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Effect of Cytozyme on Various Growth Rates of Sunflower in Relation to Resistance to Insect Pests

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Abstract The palisade characteristics of the leaves treated with a bacterial hydrolysate (cytozyme) with different dilutions on sunflower and its oil contents showed various degrees of resistance and susceptibility to insects. The palisad index of leaves treated with 1:8,000 appears to be more discriminative than the other palisad characteristics of leaves treated with 1:5,000, 1:2,000 and control. Further, the palisad cells are more compactly arranged in the treated plants, compared with the control. The dimensional values of trichomes too increase proprtionately with lowering concentration of the cytozyme which play a critical role in insect resistance.

Key words Cytozyme, Sunflower, Susceptibility, Resistance, Palisad cells, Trichome

While studying the effect of a plant growth promoting substance, bacterial hydrolysate (cytozyme), on sunflower and its oil contents, we came across some interesting details on the nature and distribution of trichomes on the leaves as well as the structure and arrangement of the palisade cells. Since sufficient information exists on the potential role in resisting invading insects (Levin 1973, Wetzstein & Spark 1983), we have attempted here to relate the structure, nature and distribution of trichomes and palisade tissues of sunflower with the patterns of invasion, colonization and feeding of an enoromous range of insects on sunflower in terms of their host preference as affected by different concentrations of cytozyme.

Materials and Methods

Cytozyme in aqueous dilutions of 1 mL in 2 litres of water (hereafter referred to as A), 1 in 5L (B) and 1 in 8L (C) were prepared. Foliar applications of these concentrations were made using a metalic atomiser at the time of flower initiation (58 days). Leaves from each treated category were collected on the 45th day for each experimental investigation (7 days after the application of cytozyme) and sections of the leaf of 7 μm thickness were cut and stained with hematoxylin-fast green. The number of palisade cells per mm^2 was counted from a point approximately 1 mm from the midrib, and width of each palisade cell was measured. Palisade index was calculated following the method of Godoy *et al.* (1985). The nature of the distribution of trichomes was assessed. The data have been analysed by two way of analysis of the variance. Comparative population of the invading insects were registered during the pre-treatment and post-treatment (2 weeks after cytozyme treatment).

Results and Discussion

Leaf structure

The dorso-ventrally differentiated leaves of sunflower have large intercellular spaces (as in TS). Along the upper epidermis, uniseriate, 3-4 celled trichomes with pointed tips occur in regular frequency. The walls of the basal and penultimate cells of these trichomes are enormously thickened (20 μm) and show clear patterns of cellulosic striations. Palisade cells are invariably 1-layered and each cell measures 35 μm x 9 μm (Table 1 and 2).

There is a general tendency in the treated leaves to increase the number of palisade cell layers from 1 to 2-3. In addition to the type of trichomes present in the normal leaf 3-4 celled pointed trichomes (type-1) and trichomes with 5-10 discoid cells arranged (type-2) also occur (Fig 1). Type 1 trichomes (120 μm x 35 μm) are subtended by an extraordinarily enlarged epidermal cell, which is

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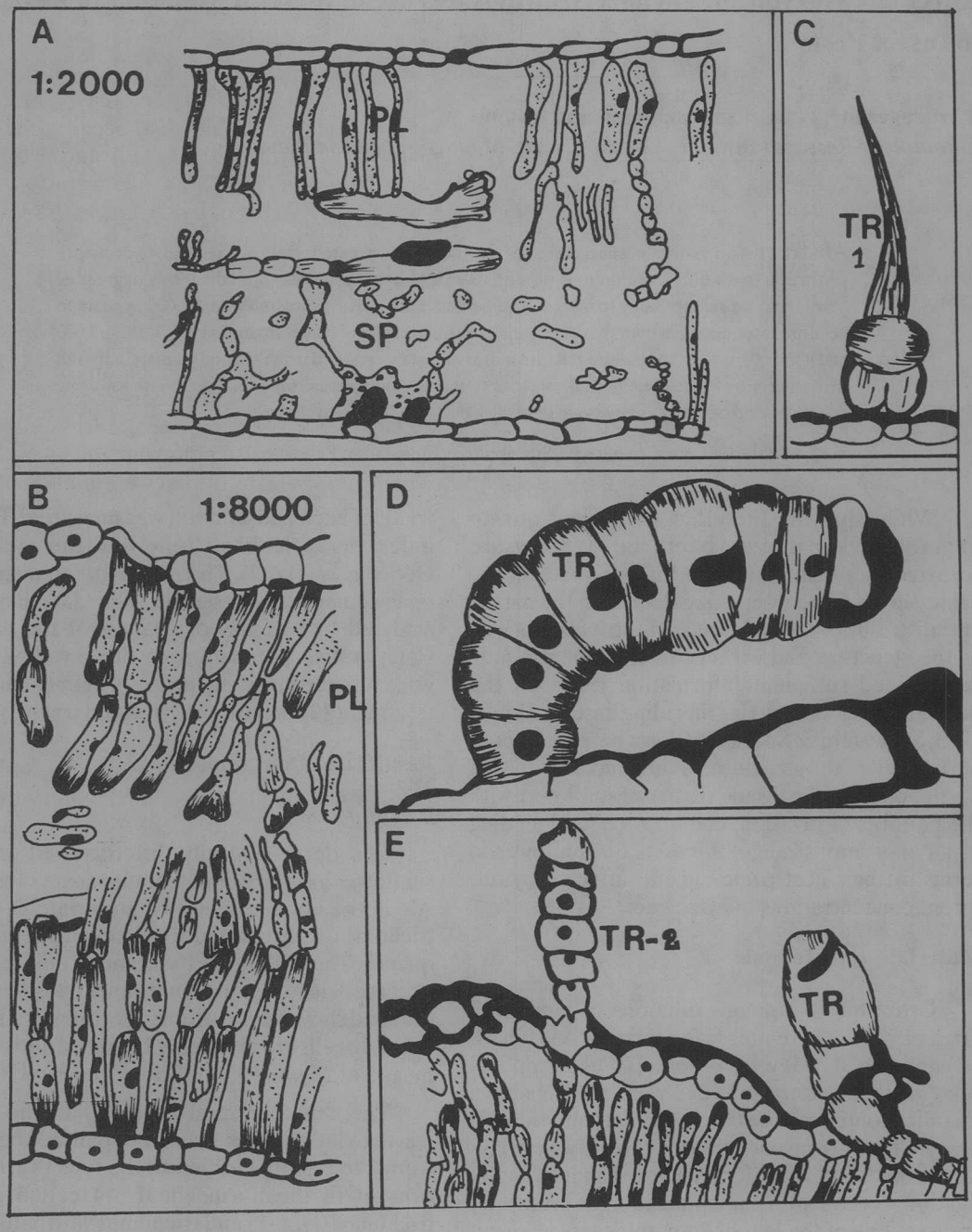

Fig 1 Structural changes in the cytozyme treated sunflower leaves
PL – Palisade parenchyma,
PL – Spongy parenchyma,
TR1 – Trichome Type1,
and TR2 – Trichome types 2

Table 1 *Average number of palisade cells per mm, cell width and palisade index of the leaf of the treated and untreated sunflower plants*

Treatments	Number of palisade cells mm^{-1}	Cell width (μm)	Index ($\mu m\ mm^{-1}$)
Control	18.807	8.956	168.43
1 : 2, 000	24.629	9.627	237.12
1 : 5, 000	33.585	11.195	375.98
1 : 8, 000	42.540	13.434	571.48
CD at 5%	0.589	0.793	

atleast 3 times larger than its counterpart. The upper most cell is slimmer than the others and is long with a pointed tip including a dynamic cytoplasm and moderately thick wall, a pointed tip including a dynamic cytoplasm and moderately thick wall, though distinctly they lack the wall striations. Trichomes of type 2 (109 μm x 54 μm) occur in regular frequency (Table 2). Interestingly, the mesophyll cells lying adjacent to these trichome type appear totally achlorophyllous with depleted cytoplasm, although in principel, they resemble the palisade cells. Obviously, cytozyme puts in some metabolic effort of the differentiating palisade cells. Although an overall expression in terms of increase in photosynthetic tissue is manifest, in the treated leaves, the structure becomes completely unorganized.

Leaves treated with B and C

Although a quantitative increase in the photosynthetic tissue, in terms of the number of cells/unit area is evident in the leaves of treated plants leaf structure appears throughly unorganized. The frequency pattern of the trichomes/unit area is considerably increased (Table 1). Numerous trichomes of type 1 frequency (55.55%) and type 2 (24.72%) occur in the 1:8,000 dilution. The size of the type 1 and 2 trichomes being 150 μm length 13 μm width, respectively in the higher dilutions of treated leaves (1:8,000 and 1:5,000). The dimensional values of the trichomes too increase proportionately with lowering concentration of the cytozyme.

Comparative population of insects

Sunflower receives populations of The treated plots registered lower numbers of the bug, weevil, beetle, grass hopper, Jassed and white flies above insects. In the control plots some plants wilted due to damage caused by the beetle. Similar patterns of improvement indices were evident with regard to other pests (Table 3).

Trichomes and palisade cells play a critical role in insect resistance and against natural enemies (Duffey 1986, Shaik 1983). A highly trichomatous host acts as a physical barrier and confers resistance to insect attack because the trichomes contain several chemical substance adequate enough to restrict the population of whiteflies, jassids, grasshoppers. This study highlights with adequate data optimal concentration of cytozyme (1:5,000 and 1:8,000) have a promotive role in plant development, particularly significant on resisting phytophagous insects.

Table 2 *Distribution of trichomes and frequency in cytozyme treated/untreated sunflower leaves*

Treatment	Trichome Type – 1			Frequency	Trichome Type – 2			Frequency
	Length	Width			Length	Width		
		Upper	Lower			Upper	Lower	
	(μm)	(μm)	(μm)	(%)	(μm)	(μm)	(μm)	(%)
Control	108.3±	4.56±	18.27±	25.29	74.65±	10.68±	42.36±	60.66
	1.8	0.44	0.83		2.11	0.94	2.24	
1 : 2,000	119.2±	4.56±	35.28±	29.62	109.26±	12.05±	53.82±	65.38
	2.2	0.62	2.67		5.29	1.21	3.67	
1 : 5,000	127.9±	9.64±	38.79±	34.48	115.67±	15.57±	67.25±	70.52
	5.9	1.24	3.01		3.82	1.79	2.13	
1 : 8,000	150.2±	13.43±	53.76±	39.34	135.68±	17.91±	85.08±	75.66
	3.4	2.71	1.97		4.56	1.01	3.97	

Table 3 *Comparative population of insects on cytozyme treated and untreated sunflower plants*

Treatments	Population (no, plant^{-1})					
	Bug	Weevil	Beetle	Grass hopper	Jassids	White flies
Control	18.2	8.4	10.2	19.03	12.2	15.3
1 : 2,000	12.5	7.5	08.3	13.02	09.2	07.1
1 : 5,000	08.9	5.3	06.2	10.01	07.1	05.7
1 : 8,000	05.7	4.3	02.7	06.05	04.3	03.3
1 : 10,000	07.2	5.3	03.3	07.02	05.7	04.1
CD at 5%	09.4	2.5	04.7	03.88	03.2	03.6

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