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# Cutting Branches of Trees and Possibilities From Their Use

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Annotation: The article analyzes the branches and their processing, which are formed as a result of pruning trees in our country. According to the analysis, in the coming year, the volume of bushy branches of trees in our republic will increase by 2-3 times, and there is a need to cut them to a length of 100-400 mm and use them as firewood. Based on this, it is urgent to develop an energy-efficient device that cuts tree branches to the required size for firewood.

Key words: garden, shrub branches, chopping, chopper, sizes of branches. .

## Introduction

In the development strategy of agriculture of Uzbekistan for 2020-2030, it is determined in the next 10 years to double the area of horticulture and viticulture in our republic to 756 thousand hectares. In addition, certain work is being carried out to expand the areas of protective forests, increase the number of windproof green corridors on agricultural land [1,2].

If we take into account that in our republic much attention is paid to laying new orchards and vineyards, expanding the area of forests, planting trees and shrubs on roads and alleys, the amount of pruning work will also increase. As a result, an increase in the size of the branches formed as a result of their molding and pruning is expected. This, in turn, can lead to an increase in waste, as the branches of the bush are piled up. Therefore, they must be further processed and considered for their intended use.

On the basis of this, statistical information was studied on orchards, vineyards, shrubs and green spaces planted in Uzbekistan, the number of branches and their size and weight indicators were determined, as well as the possibility of using tree branches in Uzbekistan.

## Literature Review and Research Purpose

M. Acuna, J. Wiedemann, M. Strandgaard, R. Spinelli, P. M. O. Owende, S. M. Ward, M. Tornero, E. Cavallo, L. Eliasson, A. Facello, E. Marchi, L.Vargula, P.Kravets, K.J. Walus, M. Doll, A. Kadey, L. Marchi, O. Moloney, R. Cavalli and S. Grigolato, P. Raut, C. Freiburger, F. Longueto, F. Mot, T. Constant, J. M. Leban, S.P. Karpachev, V.I. Zaprudnov, M.A. Bykovsky, A.P. Mokharev, Yu.A. Bezrukikh, S.O. Medvedev and other scientists conducted research. In Uzbekistan, Fayziev Zh.N., Abdullaev R.M., Aripov A.A. were engaged in pruning trees. and others, but studies on the processing of tree branches have not been conducted.

M. Akuna, J. Wiedemann and M. Strandgaard studied the process of clearing forests and gardens from tree branches. The system for collecting data from the machines used in the studies, the percentage of use and imbalances of the system were determined [3].

R. Spinelli et al. conducted research on trends and prospects for the design of mobile tree and shrub shredders [4].

In particular, R. Spinelli, P. M. Ovende, S. M. Ward and M. Tornero identified important factors affecting the performance of machines for transporting tree branches and the cost of pruning, and considered the issues of their optimization [4] .

Also, R. Spinelli, E. Cavallo, L. Eliasson, A. Facello compared disk and drum shredders used for shredding tree branches. Although disk shredders allow small branches to be shredded, their energy intensity is high and productivity is low. It has been established that drum crushers have an 8% higher productivity [5].

L.Wargula, P.Krawiec, K.J.Walus, M.Kukla studied the fuel consumption of shredders used for shredding tree branches and developed a mechanism that automatically adjusts them to the types of branches and crushing size. This made it possible to increase productivity by 20% and reduce fuel consumption by 30% [6].

A. Kadei, L. Marchi, O. Mologni, R. Cavalli and S. Grigolato, based on long-term observations, studied the biomass of bushy or damaged branches of trees in garden, mountain and forest areas, their impact on the environment and determined the efficiency of grinding [7] .

P. Raut et al. designed and developed a universal device for crushing various tree branches and conducted research. The use of the device when cutting tree branches made it possible to reduce cutting time compared to manual labor and increase labor productivity, reduce human labor, save production time and minimize costs [8].

According to the studies of S. Freiburger, F. Longeto, F. Mote, T. Constant, J. M. Leban, when processing tree branches, their density is one of the main indicators.

Based on this, they developed a method for fast and highly accurate determination of wood density using X-ray computed tomography [9].

S.P. Karpachev, V.I. Zaprudnov, M.A. The Bykovsky engaged in the use of a mobile machine for chopping tree branches and large-volume bags for chopped products, simulating the

process of their work and found that the use of these developments can increase productivity and reduce transportation costs [10].

A.P. Mokharev, Yu.A. Bezrukikh, S.O. Medvedev substantiated the advantage of obtaining secondary products from the branches of shrub trees [11].

Dj.N. Faiziev, R.M. Abdullaev, A.A. Aripov et al. gave evidence-based recommendations on the methods and techniques of tree pruning in Uzbekistan [12].

Analyzes show that the processing of branches of shrub trees has begun abroad to obtain fertilizers, construction wood, fuel materials and other products. At the same time, 30-35 percent of the products obtained by wood processing technology are products used as fuel. However, no studies have been conducted in Uzbekistan on the processing and chopping of bushy branches of trees, the development and improvement of devices used in their implementation.

## Research Methods

Statistical information about orchards, vineyards, shrubs and green spaces planted in Uzbekistan was formed on the basis of indicators defined in the decrees of the President and the Government of the Republic of Uzbekistan on the development of this industry, and statistical information about orchards and vineyards that actually exist in the regions are divided into vineyards, orchards and green parks.

Experiments to study the number of branches and their size-mass indicators formed during pruning of trees were carried out in the garden of Turgunboy ota LLC, located in the Kibray district of the Tashkent region. The indicators are determined according to GOST 20915-2011, GOST 16483.0-89, GOST 16483.7-71 and GOST 16483.1-84 [13].

The length of the branches, the diameter of the lower, middle and upper parts, the width of the branches, the number of branches in one branch, the weight of the branches, their maximum, minimum and average values were determined. , as well as the standard deviation and coefficients of variation were found on the basis of statistical analysis methods. As measuring instruments for determining the size-mass indicators of tree branches, a rod circle, tape measure and electronic scales were used.

On the basis of available literary sources and Internet information, the technologies available abroad for the utilization of tree branches or additional processing to obtain new products and the technical means used in their implementation are analyzed. Based on the above information and the results of a survey conducted among the population, the possibilities of using shrub branches of trees in the conditions of Uzbekistan were determined.

## Research Results and Examples

Annually, within the framework of the national Green Space project in Uzbekistan, from 2022 to 2024, it is planned to plant 200 million trees and shrubs, including 16 million trees in Jizzakh, Kashkadarya, Samarkand, Surkhandarya, Tashkent regions, Andijan, Bukhara, Namangan, It is planned to plant 15 million trees in Ferghana, 14 million trees in Karakalpakstan,

Navoi, Syrdarya, Khorezm. As a result, the share of green spaces in cities is expected to increase from the current 8% to 30%.

According to the Decree of the President of the Republic of Uzbekistan No. PF-46 dated December 30, 2021, it is planned to lay 156,945 hectares of vineyards, 1,278.2 hectares of "green parks" and 1,562.6 hectares of "green public parks" in the city. Republic of Karakalpakstan and its regions in 2022-2024 (Table 1) [2].

**Table 1. Plan for establishing a tree plantation in the Republic of Karakalpakstan and regions in 2022 - 2024**

| No | The name of the regions | Vineyard area, ha | "Green Gardens" area, ga | "Green public parks" area, ha |
|---|---|---|---|---|
| | | 6000 | 158,1 | 152,64 |
| 2 | Andijan region | 9000 | 128,3 | 93,48 |
| 3 | Bukhara region | 12100 | 36,2 | 68,55 |
| 4 | Jizzakh region | 23500 | 81,3 | 88,01 |
| 5 | Kashkadarya region | 15000 | 90 | 87,33 |
| 6 | Navoi region | 14000 | 70,5 | 82,93 |
| 7 | Namangan region | 15000 | 84,1 | 79,13 |
| 8 | Samarkand region | 18211 | 106,9 | 83,37 |
| 9 | Surkhandarya region | 12000 | 72,4 | 146,33 |
| 10 | Syrdarya region | 9121 | 76,8 | 69,95 |
| 11 | Tashkent region | 11013 | 116,6 | 207 |
| 12 | Fergana region | 9000 | 133,3 | 216,03 |
| 13 | Khorezm region | 3000 | 123,8 | 187,85 |
| | **Total:** | **156 945** | **1 278,2** | **1 562,6** |

Taking into account that in our republic much attention is paid to laying new orchards and vineyards, expanding the area of forests, landscaping roads and alleys, it is expected that their pruning and the number of cutting branches will increase. This requires solving the problem of their intended use by processing the branches of shrubs to reduce tree waste.

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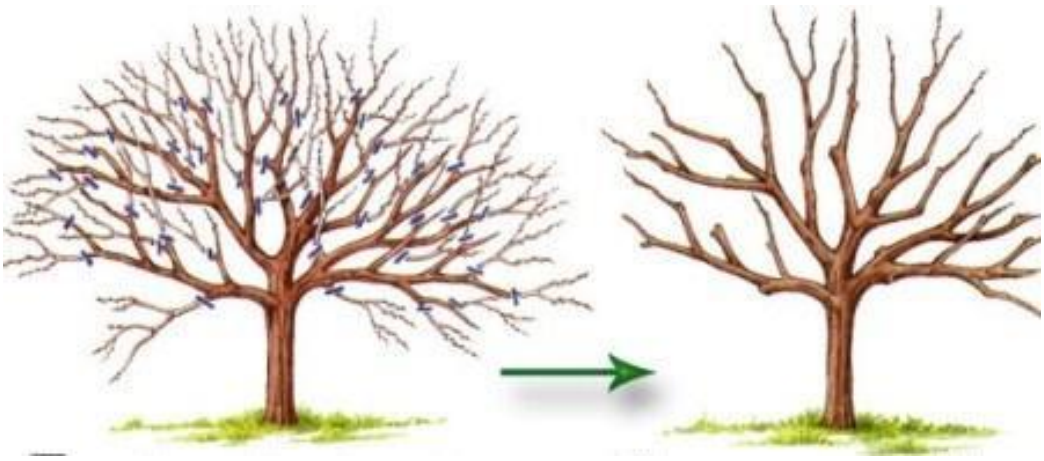
Cutting is the partial or complete removal of excess branches and branches of trees and shrubs. This event is carried out in order to give shape to seedlings and trees, as well as to remove diseased, old, broken and excess tree branches, to rejuvenate old trees (Fig. 1).



Condition in front of the cutting Condition after the cutting

**Figure 1. Condition of trees before and after pruning**

With the expansion of orchards, vineyards, shrubs and green spaces by 2-3 times and the increase in trees in Uzbekistan, it is expected that the size of the branches (Fig. 2) resulting from their molding and pruning will increase by 2-3 times.

**Figure 2. Branches formed by cutting trees**

In this regard, foreign experience shows that bushy tree branches are useful for making firewood, briquettes and pellets as fuel, as well as for the production of medicinal extracts, perfumes, carpentry and building products, filtering water from oil, preparing animal feed, and animal husbandry. breeding, used as a fertilizer in agriculture, acid, ethyl alcohol, yeast in the chemical and pulp industries, a technological product in paper production (Fig. 3).

To do this, first press down the bushy branches. For crushing antlers, drum, mills, rotary, milling, disk, saw and other types of crushers are used. With these shredders, tree branches are crushed into pieces, crumbs and powder. In the form of crushed products they are used for firewood, in carpentry and in the manufacture of toys, and in the form of coarse, powdered products, they are used to filter water from oil, as sludge in animal husbandry and as fertilizer. in agriculture, and they are processed in one or more stages to obtain medicinal extracts, perfumes, carpentry and building products, used in manufacturing, in the preparation of animal feed, in the chemical and pulp industries, in the production of acid, ethyl alcohol, yeast, paper , as well as in the preparation of briquettes and pellets, the production of fuel products.

**Figure 3. Use of tree branches as fertilizer, bedding and firewood**

In Uzbekistan, the processing of tree branches obtained as a result of tree pruning is also desirable for the production of building products, the preparation of firewood, briquettes and pellets for use as fuel, for use as a fertilizer in animal husbandry and poultry farming, and as a fertilizer in agriculture.

Based on this, it is urgent to develop machines and devices used in the crushing and processing of bushy tree branches. The use of such machines and devices leads to a reduction in labor costs and transportation costs for crushing branches by 2-3 times.

The analysis showed that the use of chopped tree branches as firewood after crushing, as livestock manure and as fertilizer in agriculture does not require large costs, and their processing to obtain fuel products in the form of briquettes and pellets and using them instead of firewood increases costs dramatically. . In surveys conducted in Uzbekistan on the feasibility of using bushy branches, the majority of the population, gardeners, farms and landscaping departments state that it is desirable to cut bushy branches into pieces 100-400 mm long and use them as firewood, and that there is a great need for this.

Based on this, one of the urgent tasks is the development of an energy-saving device capable of cutting bushy branches of trees of the required size, at the required level and of the proper quality for use as firewood. To do this, it is necessary to study the size-mass indicators of bushy branches. Based on this, experiments were carried out to determine the size and mass indicators of bushy branches of an apple tree in the garden of Turgunboy ota LLC, located in the Kibray district of the Tashkent region (Fig. 4).

**Figure 4. Branches of a cutting apple tree in the garden**

When studying pruning on the example of an apple tree, it was found that up to 30-50 percent of the total number of tree branches are bushy. The average length of the bushy branches of an apple tree is 115.0 cm, the average diameter in the bushy part is 25.6 mm, in the middle part 15.65 mm, in the apical part 7.35 mm (Table 2).

**Table 2. Indicators of the size and mass of bushy branches (using the example of an apple tree)**

| No | Name of indicators | $M_{min}$ | $M_{max}$ | The value of indicators | | |
|---|---|---|---|---|---|---|
| | | | | Middle value, $M_{mid.}$ | Middle squared deviation, | Coefficient of variation, V, % |

| | | | | | ± σ | |
|---|---|---|---|---|---|---|
| 1 | The length of the branches, cm | 43,2 | 223,4 | 115,0 | 42,54 | 36,99 |
| 2 | Diameter of antlers, mm<br>- cutting part<br>- the middle part<br>- third part | <br>8,9<br>5,8<br>3,5 | <br>48,2<br>31,4<br>16,8 | <br>25,6<br>15,65<br>7,35 | <br>10,74<br>6,55<br>2,02 | <br>41,95<br>41,84<br>27,52 |
| 3 | The width of the branches, cm | 7,1 | 124 | 42,93 | 27,32 | 63,65 |
| 4 | The number of sables on one branch, pcs | 1 | 31 | 9,05 | 7,19 | 79,46 |
| 5 | Mass of antlers, g | 30 | 1476,4 | 284,5 | 342,14 | 120,26 |

As can be seen from the second table, the length of the branches of the apple tree is in the range of 43.2-223.4 cm, the average length is 115.0 cm, the standard deviation is 42.5 cm, the coefficient of variation is 36.9. %. The diameter of the tree branches becomes thinner from the bushy part to the tip, and it is found that the difference between them is 2-3 times.

Based on this, it is important to take into account the size and mass indicators of chopped branches when developing a device that will cut the branches of a bushy tree to the required size, at the required level, with low costs for use. like firewood.

## Conclusion

In recent years, it is known in Uzbekistan that the amount of waste in the form of branches will increase by 2-3 times as a result of the expansion of orchards, vineyards, shrubs and green spaces up to 2-3 times and with the growth of trees. Based on the admissibility of using chopped firewood and other purposes for their elimination, the size and mass parameters of chopped branches were studied on the example of an apple tree, the average length of which was 115.0 cm, and the average diameter was 25.6 mm. bush, and in the middle 15.6 mm and 7.35 mm at the tip, on one branch up to 31 branches, the average width of the branches of the bush is 42.9 cm, the total weight is 284.5 g. These sizes of brushwood branches are used to develop a device that grinds them to the required size for use as firewood for livestock and poultry, as well as fertilizer in agriculture.

## References

1. Decree of the President of the Republic of Uzbekistan No. PF-5853 of October 23, 2019 "On approval of the strategy of agricultural development of the Republic of Uzbekistan for 2020-2030".(in uzbek)

2. Decree No. PF-46 of December 30, 2021 of the President of the Republic of Uzbekistan Sh.M. Mirziyoev "On measures to accelerate greening works in the Republic and more effectively organize tree protection".(in uzbek)
3. Acuna, M., Wiedemann, J., Strandgaard, M. Evaluation of an in-field chipping operation in Western Australia. CRC for Forestry Bulletin. 2009. № 4. 4. p.
4. Spinelli, R., Owende, P.M.O., Ward, S.M., Tornero, M. Comparison of short-wood forwarding systems used in Iberia. Silva Fennica 2004. № 38(1). Pp. 85–94.
5. Spinelli R., Cavallo E., Eliasson L., Facello A. Comparing the efficiency of drum and disc chippers. Silva Fennica vol. 2013 no. 2 article id 930. 11. p.
6. Spinelli R., Enrico M.T. Perspectives in the Design of Mobile Wood Chippers. Journal of Forest Engineering. 2021. Volume 787.No 42. 15. p.
7. Spinelli R., Mitchell R., Brown M., Magagnotti N., Andrew McE. Manipulating Chain Type and Flail Drum Speed for Better Fibre Recovery in Chain-Flail Delimber-Debarker-Chipper Operations. Croat. j. for. eng. 41(2020)1. Pp.137-147.
8. Spinellia R., Eliassonb L., Magagnottia N. Determining the repair and maintenance cost of wood chippers. Biomass and Bioenergy 122 (2019) Pp. 202–210.
9. Spinelli R., Conrado A.M. Productivity and Utilization Benchmarks for Chain Flail Delimber-Debarkers-Chippers Used in Fast-Growing Plantations. Croat. j. for. eng. 40(2019)1 Pp. 65-80.
10. Magagnotti N., Spinelli R., Francesco F., Lombardini C. A Versatile Terrain and Roadside Chipper for Energy Wood Production in Plantation Forestry. 2016. Baltic Forestry 22(1): 107-115.
11. Wargula L., Krawiec P., Jan K.W., Kukla M. Fuel Consumption Test Results for a Self-Adaptive, Maintenance-Free Wood Chipper Drive Control System. Applied sciences. 2020. № 10. Pp. 2-12.
12. Cadei A., Marchi L., Mologni O., Cavalli R., and Grigolato S. Evaluation of Wood Chipping Efficiency through Long-Term Monitoring. Monitoring. Environ. Sci. Proc. 2021, № 3. Pp. 2-7.
13. Cadei A., Gierz L., Warguła L., Kukla M., Koszela K., Szymon T. Z. Computer Aided Modeling of Wood Chips Transport by Means of a Belt Conveyor with Use of Discrete Element Method. Appl. Sci. 2020, 10, 9091; doi:10.3390/app10249091
14. Raut P. Design and fabrication of multipurpose wood machining device. International Journal of Scientific & Engineering Research Volume. 9, Issue 5, May-2018 ISSN 2229-5518.
15. Freyburger Ch., Longuetaud F., Mothe F., Constant T., Leban J.M. Measuring wood density by means of X-ray computer tomography. Ann. For. Sci. 66 (2009) 804
16. Karpachev S.P., Zaprudnov V.I., Bykovsky M.A. Modeling the operation of a mobile chipper with soft containers. ISSN 2542-1468, Forestry Bulletin, 2019. Vol. 23. No. 3. MSTU im. N.E. Bauman. Pp. 79-86.(in Russian).
17. Mokhairev A.P., Bezrukikh Yu.A., Medvedev S.O. Pererabotka drevesnykh otkhodov predpriyatiy lesopromyshlennogo
18. complex, kak factor ustoychivogo prirodopolzovaniya. Engineering magazine Dona, №2, ch.2 (2015) Pp. 113-118.(in Russian).

19. Sulaymanov B.A., Khalikov B.M., Saimnazarov Yu.B., Fayziev J.N, Abdullaev R.M., A.A. Aripov and others. Recommendations on agrotechnical measures to be carried out in the conditions of Tashkent region to obtain abundant harvest from gardens and vineyards. Tashkent 2015. Pp 36. (in uzbek)
20. GOST 20915-2011 Ispytaniya selskoxozyastvennoy texniki. Metody i usloviya ispytaniy [Testing agricultural technics. Methods and condition of testing]. Moscow. Standard inform, 2013, 28p. (in Russian)
21. GOST 16483.0-89 Wood. General requirements for physical and mechanical tests. - Moscow. Standard inform, 2021. - 11 p. (in Russian)
22. GOST 16483.7-71 Wood. Methods for determining moisture. - Moscow. Standard inform, 2019. - 4 p. (in Russian)
23. GOST 16483.1-84 Wood. Density determination method. - Moscow. Standard inform, 2016. - 7 p. (in Russian)
24. Juraboevich, R. K. (2020). Technical solutions and experiment to create a multipurpose machine. *International Journal of Scientific and Technology Research*, *9*(3), 2007-2013.
25. Rustamov, K. J. (2021). Innovative Approaches and Methods in Teaching Technical Subjects. *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, *12*(5), 1861-1866.
26. Rustamov, K. J. (2019). Experimental Work of the Hydraulic Equipment of the Multi-Purpose Machine Mm-1. *International Journal of Recent Technology and Engineering (IJRTE) ISSN*, 2277-3878.
27. Dj, R. K. (2019). Experimental Work of the Hydraulic Equipment of the Multi-Purpose Machine MM-1. *IJRTE, November*.
28. Rustamov, K. (2022). The Mathematical model of a positioning hydraulic drive: Mathematical model of a positioning hydraulic drive. *Acta of Turin Polytechnic University in Tashkent*, *12*(2), 76-81.
29. Рустамов, К. (2021). ОБОСНОВАНИЕ ОПТИМАЛЬНЫХ УГЛОВ ПОЗИЦИОНИРОВАНИЯ РАБОЧЕГО ОБОРУДОВАНИЯ ПРИ КОПАНИИ ГРУНТА. *Транспорт шелкового пути*, (2), 54-59.
30. Rustamov, K. J. (2023). Feasibility Study of the Designed Working Equipment of the MM-1 Machine.
31. Рустамов, К. Ж. (2009). Анализ гидропривода современных строительно-дорожных машин. *Строительные материалы, оборудование, технологии XXI века*, (1), 44-44.
32. Rustamov, K. J. (2023). Technical and Economic Indicators of a Multi-Purpose Machine. *Nexus: Journal of Advances Studies of Engineering Science*, *2*(2), 48-52.
33. Rustamov, K. J. (2023). Technical and Economic Indicators of Existing and Developed Designs of A Multi-Purpose Machine. *Procedia of Theoretical and Applied Sciences*, *4*.
34. Rustamov, K. J. (2023). Feasibility Study of the Designed Working Equipment of the MM-1 Machine. *International Journal of Discoveries and Innovations in Applied Sciences*, *3*(2), 92–97. Retrieved from https://www.openaccessjournals.eu/index.php/ijdias/article/view/1869