

## PLANT HEALTH RISKS ARISING BY THE SOIL EXHAUSTION

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**Key-words:** soil exhaustion, plant health risks

**Abstract.** Factors that determined phytosanitarian chernozems worsening was examined in the space between Prut and Nistru in the global phenomenon of agricultural soil exhaustion. It was established anthropological and natural origin (pedofunctional) phenomenon of studied exhaustion chernozems exhaustion. The main cause of chernozems exhaustion is to reduce the dominant role of the training and accumulation of humus. Through this prism of ideas, soil exhaustion and phytosanitarian worsening is inherent to agricultural system currently practiced. The impact mitigating of this process involves the bioenergy resources sustainable management involved in anthropogenic pedogenesis.

### Introduction

#### Conceptual and methodological considerations

Technologies attaching used in contemporary agriculture by phytosanitary products of synthetic fertilizers, led to neglect the traditional plant health management of agricultural soils based on natural processes supporting, especially on carbon, nitrogen, phosphorus and other elements cycle. Time accumulating negative effects (increased damage to the soil biota and their debiologysation) caused decrease, practically to the minimum, self-regulation capacity and enlarged reproduction of plant protection of soil ecosystem.

At the same time agricultural soils are affected by a number of natural - anthropological processes that intensifies the degree of soil plant health worsening. Among these are:

- disrupting of processes that ensures the substances and energy exchange in soil-plant system;
- unidirectional alienation of nutrients and plant balanced nutrition disruption;
- the biofile elements cycle and balance disrupting within ecosystems;

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- physico-chemical characteristics changing, especially soil solution reaction change. Reducing the role of the dominant cation adsorption complex Ca: Mg due to intensive Calcium alienation by crops;
- structural-aggregate composition worsening, porous space and hydro-physical characteristics degradation;
- soil biological regime disruption and soil pathogenic microflora development;
- pests and weeds multiplying. Their development cycle is dependent of various pedo-functional frameworks. However, in most cases, their ontogenesis early stages arising under the soil condition which depends on their diffusion and their negative impact.

Integrated processes index set is the phenomenon of soil exhaustion materialized in its overcultivation status. So, the soil infection degree and risk of agro-ecosystems affecting with *Orobanche* in this study is examined in the whole evolution process of soil plant health, the management of this pest, to be based on improved plant health general of the soil by reduction / exclusion of soil exhaustion phenomenon. In this context, soil exhaustion is examined as a result of ecological balance breakdown in soil-plant system as a result of unidirectional action of human activities and ecosystem agrophytocenoses ground. It restructuring materializes in order to increase the mass of soil biota specific microflora, being less valuable agronomic pedofunctional and harmful. To a large extent, this is the nature of soil biota reaction energy sources nature with debris falling annually pedogenesis organic farming. Meanwhile soil biota degradation and ecological balance disturbance in soil-plant system is driven by accelerated soil degradation processes. In this regard, the phenomenon of soil exhaustion is part of bioenergetical resource degradation processes group along with soil debiologysation, dehumification and depletion phenomena.

By ecological point of view, soil exhaustion is the result of ecological crisis which is the result of unfit agrocenosi adaptability and adaptive potential of the soil ecosystem. In a such inconsistencies, crops are no longer able to biotop modelate to provide enlarged environment reproduction. Thus, in such conditions and bio-productive function of soil ecosystem is suddenly reduced, respectively to agrocenosi. Trying to restore the environmental factors balance (pedogenetic factors that are less dependent on technical and human impact), despite intensified technical and human momentum (fertilizer, intensive works, more productive varieties, etc.) agroecosystems pass a new evolutionary phase. Within this are involved new mechanisms, able to ensure the soil-plant restoring relationships in compliance with environmental factors. This requires intensive development of weeds (ruderal flora), which is one of the first stages in the successive restoring process of steppe ecosystems (Ковда, 1973). Thus, soil exhaustion is accompanied

by intensive development of pests and pathogens. In natural ecosystems conditions, due to exhaustion, soil-plant system is transferred to another of substances and energy exchange level, thus creating the prerequisites for a biocoenosis substituting.

As agricultural, structure and agrophytocenoses sequence, it is determined by economic interests and largely carries a monoculture character as a result of short crops rotations (3-4 years). Under these conditions, soil degradation processes by soil-plant system balance disrupting are inevitable. This implies the increasing risks involving problematic plant pest. Among them, the last 20-30 years, increasing the risk of *Orobanche cumana* Wallr. infestation. Subsequently, we plan impact assessment of evolving plant health processes of soils due to bioenergetical chernozems degradation.

### Scope and study methods

The research involved field application and laboratory studies. In the field applications were collected soil samples from 0-30 cm arable layer according by the instructions in force. Each land was divided into plots with an elementary area of 12 hectares (Jigău et al, 2007). Within each plot were collected from 30 individual samples which were subsequently acquired medley weighing samples by 800-1000 g soil.

Laboratory studies were performed according to standard methods of Moldova (Tab.1). To assess the exhaustion degree were used critical levels shown in tab. 2.

Table 1. Soil agrochemical indices assess used methods

N d/a	Determined arameters	Unit	The method of determination	STAS
1	Humus content	%	Tiurin to TINAO change	26213-91
2	P <sub>2</sub> O <sub>5</sub> content		Macighin	26205-91
3	K <sub>2</sub> O content	mg/ 100	Macighin	26423-85
4	The content of N-NH <sub>4</sub>	g	TINAO	26489-85
5	The content of N-NO <sub>3</sub>	juice	ionometric	26951-86
6	The pH		potențiometric	26423-85

To make soils grouping according to the degree of fatigue was used the grouping represented in T.

### Matherial and methods

Bioenergetic resource degradation materialize by reducing humus and biofile elements reserves in soils with consequent degradation of soil biological regime. In this regard, the current research indicated the prevalence, both in the center and in the south of the republic of Moldova, soils with moderate humus content (78-81%).

Table 2. Critical levels of regimes parameters of composition and cernozems characteristics between the Prut and Dniester space under soil exhaustion certifying and plant health worsening.

The composition, characteristics and soil regimes	Critical parameters
The mineralogical composition	Montmorillonite smectite content < 30%. Kaolin content of > 10%
Particle size composition	Physical clay content > 75%. Fine clay content > 40%
Physico-chemical properties	Predomină SiO <sub>2</sub> (> 80%). Conținut de humus < 4%. The content of labile humic substances < 0.15%. Mineral salt content and neutral chemistry > 0.3% and > 0.25%, sodium chemistry. Cation exchange capacity < 20 ml / 100g soil. As < content of adsorbed Ca < 70% of the cation exchange capacity. Mg content > 30% and Na content > 10-15% of the total cation exchange capacity. The pH value 8.2.
Agrochemical characteristics	Mobile P <sub>2</sub> O <sub>5</sub> content < 3.1 mg / 100g and exchangeable potassium < 25mg / 100g of soil
Physical features	Apparent density > 1,4cm <sup>3</sup> . Total porosity of < 40%.
Structure	Content of valuable agronomic soluble aggregates (> 0.25mm) constitute less than 40%.
Hydrophysical features	The humidity under the withering coefficient. The permeability to water < 30 mm / hour. Field water capacity < 25% w / w.
Characteristics and composition of soil air	Aeration porosity of < 15%. CO <sub>2</sub> content > of 3%. O <sub>2</sub> content < of 10%.
Redox potential	E <sub>h</sub> < 250mV

Optimal soil humus content (4-5%) account for just 7-8%, and those with humus content of less than 2% 12-14% their duties.

Table 3. Cernozems grouping depending on the bioenergetical exhaustion degree

The exhaustion degree	Agrochemical parameters			
	Humus content, %	Total nitrogen content, %	Mobile P <sub>2</sub> O <sub>5</sub> content, mg/100g sol	Content of exchangeable K <sub>2</sub> O, mg/100g sol
Absent	> 4	> 0,18	> 3,4	> 25
Low	3 – 4	0,15 – 0,18	3 – 3,4	20 – 25
Moderate	2 – 3	0,10 – 0,15	2 – 3	15 – 20
Increased	1 – 2	0,06 – 0,10	1 – 2	10 – 15
Very increased	< 1	< 0,06	< 1	< 10

The obtained results involves the conclusion that contemporary processes of chernozems humus state evolution in space between the Dniester and Prut, leading to genetic distinctions blurring between typical chernozem humus moderate and

low humus in the central and poorly humus and carbonate in the south. Therefore, in anthropogenic pedogenesis in formation and accumulation of humus process no more fulfills a dominant role in progressive unidirectional cernozems evolution.

Table 4. Surfaces share with different levels of humus and micronutrients (%) insurance of typical moderate humus chernozems in central R. Moldova

Category	Humus content %	Total nitrogen content, %	Nitrogen ensuring	Mobile P <sub>2</sub> O <sub>5</sub> content, mg/100g sol	Content of exchangeable K <sub>2</sub> O, mg/100g sol
Very low	-	-	-	-	-
Low	14	-	14	36	7
Moderate	78	86	78	14	8
Relatively optimal	8	-	8	22	57
Increased	-	14	-	7	14
Very increased	-	-	-	7	14

Such chernozems state is estimated to stagnant with their subsequent regressive evolution, with reduced humus ability to ensure phytosanitary soil stability in ecosystems and increasing phytosanitary risks. This is determined, while reducing the humus content in the soil is disturbed homeostasis state within cernozems and increases the pathogens and pests share, interfering toxicosis and exhaustion of soils state (Anaeba et al., 2011). Soils with a higher humus content have physical properties and pedo-functional regims (hydric, hydrothermal, aerohidric, thermal, biological) that favor more vigorous crop plants development and their largest resistance to various pathogens and pests.

In this context, all presented in tab. 7 and 8 data show that depending of soil humus content, practically (with few exceptions) all arable chernozems are affected by the phenomenon of exhaustion. Moderately exhausted soils are dominant, demonstrating that the chernozems in space between the Dniester and Prut is characterized by a stagnant state which is also prone bioenergetics management., demonstrating that the space between the Dniester and Prut Chernozems is characterized by a stagnant bioenergetical state which is also prone management. demonstrating that the space between the Dniester and Prut Chernozems is characterized by a stagnant state which is also predisposed to management. As a result, the agrotechnical optimization system of plant-pathogen relationships, emphasis will be placed on the management of soil organic substances based on plant debris (Маръин, 1996). According to the author within experimental fields established that, under the management of organic fertilizers, the phytosanitary risks probability, including infection with broomrape is 2.5 times lower compared

to the control and 1.5 times lower than areas where mineral fertilizers were administered (Марьин, 1996).

Table 5. Surfaces share with different levels of humus and micronutrients (%) insurance of typical low humus chernozems in south region of R. Moldova

Category	Humus content %	Total nitrogen content, %	Nitrogen ensuring	Mobile P <sub>2</sub> O <sub>5</sub> content, mg/100g sol	Content of exchangeable K <sub>2</sub> O, mg/100g sol
Very low	-	-	-	6	6
Low	12	16	12	44	15
Moderate	81	84	81	-	56
Relatively optimal	7	-	7	12	6
Increased	-	-	-	26	19
Very increased	-	-	-	12	-

Despite these findings, the last 30-35 years, these components of the agricultural system are out of control, with that fact, there is a stable trend of phytosanitarian state worsening. In addition, practically everywhere crop rotation is

Table 7. Exhaustion degree assess of cernozems in central region of R. Moldova

District, town	Humus content		Nitrogen content		Phosphorus content		Potassium content		Soil reaction	
	%	Exhaust.d	%	Exhaust. d.	mg/100g	Exhaust.d.	mg/100g	Exhaust.d.	pH	Exhaust.d.
Leova, Cazangic	3,30	moderate	0,15	low	1,3	high	21,4	low	7,45	absent
Cimişlia, Gura-Galbenei	4,00	absent	0,14	moderate	0,6	very high	14,8	moderate	7,80	absent
Căuşeni, Grigorievca	2,60	moderate	0,14	moderate	4,3	absent	53,4	absent	8,00	absent
Ştefan-Vodă, Ermoclia	3,45	moderate	0,22	absent	3,7	absent	24,6	low	8,00	absent
Ştefan-Vodă, Talmaza	1,40	high	0,24	absent	9,6	absent	54,0	absent	8,05	absent
Comrat, Congaz	2,00	high	0,22	absent	1,2	high	20,6	Low	8,30	low
Comrat, Chirsova	2,30	moderate	0,18	low	1,6	high	24,6	low	8,30	low
Comrat, Beşalma	2,50	moderate	0,18	low	4,0	abs	29,4	absent	8,20	low
Comrat, Svetlâi	2,30	moderate	0,18	low	1,3	high	23,4	low	8,25	low
Basarabasca, Carabetovca	1,80	high	0,18	low	1,4	high	19,0	moderate	8,30	low
Ceadăr Lunga	2,15	moderate	0,16	low	1,6	high	22,2	Low	8,30	low
Taraclia	2,80	moderate	0,14	moderate	1,4	high	23,2	low	8,30	low
Cahul, Alexandrfield	3,45	low	0,16	low	4,2	absent	32,0	absent	7,75	absent
Cahul, Manta	3,25	low	0,24	absent	3,9	absent	19,0	moderate	7,75	absent
Cahul, Slobozia Mare	3,25	low	0,24	absent	8,0	absent	25,0	low	8,90	absent
Cahul, Crihana Veche	2,10	moderate	0,21	absent	4,8	absent	59,4	absent	7,80	absent

ignored and crop structure was reduced to 3-5 cultures, thus was creating a favorable environment for pathogens preservation and others intensive

development. Carried research are revealing high variability degree of mobile phosphorus content, in the central and south area chernozems caused by anthropogenic and landscape natural evolution. Thus, in the southern area of about 50% of the studied soils are characterized by a very low (6%) and low (44%) content of mobile phosphorus.

The soils of the central area are also in the deficiency of mobile phosphorus (36%) and moderate supplied with phosphorus soils constitute 14% of the investigated soils.

Table 8. The exhaustion degree assess of cernozems in central R. Moldova

County, locality	Humus content		Nitrogen content		Phosphorus content		Potassium content		Soil reaction	
	%	Exhaust.d.	%	Exhaust.d.	mg/100g	Exhaust. d.	mg/100g	Exhaust.d.	pH	Exhaust.d.
Telenești, Verejeni	2,25	moderate	0,24	absent	5,9	absent	60,6	absent	7,5	absent
Telenești, Căzănești	1,85	high	0,31	absent	9,3	absent	64,0	absent	8,0	absent
Telenești, Brînzeni	2,95	moderate	0,28	absent	2,7	low	51,6	absent	7,8	absent
Orhei, Ciocîlteni	3,65	low	0,26	absent	1,5	high	29,0	absent	7,8	absent
Criuleni, Izbiște	2,55	moderate	0,24	absent	3,5	absent	25,8	absent	7,8	absent
Dubăsari, Holercani	3,55	low	0,22	absent	2,4	low	27,0	absent	8,05	absent
Dubăsari, Molovata-Veche	3,55	low	0,22	absent	3,0	absent	26,4	absent	7,6	absent
Chișinău, Băcioi	2,50	moderate	0,19	absent	3,2	absent	21,4	low	7,7	absent
Chișinău, Sîngera	3,70	low	0,20	absent	1,7	increased	28,2	absent	7,3	absent
Anenii-Noi	2,00	high	0,15	low	0,8	very high	18,2	high	7,95	absent
Hîncești, Buțeni	3,05	low	0,19	absent	1,5	sporit	30,2	absent	8,2	low
Hîncești, Fundul-Galbenei	2,65	moderate	0,16	low	1,4	sporit	25,8	absent	7,4	absent
Strășeni, Rassvet	4,05	absent	0,16	low	1,9	sporit	50,0	absent	7,9	absent

Within the southern areas, half of studied lands are characterized by a relatively optimal (12%) to high (26%) content of mobile phosphorus, the central area are characterized only with 14% supplied by increased and very increased with mobile phosphorus soils, and optimally supplied 22%.

Thus, we conclude that the phosphorus content variability in soils is influenced by anthropogenic factors evaluated by the uncontrolled use of phosphorus fertilizers. However, analyzing the current situation on phosphorus supply state we can deduced that the effect of residual fertilizers with phosphorus used in the past is limited in time, so that the soil can not form reserves able to maintain a longer period of time containing stable phosphorus mobile ground that

would provide a longer period. Therefore, the phytosanitary risk, caused by phosphorus deficiency in soil, intensifies over time.

Potassium content is more stable due to the origin nature and circuit of this element. Research results show that more than 80% of soils are supplied with optimal or high potassium content. The great soil majority regenerates spontaneously the potassium content adsorbed in the primary and secondary minerals structure. This process is roots facilitated, shifting potassium by deepest soil horizons.

Thus, according to research, physicochemical mechanism for the mobile potassium recovery is even much evident as the insurance status of soil potassium is better (Ковда, 1983). This often involves the idea that the region chernozems does not require potassium intervention. However, according to calculations, Chernozems lost about 41% of initial reserves of potassium (Носко и др., 1983). Therefore, it is possible that the intensification of phytosanitary risk caused by potassium reserves reduction.

### Conclusions

At the current stage of chernozems evolution in space between the Dniester and Prut, phytosanitary soil state is one of factors determining the trend of the evolutionary pedogenesis process. The investigated soils phytosanitary state evolution is interlaced with the process of soils exhaustion. Soil exhausting is a complex phenomenon, influenced by evolutionary processes of soil within agroecosystems, determining role assigning to the bioenergetical soil resources degradation (debiologisation, humification, depletion).

The main factor that causes intensive exhaustion and accelerated phytosanitary worsening is dominance reducing of humus formation and accumulation in anthropogenic pedogenesis framework. Chernozems studied are vulnerable to exhaustion caused by mobile phosphorus deficiency and methods absence of stable reserves insurance in soil. Exhaustion risk, related to exchangeable potassium reserves evolution is attenuated, while still persist in time.

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