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POPULATION DYNAMICS AND HOST PREFERENCE OF CRUCIFER LEAF BEETLE, COLAPHELLUS APICALIS (MEN.) (COL.: CHRYSOMELIDAE) ON SOME CRUCIFERUS VEGETABLES

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A B S T R A C T

Crucifer leaf beetle, *Colaphellus apicalis* (Men.) is one of the most important pests of cruciferous vegetables in Khuzestan province. Population dynamics of *C. apicalis* in autumn and winter cultivations on white and red radish wasstudied during 2012-2013 agronomic year. In each sampling date 64 plants were collected and different growth stages of *C. apicalis* were recorded. The egg of *C. apicalis* on white radish in autumn season appeared in the beginning of October and peaked in the middle of December (33eggs/ plant). Larvae appeared in the middle of October and peaked in the late December (20 larvae/ plant). Adult beetles appeared in the beginning of October, in creased gradually and peaked in the middle of December(0.84 beetle per plant). Population dynamics of *C. apicalis* on red radish in the same season were similar to its population dynamics on white radish, however population density of eggs, larvae and adults were 19.06,12.31 and 0.34 at peak time, respectively. The eggs of *C. apicalis* on white radish in winter season peaked in the middle of march, 2013(3.81 eggs/ plant), peak of larvae population occurred at the same time(3.31 larvae/ plant) while peak of adults observed in early March 2013(0.16 beetle/ plant). Peak of egg, larvae and adult population of *C. apicalis* on red radish in winter season were 2.9 ,1.9 and 0.125 respectively. Therefore, population of *C. apicalis* was approximately two times higher on white radish than red radish in both seasons. Host preference study of adult and fourth stage larvae of *C. apicalis* on cress, white radish and red radish showed that both stages preferred cress compared to two other hosts.

INTRODUCTION

Chrysomelidae family is one of the largest families among the herbivorous insects and in aspect of species number is the second family after the *Curculionidae* (Aslan *et al*., 2003). Members of this family in the larval and maturity stages have Herbivorous and feed of different parts of the plant (Livia, 2006), and most species of this family are the most important pests of agriculture and forestry(Borror, 1989).

Crucifer leaf beetle, *Colaphellus apicalis* from Chrysomelini tribe is one of the most important economical pests that its damage has been important increasingly in vegetable planting in southern Khuzestan province. This insect activities on vegetables of Cruciferae family in Abadan, Khorramshahr, Shadegan and Hamidieh of Ahvaz and all of the larval and adult stages through feeding on the leaves of vegetables of this family (white radish, red radish and cress), during the autumn and winter seasons has created problems and causes to huge losses if not controlled. *C. apicalis* species have been reported from Near East, Middle East and Iran (Warchalowsky, 2003). Other species of Colaphellus genus are reported from Turkey (Ozdikmen, 2014; Aslan *et al*., 2003), Latvian (Bukejs, 2009), Central Europe (Schmitt & Ronn, 2011) and Iran (Sobhian, 1975; Gahari & Hawkeswood, 2011). Some species of this genus, such as *C. bowringi* (Xue *et al*., 2002) and *C. sophiae* (Muller, 1950; Vilau, 1990; Livia,2006; Bucur & Rosca , 2011) has been reported from some countries as pest of agricultural crops. So far, two species of *C. hoefti* and *C. zarudnii* has reported as agricultural pests in some provinces in Iran that active on crops such as cabbage, radish, mustard, turnips and in some cases on cotton (Modares Awal, 2012).

More researches have done on C. bowringi and the results showed that this insect is a short day species with aggregated distribution (Wang & Jiang,1999), which has one generation in spring And one to three generations in fall (Xue *et al*,2002) and photoperiod, temperature and host plant for diapause induction are effective in this species (Wang *et al*.2006,2007).

Research findings of Yukui on *C. bowringi* showed that the insect had two distinct populating peaks in Shandong,

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one in spring and another in the fall. Adults emergence from mid March to late April and after feeding, before mid-May enter to the soil, and adults of autumn generation from late August to mid- December appear from the soil and before the end of October go to *diapose*. However, Zhifeng *et al*. (2008) reported the emergence of the first generation of *C. Bowringi* in Harbin from early May to early July, and the emergence of the second generation of this insect from mid June to mid July, respectively. In Longnan of China, the adults of spring generation emerge from mid February until early April. This adult began to burrow into soil in early April to mid May. adults of autumn generation appear from mid August to mid October and began to enter diapause from mid September to mid December (Xi ting *et al*.,2009).

The study of many biological and ecological characteristics of a pest and decision-making to its control and lack of control, it is necessary to conduct sampling and evaluation of population dynamics. No studies have been done on the crucifer leaf beetle in the world. Therefore, the aim of this study is to investigate of the seasonal dynamics of Crucifer leaf beetle population *C. apicalis* and its host preference on different hosts of *Cruciferae* .

MATERIAL AND METHODS

Assessment of population dynamics

Trend of population dynamics in different growth stages of *C. apicalis* examined on red radish and white radish plants in two seasons of autumn and winter planting in the 2012-2013 crop year. This experiment was performed in a land with area of 650 m^2 and with a geographical location 30º 25 '12"N and 48º 13'16"E in Khorramshahr city. Tillage operations were conducted in accordance with local custom. Land was plowed twice and disked and then plotted. A total of 16 plots were prepared which consisted of eight plots of red radish and eight plots of white radish were planted in a randomized complete block design. Then in these plots has been studied the population dynamic of Crucifer leaf beetle during the two seasons. Length of plots was prepared 4 meters and width of plots was 2 m. 1ton of manure was given per hectare and used from local seed. The irrigation interval was approximately 4 days. The first planting date was in the mid-September and the second planting date was in early- January. Stages of the land preparing and its fertilizing, planting method, used seed rate, and amount and times of irrigation was conducted in accordance with the area calendar. According to the research purpose, no chemical and non-chemical control was made against Crucifer leaf beetle on the farm during the plan implementation. Weekly sampling was started upon emergence the early seedling. In order to sampling used from direct sampling method. In this way, in length of per plot, four plants were randomly selected and by examination all aerial parts of plant and soil surface, number of eggs, larvae and adult insects were counted and recorded.

Host Preference Of Crucifer Leaf Beetle

The first test of host preference

Host preference of *C. apicalis* were studied on three plants as white radish, red radish and cress. The experiment was conducted in a cylindrical plastic container of transparent talc in diameter 32 and height 12 cm. At first, the leaves of these plants had randomly laid (with an area of approximately 6 cm^2) at the bottom of the container, in equal intervals into a container on a wet paper (to preserve freshness). Then, 4^{rt} instar larvae that had fed the white radish deprived for 12 hours and then went into the center of container by a pipe. In order to ventilation a 3 cm hole embedded in the container lid and was covered with a fine mesh. Then the container lid put on it. Therefore, the possibility to access larvae to any leaves was equal. Then, the testing container was set in laboratory conditions at a temperature of 2 ± 21 °C, relative humidity 50 ± 5 % and photoperiod of 14:10 (L:D) and after 24 hours, the mentioned leaves are collected and feeding levels of the leaves are calculated and used as a criteria of host preference of *C. apicalis.*

The second test of host preference

In this experiment, host preference of female adult insect of Crucifer leaf beetle that had passed its pre-adult period on the red radish, investigated on three plants white radish, red radish and cress.

The purpose of this experiment is evaluation of the host preference and determination the level of damage caused by female insect on the hosts were tested. This test was conducted according to the previous method in the cylindrical container such as a pre-test. The difference is that adult insect due to more tolerance to starvation rather than larvae had been starved for 24 hours.

The third test of host preference

In this experiment, host preference of 4^{rt} instar larvae Crucifer leaf beetle that was fed on red radish in his previous life, were investigated on three plants as cress, white radish, and red radish.

Statistical Analysis

In order to normalize the data from population dynamics, different growth stages of Crucifer leaf beetle such as egg, larvae and adult, the data converting done in to Log N+ 0/5 and Excel software was used for the charting. Hatami[1] method was used to measure the eaten surface in order to the lack of area assessment set. The work method is as follows: *First*, the weight of specific surface of paper A_4, for example square of 5 cm × 5 cm with specific area 25 cm^2 measured using a digital scale 0000. Then amount of eaten surface by the insect moved on to A_4 paper and cut out transferred parts on to the paper. *Then*, we measured weight of cut pieces using a digital scale 0000 and then using fitness measured eaten area by the insect on different hosts. The obtained data was used as measurement criteria of host preference of *C. apicalis* on tested plants. This data via the analysis of variance (ANOVA) in a completely randomized design were determined and the mean comparison of all trials was determined using the software SPSS and Duncan's multiple range test at the 5% level.

RESULT AND DISCUSSION

Population dynamic of different stages of Crucifer leaf beetle on the white radish in autumn planting is shown in

[1] - Hatami, former member of the faculty of the Department of Plant Protection, Isfahan University of Technology

Table 1 The eaten surface (mm^2) by larvae and adult female of *C. apicalis* on different hosts

host	Test 1	Test 2	Test 3
watercress	56.69±12.97b	41.69±5.32b	58.19±15.59b
white radish	22.54±5.78a	25.83±21.32ab	21.38±6.52a
red radish	7.69±1.60a	15.35±8.85a	18.74±7.61a
	F=9.266	F=6.018	F=4.876
Analys	P<0.05	P<0.05	P<0.05
	df= 2,36	df= 2,12	df= 2,12

Figure1A. The emergence of the adult insects has been observed from the beginning of October and population density gradually increased with little volatility and the largest number of observed adult insects was in weekly sampling in mid December (0/844 per plant). The first batch of eggs was observed in early October. In late of October the crowd slowly began to rise. This trend continued until the middle of December so that average of population of eggs reach to 17/875. Then population fell slightly but again it rose and reached to its highest amount on Des16,2012 (33/062 eggs) during the sampling period. The population of eggs fell sharply until in the middle of January reached to its lowest level (1/128). Larvae appeared in the second decade of October and peak time of larval population appeared by average of 20/25 larvae per plant on Des23,2012. Upon the plant growth and leaves lignifications, the larvae population gradually declined until reached to 2/791.

Trend of population dynamics in different stages of *C.apicalis* on the red radish in autumn planting is shown in Figure 1- B. Emergence of the first adult insects begin from mid October (0/031 per plant) and gradually increases and time of population peak of the adult insects were recorded in the middle of December with an average 0/344per plant. Over time and ripening the radish crop, population decline and reached to the 0 /031 adult per plant.

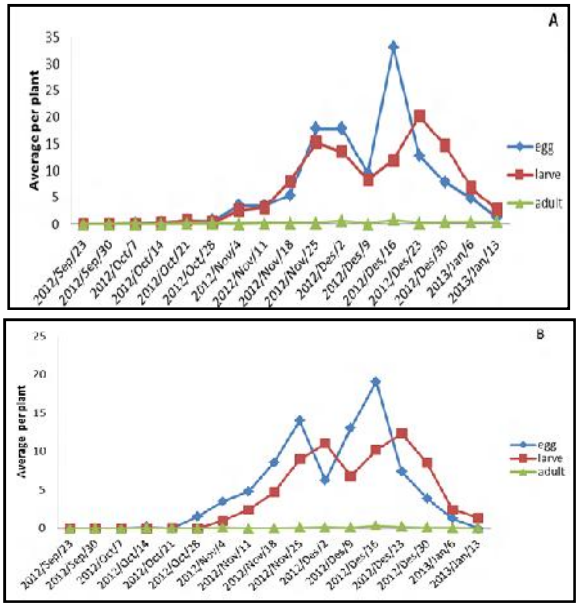

Fig.1 population dynamic of *C.apicalis* on white radish (A) and

visibility time of the first batch of observed eggs was in mid October (Oct14,2012) with an average of 0/187 eggs per plant, and the time of peak happened in the mid of December (19/062 per plant). The emergence time of *C.apicalis* larvae on the mentioned host was on Oct 21,2012 and the peak of larvae population occurred on Des 23,2012 via average of 12/312 larvae per plant.

Trend of dynamics of population in different development stages *C.apicalis* on the white radish in winter cultivation is shown in Figure 2 (A). Appearance time of the adult insects started on late January and population increased gradually and population peak of adult insects was recorded in the beginning of March with average of 0/156 per plant. Over time and the weather warming, population has declined and in early April adult insects per plant reached to zero. Observation time of the first batch of egg was on late January and from this time onwards the population gradually increased and reached to its peak on middle of March (3/812 eggs per plant). Then egg population gradually declined and reached zero on Apri 7,2013. Larvae were observed in the third week of sampling with average of 0/562 larvae per plant. Larval population by little volatility reached to its peak in the seventh week of sampling that this time coincided with the end of the first decade of March, which at this time, density of larvae per plant was recorded 3/312. Then, after plant growth and climate changes and rising temperature in the region, larvae population growth was gradually descending until it reaches zero on Apri 28,2013.

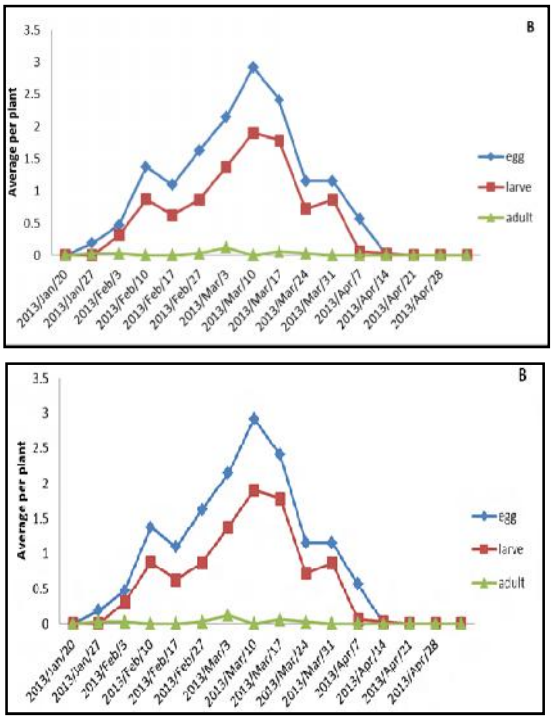

Fig.2 population dynamic of *C.apicalis* on white radish (A) and red radish (B) in winter planting

Studies on population dynamics of C.apicalis on red radish in winter season was approximately similar to white radish(Figure 2 B) and showed that peak of eggs (2.9

eggs per plant) on 3, 10,2013, peak of larval population (1.9 larvae per plant) on middle of March 2013 and peak of adult beetle population (0.125 adult on each plant) was observed on beginning of March 2013. Therefore, in both season population of C.apicalis on white radish was approximately double its population on red radish.

survey of population dynamics *C.apicalis* beetle on white and red radish in autumn and winter seasons showed that this insect has two population peaks per year in the field, that one of them was seen in fall and other in the winter, however can cause more severe damage in autumn than in winter. The results of the current study correspond to Yukui *et al* (2007) findings about population dynamics of *C.bowringi*. According to the planting season of red and white radishes is when the weather is cool, so, activity of this insect is also consistent with the growth period of the plants and the insect is active in Khorramshahr (Khuzestan) in the fall and winter seasons. However, in temperate regions such as Europe and East Asia where winters are cold, this pest has been compliance with the cool conditions of summer and become active in this time.

Host preference of Crucifer leaf beetle

The Eaten surface by larvae and adult female of *C. apicalis* on different hosts of the Cruciferae family are shown in Table 1. In the present study, Crucifer leaf beetle in three tests of the host preference has the highest eaten surface on cress among tested treatments and white radish and red radish were the next degrees therefore, this plant was identified as the host susceptible to the pest.

Chemical composition and physical structure in host plant plays an important role in host selection by herbivores insect. preference or non- preference of an insect to a host plant is due to its *antixenosis* resistance that can be caused in order to the presence of trichome, wax, elements of the food and Bio-Chemical factors (Seraj, 2008). What has important role in plant selection mechanism by insect is volatile chemicals within plants that may have attract or repellent effects than insect. Thus the study of feeding reason from a host rather than the other host plants requires further and detailed studies on the physical, chemical and volatiles structures of host plant. review of academic resources on the host preference of leaf beetles of genus *Colaphellus (Colaphus)* on various plants showed that only one study was conducted in field of using the *C. hoefti* species to control test of *Cardaria draba* . The results of this research about the larvae and adults feeding of *C. hoefti* from other different plant hosts in the North East of Iran showed that this insect easily feed plants as *Brassica sp, Capsella sp* and *Raphanus sp.* So, it cannot be used this beetle as a biological control agent to control of *Cardaria draba*(Sobhian, 1975).

The present study provides information on population dynamics and host preference of Crucifer leafbeetle than some vegetables of *Cruciferae* family. However, to complete the mentioned information; number of generation of Crucifer leaf beetle must also be studied in field conditions. Then through integration of data on dynamic of population and generation number of pests and its host preference in field, management of *C.apicalis* be planned and implemented.

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