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D. Litvinov,
Doctor of Agricultural Sciences
National Scientific Center "Institute of Agriculture of NAAS"

Formation of water regime of soil in system of short crop rotations

Goal. To determine ways of rational use of soil moisture by crops for cultivation in the system of short rotation crop rotation. Methods. Field, laboratory, comparative and analytical. Results The features of formation of water regime of soil in the system of short rotation crop rotation depending on the saturation and placement of agricultural crops in them and the level of their intensification are shown. Conclusions In the conditions of an extremely drought-growing period, the early days of productive moisture in the soil layer of 0 - 160 cm, accumulated at the expense of precipitation in the autumn-winter-early-spring periods, are the determining factors for the formation of crop yields. The highest total soil moisture consumption during the growing season for sunflower cultivation was 437-468 mm, corn for grain - 419-433, sugar beet - 405-488, and all other crops - 291 to 375 mm.

Key words: short rotation crop rotation, culture, water regime of the soil, precursor, reserves of productive moisture.

Formulation of the problem. Reservoirs of productive moisture in the soil are the main factor in the relationship between soil and plant, which is crucial for obtaining friendly stairs and subsequent vegetation of crops. Insufficient soil moisture not only negatively affects the development of culture, but also greatly reduces the effectiveness of certain elements of cultivation technology [2 - 6, 13].

Under conditions of unstable moisture, the greatest negative impact on the process of forming crop yields is the lack of rainfall during the period of vegetation and high temperatures of air and soil. Therefore, important and topical issues not only in the context of the current development of agriculture, but also in the context of global climate change is the study of their influence on the accumulation of moisture in the soil, and, consequently, the obtaining of stable crop yields. Consequently, taking into account the climatic conditions of the region, the biological peculiarities of crops with respect to water consumption and the water regime of the soil under crops, it is possible to determine ways of rational use of soil moisture and precipitation by agricultural crops in the process of their cultivation in the system of crop rotation [9 - 12].

The purpose of the research is to determine the ways of rational use of soil moisture and precipitation by agricultural crops in the process of their cultivation in the system of short rotation crop rotation.

Research methods. The paper presents the results of studies on the patterns of formation of the water regime of the soil in the system of short-rotation crop rotation. Stationary experiment on crop rotation is located on the black soil of the typical low-humus Panfilskaya SS NSC "Institute of Agriculture NAAS". The average annual rainfall in the experimental station, according to the Yagotyn meteorological observation station, is 250-670 mm, with an average value of 442 mm. In the climatic plan, this is the subzone of the unstable moisture of the Forest-Steppe of the Left Bank. Distribution of precipitation for months is uneven: in arid years, stocks the productive moisture in the arable layer decreases to a level of 3 - 5 mm, in a layer 0 - 100 cm - to 20 - 25 mm and as close as possible to the indicator of its dead stock. In the years when the greatest amount of precipitation falls in July-August, favorable conditions for winter crop sowing are created. The results of the conducted studies showed that the lowest volumetric strength in the soil layer of 0 - 160 cm on the average is 24-25%, or 286 - 312 mm (for a bulk soil weight of 1.19 - 1.25 g / cm3), the maximum hygroscopic humidity in the average - 5.6%, inaccessible moisture content is 6.08% or 76 mm. That is, the available moisture content in the soil layer of 0-160 cm at the marginal field moisture content is 210-236 mm. In the experiment two to five crop rotations with saturated cereal crops of 50-100% (including cereals 33 - 50%), fodder - 25%, technical - 20 - 50% were studied. The size of the crop area is 90 m2, the registration number is 40 m2, the repetition is 3 times. Placement of options and repetitions - systematic. Grown crops: wheat of winter and spring (fertilizer system - N60P60K60), spring barley (fertilizer system - N60P40K60), buckwheat (fertilizer system - N30P40K40), corn on grain (fertilizer system - manure 30 t / ha + N60P40K60), sugar beets (manure system - manure 40 t / ha + N90P100K100), sunflower (fertilizer system - 20 t / ha manure + N90P60K90), peas, soybeans, perennial beans (fertilizer system - P30K40) .

Research results. During vegetation, the water regime of the soil in crop rotation varies considerably, and in its dynamics, there is a clear periodicity. In the autumn-winter period, when most fields do not have a green cover, the soil accumulates different amounts of productive moisture at the expense of autumn rainfall (figure).

In this important role is played by such factors: the culture that occupied the field during the vegetation and released it, the state of the soil surface after treatment, the initial state of moisture the upper horizons of the soil. According to the averaged long-term data for 2005-2009, in the soil, which is plowed in the experiment in autumn, the highest productive moisture at the time of winter entering is accumulated after the growth of winter wheat (127 mm) and spring barley (135 mm), which liberates the field at the earliest - at the end of July Less productive soil moisture is accumulated in the fields after growing wheat wheat, its predecessor was sunflower (104 mm) and corn (113 mm). The least productive moisture is accumulated in the fields after the cultivation of beet sugar (76 mm) and sunflower (93-97 mm). Fields occupied by new winter wheat crops (variants 1-4), at the time of entry into the winter, also differed in moisture content in the soil layer of 0-160 cm: in the field where the alfalfa was preceded by wheat, 184 mm of moisture was accumulated, buckwheat - 157 peas - 138, soybeans - 115 mm.

In the spring, due to the precipitations of the winter and early spring periods, the total reserves productive moisture throughout the studied layer of soil is restored, growing and somewhat aligned in the fields, varying in the range of 211 - 276 mm. However, the amount of moisture accumulated from the soil varies by fields. The highest moisture content was accumulated from precipitation in fields plowed on the grass after the growth of sugar cane (200 mm), spring wheat (155 mm), sunflower (114-132 mm), less - after the barley menu (105 mm) and corn (106 mm), at least - after winter wheat (64 - 81 mm).

Such a state of moisture accumulation from the soil is associated with the availability of spring stocks in the ground in the fall: the higher they are, the less moisture from the precipitation absorbs the soil during the next winter-early spring period. Despite the high degree of soil moisture absorption in the fields after the cultivation of sugar beet and sunflower, the total moisture reserves in the early spring field work, as a rule, are lower compared to other predecessors. In the spring-summer period, the cost of moisture prevents its accumulation in the soil. During vegetation, soil moisture is used to a greater extent for the formation of a crop and, in part, for physical evaporation from the surface the soil In fields occupied by agricultural crops, we determined the total moisture costs due to the evaporation of the soil surface and plants (Table 1).

The start of observations coincides with the beginning of the spring field work. The dissipation of moisture under different crops is uneven during the course of the course [3, 8]. In particular, for the cultivation of grain cereal crops, the continuous use of sowing (wheat of winter and spring, spring barley) is the greatest amount of moisture in the period from the restoration of the winter wheat vegetation or the sowing of spring wheat crops before the beginning of their ear crops (Table 2).

In this period, for winter wheat production, the average perennial indicator was 199 mm, spring barley - 179, spring wheat - 198 mm. It should be noted that in this case the layer of soil is dried up the most 0-100 cm. In the future, from the beginning of the eruption to the degree of full ripeness of the cultures, the total waste of moisture decreases.

Thus, in the field of winter wheat they made 152 mm, that is, by 47 mm less than in the period from the restoration of the vegetation to ear crops, in the barley menu of the spring - 149 mm, in the wheat of wheat - 143 mm of productive moisture, which was respectively 30 and 55 mm less than in the period from sowing to colony. The peculiarity of this period of vegetation is that the consumption of productive moisture takes place from the entire thickness of the soil 0 to 160 cm. In forming the water regime of chernozem soil under cultivated crops (corn for grain, sugar beet, sunflower), two periods can be distinguished : the first - from the beginning of field work to the closure of the leaf in the intermediate row of sugar beets and the appearance of 5-6 true leaves in corn and sunflower (Table 3). During this period, small crops use a small amount of soil moisture, mainly from the upper layer of soil. So, in corn crops for grain, the moisture consumption during the period from sowing to 5-6 leaves was 80 mm, sunflower crop from sowing to the appearance of 5-6 pairs of leaves - 125-133 mm, sugar beets - from sowing to closing leaves in rows - 117 mm. In the second period from the closure of leaves in the rows of sugar beets and the appearance of 5-6 true leaves in corn, sunflower, and until the end of their growing season, the water regime of the ground changed dramatically: the plants intensively grew, and the costs of moisture increased. In particular, in corn crops they ranged from 80 mm in the first period to 296 mm in the second, in sunflower - from 125 to 133 to 314 - 316, sugar beet - from 117 to 329 mm. That is, the moisture consumption increased in corn crops by 216 mm, sunflower - 183 - 189 mm, sugar beet - 212 mm. Taking into account the residual moisture reserves in the soil, at the time of harvesting, the soil of sunflower and sugar beets is most dried out [7]. For the cultivation of these crops, the total moisture consumption from the beginning of spring and before harvesting is greater than the crop rotation of the rest of the crops. In the post-harvest period, due to the sharp reduction of evaporation in almost all fields of crop rotation, the processes of accumulation of moisture in the soil begin to predominate again. The dynamics of the formation of available moisture reserves in the soil after harvesting of agricultural crops, as an example of a 5- and 2-way crop rotation, is given in Table. 4. In absolute terms, the indexes of moisture accumulation from precipitation in fields that were the earliest subject to plowing for the winter (after winter wheat and spring wheat, spring barley) and cultivation for winter wheat after peas were 30 - 46 mm. In the fields of late spring crops, after collecting moisture reserves in the soil were recorded as the lowest, and the post harvest period was the shortest, the accumulated moisture content was 16 mm (field after sugar beet) - 50 mm (after sunflower).

However, the use of atmospheric precipitation during this period in most fields was only 20 - 45%, and only in fields after sunflowers, where the soil was the driest, - 52 - 62%. In the fields occupied by new winter wheat crops, the accumulation of moisture from the precipitates in the soil was insignificant (20%), since it was used by plants.

Conclusions

It has been established that the autumn reserves of productive moisture in the soil (layer 0-160 cm) are formed by the culture that liberated the field and the level of atmospheric humidification during this period. The highest reserves of productive moisture at the time of entry into the winter are created after the cultures that liberated the field in the earliest form - winter wheat (127 mm) and barley (135 mm), lower - after corn for grain (113 mm), wheat bran, predecessor which was sunflower (104 mm), and the smallest - after growing sunflower (93 - 97 mm) and sugar beet (76 mm). The periods of active use of moisture from the soil and precipitation in the wheat plants of winter and spring wheat crops fall to the first half of the vegetation, in the late spring (corn, sugar beet, sunflower) - to the second. In the conditions of an extremely dry arid vegetation period, the early days of productive moisture in the soil layer of 0-160 cm, accumulated at the expense of autumn-winter-early-summer periods, are the determining factors for the formation of crop crops. The highest total soil moisture and rainfall during the vegetation period for sunflower cultivation were 437-468 mm, corn for grain - 419-433 mm, sugar beet - 405-488 mm, all other crops - 291 - 375 mm.

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