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Circulation of organic carbon in agro-ecosystems of different crop rotations

The purpose. To determine normative parameters or model or a cycle of carbon in agro-eco-systems of different crop rotations at use of alternative kinds of organic fertilizers and to fix basic regularities of directedness of carbon cycle in conditions or modem climatic system or Forest steppe or Ukraine. Methods. Field, laboratory, estimation, mathematical statistical. Results. Between mass of C_{ogr} in aocessory products and mass of C_{ogr}, involved in the process of humification, the direct correlative dependence (R=0,94±0,05; R2=0,88) is installed; with mass of C_{ogr} spent for mineralization, the direct connection in the order of straight linear dependence is fixed. Critical receipt is determined of C_{ogr} from accessory products in the range of 40-70 l/hectare for year which meets minimum involving of carbon in the process of humificatian and maximal rales of mineralization and emission of CO2 in atmosphere. At importation of dung through mineralization in atmosphere on cumulative yield it is giving off in 3,45 times less CO2 than at importation of accessory products. Conclusions. In agro-ecosystems of different crop rotations at use of accessory products as organic fertilizer scarce balance is formed of C_{ogr} which value is diminished at transferring from7-10 field to 3-5 field crop rotations. That testifies to decrease of negative influence of CO2-factor and maybe considered as the proof of limitation of carbon nutrition at augmentation of productivity of cultures in agro-ecosystems. Under such circumstances vector of CO2-factor is directed aside positive values that promotes accumulations of organic carbon in major produce and organic soil, thus agro-ecosystems of crop rotations find properties of stock heat-sink systems.

Key words: organic carbon, carbon of cycle, balance, emission, CO2-factor, crop rotation, agrocenosis, dung, accessory products.

A considerable amount of scientific research [5, 9], in particular fundamental [6-12, 19], is devoted to the issue of carbon monoxide. Investigation of the problem of formation of organic carbon stocks and changes in its qualitative state in agro-crops in crop rotation requires a tax-based study both from agroecological and agronomic point of view. The work of Raynau and Lunddegord [15-18] initiated the study of one of the most determinant meteorological factors - the content of carbon-acid gas in the atmosphere. It was found that in plant groups there is no constancy of parietal pressure, since during the day and in the growing season there are significant changes, which made it possible for Huber [13, 14] to conclude that daily changes in the content of COG occur predominantly in The thicker air that directly adjoins to the vegetable this-noses in height of sable. Lunddegord [15] at the beginning of the XX century. Introduced the concept of "CO2 factor", which is interpreted as the difference between the present concentration of carbon dioxide at the same level as a plant group and in a free atmosphere. The presence of a negative COG factor was considered as evidence of limiting carbon dioxide in agroecosystems. Quantitative estimates of the annual net flow of Sorgmiz with agroecosystems and the atmosphere are few and quite opposite, which is still a controversial issue, not even with respect to magnitude, and as to the sign of the flow of carbon dioxide, it is not clear whether there is, in the end, a pound biota and a plant group Agrocenosis source or runoff for atmospheric SOg. In view of this, there is a need for more detailed research. Of particular relevance is the carbon turnover in agrocenoses of crop rotation when replacing manure with by-products in the modern climatic conditions of the forest-steppe [1, 4]. The purpose of the research is to establish the normative parameters of the carbon model when applying various types of non-rotational crop rotations and the use of alternative types of organic fertilizers and to identify the basic patterns of carbon sequestration in the conditions of the modern climatic system of the forest-steppe of Ukraine. Research methodology. The research was carried out in the central part of the Left Bank Forest-steppe of Ukraine in the long-term (more than 50 years) stationary experiment of the Drabiv experimental field of the Cherkasy State Agricultural Research Station "NSC" Institute of Agriculture of the National Academy of Sciences ". The experiment is located on chernozem with a typical low-humus volumetric-light-volcanic-loamy humus content of 3.8-4.2%, mobile phosphorus-12-14 mg per 100 g of pound, moving potassium-8-10 mg per 100 g of soil, pNn2O = 6.8-7.0. Studies were carried out according to generally accepted methods [2]. The area of 27 hectares, the number of plots - 1300; The size of the plot - 230 and 162 m2, and the accounting, respectively, 100 and 50 m2 in 3-fold repetition. Reconstructed 10-crop rotations in 12 five-crop crop rotation, two 4-pit, one 7-way and six 3-way crop rotations. The structure of crop rotation is presented in Table. 1-2. Fertilizer systems included the following doses of fertilizers: winter wheat, corn, spring barley, wheat germ, soybeans - IMbroboKeo, peas - N20P40K40, sunflower - N40P40K40, sugar beet - N100P100K100. By 1999 6 t / ha of manure were introduced, and from 2000 to 2014 - by-products of 6-7 t / ha. The method of cultivation in crop rotation is differentiated. Calculation of the carbon turnover in agrocenoses of crop rotation of different types by weight of released carbon is carried out according to the authors' method [1] and [3].

Research results. Productivity of 7-10-crop crop rotation during 1999-2013 at the cumulative exit of the c.o. From 1 hectare averaged 584 t / ha, or 38.9 t / ha each year. The variation to the maximum-typical values (max.t) was 615-675 t / ha, and to the minimum-typical (min.t) - 521 -524 t / ha, or 43 and 34.8 t / ha each year. In 72% of cases, crop rotation varied from 525 to 625 t / ha (35 t / ha and 41.7 t / ha) respectively. The average content of Sorg in the main products was 237 t / ha with a deviation of up to 308-317 t / ha by max.t interval and up to 173-175 t / ha per min.t, or 20.8 and 11.6 t / Ha annually (Table 1, Fig. 1). Consumable item Sorg associated with the mineralization of by-products, the average weight of which was 519 t / ha (34.6 t / ha) with a deviation of 565-573 t / ha (37.6 t / ha) at max.t Up to 402-463 t / ha (28.8 t / ha per year) per min.t. In terms of the mass of CO2 emitted from the mineralization of by-products and represents emissions into the atmosphere, it is on average 1902 t / ha (127 t / ha annually) with maximum and minimum intermittent deviations: 2070-2100 t / ha (136 t / ha per year) and 1471-1675 t / ha (106 t / ha per year). The yield of by-products in 7-10-hectare crop rotations indirectly amounted to 1428 t / ha with deviations to the maximum (tx) and the minimum (TP) values: 1475-1605 t / ha (102.7 t / ha) and 1266 - 1305 tons / ha (85.7 t / ha), respectively. Over 80% of the crop rotation had a by-product output of between 1250 and 1650 t / ha (83.3-177 t / ha each year). The mass of carbon in lateral products (Sorg (p.pr)) The average value was 668 t / ha (44.5 t / ha per year) with deviations to 724-771 t / ha for tachi and 526 -600 tons per hectare per type, or 49.8 and 37.5 tons per hectare annually, increasing by saturation of crop rotation with corn or decreasing for increasing in the structure of crop rotation of spring wheat crops. The total mass of primary crops of agrocenosis (Sorg (t) + Sorg (p.pr) = Sorg (agr)) averaged 905 t / ha (60.3 t / ha per year) with deviations to 1067-1088 t / Ha (max. 775-792 t / ha), or 71.2 and 52.2 t / ha annually. The increase in the emission of carbon dioxide from the mineralization of by-products correlates with the increase in the amount of input of the by-product at the direct A strong correlation (P? = 0.85-0.89 ± 0.03; P2 = 0.77). The total mass of the extracted (Copr (agr)) from the agrocenosis of 7-10-crop rotation is the sum (Sorg (t) + Cs02)) and on average amounts to 778 t / ha with deviations for shah.i and at the tip of the interval Alloys are within 908-962 t / ha and 547-649 t / ha, or 62.3 t / ha and 39.9 t / ha respectively. In percentage terms, due to the emission of 68.7% of carbon, COG is removed from agro-enzootic, and in the interval: 64.4- 71.3%. The removal of Sorg from the main products accounted for an average of 31.3%, or from 28.7 to 35.7% (figure). The balance of Sorg in the agrocenoses of 7-10-crop rotation for the use of organic fertilizers of non-market share of the harvest was 124 t / ha (-8.27 t / ha annually) with minimum negative values: -38-15 t / ha and maximum: - 184-175 t / ha, or -27 t / ha and -12 t / ha. The intensity of the balance of the Sorg in the agrocenoses of the crop rotation (In / b (agr)) was low: in the average I / B (agr) = 19.2%, with deflections for the tank L - 22-23% and for the tip ^ - 16-18%. The soil sorghum balance (Bsorg) on average in the crop rotation was negative: Brass = -0.11 t / ha with interval deviations for TL and for the interval L, the interval: Bsr = = 0.73-0.75 t / ha and Brass = -0.65-

1.13 tons per hectare. The distribution was leaning toward negative values. The intensity of the Sorg soil balance was, on average, 55% with a deviation of 96-97% for the max. And up to 27.5-30.7% for the type with a minimum interval value. Sufficiently high porosity indices of the Sorga Balance in the soil are related to the intensive use of Sorgue from by-products to gumination (Sorg (rubber)): On average 22.8% for deviations from 27 to 16.6%, and The correlation between Corg (rubber) and Corg (s02) (Cg) had a mean value of Kg = 0.29 for the interval deviations: Kg (max) = 0.37 and Kg (tip) = 0.24. The aforementioned circumstances influenced the general balance of humus: +0.056 t / ha (average) with offsets from +2.87 t / ha (max. T, -2.13 t / ha), or +0 .003 t / Ha, +0.19 t / ha and -0.14 t / ha each year (Table 3) Noteworthy is the estimation of the change in the Sorgue cycle during the replacement of manure with by-products and vice versa.In the stationary experiment up to 1990, manure was introduced, By-products of almost 85-90% were withdrawn in favor of animal husbandry. 6 m3 / ha of manure was introduced. The productivity of crop rotation, where manure was introduced (No. 8, 2, 12, 9, 7, 5), was lower by 15 t / ha, And the quantity of by-products (poppy + pericarp Remnants) was 2.3 times lower: 36.3 t / ha remained for manure every year, 83 t / ha for straw input. It was established that for the introduction of manure, the percentage of Sorgh from the by-products entering into rubberization, The maximum was the introduction of by-products of 550-600 tons / ha, or 36.6-40 tons per hectare per year, which is less compared with the use of organic fertilizers of non-market share of the yield of 2.5-2.7 times.

Turn Sorg in agrocenoses of unequal crop rotation for a cumulative yield for the conditions of the Centeltal Forest-steppe: a -7- 10-crop rotations; B - 3-5-crop crop rotation - Sorgh humification, t / ha (I.); '' Th - Sorgo mineralization, t / ha (i); '■' * - Sorga CO2 mineralization, t / ha (Ts; -ch, - Сорг гумификации to Сорг (CO2), (в)

The total removal of Agrocoenosis sorghum for manure was reduced by 2.2 times, and for the removal of Sorg, the share of the harvest accounted for 1.5 times less Sorg. The loss of organic carbon due to mineralization (Sorg (co2)) was lower by 3.39 times compared with the use of straw. The intensity of the Sorg equilibrium in agrocenosis for manure increased 1.7 times and reached 30-36%. In the absence of manure due to mineralization in the atmosphere of the cumulative yield, 3.45 times less OG is emitted: 580 t / ha against 2000 t / ha for the unproduct share of the crop, or 40 t / ha and 135 t / ha respectively. With the use of manure, the intensity of the balance in Agrocenosis increases the correlation with the values of direct strong correlation (K = 0.85-0.89 ± 0.03; K2 = 0.77) with the share of the involved carbon in the processes of humification and co With respect to Cg, and with the expense of Sor on the processes of mineralization, the bond is amplified to the strong correlation of the inverse (K = -0,85-0,88; K2 = 0,75). For the introduction of manure, the intensity of the balance of Sor in the soil increases in the range of 1.45-1.55 times. The change in the set and the ratio of crops in short rotation crop rotation modifies the Sorgo colonization both in agroeconomy in general and in soil directly. The average productivity of short-rotation crop rotation (3-5-cabins) at the cumulative yield was 410 t / ha or 27.3 t / ha annually (Table 2). Maximum-typical values of productivity were 524-551 t / ha. (34.9-36.7 t / ha), and the minimum-typical - 167-317 t / ha, in the crop rotation were 1045 t / ha (69.7 t / ha). The average Cogr content in the main products was 138 t / ha or 9.2 t / ha annually. For max.t, the value of the contents of Corg was 172-183 t / ha (11.5-12.1 t / ha), and in the min.t interval: 92-105 t / ha (6.1 - 7.0 t / ha), respectively. The maximum-typical content was at the level of 1255-1495 t / ha (83.7-99.6 t / ha), and the minimum-typical - 375-873 t / ha (25.0-58.2 t / ha) . In lateral products, 490 t / ha of sorghum were kept from 592-683 t / ha to 183-413 t / ha. The total stock of Sorg was 627 t / ha on average, or 42 t / ha each year. The maximum stock of Sorgh varied in the range of 755-828 t / ha, and the minimum - 285-505 t / ha (50.5-55.2 t / ha and 19-34 t / ha annually). Average withdrawal of Sorg (CO2) was 387 t / ha, or 25.8 t / ha annually. The maximum loss was 471-549 t / ha, and the minimum - 132-325 t / ha, or 34 and 15 t / ha annually. The mentioned costs of Sorg (GHG) due to the non-normalization correspond to emissions of carbon dioxide to atmosphere of 1420 t / ha (95 t / ha annually). The maximum emission of SOE is 2446 t / ha (163 t / ha), and the minimum - 462 t / ha (30.8 t / ha per year). Compared to 7-10-sewage changes, the loss of Sorg for mineralization in corrosion crop rotations decreases by 1.2-2.2, while the costs due to the allocation of carbon dioxide are 1.26-2.31 times. On average, in short-rotation crop rotations, the Sorgh of ag-rocenose extract is 531 t / ha, or 35.4 t / ha annually, and the Sorghese removal of the agrocenosis limits is accelerated by 1.23-2 times (Figure). The Copr balance in agro-crops of short-term crop rotation was -66 t / ha, reducing the deficit to -3 t / ha and increasing it to 182 t / ha, which is less deficit than the balance in crop rotations with prolonged rotation. Typised positive values of the balance change in the range from +0.73 t / ha to +1 t / ha, and negative: from -0.49 to -1.27 t / ha, which, in terms of the annual balance, is +0,006 t / ha, + 0,49-0,07 t / ha and -0,03-0,035 t / ha. Unlike crop rotation with long rotat-tion, the humus balance was mostly positive (+ 0.23 t / ha). Between the balance of Sorg (agr) and Sorg (UAH), the correlation relationship was at a low untrustworthy level. The transfer of Sorg from by-products to organic soil material yielded 102 t / ha or 6.8 t / ha per year (Table 3). The range from minimum to maximum consolidation varied from 50 t / ha to 160 t / ha (3.3 and 10.7 t / ha per year). On average, 22% Sorgh passes from the Sorgo byproducts, and the minimum and maximum fixations make up 16.8-30.8%, which corresponds to long-term rotation crop rotations. In the short-term crop rotation, the amount of Corg, which is involved in rubberization, is less in 1.39-2.11 times than crop rotations with long rotation. The intensity of the soil balance in the soil is 28% on average, with a variation of 44% to 22%. Compared to prolonged rotational crop rotations, the intensity of the balance of Sorgh decreases by 1.8-2.4 times due to the removal of the structure of perennial and annual grasses and an increase in the percentage of corn, soybeans, and sunflower.

A number of general patterns were found for all types of crop rotation, the essence of which is reduced to the fact that there is a direct correlation relationship between the mass of the Sorogus byproducts and the weight of the Sorg which is involved in the rubberization (K = 0.94 ± 0.05, K2 = 0,88), and with the mass of Sorg, which is drawn to the waste articles for mineralization, a bond is formed at the level of linear linear dependence. However, the percentage of involvement of Sorg from byproducts directly involved in rubberization and Kg, and the total output of the by-products of the connection was reversed (IR = -0.56-0.59 ± 0.03, K2 = 0.35). As the inflow of Sorg mass from the by-products of SorgDo's attraction increases, the humification decreases (Figure).

Conclusions

In the agrocenoses of diverse crop rotations, the deficit balance of the organic fertilizer is formed as an organic fertilizer, the shortage of which decreases during the transition from 7-10 to 3-5-crop rotation compared with the use of manure, which indicates a decrease in the negative The significance of the SO-factor and is considered as evidence of limiting carbon dioxide to increase the productivity of crops. Between the weight of Sorg in the byproduct 'and the mass of Sorg, which is involved in rubberization, a direct correlation connection (I = 0,94 ± 0,05; Я2 = 0,88) is revealed, and with the weight of Sorg which is involved The cost of articles for mineralization, the connection was established at the level of linear linear dependence, between the percentage of the involvement of Sor from the by-product to the rubberization and Kg and the total yield of the by-products of the bond was reversed (P = -0.56- 0.59 ± 0.03, No. = 0.35). The critical yield of Sorgh from the by-products is found at the level of 600-700 t / ha, or 40-70 t / ha each year, which corresponds to the lowest carbon sequestration to the humification and the highest rates of mineralization and the release of COG into the atmosphere. When replacing manure with by-products, the total removal of Sorg for the introduced manure from ag-rhenosis decreased by 2.2 times, and for the removal of the market share of the harvest accounted for 1.5 times less Sorg. The loss of organic carbon due to mineralization (COpr (C02>) was 3.39 times lower than the application of straw. Due to the introduction of manure due to micronalisation into the atmosphere, 3.45 times less COG is released after the cumulated yield: 580 t / ha Compared to 2000 t / ha for the unproduction share of the crop, or 40 t / ha and 135 t / ha respectively. For the use of by-products as organic fertilizers, the process of optimizing the carbon turnover in agrocenoses of crop rotation of different types in the direction of the natural organization leading To the growth of reserves of ground carbon, with Stipulated by the increased emission of COG into the atmosphere from mineralization of the surplus of by-products, which, in turn, leads to an increase in the productivity of agro-cenosis due to the increased absorption of organic carbon by crops of agrocenosis.In such circumstances, the CO-factor in agrocenoses increases, which acquires the properties of wastewater systems

Bibliography

1. Demidenko O. V. Management of carbon traffic in agro-crops under the influence of low carbon agrotechnologies / O. V. Demidenko, V.A. Velichko // Visn. Agrar Science -2014. - No. 11. - P. 46-52.

2. Armor B.A. Field experiment technique (with basics of statistical processing of research results) /B.A. Armor - Moscow: Agropromizdat, 1985. - 351 pp.

3. Ponomarenko S.P. Increasing the utilization rate of SOEs should become a reality on the Ukrainian lands / S.P. Ponomarenko, L.A. Anishin, L.V. Datsko // The manual of the Ukrainian grain breadman: sci.-Practice. Save T. 1 - 2014 - P. 153-155.

4. Saiko V.F. Use of fertilizer for lateral crop production in Ukraine / V.F. Saiko // Agriculture. - Vip 81. - K .: ВД «ЭКМО», 2009. -С. 3-10.

5. Tate Sh.R. Organic Soil / Sh.R. Tate; Per. From english O.D. Maslova, D.S. Orlove - M .: Mir, 1991. - 399 p.

6. Titljanova A.A. Changing the carbon-carbon cycle due to different uses of land (on the example of the Krasnoyarsk Territory) /A.A. Titljanova, B.V. Chuprova // Soil science. - 2003. - No. 2. - C. 211-219.

7. Titljanova A.A. Production process in agrocenoses / A.A. Titljanova, H.A. Tikhomirova, N.G. Chateohin - Novosibirsk: Science, 1982. - 184 pp.

8. Trofimov S.Ya. Functional Approach to the Exploration of Soils / S.Ya. Trofimov // Vestn. Moscow Uniate. Sir 17. - 1992. - No. 3. - P. 3-11.

9. Ukraine and Global Greenhouse Effects: Influence and adaptation of ecological and economic systems to climate change // [I.F. Buksha, P.F. Gorzyk, Zh.L. Yemelyanova, IV Trofimova, A.I. Shereshevsky]. - K .: Publishing House of the Agency for Rational Energy Use and Ecology, 1998. - 210 p.

10. Sharkov I.N. Methods for assessing the need for organic fertilizers for the deficit-free carbon balance in soil / I.N. Sharkov // Agrochemicals. - 1986. - No. 2. - P. 109-118.

11. Sharkov I.N. Investigation of the balance of carbon in the soil in connection with the application of organic and mineral fertilizers: author's abstract. Dis On the co-operation. Scholar steppe. Cand. Biol. Sciences / I.N. Sharkov - Novosibirsk, 1986. - 25 p.

12. Sharkov I.N. Mineralization and balance of organic matter in the soils of agrocenoses in Western Siberia: author's abstract. Dis To soup Scholar steppe. Doc. Biol. Sciences / I.N. Sharkov - Novosibirsk, 1997. - 37 p.

13. Huber W. Der Einfluss der Vegetation at Schwankungen des C02-Gehaltes der Atmosphare // Arch, für Meteorol. - 1952. - No. 4. - S. 154-167.

14. Huber B. Die Co-Konzentration in Pflan-zengesellschaft. - Handbuch der Pflanzenphysiologie, 1960. - Bd. 5. - S. 339-348.

15. Lundegardh H. Der Kreislauf der Kohlen- saureversorgung in der Natur. - Yen, 1924 - 327 s.

16. Reinhard E. Zur Kinetik der CO2 in der Luft um Griinpflanzen in geschlossenen Bestanden // Arch, für Gartenbau. - 1923. - No. 2. - S. 27-45.

17. Rhine E. Der CoG-Gehalt, Lichtproduktgesetzt und Resttheorie der Luft-C02 // Angew. Botanist - 1957 - Bd. 31. - No. 3. - S. 74-83.

18. Revelle R. Carbon dioxide and world climate // Sei. American - 1982. - V. 247. - No. 2.

19. Uzun N. Determination of Urease Catalase Activity and Respiration in Different Soils Obtained from Semi Arid Region Konya, Turkey / N. Uzun, R. Uyanoz // Trends Soil Science Plant Nutrition Journal. - 2011. - No. 2 (1). - P. 1-6.

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