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Arab Univ.
J. Agric. Sci.,
Ain Shams Univ.,
Cairo, 17(1), 185-192, 2009

SOME FACTORS AFFECTING THE SUSCEPTIBILITY OF FOUR STORED GARLIC CULTIVARS TO INFESTATION WITH *CRYPTOBLABES GNIDIELLA* MILLIERE

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Keywords: *Cryptoblabes gnidiella*, Honeydew moth, Garlic cultivars, Volatile oils

ABSTRACT

The honey dew moth *Cryptoblabes gnidiella* Milliere is one of the most important insect pests of stored garlic. Data revealed that, Egyptian (Baladi) cultivar was the least susceptible to attacke by this insect . After four months of storage, the infestation percentages were 21.68% for Egyptian (Balady) cultivar as compared to 32.39% for Sids 40, 44.88% for American and 70.99% for Chinese cultivar. The oil content of the four garlic cultivars were measured along four months of storage. Data showed that the four cultivars were differed significantly in this respect. The highest weight of volatile oils, 436.8 mg/100g was fined in the Egyptian cultivar whereas the Chinese cultivar had 340.6 mg/100g. The correlation coefficients "r" values showed highly significant and negative relationship between infestation percentages and volatile oils weight (mg) . The main components of the volatile oils of the tested four garlic cultivars were separated by GC- MS analysis. Nine sulfur compounds were separated and identified, the major compound was Diallyl trisulfide (i.e. 49.82, 46.23, 46.17 and 44.89%) for Egyptian, Sids 40, Chinese and American cultivars, respectively. Allyl methyl trisulfide ranged from 11.40 to 23.15%. On the other hand percentage of total soluble solids (TSS%) for the four cultivars were almost the same trend during the storage period extended for four months or slightly increased. These data indicate the importance of the type and quantity of volatile oils and its component in protection of stored garlic from infestation by *C. gnidiella.*

INTRODUCTION

Garlic (*Allium sativum* L.) is a widely distributed plant used in all parts of the world as a spice for food and as a medicinal plant. It is one of the most important vegetable crops in Egypt, as for exportation and for local consumption. Garlic has been used for many medicinal purposes including use as hypoglycemic, hypochloterlamic, antipasmolytic and antihypertensive agent (**Brahamchar and Augusti, 1962; Augusti, 1977 and El-Hadidy *et al* 1981**).

The pyralid moth, *Cryptoblabes gnidiella* Milliere (Lepidoptera: Pyralidae) is a very serious pest which is capable of preventing successful growing of a number of important fruits and vegetables. In Egypt, it was recorded attacking citrus fruits, mangoes, figs and grapes attracted to the honey dew of coccids and it was recorded also attacking garlic, sorghum and maize **(Swailem and Ismail, 1972). Abul-Nasr *et al* (1974)** studied the rate of infestation to stored garlic bulbs by four main insects; i.e. *Cryptoblabes gnidiella* Mill., *Laisoderma serricorne* Gab., *Carpophilus obsoletus* Er. and *Haemophlaeus ater* Oliv., during two successive seasons at Alexandria region. Data revealed that the mean percentage of infestation by the garlic moth, *C. gnidiella* was higher than that of the three associated beetles giving 8.6 and 2.3 % during the two storage seasons, respectively. Most of the

(Received December 17, 2008)
(Accepted December 22, 2008)

previously recorded research were conducted to detect the infestation of several crop plants and fruits by *C. gnidiella*. Few reports were registered concerning this pyralid infestation on stored garlic and losses due to this serious pest under Egyptian conditions (**Abul-Nasr *et al* 1974** and **Singh & Singh 1995 and 1996**). However, recently the economic importance of investigating the host preference attracted attention of many researchers. In the present work, an attempt was made to fined out the relative susceptibility of four garlic varieties, as well as the role of some chemical factors affecting resistance of garlic cloves to *C. gnidiella* infestation.

MATERIALS AND METHODS

a. Insect infestation

Balady (Egyptian), Sids 40, American and Chinese garlic bulbs were obtained from Vegetables Research Institute, A.R.C. Samples of five bulbs similar in size and weight of each garlic cultivar were placed separately in a small glass jars and fifty of newly deposited *C. gnidiella* eggs were added to each jar and the jars were covered with muslin fixed with rubber band and incubated in an incubator set at 25±2°C and 65±5% R.H. After about one month, the jars were examined to evaluate the rate of infestation by counting the adult moths emerging from each cultivar and the bulbs were weighed to determine the weight loss. These processes were carried out for about five months which was enough to show the differences in weight consumption between cultivars. Two replicates from uninfested garlic bulbs of each cultivar were incubated under the same conditions as control.

b. Garlic oil extraction, separation and identification

The method described by **Duerbeck (1993)** was followed to extract the garlic oil. A 100 g sample of fresh garlic cloves was homogenized in 100 ml water. The homogenate was diluted to 500 ml water, transferred to 2-liter glass distillatory, heated and boiled by a steam coil located at the base of the distillatory body for 3 hours. The oil constituents released form the plant material were combined with the water vapor and allowed to cool in a condenser to separate into two components, oil and water. The recovered oil was collected, measured volumetrically (v/w wt) and stored at -20C° before use. Aliquot of 2µl of 1% garlic oil in acetone (v/v) was used for injection in GC-MS equipment. A Hewlett Packard 6890 GC-MS equipped with a split-splitless injector and HP-5 capillary column (30m x 0.32 ID, 0.25 µm film thickness) was used. The column temperature was held at 60ºC for 3 min., increased at 4ºC/min. to 200ºC and held for 10 min. and helium was used as the carrier gas. Detection was made by electron impact (EI) mass. Spectra were obtained at 70 eV and the instrument scanning from 35 to 40 amu. Identification of the peaks was carried out by mass spectral machine using the Wiley 275 k Mass manual comparing the fragmentation pattern of the same compound provided by Wiley library. The relative amount of each compound was calculated using area under the peak and expressed as a percentage of total sulfur compound.

c. Total soluble solids

Total soluble solids (TSS) percentage was determined using hand refractometer (Brixo, 32%) in a section taken from the central axis of the glove according to **(A.O.A.C., 1990).**

RESULTS AND DISCUSSION

Susceptibility of certain garlic cultivars to *C. gnidiella* infestation

Percentage insect infestation of four garlic cultivars namely; Egyptian (Balady), Sids 40, Chinese and American as well as the weight loss due to *Cryptoblabes gnidiella* infestation through various storage periods are shown in **Table (1).** The data demonstrated that as the storage period increases, the percentage of infestation and accordingly the losses in bulb weight also increase. When the infested cultivars stored for one month, the percentages of infestation were, 5.82, 7.20, 25.76 and 14.62% for Egyptian, Sids 40, Chinese and American cultivars, respectively. After storaging for four months, Egyptian cultivar was the least attacked by the insect as the percentage of infestation was 21.68%, whereas, Chinese cultivar was the most susceptible cultivar (70.99 %).

As a result of insect infestation, the weight of stored garlic was affected. The percentage of weight of Egyptian (least infested) was only reduced by 17.01% and this result indicated that the Egyptian cultivar was the most resistant one against insect infestation. Meanwhile, the other cultivars could be arranged in an ascending order in regard to percentage of weight loss as Sids 40 (18.56 %), American (20.20 %) and Chinese (41.65 %). These results demonstrated extensive

feeding and reproduction potential of the insect on the susceptible cultivars and this may be due to the chemical composition of the garlic variety.

After four months of storage, the highest percentage of infestation (70.99 %) and accordingly the highest losses (41.65%) occurred in Chinese cultivar followed by American (44.89 & 20.20 %), Sids 40 (32.39 & 18.56 %) and Baladi (21.68 & 17.01%).

The role of chemical and physical factors in resistance of garlic bulbs to *C. gnidiella* infestation

The oil constituents of garlic cultivars were measured during four months of storage. Data in **Table (2)** show that the four cultivars under investigation differ in their content of volatile oils. The highest value (436.8 mg) was confined to the Egyptian cultivar, whereas the Chinese showed the lowest values 340.6 mg after one month of storage. The same trend was observed for the next two months of storage. In the fourth month, the American cultivar was the least in oil content (161.6 mg), while the Egyptian was the highest (392.9 mg). It is obvious from this table that the oil content in garlic cloves is decreasing as the storage period increasing.

The correlation coefficients "r" values between infestation percentages and volatile oils weight (mg) in the tested garlic cultivars, indicated highly significant and negative relationship, which emphasize that as the weight of volatile oils decreases in garlic cloves, as a result of increasing storage period, the infestation with *C. gnidiella* increases in a steady manner.

On the other hand, percentages of total soluble solids (TSS%) were almost the same during the storage period extended for four months or slightly increased. The correlation between TSS and infestation percentage was positive and very highly significant. By the end of storage period, the percentage of volatile oils was estimated in all tested cultivars, it was found that these oils were obviously reduced in the Chinese cultivar rather than in the others. The susceptibility of the Chinese cultivar could be attributed to its high content of moisture that plays an important role in its suitability for *C. gnidiella* infestation.

Man never ceased to check insect attacks by all possible means. In the early days he used chemical compounds such as sulphur to combat many insects **(Hafez, 1976).** *Allium* vegetables, especially garlic, could be distinguished by their characteristic smell which could be attributed to volatile sulfur compounds. For centuries, *Allium* species (garlic, onion and leek) have been used in intercropping as they show well-known effects on many polyphagous insects and fungi. They produce characteristic sulphur allelochemicals with repellent and antifeedant effects against insects (**Rahman and Motoyama, 2000**).

The main compounds of the volatile oil of the tested four garlic cultivars that separated by GLC as well as their relative percentages are shown in **Table (3).** Nine compounds have been identified out of the twelve major compounds detected from the volatile oils of garlic cultivars under investigation. The major compound was found to be Diallyl trisulfide (49.82, 46.23, 46.17 and 44.89%) after one month from storage for Egyptian, Sids 40, Chinese and American cultivars, respectively. Allyl methyl trisulfide ranged from 11.40 to 23.15%.

El-Hadidy *et al* (1981) mentioned that GLC analysis clearly indicate that diallyl trisulphide and diallyl disulphide were the main constituents of garlic oil extracted by steam distillation. Also, GLC profiles showed that garlic oil obtained by this method does not contain allyl mercaptan where its peak appears after 6 minutes. The two major constituent methyl allyl disulfide and diallyl trisulphide, were tested to two species of stored product pests **(Huang-Yan *et al* 2000)**. Diallyl trisulphide totally reduced egg hatching, the nutritional indices in all larvae and suppressed adult emergence. Methyl allyl disulphide significantly decreased the growth rate, food consumption, and food utilization of adults of both insect species.

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