**Role of green manure in soil fertility increasing.**

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**Abstract.**

Nowadays the issue of retaining and accumulating of the humus in the **soil** gains

the particular urgency, because of significant degradation of the **soil** as well as decrease in the efficient and prospective **fertility**. In case of no opportunity to deliver the sufficient volume of the fertilizers, getting the high yield of crops is possible only if the crop

rotation is applied. The enhancing of crop rotation and modification of fertilizer groups

( replacing of the pure field with the green manure, the presence of perennial grasses is mandatory ) contributes to mitigation of soil degradation. According to statistics, the

recent agricultural utilization of soils is followed with the **fertility** decline of them. The amount of fertilizers, which is put on each given hectare of fields, has been reduced

recently: mineral fertilizers have been reduced by 4-5 kg, organic ones- by 0.8-1 t

respectively. However, the climatic factors, constituting positive impact on crops yield

in terms of decline tend, have been almost unchanged. So the fertility of soil and

**fruitfulness** of agriculture crops is getting lower each year as a result. According to data of scientific institutions, the humus losses of the soil reach 0.6-1 tons per one hectare

per one year, even in case of applying of mineral and **organic fertilizers**. In the existing

structure of sown areas, to cease the degrading processes of **soils**, according to scientific

normas, it is necessary to deliver 200-250 kg of mineral fertilizer per one hectare of arable land, and 8-10 tons of manure, not less [2,3]

Working out the new concept of maintaining the **fertility of soil** is required under modern recent existing conditions in the agricultural branch ( expensive fuel, equipment fertilizers and other stuff ), which will ensure the getting of more cheap agricultural

goods of fine quality. Solving this problem, the major role is given to crop rotation, with addition of perennial and bean cultures, green manure[4,5].

The research of revealing the role of different cultures and green manure as the

main predecessors of winter crops in maintaining and improving of crops fertility with

green manure and root-stubble culture remains, is getting special importance.

**Key words:** green manure, soil, fertility, organic matter.

It is well known, that retaining and maintaining supplies of organic stuff in soil,

one of the most topical issues of the modern organic agriculture. Intense use of

chernozem leads to the increase of mineralization process, that causes not only the

decay of the fresh residue in the soil, but in the humus. Because of the alienation of the huge quantity of non-humified leftovers of vegetable origin, the delivery of the fresh

organic matter to the **soil** is reducing[1].

The scientific progress has enabled the mankind to change the nature of soil

crucially, to adjust the processes, influencing the **fertility**. The issue of fertility control

of soils is compound and could be solved only with the mixture of different means:

meliorative ( profound enhancement of natural features of soils ), agrochemical

( improvement of substances circulation ), agrophisical ( treatment of soils, erosion

elimination ), and agrotechnical ( crop rotation ).

Generally there are three main tasks to solve within an issue of focused

 adjustment of **fertility**:

1. To optimize the use of sown areas and the fruitfulness of them.
2. To prevent deterioration of the efficient fruitfulness of soils ( struggle against erosion, the reducing of humus content with salinization and swamping-up ).
3. To restore the fertility of soils, damaged by the industrial activity of humans

( recultivation of the impaired soils. ) [7]

It is well-known, that **fertility**- is a feature of soil’s ability to produce crops. The

quality of soil is defined with the value of fruitfulness. Humus is among the most

important indications of the fertility level of soil in its turn. The study of **fertility**

was done in our country since time immemorial. The base of this study was started by such outstanding scholars like Kostychev P. (1937, 1951,) Williams V. ( 1948, 1949, 1951 ), Dokuchaev V. ( 1950 ), Pryanisnikov D. (1951, 1965 ) and many

others.

The main method of the organic matter recovery is to put the sufficient amount of fresh organic matter as a vegetable residue and organic fertilizers into soil, and

arranging conditions, contributing to adjustment of humification and

mineralization.

The organic matter mode optimization is the most acute problem within the enhancement of **fertility** of chernozem nowadays. Quantitative and quality assessment of variation in content and supply of humus constitutes one of the most important

scientific issues, but the search for the most modifiable part of organic matter is

gaining more importance[6].

To provide the more efficient intensifying factors it is necessary to improve

further the agriculture, the implementation of crop rotations are the important

link here, followed with scientifically proved crops alternation. The crop rotation

theory is based on the study of the relationship between plants and environmental

conditions, hereby the impact on the soil and its fruitfulness by plants is important. The item, mentioned above, depends on the presence of organic matter in the soil most of all, as humus and non-humified botanic residue, which are accumulated

during growing season and remain here after harvesting.

The meaning of research of the role of perished non-humified vegetable residue is really important for the right understanding of humus-formation processes, the

residues, mentioned above, are actually the basis for its formation. We should

note, the study of vegetable remains and stubble-remains have been paid little

attention by researchers, and many aspects are not highlighted completely still.

According to Dedov A. opinion, the humus production in arable chernozem is

necessary to provide with the organic matter, produced in agrocenosis. But thus

the role of vegetable residues and intermediate decay products is underestimated

[2].

The immense and so important among the affordable and cheap sources of

increasing delivery of organic matter into the soil, which is still seldom used in

the central chernozem reserve is the use of green manure. They can be grown at

the green manure field and till the harvest as well as till haymaking. Green

manure crops protect the soil from destruction, prevent soluble mineral matter

from washout. The percentage of washing-proof matter increases under the

influence of green manure fertilizers, the soil turns less dense.

Green fertilizers- are special cultures, which residues are partly or completely

ploughed into soil as an organic fertilizer.

Green manure as a simple manure contains all necessary components for plants

nutrition. There is as much nitrogen as in litter manure, and phosphorus and

potassium a bit less in the organic compound of green manure. In the green mass

 of forage beans is 1.4-1.5% of nitrogen, 0.4-0.5% of phosphorus, 0.7-0.8% of

potassium. The use percentage of nitrogen of green fertilizer by plants is higher

during the first year and higher in comparison of consumption of nitrogen from

manure, it is 23-25%. The loss of accumulated nitrogen is almost completely

eliminated during the plowing down of green fertilizer. The decay process of

**green manure** is happening in the soil at different velocity due to uneven

chemical content of crops. The decay of bean and vie is more intense, which

impacts the rise of crops since the first season. The one of rapeseed is less

fast, as that

one, the favorable influence on the yield of crops manifests in the second or even

third season culture.

The mass of ploughed green manure increases the activity of processes in soil,

contributes to the reproduction of germs in soil, some of them are antagonists of microbes, which cause the root decay. It was experimentally proved, that the

harvest yield of winter crops and total fruitfulness of crop cereals rotation of

naked fallow ( 20t of manure per 1ha ) with green manure were equal. At average **green manure** plowing the consumption is less, compared to manure. Moreover,

green manure are spreading more evenly across the field[11].

Green manure favorably influence the organic processes in soils, the fraction of

nutritive matter and the vitality of them. They increase the fertility of soils mostly due to enhanced mineral nutrition, primarily with nitrogen, as well as enrich the

soil with **organic matter** and prevent the erosion, with the inhibiting of humus

mineralization.

So, during the research we learned the following issues:

1. The organic matter input into soil after plowing of root residues and outer

layer of green manure.

1. The percentage of nitrogen, phosphorus and potassium in outer layer of green

manure and root remains.

**Methods and matter**.

Nowadays the role of naked fallow as a predecessor of winter wheat is

contradictory because of lack of fuel and equipment. The fields assigned as naked fallow often remain untreated throughout the summer and are being covered with weed. To tell more, there is no yield of naked fallow. Hereby the investigation on well-known and conventional forerunner of wheat- black manure was held, and

the subject of them was the partial removal of black manure with green manure to evaluate the impact on the recovery of soil fertility.

Green manure input record was carried out threefold on the field of 0.25 ha

correlated to one hectare. The root residue and stubble residue record was made

on the arable layer with the soil monolith method [ 9,10 ]. The quantity of total

nitrogen in the root residue and outer layer of **green manure** was determined

with the colorimetric method, suggested by Usovich A. and Lebedev P. (1976 ),

the one of phosphorus – with the colorimetric method by Hrenovaya-Denizhe

( st.Petersburg, 1968 ) with the optical colorimeter KFK-2, the one of potassium- with the method of flame photometry by Razumov V ( 1968 ) with a flame

photometer PFM.

**Results and discussions**.

The use of cereal and bean cultures in crops rotation of arable lands is one of the most important elements of organic matter producing, as well as the use of

perennial grass. The role of them is determined with biological peculiarities and

the technologies of cultivation. If the entire vegetable mass is delivered into **soil**,

 the carbon, nitrogen and cinder parts are accumulated in the upper layer. In case of alienation of the major part of accumulated amount of vegetation of the field,

the deficiency of the mentioned above elements will take place. The quantity

markers of organic remains in soil will significantly differ as well. The content of vegetable residue, represented with stubble and root masses remarkably differs

within different cultures. Due to insufficient input of organic fertilizers, we were determined to study the impact of green manure on some elements of fertility of soil, and to give some recommendations to optimize these values, based upon the

results of this study.

It is necessary to consider, that plowing of 20-30t/ha of **green manure** is equal to 30-40t/ha of the one of manure. Green manure crops in the field are the reliable

protection mean against erosion. We used forage bean as a green manure

( paluska ) and lupine. They should ploughed down during the period of

maximum vegetable mass accretion. Once green manure and green fertilizer are

used, physical features of soil improve, water-resistance is increasing. Plowing

input of green fertilizers provides more rough outer surface for seeding of next

crops. The importance of green manure delivery in case of crop rotation

nowadays is attributed to lack of mineral and organic fertilizers input.

According to our research, green cultures like forage bean and lupine enabled the input of 22.7 and 27.1 t of organic matter respectively (as shown in tables 1,2.)

Table1- the mass of **organic matter**, was put into soil after plowing delivery of

green manure (forage beans ).

|  |  |  |
| --- | --- | --- |
| Organic matter |  soil layer, см | Organic matter weight, t/ha |
| 2012 г. | 2013 г. | 2014 г. | Average for 3 years |
| Outer layer of green manure | 18 | 15,6 | 19,36 | 17,67 |
| The weight of root residue of green manure | 0-10 | 1,59 | 1,44 | 1,68 | 1,57 |
| 10-20 | 1,14 | 1,01 | 1,01 | 1,08 |
| 20-30 | 0,5 | 0,54 | 0,58 | 0,54 |
| 0-30 | 3,23 | 2,99 | 3,35 | 3,19 |
| total | 21,23 | 18,64 | 22,71 | 20,86 |

Table2- the weight of **organic matter**, delivered into soil after plowing of **green manure** (lupine)

|  |  |  |
| --- | --- | --- |
| Organic matter | Soil layer, см | Weight of organic matter, t/ha |
| 2012 г. | 2013 г. | 2014 г. | Average for 3 years |
| Upper layer of green manure | 23,66 | 22,32 | 24,58 | 23,52 |
| Weight of root residue of green manure | 0-10 | 1,77 | 1,62 | 1,86 | 1,75 |
| 10-20 | 1,28 | 1,13 | 1,31 | 1,24 |
| 20-30 | 0,6 | 0,56 | 0,64 | 0,6 |
| 0-30 | 3,65 | 3,31 | 3,81 | 3,59 |
| total | 27,31 | 25,63 | 28,39 | 27,11 |

The level of non-humified matter in the **soil** increased significantly after input of green manure mass. The green bean mass analysis showed, that the average

percentage of nitrogen was 1.56%, 0,54% of phosphorus, and 0,76% of potassium in the green manure harvest. The most of root system is located in ploughed layer. Here is a bit less nutritive matter, compared to outer layer: 1,54% of nitrogen,

0.48% of phosphorus, 0,53% of potassium in average. (see table 3)

Table 3- the number of nutritive elements, was put into soil with the green

manure plants. ( forage beans )

|  |  |  |  |
| --- | --- | --- | --- |
|  Green manure | The year of experiment | The nutrition elements content, % | The nutrition elements input in soil, kg/ha |
| nitrogen | phosphorus | potassium | nitrogen | phosphorus | potassium |
| Upper mass of green manure | 2012 | 1,55 | 0,51 | 0,75 | 279,0 | 91,8 | 135,0 |
| 2013 | 1,56 | 0,52 | 0,76 | 244,1 | 81,4 | 118,9 |
| 2014 | 1,57 | 0,58 | 0,78 | 304,0 | 112,3 | 151,0 |
| average | 1,56 | 0,54 | 0,76 | 275,7 | 95,4 | 134,4 |
| Root remains of green manure | 2012 | 1,53 | 0,50 | 0,55 | 49,4 | 16,2 | 17,8 |
| 2013 | 1,56 | 0,45 | 0,50 | 46,6 | 13,5 | 15,0 |
| 2014 | 1,52 | 0,49 | 0,53 | 50,9 | 16,4 | 17,8 |
| average | 1,54 | 0,48 | 0,53 | 49,1 | 15,3 | 16,9 |
| total | 1,55 | 0,51 | 0,65 | 324,8 | 110,7 | 151,3 |

Table4- the number of nutritive elements, was put with green manure into soil.

 (lupine )

|  |  |  |  |
| --- | --- | --- | --- |
| Green manure | Year of experiment | Nutritive element content, % | Nutrition input into soil kg/ha |
| nitrogen | phosphorus | potassium | nitrogen | phosphorus | potassium |
| Outer layer of green manure | 2012 | 1,86 | 0,62 | 0,90 | 440,1 | 146,7 | 237,5 |
| 2013 | 1,80 | 0,66 | 0,85 | 401,8 | 147,3 | 189,8 |
| 2014 | 1,88 | 0,65 | 0,87 | 462,1 | 159,8 | 213,8 |
| average | 1,85 | 0,64 | 0,87 | 435,1 | 150,5 | 204,6 |
| Root remains of green manure | 2012 | 1,85 | 0,58 | 0,84 | 67,5 | 21,8 | 30,7 |
| 2013 | 1,83 | 0,55 | 0,80 | 60,6 | 18,2 | 26,5 |
| 2014 | 1,82 | 0,55 | 0,82 | 69,3 | 21,0 | 31,2 |
| average | 1,83 | 0,56 | 0,82 | 65,7 | 20,1 | 29,4 |
| total | 1,84 | 0,60 | 0,85 | 500,8 | 170,6 | 234,0 |

While studying the green mass of lupine and its root residue, it was determined,

 that it was 1,85% of nitrogen, 0,64% of phosphorus, 0,87% of potassium in the

harvest of this green manure. The nutritive matter are less numerous in the root system, as well as the ones of forage beans, compared to vegetative mass and constitutes at average 1,83% of nitrogen, 0,56% of phosphorus, 0,85% of potassium.

(table 4)

We can note in general, that percentage of main nutritive elements in the green

manure mass of lupine surpasses slightly the same numbers of forage beans.

The arable soil layer received 20,86t of **organic matter**, while using forage beans as a **green manure**. This comprises 324,8kg of nitrogen, 110,7kg of phosphorus,

and 151,3 kg of potassium. When using lupine as a green manure, the soil was

enriched with organic matter considerable more, than when using forage beans,

amounted to 27,11 t/ha in three years, comprising 500,8 kg of nitrogen, 170,6 kg of phosphorus and 234 kg of potassium. This amount of organic matter input

equals to input into lay 30-40t of covering manure.

Thus the soil was enriched with organic matter, which are easily to mineralize.

And this caused intense process of decay with germs. So the vegetable mass

decayed up to 50% by the seeding of winter wheat at average within 2012-2014

as a result.

We should note, that decay velocity of green manure mass was influenced mostly with the depth of plowing of these ones into field. The organic matter dissipated in the upper layer (0-10cm) less, than in medium one, of depth 10-20cm. The destruction velocity of organic matter reduced in the bottom layer. The less intensity of

destruction in the upper layer is more likely connected to the periodic drying out, and the one in the bottom layers- connected to insufficient aeration.

**Conclusion.**

That is why the green manure is an efficient method of agriculture, which positively impacts on soil, plants, environmental settings. It makes a manifold effect on

soil: facilitates mode of modification of organic matter in soil, increase the

efficiency of yield from other crops. Bean cultures involve the biologically fixed nitrogen into rotation, contribute the improvement of quality indexes of harvest,

play the sanitary role in the vegetation. Green manure reduce the contamination

of fields, protect soil, reduce labor efforts and expenses on the production.

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