EFFECT OF DIFFERENT TILLAGE SYSTEMS ON POPULATIONS OF COMMON VOLES *(MICROTUS ARVALIS PALLAS, 1778)*

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Abstract: The cultivation of soil above other advantages has favorable effect in destroying pest shelters and disrupts their life cycles. The aim of this paper is to present the effect of different tillage systems on population of common voles (*Microtus arvalis* Pallas,1778). The experiment was done through three years in Baranya County in Croatia, on winter wheat in crop rotation after soybean. Eight different tillage systems: Conventional soil tillage by ploughing – CT; Diskharrowing – DH; Chiseling + diskharrowing – CH; No-tillage for both crops – NT; Diskharrowing for w. wheat and ploughing for soybean (year before) – CSDW; Ploughing for w. wheat and diskharrowing for soybean (year before) – CWDS; No-tillage for w. wheat and ploughing for soybean (year before) – CsNw; Ploughing for w. wheat and no-tillage for soybean (year before) – CwNs. Results showed statistically significant differences between tillage systems and years. The biggest number of burrows occurred in treatments where soil tillage was omitted in year before and where common voles remained from previous year. Based on all obtained results, it can be concluded that tillage system has great impact on presence of common voles, and continuously deep ploughing decrease their number significantly in comparison to treatments where deep ploughing is omitted, either in current year or year before.

Keywords: tillage systems, common voles

Introduction

Soil tillage, especially reduced tillage has been often object of research (Zugec et al., 1986; Birkas and Gyuricza, 2000; Jug et al., 2006). Impact of soil tillage had effect of nutritional status of plants (Jug et al., 2007a), yields (Jug et al., 2007b), pest and weed occurrence (Tolimir et al., 2006), aeration of the soil, and finally on general profit in agricultural production (Loncaric et al., 2007).

The cultivation of soil by using mouldboard plough has advantages in destroying pests and their shelters and disrupts their lifecycles. In agricultural production, at high population density the common voles may become the major agricultural pest (Jobsen, 1998).

The aim of this paper is to present the effect of different tillage systems on population of common voles through three years in crop rotation by counting the barrows.

Materials and methods

The field experiment

Field experiment was conducted in Baranya County, Croatia, at experimental field near Knezevo (N: 45°82′, E: 18°64′) for winter wheat (*Triticum aestivum* L.), cultivar Demetra, in crop rotation with soybean (*Glycine max* L.), cultivar Tisa, during three years (2003, 2004, 2005).

The main experimental set-up was a complete randomized block design in five replications, with eight tillage systems. Area of experimental field was divided into

basic experimental plots of 900 m^2 for each tillage treatment. Burrow made by common voles were counted 2 weeks after sowing in each year of investigation.

Soil tillage treatments

1. Conventional soil tillage by ploughing – CT
2. Diskharrowing – DH
3. Chiseling + diskharrowing – CH
4. No-tillage for both crops – NT
5. Diskharrowing for w. wheat and ploughing for soybean (year before) – CSDW
6. Ploughing for w. wheat and diskharrowing for soybean (year before) – CWDS
7. No-tillage for w. wheat and ploughing for soybean (year before) – CsNw
8. Ploughing for w. wheat and no-tillage for soybean (year before) – CwNs

CT) Conventional tillage includes ploughing up to 30 cm depth, followed by diskharrowing, sowing preparation and sowing with no-till driller John Deere 750A; DH) includes diskharrowing and sowing as for CT; CH) includes chiseling on up to 30 cm depth, followed by diskharrowing and sowing as for CT; NT) No-tillage sowing without any primary tillage operation. CSDW and CWDS are combinations of CT and DH, whereas CsNw and CwNs are combinations of CT and NT treatments.

Soil characteristics

The experimental site soil is classified as a calcareous chernozem on loess substrate. The soil analyses presented very favorable chemical properties (pH in H_2O = 8.1, pH in 1M KCl = 7.5; humus = 2.6%, $CaCO_3$ = 2.1%; AL-soluble P_2O_5 and K_2O = 18.7 and 28.4 mg $100g^{-1}$, respectively).

Weather characteristics

Weather characteristics were mainly specific in comparison with long-term means. For example, precipitation in the period April-July were lower for 116%, and mean air temperatures were higher for 2.5°C in 2003 (Table 1).

Table 1.: Precipitation and mean air-temperatures (the data of Knezevo - Brestovac Weather Bureau) 2002-2005 and long-term means (LTM: 1965-2005)

	2002	2003	2004	2005	LTM	2002	2003	2004	2005	LTM
	Precipitation (mm)					Mean air temperatures (°C)				
Humid period	182	222	332	384	266	4.8	3.5	4.3	3.8	4.5
April	64	9	119	54	49	11.4	11.2	12.0	11.5	11.1
May	86	33	77	55	58	18.8	20.0	14.9	17.0	16.5
June	49	19	114	88	88	21.7	24.5	19.5	20.4	19.7
July	61	61	41	168	68	23.8	22.8	21.9	21.4	21.2
August	111	23	52	155	54	21.5	24.7	21.6	19.7	20.9
September	63	34	43	82	55	15.9	16.4	15.9	17.5	16.4
Dry period	434	179	447	602	372	18.9	19.9	17.6	17.9	17.6

Results and discussion

Number of burrows made by common voles occurred in all three years of investigation is presented in Figure 1.

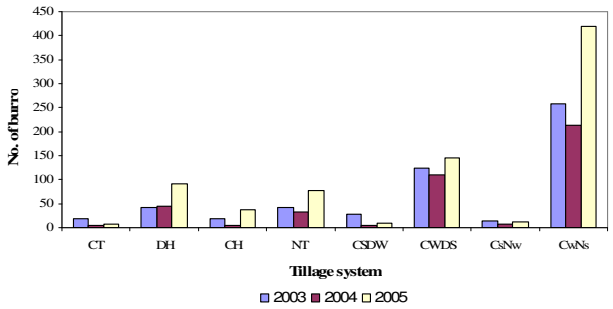

Figure 1. Number of burrow occurred in different tillage systems in period 2003-2005.

Deep tillage reduced the number of burrows. In Figure 1 is visible that treatment CwNs had the greatest number of burrows in all years of investigation, followed by CWDS. It is obvious that even if ploughing had been done in current year, the common voles remained from year before. On the contrary, treatments where deep ploughing had been undertaken in previous year (CT, CSDW, CsNw), the lowest number of burrows occurred.

In an analysis of variance combined across soil tillage systems and years, significant differences occurred among number of burrows (Table 2 and 3).

Table 2. Result of combined ANOVA

Source of variation	df	Number of burrows made by common voles
Tillage systems	7	**
Years	2	**

*P<0.05; **P<0.01

Table 3. Average values and LSD test of common voles burrows for all soil tillage systems and years.

Tillage system		Year	
CT	10a	2003	68a
DH	59 b	2004	53a
CH	20a	2005	100 b
NT	51 b		
CSDW	14a		
CWDS	126 c		
CsNw	11a		
CwNs	297 d		
LSD 0.05	21	20	
LSD 0.01	28	29	

a, b, c = average means labelled with the same letter are not significantly different at P<0.05 level

Statistical analyses showed the main point of this study which is importance of continuously deep soil tillage in order to decrease the number of burrows.
Tillage system may serve as one of variables to assess the outbreak risk of common voles together with landscape design (Dellatre et al., 1996) and other relevant factors.

Conclusions

In three years investigation at the area of Baranya County eight different tillage systems were tested to identify the influence of tillage on the number of burrows made by common voles. The conclusion is that the continuously deep ploughing has the most favourable effect at the number of burrows. It is important to stress out that one year of deep ploughing is not enough to destroy the common voles burrows and shelters.

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