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THE INFLUENCE OF SOIL MANAGEMENT ON SOIL WEED SEED BANK

Stationary field experiments with different soil tillage systems were conducted in 2003-2006 at the Lithuanian Institute of Agriculture in Dotnuva. Investigations to evaluate effects of soil tillage regime on weed seed bank and distribution in the soil layers were made after four years of experiment in autumn 2006. Total of 17 weed species were found in soil seed bank; 98 percent – annual dicotyledonous. The depth and intensity of soil tillage has an influence on amount of weed seeds and distribution in the soil seed bank. After four or more years with shallow tillage the amount of weed seeds in top layer (0-10 cm) of soil increased significantly. There were not found significant differences in amount and distribution of weed seed between reduced tillage and direct sowing treatments.

The interest in reduced soil tillage in Lithuania appeared during the last ten years. It was established, that shallow ploughing and rotottiling did not exert any negative effect on soil agrochemical and physical properties (Feiza at all., 2004), nonetheless abandonment of soil ploughing and using shallow loosening by a rotary cultivator in spring, compared with deep autumn ploughing, resulted in an increase in weed incidence in a barley crop by a 2.3-10.3 times (Bogužas, Kairytė, 2003). Weeds are problem in most cropping systems and their control is essential for successful crop production. The goal of weed control is not only to preserve plants from yield loss, but also to minimize weed seed reserve in the soil.

The weed seed bank develops in two ways: it increases in amount from those weed seeds which mature weed plants spread by wind and running water into soil, and decreases by that amount which germinates or is lost due to activity of soil fauna. Knowledge of the weed seed bank is very important because it provides evidence of past field management and may allow forecasts on future weed problems (Forcella, 1992).

Changes in the soil weed seed reserve depend on soil tillage, crop rotation, and implements of weed control. (Barberi, Casio 2001, Menalled et all, 2001,

Benoit et all, 2003, Riemens et all., 2007). Weed community composition in the surface (0-15 cm) layer seems more influenced by tillage system than by crop rotation (Barberi, Cascio, 2001).

Material and Methods. Stationary field experiments were conducted in 2003-2006 at the Lithuanian Institute of Agriculture on a cultivated field of Central Lithuania (55°23`50``N and 23°51`40``E). The sequence of crops in rotation following: 1) field pea 2) winter wheat 3) spring wheat 4) spring barley. Soil was prepared according trial design:

1. Stubble cultivation to 10-12 cm depth; mould board plough to 22-23 cm depth; tillage with precision seedbed cultivator before sowing to 4-5 cm depth, sowing with disc coulters drill «Saxonia» (CT);

2. Stubble cultivation to 10-12 cm depth; tillage with precision seedbed cultivator before sowing to 4-5 cm depth, sowing with disc coulters drill «Saxonia»(RT1);

3. Stubble cultivation to 10-12 cm depth; sowing with disc sowing aggregate DS-3 (RT2); non-selective herbicide (glyphosate) spray applied after harvesting.

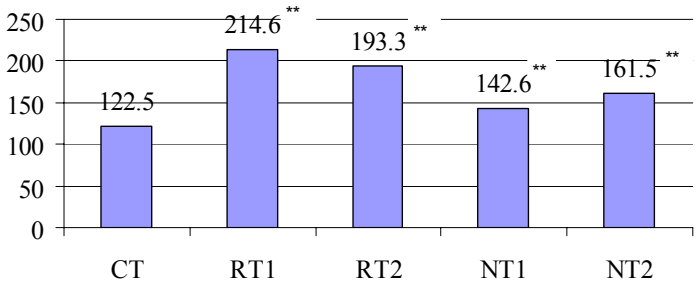
4. No tillage; sowing with disc sowing aggregate DS-3 (NT1), non-selective herbicide (glyphosate) spray applied after harvesting.

5. No tillage; direct sowing with sowing aggregate 'Amazone' with rotary cultivator (NT2), non-selective herbicide (glyphosate) spray applied after harvesting.

Field experiment was arranged as complete randomized block design in four replicates. Gross plot size was 10 x 20 m and net harvested plot size – 2.3 x 10 m. Soil Endocalcari-Endohypogleyic Cambisols, sandy loam. Soil samples to determine soil seed bank were taken in year 2006 in the beginning of growing season of cereals. Two soil cores of 20 cm depth (0-5, 5-10, 10-20 cm) were randomly taken from each plot, using 5 cm diameter steel probe. Consequently, a total 240 soil samples were collected for weed seed bank analysis. Samples were stored at 4°C in the dark until processing (Lambelet-Haueter, 1984, Barberi, Cascio, 2001). Weed seeds were counted and identified using a binocular with 8x magnification. Seed viability was determined by «destructive crushing» of seed using forceps (Rahman at all, 1995). All data were analyzed using ANOVA from package SELEKCIJA (Dospechov, 1985, Brewbaker, 1995; Tarakanovas, Raudonius, 2003). To achieve homogeneity of variance, the weed seeds data were (log+2) transformed.

Results and discussion. A total of 17 species was recorded in the seed bank, 98 percent of them were annuals. Major weed species included *Chenopodium album* (L.), *Lamium purpureum* (L.), and *Stellaria media* (L.),

Vill. These species together accounted for 82.4-84 % of total weed seeds number in seed bank, regardless of the experiment treatment. The amount of weed seeds in the upper soil layer (0-10 cm) was significantly at $P > 0.01$ higher in the treatments with shallow tillage or with direct sowing (fig. 1).



CT – conventional tillage, 20-25 cm depth, RT1 – reduced tillage 10-12 cm depth, Disc drill – machine, RT2 – reduced tillage 10-12 cm depth, glyphosate treatment NT1 – glyphosate, no- till, disc drill – machine, NT2 – glyphosate, no- till, rotary drill – machine.

Fig. 1. Mean seed bank density (seeds kg^{-1} soil) found at soil depth of 0-10 as affected by tillage regime

The data are in coincidence with results of investigations of other researchers (Bogužas, Kairyte, 2003). At the soil layer of 10-20 cm there were found significant difference only in treatment RT1 – reduced soil tillage at 10-12 cm depth and disc drill machine (fig. 2).

The reason for difference between amount of weed seed in soil in treatment of conventional tillage and reduced tillage might evidenced consequently short duration of experiment. Barberi, Cascio (2001) noted that negative effect is more likely to arise in no tillage systems, given their significantly higher weed seedling density in the surface layer. In our experiments was did not found any significant differences in amount and distribution of weed seeds between reduced tillage and no – tillage treatments.

Conclusions. 1. The depth and intensity of soil tillage has an influence on amount of weed seeds and distribution in the soil seed bank.

2. After four years with shallow tillage the amount of weed seeds in surface layer (0-10 cm) of soil increased significantly.

3. There were not found significant differences in amount and distribution of weed seed between reduced tillage and direct sowing treatments.

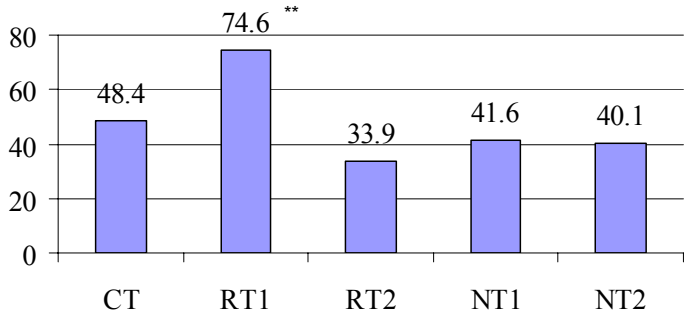


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Fig. 2. Mean seed bank density (seeds kg^{-1} soil) found at soil depth of 10-20 as affected by tillage regime

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