INDUCTION OF RESISTANCE AGAINST THE TWO SPOTTED SPIDER MITE, *TETRANYCHUS URTICAE* KOCH (ACARI: TETRANYCHIDAE) USING JA & BTH

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Abstract

This study was conducted to evaluate the potential of induced resistance by of jasmonic acid (JA) and benzo (1, 2, and 3) thiadiazole-7-carbothioic acid S-methyl ester (BTH), a functional analogue of salicylic acid, against *Tetranychus urticae* infestation. The data demonstrated that both JA and BTH treatments significantly impair the development of *T. urticae* compared to control. They reduced the percent of *T. urticae* infestation especially at optimal rate. Where, 1.5 mM JA-treatment and 1 mM BTH significantly reduced the production of *T. urticae*. Evaluation of mite performance revealed that there was highly significant effect of JA, BTH treatments on development of the egg and adult stages, while immature stage slightly affected. On the other hand, data reported that BTH significantly reduced the fecundity of the *T. urticae* females when compared to JA and control. Therefore, we concluded that JA and BTH increase plant defense against *T. urticae*.

INTRODUCTION

The tetranychid mite, *Tetranychus urticae* Koch (Acari: Tetranychidae) is one of the most common mites infecting economic crops. It heavily damaged crops and brought loss to agriculture production. In spite of many control measures (chemical, biological and physical methods) recommended and practiced, still innovative measures need exploration since none of the methods singly can maintain the pest population below threshold level. Induction of resistance by exogenously applied synthetic jasmonic acid (JA) and salicylic acid (SA) analog Benzothiadiazole (BTH) could supplement biological control strategies (Choh *et al.*, 2004; Risal *et al.*, 2008). JA plays an important role in both herbivore resistance and pathogen resistance (Wasternack and Parthier, 1997). The exogenous application of JA & BTH to plants increases their defense against herbivores (Omer *et al.*, 2001; Redman *et al.*, 2001). Besides, Ozawa *et al.* (2000) showed that *Tetranychus urticae* infestation resulted in the expression of acidic and basic pathogenesis-related (PR) genes that were also induced by methyl salicylate and JA in leaves this suggesting that both the SA and JA related signaling pathways are induced in response to *T. urticae* damage.

Therefore, the aim of this study was to develop a method to determine the potential of induction of resistance by of jasmonic acid (JA) and benzo (1, 2, and 3) thiadiazole-7-carbothioic acid S-methyl ester (BTH), a functional analogue of salicylic acid, against *T. urticae* infestation.

MATERIALS AND METHODS

These experiments were conducted using bean plants. Plants were grown in greenhouse at 26 ±2 C and 60-70 % R.H. in 1L pots. One week after germination, JA and BTH were sprayed to runoff onto the desired portion of the plant and applied in three treatments (0.1, 1 or 1.5 mM JA; 0.1, 0.75, 1 mM BTH) and control. The leaves were collected one days after JA and BTH applications for the herbivore bioassay

For assessment of herbivore preference to either treated (0.1, 1 or 1.5 mM JA; 0.1, 0.75, 1 mM BTH) and control, leaves were placed in a Petri dish lined with a moist cotton ball to maintain leaf water content where, three female spider mites were placed on each leaflet and allowed to reproduce for 10 days, after which the number of mites settling on either treated or control leaves were counted using stereo microscope (Thaler *et al.*, 2002).

For assessment of *T. urticae* performance to either treated (1 mM BTH and 1.5 mM JA) or a control plant, the number of eggs, immatures, and adults was counted.

For assessment of fecundity of females developed on induced plants, females that emerged from treated plants (1 mM BTH, 1.5 mM JA and control) were placed individually on untreated leaf discs for egg deposition, to monitor the number of eggs laid per female and estimate the fecundity of female.

Chemical analysis, carried out in this experiment for extraction and quantification of both jasmonic acid (JA) and methyl jasmonate (MeJA) from plant sample. JA and MeJA were extracted from plant before and after applications of different treatments and determined using the GC- MS system by the method of Weber, *et al.* (1997).

Data obtained in this study were analyzed statistically using analysis of variance (ANOVA) and means were separated by a least significant differences test in SAS.

RESULTS AND DISCUSSION

Induction of resistance by exogenously applied synthetic jasmonic acid (JA) and salicylic acid (SA) analog Benzothiadiazole (BTH) could supplement biological control strategies. However, the response of the hosts as well as pests varies in different systems.Thus, this study was carried out to investigate the potential of induced

resistance by jasmonic acid (JA) and benzo (1, 2, 3) thiadiazole-7-carbothioic acid S-methyl ester (BTH), a functional analogue of salicylic acid, against *Tetranychus urticae* infestation

Data in figure (1) revealed that the efficiency of both JA& BTH in enhancing plant resistance against mites was changed with different concentrations. BTH reported highest level of efficiency at 1 mM, and lower ones at 0.1 mM BTH and control, respectively. Besides, there was observable significant effect due to 1.5 mM JA application against *T. urticae* when compared to 0.1, 1 mM JA and control. However, chemical analysis proved that the levels of JA increased with increasing concentrations.

Figure (2) indicated that there was highly significant effect of treatments JA, BTH on development of the *T. urticae* mites. Where, both of the treatments reduced the production of egg and adult stages when compared to control. However, the immature stage slightly affected by the different treatments at 5% significance level.

Regarding to the effect of different treatments on fecundity, data showed that BTH significantly reduced the fecundity of the females compared to control and JA at 5% level of significance. Since, females emerged from BTH treated plants laid significantly fewer eggs (3.25 eggs/female/day) than females from JA (4.26 eggs/female/day) and control (5.53 eggs/female/day).

The results showed that both JA and BTH treatments significantly impair the development of *T. urticae* compared to control. They reduced the percent of *T. urticae* infestation at optimal rate. Brody and Karban (1989) reported similar results on studying induced resistance in cotton plants against spider mite. In addition, Li *et al.*, (2002) cleared that the treatment of tomato mutant deficient in the biosynthesis of JA with methyl-JA restored resistance to *T. urticae* feeding and reduced the fecundity of *T. urticae*. Choh *et al.*, (2004) showed that the BTH treatment was as effective against *T. urticae* as JA-treatment and JA-mediated lima bean defenses against spider mites may operate at an optimal dose response.

Moreover, Nombela *et al.*, (2005) observed that impaired egg hatch and delayed development of *B. tabaci*, preventing the L1 immature from reaching the second or third developmental stage on BTH treated plants. However several authors mentioned that BTH-induced plant defense was initially believed to be effective against pathogens but not against herbivorous insects (Heil *et al.*, 2000; Inbar *et al.*, 2001; Zarate *et al.*, 2007).

Accordingly, the mechanism of both JA and BTH induction processes needs further investigation. Since it is well established that the jasmonate pathway and the salicylate pathway (conditioning systemic acquired resistance, SAR) are two of the

biochemical response mechanisms that can be triggered by various attackers and the components of these pathways, jasmonic and salicylic acids, function as necessary signaling molecules that mediate such defensive responses (Durner *et al.*, 1997; McConn *et al.* 1997). In many plants, enhancing disease resistance is frequently accompanied by the activation of genes encoding pathogenesis related proteins PRPs (Van loon and Van strien, 1999 & El Samawaty *et al*, 2008)).

Application of BTH to leaves does not cause the biosynthesis of SA but mimics the effect of SA, apparently by interacting with the same cellular sites of action as SA (Tally *et al* .1999). Thus, all or a significant subset of the defense related biochemical responses induced by SA are also induced by BTH. Thaler *et al.*, 2002, showed that simultaneous application of both JA and BTH to field grown tomato plants resulted in attenuated expression of hallmark biochemical responses to these inducers compared to plants induced with just a single.

Therefore, we agree that different elicitors may behave differently in different disease complex depending on the factors involved in pathogenesis (El Samawaty *et al.*, 2008)

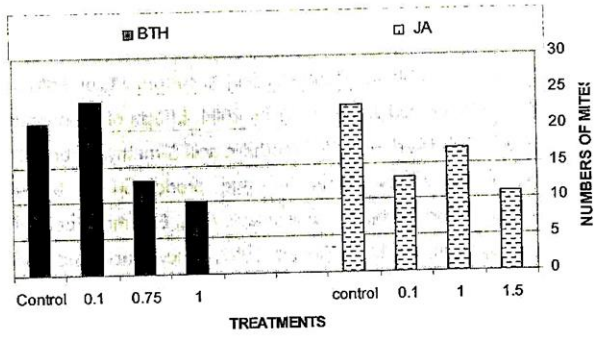

Figure 1. Preference of of mites on treated and control plants

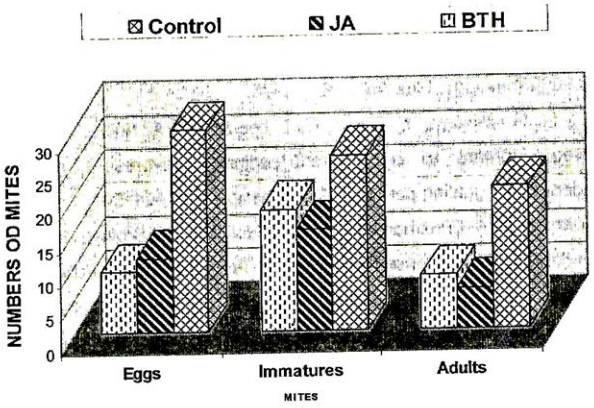

Figure 2. The number of spider mites per leaflet in three stage eggs, immatures and adults in JA, BTH and control.

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استحثاث المقاومة الجهازية ضد العنكبوت الأحمر العادى بإستخدام كلا من BTH & JA

غـــادة رفاعى

معهد بحوث وقاية النباتات – مركز البحوث الزراعية – الدقى– الجيزة

تعتمد طرق المكافحة الشائعة للأكاروس العنكبوت الاحمر العادى على استعمال المبيدات مما يسبب الكثير من الأضرار المتنوعة مع إكتساب الأكاروس مناعة سريعة ضد هذه المبيدات.

من هنا إهتمت هذه الدراسة بإقتراح طرق وأساليب مكافحة جديدة فى خفض نسبة الإصابة بهذا الأكاروس، هى استحثاث المقاومة الجهازية المكتسبة للنبات ضد العنكبوت الاحمر العادى باستخدام محفزات المقاومة JA &BTH.

هذا وقد دلت النتائـــــج على أختلاف فاعلية كلا المادتين باختلاف التركيز فى خفض نسبة الإصابة بالعنكبوت الأحمر العادى حيث أظهرت التجارب المعملية كفاءة JA عند تركيز ١,٥ ميلي مولار وBTH عند تركيز ١ ميلي مولار فى إكساب النبات صفة المقاومة لهذا الاكاروس. ومن ثم ادت المعاملة بهذة المركبات الى خفض تعداد اللأطور المختلفة للأكاروس ، حيث انخفض الطور البالغ والبيض انخفاضاً معنوياً عالياً بينما الأطوار الغير بالغة انخفضت أقل. وعلى الصعيد الأخر وجد أن درجة الإستجابة لتأثير BTH فى خفض كمية وضع البيض كانت أعلى معنوياً من JA.