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AGREGATE FOR STRIP TILLAGE OF SLOPE SOILS

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Abstract

A combined plowing unit with energy-saving universal working parts has been proposed for mountain farming, in particular for strip tillage of slope soil which will reduce topsoil dusting and overgrowth of inner layers, will ensure the water resistance of the loosened strip, will reduce soil erosion along which the removal of useful organic residues and herbicides will be provided and will increase soil fertility and crop yields.

The parameters of the placement of the working organs on the unit have been determined.

The use of a combined aggregate also solves environmental problems related to water-wind erosion in the fields during crop cultivation.

Key words: slope, strip tillage, universal, aggregate, working part, erosion.

Introduction

Modern agriculture is a rather complex and labor-demanding process that involves the application of various tillage systems the main ones being traditional, minimal, no-till and strip-till technologies.

Strip-till technology, unlike others, involves soil tillage by strips on which further cultivation is carried out. The use of this technology is effective because it increases the water resistance of the loosened layer, saves about 50% of the application of mineral fertilizers, nutrients are concentrated in the root zone of plants and yields increase by 25%. This technology is usually used once a year during autumn or spring loosening. In spring the cultivated strips should be sown with correct sowing machines [1].

Strip-Till technology is now widely used in advanced farms in the United States, Canada, Argentina, Germany and other countries [2].

The use of soil strip tillage technology is more effective in mountain farming as it is possible to create deep chisel zones that facilitate the penetration of surface water to the lower layers of soils helping to prevent water erosion.

Material and method

In order to ensure the water resistance and to prevent soil erosion of the sloping strip a combined slope-loosening unit of strip tillage is proposed (Fig. 1, a), on the frame (4) of which the combined working instruments arranged at a certain distance from each other are assembled, the working parts with flat hands for total soil loosening (3) and the flat discs (1) located in front of the combined sprockets are designed to facilitate the technological and dynamic stability of the agregate on the slope.

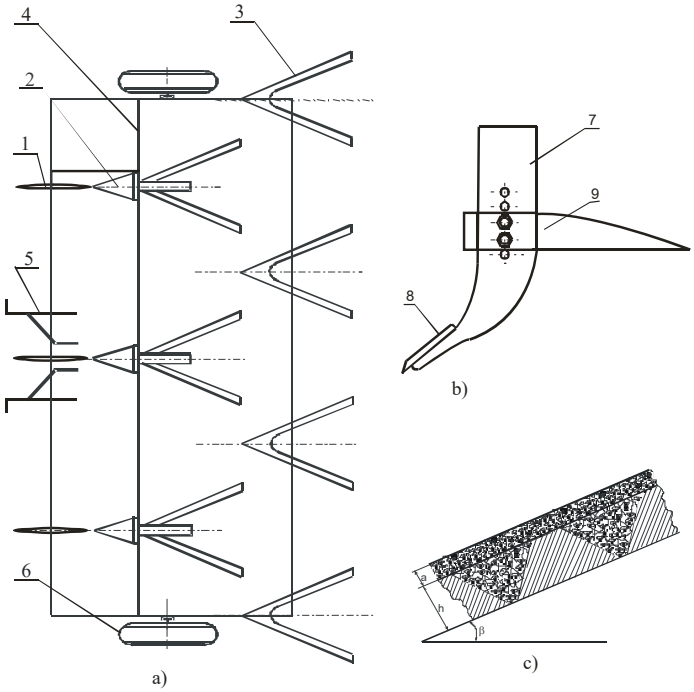

Fig. 1 Structure of combined agregate for strip tillage of the slopes

The combined working body (2), which is designed for strip tillage of the slope soil, consists of a stand (7) (Fig. 1, b), on which the digger-crusher (8) and the flat-cutter hoe (9) are assembled. The flat-cutter hoe (9) attached to the stand (7) performs a general deflection

of the top layer of the slope at a depth of a process and the digger-crusher (8) forms a V water-accumulating h depth (Fig. 1, c), where snowmelt water and rain waters accumulate.

When cultivating the soil with a combined slope cultivator, the water resistance of the loosened layer and the soil fertility increase, the soil erosion decreases and the removal of herbicides and useful organic residues takes place.

The combined slope tillage agregate performs two-layer soil loosening during the work. The top layer of soil is loosened with flat pads for total loosening to a depth of 8-12 cm and the bottom layer is loosened to a depth of 30-35 cm forming V-shaped water storage tanks at some distance from each other.

Results and analysis

Let us determine the placement parameters of working parts of agregate for clarifying their layout (Fig. 2).

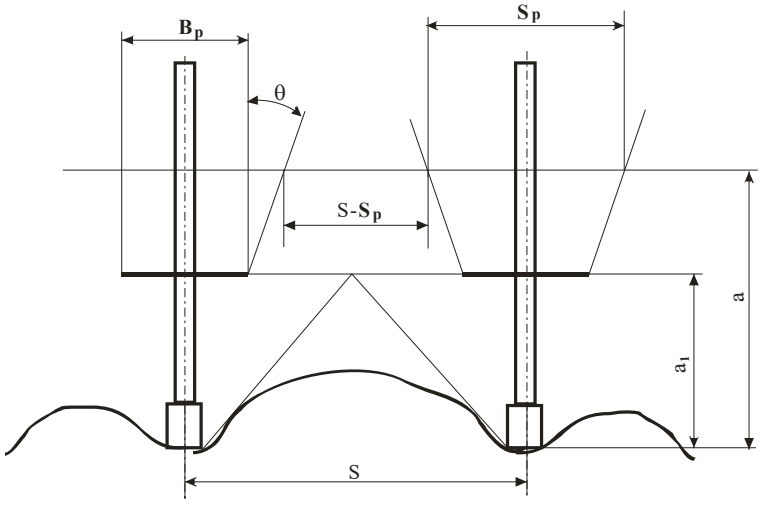

Fig. 2 Calculation sheme of layout of working parts

According to Fig. 2, the distance between the traces of combined working parts is determined by the following formula:

$$S = \left(S - S_p\right) + B_p + 2(a - a_1)tg\theta, \tag{1}$$

where B_p - is the width of coverage of flat digger, a - is the depth of tillage of loosened strips, a_1 - is the height of flat digger placement on the stand, S_p - is soil width tilled by flat digger, θ - is the angle of crack direction to the vertical in vertical-horizontal area.

The width of coverage of flat digger will be

$$B_p = S_p - 2(a - a_1)tg\theta, \tag{2}$$

According to agro-technical requirements, the width of cultivated strips should be within $0.25 \div 0.28m$. So when the depth of tillage is $a = 0.3m$, the height of flat digger placement on the stand $a_1 = 0.2m$, the angle of crack direction $\theta = 18°$, then the width of coverage of flat digger will be within $B_p = 0{,}18 - 0{,}24m$, and the distance between combined hoes is $S = 0{,}5 \div 0{,}56m$.

The working parts of the combined tillage unit must be arranged in such a way as to exclude the accumulation of soil between them. In order to prevent the accumulation of soil between the drill hoes and the flat disks placed in front of them in the proposed unit, it is necessary to place these working parts at a certain distance in the direction of action. This distance is determined by the length of crack of deformed strip of the soil (l') (Fig. 3).

$$L = l\cos\alpha + l', \tag{3}$$

where l - is the length, l' - is length of crack of deformed strip of the soil which was determined by the dimensional condition of soil deformation:

$$l' = \frac{a}{\sin\psi}\cos\psi, \quad \text{or} \quad l' = a\,ctg\,\psi, \tag{4}$$

where a - is tillage depth, ψ - is the angle of crack direction of deformed soil to the direction of agregate action which is determined by the following expression (Fig. 3) [3, 4].

$$\psi = 90^0 - \frac{\alpha + \varphi + \varphi_1}{2}, \tag{5}$$

where φ - is contact angle of soil and metal, φ_1 - is the angle of soil internal contact.

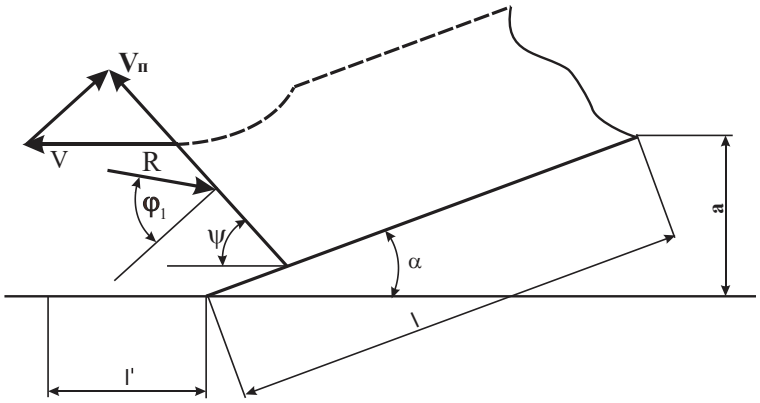

Fig. 3 Scheme of determining the distance between working organs to the direction of tillage unit

Inserting (4) and (5) in (3) we will get

$$L = l\cos\alpha + a\,tg\,\frac{\alpha+\varphi+\varphi_1}{2} \tag{6}$$

The research showed that working part of hoe for deep tillage of dark soils should have $\alpha = 20 - 25^o$ loosening angle and 0.2m length [4, 5, 6], hence according expression (6), the distance between the working parts to the direction of tillage unit action will be $L = 0.58 - 0.66m$.

Conclusion

1. In case of tillage with the proposed two-strip tillage unit, both topsoil dusting and over-condensation of soil internal layer are reduced, water resistence is ensured, soil erosion

and soil washing are reduced and the removal of herbicides and useful organic matter is noted and the fertility of the soil is increased.

2. The application of combined aggregate solves a number of ecological issues connected with the water and wind erosion occurred in fields during crop cultivation.
3. In order to exclude the accumulation of soil between the drill hoes and the flat disks placed in front of them in the proposed unit, it is necessary to place these working parts at a distance of 0.58 - 0.66 m in the direction of action.

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ԼԱՆՋԵՐԻ ՀՈՂԻ ՇԵՐՏԱՎՈՐ ՄՇԱԿՄԱՆ ԱԳՐԵԳԱՏ

Տոնապետյան Պ.Ա.[1], Գասպարյան Պ.Յու.[2], Տոնապետյան Ա.Պ.[1], Առաքելյան Ա.Ա.[1]

[1]Հայասանի ազգային ագրարային համալսարան

[2]Շուշիի տեխնոլոգիական համալսարան

Լեռնային երկրագործության, մասնավորապես՝ լանջերի հողի մշակման համար առաջարկվել է շերտավոր մշակման կոմբինացված ագրեգատ, էներգախնայող ունիվերսալ բանող օրգաններով, որոնց կիրառմամբ կնվազի հողի վերին շերտի

փոշիացումը, ներքին շերտերի գերխտացումները, կապահովվի փխրեցվող շերտի ջրակայունությունը, կնվազի հողի էրոզիան, իսկ դրա հետ նաև՝ հերբիցիդների և այլ օգտակար օրգանական մնացորդների հեռացումը, կբարձրանա հողի բերրիությունն ու մշակաբույսերի բերքատվությունը:

Որոշված է ագրեգատի վրա բանող օրգանների տեղակայման պարամետրերը:

Կոմբինացված ագրեգատի կիրառումը լուծում է նաև էկոլոգիական խնդիրներ՝ կապված մշակաբույսերի մշակման ժամանակ դաշտերում առաջացող ջրային և քամու էրոզիայի հետ:

Բանալի բառեր. լանջ, շերտավոր մշակում, ունիվերսալ, ագրեգատ, բանող օրգան, էրոզիա:

АГРЕГАТ ДЛЯ ПОСЛОЙНОЙ ОБРАБОТКИ ПОЧВЫ НА СКЛОНАХ

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Для горного земледелия, в частности, для обработки почвы на склонах, предложен комбинированный агрегат с энергосберегающими универсальными рабочими органами для послойной обработки почвы, с применением которого уменьшится распыление верхнего слоя почвы, уплотнение внутренних слоев, будет обеспечена водоустойчивость взрыхленного слоя почвы, уменьшится эрозия почвы, а вместе с ней и вынос гербицидов и других полезных органических остатков, повысится плодородие почвы и урожайность культур.

Определены параметры размещения рабочих органов на агрегате. Применение комбинированного агрегата решает также экологические проблемы, связанные с водной и ветровой эрозией полей при возделывании сельскохозяйственных культур.

Ключевые слова: склон, послойная обработка, универсальный, агрегат, рабочий орган, эрозия.

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- Հետազոտությունն իրականացվել է ԱՀ ԿԳՄՍ նախարարության կողմից տրամադրվող ֆինանսական աջակցությամբ՝ №SCS20-007 «ԱՀ Լեռնային երկրագործությունում հողի մշակման նոր էներգախնայող տեխնոլոգիայի և լիակատար մեքենայի մշակում և արտադրական փորձարկում» գիտական թեմայի շրջանակներում:

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