Bridge Agriculture as the Basis of Preserving Soiled Bioorganisms

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Abstract. Scientifically based agriculture causes ensuring the increasing growth of productivity of crops at preservation and increase in fertility of soils.

1. Introduction

The soil – it a difficult organism a part of which is 25% of water, 25% of air, 50% of solid substance, 5% of mass of solid substance is presented by organic substances - it is roots of plants, a humus, live organisms. Live organisms are earthworms, bacteria, mushrooms, etc., as a result of the activity mineralize the died-off roots and land, transform mineral connections and nitrogen of air to connections available to food of plants, causing fertility of soils.

Normal functioning of a soil biota, depends on consolidation of the soil when performing technological processes.

There is a number of the agrotechnical actions promoting decrease in negative impact of heavy machinery on a soil cover. Treat their number:

- use of bridge tractors with a width of flight of a track of 4-12 meters;
- the agrobridge with a width up to 50-100 meters;
- to the movement on constants we freeze, etc.

The most rational, in our opinion, is the option of use of the agrobridge in the form of the walking platform carrying out movement across the field on constants, specially equipped technical "points" by means of the moving-forward beams plates. The complete elimination of pressure upon the soil of power mechanisms and considerable decrease in consolidation by working bodies will create optimum conditions for the water-air mode, and together with it preservation and normal functioning of a soil biota of preservation and increase in fertility of soils.

The main quality indicator of the soil as main means of production in agriculture is its fertility. The fertility of the soil is defined by a complex of the physical and biological factors providing optimum conditions for life and development of the cultivated cultures.
Each of elements as a part of the soil, presented in the figure 1 is irreplaceable for normal functioning of root system of plants, formation of a harvest a tuber (root) of fruits. At the same time those types where solid substances make 50%, water – 30% and air of 20% belong to optimum types of soils. [1]

Under natural conditions this ratio is supported due to particle size distribution and chemical and physical processes. In firm fraction of soils external impact on which is made by modern power and technological agricultural units with their weight to 14 t in the course of performance of agrotechnical operations, repeated for the vegetative period, lead to violation of this ratio due to reconsolidation. Expression from interstices of soil of air and water increases the specific weight of the soil that leads to a number of negative consequences. The high density of the soil creates mechanical difficulties for growth and development of root system, results in ugliness a root tuber crops. The lack of water and oxygen constrains oxidizing processes in translation of mineral substances of soils (NPK, etc.) in usvoyaemy forms.

Depth of penetration of root systems into the soil substantially depends on density of her addition.

Roots of plants can sprout through rigid structure of the soil if a time in her is larger than the sizes of root chekhlik. Backs can't get without energy expenses into a rigid time less than 0,1-0,2 mm in

Figure 1. Structure of 1m³ of the soil at a depth of 20 cm (according to K. Haynitsu).
size, and root hairs during a time less than 0.01 mm. The penetration of roots decreases at increase in density of soils. Roots can't sprout through excessively condensed layers and are forced to grow often horizontally along them. [2]

A specific place in formation of fertility is held by the organic part of soil structure presented by live organisms. Proceeding from the sizes of live soil organisms, they are divided into the following groups:

- a macrobiota – roots of plants, large insects and earthworms;
- a mesobiota – nematodes, pincers, nogokhvostka, the smallest larvae of insects some other organisms;
- a microbiota – bacteria, mushrooms, seaweed, the elementary;

The soil serves as vital space for many animals. From 22 types of the animals totaled by zoologists 10 have the representatives living in the soil. From invertebrates the elementary live in soils, flat, round and Annelidas, mollusks, tikhokhodka, arthropods, etc. Vertebrata are presented by amphibians, reptiles, mammal. The most numerous inhabitants of the soil are the elementary, round and Annelidas, arthropods.

So the number of earthworms, pincers and other invertebrates depending on type and a condition of the soil can change in hundreds thousands times, for example for the earthworms giving the main contribution to the zoomass of the soil, it can fluctuate within 50-4000 kg/hectare. At the same time their weight considerably concedes to more numerous small animals – ticks, mnogokhvostka, nematodes, etc. Protozoa, up to 200 billion individuals on 1 m3 are most plentiful in soils (in a layer of 0-1 cm), also fast updating is peculiar 1-3 days to them. [3]

Inhabitants of the soil as a result of the activity perform huge pochvoobrazovatelny work:

- mix among themselves her various layers;
- carry away organic substances on depth;
- mechanically destroy vegetable fabrics (especially roots);
- decompose and mineralize sheet опад and the died-off organisms;
- emit biologically active agents, stimulating growth of microorganisms and roots of plants;
- laying the courses, improve temperature, water, gas and salt structure of the soil;
- change particle size distribution of soils.

The essence of all activity of soil animals comes down to movement of material from the lower horizons on a surface, to pull-in deep into of the vegetable remains and a humus blanket, to change of the chemical composition and structure of a soil cover. In optimum conditions soil animals are capable to overwork of 1 hectare up to 225 t of soil weight a year, completely mixing a superficial korneobitayemy layer approximately in 20 years.

In formation of fertility the significant role is played by soil microorganisms. The quantity of microorganisms are more in more gumusirovanny horizons, not condensed soils. Much they are in the layer of earth adjacent to roots of plants (rizosfer), in hundreds times more, than in other mass of the soil. In a zone of a young root bacteria and mushrooms, nitrifiers, yeast, seaweed actively breed. Microorganisms rizosfer, producing a number of vitamins and growth substances (гидберелин and heteroauxin), promote strengthening of growth of plants. По способности вызывать определенные процессы в почвах микроорганизмы делятся на группы:

1. The Zimogenny group decomposing the fresh vegetable and animal remains.
2. The autochthonic group possessing the powerful enzymatic device which is capable to decompose complex humous substances.
3. The Oligotrofny group consuming very low concentration of simple organic substances, finishing process of a mineralization of organic substances on a surface.
4. The autotrophic group transforming mineral connections. Nitrous oxide, hydrogen, iron protoxide, hydrogen sulfide, carbon monoxide, methane, ethylene and other connections can be power supplies and energy for soil autotrophs.

Air is one of the most important factors of normal activity of soil microorganisms. So at a lack of air activity of aerobic bacteria decreases and consequently processes of education in the soil of
nutrients, necessary for plants, fade. At the same time in anaerobic conditions inevitably there are recovery processes as a result of which in the soil different zakisny connections, harmful to plants, collect [4]. One of the major factors in formation of solid of plants in the course of photosynthesis as is well-known are carbonic acids in composition of the atmosphere air. The lack of carbonic acid of air is compensated by the carbonic acid emitted from the soil which collects in the course of breath of microorganisms. Normalization of the air-and-water mode of the soil considerably is defined by optimization of density of the soil which considerably depends on technology of influence of crops.

Nitrogen one of the major elements in formation of a harvest of plants which considerable part plants receive for the account of activity of microorganisms in the course of ammonification or decomposition of the vegetable remains. The special value in fixing of nitrogen of air is occupied by tuberous bacteria as a result of symbiosis with bean plants. Using organic compounds of plants (owner) for the activity bacteria absorb nitrogen from air fixing him in klubenka on roots of bean plants. One of the most important conditions of vigorous activity of klubenkovy bacteria is rather good air mode of the soil. Thus normal functioning of a soil biota, and together with it preservation and increase in fertility of soils substantially depends on the optimum water-air mode of soils, extent of her consolidation in the course of performance of technological processes. In modern agriculture consolidation of the soil became one of the main problems regarding decrease in degradation processes [5]. Use more and more powerful, and together with it more and more heavy tractors, combines and agricultural tools leads to her consolidation. Consolidation of the soil is aggravated with low contents in the soil of organic substance and use of an arable land and pastures at high humidity of the soil [5].

Destruction of structure of the arable horizon and the soil sharply reduces fertility. At the same time the arable horizon separated by a dense plow sole from other profile of the soil which almost isn't participating in a metabolism of an agroecosystem [6] is formed.

Reconsolidation and deformation of soils under the influence of heavy machinery extends up to the depth of 1 m.

Under the influence of heavy machinery density of the soil increases for 20-40% that reduces water penetration by 2-3 times. Consolidation of the soil leads to increase in her specific resistance due to increase of the efforts spent for layer cutting, his turn and friction of the soil about the working surface of the tool. At the same time fuel consumption increases, in the CIS countries his overexpenditure makes about 1 million tons per year. The high density of the soil sharply worsens its agrophysical properties, the water-air and nutritious modes, contributes to the development of an erosion, there is an oppression of activity of soil microorganisms. The general losses of a harvest of crops caused by consolidation of the soil on chernozems can reach 45% a year, and in general reduce productivity by 25-30%. According to the estimates of the German experts because of reconsolidation of soils about 50% of a harvest don't reach [6].

Soil consolidation reduces efficiency of fertilizers and use of energy in production of agricultural production, worsens environment ecology [7].

There is a number of the agrotechnical actions promoting decrease in negative impact of heavy machinery on a soil cover. Improvement of technology and the equipment belong to their number combination of operations for decrease in number of passes of heavy machinery on fields. According to G.V. Matuzov, O.S. Bezuglov [8] wheel tractors depending on number of passes condense the soil from 1,02 to 1,49 g/cm3, caterpillar – from 1,09 / см3.урожайности at the same time decreases to 1,35 g almost twice (table 2).

In Russia about 10% of a soil cover of fields are condensed in weak degree, 50% - in average and 40% - in strong.

Losses of an arable land due to reconsolidation under the influence of the equipment can reach 10-15% of the used lands. It amplifies in case the soil at the time of loading is in the rehumidified state.

In this regard the problem of improvement of the equipment is rather relevant.
Improvement of the equipment and her use includes a number of technology and design solutions. In the review article A. Skuratovich [9] are considered and a number of ways of reduction of pressure upon the soil at increase in productivity and quality of the grown-up cultures are offered:

**Table 1.** Influence of the compacting effect of tractors on the soil and the yield of the green mass of the wick suck mixture.

| Number of passes of the tractor | Volume mass of the soil (g/cm³) before crops at a depth, cm | productivity |
|--------------------------------|-------------------------------------------------------------|--------------|
|                                | 0-10            | 10-20         | 20-30         | 30-40         |              |
| tractor MT3-50 (3-4 tonn)      |                 |               |               |               |              |
| 0                              | 1.02            | 1.13          | 1.39          | 1.40          | 218.3 ± 5.6  |
| 1                              | 1.02            | 1.25          | 1.41          | 1.42          | 179.9 ± 1.7  |
| 3                              | 1.32            | 1.34          | 1.43          | 1.47          | 153.3 ± 3.0  |
| 5                              | 1.49            | 1.50          | 1.52          | 1.53          | 116.6 ± 3.0  |
| tractor T-74 (7 tonn)          |                 |               |               |               |              |
| 0                              | 1.09            | 1.18          | 1.31          | 1.39          | 218.0 ± 4.1  |
| 1                              | 1.19            | 1.22          | 1.35          | 1.42          | 190.0 ± 2.9  |
| 3                              | 1.27            | 1.33          | 1.40          | 1.47          | 164.0 ± 2.9  |
| 5                              | 1.35            | 1.38          | 1.45          | 1.47          | 110.0 ± 1.4  |

1. Use of a constant technological track:
   - the movement of cars across the field with an identical width of a track at all cars;
   - use of the bridge tractor with a width of flight of a track of 4-12 and more meters;
   - use of the agrobridge with a width up to 50-100 meters;
   - reduction of the area of traces in the field due to transition to the movement on constant technological "points" - the walking cars, the string agrobridge.
2. Transition to the contactless propeller – the airbag, the airship.
3. Transition to self-moving agricultural tools.
4. Reduction of number of passes of the equipment across the field due to reduction of number of agrotechnical operations:
   - to use the cars which are carrying out several operations for one pass;
   - to reduce the number of agrotechnical operations;
   - to pass from traditional technology of processing of the soil to zero (no-till);
   - to pass to crops of seeds in covers in 2-3 years;
   - to pass to crops of seeds in covers on the surface of the field.

The most radical, in our opinion, is the option of use of the agrobridge in the form of the walking platform carrying out movement across the field on the constants which are specially equipped technological to “points” by means of the moving-forward beams plates. The complete elimination of pressure upon the soil by power mechanisms and considerable decrease in consolidation by working bodies will create optimum conditions for the water-air mode, and together with it preservation and normal functioning of a soil biota, preservation and increase in fertility of soils. Considerably the patented Automated Agrotechnical Platform device (AASP) [10] the General principle a platform utrosytsvo in fig. 1-2 meets these requirements. In the figure 1 the ground equipment is presented. The ground is presented by sites of the field of 30 m of width (length depending on the site sizes), water intaking channels – 2, mezhpoly roads – 3. Sites are processed by the working mechanism moving according to the platform 4. Crushed-stone pillows-5 where are placed basic concrete blocks (9), settle down through 10 m, on them the platform moves.
Figure 2. Basic device of the AASP self-moving platform. 5 - support, 6 – the AASP platform from a profile of P-shaped section, 7,8 - mobile beams, 9 – crushed-stone pillows, 4 - the working bodies placed on the platform, 10 - hydraulic cylinders.

The self-moving platform (fig. 2) represents a frame of 10x30 m from profiles of P-shaped section 6 in which take place a beam 7 and 8 which moving forward lay down on concrete blocks 9. The working bodies placed on the platform 4, moving on long cross beams 6, carry out technological operations.

Movement of the platform is carried out by step-by-step promotion on support of 9 beams 7. The system at the same time unloads at the expense of hydraulic cylinders (10).
2. Conclusion
Thus when performing technological operations by the bridge platform (AASP) the soil cover actual isn't exposed to consolidation that causes the optimum mode for development of root system and a soil biota, promotes preservation and increase in fertility of the soil of high profitability of agriculture.

3. References
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Figure 3. Ground Equipment. 1 – a field cage, 2 – the water in taking channel, 3 – the turning strip (is expensive) 4 – the AASP platform, 5 - supports.
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