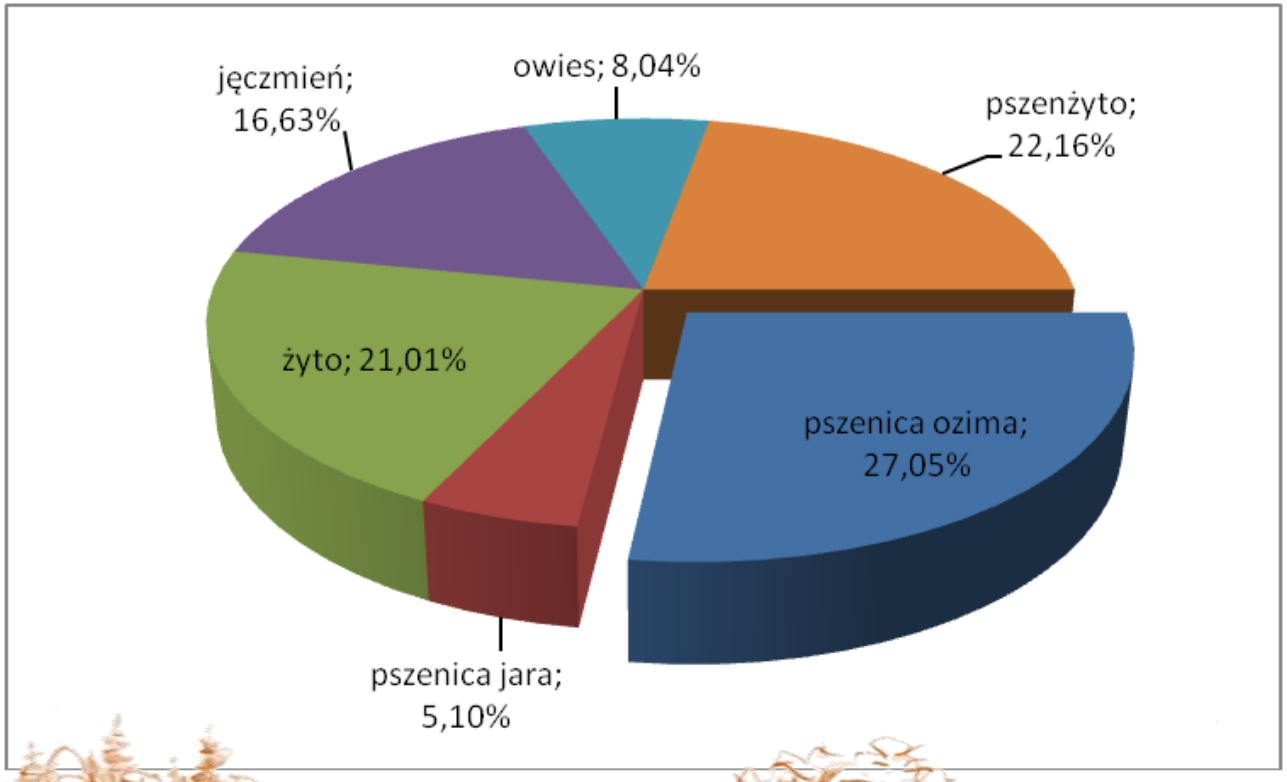
UNIVERSITY OF TECHNOLOGY AND LIFE SCIENCE
in Bydgoszcz, Poland

Dorota Walczak

Effect of post-harvest cultivation using straw and bio-compounds in monoculture of winter wheat in aspect of wheat productiveness, soil quality and herbivorous insects

Wheat in Poland

Cereals are cultivated on **7859 kha,** in which 22,9% is covered by wheat.



Winter wheat monoculture in Poland

- Monoculture effects on the plant as well as soil properties.
- Reduces the mineral elements content of the soil.
- Causes bacterial and fungal infections in the plant.
- Speeds up the soil degradation.

Winter wheat has the strongest reaction of any grain crops to monoculture cultivation; **crop yield is reduced.**

Soil degradation – main causes

- Monoculture cultivation
- Short rotation change
- Reduction in farming biodiversity

Soil degradation - symptoms

- Negative changes include:
  - macro- and microelement content,
  - physical and biological properties,
  - increased weed infestation and associated proliferation of other harmful species
- Changes in quantity, spectrum of species and activity of organisms responsible for metabolisation and soil fertility

Methods for improving soil conditions

- Using biopreparations – microorganism application,
- Introducing straw and other cultivation remains into the soil.

EM – Effective Microorganisms (naturally active)

This is a liquid organic fertiliser with soil bacteria. It contains organic forms of nitrogen, a concentrated dose of Effective Microogranisms™ and *Azotobacter.*

EM

Recommandation

- Soil structure improvement,
- Faster decomposition of cultivation remains – straw, catch crops, manure etc.,
-Slows down rotting and reduces the spread of soil disease
-Binds free nitrogen from the air,
-Intensifies root development
-Enhances fertiliser absorption,
-Improves plant health and condition

UG$_{max}$

UGmax is a natural concentrate that contains microorganisms as well as micro- and macroelements

UG_{max}

UG_{max} is used for:

- Replacing nitrogen to speed up decomposition of cultivation remains – straw, catch crops, manure etc. ,
- Rebuilding organic matter (humus) – main factor in soil fertility,
- Extracting nutrients from previously unavailable sources

Biopreparations effect:

- soil conditions,
- winter wheat crop yield and quality
- herbivorous insect populations

Effects are dependent on the use of straw and methods of biopreparation application

Hypothesis

The expected reaction of the winter wheat to the various treatments will have the effects on wheat in five aspects:

- productivity,
- soil condition,
- herbivorous insects fluctuation,
- energy balance,
- economic results.

Production effect

- plant density after initial growth in the phase BBCH 11-12,
- evaluation of plant nitrogen content based on the SPAD index,
- density of heads before harvest - BBCH 89,
- stem length,
- head length and the number of grains in head,
- grain yield,
- mass of a thousand grains (WTG),

Soil condition effect

- analysis of spectrum and quantity of harmful weeds before herbicides application,
- during the growing season the following factors are measured:

  - density and soil moisture at stages:
  - in the third decade of September, before winter wheat sowing,
  - after growth start in spring (winter wheat) and before planting of the spring wheat,
  - after harvest of winter and spring wheat,
  - thickness of the soil - at the same time as soil moisture measurements,
  - soil respiration – before tillage

Energy effect

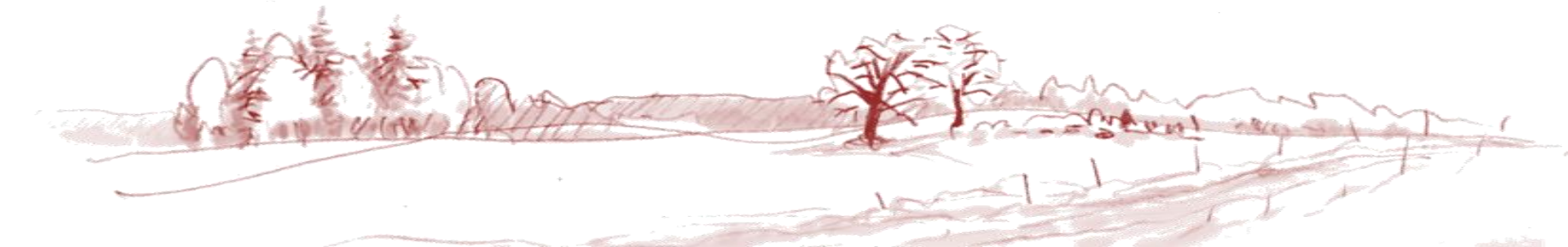
The energy effect of straw and biopreparation application methods is estimated every year as the difference between the crop yield of wheat and the energy used on individual plots as well as the control plot. Energy value of crops and recorded expenditures of the experiment will be estimated according to norms and standards.

Economic effect

The estimated economic effect is the direct surplus calculated as the product of the crop yield and its unit price increased by grant money and reduced by direct costs.

Purpose of research

The scientific purpose of the projected study is determining the effects of different methods of applying straw and biopreparations on winter wheat productivity, specific soil properties and herbivorous insect populations in short term monocultures.



MATERIALS AND METHODS:

Experiment set-up

- duration: 2010-2013
- static experiment – Mochełko Research Station
- two factors: straw, biopreparations,
- winter wheat was previously cultivated

Objects of the experiment:

- soil properties,
- winter wheat productivity
- population of herbivorious insects

Factor A - straw introduction:

1. fragmented straw + nitrogen +postharvest cultivation + ploughing cultivation,
2. fragmented straw +postharvest cultivation +ploughing cultivation,
3. postharvest cultivation+ ploughing cultivation,

Factor B - applying biopreparations:

1. EM-1 into the soil* * in the period of postharvest cultivation,
2. EM-1 into the soil (in the period of postharvest cultivation) and on the leaf surface (with spring after growth begins)
3. UGmax into the soil * * * in the period of postharvest cultivation
4. Ugmax into the soil (in the period of postharvest cultivation) and on the leaf surface(with spring after growth begins).
5. without biopreparations (control)

Layout of experimental plots split-block

	EM with post-harvest cultivator	EM with post-harvest cultivator + on the leaf surface in the spring	UG_{max} with post-harvest cultivator (0,9)	Ugmax with post-harvest cultivator (0,6) + on the leaf surface in the spring (0,3)	CONTROL
Straw + cultivator + ploughing					
Straw + N + cultivator + ploughing					
cultivator + ploughing					

The strips are the treatments of Factor A

RESULTS

Table 1. *Wheat grain yield depending on the way of postharvest cultivation using straw and applications of microorganism preparations in 2012*

POSTHARVEST CULTIVATION USING STRAW (A)	APPLICATIONS OF PREPARATIONS CONTAINING MICRO-ORGANISMS (B)					Average for A
	control	EM 1x	EM 2x	$UG_{max.}$ 1x	$UG_{max.}$ 2x	
cultivator + ploughing	3,29	3,64	3,89	3,66	4,06	**3,71**
Straw +cultivator +ploughing	2,61	2,92	3,16	2,68	2,74	**2,82**
Straw+N+cultivator+ploughing	3,47	3,42	3,84	3,46	3,76	**3,59**
Average for B	**3,12**	**3,33**	**3,63**	**3,27**	**3,52**	**3,37**

$NIR_{p=0,05}$ dla: A = 0,768 B = 0,361 A/B = n.i. B/A = n.i.

RESULTS

Table 2. *The number [units per m^2] of wild weeds depending on the way of developing the stubble field and the application of biopreparations - autumn 2012*

POSTHARVEST CULTIVATION USING STRAW (A)	APPLICATIONS OF PREPARATIONS CONTAINING MICRO-ORGANISMS (B)					Average for A
	Control	EM 1x	EM 2x	$UG_{max.}$ 1x	$UG_{max.}$ 2x	
cultivator + ploughing	58	55	50	45	51	51
Straw +cultivator +ploughing	70	70	71	74	73	72
Straw+N+cultivator+ploughing	69	69	67	71	63	68
Average for B	66	65	62	63	62	64

$NIR_{p=0,05}$ dla: A = 12,2 B = n.i. A/B = n.i. B/A = n.i.

RESULTS

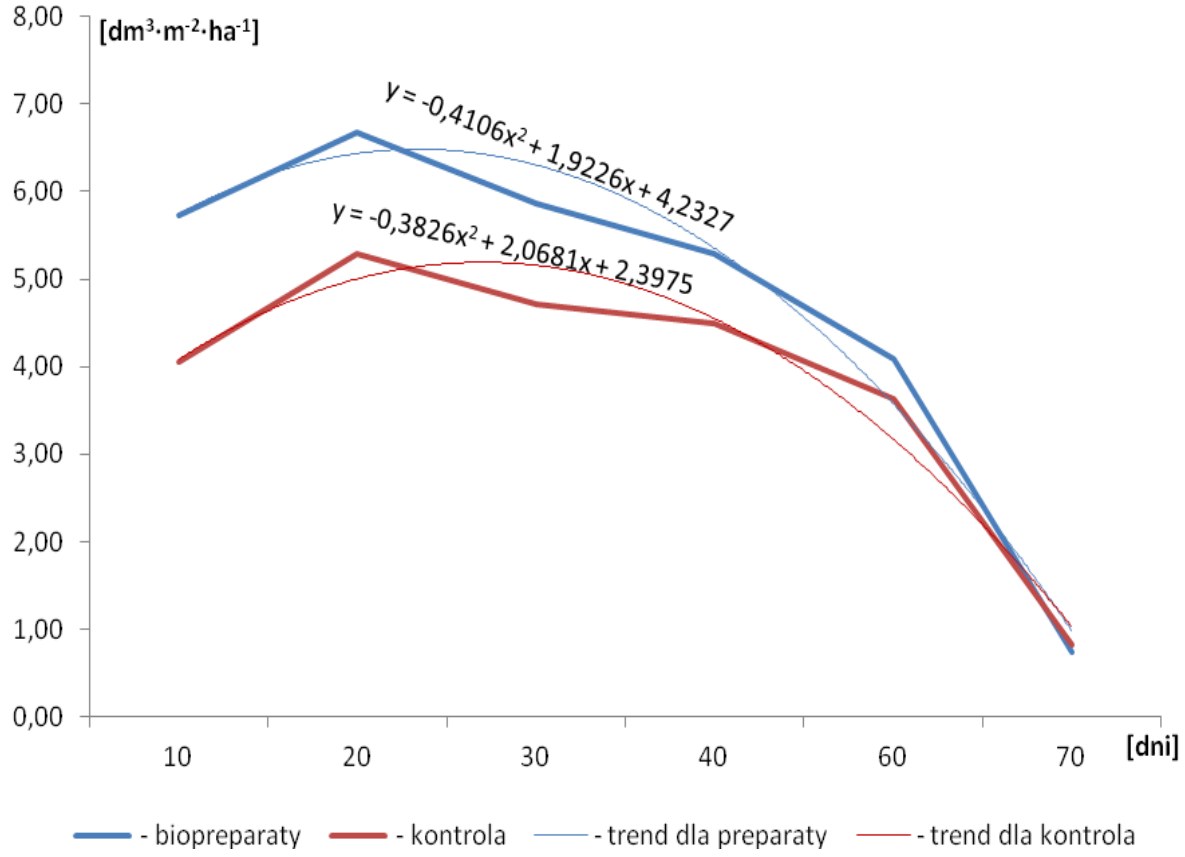


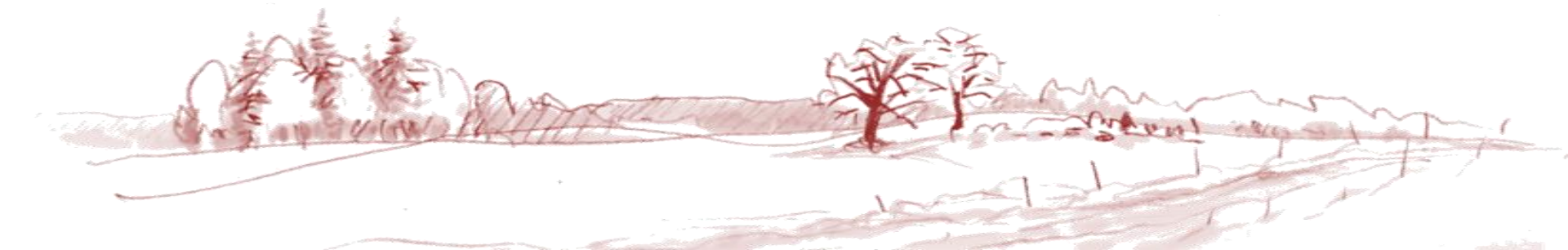
Fig. 1. *Carbon dioxide emission from the soil after biopreparation application with regard to the amount of days passed from their application.*

RESULTS

Table 3. *Value of the SPAD indicator in wheat, depending on methods of developing the stubble field and application of biopreparations in the spring of 2012.*

POSTHARVEST CULTIVATION USING STRAW (A)	APPLICATIONS OF PREPARATIONS CONTAINING MICRO-ORGANISMS (B)					Average for A
	Control	EM 1x	EM 2x	$UG_{max.}$ 1x	$UG_{max.}$ 2x	
cultivator + ploughing	640	647	612	627	663	638
Straw +cultivator +ploughing	**498**	609	621	637	667	606
Straw+N+cultivator+ploughing	589	638	651	663	**681**	649
Average for B	**576**	631	628	642	**670**	629

$NIR_{p=0,05}$ dla: **A = n.i.** **B = 11,1** **A/B = 101,3** **B/A = 30,6**

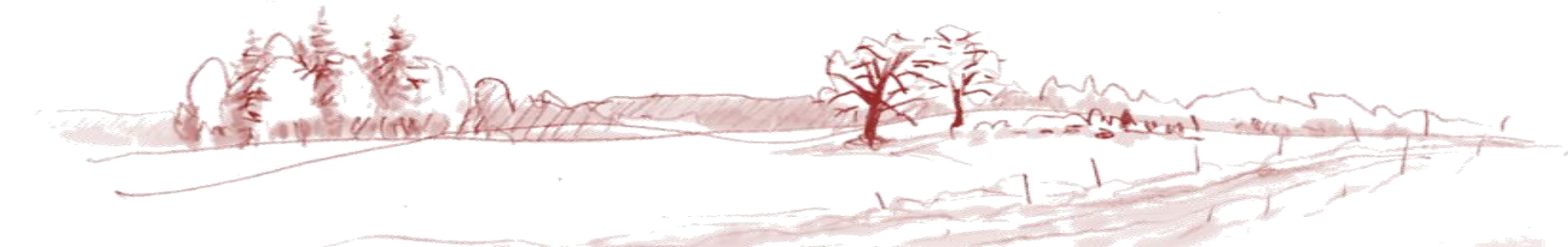


RESULTS

Table 4. *Average soil thickness [kN·cm^{-2}] in the 0-25cm layer from three autumn measurements, depending on the way of developing the stubble field and the application of biopreparations - in autumn 2012.*

POSTHARVEST CULTIVATION USING STRAW (A)	APPLICATIONS OF PREPARATIONS CONTAINING MICRO-ORGANISMS (B)					Average for A
	Kontrola	EM 1x	EM 2x	$UG_{max.}$ 1x	$UG_{max.}$ 2x	
cultivator + ploughing	0,56	0,47	0,38	0,48	0,40	**0,46**
Straw +cultivator +ploughing	0,43	0,35	0,34	0,36	0,36	0,37
Straw+N+cultivator+ploughing	0,36	0,32	0,32	0,32	0,29	**0,32**
Average for B	**0,45**	0,38	**0,35**	0,39	**0,35**	0,32

. **$NIR_{p=0,05}$ dla: A = 0,069 B = 0,076. A/B = n.i. B/A = n.i.**



Conclusions

- Introducing straw into the soil, especially with the addittion of nitrogen has a negative effect on winter wheat yield and increases the population of weeds.
- Biopreparation application showed a preliminary result of increase in yield, more intensive soil respiration and greater SPAD value.
- Experimental results may be caused by extreme weather conditions (large amount of snow and low temperatures) at the beginning of 2011-2012 vegetation season. The observed trends can be confirmed by the third year results.

Thanks you for Your attention