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CALCULATION OF A KNIFE SETTING OF THE POTATO DIGGER'S ROTARY CLOD CRUSHER CONVEYOR

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Potato-digging machines operating under heavy ground conditions should be equipped with a clod-crusher-conveyors with dynamic properties. In the course of operation on the clod-crusher-conveyor circular belts knives are mounted angularly and the distance between them on the rotor should be taken into consideration for the crushed lump of soil not be clogged between neighboring knives. The relation of the distance between two neighboring knives and their number has been established. The installation of clod-crush-conveyors with oblique replaceable knives on potato-digging machines provides 96 percent of tubers separation from the soil.

***Key words**: potato digger, tuber, clod-crusher conveyor, bed, separation*

Introduction

Current potato diggers and combines are designed for operating in light and average clay, clay sand soils. They provide up to 85 percent of separated tuberous soil mass [1,2].

The most part of land under farming agriculture of the Republic of Armenia is of heavy type, which after irrigation are crusted over by thick layer. The number of machine-friendly areas good for potato cultivating is quite limited, because of that most cultural plants like tubers and root crops are cultivated in difficult land pieces.

Conflict settings

In potato harvesting up to now clod crushers do not provide necessary technological quality of the tuberous plants digging process. The entire tuber-and-soil mass of the bed is loaded on the digging machine due to which it is becoming overloaded, tubers cleaning process is worsening, as a result occurs a loss of machine productivity and rate of working, on the other hand expenditures on energy are increasing [3,4].

Machines working in bad conditions in terms of soil properties should become completed with clod crushers of dynamic characteristics. They should be installed in front of ploughs and embrace the whole profile of the tuber pit.

Research results

As a result of the study, it has been established that the executive organ of the clod-crusher conveyor operating in the design of the potato digging machine should have such a structure that parallel with the crushing of clods on the ridge it transports the crushed material to the furrow space and prevent the soil mass from entering the potato digging machine.

Application dynamically operating rotary clod-crushers on a potato digging machines will enable to essentially lighten the weight of machines and to lighten their work. The executive organ will perform better grinding of clods, will prevent soil degradation, will be possible effective separation of tubers and soil mass, and provide required technological quality of harvest.

To reduce the degree of tubers' mechanical damage and increase the intensity of clods crushing it is necessary during the development of the clod-crushing conveyor's design and substantiation of its

parameters it is necessary to take into account the geometrical shapes of the furrow and tuber pit and their dimensions and their relative position.

On the chain belts of the clod-crusher-conveyor cutting knives are fixed angularly relative to the direction of the machine movement. Trajectory of the knives is a cycloidal curve which plays a positive role in loosening of clods on the ridge surface. Due to obliquely mounted knives the loosened mass of the ridge surface the gradually is moved to the furrow space and is not entirely fed to separation unit. The clod-crusher-conveyor not only crushes clods on the surface of the ridge but also removed the cuttings aside [5].

Technological process of the clod-crusher of the executive organ consists of two consecutive operation – first, cutting the soil crust covering the ridge by the width equal to the amount of feed, second, throw it to the furrow space. Technologies used in these two operations differ greatly from one another, therefore, the structural and kinematic parameters of the of the executive organ should be grounded in such a way that the cutting of the soil crust and throw of cuttings are not performed on account of work quality .

Let us make a theoretical analysis of the technological process' two operations with the agreed substantiation of the main parameters .

Cutting off the ridge surface crust without pushing the front soil mass by the knife it is necessary to provide $\lambda > 1$ requirement of the kinematic index. This condition is necessary for providing the cuttings be thrown in the ridge's side furrow.

Therefore, ensuring of the ridge cleaning from the soil crust is satisfied by $\lambda > 1$ condition with $\lambda = \frac{\omega R}{V}$ reservation, where ωR member, simultaneously, should not influence too much diminution of cuttings width. The width of soil slice is equivalent to the feed $S = \frac{2\pi R}{\lambda z}$, where z is the number of knives installed on the roller o9f the executive organ. On the other hand the distant between knives on the perimeter of the roller should also satisfy the requirement that cut-off soil slice should not be stuck between neighboring knives.

The study of the above presented technological procedure suggests starting the solution of this problem from elimination of sticking of the soil slice in a space between knives.

According to studies carried out by S.S.Golushkevich [6] it was established that shear planes are not rectilinear (Figure 1,b). It should be noted that S.S.Golushkevich also found that within the range of the knife installation angle $\alpha \geq 90 - \varphi$ interaction of the deformator with the soil can be considered as an influence on the vertical wall. The crack in AC and DB sections is rectilinear, and in CD section has the appearance of a logarithmic spiral. As regarding this point Sh.M.Grigoryan [3] found that by slight deviations it can be assumed that $X = O''B = (2{,}5 \div 4)h$.

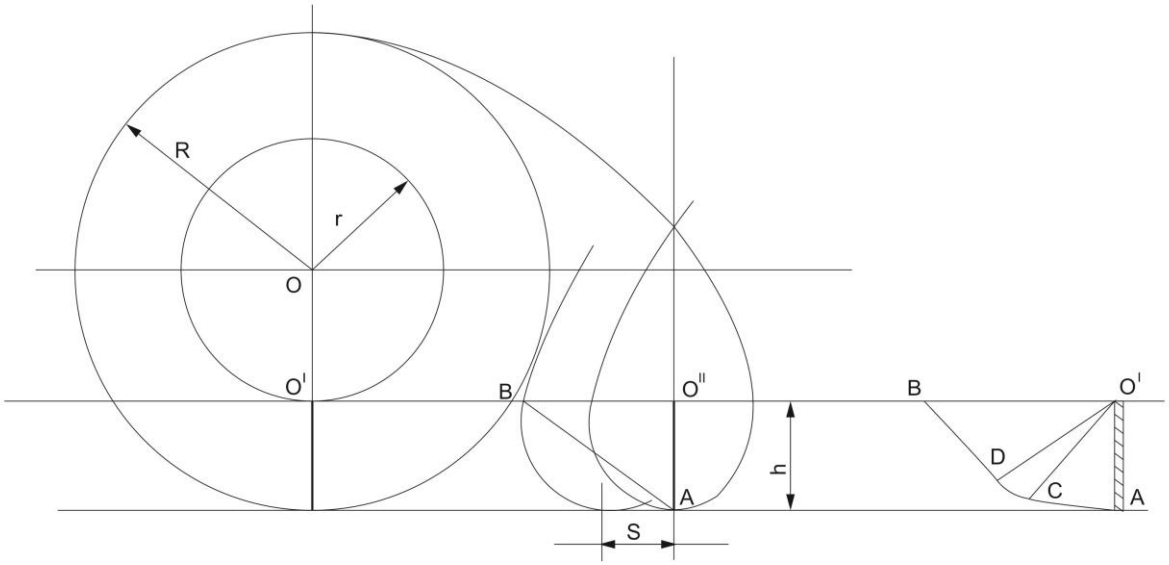
Proceeding from the above description it is possible to confirm that for the problem under study the distance between two neighboring knives is equal to $AB = \frac{2\pi R}{z}$, where z is the number of knives fixed on the perimeter of the roller. At the same time in the position $O'A$ of the next knife the edge of the previous knife is on the at the point B (Figure 1,b). Thus, for the reliable calculation the distance between knives should be

$$AB \geq \sqrt{h^2 + (2{,}5h)^2}, \text{ or}$$
$$AB \geq 2{,}69h: \quad (1)$$

Making use of Eq.(1) the number of knives on the will be

$$Z = \frac{2\pi R}{2{,}69h} \approx 2{,}33\frac{R}{h}: \quad (2)$$

The radius of the executive member's roller developed by the authors is $r = 13 \div 28$ cm. Calculating the value of $R = r + h = 20 + 12 = 32$ cm, ($h = 3 \div 12$ cm), we get $Z = 2{,}33\frac{R}{h} = 2{,}33\frac{32}{12} = 6{,}2$. Thus the number of knives will be $Z \approx 6$.



(a) **(b)**

Figure 1. (a) Calculation scheme for the distance between knives installed on the roller (b) scheme determining shear planes directions of the soil

The analysis of the designed magnitude of the knife installation angle shows that the optimal position of the knife within the range of turning angle of the rotor depends only on the kinematic parameters, which in case of driven rotor changes in the range of 0 to 1 and in the case of the driving one it is from 1 to 16.

Installation of rotary clod-crushing-conveyor with angled knives on potato digging machines will enable to perform clods breaking on furrow ridge and their cuttings` removal to the side, due to which almost 96 percent of tuber mass can be separated from soil just on the conveyor.

Conclusion

Ensuring the operation of cleaning the ridge from the soil crust meets the $\lambda > 1$ requirement. The width of the ground slice is equivalent to the feed. The distance between knives fixed on the roller's perimeter should satisfy the requirement that the cut-off soil slice not to be stuck between neighboring knives. The distance between two neighboring knives should be $AB \geq 2{,}69h$ which is necessary for carrying out the calculation. The number of angled knives installed on rollers of the clod-crusher-conveyor as a result of the study came out to be equal to 6. Installation of rotary clod-crusher-conveyors with angled knives on potato-digging machines ensures almost 96 percent of tuber mass separating from the soil.

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ԿԱՐՏՈՖԻԼԱՀԱՆ ՄԵՔԵՆԱՅԻ ՌՈՏԱՑԻՈՆ ԿՈՇՏԱՄԱՆՐԻՉ-ՓՈԽԱԿՐԻՉԻ ԴԱՆԱԿՆԵՐԻ ՏԵՂԱԿԱՅՄԱՆ ՀԱՇՎԱՐԿԸ

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Ծանր հողային պայմաններում աշխատող մեքենաները պետք է համալրվեն դինամիկական սկզբունքով աշխատող կոշտամանրիչներով: Դրանք պետք է տեղակայվեն խոփերից առաջ և ընդգրկեն պալարաբնի ամբողջ պրոֆիլը:

Դանակի տեղակայման անկյան հաշվարկային մեծության վերլուծությունը ցույց է տալիս, որ ռոտորի պտտման անկյան տիրույթում դանակի օպտիմալ դիրքը կախված է միայն կինեմատիկական պարամետրից: Կարտոֆիլահան մեքենաների վրա թեքադիր դանակներով ռոտացիոն կոշտամանրիչ-փոխակրիչների տեղակայումը հնարավորություն կտա իրականացնել մարգաթմբի մակերևույթի կոշտերի ջարդում և կողհեռացում, ինչի շնորհիվ փոխակրիչի վրա կապահովվի գրեթե 96% պալարահողային զանգվածի զտում:

Բանալի բառեր. կարտոֆիլահան մեքենա, պալար, կոշտամանրիչ-փոխակրիչ, մարգաթումբ, զտում

РАСЧЕТ УСТАНОВКИ НОЖЕЙ РОТАЦИОННОГО КОМКОИЗМЕЛЬЧИТЕЛЯ-ТРАНСПОРТЕРА КАРТОФЕЛЕКОПАТЕЛЯ

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Картофелекопательные машины работающие в тяжелых грунтовых условиях должны быть укомплектованы комкоизмельчителями работающими динамическим принципом. На круговых поясах комкоизмельчителя-транспортера под углом в отношении хода движения машины устанавлеваются ножи, отдаленность которых на роторе должна учитывать условия, чтобы разрезанная щепка не застревала между соседними ножами. Установлено расстояние между двумя соседними ножами и их количество. Установление комкоизмельчителей-транспортеров с косыми заменяемыми ножами на картофелекопательных машинах обеспечивают 96% очистки клубней от почвы.

Ключевые слова: картофелекопательная машина, клубень, комкоизмельчитель-транспортер, грядка, сепарация