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DUCED RESISTANCE TO SPIDER MITE *Tetranychus urticae* Koch INFESTATION IN COTTON AND SOYBEAN PLANTS.

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ABSTRACT

Studies were done to estimate the relationship between initial damage of spider mite *Tetranychus urticae* Koch and induced resistance in cotton and soybean plants. Spider mites raised on plants that had been damaged by a previous bout of mite feeding and on control plants that were previously not exposed to mites. The results indicated that the mite populations grew more rapidly on new growth of the seedlings whose cotyledons were undamaged than on new growth whose cotyledons had been damaged previously by spider mites. The ratio of the population on exposed plants to the population on controls was about 1 : 2 or more.

Results of these works identify a new source of resistance, could be used as a management tool at the field.

INTRODUCTION

Plant pathologists have recently found that restricted inoculations of viruses, bacteria, and fungi can induce resistance in plants against subsequent disease caused by those pathogens. Stimulated by reports of “plant conditioning” in the entomological and ecological literature, (Karban, 1986) explored the possibility of using this phenomenon in inducing resistance in cotton seedlings against spider mites and other pest.

Current interest in induced plant resistance has been motivated by experiments which demonstrated that chemical and physical changes occurred after herbivorous attack (Green and Ryan, 1972 and Rhodes, 1979). Plants damaged by feeding insects contained higher concentrations of “secondary metabolites” which were presumed to possess deterrent or antibiotic activity against some insect species (Karban, 1986).

Recently many workers have began to examine the effects of host plant responses induced by wounding upon herbivorous arthropods, that feed subsequently on damage plants. In most cases, this response of plant was not species-specific. Karban and Carey (1984), demonstrated that populations of spider mite *Tetranychus urticae* grew more slowly in small numbers on laboratory-grown cotton seedlings that had previously been exposed to a second species, *T. turkestani*, compared to populations on cotton that had not been exposed previously. They showed also that induced resistance against mites is systemic throughout the seedling. Leaves that were not present at the time of “inoculation” were characterized with resistance. Karban (1985), found that the growth of *T. urticae* was also reduced on seedling whose cotyledons had been mechanically damaged compared to undamaged controls. Similar results were found in field experiments by the same author (1986a), mites were less likely to colonize and build-up large populations on plants that had been mechanically abraded or previously exposed to mites compared to undamaged controls. The same results were confirmed again by the same author in 1986a. Harrison and Karban (1986), showed that adult females *T. urticae* preferred undamaged control plants when offered a choice between undamaged cotton and cotton that had previously been the host of *T. turkestani*. Karban (1987), studied the environmental conditions affecting the strength of induced resistance against mites in cotton. On the other hand, Karban *et al.* (1987) found that populations of the spider mite *T. urticae* grew less rapidly on seedlings that had been inoculated with the fungal pathogen *Verticillium dabliae* than on uninoculated controls, and vice versa. The same result was found also between beet armyworms (*Spodoptera exigua*) and *T. turkestani* in cotton (Karban, 1988).

These results suggested that it might be possible to induce resistance against economically important pests such as spider mites on some crops, thus reducing the need to use chemical pesticides.

Therefore, our work here aims to study the possibility of inducing resistance in cotton and soybean plants to spider mite infestation under Egyptian conditions.

MATERIALS AND METHODS

The methods for the experiments are described in detail elsewhere (karban and Carey, 1984; Karban, 1985) and summarized in fig. 1.

The same design was followed with soybean plants.

Cotyledons

10 T. urticae

Control
No mites

7 days

Tedifol Removal no true leaves

14 days

Mites placed on new
Leaves

3 T. urticae

3 T. urticae

14 days
1.5 generations
Remove and Count All Mites

Fig.1: Experimental procedure for the basic experiment, (Karban, 1987).

We randomly assigned cotton seedlings at the cotyledon stage sown in 20-cm pots to carry out this study. Each plant of the first treatment (20 plants) was infested with 10 adult females of *Tetranychus urticae*. While the second treatment was a control without mites.

After seven days, we removed all spider mites from plants with using acaricide Tedifol. Allowed the plants to grow without mites for 14 days, and then challenged each one with three adult mite females. These mites fed and reproduced for 14 days, more than enough time to complete a generation, when the experiment was stopped and mite populations were counted. Mites were taken from laboratory culture maintained under room conditions, the experiment was conducted under laboratory conditions.

The strength of induced resistance was estimated as the ratio of the mean population of mites on exposed plants to the mean population of mites on unexposed control plants, (Karban, 1987).

RESULTS AND DISCUSSION

To study the phenomenon which showed that "plants previously exposed to herbivores can become more resistant to subsequent herbivory compared to plants without previous exposure"; spider mites were raised on cotton and soybean plants that had been damaged by a previous bout of mite feeding and on control plants. The results are presented in tables (1 and 2) and shown in Fig.2 Mite populations feeding on exposed plants were significantly less than those on unexposed plants (Tables 1 and 2).

Table 1. Mite population size on exposed and control cotton plants and the strength of induced resistance.

Rep	Mite population per plant on								Strength of Resistance a/b
	Exposed plants				Unexposed plants				
	Eggs	Moving stages	All stages	Mean a	Eggs	Moving stages	All stages	Mean b	
1	18	39	57		61	83	144		
2	37	46	83		79	110	189		
3	39	64	103		111	87	198		
4	43	66	109		79	177	256		
5	28	64	92		93	162	255		
6	50	35	85		96	188	284		
7	25	55	80		63	68	131		
8	30	21	51		68	141	209		
9	19	68	87		83	137	220		
10	53	30	83	69.35	69	148	217	198.1	0.35
11	25	25	50		71	66	137		
12	13	41	54		68	166	234		
13	21	38	59		66	113	179		
14	17	20	37		56	139	195		
15	28	38	66		96	111	207		
16	18	57	75		81	87	168		
17	15	36	53		86	91	177		
18	27	46	73		53	107	160		
19	19	28	47		94	76	170		
20	12	31	43		151	81	232		

Table 2. Mite population size on exposed and control soybean plants and the strength of induced resistance.

Rep	Mite population per plant on								Strength of Resistance a/b
	Exposed plants				Unexposed plants				
	Eggs	Moving stages	All stages	Mean a	Eggs	Moving stages	All stages	Mean b	
1	53	61	114		183	197	380		
2	66	54	120		99	211	310		
3	33	48	81		181	209	390		
4	22	47	69		132	191	323		
5	34	87	121		161	190	351		
6	75	58	133		173	248	421		
7	87	83	170		141	134	275		
8	65	46	111		77	119	196		
9	28	52	80		105	198	303		
10	58	53	111	114.5	204	191	395	339.1	0.34
11	53	58	111		193	171	364		
12	51	84	135		187	207	394		
13	38	37	75		118	208	326		
14	21	55	76		131	150	281		
15	84	49	133		201	288	489		
16	131	76	207		193	188	381		
17	56	111	167		188	171	359		
18	38	49	87		117	155	272		
19	56	51	107		123	161	284		
20	41	41	82		88	200	288		

Mite population (moving stages was arranged from 20 to 68 and from 37 to 111/plant on cotton and soybean exposed plants, respectively.

While it was from 66 – 188 and 134 – 288/plant on the unexposed plants, respectively. It means that the average number of mites reduced from 116.9 and 189.35 to 42.5 and 60.00/plant with a reduction reached 63.64 and 68.31%, when the mites grew on cotton and soybean plants that had previously been exposed to mite infestation, respectively.

The same results was found with the female fecundity; the average number of eggs decreased from 81.2 and 149.75 on cotton and soybean exposed plants, respectively; to 26.85 and 54.5/plant on unexposed plants with a reduction reached 66.93 and 63.61% on cotton and soybean, respectively (Fig.2).

On the other hand, the strength of induced resistance was estimated, it was 0.35 and 0.34 on cotton and soybean, respectively. The ratio is inversely related to the strength of resistance; the ratio is large when resistance is weak and becomes smaller as resistance becomes stronger. The ratio 0.35 mean populations of mites on control plants were about 3 times as great as those on plants that had been induced.

This finding is similar to the results which reported by Karban and Carey (1984), Karban (1985, 1986 and 1986a), Harrison and Karban (1986) and Karban *et al.* (1987). Also, Green *et al*. (1972) and Rhodes (1979), this findings gives an explanation for the relation between the initial damage and induced resistance.

Fig. 2: Mite popullation growth on previously exposed and unexposed on cotton and soybean plants.

Obviously, the growers will not be able to expose their cotton or soybean seedlings to mite feeding for five days and remove the mites at the end of this period, as was done in the laboratory. Therefore, for induced resistance to become a practical pest management tool, the laboratory demonstration of induced resistance must be repeatable in the field. Karban (1986) (repeated these trials in the field). He showed that resistance against spider mites can be induced under field conditions. He demonstrated three potential barries to the use of induced resistance as a management tool at the field.

Results of other workers and these tests identify a new source of resistance, which clearly indicate that attacked plants undergo changes that reduce their quality as food for subsequent insects and mites. It remains a challenge to entomologists to learn to manage induced plant resistance, so that it becomes a useful pest control tool.

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استحداث صفة المقاومة للإصابة بالعنكبوت الأحمر العادى فى نباتات القطن و فول الصويا

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أجريت هذه التجارب لدراسة العلاقة بين الأصابة الأولية أو البدائية بالعنكبوت الأحمر العادى *Tetranychus urticae* Koch و استحدث صفة المقاومة فى نباتات القطن و فول الصويا. حيث تم تربية الأكاروسات على بعض النباتات التى سبق تعرضها للإصابة بالأكاروس و على بعض ا لنباتات التى لم تصب من قبل. و أوضحت النتائج أن معدل نمو الأكاروس و كثافته العددية كان سريعا على النموات الحديثه للبادرات التى لم يسبق معاملة أطوارها الفلقية بأى اصابات سابقة بينما العكس وجد على النموات التى سبق تعرض أطوارها الفلقية للإصابة بالأكاروس و كان معدل النمو و الكثافة العددية للأكاروس على البادرات السابق تعرضها للأصابة الى الكنترول ١ : ٢ و فى بعض الحالات كان أكبر.

توضح هذه التجارب مصدرا جديدا من مصادر صفة المقاومة فى النبات لبعض الأفات الثاقبه الماصه و التى يمكن استخدامها فى برامج المكافحة المتكاملة فى الحقول.