Iran Agricultural Research, Volume 3, No. 2, 1984

EVALUATION OF FEEDING RESPONSE, AGE SPECIFIC SURVIVAL AND LONGEVITY OF POPLAR LEAF BEETLE CHRYSOMELA POPULI L. (COLEOPTERA; CHRYSOMELIDAE) ON FIVE HOST PLANTS[1]

N. Zareh, A.A. Ahmadi and A. Alishah[2]

ABSTRACT

Food consumption by weight, age specific survival and age specific longevity of poplar leaf beetle *Chrysomela (Melasoma) populi* L. were studied on five plant species, namely, weeping willow (*Salix babylonica* L.), black willow (*Salix nigra* L.), common (white) willow (*Salix alba* L.), black poplar (*Populus nigra* L.), and white poplar (*Populus alba* L.) under laboratory and field conditions. Although larval and imaginal instars consumed small amounts of weeping and black willows, they could not survive long after feeding. Age specific survival was significantly different between poplars and common willow both in laboratory and field tests except for the pupal stage under field conditions. No significant differences were found between age specific longevity of poplar leaf beetle on poplars and common willow under the experimental conditions. The feeding response on poplars was significantly different from that on willows. No significant difference was found in the food consumption of the larvae among the members of the poplar and willow groups. Also the amount of food consumed by imagines on poplars and common willow was statistically the same. The results of food consumption, age specific longevity and survival indicate the presence of feeding deterrent factors in black and weeping willows.

تحقیقات کشاورزی ایران
جلد سوم شماره دوم ۱۳۶۳

ارزیابی اثر پنج منبع غذائی در ادامه حیات و طول سنین مختلف سوسک برگخوار تبریزی CHRYSOMELA POPULI L. (COLEOPTERA; CHRYSOMELIDAE)

ناصر زارع، علی اصغر احمدی و آصف علیشاه
بترتیب استادیاران و دانشجوی سابق بخش گیاهپزشکی دانشکده کشاورزی دانشگاه شیراز

---

1. Contribution from the Department of Plant Protection, College of Agriculture, Shiraz University, Shiraz, Iran. Paper No.K-547-63 . Received 22 July 1984.

2. Assistant Professors and former Graduate Student, respectively.

by Detheir (3), Thorsteinson (8), and Bec (1). House (6, 7) concluded that nutrient balance may be the prime factor determining host selection. In the field, the extent to which food plant slection by *C. populi* L. is related to the plant's chemistry is still unknown. Consequently knowledge of larval and imaginal food consumption, and their associated field longevity and survival can promote understanding of the feeding ecology of *C. populi* L. The present paper deals with the feeding response and age specific survival and longevity of *C. populi* L. on five plant species.

MATERIALS AND METHODS

The five plant species used in this study were white poplar (*Populus alba* L.), black poplar (*Populus nigra* L.), weeping willow (*Salix babylonica* L.), black willow (*Salix nigra* L.) and common (white) willow (*Salix alba* L.).

Laboratory Tests

The egg masses, collected from the leaves of common willow and poplars, were reared in plastic boxes (5x10x5 cm) under laboratory conditions (Temp. 20±3° C., R.H. 65±5% and hotoperiod 12 hr.). Ten newly emerged larvae were released on the partially expanded foliage at the tips (5 cm) of young shoots of each host. To maintain freshness of leaves the shoots were inserted in wet cotton wool in glass vials (5x 3 cm) which were glued to the wall of the rearing box. The life cycle of the leaf beetle was studied under the conditions described above. Food consumption was measured by drawing the consumed leaf area on a graph paper every other day at which time all foliage was discarded and fresh foliage from the parent plant was added. This also prevented foliage expansion. Leaf area consumed was converted to biomass by multiplying the weight of 1 mm^2 of fresh leaf by the total consumed leaf area. After adult emergence each pair (♂ and ♀) was introduced to a new rearing box containing a fresh leaf shoot from the appropriate host and adult

fecundity and longevity were determined. Adult food consumption was measured as in the larval stage, and mortality or survival of each stage was determined for each treatment. The experiments were conducted in a completly randomized design and each trial consisted of 5 replicates. Data were subjected to Duncan's Multiple Range Test.

Field Test

Preliminary observations showed that imaginal stage of *C. populi* after emerging from the overwintering stage, preferred common willow and poplars for feeding and oviposition. Age specific survival and longevity were studied on 5 different hosts with 5 replicates. Uninfested healthy branches with young to moderately mature leaves were enclosed in cheese cloth bags (50 cm in diameter & 75 cm in length), and 10 lst-instar larvae were released onto the foliage inside each bag. Observations were made twice a week to evaluate the larval and pupal longevity and survival. The experiment was continued up to the adult emergence. Then, pairs of newly emerged adults were collected and introduced into new bags on the same host plant in order to evaluate adult longevity and fecundity. The experiment was replicated 10 times. Mean daily temperature and R.H. recorded during the experiment are shown in Fig. 1.

RESULTS AND DISCUSSION

Both food quality and quantity are important factors affecting age specific longevity and survival. The effect of food shortage or nutrient content of the host plants were not examined at this stage, but an attempt was made to determine feeding response and age specific longevity and survivorship of *C. populi*. Food consumption on various host plants was closely related to the larval, pupal and generation survival. Larval food consumption was almost three times greater on poplars than on willows. The same trend was followed by the imaginal stage with the exception that food consumption on common willow was the same as on poplars (Table 1)

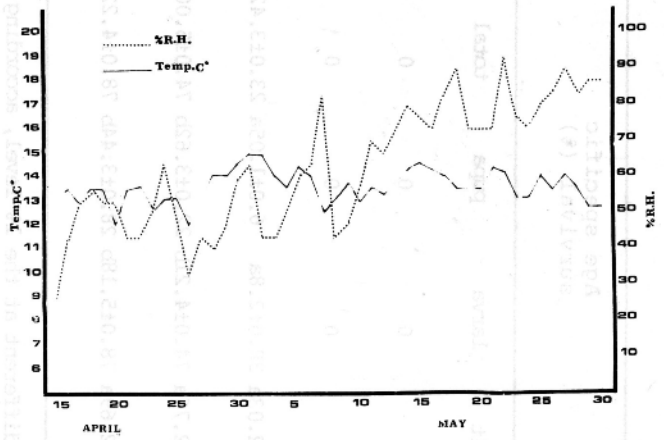

Fig. 1. Daily average of temperature and relative humidity recorded during the field experiment.

In both experiments the young larvae survived for up to 5 days on weeping and black willows, but none survived to the pupal stage (Tables 1 and 2). Possibly inhibitory factors may be present in these host plants which make the food unpalatable to *C. populi* and prevent the completion of larval development. Any factors responsible for unpalatability remain to be studied.

C. populi seems to be more adapted to feed on common willows than on black and weeping willows (Table 1). Therefore, both poplars and common willows acted as staple foods for larval and adult stages of *C. populi* under laboratory conditions, and the insects appeared to eat normally under the artificial conditions. These results confirm previous

Table 1. Means ± SE of food consumption, age specific longevity and survival of *C. populi* L. on different host plants under laboratory conditions †,§.

Host plants	Food consumption (g) (Biomass)		Age specific longevity (day)			Age specific survival (%)		
	larva	adult	larva	pupa	adult	larva	pupa	total
Weeping willow (*Salix babylonica* L.)	2.6±0.01a	0.4±0.02a	NC¶	0	0	0	0	0
Black willow (*Salix nigra* L.)	2.7±0.23a	0.5±0.01a	NC	0	0	0	0	0
Common (white) willow (*Salix alba* L.)	4.7±0.62a	4.8±0.73b	16.0±1.85a	4.0±0.42a	16.5±2.03a	38.0±2.8a	6.0±1.05a	23.0±3.42a
Black poplar (*Populus nigra* L.)	12.6±2.51b	6.3±1.16b	17.0±2.12a	3.0±0.37a	17.0±2.76a	74.0±4.21b	22.0±3.62b	74.0±5.00b
White poplar (*Populus alba* L.)	14.0±2.87b	6.3±1.16b	17.5±1.94a	3.0±0.29a	19.0±2.69a	78.0±5.18b	28.0±3.44b	78.0±4.22b

†For each column, means with the same letters are not significantly different at the 1% level, according to Duncan's Multiple Range Test.

§Replicated 5 times with 10 individuals per replicate.

¶Not continued.

Table 2. Means ± SE of age specific longevity and survival of *Chrysomela populi* L. on different host plants in the field †, §.

Host plants	Age specific longevity (day)			Age specific survival (%)		
	larva	pupa	adult	larva	pupa	adult
Weeping willow (*Salix babylonic* L.)	NC¶	0	0	0	0	0
Black willow (*Salix nigra* L.)	NC	0	0	0	0	0
Common (white) willow (*Salix alba* L.)	9.5±2.63a	4.1±0.29a	19.5±3.35a	14.0±1.62a	85.7±1.80a	12.0±0.88a
Black poplar (*Populus nigra* L.)	9.5±2.27a	5.0±0.44a	22.1±2.85a	52.0±2.30b	84.6±2.93a	44.0±2.30b
White poplar (*Populus alba* L.)	11.5±2.14a	4.5±0.52a	23.2±2.28a	60.1±3.41b	93.3±5.13a	60.0±3.67b

†For each column, means with the same letter are not significantly different at the 1% level, according to Duncan's Multiple Range Test.

§Replicated 5 times with 10 individuals per replicate.

¶Not continued.

field observations in the woodlands and national parks in Fars and neighboring provinces where the host trees and the beetle are widely distributed. Around Shiraz, common willow is attacked early in the season as the foliage on this species develops before that of poplars, especially white poplar to which the pest moves later.

Age specific longevity was statistically similar on the two poplars and common willow for each developmental stage in both the laboratory and the field trials (Tables 1 and 2) However, age specific survival was significantly different between poplars and common willow, except for the pupal stage in the field (Tables 1 and 2). Higher larval and lower pupal mortalities in the field were probably due to microenvironmental effects which were not present in the laboratory. Significantly lower total survival (higher real mortality) on common willow, both under laborartory and field conditions, may be due to the inherent properties of the host resulting in a considerable suppression of the population. However, information about the presence or absence of secondary metabolic compounds which may be responsible for the insect feeding behavior needs to be studied later.

With respect to the results obtained from the experiments (Tables 1 and 2), significantly more food was consumed on poplars than on willows. However, no mating or oviposition was observed. Probably, this is due to the absence of suitable conditions such as shelter, oviposition site, shortage of space for courtship and mating behavior, etc. , which were not available to them under imposed artificial conditions. Hagvar (5) showed that the adults need a rest period before reproduction, suggesting that they are not physiologically prepared for reproduction immediately after feeding.

The high mortality in early larval stage on weeping and black willows and the moderate mortality on common willow are probably due to quantitative food consumption. This may also be an indication of some nutritional inhibiting factors

or lack of an essential nutritional element in these host plants. Woodlands , gardens, and national parks in Iran contain all kinds of willows and poplars, but according to these results heavy infestation can occur on poplars and common willow and cause economic losses to timber, wood, and wood industries.

An understanding of the feeding behavior of this pest is important for the development of control measures. From our studies it is evident that food quality has a marked influence on the age specific longevity and survival of *C. populi* in both laboratory and field conditions. This ultimately affects the population of future generations. The energy budget of different developmental stages of *C. populi* in relation to growth data should be worked out under field conditions.

LITERATURE CITED

1. Beck, S.D. 1965. Resistance of plants to insects. Ann. Rev. Entomol. 10: 207-232.
2. Damanabi, K., M.L. Kazemi, and F. Akrami. 1977. *Melasoma populi* L. (Col: Chrysomelidae): A poplar leaf eater. Entomol. Phytopath. Appl. 45: 14.
3. Dethier, V.G. 1953. Host plant perception by phytophagous insects. Symp. 9th. Int. Cong. Entomol. Amsterdam 2: 81-83.
4. Farahbakhsh, Q. 1961. A checklist of economically important insects and other enemies of plants and agricultural products in Iran. Dept. of Plant Protection. Min. of Agric., Tehran. 153 p.
5. Hagvar, S. 1975. Studies on the ecology of *Melasoma collaris* L. (Col: Chrysomelidae) in alpine habitats at Finse, South Norway. Norw. J. Entomol. 22: 31-47.
6. House, H.L. 1967. The role of nutritional factors in food selection and preference as related to larval nutrition of an insect, *Pseudosarcophaga affinis* (Dip. Sarcophagidae) on synthetic diet. Can. Entomol. 101:

409-412.

7. House, H.L. 1970. Choice of food by larvae of the fly *Agria affinis* related to dietary proportion of nutrient. J. Insect Physiol. 16: 2040-2050.
8. Thorsteinson, A.J. 1960. Host selection in phytophagous insects. Ann. Rev. Entomol. 5: 193-218.