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Combination machine for soil preparation and sowing of gourds

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Abstract. The purpose of the study is to substantiate the method and design scheme of a combined machine for preparing the soil and sowing melons. The authors propose a new method of soil preparation and sowing, as well as a machine for its implementation. The basic principles and methods of classical mechanics, mathematical analysis, and statistics were used in this study. The method of preparing the soil and planting gourds provides a combination of the following technological processes: the turnover of the layers of the upper layer of soil, the sowing area to the left and to the right, shallow tilling the soil of the field with the left and right sides of the sowing area, deep tillage seeding areas with simultaneous formation of irrigation furrows and the local application of fertilizers, soil preparation for sowing in line sowing and sowing seeds of melons. The machine consists of lister housings installed along the axis of symmetry of the unit, flat cutters, parallel-type deep-diggers, furrowers, coulters for fertilizing, and a sowing device. It was found that preparation of soil for sowing and planting of melons with a minimum expenditure of energy is provided by the width of Lusternik buildings 86 cm, the width of tillers and cultivators, respectively, 45 and 33 cm, the longitudinal distance between the body and the plane of 35 cm between the cultivators of 42.3 cm, and longitudinal spacing of the chisel cultivator and sowing device 110 cm.

1 Introduction

In the world, research works are being carried out to improve technologies and technical means for the cultivation of melons and vegetable crops in the following priority areas: maintaining the potential fertility of the soil for obtaining a high crop yield, developing minimal tillage to reduce energy and labor costs; creating combined machines that ensure the simultaneous implementation of various technological processes; creation of combined machines and technologies that perform smooth plowing and tillage of the soil by working bodies that form furrows, sow and apply fertilizers; development of scientific and technical solutions for the creation of tools that provide high-quality tillage, seeding devices for precise sowing of seeds and local fertilization [1-23].

The development of machines for processing and preparing the soil for sowing melons in the conditions of Uzbekistan F.Mamatov [1-23], B.Mirzaev [4-23], N.Aldoshin [3, 10-

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11, 19-20, 24], U. Umurzakov [4, 19], D.Chuyanov [5, 27], U. Kodirov [6, 24], H. Ravshanov [4-6], [25-26], H. Fayzullaev [5, 25] and others.

Existing technologies for preparing the soil for planting melons have several disadvantages. In particular, they are material-intensive and energy-intensive [28-29].

The purpose of the study is to substantiate the method and design scheme of a combined machine for preparing the soil and sowing melons.

2. Methods

The proposed method of tillage and planting is to loosen the right and left sides of the overturned soil layers, overturning the layers relative to each other by shifting their centers of gravity towards the overturning side, deep loosening of the topsoil, fertilizing, preparing the soil for planting. involves the formation and planting of branches. (Fig.1). When melons are sown in place of winter wheat as a secondary crop, turning the topsoil of the field at a depth of a_1 = 6-10 cm to the right and left on a softened strip at a depth of a_2 = 12-16 cm allows to clear the planting area of plant debris. Surface treatment of the planting area and the adjacent row spacing to be formed, as well as tillage with and without tillage, as well as the deep loosening of the strip soil, simultaneously forming an irrigation ditch will result in a sharp reduction in energy consumption and prevent water and wind erosion. Applying fertilizer to a specific location in two layers increases the efficiency and productivity of the use of mineral fertilizers.

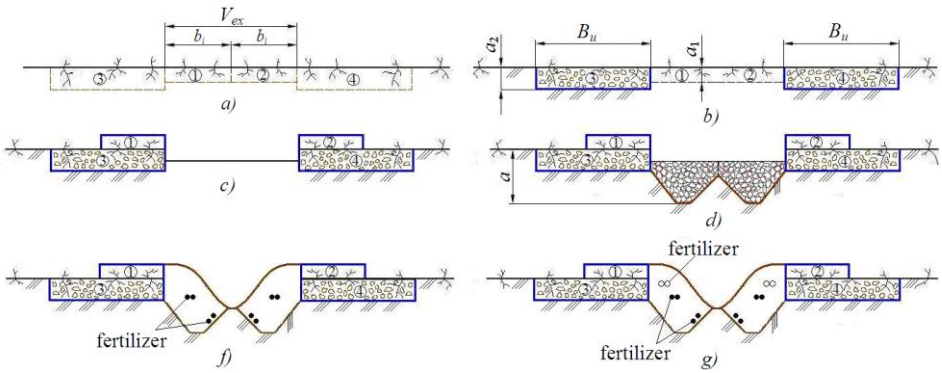

Fig. 1. Method of tillage and planting: a is the appearance of the cross-section of the field before tillage; b and c are the cross-sectional profile of the field after the planting area has been softened between the surfaces and the stalks have been turned to the right and left; g and d are the cross-sectional profile of the field after deepening of the row spacing and formation of irrigation ditches with fertilizers; e is the cross-sectional profile of the field after sowing

According to the proposed method, the unit processes a field with a width of 2.8 m in one pass. In this case, the unit forms an irrigation ditch with a depth of 20-22 cm and a width of 40-45 cm in the planting area and sows the seeds in rows between rows with a width of 70-90 cm. The soil of the remaining row spacing is loosened with levelers to a depth of 8–10 cm, and weeds are killed.

Determine the width of the sowing area to sow the seeds in a row spacing of 70 cm (Fig. 2)

$$V_{ex}=2b_p=B_m+b_s/2, \quad (1)$$

where bs is the width of the soshnik, m; B_m is the width of the row spacing, m.

According to (1), the width of the planting area is V_{ex}=86 cm when B_m=70 cm and b_s=16 cm. The planting area is treated with a double hull. Then the coverage width of the bit body is b_k=b_p=V_{ex}/2=43 cm. We assume b_k = 45 cm.

(1) The width of the aisle treated with straighteners is V_1 = 190 cm when the width between adjacent ditches is B_{ao} = 2.8 m, and the width of the planting area is V_{ex} = 90 cm. The corridor between adjacent irrigation ditches of Bao width is treated by the double passage of the unit. In this case, the width of the machined corridor between the straighteners and the ditches in one pass of the unit is V_2 = B_1/2 = 95 cm. The main purpose of trenching between the ditches is to cut the weed roots and loosen the soil to a depth of 12 cm. Therefore, a 330 mm universal curved claw with a coverage width was chosen to handle this corridor. Based on the above, the number of claws to be installed on the left and right sides of the unit is 6.

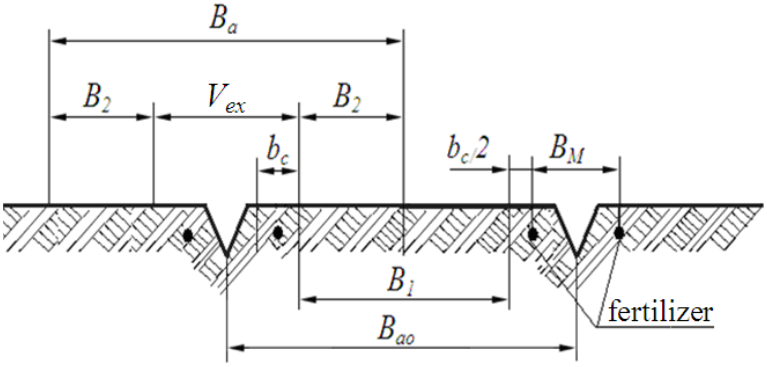

Fig. 2. Scheme for determining the areas to be processed

3. Results and Discussion

A combined aggregate was created to implement the tillage and planting method (Figure 2). The combined unit includes the following elements: right and left overturning bodies (in the form of a lister body) along the axis of symmetry of the unit, planers, "parallel" type pits with a ditch, and a fertilizer spreader. After the pitcher, the roller, and the sowing device are installed. The structural scheme and general view of the unit are shown in Figures 2 and 3.

The width of the enclosures was 40 cm in terms of processing them in the middle of the ridge, the width of the inclined working body was 45 cm, and the width of the flatteners was 33 cm. According to the study results, the longitudinal distance between the pre-sloping ridges of the combined aggregate hull is 35.1 cm, the longitudinal distance between the slopes is 42.3 cm, and the minimum longitudinal distance between the support wheel and the slats is 24 cm. prepared.

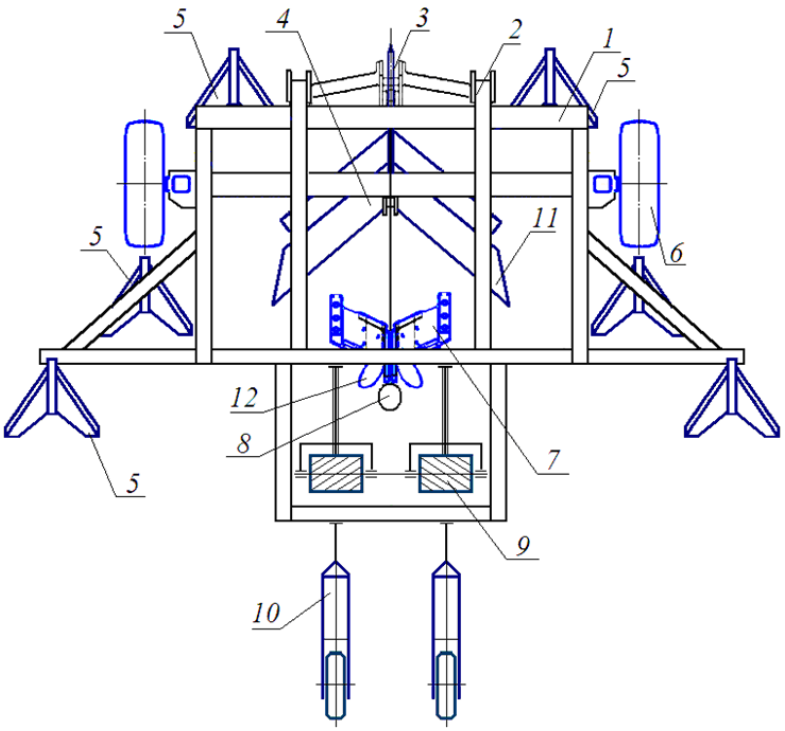

Fig. 3. Structural scheme of the combined unit: 1 is frame; 2 is hanging device; 3 is disc blade; 4 is double housing with a guide plate in the form of a lister; 5 is straight cutter; 6 is base wheel; 7 is sink; 8 is fertilizer; 9 is reel; 10 is sowing device; 11 is reference plate; 12 is thinner

Fig. 4. General view of the combined aggregate

The height of the slope of the sinkhole handle is H_k

$$H_k = b_i ctg\psi = (\frac{V_{ex}}{2} - a_i ctg\psi - b_i) ctg\psi, \quad (2)$$

where b_i is the width of the scan, cm; ψ is the angle of refraction of the soil in the transverse plane, grad; a_i is the maximum processing depth of the pit, m.
The minimum length of the working surface of the softener plate installed in the sink is determined from the following connection

$$l=(b_u - b_n - b_{op})/\cos\alpha, \quad (3)$$

where b_u is the width of the column with a sloping handle blade, cm; b_n is the width of the blade, cm; b_{op} is width of the base of the plate, cm; α is the mounting angle relative to the column surface of the softener plate, grad.
b_{op} = 10 cm, b_p = 45 cm, b_n = 9.0 cm, and l = 23.4 cm when α = 25°. We accept 25 cm.
As a result of theoretical research, the following expression was obtained to determine the height H_t of the sinker

$$H_m = 1{,}2\sqrt{a_k^2 + b_k^2} + a_i, \quad (4)$$

where a_k and b_k are the processing depth and coverage width of the double hull, respectively.
H_t = 85.2 cm when a_k = 10 cm, b_k = 45 cm and a_i = 30 cm. We accept 86 cm.
The following expression was obtained to determine the traction resistance of the working body with the bevel handle

$$R_t = (k + \varepsilon V^2)(V_{ex} a_i - H_k^2 ctg\psi + b_i^2 ctg\beta_k), \quad (5)$$

where k is the specific resistance of the soil, N / m^2; a_i is working depth of the working body on the bottom of the ditch, m; V is speed of the unit, m / s; ε is coefficient depending on the parameters of the working body (a geometric shape) and soil properties, Ns^2/m^4; b_i is the width of the working body, m;

H_k is the height of the sloping part of the sinkhole handle, m; bk is angle of inclination in the transverse vertical plane of the working body, grad; V_{ex} is width of row spacing, m.
(5) formula ψ = 45º; ε = 16·10^2 Hc^2 / m^4; k = 43·103 N/m^2; V = 2 m/s; a_i = 30 cm; b_i = 5 cm; b_k = 450; V_{ex} = 90 cm was found to be P = 3.58 kN.

In the field tests carried out on the farm of the developed combined unit, the depth of cultivation of the sown area was set at 30 cm, but its average value was 30.8 cm in practice. The average fraction of fractions with a size of less than 50 mm in the planted area treated by the unit was 81.3%, the unevenness of the treated field surface was 8.2 cm. The width of the upper part of the irrigation ditch was 61.7 cm, and the depth of the irrigation ditch was 25.6 cm.

The developed combined unit, equipped with the sowing device of the seeder SPCh-6, reliably performed the sowing processes specified in the technology in tests. In general, the performance of the combined technical means meets the requirements of agrotechnics.

The test results of the developed combined machine for soil preparation and sowing show that the use of SLS for sowing melons in comparison with the technical means used

reduces the operating costs for processing one hectare of the area to 39.2% and the consumption of fuel and lubricants by 46.2 %.

1. Conclusions

1. The method of preparing the soil and planting gourds provides a combination of the following technological processes: the turnover of the layers of the upper layer of soil, the sowing area to the left and the right, shallow tilling the soil of the field with the left and right sides of the sowing area, deep tillage seeding areas with simultaneous formation of irrigation furrows and the local application of fertilizers, soil preparation for sowing in line sowing and sowing seeds of melons. The machine consists of lister housings installed along the axis of symmetry of the unit, flat cutters, parallel-type deep-diggers, furrowers, coulters for fertilizing, and a sowing device.
2. To prepare the soil for planting at the required level with low energy consumption, the coverage width of the double hulls should be 86 cm, the coverage width of the working body with a sloping handle should be 45 cm, and the coverage width of the planers should be 33 cm.
3. The minimum longitudinal distance between the nozzle and the flattener of the combined unit body is 35 cm, the minimum longitudinal distance between the flatteners is 42.3 cm, and the minimum longitudinal distance between the support wheel and the flattener is 24.1 cm, the distance from the working body is 110 cm. The availability of low-energy field melons allows for quality preparation at the level required for planting melons.

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