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INNOVATIVE APPROACH TO INTER-ROW TILLAGE IN TOMATO CULTIVATION

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Tomato (Solanum lycopersicum) is one of the leading vegetable crops in Ukraine, with a cultivation area of about 85 thousand hectares. The main growing regions are the steppe zone and Polissya. However, in the context of the transformation of agricultural production caused by military operations, the expansion of tomato areas in the Forest-Steppe zone, particularly in Vinnytsia region, is becoming increasingly important. The Agronomical Research Farm of Vinnytsia National Agrarian University is a promising platform for scientific support of such agricultural technologies.

The nutritional and industrial value of tomatoes is due to their high content of dry matter (2,5 – 7%), sugars (1,5 – 4%), vitamin C (20 – 35 mg%), organic acids and mineral salts. The fruits are widely used fresh and for processing, accounting for about two-thirds of the vegetable raw materials for the canning industry.

In order to improve the efficiency of tall-stemmed tomato cultivation in the Forest-Steppe region, we have developed a cultivator-plant feeder that provides simultaneous performance of technological operations: loosening row spacing, weed control and application of mineral fertilisers to the root zone. Such agrotechnical integration helps to improve the water and air regime of the soil, reduce compaction, and optimise plant nutrition, which ultimately has a positive impact on fruit yields and quality.

The preliminary results of the research conducted at the Agronomic Research Group of the National Academy of Sciences of Ukraine indicate that it is advisable to introduce this unit into production practice. Its use allows to optimise agricultural technologies for growing tomatoes in the face of climate change and agro-social circumstances typical for the modern agricultural sector of Ukraine.

Key words: *cultivator-feeder, tomatoes, cultivation technology, unit, maintenance, shear conditions.*
Eq. 9. Fig. 9. Ref. 12.

1. Problem formulation

The rational use of liquid mineral and organic fertilisers in modern agriculture is a key factor in intensifying agricultural production and increasing its profitability. This is especially true for fertilisers such as ammonia water and liquid manure, which provide a high level of available nitrogen for plants.

In production conditions, universal feeder-sprayers of the POM-630 type are usually used to apply ammonia water in combination with KRN-4.2 cultivators, aggregated with tractors of traction class 1,4. However, such a technological scheme has a low level of productivity, requires significant time spent on preparatory operations and setting up the unit [1, 3].

As for the application of liquid manure, it is usually carried out by machines such as MZHT-F-6 or RZHT-8 with subsequent incorporation into the soil. However, this process causes significant losses of nitrogen in the form of ammonia due to evaporation, which not only reduces the efficiency of fertilisers but also leads to a negative impact on the environment [2, 7, 8].

In this regard, a promising direction is the introduction of a wide-coverage combined unit that allows for the simultaneous application of liquid fertiliser and inter-row tillage. This approach ensures that two agrotechnical operations are performed in one pass - loosening the soil between rows and local application of fertilizers directly to the root zone at a given depth, which significantly reduces nutrient losses and increases the efficiency of absorption [4, 10].

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The design unit (Fig. 9) includes a power vehicle of traction class 1,4, a specially designed cultivator adapted for inter-row cultivation of tall row crops, and a POM-630 type feeder-sprayer. This design scheme ensures the stability of operating parameters, high productivity and agrotechnical quality of operations in different soil and climatic conditions [8].

The use of this unit makes it possible to increase the efficiency of the technological process, reduce the consumption of fuel and lubricants, optimise the use of machinery and labour, and improve the environmental performance of agricultural production [9].

2. Analysis of recent research and publications

Before starting work on inter-row cultivation with simultaneous application of nutrients, the machine-tractor unit must be repaired and fully equipped.

During machine maintenance, check the reliability of fastening of components and assemblies to the machine frame, the technical condition of the hoses and their connections, the serviceability of the inlet, suction and pressure filters, and install and adjust chain and belt drives.

Fill gearboxes with oil and lubricate machine parts in accordance with the factory instructions.

Once the machine has been assembled and checked, it is set up according to the nature and conditions of the work to be performed.

The height and width of the booms and the angles of the pellet arms are set to the appropriate values.

The rate of consumption of working fluids for fertilisation is set by the crop protection agronomist in accordance with the specific conditions. [3, 7].

The fluid consumption per unit area depends on the amount of fluid consumption per 1 minute, the forward speed and the working width of the machine.

Hitch the cultivator and sprayer in the following sequence:

- set the length of the tractor hitch braces and connect the brace forks to the longitudinal ties, limit the lifting height of the tractor hitch by the hydraulic valve stop on the cylinder rod;
- put one joint of the universal joint with the cardan shaft on the tractor power take-off shaft, and the other on the power unit intake shaft and secure it;
- lower the longitudinal rods of the tractor hitch, drive the tractor to the sprayer and connect the power take-off shaft so that the ears of the inner forks are in the same plane. After that, put the longitudinal rods on the pins of the sprayer frame, and connect the central rod to the upper bracket of the sprayer frame;
- lift the cultivator with the spraying hoses to a certain height, tighten the locking chains of the hitch so that the axis of the pump coincides with the axis of the tractor, adjust the length of the central rod to achieve a vertical position of the pump, mount the hydraulic drive pipes of the hoses on the tractor.

Field preparation [3, 4]. Before starting treatment, the area is cleaned of used pesticide containers and other obstacles. The field is divided into plots.

The tomatoes are planted in the following sequence: undersized tomatoes are planted in the area of the machine's passage with a distance of 1400 mm between the wheels, tall tomatoes are planted along the edges of the field along the width of one pass of the machine in the middle within two passes (Figure 1).

Operation of the machine in the field

The process of inter-row tillage with the simultaneous introduction of nutrients into the soil directly depends on the meteorological conditions, how much the dust particles of the preparation hang in the air and the slightest movement of the preparation away from the tomato rows. It is more expedient to carry out processing in the evening or in the morning on dew, while the fertiliser will be better sprinkled with soil.

Compliance with the specified consumption rates per unit area during cultivation largely depends on the speed of the machine. By increasing the speed, we thereby reduce the consumption of the preparation per 1 ha, and vice versa, by reducing the speed, we increase the consumption. Therefore, manoeuvring gears during operation is not allowed. Work only at the speed at which the application rate was adjusted. At the ends of the bend, close the flow control valve tightly.

For the effective performance of crop cultivation in a short agrotechnical time frame, it is important to properly organise labour and use of machines, prepare working fluid and fill the sprayer tank with it. [9].

The sprayer is refuelled on the headland. The working fluid is prepared at the station, transported and refilled mechanically.

In this scheme, the cultivator and sprayer are used most efficiently. The way the machine moves is shuttle with a move through 7 rows.

The quality of work during inter-row cultivation is checked for each unit separately by the farm agronomist. The following indicators are determined: [12, 13].

1. Application rates - on the area where the fertiliser is applied.
2. The speed of the machine - compliance with the working speed in accordance with the specified speed is determined by the time the machine travels the calculated distance.
3. Working width - in this case, the machine should pass through the garden through one row spacing.
4. The uniformity of the application is recorded visually.

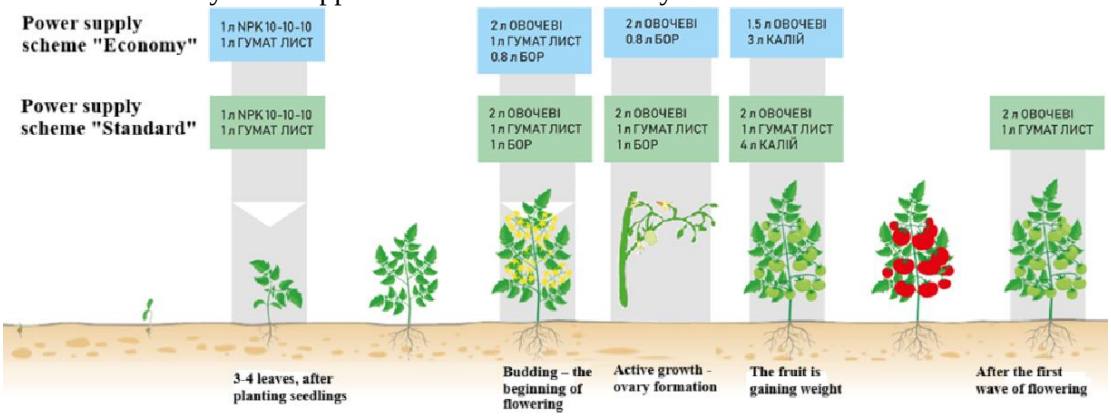

Fig. 1. Plant feeding scheme [3]

In the event of poor quality soil application, stop the machine and eliminate the causes of the defect.

The machine may only be operated by persons who are familiar with the machine's construction, adjustment and work organisation. The tractor driver must have at least three years of practical experience with the relevant machines. [10].

The following rules must be observed when connecting rotating parts of the machine:

- drive the power vehicle slowly;
- connect the hydraulic system and electrical equipment in accordance with the operating instructions;
- mount the hydraulic system in accordance with the factory manual.

The proposed procedure for preparing the machine for operation will help to avoid injuries.

The MZHT-F-6 liquid organic fertiliser application machine (Figure 2) is designed for transporting and continuous surface application of liquid organic fertilisers to the soil. The machine is self-loading with a filling hose and a vacuum system. It is also possible to mix the liquid substance in the tank while driving.

The machine is controlled from the cab of the tractor with which it is aggregated (it can be operated in conjunction with various modifications of domestic and foreign tractors). This model has the ability to adjust the dose of fertiliser to be applied (from 10 to 60 tonnes per hectare).

The application of liquid organic fertilisers in this model is realised through the use of a centrifugal pump and a filling system.

In addition to applying fertiliser to the soil, this equipment can also be used to perform other tasks. It is used for transporting water, for long-range crop irrigation, for extinguishing fires, and for washing vehicles and other equipment.

Fertilisers are loaded using a vacuum system; if necessary, fertilisers can be mixed during transport. The fertiliser is applied using a centrifugal pump and a dispensing device.

The machine is manufactured in three series:

1) MZHT-F-6 - a machine with a lifting capacity of 6 tonnes;
2) MZHT-F-6-1 - machine with a lifting capacity of 7 tonnes;
3) MZHT-F-6-2 - a 6-tonne capacity machine on low-pressure tyres.

Domestic machines for applying liquid organic fertilisers to the soil have the following distinctive features that allow them to successfully compete with foreign analogues: [3, 7, 8].

- design of the filling system. The special design of the system allows for even and precise fertiliser application. This technology also ensures rational fertiliser consumption;
- the ability to operate on any soil. The equipment can be used in different latitudes and climatic zones. No structural modifications are required to the carrying chassis;

- the ability to be combined with various types of tractor equipment. The equipment can be easily used in conjunction with tractors of domestic and foreign production. It should also be noted that almost all models have the ability to control fertiliser application processes from the driver's cab;

- reasonable cost of purchasing, maintaining and repairing equipment. Components, consumables and spare parts for Belarusian machines for applying liquid organic fertilisers are notable for their low price. This has an impact on the process of maintenance and repair of this equipment;

- high reliability and the ability to work under conditions of prolonged loads on the equipment. The simplicity and thoughtfulness of the design of this equipment determine its excellent performance.

The MZHT-6Sh liquid fertiliser applicator (Figure 2) is designed for self-loading, transporting, mixing and continuous surface distribution of liquid organic fertilisers using the boom method.

The fertiliser is loaded by a vacuum unit; if necessary, the fertiliser can be mixed during transport.

Fig. 2. MZHT-F-6 machine [3]

Fig. 3. MZHT-6Sh machine [3]

The fertiliser is applied using a centrifugal pump and a boom spreader. The operation is controlled from the tractor cab.

The use of the boom distribution principle improves the quality and uniformity of fertiliser application and reduces the amount of nitrogen compounds emitted into the atmosphere to a minimum.

Fig. 4. MZHT-F-8 machine [3]

Fig. 5. MZHT-F-11 machine [3]

We also use the MZHT-F-8 and MZHT-F-11 liquid fertiliser application machines (Figures 2 and 3), which are designed for self-loading, transporting, mixing and continuous surface distribution of liquid organic fertilisers.

The ammonia water application unit ABA-8 (Figure 6) is used to apply liquid mineral or organic fertilisers with their simultaneous incorporation into the soil.

The use of liquid fertilisers reduces the cost of purchasing fertilisers and increases the efficiency of nitrogen uptake by plants compared to solid fertilisers by 10% to 20%.

The APZh-12 liquid fertiliser applicator (Figure 7) is used for surface application of liquid fertilisers: urea-ammonia mixtures, liquid complex fertiliser, nitrogen fertilisers, etc. This special equipment is also designed for foliar feeding of various vegetative crops during spring and summer field work. APZh-12 can also be used in the autumn months.

The machine is based on the so-called boom principle of fluid distribution. It ensures the most uniform application of fertiliser. The machine has a working capacity of up to 14 ha/h and a maximum transport speed of 25 km/h. The working width of the machine is 12 m.

One of the most important technical and operational parameters of the APZh-12 fertiliser machine is the working fluid consumption. It depends on the type of fertiliser used and the type of crops being fertilised and ranges from 80 to 300 litres per hectare.

Fig. 6. Ammonia water application unit ABA-8 [7]

Fig. 7. APZh-12 machine [7]

This equipment is combined with tractors of traction class 1,4 equipped with the TSU-2 or TSU-2V hitch.

Crop care methods[4]. Crop care technology includes harrowing before and after emergence, thinning of seedlings, longitudinal and transverse cultivation, hilling, cutting irrigation furrows, fertilisation, etc. In industrial arable crop cultivation, tillage operations are reduced to a minimum, and weeds, pests and plant pathogens are destroyed by spraying crops with herbicides and other pesticides. In some cases, herbicides are incorporated into the soil and mixed with it.

To destroy the crust and weed seedlings in the surface soil layer, the crops are cultivated with rotary hoes along the rows, medium and mesh harrows across the rows or at an angle to them. Pre-emergence harrowing is carried out four to five days before emergence, and post-emergence harrowing is carried out in the phase of the first pair of true leaves. By this time, the plants have time to take root sufficiently, and young weed seedlings are poorly developed and easily destroyed. However, due to some damage to cultivated plants, thinned crops are not harrowed. The working speed for pre-emergence harrowing should not exceed 5...6 km/h, and for post-emergence harrowing – 3...3.5 km/h.

The required plant density is achieved by transverse harrowing in two or three passes or by bouqueting – transverse thinning of seedlings with a cultivator.

The row spacing of row crops is cultivated with plant feeder cultivators along the rows, and the spacing of square-nested crops is also cultivated across. To avoid damaging the seedlings, the edges of the cultivator's working parts are positioned at a certain distance from the plant row axis. This distance is called the protective zone. For the first cultivation of plants, the width of the protective zone is 8...12 cm, and for subsequent cultivation it is increased to 14...15 cm. In uneven areas, the protective zones are increased.

One of the most important measures in the cultivation of row crops is the care of crops. When caring for them, depending on their type and condition, the following mechanised operations are carried out: crust destruction, soil loosening, weeding, hilling, transverse thinning in rows, plant fertilisation, irrigation, measures to control pests and diseases of row crops.

Mechanised tillage operations are performed in the appropriate sequence and in various combinations depending on the type and condition of the plants, soil and weather conditions. Of particular importance are soil cultivation operations between rows and in protective zones: loosening, weeding, hilling, etc.

Agricultural requirements for inter-row cultivation

Agricultural requirements for inter-row cultivation of row crops are as follows:

- care should be carried out within a short agronomic time frame;
- loosening should be carried out to the prescribed depth and without turning the lower moist soil layers to the surface (loosening facilitates air access to plant roots);
- weeds shall be completely cut off during cultivation;
- adhere to the established protection zone, the width of which depends on the type of row crops and their developmental stage;
- cultivated plants should not be covered with soil or damaged by the machine during cultivation;
- when cultivating row crops, the cultivation of protective zones should be mechanised as much as possible.

Technology of using different types of cultivators for inter-row tillage

Inter-row tillage is used for loosening the soil, weed control, fertilisation, and soil crust destruction in the inter-row crops in nurseries, tree schools and plantations, on areas after cultivation and in forest belts.

The number of treatments and their timing are determined by the natural conditions of the crops, the amount and intensity of weed growth. Under average conditions, during spring planting, 4-5 inter-row cultivations are usually carried out in the first year, 3-4 in the second, 2-3 in the third, and 1-2 in the fourth and subsequent years. The depth of soil cultivation during the growing season varies depending on the natural and climatic conditions of the zone and the time of its implementation. For example, on chernozems, the first tillage is carried out to a depth of 8 cm, the second – 10 cm, the third – 12 cm, and the subsequent –14 cm.

When choosing machines for inter-row tillage, you should take into account the arrangement of rows and plants in them, the width of the rows and the degree of straightness of the rows of crops, the height of the crops, the type of soil and its condition.

For inter-row cultivation, use trailed, mounted, universal and row cultivators, as well as machines with disc working tools and soil forestry cutters.

Inter-row tillage is performed in two ways. During the cultivation of forest crops in the first years of their growth, when the height of the plants does not exceed 50 cm and they are not damaged under the tractor and cultivator, more than one (two or three) row spacing is cultivated simultaneously with one wide-cutting cultivator such as KRN-2.8A or cultivators KPN-2, KPN-4, KL-2.6, etc. It is advisable to complete the units with tractors of classes 1.4 and 2.0, a semi-mounted hitch and three KRN-2.8A cultivators.

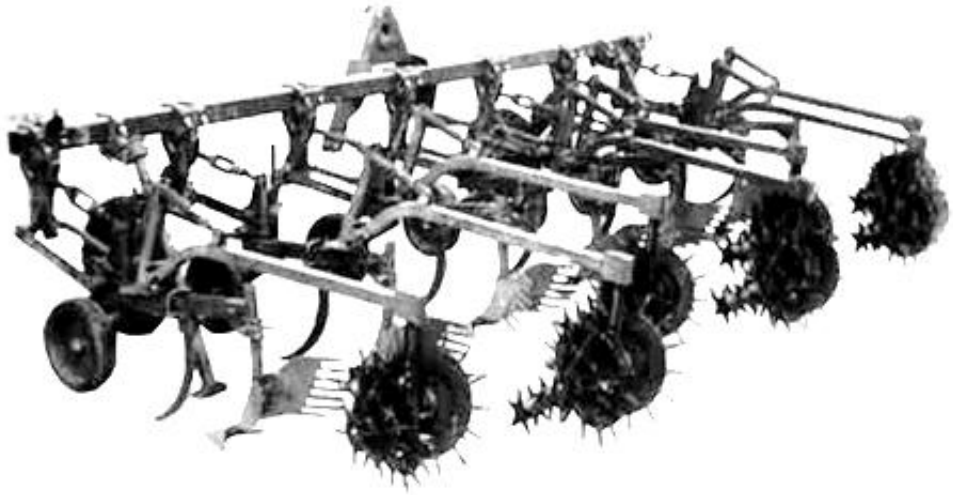

Fig. 8. Cultivator for inter-row cultivation KRN-4,2

To reduce the width of the protection zones during row spacing in the first years after planting, some forestry enterprises use the KRN-2.8MO cultivator, which is combined with tractors of classes 0.6 or 0.9. This cultivator is equipped with steering, which allows the tractor driver to steer the cultivator without damaging the plants, even when they are not straight.

The KRN-4.2G-05 cultivator is mostly used for potato cultivation in areas lightly clogged with stones. It is designed for cultivating 6-row plantings with row spacing of 70 cm, which we can use for cultivating row spacing for growing tomatoes. It is combined with tractors of traction class 1,4.

3. The purpose of the article

Improving the efficiency of the liquid fertiliser application process by developing and implementing a wide-coverage unit capable of simultaneous inter-row cultivation and local fertilisation to reduce nutrient losses and optimise agronomic and resource performance.

This goal includes the following components:

– Increasing the productivity of agricultural operations;

– reduction of nutrient losses (in particular ammonia);

– combining several technological operations in one pass;

- improving plant nutrition conditions;

- reducing resource consumption and improving environmental performance.

4. Results and discussion

Development of a project machine.

A unit for applying liquid fertiliser. For the application of ammonia water, a universal feeder-sprayer POM-630 and a cultivator KRN-4.2 are usually used in combination with a tractor of 1.4 traction class. Such a unit is inefficient and requires considerable time for assembly and adjustment. Liquid manure is applied with MZHT-F-6 and RZHT-8 machines and then ploughed in. At the same time, there are significant losses of ammonia due to evaporation. The introduction of the designed wide-coverage unit for applying liquid fertilisers with simultaneous inter-row cultivation is more efficient and performs two operations simultaneously: loosening the arable land and applying organic fertilisers directly into the soil at the required depth. It consists (Figure 9) of a power vehicle with a traction class of 1.4, a design cultivator capable of inter-row cultivation of tall crops, and a POM-630 fertiliser sprayer.

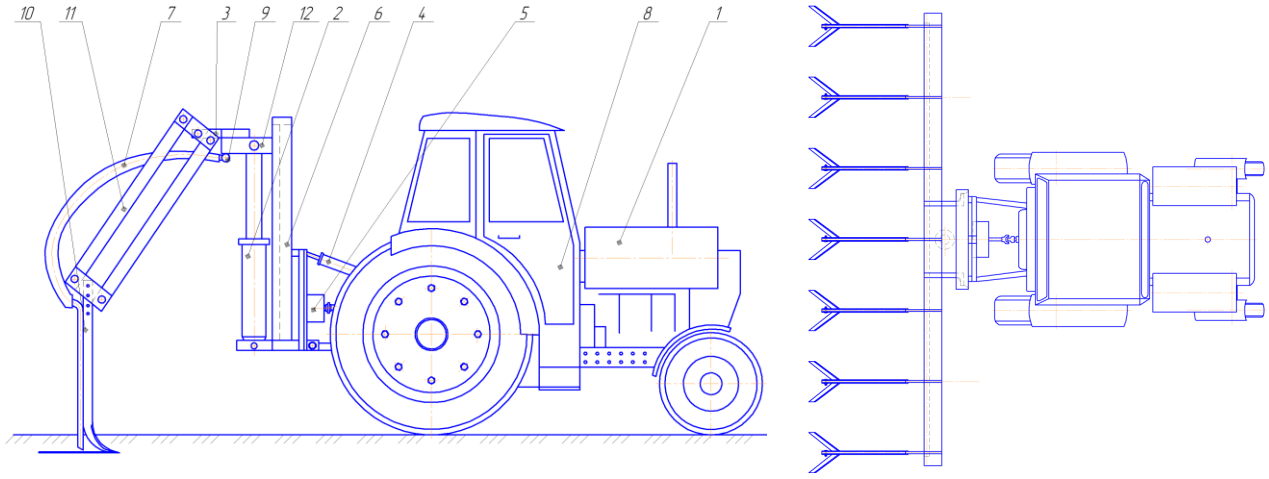

Fig. 9 Design unit for inter-row tillage:

1 – cylinders of the POM-630 sprayer; 2 – hydraulic cylinder; 3 – attachment; 4 – attachment; 5 – pump; 6 – cultivator frame; 7– hose; 8 – tractor; 9 –pipeline; 10 – tine; 11 – parallelogram suspension; 12– movable frame

The design cultivator is mounted on a frame 6, which protrudes in height, allowing for the cultivation of tall crops. The hydraulic cylinder 2 sets the height at which the movable frame 12 should be installed. To move the tillage tines 10 in the vertical plane, a parallelogram suspension 11 is attached to the movable frame 12, the tines 10 are adjusted to the desired tillage depth under the force of their own weight. To supply the fertiliser to the machine, we use a POM-630 sprayer, which allows us to reduce the dimensions of the machine. The liquid is supplied by a pump through the liquid supply pipeline 9, then through the sleeve 7 it enters the processing tines through a metal pipeline that is welded to the tines 10, and the plants are fed with liquid that is introduced into the soil and earned by the processing tines.

To treat the plants against pests and diseases, the tillage tines are removed and nozzles are connected.

In this case, the shaft is subjected to shear deformation. The strength condition under shear deformation is as follows [6, 11]:

$$\tau = Q / F \leq [\tau], \quad (1)$$

where τ is the tangential voltage; [τ] is the permissible voltage.

1. Determine the force acting on the shaft shear [4]:

$$F_d = \frac{F \cdot B}{A} = \frac{700 \cdot 0{,}7}{0{,}3} = 1633\text{H}, \quad (2)$$

2. Determine the destructive load:

$$P_{pH} = \tau_з \cdot S, \quad (3)$$

where P_{pH} – destructive load; $\tau_з$ – is the critical stress at which the shaft shears (= 70 MPa).

Find the cross-sectional area of the shaft:

$$S = \pi \cdot d^2/4 = 3{,}14 \times (0{,}018)^2/4 = 254 \times 10^{-6}\ m^2. \quad (4)$$

$$P_{pH} = 70 \cdot 10^6 \text{Па} \cdot 254 \cdot 10^{-6} m^2 = 17780\text{H}, \quad (5)$$

Given that the tractor is moving, we assume a dynamic safety factor of 3, then the force acting on the shaft will be equal:

$$F_{d^!} = F_d \cdot К_d = 1633 \cdot 3 = 4899Н, \quad (6)$$

The strength condition is satisfied if: [5, 6].

$$F_д < P_{рн},$$

where 4899 < 17780 H – the strength condition is satisfied and the shaft can withstand the given loads.

The maximum frame overhang required to ensure the technological process is 4,55 m.

The frame is subjected to bending deformation. The strength condition for bending deformation is as follows [5]:

$$\sigma = \frac{M_{bmax}}{W} \leq [\sigma_b]., \quad (7)$$

where σ is the working shear stress; M_{bmax} is the maximum bending moment; W is the bending resistance moment; [σ] is the permissible stress, [σ] = 100 MPa.

The weight of the frame is 150 N. Taking into account that the tractor is moving, we take the dynamic coefficient K_d = 3, then the force that bends the frame will be equal:

$$F = G \times K_d = 150 \times 3 = 450 \text{ H} \quad (8)$$

The force F applied at the point of the frame scales is determined experimentally at a distance of 1,45m.

Determine the bending moment at the characteristic points of the frame.

$$M_b^A = 0;$$

$$M_b^B = F \bullet AB = 450 \bullet 1,45 = 652 \text{ Н} \bullet \text{М}.$$

The largest bending moment is at point B, so it is the most dangerous, and we calculate the strength condition for this section:

The bending moment in the cross-section of the frame is determined by the formula [4]:

$$W = 0,1 \cdot \frac{D^4 - d^4}{D}, \quad (9)$$

where W is the bending resistance moment; D is the outer frame dimension of 25 mm; d is the inner dimension of 20 mm.

Substitute the values into the formula and perform the calculation:

$$W = 0,1 \cdot \frac{25^4 - 20^4}{25} = 922,5 \cdot 10^{-9} m^3.$$

Determine the working bending stress, substitute the value in Formula 7 and perform the calculation:

$$\sigma = \frac{M_{b.max}}{W_{\frac{652}{922,5 \cdot 10^{-9}}}} \text{ MPa},$$

70.6 MPa < [100 MPa] – the condition of bending strength of the frame is met.

Maintenance of the cultivator and sprayer includes: [13].

- daily maintenance (DMT), maintenance № 1 (MOT-1) and maintenance № 2 (MOT-2).

Daily maintenance includes:

- cleaning the machine from recycled material and dirt, checking and, if necessary, tightening the fasteners of the component parts, checking the condition of the drive and working bodies, visual inspection of safety devices and lubrication of some components.

MRO-1 - includes all MRO operations, as well as checking and, if necessary, adjusting the tension drive, disassembling and replacing some parts and lubricating some components.

MRO-2 - in addition to the MRO-1 operation, includes: checking and adjusting the clearances of bearings and other mating parts, replacing some parts in assemblies, painting damaged surfaces, and controlling the machine at idle and under load. During maintenance 2, repair work is also carried out if necessary.

The maintenance procedure is described in the process flow charts. They specify technical requirements, a list of necessary instruments, tools, devices and materials, and the labour intensity of the work. Maps are developed for checking and adjusting the machine or its components, for using cleaning and disinfectant solutions, and for changing the lubricant.

Before storing the machine, extraordinary maintenance is carried out and damaged surfaces are repaired. Units, assemblies and parts that require warehouse storage conditions are put into storage. Unpainted areas that are subject to corrosion are coated with preservative grease, and wheel tyres are coated with a light-protective coating.

5. Conclusion

The dry matter content of tomato products (by refractometer) is as follows: in tomato juice – not less than 4.5%; tomato puree – 12, 15, 20%; salted tomato paste (excluding table salt – 27, 32, 37%; tomato sauce «Ostryi» – not less than 29%; pickled tomatoes – 4%. In salted tomatoes, the acidity in terms olactic acid is as follows, %: in red and pink tomatoes – first grade – 0,8-1,2, second grade – 0,8-1,5; brown and milk tomatoes – first grade – 0,7-1, second grade – 0,7-1,3; green tomatoes – 0,8-1,5.

The annual per capita consumption of tomatoes is 32 kg. To fully provide the population with tamatas, their production needs to be increased by 1,5-2 times. The basis for solving this problem is to deepen the specialisation and concentration of the farm, as well as to switch to intensive methods of vegetable growing.

At the same time, the formation of highly productive tomato agrocenoses largely depends on the soil cultivation system, which provides optimal conditions for growth, root development, efficient absorption of nutrients and regulation of the phytosanitary condition of crops. In particular, when growing high-stemmed tomato varieties characterised by intensive vegetative growth, high-quality inter-row tillage combined with local fertilisation is of particular relevance.

Science and best practices in agricultural production in Ukraine have developed, tested and widely implemented intensive tomato growing technology. The proposed technology for Agronomic Research and Development Group will improve the quality of tomato cultivation and the impact of the number of operations on soil and yield. The development of a cultivator-plant feeder for cultivating tall crops, namely tomatoes, prevents the problem of achieving high yields of this crop.

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ІННОВАЦІЙНИЙ ПІДХІД ДО МІЖРЯДНОГО ОБРОБІТКУ ҐРУНТУ ПРИ ВИРОЩУВАННІ ТОМАТІВ

Томат (Solanum lycopersicum) є однією з провідних овочевих культур в Україні, площа вирощування якої становить близько 85 тис. га. Основні регіони вирощування – степова зона та

Полісся. Проте в умовах трансформації агровиробництва, зумовленої військовими діями, актуальності набуває розширення площ під томати в зоні Лісостепу, зокрема у Вінницькій області. Перспективним майданчиком для наукового супроводу таких агротехнологій є навчально-дослідне господарство «Агрономічне» Вінницького національного аграрного університету.

Харчова та промислова цінність томатів обумовлена високим вмістом сухих речовин (2,5–7 %), цукрів (1,5–4 %), вітаміну С (20–35 мг%), органічних кислот і мінеральних солей. Плоди широко використовуються у свіжому вигляді та для переробки, становлячи близько двох третин овочевої сировини для консервної промисловості.

*З метою підвищення ефективності догляду за високостебельними томатами в умовах Лісостепу нами було розроблено культиватор-рослинопідживлювач**,** що забезпечує одночасне виконання технологічних операцій: розпушування міжрядь, боротьбу з бур'янами та внесення мінеральних добрив у прикореневу зону. Така агротехнічна інтеграція сприяє покращенню водно-повітряного режиму ґрунту, зменшенню ущільнення, оптимізації умов живлення рослин, що в підсумку позитивно впливає на врожайність і якість плодів.*

Попередні результати досліджень, проведених на базі НДГ «Агрономічне» ВНАУ, свідчать про доцільність впровадження даного агрегату у виробничу практику. Його застосування дозволяє оптимізувати агротехнології вирощування томатів в умовах змін клімату та агросоціальних обставин, характерних для сучасного аграрного сектору України.

Ключові слова: *культиватор-піджівлювач, томати, технологія обробітку, агрегат, технічне обслуговування, умови зсуву.*

Ф. 9. Рис. 9. Літ. 11.

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