Cereal crop productivity in crop rotation under different management intensity

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Valinava long-term experiment (55.22° N, 23.51° E) established in 1991 at the Institute of Agriculture, Lithuanian Research Centre for Agriculture and Forestry and is managed by the staff of the Department of Plant Nutrition and Agroecology. The experiment is situated on the terrace of the Dotnuvele River and occupies 4.4 ha. Prevailing soil is sandy loam and light loam *Endocalcari – Endohypogleyic Cambisol* (*CMg-p-w-can*). Carbonates depth is 40-60 cm. Soil pH_{KCl}: 7.2, total N content: 0.18 %; available phosphorus (P_{AL}): 66 mg kg^{-1}, available potassium (K_{AL}): 99 mg kg^{-1}. Crops are grown in 4-course crop rotation: spring barley (*Hordeum vulgare* L.), red clover (*Trifolium pratense, L.)*, winter wheat (*Triticum aestivum, L.*) and spring oilseed rape (*Brassica napus, L.*). Crops are grown under three levels of management intensity: a) conventional, b) integrated and c) organic, each replicated twice in space, occupies approximately 786 m^2 (32.2 m long, and 24.4 wide) and contains 6 sub-plots of 44 m^2 (20 m long, 2.2 m wide). Cereals in conventional and integrated agro-ecosystems were applied with herbicides, fungicides and insecticides and in organic system were grown without application of industrial fertilizers and plant protection measures. In conventional system, winter wheat grown for a target yield of 6 – 7 t ha^{-1}, and spring barley for 5 t ha^{-1}.

In this experiment measuring of drainage water runoff amount, ground water table levels, and crop yield and biomass production are performed. For soil moisture monitoring sensors, irrometers 'Watermarkt' are used. Experimental area includes plots with perennial grasses thus providing possibility to observe the changes in plant species. For indication of nitrogen and water deficit in cereal crops simulation with model DSSAT v4.0.2.0 is performed. These studies showed that water stress simulated by the DSSAT v4.0.2.0 model correlated relatively well with actual readings of irrometers. The correlation coefficient of three years' data in spring barley was 0.85, $p<0.05$, and in winter wheat – $r = 0.80$, $p<0.05$. The growing period of crops during the experimental years was warmer than the climate normal, with contrasting rainfall. Drainage water runoff measurements show that substantial part of precipitation was lost during the non-growth period resulting in lower levels of ground water table and temporary moisture deficiency in crops. Although soil moisture measurements and simulation indicated water stress in late spring or early summer in all experimental years, significant yield losses occurred only in a few cases. On average, the yield of winter wheat grown without fertilizers and pesticides was 67%, spring barley 70%, spring rape 47% and red clover 124% of that under conventional management.

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