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PROCEEDINGS

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Belgrade, Serbia

31.October - 2.November 2019

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APPLICATION OF MACHINES IN THE GRAPEVINE DEFOLIATION

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Abstract: *Modern grapevine production technology involves the implementation of various technological operations, among which grapevine defoliation has an important place. Defoliation is an ampelotechnical measure of removing a certain number of leaves from the cluster zone. Removing the leaves changes the microclimate conditions of the grapevine (light intensity, temperature, humidity, ventilation), which affects the yield, structure of the clusters and the quality of the grapes. Leaves removal can be done manually, with chemical agents (defoliant) and with the use of machines. With development of different technical solutions and different designs of defoliation machines, the productivity of work today is significantly increased compared to the manual removal of leaves, which is still dominant in Serbia region. The technological parameters of grapevine plantations necessary for efficient and rational application of defoliation machines will be presented in this paper. Modern technical solutions and basic operating parameters of machines commonly used in practice will also be presented in this paper.*

Key words: *grapevine, defoliation, technical solutions, working parameters.*

1. INTRODUCTION

The main goal of viticultural production is the production of high quality grapes with the optimal amount and ratio of chemical components responsible for the quality of wine (Sabbatini, 2015). Modern grape production technology involves the application of various ampelotechnical measures which are more and more often implemented using modern technical systems intended for certain operations (Lanari, et al., 2013; Clingeffer, 2013; Morris, 2000; Morris, 2007). Defoliation represents one of the

measures that occupies an important place in the grape production technology (Bešlić, at al., 2016). With mature pruning, leaving a certain number of winter buds on the vine, it is not possible to fully balance the formation of vegetative and generative organs (2), the operations of green pruning and defoliation are applied as supplementary measures. Defoliation represents the removal of a certain number of leaves from the zone of bunches. The removal of leaves changes the microclimate conditions of the grapevine (light intensity, temperature, moisture, ventilation) which influences the yield, bunch structure and grape quality (Noyce et al., 2016; Kotseridis at al., 2012; Bešlić, at al., 2018; Almanza, at al., 2011).

The removal of leaves can be done manually, with chemical agents (defoliant) and with the use of machines. Thanks to the development and refinement of different technical solutions, various constructions of defoliation machines are increasingly used in practice today, which significantly increases the work productivity in relation to manual removal of leaves, which is still dominant in our regions. Modern defoliation device constructions can be applied from the phase of vine flowering until just before grape harvesting without the risk of damage to the plant and fruit. Given that modern technology of grape production involves defoliation as obligatory ampelotechnical measure, the procurement and use of machines for performing this operation is increasingly economically justified.

2. TECHNICAL SYSTEMS APPLIED IN VINE DEFOLIATION

Today, in practice, one can encounter various constructions of devices intended to perform vine defoliation. These devices appear as attachments that are aggregated on standard tractors from which they are driven for the work of working elements. The devices for removal of leaves can be aggregated from the front (figure 1a) or from the rear side of the tractor (figure 1b). There are also technical solutions which can be installed on self-propelled machines which are applied in pruning, protection, harvesting and other operations in grape production (figure 1c).

Mechanical removal of leaves from the zone of bunches, by applying modern technical systems, can be performed in various manners. One group of technical systems uses low-pressure compressed air which is precisely directed to the zone where the leaf mass is to be removed. The device is aggregated on standard tractor which, through hydraulic system and connecting shaft, enables working and control of the working organs of the device. Connecting shaft of tractor drives the compressor which enables the compression of air intended for the removal of leaf mass. The compressor is mounted on the rear of tractor and through elastic lines compressed air reaches working head which can be mounted on the front or rear part fig. 2b. Hydraulic system of tractor, performs positioning and control (adjusting) of the working head during the procedure of defoliation. The device can have one, two or a larger number of working heads thus simultaneously performing defoliation in two rows fig. 2a.

Application of machines in the grapevine defoliation



Fig. 1 a) defoliation device aggregated from the front of tractor; b) defoliation device aggregated from the rear of tractor; c) defoliation device aggregated on self-propelled machine



Fig. 2 a) device with a larger number of working heads; b) position of compressor and working head mounted on the front of tractor.

During the process of removal of leaf mass, working head slides across the surface of the rank in the zone in which defoliation is performed. Inside the working head, there are two rotors that carry nozzles through which compressed air is passed through (fig. 3). The outer side of working head is covered by stainless steel sheet with slits to protect the rotors with nozzles from leaf mass and to enable unobstructed work of the rotors. By alternating rapid pulsation of compressed air through rotating nozzles, short and sharp air currents are generated. The action of alternating air currents causes the leaves to be twisted and separated (removed) in the desired zone.



Fig. 3 Working head of defoliation device

The carrier is designed to allow the rotation of the working head and adaptation to different growing forms and required technologies of vine production. By rotation of the working head as shown in figure 4, the width of the working zone in which defoliation is performed can be adjusted. Changing the angle of the working head as shown in figure 5, enables the removal of leaf mass from the desired zone which is the most suitable for the given growing form and ampelotechnical measures that are applied.

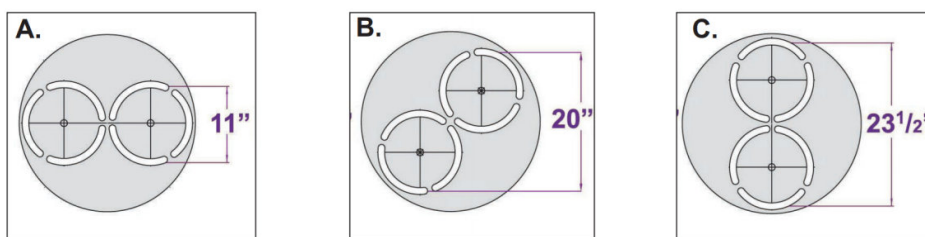


Fig. 4 Positions of the working head depending on the width of the working zone

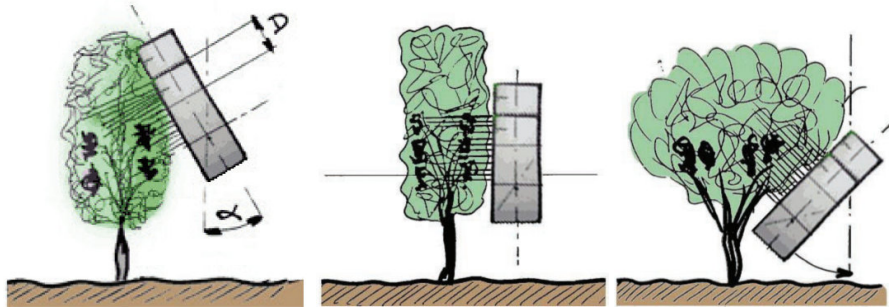


Fig. 5 Position of the working head in relation to the growing form

The newer technical solution is a defoliation device with vertically mounted pair of rollers fig. 6. During operation, the rollers rotate in opposite directions whereby leaves come into the space between rollers which grip them and cut them. One roller is made of PVC material with embossed surface in order to enhance the effect of gripping the leaves. The other roller is made of elastic material with the goal of increasing the friction on the spot where the roller touches the vine leaf. During work, the elastic roller vibrates and enhances the procedure of cutting the leaves. The fan (figure 7) is mounted on the inside of the rollers. During operation, the fan creates a suction air stream which is directed into the space between rollers. The task of the suction air stream is attracting vine leaves and bringing them into the interspace between rollers which grip them and cut them. After cutting, the fan air current blows the leaves out of the device. The drive of the rollers and fan is made through hydro motor driven by hydraulic system of the tractor on which the device is aggregated. The joint frame of telescopic type enables the adjustment of the device to the form of rank and the zone in which defoliation is performed.



Fig. 6 Device for defoliation with vertical pair of rollers

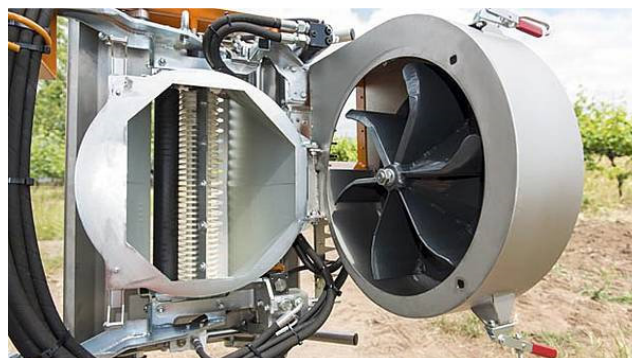


Fig. 7 The fan of defoliation device

The construction of defoliation device shown in figure 8 consists of vertically mounted perforated drum and a rubber roller which during operation rotate in opposite directions. The central part of the drum is connected with the fan which inside the drum creates suction air current. Around the edge of the drum there are openings through which suction air current attracts leaves and glues them to the surface of the drum. Due to the rotation of the drum, the attracted leaves are brought into the interspace with rubber roller which rotates in the direction opposite to that of the drum. The rotation and gripping of leaves by rubber roller result in cutting leaves. By further rotation, the edge of the perforated drum enters the zone in which the activity of the suction air current ceases, which causes the removal and falling of separated leaves from the surface of the drum to the ground. The fan, perforated drum and rubber roller are driven through hydro motor driven by hydraulic system of tractor. The device is mounted on the joint carrier of telescopic type which allows for the freedom of movement of the working part in all directions and the application in different growing forms of grapevine. This device has the possibility of installation and application in standard tractors and self-propelled machines.



Fig. 8 Device for defoliation with perforated drum

Application of machines in the grapevine defoliation



Fig. 9 Device for defoliation with perforated drum aggregated on the tractor from the rear side

3. CONCLUSION

The removal of leaves from the zone of bunches has become an increasingly popular ampelotechnical measure which is regularly applied in practice. The removal of certain leaves significantly improves the brightness and aeration of bunches, which contributes to the better and higher quality ripening, lesser development of diseases and easier performance of the operation of manual or machine grape harvesting. In our country, the procedure of defoliation is mostly done manually, which is the consequence of the lack of monetary funds for procurement of defoliation devices. The original technical solutions of these devices did not satisfy necessary requirements related to possible damage to the very plant, which was another important reason that slowed down the introduction and application of mechanical procedure of defoliation in the technology of grape production. Recently, due to the lack and high price of workforce, manufacturers increasingly opt for procurement and application of various construction solutions that can perform mechanical removal of leaves from desired zone. Another reason for the introduction of mechanical procedure of defoliation to practice is that modern technical systems can realize great performance with satisfactory quality of work and minimal possibility of damage to the fruit and vine tree.

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