DEVELOPMENT AND INTRODUCTION OF THE CULTIVATOR FOR FOR THE SOIL TILLAGE AT ROW-SPACINGS AND VINEYARDS LINES

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Annotation
The article presents the results of theoretical and experimental studies on finding the optimal scheme of a cultivator for tillage in vineyards, providing high-quality tillage with minimal energy (power) consumption. The basic parameters of the machine and operational elements are substantiated.

Keyword: Vinograd, cultivator, soil, experiment, parameter, ryad, vnedrenie, kachestvo.

Introduction

Wide-scale activities on reducing the labor and energy (power) costs, as well as resources saving in applying the enhanced technologies and developing the high-effecient agricultural machines in grapes production are being implemented throughout the Republic of Uzbekistan. At the Strategy of actions on further development the Republic of Uzbekistan in 2017-2021 years, in particular, tasks on «.....increasing the volume of Gross Domestic Product (GDP) more than two times up to 2030; ... further strengthening the food safety, expansion the production of ecological pure product; rational usage of land and water resources, introducing the state-of-the-art intensive agrotechnologies; increasing the gardens and vineyards by optimization the sowing places at the account of reducing the land areas for cotton-plant and wheat in 2017-2020 years» [1,2]. In effort to implement those above tasks and assignments the important sphere is obtaining high yield crops and - very necessary manner, however implementing it manually requires more labor consumtion. Therefore such work is being performed by mechanical tools of inter-bushes processing succesfully.

Keeping the vineyards, in particular, performing the most labor-consuming and energy-consuming operations in soil tillage on them (cultivation either или loosening, bushes spaces processing, fall ploughing at row-spacings, updating the plantage and etc.), can be implemented only on the basis of mechanization [3-13]. However machines, purposed for soil tillage at vineyards, are not yet being produced. One of the reasons for such provision is absence of sufficient theoretical and experimental data, required for development and industrial output of cultivator for soil tillage at row-spacings and vinyards lines.

Methods of Researches

Creating favorable conditions for plants growth and fructification is included into the task for soil tillage at vineyards. Accumulation and reserving the humidity, consume it thrifty, aearation improve, weeds and pests removal, closing the fertilizers, protecting the vineyard from winter frosts are achieved by soil processing.

Soil at vineyard will be supported at loosened state and such condition free from the weeds. It can be achieved by systematic (three-four times during whole summer) cultivations of row-spacings at depth 10-12 cm ploughers PRVM-3 and MPV-3 and chisel. Cultivations of row-spacings will be implemented after each watering, and on rain-fed vineyards – after torrential rain.

By summer treatments the weed vegetation on surface is removed, on the soil surface loosened layer is formed, which facilitates moisture reserving, improvement the water-air and nutrition mode of soil in the area where roots mass is located.

Soil processing at the same row between bushes is very necessary way, however implementing it manually requires more labor costs. Therefore, at present, such work is being performed successfully by mechanizms of interbushes processing.

In summer period the soil between the bushes will be loosened two-three times for the purpose to remove the weeds. When the loosening is being performed it is recommended to leave lower deepening between bushes up to 10 cm like strip, to where the part of vines to be cloased before winter, will be allocated during autumn packing.

The scientists of SRI Gardening, Viticulture and Winemaking named after M.M.Mirzaev, "Agromash" BMKM factory have implemented the development of machines for soil tillage. Development of technologies and structures for trial vineyard machines for tilling the soil at vineyards continued [11-15].

Trial cultivator for tillage at row-spacings and lines of vineyards (conditional brand UK-3) (see fig.1) is tool consisted of framework of the iniversal straigt-angle shaped, purposed for fastening machine's all components on it; two universal longitudinal beams (as part of plougher); two leashes, one central loosener, three fertilizer devices with drives; posts for fastening the operating elements, operating elements kit, two sheltered and four ploughing frames; as well as two supporting wheels with mechanizms of regulation the progress depth of operating elements.

Fig.1. Cultivator-loosener of vineyards UK-3 on cultivation works of row-spacings by processing of inter-bushes lines

As a result of search, trial-design works and researches implemented previous years (2010-2019), entirely certain tendency and method relatively scheme and design of machines on tillage at vineyards were made up by 2019, namely the following: the machine must have sharpened framework having regulation its seizure [17,18,19].

However up to present none of those proposed and described above machines didn't appear as prototype for industrial output, that, along with the other reasons, obviously, can be explained by lack of scientifically substantiated enough data, particularly, about operation quality, energy comsumption of process at vineyards under particular conditions. Researches of mechanization laboratory pf SRI GVV named after acad.M.M.Mirzaev has represented significant interest in that relation (2010-2019) of wide seizure cultivator UK-3 which was developed here.

Researches on UK-3 cultivator have been implemented at farm field of "Negmatov Rahsiboy agrofayz" Zangiata district Tashkent region (in July and August of 2018) on tractor-drawn TL-100 on the plantings among row-spacings 3 m (distance between the plants at a row – 1,5-2 m, height of boles – 110-120 cm, (Tayfi rose colored – grapes grade) on cultivation the row-spacings with inter-bushes tillage having developed devices. Soil humidity was lower and at the layer 5-10 and 10-30 cm appropriately amounted averagely 15,5% and 19,6%. At the same time soil hardness was very high and nonuniformly throughout row-spacing width: out of gauging, at layer 0-10 cm it amounted 0,56-1,01 Mpa; at layer 10-30 cm – 2,21-2,80 Mpa; and base on gauging from the previous passages of soil assemblies was strongly consolidated throughout whole horizon and at layer 0-30 cm its hardness has attained 2,8-2,96 MPa (figure 2).

Fig. 2. Cultivator-loosener for vineyards UK-3 for using row-spacings cultivation activities with inter-bushes lines tillage at assembly of the tractor TL-100 "NEW Holland"

Despite disadvantageous soil conditions for operating the machines UK-3 average arithmetic value of cultivation depth at passage zone of the wide seizure cultivating claws amounted 12,1 cm at experiment accuracy ± 2,6%. No damages on the ground part of bushes,boles and vines, vine-props and posts were noticed.

Traction resistance of wide secizure cultivator UK-3 determined by tenzometry method, amounted 16-22 kN, assembly velocity – 1,4-2,0 m/s, performance effeciency 12-16 h per shift, that almost for two times higher in comparing with the machine MPV-1A on cultivation of inter-bushes tillage of vineyards at row-spacings 3-3,5 m.

In this case, as pointed out before it is required to specify the achievements of leading agromachines and promising technologies of soil tillage at vineyards in effort for them to allow obtaining high performance indicators and achieve reducing the energy costs and increasing the machines operation efficiency.

The Results and Discussions of Research

At two row scheme by increasing the seizure width of operating elements tools, functioning under entire surroundings will not ascend; in this case the operating elements will not be clogged by soil and plant residues; all the operating elements, besides middle one will function at released surroundings, significantly less of tools mass and centre of its gravity is allocated closer to tractor. Traction resistance is reduced significantly, the operating elements wear will be reduced; formation of large-scale clods and soil surface leveling are not allowed; free and convinient access to the operating elements for technical maintenance works is provided and etc.[11,13,15].

Considering above in effort not to allow plugging the operating elements with soil and plant residues the operating elements will be allocated on the framework base on the two-row scheme.

Cultvation of row-spacings and inter-bushes lines is performed by flat cutter operating elements and turning flat cutter claw at row.

Technologic process of rows-spacing cultivation in the principle is analogous to the proceedings of total loosening and differ from it in that cutting the weeds and soil loosening is implemented throughout all rows-spacing and operating elements, adjusted longitudinal ploughshares and lesser depth - 10-12 cm.

Due to less depth of loosening in cultivation an issues will arise on is it necessary for the purpose of deepening the flatter cutting ploughshares to install the operating elements of chisel on the side posts.

The results of comparative researches of qualitative indicators of designing the operating elements of cultivator UK-3, shown on table 1, confirm on usefullness when chisel is installed on the side loosening posts of the operating elements. They provide required steadiness of depth at surface cultivation [16,17].

Table 1. Dependence of qualitative indicators of cultivator operating elements of the machine UK-3 from the installation angle of chisel at a velocity translational movement 1,45-1,95 m/s

№	Indicators	Lifting angle of chisel of the operating element рабочих органов, град.			
		24	26	30	32
1	Tillage depth, cm: installation	12,0	12,0	12,0	12,0
	average arithmetic	12,73	11,15	12,29	11,60
	average meansquare deviation.	1,42	1,11	1,24	1,23
	variation coefficient, %	11,15	9,96	10,09	10,60
2	Soil crumbling per fractions, %				
	lower than 10 mm	68,61	67,05	62,08	53,64
	10-20	11,08	13,29	12,35	9,08
	20-50	12,95	9,61	14,37	10,92
	50- 100	7,58	10,05	11,18	8,47
	over than 100 mm	-	-	-	17,89
3	Ridgedness , cm:				
	average arithmetic	4,21	5,05	5,79	6,58
	average meansquare deviation.	1,96	2,19	2,57	2,60
	variation coefficient, %	46,56	43,37	44,39	39,51
4	Protecting zone, cm:				
	average arithmetic	26,27	27,15	27,49	29,05
	average meansquare deviation.	5,39	5,83	5,88	6,02
	variation coefficient, %	20,52	21,47	21,39	20,72

As shown in the table 1, by increasing the rising angle of chisel from 26 to 34° deepening capacity of the operating elements significantly raises, varying within the range of 11,60-12,73 cm at the fixed depth of process 12,0 cm. In this case allowed limit has values of the average mean square deviations 1,11-1,42 cm with variation coefficients 9,96-11,15 %. In the event when throughout process in appropriate deepening from 11,18 to 12,02 cm and satisfactory values of means square deviations 1,00-1,49 cm; variation coefficient 9,68-13,94 % and experiment error 0,04-0,06 cm at that time similar results are obtained and throughout uniformity of depth.

It should be mentioned, however, in the event when the weeds are totally annihilation (cleaned) by flat cutting plowshares the following will be observed: certain decreasing the degree of soil crumbling onto optimum fractions: less than 10 mm – from 68,61 % to 53,64%; from 10 to 20 mm – from 11,08% to 9,08 %; decreasing the working width of seizure from 2,953 to 2,940 m; increasing the ridgedness from 4,21 to 6,58 cm and protection zone from 26,27 to 29,05

cm. Moreover, worsening of those indicators is insignificant at rising the lift angle of chisel up to 32° and evidently perciptible at the value 32°.

Conclusion

By analyzing and comparing the averaged indicators of traction resistance depending on the velocity in cultivation of inter-bushes line and rows-spacing, as well as only cultivation of rows-spacing at hard soils processing; in this case let's determine difference between them with enough accuracy for acting values of side universal operating elements of the machine UK-3. The values of traction resistance for two operating elements working at adjacent rows of inter-bushes lines of the vineyards, in terms of velocities accordingly 1,45; 1,55; 1,75 and 1,95 m/s will be 0,25; 0,50; 0,65 and 1,20 kN.

Thus, in avoid any damages to the root system of vineyards the results of power evaluation of traction resistance of the side rotary operating elements, contacting with root boles of vineyards bushes provide basis to consider as optimum movement velocity at a range 1,48-1,60 m/s.

Analysis of required capacity confirm reasonability of cultuvator assemblies operation on velocity modes within the range 1,45- 1,75 m/s. Required traction capacity at those modes is less differed and not so great for cultivation of row-spacings and cultivation of inter-bushes lines, spacings (accordingly 21,20- 24,27 kW and 21,53-24,78 kW).

Cultivator for the soil tillage at row-spacings and lines of vineyards UK-3 has been implemented laboratory and field tests at Accredited Agrotechnical Testing Center at Joint-Stock Company «BMKB – Agro7mash» (Protocol № 1-2016) [15].

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