experimental researches on speed of moving substances cells of leaves it is found that this indicator does not exceed 0.1×10^{-3} m^2/min. for stevia grown in agroclimatic terms of Ukraine.

Processing the results of studies on changes in moisture content, diterpene glycosides and flavonoids for two years, samples of stevia leaves dried at different temperatures were the basis of the regression equation. Data processing allows obtaining coefficients characterizing the degree of influence of one of the two parameters used during drying of the ground part of stevia: temperature and time.

Thus, conducted theoretical and experimental studies became the basis for obtaining mathematical model of stevia growing and regression equation of storing its leaves.

***Key words**: stevia, post-harvest processing, diterpene glycosides, porosity of leaves*

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INFLUENCE OF PECULARITIES OF PRIMARY CULTIVATION ON ITS AGROPHYSICAL INDICATORS OF FERTILITY AND WATER REGIME WHEN GROWING SPRING RAPE

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Наведено аналітичний огляд вітчизняних і зарубіжних літературних джерел, щодо впливу різних способів і глибин основного обробітку ґрунту на агрофізичні показники родючості ґрунту, а також його водний режим. Встановлено, що існуючі рекомендації містять недостатньо інформації про оптимізацію основного обробітку ґрунту під ріпак ярий. До того ж, питання заміни полицевого обробітку безполицевим після стерньового попередника практично не висвітлене. Мало даних і про вплив глибини оранки та плоскорізного розпушування на умови росту, розвитку і продуктивність ріпака ярого на чорноземах опідзолених.

***Ключові слова:** ріпак ярий, спосіб і глибина основного обробітку ґрунту, агрофізичні показники родючості ґрунту, водний режим ґрунту.*

Agriculture of Ukraine during its reforming is characterized by instability of production, land depletion, deterioration of material and technical base, reduction of capital investment and increasing social tensions. Course on market reforms in the short term did not improve the situation in the field because of lack of competitiveness of crop production, in cost structure of which a large share of expenses for mechanical tillage and basic one occupies in particular.

One way to reduce the cost of manufactured products is minimizing tillage based on the reducing of basic tillage depth and introducing other less energy-intensive primary tillage instead of moldboard plowing [1].

In current economic conditions when economically profitable crops are grown mainly (among cereals – winter wheat, among oil crops – sunflower), schemes of crop rotations and structure of sown areas are violated resulting crops are not provided with good predecessors and their yield is reduced due to deterioration of the physical, chemical and phytosanitary state of fields. To solve

this problem is possible due to spring rape which as a good predecessor for winter wheat has to become that crop in levels of crop rotations which will ensure stability of agricultural production in different regions of Ukraine. Applying rape into crop rotation will reduce sown areas of sunflower by half because their yield and commodity cost is almost the same but costs for rape cultivation are much less [2]. In addition, it significantly improves soil fertility state and phytosanitary of fields because rape does not deplete the soil, but rather improves its structure and increase fertility, leaving after by 1.5 times more residues than cereals, improves the phytosanitary state of crops and is an excellent predecessor for many crops including winter wheat.

One of the most important indicators of agrophysical condition of the soil is its density. For most agricultural crops its optimal values are in the range of 1.1 to 1.3 g/cm^3 which corresponds to 50–60 % of the total porosity at aeration porosity no lower than 15 %. Parameters of such physical condition of the soil determine the possible limits of tillage minimization in different areas of its application [3]. The optimum density promotes fast and simultaneous sprouting, better root development and growing vegetative mass of crops which ultimately helps to ensure higher yields. Over soil compaction causes deterioration of plants – the root system has a lower weight and volume because the soil is a mechanical barrier to the growth of roots, has fewer pores filled with water and air. At the same time plants also react negatively to excessive tillage especially in the period from sowing to germination because sown seeds in this case have a little contact with the ground.

It is found that moldboard plowing and boardless plowing unequally affect the indicator of the soil density. Thus, according to data of I. Popova [4] the density of the soil before the winter period and at the beginning of field work was higher in variants with boardless cultivation compared with variants where plowing was done, though, and remained at the same time in optimal range.

When studying different ways of cultivation in the Crimean Experimental Station of the southern black soil with a low content of humus it is found that the density of the soil in variants with tillage and moldboard plowing to a depth of 12–14 cm was almost equal and was in the soil layer of 0–10 cm before winter 0.90–0.92, in spring – 0.92–0.96 g/cm^3, and in the layer of 10–20 cm – accordingly 0.98–1.02 and 1.07–1.11 g/cm^3. In summer density of the plowed soil in the layer of 0–10 cm increased to 0.11 g/cm^3. The density of soil of 10–20 cm in both variants retained at the level of 1.11–1.13 g/cm^3 and did not extend beyond the optimal [5].

When studying different ways of cultivation in typical chernozem of Lugansk region there is no significant difference of the soil density in different variants before winter and at the beginning of spring field work [6].

Experiments carried out in other soil-climatic zones also found no significant differences between the ways of cultivation on the effect on the soil density [7].

Changing the way of basic tillage and reducing its depth from 28–30 to 10–12 cm cause no significant density of the typical chernozem in the conditions of the former Tatar ASSR [8]. Similar results were obtained in Uman State Agrarian University in the study of different ways and depths of main cultivation for sugar beets [9].

A.M. Pestriakov [10] believes that only through deep cultivation regardless of the method it is possible to reduce the soil density for optimum indicators which in turn provides increasing yields over 10 %.

Observations [11] showed that sod-podzolic soils in spring volume density of the soil was close to 0.99–1.17 g/cm^3 that is optimal for all variants of the experiment but the lowest density was noted with deep moldboard plowing at 25–27cm.

The soil composition and structure is closely related with its density. Some scientists [12] believe that the soil depth has a little effect on the soil porosity in the layers of 0–10 and 20–30 cm. Thus, when plowing for barley at a depth of 20 and 27 cm porosity was 57.5–58.0 % without significant differences between the variants. However, there is evidence that the method and depth of tillage affect its density (preferably in layers of 10–20 and 20–30 cm) only in the early growing season. The soil porosity in the layer of 0–30 cm before sowing of spring crops only by 1 % was higher after the autumn plowing than after shallow moldboard plowing.

Years of research [13] showed that when the soil has good structure (waterproof agronomical valuable aggregates over 70 %) and the topsoil density is optimal for agricultural crops, the annual deep main tillage for them should not be carried out.

Many researchers found that replacement of moldboard plowing with boardless one and changing the depth of these plowings had a little influence on structuring topsoil. Yes, A.H. Kulikova and S.E. Erofeev [14] claim that by the content of the total number of agronomical valuable aggregates (0.25–10 mm) in the topsoil difference between variants of the experiment where moldboard tillage and plowing were carried out at 20–22 cm was not observed.

Replacement of moldboard plowing with boardless one and depth reduction of moldboard tillage for growing corn in steppe regions of Ukraine do not affect on content in the topsoil of agronomically valuable structure and its water resistance even tended to increase.

It was found [15] at boardless soil cultivation the aggregate composition of the soil was not adversely affected and the coefficient of structuring soil after plowing was slightly lower than after cultivation with boardless instruments. The content of waterproof aggregates larger than 0.25 mm not depending on methods of cultivation remained relatively high. Similar results were obtained by other researchers.

However, in studies of I.D. Primak [16] deterioration of the structural state of the topsoil at boardless cultivation compared with long moldboard one was mainly due to the formation of clods and lumps more than 10 mm in diameter. Thus, the amount of dusty particles (less than 0.25 mm) at all stages of cultivation was close – 6,2–8,0 % and soil layer, which was processed, was crumbing most intensively during tilling: structuring coefficient was 1.33. Some its reduction (by 1.19–1.20) was at moldboard plowing, especially at shallow one (1.05–1.13), stimulated by increasing lumps. So in spring areas after boardless tillage usually become flooded less than plowed ones. The reason is that at cultivation without chunk rotation the natural character of putting processed soil layer remains unchanged. The surface layer of soil, enriched with plant remains, becomes well structured, that is why

does not become flooded and is processed in spring more easily with harrows and cultivators.

A number of authors [17] believe that after stubble predecessors and applying for the field a couple of only mineral fertilizers the best way of cultivation in the second rotation under winter wheat is deep moldboard plowing which does not only improve yielding but also increases the resistance of soil to erosion by improving soil structure. It was determined that the systematic implementation of non-plowing cultivation in crop rotation increased content of structural jointings in the size of 2–5 mm in layers of the soil 10–20 and 20–30 cm compared to plowing by 1.34–1.53 times.

One of the important indicators characterizing the soil fertility is water resistance of aggregates that means the ability not to collapse under the action of water. The most number of waterproof aggregates in the soil [18] was after moldboard plowing (69.2–70.7 %) while in other conditions [19] in variants where the subsurface plow was used, waterproof aggregates were lower. For example, in the soil layer of 0–20 cm in variants with moldboard plowing there were 50 % waterproof aggregates and with boardless plowing – 55–59 %. There is also evidence [20] that the number of waterproof aggregates in the size of 0.5–3.0 mm and 2–5 mm structural jointings in the layer of 0–10 cm was the same in different ways of the basic tillage.

Different ways and depth of primary tillage differently influence the water regime of the soil. Currently, there is no consensus on the choice of basic soil tillage method, implements which at the same time will be used and the depth of its applying.

Spring rape is demanding to moisture, especially in the early stages of growth and development (sowing-shoots). Group of scientists of Uman NUH [21] proved that the yield of early grain crops depends more on groundwater reserves at the time of sowing than on rainfall during the growing season. This opinion is shared by V. Stoliarov [22] who notes that in conditions of unstable humidity with frequent droughts in summer, winter precipitation is the main source of moisture accumulation in the soil and in some years – the main source for plants in the growing season.

The study [23] at Erastivska Experimental Station showed that in dry conditions of autumn-winter period at the beginning of sowing slightly higher moisture amounts were accumulated during moldboard plowing by 28–30 cm compared with plowing at the same depth and were in 1.5-meter layer respectively 142 and 125 mm. When autumn-winter period was very humid some preference was for deep plowing. In average years for moisture available moisture reserves were slightly higher in areas with moldboard plowing.

I. Chudanov [24] when comparing tillage and moldboard plowing determined the dependence that autumn cultivation with moldboard instruments due to stubble leaving in the field, which is mulch, contributes to moisture accumulation in the soil in autumn. With such cultivation in his studies on average for six years moisture in a meter soil layer was to 100m^3/ha more than when plowing. It is also proved that in fields processed with the subsurface plow due to stubble snow was more accumulated that was better kept from blowing. In such fields snow of the first snowfall was left, the soil was frozen to a lower depth; in spring it was

melting faster and better absorbed melt water. The difference in productive moisture reserves in the time of sowing of early spring crops between plowing and the subsurface plow was on average 19.5 mm during years of research for the benefit of moldboard plowing.

According to other researchers [25] significant difference by humidification of arable and meter layers of the soil during plowing to 20–22 cm and moldboard plowing to 18–20 and 20–22 cm was not found. Thus, for 1977–1978 reserves of available moisture in a meter layer in the time of sowing in all variants of cultivation were 151.8–155.2 mm.

According to many researchers methods of basic cultivation almost do not affect the moisture accumulation in autumn [4].

Comparing moldboard tillage by 25–27 and 14–16 cm in the study of dynamics of soil moisture preference of deeper cultivation was found where moisture reserves in a meter soil layer were higher by 37 mm. The author explains the fact that in the cultivation by 25–27cm the soil was plowed deeper and accumulated rainfall moisture better [26].

Similar results were obtained by other researchers [27]. However, there are conflicting data when on the background of moldboard tillage by 12–14 cm plants were provided with moisture better than in the variant with moldboard cultivation by 20–22 cm [5].

By depth of wetting soil during autumn-winter period plowing (20–22 cm) had no advantage over boardless one including shallow tillage (10–12 cm). Moreover, the accumulation of available moisture shallow tillage dominated over other cultivations [28].

But according to some authors tillage takes precedence over moldboard plowing in accumulation and preservation of moisture. Therefore, they recommend carrying out plowing to a depth of 18–20 and 20–22 cm [29, 30].

Conclusion. From the above analytical review it can be seen that even in conditions of one soil-climatic zone conflicting data were obtained on the impact of different ways and depths of basic tillage on agrophysical indicators of soil fertility and its water regime. So this issue in terms of Right-Bank Forest-Steppe of Ukraine remains relevant today and deserves the further study.

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Аннотация

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Влияние особенностей основной обработки почвы на его агрофизические показатели плодородия и водный режим при выращивания рапса ярового

В нынешних условиях, когда выращиваются преимущественно экономически выгодные культуры (из зерновых – пшеница озимая, а из масличных – подсолнечник), нарушаются схемы севооборотов и структура посевных площадей, в результате чего культуры не обеспечиваются хорошими предшественниками, их урожайность снижается из-за ухудшения физического, химического и фитосанитарного состояния полей. Кроме этого, спрос мирового рынка на масличное сырье стабильно высокий и постоянно растет. Увеличение производства продукции масличных культур в Украине становится острой проблемой, решить которую можно благодаря широкому использованию рапса ярового. Он является хорошим предшественником для озимой пшеницы и должен стать той культурой в звеньях севооборотов, которая обеспечит стабильность сельскохозяйственного производства различных регионов Украины. Чрезвычайно актуальным этот вопрос является для тех западных, центральных и северных областей Украины, где другие масличные культуры в связи с почвенно-климатическими особенностями выращиваться не могут. Введение в севооборот рапса ярового позволит уменьшить посевные площади подсолнечника наполовину, поскольку их урожайность и товарная стоимость почти одинакова, а затраты на выращивание рапса значительно меньше [2]. Кроме того, это существенно улучшит плодородие почв и фитосанитарное состояние полей, так как рапс не истощает, а наоборот, улучшает структуру почвы, повышает её плодородие, оставляет после себя в 1,5 раза больше пожнивных остатков, в сравнении с зерновыми.

Поэтому важным является выполнение на должном уровне всех агротехнических приемов, которые являются основой технологии выращивания и направлены на повышение урожайности и увеличение выхода масла с единицы площади. Творческое применение ресурсосберегающих технологий с учётом конкретных метеорологических условий, агрофона и биологических особенностей рапса ярового позволит выращивать сравнительно высокие урожаи этой культуры в разных зонах, так как агроклиматический потенциал большинства регионов Украины соответствует его биологическим потребностям.

Ключевые слова: *рапс яровой, способ и глубина основной обработки почвы, агрофизические показатели плодородия почвы, водный режим почвы.*

Annotation

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Influence of pecularities of primary cultivation on its agrophysical indicators of fertility and water regime when growing spring rape

In current economic conditions when economically profitable crops are grown mainly (among cereals – winter wheat, among oil crops – sunflower), schemes of crop rotations and structure of sown areas are violated resulting crops are not provided with good predecessors and their yield is reduced due to deterioration of the physical, chemical and phytosanitary state of fields. In addition, the demand on the world market of oilseeds is high and growing. Increasing production of oilseeds in Ukraine is becoming an acute problem; it can be solved through increased use of spring rape. It is a good predecessor for winter wheat has to become that crop in levels of crop rotations which will ensure stability of agricultural production in different regions of Ukraine. This issue is extremely important for those western, central and northern regions of Ukraine where other oilseeds because of soil and climatic features cannot be grown. Applying rape into crop rotation will reduce sown areas of sunflower by half because their yield and commodity cost is almost the same but costs for rape cultivation are much less [2]. In addition, it significantly improves soil fertility state and phytosanitary of fields because rape does not deplete the soil, but rather improves its structure and increase fertility, leaving after by 1.5 times more residues than cereals.

So implementation is important at the appropriate level of all agrotechnical techniques

that are the basis of growing technology and designed to improve productivity and increasing oil yield per unit area. Creative use of resource-saving technologies based on specific weather conditions, agricultural background and biological characteristics of spring rape will help to grow relatively high yields of this crop in various areas of Ukraine, as agro-climatic potential of most regions of Ukraine meets its biological needs.

Key words: *spring rape, method and depth of primary tillage, agrophysical indicators of soil fertility, soil water regime.*

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ВРОЖАЙНІСТЬ КУКУРУДЗИ ЗАЛЕЖНО ВІД ОСНОВНОГО ОБРОБІТКУ ТА УДОБРЕННЯ НА ОСУШУВАНИХ ОРГАНОГЕННИХ ҐРУНТАХ ЛІСОСТЕПУ

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Наведено вплив основного обробітку староорного торфового ґрунту та органо-мінерального удобрення на продуктивність кукурудзи, тривалість вегетаційного періоду та масу зерна у Лісостепу.

***Ключові слова*:** *осушувані ґрунти, торфовища, водний режим, основний обробіток ґрунту, добрива, кукурудза, продуктивність*.

Постановка проблеми. Кукурудза – цінна кормова культура, яка за відносно короткий період вегетації утворює велику кількість органічної маси з високою калорійністю. За різноманіттям кормової продукції високої поживності вона перевищує інші культури і дає повноцінний корм для всіх сільськогосподарських тварин. Народногосподарське значення виробництва кукурудзи в тому, що вона не тільки найважливіший компонент в раціоні худоби та птиці, але найбільш врожайна серед зернових, фуражних і кормових культур [1].

Аналіз останніх досліджень і публікацій. Одним із основних завдань сільськогосподарської науки в гумідній зоні є розробка ефективних способів використання осушених земель, які могли б забезпечувати не лише високу окупність одиниці площі, але й запобігати деградації та підвищувати природну родючість ґрунтів. Землеробство на меліорованих землях має свої особливості, яке вимагає контролю за станом ґрунтів, виконання агромеліоративних та агротехнічних заходів, внесення обґрунтованих доз органічних та мінеральних добрив.

Органічні і мінеральні добрива є потужним фактором впливу на ріст і розвиток рослин, урожайність і якість продукції. Без їхнього внесення продуктивність рослин різко знижується, бо добрива є не лише прямим джерелом живлення, а за обґрунтованого застосування підвищується стійкість молодих рослин до низьких температур, прискорюються темпи росту та дозрівання культур, збільшується частка качанів у врожаї силосної маси, підвищується вихід білка, крохмалю та кормових одиниць з площі посіву [2, 3].