

15-17 March 2016, Berlin, Germany

iCROP M<sub>2016</sub>



MACSUR and AgMIP jointly present the International Crop Modelling Symposium  
**Crop Modelling for Agriculture and Food Security  
under Global Change**



**ABSTRACTS**

## **Comparative model analysis of various sparing measures intended to crop production sustainability by “APEX-AGROTOOL” simulation system**

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### **Introduction**

Maintaining or even increasing the fertility of agricultural landscapes during their active agricultural use is one of the most important scientific problems in theoretical agricultural science. In recent years scientific community reinforced the efforts to achieve agro-landscape environmental sustainability instead of maximum productivity. It becomes especially important under global changes expected. The paper presents author efforts to develop and improve the integrated system of crop simulation “APEX-AGROTOOL” for analysis and investigation of various sparing measures intended to crop production sustainability.

### **Materials and Methods**

AGROTOOL is a mechanistic crop model developed to estimate the agrometeorological crop state, to forecast crop yield, as well as to support agricultural decision making and analyze the sowing, irrigation, fertilization and harvesting management (Poluektov et al., 2002). In turn, APEX (Automation of Polivariant EXperiments) is a software system developed for design and performing of multi-factor computer experiments with arbitrary dynamic crop models. It encapsulates two basic functionalities: versatile repository of external crop model descriptors and generic environment for model polyvariant analysis. The latter means the designing and preparation of multivariate computer case study, performing the model runs in batch mode and applying advanced procedures of statistical treatments for results obtained (Medvedev and Topaj, 2011).

AGROTOOL as a comprehensive ecologically oriented crop model (Badenko et al., 2014) coupled with APEX which supports cyclical scheme of model computation (taking into account crop rotation) became an effective tool of analyzing long-term trends of indicators of soil fertility and other parameters of the environmental sustainability of agricultural landscapes. “APEX-AGROTOOL” integrated simulation system allows the conventional agro-technics as well as additional sparing measures intended to crop production sustainability to be investigated (Medvedev et al., 2015).

### Results and Discussion

Imitation complex "APEX-AGROTOOL" was used to perform a series of model experiments in order to obtain estimates of the relative effectiveness of different measures of prolonged action, which are aimed to improving the ecological stability of the agricultural landscape and conservation of soil fertility, taking into account the possible climate change as a background. Numerical experiments have been designed for several alternative schemes of different types of crop rotation: food, feed and energy (spring and winter cereals, potatoes, canola, corn for silage) in a continuous cycle of vegetation seasons. The following methods were considered as measures of the maintaining the main indicators of the ecological state of the agro-ecosystem within the boundaries of its stable functioning and soil fertility reproduction:

- a) Selection of the optimal sequence in crop rotation from a limited crop set, i.e. the planning the schemes of crop change order using the methods of combinatorial optimization;
- b) Transition to the sparing harvesting technologies for avoiding unproductive removing of aboveground crop residues having no economic value (straw, etc.)
- c) Cultivation of the intermediate "green manure" catch crops during non-vegetation period of the main crop rotation for soil carbon sequestration; furthermore usage the legumes for this purpose can increase the level of labile soil nitrogen through symbiotic nitrogen fixation process;
- d) Extensive usage of organic fertilizer in the form of cattle manure.

The results of a comparative analysis of the measures considered in terms of guaranteed productivity and sustainability of agro-ecosystems are presented.

### Conclusions

The results obtained prove, that total abilities of developed integrated environment «APEX-AGROTOOL» cover completely the challenges of mid-term forecasting of agro-landscape sustainability and, therefore, it can be effectively used as a tool of model-oriented long-term analysis of different crop rotation practices in land use.

### References

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