Placement of working bodies on the frame of the tool plow-ripper

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Abstract. The purpose is to investigate substantiate relative position working bodies of improved plow-ripper. Scheme of the plow-ripper is given. The plow-ripper consists of the left and right sections, a ripping share established down the axle of symmetry tool, improved working bodies with inclined racks. Analytics dependencies are mined to define distance between working organs and the distance between them along the plow-ripper. Experiments have been carried out come true the relation stance working bodywork. Experiments have established that with an increase in the distance between the working bodies with an inclined stand along the plow, the hail of crumbling ground increasing accordance law of a convex edge and the pulling force in accordance law of a curved parabola. It has been determined that in order to ensure the reliability of work and the quality of tillage with a minimum traction resistance, the spacing should be at least 30 cm, and the distance between the working bodies along the plow-ripper should be 60 cm.

1 Introduction

Moldboardless tools currently produced by the industry have a number of disadvantages that limit their widespread use. So, subsurface cutters, although they provide sufficient stubble preservation, form large blocks when processing dry soils, the tool is poorly deepened, and the plow pan is not destroyed [1-5]. As evidenced by domestic and foreign experience, chisel plows for non-moldboard soil are widely used. Promotes the preservation and concentration of humidity, improve processes of aeration infiltration, and avoid the growth of water and breeze erosion of soils [6–15]. A variety of chisel implements that provide a reduction in the degree of damage to the surface vegetation and a better leveling of the cultivated field are plows-rippers with racks of working bodies inclined in the transverse vertical plane F Maiviatov [1, 2], I Ergashev [3], N Rashidov [5, 8, 21], B Mirzaev [6, 7-9, 12, 13], O Hamroyev [4, 7], N Aldoshin [8, 22], F Mamatov [3, 7-18, 20, 21, 24] and other songwriters.

In these studies, the issues of placing improved working bodies of a plow-ripper on its frame were not considered [11, 19]. In this regard, the research work devoted to the substantiation of the scheme and parameters of a moldboardless plow-ripper with inclined

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racks of working bodies, which provide an increase in labor productivity and improve the quality of tillage, is appropriate in research and practical names.

The purpose of the paper is to substantiate relative position of the working bodies of the improved plow-ripper.

2 Materials and methods

The authors have developed a plow-ripper by topsoil cultivation between rows of orchards (Figure 1). The main working bodies of the plow-ripper are a ripper paw mounted along the axis of symmetry of the tool, fixed on the left 5 and right 6 sections and successively improved working bodies with inclined racks 7 and 8. The working surfaces of the working bodies 7 and 8 in the left and right sections are opposite to each other.

Working bodies with an inclined handle consist of a column 1, a knife 2, a needle 3 and a pin 4, which consists of an upper softener 5 attached to a column 1 and a lower softener 6 attached to a pin 4 (Figure 1).

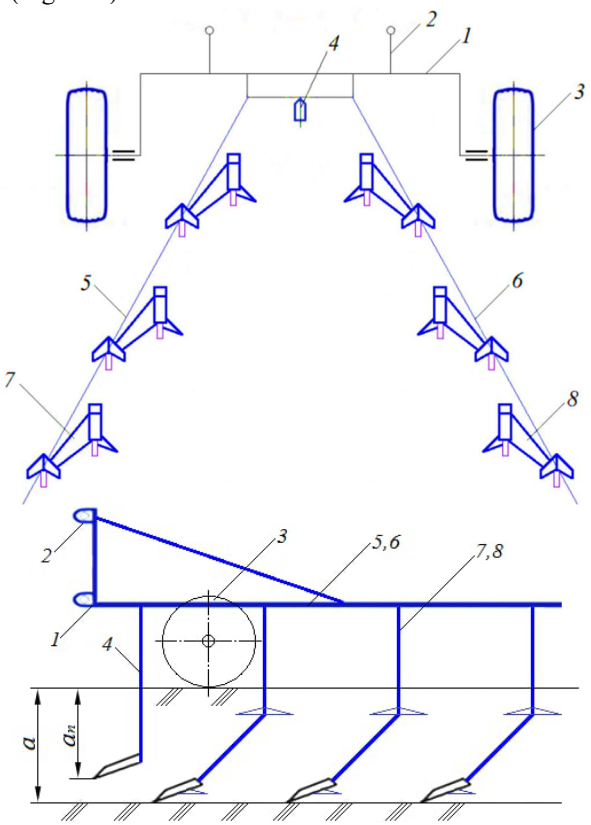

Fig. 1. Circuit improved plough -ripper: a – top view; b – side view; 1-chassis; 2 – hinged instrument; 3 – support tire; 4 – loosening paw; 5 and 6 – frames of the left hand and right sections; 7 – rippers with the right bend of the rack; 8 – rippers with the left bend of the rack.

During the working process of the machine, the softener claw works the soil at a depth a1>a along the axis of symmetry of the weapon. In this case, the softener paw deforms the soil during its operation and softens it. The cross-section of the deformation zone has the shape of a trapezoid. The softener operates under closed cutting conditions. The blade of the improved inclined handle softener located in the left and right sections penetrates the driving

layer and breaks the soil into small pieces. The resulting spall distribution to earth surface at angle of yk. After which, blade of the handle enters the soil zone deformed by the needle. The soil separated by the chisel rises along its surface and falls on the blade. In this case, a piece of soil bends and stretches in longitudinal and transverse sections, which causes it to rapidly disintegrate. In the process of work, the bottom softener 5, which is attached to the auger 6, softens the scythe at the bottom of the soil layer and the bottom of the egate. As a result, the height of the scythe at the bottom of the field is significantly reduced. An arrow-shaped softener mounted on a column softens the upper layer of the softened zone with a slanted handle to a thickness of 1000 mm. Further working bodies will also soften the soil. As a result, the machine covers the soil at the level of agrotechnical requirements and ensures the height of the scythe at the bottom field.

The range among the operating flesh, that is, distance between working bodies in the transverse plane, is determined from the condition of observing the permissible height of irregularities at the bottom of arable land according to agrotechnical requirements [2]

$$M = \frac{n_1 a}{tg\psi_e} + b_u, \tag{1}$$

where п1 – is a coefficient, п1=0.8-1.1[2].

Taking into account the reduction of the height of the scythes with the help of lower softeners installed on the working body with a sloping handle, we accept p1=0.9.

When a=28 cm, п1=1,1, bи=5 cm and ψё=45° the transverse distance between working bodies with an inclined handle should not be greater than 30.2 cm. We accept M=30 cm.

When placing the working bodies with a slanted handle in the longitudinal direction, we determine the condition of eliminating their clogging with plant debris and soil. In our case, sliding plane blade deformed next working organ punch should not reach the structural elements of the previous working body [7, 21].

According to Figure 1

$$L_n = L_1 \geq l_1 + l_u \cos\alpha_u + H_к tg\beta_б, \tag{2}$$

where l1 – is the length of the soil deformation zone under the influence shaft slanted cop, m; lи – the length of the needle, m; hи – height scaffold, m; Hк – altitude inclined portion column of the processing body along with an inclined cope, m.

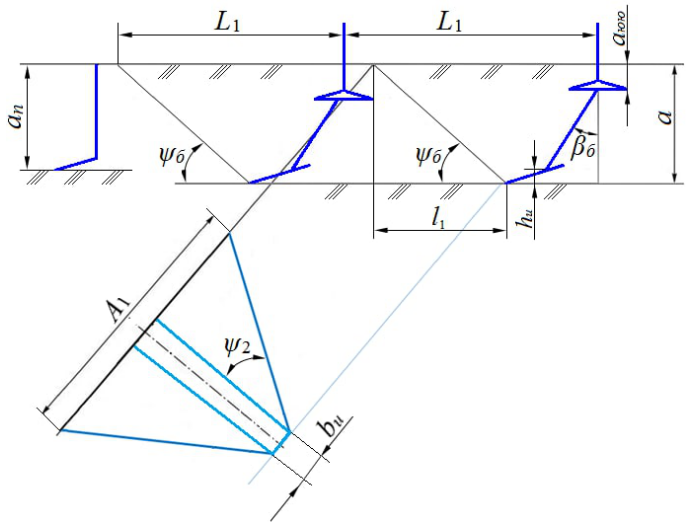

Fig. 2. Circuit for establishing the zone soil deformation by working body.

Deformation zone can be decisive by further expression

$$l_1 = a_{\max} ctg\,\psi_б, \tag{3}$$

where ψb – angle of refractory soil longitudinal direction, º.

We put the value of l1 in (1) according to (3).

$$L_n = L_1 \geq a_{\max} ctg\,\psi_б + l_u + H_к tg\beta_б. \tag{4}$$

According to the expression (4), the longitudinal range among bodies plug-softener depends on the depth of their processing, the physiological and mechanic properties of soil, and the parameters working body with a sloping handle.

By putting amax=27 cm, Hk=16 cm, β=18º in the expression (4), it was determined that the longitudinal range among bodies should not be less than 0.6 m.

3 Results and discussion

To determine the optimal values of the transverse and longitudinal distances between the working bodies with an inclined rack, one-factor experiments were carried out. The indicators for evaluation were the height of irregularities at the bottom furrow, the degree of crumbled traction force. In experience, the width of the upper ripper, that is, the universal share, was 22 cm, lower ripper 8 cm the outcome of experiments are given.

Figure 3 shows as speeds movement with an increasing in the longitudinal range among bodies with an inclined rack, the extent disintegrating of soil increasing in accordance law of a curved parabola, and the traction active resistance according law of a curved parabola. With an increase in the distance L of more than 60 cm, it does not affect these indicators of the work of the working bodies. From these data, shown in Figure 2, it can be seen that the longitudinal range among bodies should no more than 60 cm.

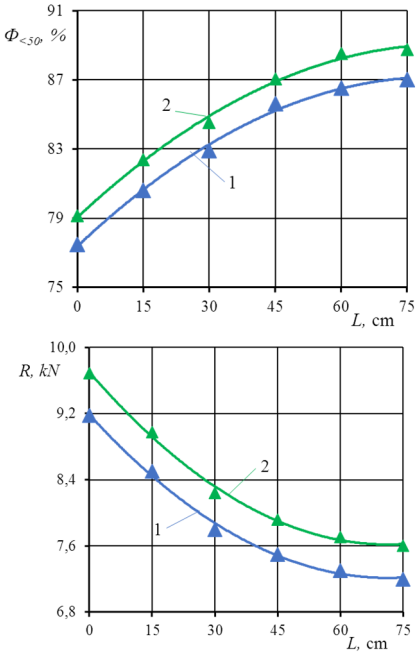

Fig. 3. Dependences of the soil (*F*<50) and the thrust impedance of the ripper (*R*) on the longitudinal distance between the working bodies *(L)*: 1, 2 – respectively at unit of measure speed of 6-9 km/h.

The conducted experiments show (Figure 4) that at all speeds of movement with an increase in the distance among the operating flesh along the plow-ripper, the degree of crumbling of soil growth according to law of a curved parabola, and traction impedance - in accordance curved parabola. In that case, height of the irregularities increases according to the straight line law. From these data, it can be seen that in order to provide the required height of irregularities, the spacing should be no more than 30 cm.

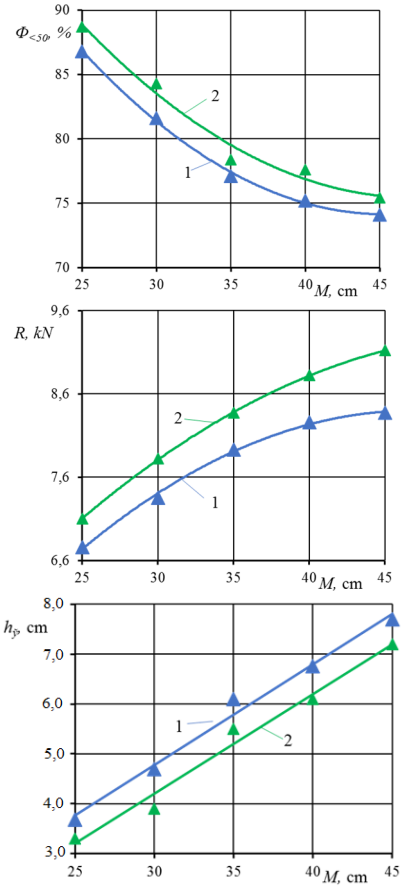

Fig. 4. Dependences extent of crumbly of soil (F<50), traction resistance of working bodies with an inclined rack (R), altitude of roughness at the bottom of plough land on spacing working bodies (M): 1, 2 – respectively, at the unit speed of 6 and 9 km/h.

4 Conclusions

Proposed plow-ripper consists of left and right sections, loosening paws established down the axis of rotation proportionality tool, improved working bodies with inclined racks. Analytic dependence purchased to define distance between working orans and the distance between them along the plow-ripper. It has been established that with an increase in the distance between the working bodies with an inclined stand along the plow, the extent of crumbly of the ground correspond law of a arched parabola and the thrust impedance according to law of a arched parabola. It has been determined that in order to ensure the reliability of work and the quality of tillage with a minimum traction resistance, the spacing should be at least 30 cm, and the distance between the working bodies along the plow-ripper should be 60 centimeter.

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