphids on the one hand, and their reproduction and population on the other was observed by several earlier workers.

iii) **Nutritional conditions of host plants.**

The treated plants contained more of moisture, ammoniacal nitrogen, and potassium contents, and less of carbohydrates, calcium and magnesium. The total phosphorus content did not show much variation (Table 1).

The susceptibility of bhendi plants treated with phorate was due to change in the nutritional conditions for the pests. The increased moisture percentage may lead to increased turgor pressure of the plant facilitating easy feeding by the sucking insects. Increased moisture content was found to favour *Aphis fabae Scop.* (House, 1961) and *Bemesia tabaci* Genn. (Raghuraman, 1968). The slightly increased moisture content of the plants treated with phorate might have facilitated the aphids and jassids for easy feeding. The total ammoniacal nitrogen and its proportion to total nitrogen were greater in the treated plants which were apparently preferred by tbe insects. Though increased nitrogen content has been reported to be favouring aphids by several workers, the present studies indicated varied preference of the insects for the ammoniacal form of nitrogen rather than total nitrogen. Higher contents

of ammoniacal nitrogen found in the treated plants might also enhance the contents of amino acids, which may be preferred by aphids and jassids.

Though sugars act as phagostimulants for aphids and jassids, high concentration was reported to be detrimental in several phytophagous insects. Hence, the lower sugar contents observed in phorate treated plants may be favourable to the insects.

Phosphorus plays a major role in various enzymatic reactions in carbohydrate metabolism including interconversion of carbohydrates and in providing respiratory energy for the chemical reduction of nitrates. The enhanced activity of phosphorus made available from the insecticides as has been observed by El-Kadi *et al.* (1964) may be associated with increased ammoniacal nitrogen and potassium. Aphids like *A. rumicis* Linn. (Davidson, 1925) and *Macrosihum pisi* Kalt. (Barker and Tauber, 1951) were favoured by high potassium supply to plants. Similar effect was noticed for *A. gossypii* by Jayaraj and Venugopal (1964). This lends support to the present study that plants harbouring more insects had higher potassium content.

The treated plants had invariably low amount of calcium. Potassium had inverse effect on calcium content. Potassium exhibited certain amount of antagonism to calcium uptake (Thandapani, 1969). Whenever phosphorus level was favourable for potassium uptake and accumulation, calcium content was minimised. Since calcium is required for strengthening cell wall decrease in its content will make the plants vulnerable for stylet penetration as in the case of *M. Persicae* (El Tigani, 1962).

Fennah (1951) stressed correlation between feeding activity of homopterans and metabolic activity of the plant. The rise and fall in soluble nutrients govern acceptability, but it is again possible that this fluctuation in plant sap constitution is but a reflection of deep-seated chemical changes at the cellular level of plant tissues. A chemical change brought about by enhanced supply of phosphorus from the insecticide made bhendi plants more susceptible after the toxic effects were over.

Aphid resurgence was noticed earlier when compared to jassids on treated plants. This could be explained first on the basis of differential biology. The aphids with parthenogenetic reproduction coupled with short developmental period and high fecundity are able to build up population at higher rate than jassids.

Secondly the discriminatory power vested in the jassids helps them to change to more favourable plants, whereas in aphids once the alatae laid their nymphs at the time, when the condition was acceptable, the multiplication of aphids continues until adverse effects set in.

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