INFLUENCE OF ARTIFICIAL INFESTATION WITH WESTERN CORN ROOTWORM EGGS ON MAIZE MORPHOLOGY

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Abstract: A field experiment was carried out in Bečej (Serbia) during 2014 with Serbian maize cultivar NS-640. In experimental field, 96 plants were selected, marked, and arranged in 48 pairs. In each pair, one plant was artificially infested in root zone with 4 mL of *Diabrotica v.* sp. *virgifera* eggs 0.125% agar suspension (D plants). The maximum measured height on D (infested) and C (control) plants was 295 cm and 320 cm, respectively. The maximum measured diameter on D plants was 27.93 mm and on C plants was 32.13 mm respectively. The maximum recorded number of leaves was 15 on both categories. Statistical analysis shows that differences between plant diameters and the number of leaves between D and C plants are significant.

Key words: WCR, artificial infestation, maize, morphology

Introduction

Western corn rootworm (WCR) *Diabrotica virgifera* sp. *virgifera* Le Conte (Coleoptera, Chrysomelidae) is an insect species native to America. In Europe, WCR was first detected in the early nineties in Serbia (Bača, 1993). WCR imago spreads up to 100 km per year (MacLeod et al., 2004; Baufeld, 2003). Today WCR is economically very important pest of European maize fields (EPPO, 2017).

It is an oligophagous, univoltine pest and it leaves serious consequences on maize roots, above-ground parts and maize yields (Bača, 1993; James et al., 2005; Hummel et al., 2008; Ciobanu et al., 2009). Beside maize, WCR can feed on more than 20 plants from fam. Poaceae. However, WCR completes development and survival only on the maize, which represents reproductive WCR host plant (Clark and Hibbard, 2004).

The most important damages on maize are caused by WCR larvae (Ciobanu et al., 2009; Wesseler and Fall, 2010). By feeding on nodal and lateral roots, WCR larvae damage the entire root system (Chiang, 1973; Kahler et al., 1985; Gavlovski et al., 1992), which leads to inability of maize to uptake water and nutrients (Riedell, 1997; Gray, 2009). Larval attack causes plant lodging, a symptom known as "goose neck", only characteristic for WCR presence (Wesseler and Fall, 2010).

Plant lodging cusses mechanical (inability to harvest maize during mechanical harvesting) and physiological (due to inability of the injured roots to uptake water and nutrients) losses (Tollefson, 2007; Dun et al., 2010).

Maize monoculture leads to serious plant damages and increase of WCR population in the fields (Sivcev et al., 2009). WCR larvae presence in maize monoculture can cause

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increased plant lodging, up to 75% (Čamprag et al., 1998; Bača et al., 1998). Yield losses also represent the results of the plant lodging (Spike and Tollefson, 1991). In the conditions of WCR eggs artificial infestation at different levels Chiang et al. (1980) reported yield losses ranging from 2 to 50%. Yield losses can be 10 to 40% and even 90% in extreme cases (McBride, 1972; Spike and Tollefson, 1991).

The aim of this research was to examine the impact of WCR larvae under condition of artificial eggs infestation on maize morphology i.e. leaf number, plant height and stem diameter.

Material and method

The field experiment was carried out in Bečej, province of Vojvodina, Northern Serbia. It was performed from June 2nd until the September 19th, 2014, with Serbian maize cultivar NS 640. The chosen field for experiment represents the field with low natural WCR infestation.

During the experiment, 96 maize plants were selected, labeled and arranged into pairs. The plants were sawn in two rows with 1 m space between labeled plants. In each pair, one plant was artificially infested in root zone with 4 mL of WCR eggs 0.125% agar suspension (D plants). One mL of suspension contained 136 WCR eggs. The other plant from the pair was the control plant, marked with C. The same amount of distilled water (4 mL) was injected in the root zone of C plant.

After the artificial infestation, field experiment was inspected every week for four months. Inspections of plants included the measurement of heights, stem diameters and counting the number of leaves. The measurements of plant height was made using simple meter, while stem diameter was measured using a ± 0.05 mm precision Caliper, Pro-Max 67 IP Sylvac System.

The differences between the heights of stem diameter and the number of leaves among D and C plants were analyzed using Two-sample t-test (Test for equality of sample variances) Gen Stat 12Th edition.

Results and discussion

Plant heights recorded during the last observation are presented in Figure 1. The maximum measured height on D plants was 295 cm and it was only one plant. The minimum height was 210 cm, and it was recorded on four D plants. The biggest number of D plants (12 D plants) was with registered height of 280 cm. On the other hand, on C plants only one plant was with maximum measured height (320 cm). The largest number of C plants (24 C plants) had height more then 280 cm, while the smallest measured height was 210 cm (two C plants).

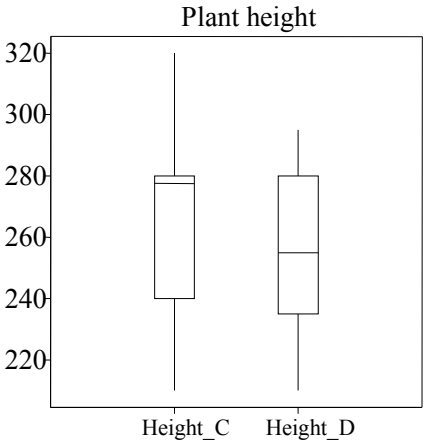

Figure 1. Heights of D and C plants

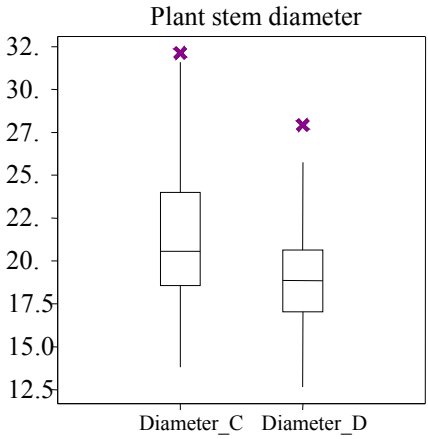

Figure 2. Stem diameter of D and C plants

Values of plant stem diameter recorded during the last observation are presented in Figure 2. A diameter of D plants ranged between 12.66 mm and 27.93 mm, while of C plants ranged from 13.83 mm to 32.13 mm. The largest number of D plants (20 D plants) was in the range of 17.04 – 19.87 mm. On the other hand, the largest number of C plants (23 C plants) was in the range 20.6 – 28.57 mm (Figure 2).

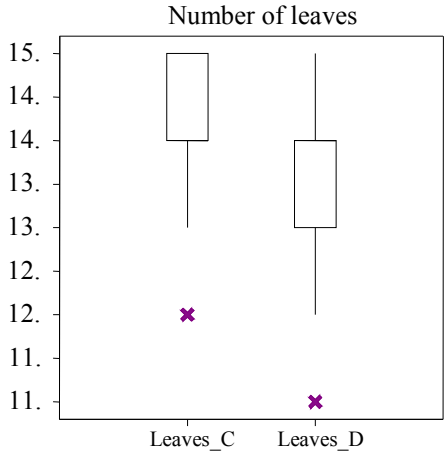

Figure 3. Number of leaves on D and C plants

The number of leaves on D and C plants recorded during the last observation are presented in Figure 3. The number of maize plants with the highest number of leaves (15) on D and C plants was 10 and 22, respectively. The number of D and C plants with

14 leaves were the same in both categories (23 maize plants). The total number of plants with 13 leaves on D and C plants was 13 and two, respectively. During the last inspection in category of infested plants, one D plant was recorded with 11 leaves, while among control plants, one C plant was recorded with 12 leaves (Figure 3).

Statistical analysis shows that there are highly significant differences in plant diameters and number of leaves between D and C plants ($F=1.39$; 1.63, $p< 0.001$). According to the statistical analysis, there are no differences in heights between D and C plants ($F=1.33$ ns, $p<0.05$) (Table 1).

Table 1. Differences between height, plant diameter, and number of leaves of WCR infested plants and control plants

Year	Observation	Means values		F	Sig.
		D plants	C plants		
2014	Height (cm)	253.4 ± 24.813	264.1 ± 28.596	1.33	0.053ns
	Stem diameter (mm)	19.01 ± 3.445	21.19 ± 4.062	1.39	0.007**
	Number of leaves	13.83 ±0.859	14.38 ±0.672	1.63	0.001**

During the research in conditions of artificial WCR eggs infestation, Popović (2017) did not found statistically significant differences in plant height and plant diameter between artificially infested and uninfested maize plants. In the research of Tanasković et al. (2016), WCR eggs infestation caused 95.7% damages on infested plants with different rate of root damages. In conditions of artificial WCR eggs infestation in 2015, Tanasković et al. (2017) reported significant differences in the level of root damages and root mass between infested and uninfested (control) maize.

Artificial infestation with WCR eggs in the research of Popović et al. (2017) shows that there were no differences in the root damages and root mass between infested and uninfested plants during 2016. The differences between root damages on infested and uninfested plants in 2017 were higher than differences in their root mass (Popović et al., 2017). These results are completely different then the results recorded during this research.

The available literature reports similar research of artificial WCR eggs infestation (different number of eggs), but points out consequences to the population density, size, longevity, and fecundity of emerged females. There are no available data of the influence on plant morphology parameters.

Artificially infested maize roots with WCR larvae in the research of Gavlovski et al., (1992) did not differ in fresh or dry weights or in plant heights. On the other hand, Riedell (1989) reported results of experiment with infestation with 150 second-instar WCR larvae. Obtained results indicate differences in plants height, ears length and width, shoot fresh weight, ear dry weight, and husk dry weight between infested and uninfested maize plants.

Conclusion

According to this research, artificial infestation in conditions of low natural infestation caused significant statistical differences in plant diameter and number of leaves between D and C plants while there were no differences between plant heights.

Ackowledgement

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