"Effect of Monoculture and crop rotation (Five- field courses) on the number of physiological groups of microorganisms in soil''

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Abstract *:* Agricultural management practices such as crop rotation, fertilizer and pesticide addition, nutrient sources, tillage, or drying-rewetting and grazing animals not only effects on diversity of microbial communities, also physical and chemical properties in the agricultural soils. As a consequence this effects on fertility of the soil, and quality and quantity of yielding of crop. Crop plants plays Very important function in the soil life. It is connected with root exudates (such as: vitamins, organic acids, phenol etc.), which go to the soil and changing some properties of soil. The northern and east-central regions of the Poland mainly offered poorer sandy soils suitable for rye and potatoes. So, the objects in this research were : Potato and Rye monoculture and five-fields courses, by in diverse fertilization (Ca, NPK and CaNPK, additionally in monoculture FYM).

The grain production in Poland is dominated by the highest yields came from wheat, rye, barley, and oats. Other major crops included potatoes, sugar beet, tobacco, fruits etc. In the east-central regions of Poland there are mainly the stagnant luvisols. These soils are very suitable for rye and potatoes. Our investigation was carried out on soils originated from Experimental Station of Faculty of Agriculture and Biology, Warsaw University of Life Sciences which is located in Skierniewice near Warsaw, Poland. The soil samples were collected once in May 2017 from rye and potatoes monoculture and 5-fields-courses. As control was used soil with fallow-land. Microbial properties of soils were evaluated on the base of the total number of microscopical fungi, copiotrophic and oligotrophic bacteria, also the most probable number of Azotobacter sp. and cellulolytic microorganisms using selective microbiological mediums. This thesis provide a better understanding of some microbiological aspects of agriculture soils (mainly monoculture and 5-fields courses) versus soil with fallow lands. It also emphasizes the importance use of the O:K (oligotrophs : copiotrophs) ratio as a good index of biological balance of soils and its applying for estimation quality of agricultural soils.

We are estimating the number of organisms on their selective mediums, and calculating dry matter of soil. In the result what was found was the soil from Rye Monoculture has the best oligotrophic : copiotrophic ratio, and, the number of *Azotobacter*, Fungi and aerobic cellulolytic bacteria was found mostly in Potato and Rye monocultured soil.

***Key words**: Monoculture, Crop rotation, Five field course, Exhaustion of soil, Sound soil, Tillage, root exudates*

I. INTRODUCTION:

Poland lies in the boundary zone of the European continental climate with rather dry summers and cold winters and the moderate climate influenced by the Atlantic Ocean. The area of agricultural land in Poland is about 16.2 million ha. The grain production in Polish agriculture is dominated by the highest yields came from wheat, rye, barley, and oats. Other major crops included potatoes, sugar beet, fodder crops, flax, hops, tobacco, and fruits. The northern and east-central regions of the Poland mainly offered poorer sandy soils suitable for rye and potatoes. Soil cultivation, fertilization, protection and soil pollution modify the physicochemical properties of soil and change its biological activity. Biological activity in soil,which includes all transformations of compounds and energy, can be measured by enzymatic activity. It depends both on soil type, depth of soil profile, vegetation cover,atmospheric conditions and the method of soil cultivation and fertilization, as well as on many other factors acting on the soil.

Investigation are conducted on the fields of long-term static fertilization experiments located at the Experimental Field in Skierniewice name of S. Górski. This experiment were started in 1922-1924 with using modern statistical methods. From the beginning until now the experiments are conducted in three or five replications. Surface of experimental fields, belonging to the

Station, is covered by soils of glacial origin, on ground moraine, type of these soils are stagnant luvisols. The substratum is a loamy sand (14–17% of silt) to a depth of about 40 cm, and a loam in deeper soil layers. The average content of total organic carbon in these soils is about 0,6–0,75%. Soils are classified as very good rye agricultural suitability complex. Soils of the Field I belong to IIIb (17%) and IVa (83%) quality classes.Mineral fertilizers, under all fertilization and crop rotation systems, are applied in the same doses. At the beginning of the experiments, fertilizers were applied in following doses: 30 kg N ha^{-1}, 30 kg P_2O_5 ha^{-1} and 30 kg K_2O ha^{-1}. Mineral fertilizers doses used at present time are given below (tab.) and they entered into force in the year 1976. There seems to be a clear relationship between soil microbial diversity, soil, and plant quality, as well as ecosystem sustainability and it is investigated if crop rotation and monoculture (from Rye and potato) benefits or harms the soil. The question now arises: can agricultural management practices bring about changes in the soil's physicochemical and biological properties—the ecosystem profile—of a Rye and potato field? This study was conducted to evaluate selected soil physiological groups of microbes, and microbial parameters under two different management systems, namely, Rye & potato monoculture and their rotation with 5 other plan.

II. BACKGROUND:

To investigate the physiological groups of *Azotobacter,* Cellulolytic bacteria, Fungi, Oligotrophic and Copiotrophic bacteria in different soil tillage on the basis of different fertilization, we have started this experiment. The following map shows our collected Different 15 kinds of soil.

In the following map it is showed the diagram of the field from where we have taken Different soil for our experiment. Where, (Table -1)

- Between C3 + 6 and DV is the soil of fallow land where no fertilizers are used
- The crop rotation land, in E (1a-1e), the crops harvested are - 5-field course (a-lupine variety Sonet, b- winter wheat variety Symfonia, c- rye variety Dańkowskie złote, d- potatoes variety Hermes (+ 30 t of FYM) , e- spring barley variety Stratus) **.** But we have taken the soil when potatoes variety hermes and Rye variety Dańkowskie złote were cultivated.

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- Land DV is the Potato monoculture and DVI For Rye monoculture. where Ca, CaNPK, NPK and FYM (FYM 30 t ha-1 every 4 years) were used
- Doses are given since 1976: 1,6 t CaO ha-1 every 5 years on E fields, 90 kg N ha-1, 26 kg P ha-1, 91 kg K ha-1

Below is given the area of Rye production in Poland from 2013-2016

Area of Rye sowing in Poland in the years 2013 – 2016, (000) HA					
2013	2014	2015	2016	Structure of sowing in 2015 (%)	Structure of sowing in 2016 (%)
1,173	885	700	900	9.8	12.2

Does microbes affects the annual production of Rye and potato?This answer could not be found because of lack of time of our experiments.

Oligotrophic organisms - An Oligotroph is an organism that can live in An environment that offers low levels of nutrients.

Features - Slow growth
Low rates of metabolism
Low population density
Oligotrophic environment includes deep oceanic sediments,
Caves, glacial and Polar ice, deep subsurface soil, aquifers,
Ocean water and leached soil. Example - cave dwelling olm, *Pelagibacter ubique*, Lichens with low metabolic rate

Copiotrophic organism - It tends to be found in environments which are rich in nutrients, particularly carbon and opposite to oligotrophs. They are found in sewage lagoon.

The following Table 1 gives a detailed proper explanation of the scheme of our research field.

Table 1. Scheme of the field

Field name	Crop rotation	Fertilization [1]
Between C3+6 field and DV	Control- fallow land	X
E 1a-1e	5-field course (a-lupine variety Sonet, b- winter wheat variety Symfonia, c- rye variety Dańkowskie złote, d- potatoes variety Hermes (+ 30 t of FYM) , e- spring barley variety Stratus)	Ca
		NPK
		Ca NPK
E 1a-1e	5-field course (a-lupine variety Sonet, b- winter wheat variety Symfonia, c- rye variety Dańkowskie złote, d- potatoes variety Hermes (+ 30 t of FYM) , e- spring barley variety Stratus)	Ca
		NPK
		Ca NPK
DV	Potato monoculture (potato variety Hermes)	Ca
		NPK
		Ca NPK
		FYM (30 t ha-

		1 every 4 years)
DVI	Rye monoculture (rye variety Dańkowskie złote)	Ca
		NPK
		Ca NPK
		FYM (30 t ha-1 every 4 years)
1)Doses since 1976: 1,6 t CaO ha-1 every 5 years on E fields, 90 kg N ha-1, 26 kg P ha-1, 91 kg K ha-1		

III. SCOPE & OBJECTIVES:

The experiment certainly has a good scope in future. There are chances to examine more soil from various grounds and judge that soil for presence of particular amount of microbes and their effect on plant growth. Root exudates also effects the growth of microbes. Some bacteria like *Rhizobium* has beneficiary effects on plant root, they inhabit there and makes a mutual relation with plant.

We can examine soils for counting the number of physiological groups of microorganisms, both the pathogenic and good Bacteria. We have experimented only five kind of organisms. But Further for development many other organisms (macro and micro) can be isolated and can be counted for their harm full activities or beneficial effects on the particular field. This experiment with more some steps ahead can bring out a solution for pesticide uses and how far we should restrict ourselves for those.

IV. ACHIEVEMENT:

1.The aim of the experiment was successfully achieved. 2. Idea about more experiments like this in Indian soil were gained. 3.Number of the physiological groups of five kind of organisms were known. 4.Scope for further studies about the effect of these microbes in soil and growth of Plant. 5.The soil under rye monoculture characterized the largest O:C ratio as compared to other experimental variants. That means that rye monoculture affects positively biological balance of soil. 6.The experiment opens a vast area for study of soil biology and regulate the dosage of fertilization. 7. Our experiment also gives us a knowledge about what kind of microbes can be Found where and how to study their good and bad effects. 8. The ways of how soil microorganisms are Cultured. 9.The way of how dry matter and colony forming units of microorganisms in 1 g of dry soil is calculated. 10.Detecting fungi and physiological groups of bacteria in soil. 11.Estimating the effects of tillage and fertilization on the basis of microbiological properties of soil.

V. AIM & OBJECTIVES:

The aim of our studies was to investigate the effect of the agriculture tillage types (monoculture and 5-fields courses) on abundance of microorganisms in soil depending on fertilizers used. Organisms in crop fields has a vital role for crop growth and products. The number of *Azotobacter*, Fungi, Oligotrophic, Copiotrophic and cellulolytic organisms may have affects on the crop fields (fallow land vs monocultured land and crop rotation). But in this study we are examining only the physiological groups of microbes present in above mentioned fields. Does the number increases or decreases with fertilizers used, our object was to have a focus on that.

VI. RESEARCH METHODOLOGY:

The investigation was carried out on soils originating from Experimental Station of Faculty of Agriculture and Biology of the Warsaw University of Life Sciences which is located in Skierniewice near Warsaw, Poland. The soil samples were collected once only in May 2017 from rye and potato monoculture and 5-fields-courses. With fallow-land was used for testing. Microbial properties of soils were evaluated on the basis of the total number of microscopical fungi, copiotrophic and oligotrophic bacteria, as well as the most probable number of *Azotobacter* sp. and cellulolytic microorganisms using selective microbiological mediums.

1. Collection of soil from 15 different fields of potatoes and Rye, from Skierniewice,

Poland.

2. Selective medium preparation for estimation of number of five different Microorganisms of our investigation-

2.1 Copiotrophic organism - Broth agar medium :

For 1000 ml (a) Dist. water 1000 ml
(b) Broth - 15 g
(c) Agar - 15 g
(d) pH - 7.5
(e) Actidione 50 microgram/ ml of medium

2.2 Oligotrophic organism - Broth agar medium :

For 1000 ml (a) Dist. water - 1000 ml
(b) Broth - 0.05 g
(c) Agar - 15 g
(d) pH - 7.5
(e) Actidione - 50 microgram/ ml of medium

2.3 Microscopical Fungi - Martin's medium :

For 1000 ml (a) Dist water - 1000 ml
(b) Glucose - 10 g
(c) Peptone - 5 g
(d) KH_2PO_4 - 1 g
(e) $MgSO_4$ - 0.5 g
(f) Agar - 15 g

2.4 Azotobacter sp. – Winogradski's medium :

For 1000 ml (a) Tap water - 1000 ml
(b) Glucose - 20 g
(c) K_2HPO_4 - 1 g
(d) $MgSO_4$ - 0.5 g
(e) $CaCO_3$ - 5 g
(f) Micro-element solution - 1 ml
(g) pH - 7.5

2.5 Cellulolytic bacteria – Dubos's medium :

For 1000 ml (a) Dist water - 930 ml
(b) NH_4NO_3 - 1 g
(c) Soil extract - 20 ml
(d) Winogradski's solution - 50 ml
(e) Micro-element - 1 ml
(f) pH - 7.5

3. 15 different soil were serially diluted from 10^0 to 10^{-6}

4. Test tubes and petri plates were prepared for culture of investigated microorganisms -

4.1 For Oligotrophic - 10^{-4} - 10^{-6} (3 dilutions) triplicate Petri-plates were prepared for 15 different soil samples i.e., 15 x 3 x 3 = 135 plates

4.2 For Copiotrophic - 10^{-4} - 10^{-6} (3 dilutions) triplicate Petri-plates were prepared for 15 different soil samples i.e., 15 x 3 x 3 = 135 plates.

4.3 For Microscopical Fungi - 10^{-2} - 10^{-4} (3 dilutions) Triplicate petri-plates were prepared for 15 different soil samples i.e., 15 x 3 x 3 = 135 plates.

4.4 For Azotobacter sp.- 10^{0} - 10^{-5} (6 dilutions) triplicate test tubes were prepared for 15 different soil samples i.e., 15 x 6 x 3 = 270 TT

4.5 For cellulolytic microorganisms- 10^{-2} - 10^{-6} (5 dilutions) triplicate test tubes were prepared for 15 different soil samples i.e., 15 x 5 x 3 = 225 TT with filter strips as carbon source.

5.Inoculation - 1 ml of each soil suspensions were inoculated to the test tubes and petri-plates.

6.It was incubated at 28 ° C for proper growth of microorganisms: - for oligotrophic 14-21 days , - for copiotrophic 2-3 days ,

- for fungi and Azotobacter sp. by 7 days. - for cellulolytic microorganisms until 3 weeks.

(Growth of this microorganisms were estimated after time of incubation on the basis of macroscopical and microscopical (using negative staining method of cells) observation of cultures, and (Growth of this microorganisms were estimated after time of incubation on the basis of yellow colour of filter paper and erosion or degradation of cellulose strip.)

7. Estimation of the total number of oligotrophic , copiotrophic and fungi in 1g of dry matter soils.

Most probable number of Azotobacter sp. and cellulolytic microorganisms in 1g dry matter of soil Using Mc' Credyego's statistical tables was read (Table - 3).

METHOD - (Table -9) 7.1 At first small glass jars were weighed (A) 7.2 Then jars with some amount of fresh soil were weighed (B) 7.3 Then jars were dried in 105^{0}C for two days 7.4 Then jars with dry soil were weigh7.5 Then C-B/ B-A were calculated for dry matter

8.1 Plate count method was used for counting colonies of Copiotrophic, Oligotrophic and Fungi (Table - 4, 5, 6).
8.2 Turbidity of test tubes were seen for Azotobacter.
8.3 Colour change and breakage of filter paper strips were Seen for Cellulolytic organisms.
8.4 And for verification of these test tubes, slides were Prepared with proper staining and growth was confirmed (Figure 2).
9.The following Table 2 shows different fertilizers used in different fields in Potato and Rye monoculture.

Table 2. for Fertilizer used in different soil samples

Soil sample	**Fertilizers used**	**Crops**
1	Without tillage	x
2	CaNPK	Potato Monoculture
3	Ca	‘‘
4	NPK	‘‘
5	FYM	‘‘
6	CaNPK	Rye monoculture
7	Ca	‘‘
8	NPK	‘‘
9	FYM	‘‘
10	CaNPK	Potato 5 field course
11	NPK	‘‘
12	Ca	‘‘
13	CaNPK	Rye 5 field course
14	NPK	‘‘
15	Ca	‘‘

Table 3. Statistical table of Mc'Credyego

Number of tubes with positive reaction out of 3 for the chosen dilutions			**MPN value per gm**
0	0	0	0,0
0	0	1	0,3
0	1	0	0,3
0	1	1	0,6
0	2	0	0,6
1	0	0	0,4
1	0	1	0,7
1	1	0	0,7
1	1	1	1,1
1	2	0	1,1
1	2	1	1,5
1	3	0	1,6
2	0	0	0,9
2	0	1	1,4
2	0	2	2,0
2	1	0	1,5
2	1	1	2,0
2	1	2	3,0
2	2	0	2,1

2	2	1	2,8
2	2	2	3,5
2	2	3	4,0
2	3	0	3,0
2	3	1	3,5
2	3	2	4,0
3	0	0	2,3
3	0	1	3,9
3	0	2	6,4
3	1	0	4,3
3	1	1	7,5
3	1	2	11,5
3	1	3	16,0
3	2	0	9,3
3	2	1	15,0
3	2	2	21,0
3	2	3	30,0
3	3	0	25,0
3	3	1	45,0
3	3	2	110,0
3	3	3	140,0

VII. OBSERVATION:

For Fungi, Oligotrophic, and Copiotrophic bacteria growth were observed in Respective petri-plates. For *Azotobacter*, growth was Observed in the test tubes & they were further cultured in petri plates. For cellulolytic bacteria growth was observed in test tubes.

Figure 1. Fungi plate

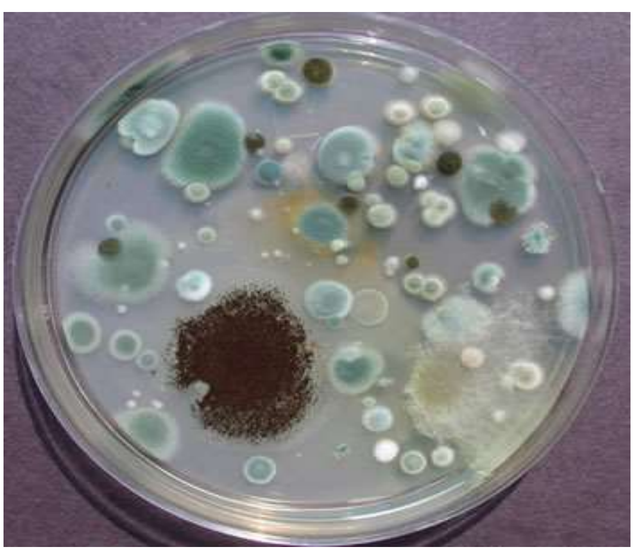
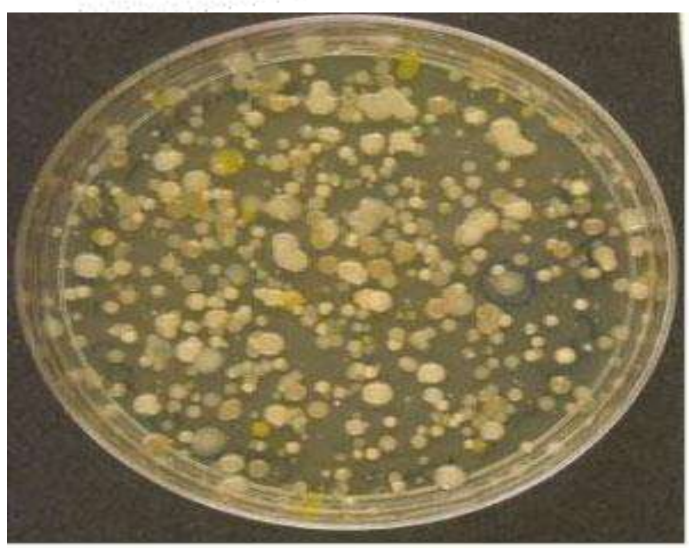


Figure 2. Oligotropic bacteria



No. of soil sample	Dilution	Colonies in fresh soil	Colonies in fresh soil	Colonies in fresh soil

Figure 3. Azotobacter with nigrosin stain
Figure 4. Copiotropic bacteria

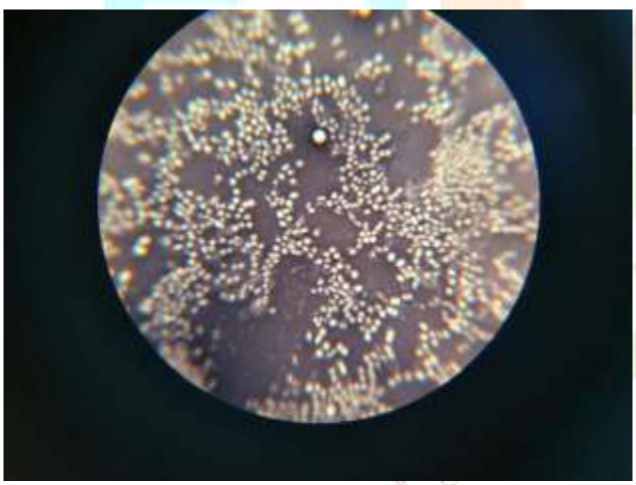


Table 4. For Fungi colonies

1	-2	211	190	191
	-3	21	11	14
	-4	4	4	4
2	-2	141	152	130
	-3	29	28	35
	-4	5	6	4
3	-2	133	169	134
	-3	41	33	24
	-4	2	3	5
4	-2	243	169	230
	-3	26	29	39
	-4	12	9	11
5	-2	245	250	236
	-3	56	53	42
	-4	5	9	14
6	-2	146	132	128
	-3	24	27	41
	-4	1	3	0
7	-2	121	112	106
	-3	37	28	30
	-4	6	4	3
8	-2	119	123	107
	-3	35	32	28
	-4	3	2	6
9	-2	105	103	110
	-3	25	25	27
	-4	6	3	5
10	-2	39	73	85
	-3	15	19	20
	-4	2	3	3
11	-2	45	47	45
	-3	19	21	16
	-4	4	3	3
12	-2	70	58	58
	-3	13	20	19
	-4	8	2	3
13	-2	45	108	98
	-3	17	16	15
	-4	4	4	2
14	-2	74	65	69
	-3	21	18	28
	-4	4	0	2

No. of soil sample	Dilution	Colonies in fresh soil	Colonies in fresh soil	Colonies in fresh soil
1	-4	33	34	17
	-5	2	2	7
	-6	0	0	0
2	-4	43	49	39
	-5	4	9	9
	-6	2	0	0
3	-4	2	47	46
	-5	7	7	13
	-6	0	0	1
4	-4	90	90	10
	-5	1	3	1
	-6	11	4	0
5	-4	111	106	10
	-5	24	24	11
	-6	9	10	6
6	-4	109	105	10
	-5	4	4	10

Table 5. Colonies for OLIGOTROPHIC bacteria

	-6	3	1	3
7	-4	113	113	10
	-5	21	21	17
	-6	3	5	4
8	-4	94	100	90
	-5	25	24	24
	-6	5	4	3
9	-4	80	60	88
	-5	17	22	18
	-6	12	6	4
10	-4	78	56	76
	-5	3	0	0
	-6	0	0	0
11	-4	39	32	37
	-5	5	3	0
	-6	0	0	0
12	-4	24	29	26
	-5	13	4	3
	-6	0	0	0
13	-4	28	34	31
	-5	1	1	3
	-6	1	1	5
14	-4	48	22	29
	-5	2	2	
	-6	0	0	0

Table 6. Copiotrophic Colonies for Bacteria

No. of soil sample	Dilution	Colonies in fresh soil	Colonies in fresh soil	Colonies in fresh soil
1	-4	71	75	28
	-5	11	12	24
	-6	9	9	8
2	-4	54	56	93
	-5	31	27	24
	-6	18	18	23
3	-4	60	43	96
	-5	27	34	37
	-6	1	4	2
4	-4	85	167	85
	-5	24	25	30
	-6	1	1	0
5	-4	76	53	56
	-5	24	50	35
	-6	8	8	9
6	-4	58	90	55
	-5	36	35	30
	-6	3	2	4
7	-4	55	27	77
	-5	32	14	20
	-6	6	8	5
8	-4	56	27	77
	-5	32	14	20
	-6	6	8	5
9	-4	56	60	31
	-5	17	37	16
	-6	7	4	2
10	-4	101	213	100
	-5	50	40	52
	-6	6	10	11
11	-3	181	172	171
	-4	71	74	74

	-5	20	22	11
12	-4	22	20	26
	-5	5	13	6
	-6	0	0	1
13	-4	240	237	244
	-5	100	122	110
	-6	14	20	17
14	-4	233	240	236
	-5	75	65	80
	-6	20	19	20

Table 7. Growth of Azotobacter in various dilutions

	10^{-0}			10^{-1}			10^{-2}			10^{-3}			10^{-4}		
1	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-
2	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-
3	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-
4	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-
5	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-
6	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-
7	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-
8	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-
9	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-
10	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-
11	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-
12	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-
13	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-
14	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-
15	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-

Table 8. Growth of Cellulolytic Microorganism

	10^{-2}			10^{-3}			10^{-4}			10^{-5}			10^{-6}		
1	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-
2	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-
3	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-
4	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-
5	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-
6	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-
7	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-
8	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-

9	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-
10	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-
11	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-
12	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-
13	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-
14	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-
15	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-

Table 9. Calculation of Dry matter of Soil

No. Of soil sample	Weight of jar after drying in 105^{O}C (A)	Weight of jar with fresh soil (B)	Weight of Jar with dry soil (C)	Dry matter = C - A/ B-A
1	21.107	24.419	24.018	0.879
2	20.441	22.803	22.581	0.920
3	22.867	25.196	24.998	0.915
4	29.236	32.305	32.123	0.941
5	19.150	20.573	20.446	0.911
6	27.543	30.420	30.147	0.907
7	20.062	23.381	23.030	0.893
8	28.920	31.000	30.797	0.902

9	21.295	23.115	22.936	0.901
10	19.698	21.102	20.990	0.920
11	21.040	22.636	22.450	0.919
12	23.726	24.292	24.785	0.880
13	29.452	31.507	31.324	0.886
14	20.875	23.069	22.861	0.898
15	17.513	18.927	18.765	0.885

Table 10. For cellulolytic organism (calculation of Microbes in 1 gm of Dry matter

Sample No.	Characteristic No.	Microbes in 1 gm of soil	Microbes in 1gm Of dry matter x 10^2
1	3 0 0	2.3×10^2	2,6
2	3 1 0	4.3×10^2	4,7
3	3 3 1	450×10^2	491,8
4	3 3 0	25×10^2	26,6
5	3 3 1	450×10^2	494
6	3 3 1	450×10^2	496,1
7	3 3 2	110×10^2	123,1
8	3 3 1	45×10^2	12,3
9	3 3 1	45×10^2	50
10	3 0 0	2.3×10^2	2,6
11	3 3 1	45×10^2	49
12	3 1 0	4.3×10^2	4,9
13	3 0 0	2.3×10^2	2,6
14	3 3 0	25×10^2	27,8
15	3 3 1	45×10^2	51

Sample no.	Characteristic no.	Microbes in 1 gm of soil	Microbes in 1gm Of dry metter
1	3 3 1	45×10^0	51,1
2	3 3 3	140×10^0	152,1
3	3 3 3	140×10^0	153
4	3 3 1	45×10^1	478
5	3 3 1	45×10^1	494

6	3 3 1	$45x10^1$	496
7	3 3 1	$45x10^1$	504
8	3 3 2	$110x10^0$	122
9	3 3 3	$140x10^0$	155
10	3 0 0	$2.3x10^0$	2,5
11	3 1 0	$4.3x10^0$	4,7
12	3 3 0	$25x10^0$	28,4
13	3 1 0	$4.3x10^0$	4,9
14	3 1 0	$4.3x10^0$	4,8
15	3 3 0	$25x10^0$	28,2

Table 11. for Calculation of Azotobacter in 1 gm of dry matter of soil

Table 12. The average number of investigated physiological groups of microorganisms in 1g dry matter of soil depending on agricultural til fertilization

Experimental variants	Fertiliz a-tion	Oligotrophic (O) x 10^4 cfu	Copiotrophic (C) x 10^4 cfu	O:C ratio	Fungi x 10^2 cfu	Azotobacter sp. cfu	Cellulolytic microorganisms x 10^2 cfu
1.Fallow-land	lack	155,0	112,3	1,4	197,3	51.2	2,6
2.Potato monoculture (*potato variety Hermes)*	Ca	171,3	108,0	1,6	160,0	153.0	491,8
	NPK	206,3	182,0	1,1	224,3	478.2	26,6
	Ca NPK	117,0	113,7	1,0	153,7	152.2	4,7
	FYM	229,7	95,3	2,4	256,7	494,0	494,0
3.Rye monoculture (*rye variety Dańkowskie Złote*)	Ca	263,0	70,7	3,7	138,3	503.9	123,2
	NPK	246,7	64,7	3,8	162,0	122,0	12,3
	Ca NPK	225,7	82,3	2,7	177,7	496.1	49,6
	FYM	206,0	180,7	1,1	161,0	155.4	499,4
4.Five-field course *(a-lupine variety Sonet, b-winter wheat variety Symfonia, c- rye variety Dańkowskie Złote, d- potatoes variety Hermes (+ 30 t of FYM) , e-spring barley variety Stratus)*	Ca	136,3	102,0	1,3	135,7	28.4	4,9
	NPK	169,3	106,3	1,6	121,7	4.7	49,0
	Ca NPK	219,7	104,7	2,1	103,7	2.5	2,5
5.Five-field course *(a-lupine variety Sonet, b-winter wheat variety Symfonia, c- rye variety Dańkowskie Złote, d- potatoes variety Hermes (+ 30 t of FYM) , e-spring barley variety Stratus)*	Ca	91,0	75,0	1,2	59,0	28.2	50,8
	NPK	226,7	90,7	2,5	133,0	4.8	27,8
	Ca NPK	139,7	132,3	1,1	106,3	4.9	2,6

Table 13. Effect of agricultural tillage on the number of chosen physiological groups of microorganisms in 1g dry matter of soil ([a,b,c]- *various letters were used to points out means which differ significantly*).

No.	Experimental variants	Oligotrophic (**O**) x 10^4 cfu	Copiotrophic (**C**) x 10^4 cfu	**O:C ratio**	Fungi x 10^2 cfu
1.	Fallow-land	176,3 [ab]	127,8 [a]	**1,45**	224,1 [a]
2.	Potato monoculture *(potatoes variety Hermes)*	187,6 [a]	136,1 [a]	**1,54**	298,8 [a]
3.	Rye monoculture (*rye variety Dańkowskie Złote*)	252,1 [b]	110,6 [a]	**3,08**	177,4 [a]
4.	Five-field course *(a-lupine variety Sonet, b- winter wheat variety Symfonia, c- rye variety Dańkowskie Złote, d- potato variety Hermes (+ 30 t of FYM) , e- spring barley variety Stratus)*	192,7 [ab]	116,6 [a]	**1,66**	133,1 [a]
5.	Five-field course *(a-lupine variety Sonet, b- winter wheat variety Symfonia, c- rye variety Dańkowskie Złote, d- potato variety Hermes (+ 30 t of FYM) , e- spring barley variety Stratus)*	165,7 [a]	110,1 [a]	**1,60**	111,6 [a]

Table 14.
Effect of fertilizer under monocultures (rye, potato) on the number of chosen physiological groups of microorganisms in 1g dry matter of soil ([a,b,c]- *various letters were used to points out means which differ significantly*)

Fertilizer	Oligotrophic (O) x 10^4 cfu	Copiotrophic (C) x 10^4 cfu	O:C ratio	Fungi x 10^2 cfu
Ca	240,9 [b]	98,6 [a]	2,98	165,1 [a]
NPK	235,3 [b]	118,6 [a]	2,67	315,7 [a]
CaNPK	127,2 [a]	127,2 [a]	1,06	167,0 [a]
FYM	222,1 [ab]	153,3 [a]	1,73	230,2 [a]

Table 15.
Effect of fertilizer under five-fields courses (rye, potato) on the number of chosen physiological groups of microorganisms in 1g dry matter of soil ([a,b,c]- *various letters were used to points out means which differ significantly*)

Fertilizer	Oligotrophic (**O**) x 10^4 cfu	Copiotrophic (**C**) x 10^4 cfu	**O:C ratio**	Fungi x 10^2 cfu
Ca	128,9 [a]	100,3 [a]	**1,28**	110,4 [a]
NPK	199,0 [b]	110,1 [a]	**1,95**	140,2 [a]
CaNPK	209,5 [b]	129,6 [a]	**1,68**	116,3 [a]

VIII. RESULTS AND DISCUSSION:

Table 12 shows that the number of physiological groups of microorganisms clearly depends on fertilization in monoculture and crop rotation fields. In case of oligotrophic and copiotrophic organisms the number is smaller in five field course with calcium fertilization and the highest number of oligotrophic is in rye monoculture. The highest number of copiotrophic bacteria is in potato monoculture with NPK and the biggest number of fungi, *Azotobacter* sp. and aerobic cellulolytic bacteria growth is noticed in potato and rye monoculture.

In Tables 13,14,15 The results of investigation show significant effect of tillage and fertilization on the number of oligotrophic bacteria versus copiotrophic bacteria and fungi. The soil under rye monoculture characterized the largest O:C ratio as compared other experimental variants. That means that rye monoculture affects positively biological balance of soil.

Tables 14 and 15 shows**,** effect of fertilization under rye and potato monoculture and five-fields courses. Full mineral fertilization (NPK) and liming (Ca) under rye and potato monocultures have the best effect on the O:C ratio. Using fertilization does not significantly affect the number of fungi, although the number of fungi is the highest with soil into which far manure (FYM) was added (Tab. 3). However, under five-fields courses the best biological properties are in soil with mineral fertilization (NPK) and CaNPK because in these variants the O:C ratio is the highest.

It is, however, also clear that the type of agricultural management had an effect on the number of microbes in agricultural soil. After the whole experiment and observing the results with tables we can conclude that:

1) The number of microorganisms depends on agriculture tillage and fertilization.
2) Oligotrophic : Copiotrophic ratio showed good index for estimation of biological balance in agricultural soil.
3) On the basis of the result we can say that agricultural tillage with fertilization determine the microbiological balance of the soil environment.

Rye monoculture disturbs the least biological balance of the soil as compared to fallow-land and potato- monoculture.

IX. REVIEW OF LITERATURES:

For the whole experimental studies some literature were reviewed. To have some knowledge about from where and to collect soil samples and how the experiment shouldbe conducted, these literature were studied, like, "Crop rotation versus monoculture; yield, N yield and ear fraction of silage maize at different levels of mineral N fertilization", "Effects of Monoculture, Crop Rotation, and Soil Moisture Content on Selected Soil Physicochemical and Microbial Parameters in Wheat Fields" ,"Relation between soil health, wave-like fluctuations in microbial populations, and soil-borne plant disease management" etc. Study of these above mentioned and some other literature gave a clear image of the basis of our experiment.

X. SUMMERY:

Our experiment was carried out to see the Effect of Monoculture and crop rotation (Five- field courses) on the number of physiological groups of microorganisms in soil.We collected 15 different soil from different soil of potato and rye monoculture. We measured the number of physiological group of fungi, cellulolytic, oligotrophic, copiotrophic, and *Azotobacter.* The count of organisms i.e., oligotrophicvs copiotrophic ratio were large in the soil from rye monoculture. Different medium were used to culture different microbes. By plate count method Their colonies were count and using Mc'credyego table the result was obtained.

The relevance of the research is, This thesis provides a better understanding of some microbiological aspects of agricultural soils (mainly monoculture and 5-fields courses) versus fallow-lands. It also emphasizes the importance of using of the O:K (oligotrophs : copiotrophs) ratio as a good index of biological balance of soils as well as number of fungi, *Azotobacter* sp. And aerobic cellulolytic microorganisms as a good index their application for estimation of the quality of agricultural soils.

There seems to be a clear relationship between soil microbial diversity, soil, and plant quality, as well as ecosystem sustainability and it is investigated if crop rotation and monoculture (from Rye and potato) benefits of harms the soil. The question now arises: can agricultural management practices bring about changes in the soil's physicochemical and biological properties—the ecosystem profile—of a Rye and potato field? This study was conducted to evaluate selected soil physiological groups of microbes, and microbial parameters under two different management systems, namely, Rye & potato monoculture and their rotation with 5 other plants

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