WESTERN CORN ROOTWORM LARVAL HEAD CAPSULE WIDTHS SHOW HIGHER VALUES IN IRRIGATED FIELDS IN NORTHERN ITALY

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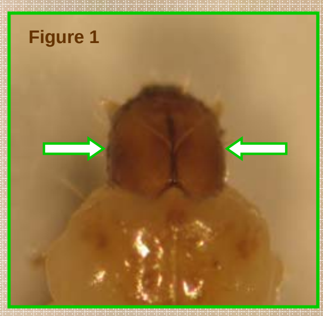
Introduction

The Western Corn Rootworm (WCR), *Diabrotica virgifera virgifera* LeConte, is becoming one of the most important pests of maize in the Po Valley of Northern Italy, especially where maize is grown as a continuous crop. Most of the damage is caused by larval feeding activity on roots. In highly infested fields, larval feeding can cause plant lodging, reduction of the plant fitness and economic losses. The number and size of larvae can be related to the amount of root tissue damaged during the feeding activity. In this study, head capsule width was measured to determine WCR larval instars from irrigated fields in Northern Italy and as a body size indicator to compare the sampled population with populations in other studies.

Materials and Methods

WCR larvae were collected weekly in 2006, 2007 and 2008 in different irrigated maize fields of Brescia province, Lombardy region. The beginning of the sampling period was determined each year following the output of a provisional degree day model previously validated for the area and routinely used in our research studies and outreach activities.

Each year, ten root systems and the surrounding soil were dug up each week in three fields and brought to the laboratory.



WCR larvae were collected from the roots using Berlese funnels and by sieving the soil collected from around the roots. Samples were preserved for several months each season in an alcohol-water solution. Head capsule width (Fig. 1) was measured using a dissecting scope (80X magnification) outfitted with a measuring grid.

Data for the three years (2063 specimens) were combined and grouped in classes of increments of 20 µm width sizes and the frequency of larvae within each grouping was graphed as a histogram.

Assuming a normal distribution of head capsule widths, multiple nonlinear Gaussian curve regressions were applied to the frequency histogram as described in Hammack *et al.* (2003).

Because 2007 and 2008, dry and wet early growing seasons, respectively, were quite different during the period of larval activity, we compared the data from these two years to better understand the effects of different soil moisture levels on larval body size. Data were analyzed using the Student t test.

Results and Discussion

The frequency distribution of head capsule widths showed three distinct groupings that were interpreted to represent the frequency of the head capsule widths of the three WCR larval instars (Fig. 2). Multiple normal Gaussian nonlinear regressions of the frequencies showed a good fit of the data, as also reported by Hammack *et al*., (2003), for all the three larval instars (Table 1).

Center and Standard Error (SE) of the fitted curves were 227 ± 3 µm, 353 ± 6 µm, and 519 ± 3 µm, compared to the grouping mean values of 225, 350 and 524 µm for the first, second and third instars, respectively.

The comparison of these data (Table 2) with those reported by George and Hintz (1966) and Hammack *et al.* (2003), showed larger head capsule widths of the larvae collected in irrigated fields of Northern Italy, suggesting that the good soil moisture provided by these fields and subsequent optimal plant development and nutrition have a positive influence on increasing WCR larval size.

To confirm our hypothesis that good soil moisture and subsequent optimal plant development and nutrition have a positive influence

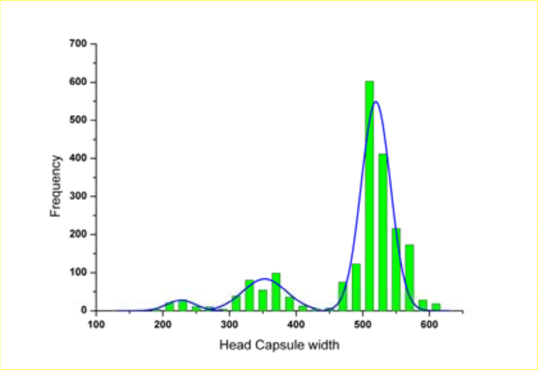


Fig.2: Frequencies of head capsule widths observed for WCR larvae collected irrigated maize fields of Northern Italy in the years 2006, 2007 and 2008 (2063 items).

Table 1: Parameters of the three fitted normal Gaussian curves.

	Center±SE	R^2	Lower limit (95%)	Upper limit (95%)
First-instar	227.14±3.01	0.88	219.77	234.51
Second-instar	353.73±5.98	0.79	338.09	367.35
Third-instar	519.51±3.09	0.88	512.39	526.64

Table 2: Mean of WCR larval head capsule widths observed in Northern Italy compared to other published data.

	Northern Italy (2006-2008)	George and Hintz (1966)	Hammack *et al.* (2003)
First-instar	225.05±3.02	200	216±1
Second-instar	350.36±1.49	325	332±1
Third-instar	524.11±0.74	500	501±1

on increasing WCR larval size, we compared first, second and third WCR larval head capsule widths from 2007 and 2008, dry and wet early growing seasons, respectively. For both the second and third instars, the mean value for larval head capsule width was significantly higher in 2008 than in 2007 (Table 3), thus supporting the positive effect of soil moisture on plant development and nutrition and WCR larval size.

Table 3: Mean comparison of WCR larval head capsule widths observed in 2007 and 2008.

	2007 (dry)	2008 (wet)	Sig. (t-test)
First-instar	210.00±5.93	227.30±0.46	n.s.
Second-instar	340.68±5.07	372.12±4.09	**
Third-instar	514.28±1.54	536.62±3.20	**

Conclusions

Head capsule width represents a reliable indicator of WCR larval instar stage. Nevertheless, different environmental conditions can influence larval development and size. The higher values for head capsule width observed in irrigated fields in northern Italy compared to those reported by authors of similar studies, but in non-irrigated fields, suggests that good soil moisture provided by irrigation and subsequent optimum plant development and nutrition has a positive influence on WCR larval growth. This was confirmed for second and third instar larvae by comparison of larval head widths in a wet year (2008) to a dry year (2007) with significantly higher values measured in 2008.

Bibliography

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