REVISTA Ação Ergonômica

R. Ação Ergon., 15(1), 2021.
ISSN 2965-7318. doi: 10.4322/rae.v15e202103.en

PRUNING AND THINNING ACTIVITIES IN GRAPEVINE CROPS: A STUDY ON OCCUPATIONAL RISKS AND THE USE OF PPE AND CLOTHING

Bruno Fagner Santos Sousa [1]*

Rosiane Pereira Alves [2]

Abstract

This study conducted an ergonomic analysis of the work activities of pruning and thinning in grapevine cultivation. The objective was to investigate the working conditions with a focus on the occupational risks associated with the postures and movements adopted, the use of work tools, PPE and clothing. In the pruning and thinning activities, it was possible to observe an increase in the work pace, which can cause musculoskeletal disorders. Methodologically, the data were obtained through photographs, filming, interviews, temperature and light measurements, in addition to the survey of clothing and PPE. The results showed the need for postural corrections in both activities, in the distal limbs and in all other body segments due to the high risk of injuries. In addition, there is a need to change the workstation due to the high temperature during execution. The light was sufficient, requiring only the use of protection to avoid the incidence of sunlight. The PPE provides the necessary protection for the execution of the activities. Therefore, it was possible to propose some recommendations, such as the inclusion of breaks, workplace gymnastics, replacement of uncomfortable PPE, rotation between activities, creation of an ergonomics committee and lectures so that corrections are implemented appropriately.

Keywords: Ergonomics. Pruning and thinning of grapes. PPE. Clothing.

1. INTRODUCTION

The work environment, influenced by market demands, high productivity and high competitiveness, can trigger several negative effects on the health of rural workers, including those who work in viticulture.

In the Northeast of Brazil, grape production is concentrated in the region of the Submédio São Francisco Valley, in the hinterlands of Pernambuco and Bahia. Due to the richness of natural resources and the public and private investments made in irrigation projects, in this locality, there is an expansion of cultivated areas every year (SILVA; COELHO, 2010).

[1] Federal Institute of Education, Science and Technology of Bahia. * brunosousa16@gmail.com
[2] Federal University of Pernambuco.

Among the activities developed in viticulture are the pruning and thinning of the vine. The pruning of the vine comprises the removal of excess diseased and weak branches, with some deficiency or even poorly positioned.

The thinning activity, in turn, consists of decompacting the bunches and aims to reduce the number of berries. By removing the excess, the development of the grapes that remain in the bunch occurs. About 60% to 70% of the berries are eliminated from each bunch (MASHIMA, 2014). In the place studied, pruning activities are performed by men and thinning activities are performed by women – it is noteworthy that, in the region, this sexual division of labor is common.

It is worth mentioning that pruning and thinning activities are carried out manually, requiring a high number of workers, who generally develop their activities in inadequate conditions, with the adoption of postures that probably bring discomfort and problems to the worker's health. Allied to these factors, there are unfavorable environmental conditions such as high temperatures, excessive luminosity, air quality and rainfall.

The postures adopted during thinning and pruning activities can lead the worker to present Repetitive Strain Injuries and Musculoskeletal Disorders (RSI/WMSD). Therefore, there was a need to study such attitudes, the movements and their impact on the health of the workers involved. Couto (2007) states that shoulder movements allow for a large number of changes in postures. However, exaggerated movements can be performed a few times during the workday, otherwise they can overload these muscles.

On the other hand, there is a difficulty in analyzing and correcting inappropriate postures within a company. Generally, the evaluation is carried out through interviews with employees. And commonly, measures to correct the workplace, such as workplace gymnastics, adaptation of tools and breaks, are taken late, that is, when the injury has already been acquired (LOPES et al 2013).

In agriculture – and more specifically in viticulture – during an exploratory survey, some complaints of pain were identified, possibly related to the postures adopted in the workplaces during pruning and thinning activities. This led to the need to deepen the study on the relationships between the activities performed by workers and the physical and biomechanical risks.

In addition to postural problems, other elements can influence the development of the activities performed by workers, such as environmental factors, such as temperature, ventilation

and lighting and their relationship with protective measures, which in turn depends on the good wearability of Personal Protective Equipment and clothing.

It should be noted that rural companies have incorporated the use of Personal Protective Equipment (PPE). Some do so because they consider it an important part of the process and others because of the requirements of regulatory standards, which aim to eliminate or reduce risks and increase the safety and health of workers, especially during the handling of chemical products. However, there are reports of wearability problems during use that can impair the level of protection provided by these equipment. For example, Garrigou et al (2010), in a study carried out with rice cultivation workers, identified that PPE did not provide the necessary protections and, therefore, workers could be easily contaminated due to the lack of effectiveness of protective equipment. It was also found that rural workers became contaminated when they wore, removed or even washed their PPE. Thus, studying the wearability of such equipment in pruning and thinning activities is also relevant to this study.

Wearability, according to Alves (2016), refers to the extent to which a garment or any other artifact can be worn and used by a certain group of users to achieve specific goals effectively, efficiently, and satisfactorily in a given context. The study of clothing and PPE also involves the issue of thermal comfort, as excessive exposure to the sun and the lack of comfort of the equipment can contribute to the non-use by workers.

In addition to PPE, work clothing used in viticulture, consisting mainly of long pants and a blouse, needs to be investigated, especially for its protective function. In addition, in this context, there are few studies on the relationship between occupational risks and the use of PPE and clothing.

Therefore, this article presents proposals for measures to increase the safety of rural workers, based on research on working conditions in pruning and thinning activities in grapevine crops, focusing on physical, biomechanical and environmental occupational risks and their relations with the use of work tools, PPE and clothing.

2. THEORETICAL FOUNDATION

2.1. Viticulture and ergonomics

The viticulture sector has a great demand for ergonomic actions, especially in relation to pruning and thinning activities, considering that there are few studies carried out on the impact of these activities on the well-being of workers (TORRES; PINHEIRO, 2009). Some easily observable characteristics contribute to this opinion: the posture to which workers submit

themselves to perform the activity; the time spent on the activity; and the tools used. It is noteworthy that all these factors are related to the field of study of ergonomics.

According to Wisner (1994), ergonomics applied to the work field improves the quality of the activity and contributes to the satisfaction and well-being of employees, also reducing costs related to occupational diseases. The application of ergonomics results in benefits for the employer and the company, especially greater safety, while maintaining physical and mental integrity. Consequently, employee performance tends to improve, with a reduction in absenteeism.

In the grapevine sector, the need to carry out ergonomic studies is also high, especially in pruning and thinning activities, which are carried out using manual methods. In addition, the activities involve a large contingent of workers, who work in the open field, exposed to unfavorable weather conditions and perform tasks with high physical demand in the standing position throughout the working day.

2.2. Importance of viticulture in the sub-middle São Francisco

The Submédio São Francisco is located in the Brazilian semi-arid region, and is composed of cities surrounding the states of Pernambuco and Bahia. Its outstanding characteristics are its dry and hot climate (PEEL; FINLAYSON; MCMAHON, 2007), with low rainfall and long periods of drought (LIMA et al., 2009). The various favorable conditions that provide good productivity, combined with the presence of the São Francisco River in a semi-arid region, have attracted government incentives, making the region nationally and internationally prominent in irrigated fruit growing, with a main emphasis on grapes and mangoes.

This locality has consolidated itself in recent decades as the main producing region of fine table grapes in the country. The region concentrates the cultivation of pinenic grapes (seedless), being responsible for 95% of exports (MENDES, 2012).

The seedless table grapes in the region have greatly increased the demand for domestic and foreign markets. The latter, especially, has a predilection for aspiritenic grapes (PROTAS; CAMARGO, 2011). In order to have quality fruits, some specific cultural treatments are necessary, such as pruning and thinning.

2.3. Thinning and pruning

In the thinning stage, with the use of thinning shears, berries 3 – 6 mm to 7 – 10 mm in diameter, called peas, are removed. Small, defective and excess berries are removed.

Subsequently, several transfers are made as the differences in the size of the berries become more visible (NACHTIGAL, 2005). In the activity of thinning, the fingers are usually used. However, in extreme cases, when the thinning is overcooked, the berries become large, making it impossible to remove them with the fingers. In this way, you have to use scissors.

Pruning comprises a set of operations that are carried out on the plant and that consist of the removal of the woody vegetative system (trunk) or herbaceous system (shoots or leaves). There are four types of vine pruning: implantation, formation, fruiting and renewal, carried out according to the age of the vine (MANDELLI et. al. 2003).

The execution of pruning and thinning activities can probably trigger health problems when inappropriate postures are adopted. That is, there are reports of pain in the upper limbs such as back, neck, shoulders, arms, wrists and hands; in the lower limbs such as legs, ankles and feet. Combined with sun exposure, which can cause vision and skin problems. In this scenario, the knowledge generated by studies from the perspective of ergonomics plays a key role in adapting the work environment, eliminating or reducing risks related to posture and the physical work environment, among others.

In Brazil, Regulatory Standard No. 17 (NR 17), despite being considered incomplete by some researchers, represents an important advance for the application of ergonomics principles (SILVA 2016). NR 17 establishes parameters for the psychophysiological adaptation of the work environment to the worker, deals with furniture, equipment, environmental conditions of the workplace and the organization of work itself, aiming to provide comfort, safety, well-being and a better performance of activities within this context (BRASIL, 2017).

It should be noted that NR17 does not contemplate activities in outdoor environments, in turn, it regulates activities carried out in the field. It aims to make the planning and development of agriculture, livestock, forestry, forestry and aquaculture activities compatible with safety, health and the work environment (BRASIL, 2013).

All the variables mentioned can be verified through the application of methods and tools, such as the Ergonomic Work Analysis (AET) method and the tools of Moore & Garg and Reba.

2.4. Ergonomic Work Analysis (AET):

To evaluate the workstations of the raleaders and pruners, the methodology of Ergonomic Analysis of Work (AET), developed by Jacques Duraffourg in 1977, was used. This methodology is divided into analysis of demand, task, activity, diagnosis and ergonomic

recommendations. Although the ELA is used for technical intervention. In this study, it was used as a guide for data collection and analysis.

2.4.1. Demand analysis

Demand analysis is the description of a problematic situation that justifies the need for ergonomic action, or in this case, a scientific investigation. It can have different origins, both on the part of the company's management and on the part of the workers and their union organizations. Demand analysis seeks to understand the nature and dimension of the problems presented (IIDA and BUARQUE, 2016).

2.4.2. Task Analysis

In the task analysis phase, the differences between what is prescribed and the activity that is performed by the worker are evaluated. This difference can occur due to the various factors involved in the activity, as the effective conditions may be different from those provided for in the execution. Also, workers do not always develop what is described correctly. Therefore, the analysis should not be based only on the required task (IIDA and BUARQUE, 2016).

2.4.3. Activity analysis

In this stage, the activities developed by the workers are studied, evaluating the work and not the worker, trying to understand the relationship between the worker, the task and the means to perform it.

2.4.4. Diagnosis

Based on the data obtained in the previous phases, a diagnosis should be generated. According to Iida and Buarque (2016), in the diagnosis, the causes that cause the problem described in the demand are identified, encompassing the various factors related to work and the company

2.4.5. Recommendations

The recommendations refer to the measures that should be taken to solve the diagnosed problem. These recommendations should be clearly specified, describing all the steps necessary to address the problem (IIDA; BUARQUE, 2016).

3. METHODOLOGY

An exploratory and descriptive field research of qualitative nature was carried out. The variables that were studied to characterize the processes of thinning, pruning and working conditions, as well as the PPE and clothing worn by the workers, were mostly described based on the perceptions of the interviewees and the interviewer.

The field study was carried out on a farm in the Submédio Vale do São Francisco, focusing on the export of table grapes, located in Santana do Sobrado, municipality of Casa Nova (BA), at a distance of 50 km from Petrolina (PE).

Data collection began after it was approved by the Research Ethics Committee of the Federal University of Pernambuco. Approved on 03/14/2019, by opinion No. 3,197,883. 20 pruners and 45 harvesters participated in the research, and all of them signed the Informed Consent Form.

3.1. Steps and procedures for data collection.

- Stage 1: survey of employees on leave and certificates referring to complaints of musculoskeletal pain in a period of 3 years;
- Stage 2: documentary analysis of the work prescribed by the company;
- Step 3: observations and video and images of the pruners and raleaders performing their work activities were carried out using a Canon Power Shot SX520HS camera and the Poker Pro Running Digital stopwatch to determine the work cycle, later postural analyses were performed. For the analysis of the risk of wrist and hand injury, the Moore & Garg Index was applied, and the REBA tool was used for whole-body evaluation. These tools help identify postural overload and point out the level of severity for possible injuries. The tools were used within the Ergolândia Software.
- Step 4: application of the Corllet diagram;
- Stage 5: interviews mediated by a questionnaire were applied to assess the wearability of PPE and clothing and its relationship with occupational risks. The efficacy and satisfaction components were evaluated. And subsequent content analysis with quantification of frequency and percentage;
- Stage 6: application of the sociodemographic questionnaire to characterize the profile of the interviewees;

- Step 7: To measure the ambient temperature, the globe thermometer instrument was used - positioned between the lines of the vineyard with the globe at a height of 1.50 m for a period of 3 hours between 11 am and 2 pm, as recommended by the Occupational Hygiene Standard (NHO 6) of fundacentro. For evaluation, the formula for outdoor environments with solar load was used: IBUTG = 0.7tbn + 0.2tbs + 0.1tg, where tbn is the temperature of the natural or humid bulb; TBS is the dry-bulb temperature; tg is the globe temperature;
- Step 8: To measure the brightness of the environment, the luxmeter instrument was used. The readings were carried out during the day, between 11 and 14 hours. The lux meter was positioned in a horizontal plane at eye level, where the various activities are performed, obtaining the reading in lux, in accordance with the Occupational Hygiene Standards (NHO 11) of Fundacentro. For evaluation, NBR ISSO/CIE 8995-1 was used as a parameter.

4. RESULTS AND DISCUSSIONS

4.1. Profile of the research subjects

The average age of the pruning workers was 35.5 years (24 to 48). From thinning, mean age was 40.6 years (24 to 55). Regarding education, most of the pruners (75%) and the raleaders (49%) had incomplete elementary education. According to the farm's agronomist, during the hiring of employees, schooling is not required as a prerequisite, but experience in pruning and thinning is required.

4.2. Ergonomic demand analysis

After some visits and informal conversations with the workers involved and with the farm's health sector, it was identified that the working hours associated with the postures exercised without the proper guidance and the lack of breaks during the execution of the activities could generate musculoskeletal injuries. Environmental factors such as temperature and lighting could also influence the development of activities. The PPE and the clothing used were evaluated, especially their effectiveness during the execution of the tasks.

4.3. Task Analysis

The work routine of the raleaders and pruners begins with the arrival at the farm, around 06:40 and subsequent concentration for the registration of the time at 07:00. After this time, they take the bus to the specific place of work. The total working day comprises 9 hours per day. That is, totaling 45 hours per week. The activities are developed without minor breaks. There is only the one-hour break for lunch and rest.

Pruners start their activities after determining the person in charge, using scissors as the main tool. With the pruning shears in their right hand, they cut the branch, while with their left hand, they remove the branch, dropping it on the ground (Figure 1). Its activity consists of removing all the leaf mass along the branches so that the plant can recover and start producing again.

Figure 1 - Pruning of the vine, cutting and removal of the branch.

The raleaders use the metal bench to improve the reach to the grape bunch. However, this bench usually does not give adequate access, due to the fact that it does not have an adjustment mechanism to adapt to the different heights of each scraper. The workers start the activity of thinning, using their hands, without the aid of additional tools. They perform small twists with their left hand to facilitate the visualization of the bunch, while with their right hand they use their fingers in the shape of tweezers to remove damaged or uneven berries (Figure 2).

Figure 2 - Graveling of the vine with the hands.

4.4. Activity analysis

In this stage, the activities developed by the pruning and thinning employees were observed; the postures; the use of PPE and clothing and its relationship with the company's prescription.

4.4.1. Physical and gestural constraints

It was identified that during the execution of the activities, the pruners alternate the position of the upper limbs. The right arm spends most of its time above the shoulder line cutting the branches, while the left alternates the posture above when it withdraws the branch and below the shoulder line when it deposits the branch on the ground (figure 3).

Figure 3 - Posture during pruning.

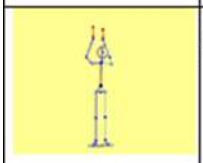
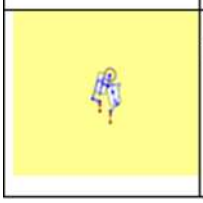
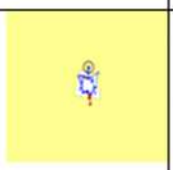
According to Dul and Weedmeester (1995), the posture of working with the limbs above the shoulder line can be harmful to the health of workers. And if it is impossible to keep the arms below the shoulder line, such activity should be performed for a limited time.

Pruners also perform repetitive movements with their right hand while cutting branches with the aid of pruning shears. The back remains most of the time with a slight slope, while the neck performs backward tilts due to the need to observe the branch while cutting. The activity is dynamic with low-intensity lower limb movements. Most of the time, there is little knee flexion, which occurs only during displacement.

The raleadeiras develop their activities in the static position without movement of the lower limbs. They are in an upright position throughout the workday, which can cause circulation problems. Dul (2012) states that it is not appropriate to spend the entire working day in a standing position. Such a posture can cause fatigue in various regions of the body, such as legs and back.

However, in some activities, the standing position is recommended because the spine is correctly aligned, exerting less pressure on the intervertebral disc. The arms remain throughout the activity, above the shoulder line, performing repetitive movements of the distal limbs, more specifically the fingers during the removal of the berries. There is a backward tilt on the back and head to visualize the grape bunch (Figure 4).

Figure 4 - Posture of pruners and rakers during activities.

Pruners posture	Postural description	Posture of the graters.	Postural description
	Arms above shoulder level; Right hand performing the cut with wrist movements and left hand removing the branch.		Arms above shoulder level; Left hand holding the bunch and right hand removing the berries. With fingers in the shape of tweezers.
	Side view: Neck and back tilted in an extended position. Legs slightly flexed during movement.		Side view: Tilt in a position of neck and back extension. Legs completely straight.
	Front view: Legs in low intensity movements;		Front view: The legs spend most of their time static.
	Top view: The arms are open and raised, causing tension.		Top view: The arms tend to be more closed, however, raised causing tension.

Source: SSPP software version 7.0.5.

For Martins (2001), no posture is good enough to be kept comfortable for long periods. No matter how good the posture is, it can bring static overload on the muscles and, as a consequence, result in discomfort.

Therefore, it was possible to infer that there is a need for intervention regarding postural improvement, mainly because the company does not yet have an ergonomic intervention policy, nor the necessary knowledge for short-term adaptation.

4.4.2. Analysis of the map data of the painful areas

The data obtained on the occurrence of pain in the pruning workers reinforced the need for postural interventions. In other words, the body segments with the most frequent complaints were the neck (80%), the arms (65%) and the shoulders (55%), followed by the forearms, wrists and hands and finally the back. Although the upper limbs had the highest percentages of pain, the lower limbs - legs (20%) and thighs (20%) also had a relevant occurrence of pain.

Among the thinning workers, complaints of discomfort were also concentrated in the upper part of the body - neck (93.3%), arms (88.8%) and shoulders (86.6%). Then comes the forearm, back, hands and wrists (33.3%). In the lower limbs, ankles and feet were the most mentioned, followed by legs and thighs.

During the working day in pruning and thinning, there is a high demand on the distal upper limbs with a predominance of repetitive movements. Consequently, it may cause injuries.

4.4.3. Risk of upper and lower limb injuries

In pruning, the worker, with his right hand with scissors, cuts the branch and with his left hand, removes the newly cut branch. During this process, a marked curvature can be observed in the cervical spine and neck of the pruners (Figure 5). The legs also vary in position: sometimes the weight of the body is distributed on both legs, sometimes it is distributed on one of the legs. The right arm remained constantly above the shoulder line and the left arm alternating between the line above the shoulders and below, when the branch is left on the ground.

Figure 5 - Laying sequence in the pruning activity.

The body segments of group A, composed of trunk, neck and legs; and Group B, consisting of arm, forearm and wrist. In the pruning evaluations, two types of posture were considered, due to the inherent dynamics of the activity - with fast and repetitive movements.

The posture in position A presented: neck and trunk in extension, legs with unilateral weight support; arms above 90° degrees; forearm above 100° degrees; 15° up-and-down mobility grips; catch considered reasonable; Load less than 5 kg. In position B, it was found that: neck and trunk varied between 0° and 20°; weight bearing on both legs; arms alternating between 45° to 90°. Forearm above 100° degrees; 15° up-and-down mobility grips; catch considered reasonable; Load less than 5 kg.

In the analysis of pruning, the optional ones of neck, trunk, load and activities (repetitive movements and large postural changes or unstable posture) were added. Necessary to get as close as possible to the posture exercised by employees.

Chart 1 describes the results of the risks related to positions A and B, adopted during the pruning activity. In position A, score 11 indicates a very high risk of injury. Therefore, for this position, changes must be implemented immediately.

In position B, score 8 indicates a high risk of injury, so it is necessary to carry out the investigation and later implement changes. (Table 1).

In the evaluation, using the REBA tool, it was identified that in both positions (A and B), there is a need for an ergonomic intervention in all postures assumed during the task.

Chart 1 – Postural analysis during pruning activity.

Position	Neck	Trunk	Legs	Arm	Anteb.
(A)	Extension	Extensio n	Support on one leg	> 90°	> 100°
(B)	0 to 20°	0 to 20°	Support for both legs	45° and 90°	> 100°
(A)	Between 15°	Razoa.	Smallest 5kg	11	Very High
(B)	Between 15°	Razoa.	Smallest 5kg	8	High

Source: Data analyzed in the Ergolândia software.

The raleadeiras develop their activities always in the standing position, alternating body weight on both legs or only on one; the arms are always above the shoulder line throughout the task cycle; the cervical spine and neck alternate between the upright position and the extension position with torsion of the trunk and neck; the left hand holds the grape bunch and the right hand removes the berries (Figure 6).

Figure 6 - Laying sequence in the thinning activity.

For the application of the REBA tool in the activities of the raleadeiras, the same body segments described in the pruning activity were considered: group A, which involves the trunk, neck and legs, and group B, with arm, forearm and wrist.

Two postures were evaluated in the thinning task. In position A: neck and trunk in extension; unilateral leg support; arms above the shoulder line - greater than 90° degrees; forearm above 100° degrees; cuffs with an angle of up to 15°; reasonable grip; Load less than 5 kg. Posture B differs from the previous position because the neck and shoulders remained at an angle between 0° and 20° degrees and the body weight support was bilaterally distributed in both legs. The arms between 45° and 90° degrees, forearms above 100° degrees, reasonable grip and the load less than 5 kg.

In the optional items, the neck rotating to the right or left side and leaning to the side, the trunk also rotating to the right or left with inclination to the left or right side, were considered as additional to the posture. Regarding activities, one or more body parts were considered to be held for more than 1 minute and repetitive movements with more than 4 movements per minute.

In the interpretation of the data, present in Chart 2, positions A and B obtained the same score (9), indicating a high risk of injuries due to inadequate posture. Therefore, all interfering factors must be investigated, with subsequent implementation of changes. In thinning tasks, it is necessary to intervene to avoid musculoskeletal injuries or other health problems such as RSI/WMSD.

Table 2 - Application of the REBA tool for the thinning task.

Position	Neck	Trunk	Legs	Arm	Forearm
(A)	Extension	Extensio n	Support on one leg	> 90°	> 100°
(B)	0 to 20°	0 to 20°	Support on both legs	> 90°	> 100°
Position	Fist	Magpie	Load	Pont	Risk
(A)	Between 15°	Razoa.	Smallest 5kg	9	High
(B)	Between 15°	Razoa.	Smallest 5kg	9	High

Source: Adapted by the author of the Ergolândia software

4.4.4. Risk of distal limb injuries

In the pruning activity, it was identified that the activity cycle lasts an average of 6 to 8 minutes, the time needed to complete 1 plant. The cycle begins when the worker begins pruning 1 plant and is finished after its completion. With the right hand, during the cut, 320 beats are made with the scissors, while the left hand removes, on average, 290 times the branches, thus completing the cycle. The duration of the daily working day is 9 hours.

After applying the Moore & Garg tool, the final value of the IMG obtained was 54, therefore, it is above the value of 7. Thus, the activity presents a serious risk of injury to the distal limbs - hands and wrists, requiring immediate intervention.

In the research, the evaluations of the two hands were carried out separately, because each hand performed a different activity during the task cycle. However, the results were the same.

In the pruning activity, the worker uses scissors in the right hand (right-handed) and removes the branch with the left hand. Generally, the branches are stuck in other branches, requiring force to be removed. The frequency is quite high, with an average of 62 cuts per minute. In addition to the high frequency, the wrists perform twisting movements, which can lead to wrist or hand injuries, according to Moore & Garg

In the thinning activity, both hands perform the same activity. Therefore, only one evaluation was necessary. 20 bunches were monitored to determine the cycle time. The thinning of each bunch lasted an average of 11 seconds. After starting the thinning of the bunch, the cycle begins and is completed when the rake picks up another bunch. 10 efforts were performed during the cycle period (tightening the scissors to cut the berries). It is concluded that the result of the multiplication of the factors was below the pruning values with an IMG of 27. However,

the value obtained was quite high, being of high risk, requiring immediate ergonomic intervention.

In the thinning activity, the interviewees complained of pain in the wrists and hands, and this can be confirmed with the result of Moore & Garg, which requires an ergonomic intervention due to the risk of injury to the distal limbs. Improper position of the wrists and fingers (pinching) throughout the workday can result in injuries. This happens due to the repetitiveness associated with the frequency of execution. Therefore, a change should be made to minimize the high risk of injury.

4.5. Environmental factors

4.5.1. Thermal overload analysis

This evaluation aimed to survey the environmental conditions of thermal comfort in the pruning and thinning tasks, since excessive exposure to heat can cause thermal overload in workers. Evaluations were carried out on May 29, 2019, between 11 am and 2 pm, thus considering the most unfavorable period for the development of the activity.

The activity is considered continuous and the tolerance limit used in the present work was 26.7°C (moderate) for pruning and thinning, according to NR 15 unhealthiness. In pruning, the average value obtained from IBUTG for a "moderate" activity was 34.50 °C, while in thinning the average value obtained from IBUTG considering a "moderate" activity was 28.30°C (Table 1). Therefore, the values obtained were higher than those allowed by NR 15, characterizing the two activities as unhealthy. The pruning work environment was well above what is allowed, thus causing problems for the health of the workers involved.

Table 1 - Value of IBUTG found in pruning and thinning.

Activity	IBUTG found
Pruning activity	34.50°C
Thinning activity	28.30°C
Maximum Allowed	26.7° C

Source: Author's research.

4.5.2. Luminosity analysis

For the evaluation of natural illuminance in outdoor areas, there are no standards that serve as a parameter. The ABNT NBR ISO/CIE 8995-1 (2013) standard provides the

parameters for indoor and outdoor environments, the latter considers artificial illuminance such as luminaires and poles.

At the site studied, the illuminance varied according to the characteristics of the two stations. The evaluations took place between 11 and 2 pm on May 29, 2019. 10 evaluations were carried out. Subsequently, the average of the evaluations was obtained at each workstation: 82771 lux in pruning and 5327 lux in thinning. The lighting in the place is quite high, and it is necessary to use protections to avoid direct contact of the eyes with the ultraviolet radiation emitted by the sun.

4.6. PPE wearability

During both activities - pruning and thinning - safety glasses, cotton gloves, caps and protective boots are the main PPE used by the interviewed workers.

The cap has the function of protecting against solar radiation for most pruners (75%) and solar and physical radiation for 25% of them. Similarly, among the raleadeiras, the Arab cap has sun protection (80%) and sun and physical protection (20%). In other words, the respondents perceive the importance of wearing a cap during work activities. And this use occurs with high satisfaction, according to 100% of the pruners and 96% of the rakers.

For 80% of pruners, gloves serve to protect against solar radiation, for the other 20%, they have the functions of physical, solar and insect bite protection. For the raleteiras, the gloves have the function of sun protection (71%), physical protection in the sun and against insects (29%).

Regarding satisfaction, all pruners said they are satisfied with the cotton gloves, that is, there were no reports of discomfort. In thinning, for 87% of the respondents, gloves are comfortable, and for 13% of them, gloves are uncomfortable.

Glasses have the function of protecting the eyes: from the projection of particles; exposure to environmental factors such as sun, rain and dust. For pruners, the glasses have the function of physical protection (55%), physical and sun protection (45%). Similarly, according to the raleadeiras, glasses are used for physical protection (84%), physical and sun protection (16%). This confirms, among the respondents, the perception of the importance of using this PPE. However, the majority of pruners (55%) and raleters (62%) consider the glasses uncomfortable. Respondents to both activities reported that glasses cause headaches, dizziness and generally fog up on colder days. In addition, the lenses are commonly scratched during handling, with damage to good visibility. These discomforts can be caused by the material of

the glasses (plastic) and the presence of prescription. The degree can cause dizziness and headache, according to the interviewees.

Another extremely important PPE in agriculture is the boot. Mainly, because in the work environment of this group of workers, there is a risk of accidents with insects or venomous animals. Among pruning employees, the boot serves for physical protection (55%) or physical protection and against insects (45%). For women of thinning, physical protection and against insects (60%) or physical protection (40%). The use of boots was considered comfortable by most pruners (75%) and uncomfortable by most of the rakers (62%). There have been reports of thermal and physical discomfort with callus formation. In addition to the proliferation of nail fungus. Boots probably cause thermal discomfort, due to the negative interaction between the body, the boot material and the high temperatures of the studied region. Which leads some of the workers to replace the boots supplied by the company. This is the case, reported by five women from thinning, who during the research were wearing boots from their own purchase, in an attempt to minimize discomfort.

In summary, most employees feel some type of discomfort while using PPE. In addition, the fact that there is no appropriate place to store these PPE on the farm, it is common for employees not to use this PPE in their homes. On the other hand, in these cases, there is also resistance on the part of safety technicians to provide new PPE.

Regarding the non-use of PPE, Bezerra et al. (2012) stated that many of the farmers do not have the habit of using PPE, especially for long periods. This increases exposure to risks. And possibly, the lack of training on the use of PPE contributes to aggravate this situation. Although most of the interviewees (95% of the harvesters and 55% of the pruners) reported that they had undergone training on the use of PPE.

4.7. Clothing evaluation

Human beings spend up to a third of their lives working. Therefore, there are several factors that influence their productivity (MOURA and XAVIER, 2010). Among them, the limited wearability of clothes used in the work context.

Regarding wearability, the metrics of the "effectiveness" component provide data on how much the clothing has achieved its function in a given context, and the metrics of the "satisfaction" component, how free the user is from discomfort and their positive attitudes towards the clothing used (ALVES and MARTINS, 2017). According to Alves (2016), comfort is related to the configurative characteristics of the garment, resulting from the combination of modeling and the material used in its manufacture.

From this perspective, during data collection, there was an attempt to identify the composition of the clothes worn by the respondents. However, this characterization proved to be unfeasible, because they have the habit of wearing worn clothes to work. In this way, most of the clothes did not have composition labels or the labels were deteriorated.

Another relevant factor was the identification of the parameters used by the workers in the choice of clothing used for work activity. It was observed that the pruning workers wear long pants, usually in polyester or jeans, and long-sleeved polyester or cotton shirts (Figure 7).

Figure 7 - Labor clothing of the pruners.

The raleteiras wear polyester garments - long pants, sometimes skirts or dresses over leggings, long-sleeved shirts and coats for increased protection (Figure 8).

Figure 8 - Labor clothing of the raleadeiras.

Most pruners (60%) reported not having a preference for a certain type of clothing. On the other hand, the majority of the raleadeiras (56%) confirmed that they had a preference.

However, the interviewees reported three main parameters for selecting clothes to work with: 1) light or less warm clothes – pruners (55%) and shredders (60%); 2) thick clothes - pruners (10%) and raleters (9%); 3) any type of clothing - pruners (35%) and raleters (31%). The use of synthetic cold knitted clothes was also recurrent, due to the thermal sensation of freshness perceived in the touch and cotton knits. However, considering the high temperatures of the environment studied, synthetic fiber clothing possibly causes greater thermal discomfort due to the increase in temperature than cotton clothing.

It was also observed that most pruning and thinning employees use cloths covering the entire face in order to increase protection against the sun's rays and projection of plant particles on the face. When pruning, 70% of respondents said they use the cloth covering their face as sun protection and 30% said they use it as sun and physical protection. In thinning, 93% said that the cloth covering the face is for sun protection and only 7% said that it is for sun and physical protection.

Pruning and thinning employees are exposed to factors related to heat stress, as the activities are carried out in open environments and with temperatures that can reach 38°C, depending on the time of year. According to Moura and Xavier (2010), for heat release to occur, it is necessary that the temperature of the environment is below 34º C, as this is the natural temperature of the skin. Therefore, clothing is an important factor for adequate heat release.

4.8. Discussion of diagnoses

According to the data obtained through the ergonomic analysis of the work, it is possible to point out several factors that can contribute to risk conditions in the work context investigated, such as the emergence and worsening of musculoskeletal problems, resulting from the work postures adopted for the development of pruning and thinning activities.

In pruning, everyone performs activities in a standing position with low-intensity movements on the lower limbs. However, the upper limbs perform activities with moderate movements alternating positions above or below the shoulders, and the hands perform an average of 62 cuts of the branches per minute.

The raleadeiras develop their activities in the standing position with practically no movement of the lower limbs. The arms are always above the shoulder line due to the need to maintain contact with the grape bunches. Consequently, they spend most of their activity with their arms extended and their neck and back usually in the extension position. Also, the wrists and hands perform repetitive movements exhaustively and the fingers perform pinch movements to remove the berry at an average of 10 times per minute.

The extension of the upper limbs without adequate support requires the muscle groups involved to remain under tension, requiring a static effort that is configured as a state of muscle contraction (ABRAHÃO et al 2009).

The pace of work is exhausting, generating repetitive effort in the upper limbs, especially the distal limbs, wrists and hands. The posture is inadequate, as mentioned earlier. The lack of breaks in both activities ends up increasing the risks of occupational diseases, favoring the emergence or worsening of musculoskeletal diseases.

At workstations, it is also not possible to alternate the standing position with the sitting position. Because of this, the entire working day is performed standing. It is worth noting that repetitive, static or even dynamic efforts for a prolonged time can result in micro traumas, causing injuries to joints, tendons or ligaments (KROEMER; GRANDJEAN, 2005).

The metal benches aim to raise the raleadeiras, thus facilitating access to the bunches. However, some do not have anthropometry-based adjustment, making it difficult to adapt to the height of each employee and thus collaborating with the existence of inadequate posture.

In relation to PPE, it can be inferred that workers understand their function and importance to protect against occupational risks, but most of them were evaluated as uncomfortable. For example, glasses have been linked to headaches and fogging on cloudy days; pigmented gloves protect in both activities, although the ideal pruning is the leather glove,

which has greater protection against mechanical agents or sharp punctures; Boots usually get very hot as a result of the temperature of the environment and can cause calluses or nail loss.

The temperature of the environment was above the thermal comfort determined by NR17, reaching 26.7 °C. Even so, the number is below the average for the region, as the collection period coincided with the coldest period of the year, which runs from April to July. The temperature tends to rise from the months of August and September.

Workwear is not adequate as it does not provide the necessary thermal protection, considering that the choice is not based on the real need for protection. For example, the use of polyester clothing can increase physical and thermal discomfort. In addition, wearing several pieces of clothing simultaneously, such as blouses and coats, can make perspiration even more difficult and, consequently, increase fatigue and dehydration.

4.9. Ergonomic recommendations

Based on the results obtained, here are some recommendations with the objective of improving the quality of life in the work environment, aiming at the comfort and well-being of the people involved in pruning and thinning activities in the grapevine crop.

- Initially, to create an ergonomics committee along the lines of the CIPA, with monthly meetings, aiming to investigate and monitor the working conditions related to environmental factors, in order to discuss and suggest improvements;
- The implementation of the practice of stretching for the spine in order to reduce tension, improves body performance, in addition to compensating the body structures most used during work and avoiding those that are not required, relaxing and toning. Perform hand stretches at short intervals during the workday to reduce injuries to the distal limbs;
- Workers in the two activities must perform alternations of functions, placing in two areas with different characteristics, alternating between the thinning, which is an open area, and the packing house, which is a closed area, in addition to different postural characteristics.
- 10-minute breaks for each hour worked in order to reduce the risks of repetitive efforts and consequently reduce fatigue;
- Workers who were affected by RSI/WMSD establish a program for clinical follow-up of recovery;

- Lectures with all pruning and thinning employees informing about occupational risks;
- Replace the boots with a more comfortable model, such as lining in polyester fabric that is quickly absorbed and desorption of sweat that allows breathability and maintains the temperature of the feet;
- As for glasses, replace them with a model that does not fog up;
- Develop pamphlets, educational booklets and short videos that can be presented in the training sessions and shared via WhatsApp among workers;
- Implement the use of uniforms for effective protection against ultraviolet rays, and materials that facilitate heat exchange between the skin and the environment to increase user satisfaction.

5. CONCLUSION

The present study investigated the working conditions in pruning and thinning activities in grapevine crops, focusing on the occupational risks associated with the postures and movements adopted, the use of work tools, PPE and clothing. He also proposed recommendations aimed at increasing the safety of rural workers.

The starting point was the evaluations guided by the methodology of Ergonomic Analysis of Work, to identify the demands and subsequent report for future interventions. The results found in the two activities after the application of the auxiliary tools indicate, in general, that changes in the postures assumed by the pruners and the rakers are necessary, therefore, they can trigger repetitive strain injuries and musculoskeletal disorders.

Based on the questionnaires to identify the painful areas, it can be concluded that the regions of the neck, shoulders and arms are the areas with the greatest complaint of discomfort, according to the workers interviewed in the pruning and thinning. This was evidenced in the field evaluations, as all the workers involved remain standing throughout the day, with their arms above the shoulder line, more specifically in the thinning.

Regarding the environmental heat assessments, it is concluded that the results obtained in the two activities are above the tolerance limit, making the environment unhealthy, which can result in discomfort, heat stroke, cramps, fatigue and, in extreme situations, exhaustion. It is up to the company to guide its employees about the health risk caused by sun exposure.

The illuminance of the place is natural and high. For the development of the activities, it is necessary to wear glasses. On the other hand, according to the literature, ultraviolet rays

can cause cancer or lesions in the cornea or lens, as well as cause glare when the neck is in the extension position.

Regarding PPE, there is the provision of necessary protections for the safety of workers in the two activities evaluated. However, glasses and boots generate dissatisfaction during use.

Employees wear their personal attire. According to the survey, most prefer lighter clothes, as they facilitate the sweating process. In pruning, workers say they prefer lighter clothes, while the minority said they prefer thicker clothes. In thinning, most workers prefer lighter clothes and the minority prefer thicker clothes. However, the ideal would be work uniforms adapted to the activities.

It is expected, therefore, that the results of this research will contribute to the improvement of the quality of the activities performed by the workers in pruning and thinning, as well as in the comfort and safety of this group of workers. It seeks to make managers aware of the need for ergonomic intervention in agriculture, aiming to increase productivity and reduce occupational risks.

REFERENCES

ABRAHÃO, Júlia; SZNELWAR, Laerte; SILVINO, Alexandre; SARMET, Maurício; PINHO, Diana. Introdução a Ergonomia: da prática à teoria; - 1ª ed. – São Paulo: Editora Blücher, 2009.

ALVES, Rosiane Pereira. Vestibilidade do sutiã por mulheres ativas no mercado de trabalho / Rosiane Pereira Alves. – Recife, 2016.

ALVES, Rosiane Pereira; MARTINS, Laura. Bezerra. . VESTIBILIDADE: TRANSPOSIÇÃO TEÓRICA E METODOLÓGICA COM BASE NA ABNT NBR 9241-11/210. In: 13º Colóquio de Moda | 10o Edição Internacional, 2017, Bauru-SP. GT6 - Design e Processos Produtivos em Moda. SÃO PAULO: UNESP, 2017. p. 1-16.

BEZERRA, André Luiz Dantas; COSTA, Tarciana Sampaio; QUENTAL, Ocilma Barros de; ASSIS, Elisangela Vilar de; SOUSA, Milena Nunes Alves de. Exposição Solar: Avaliação do conhecimento e medidas de prevenção dos agricultores. FIEP BULLETIN - Volume 82 – Special Edition - ARTICLE II – 2012

BRASIL. MINISTÉRIO DO TRABALHO. Portaria MTb n. 3.214. NR 17 – Ergonomia. Publicada em 08 de junho de 1978. Brasília, DF. 120, 2017.

COUTO, H. A.; NICOLETTI, S. J.; LECH, O. Gerenciando a LER e os DORT nos tempos atuais. Belo Horizonte: Ergo, 2007.

DUL, J.; WEERDMEESTER, B. Ergonomics for beginners – A quick reference guide. London: Taylor & Francis, 1995.

GARRIGOU, A., BALDI, I., LE FRIOUS, P., ANSELM, R., & VALLIER, M. Ergonomics contribution to chemica.l risks prevention: An ergotoxicological investigation of the effectiveness of coverall against plant pest risk in viticulture. Applied Ergonomics. 2010.

IIDA, Itiro; BUARQUE, Lia. Ergonomia: projeto e produção. 3. ed. rev. São Paulo: Edgard Blücher, 2016.

KROEMER, K.H.E. AND GRANDJEAN, E. Manual de Ergonomia - adaptando o trabalho ao homem. Edtion ed. São Paulo: Bookman, 2008.

LIMA, M. A. C.; SÁ, I. B.; KIILL, L. H. P.; ARAUJO, J. L. P.; BORGES, R. M. E.; LIMA

NETO, F. P.; DOARES, J. M.; LEÃO, P. C. S.; SILVA, P. C. G.; CORREIA, R. C.; SILVA,

A. S.; SÁ, I. I. S.; SILVA, D. F. Subsídios técnicos para a indicação geográfica de procedência do Vale do Submédio São Francisco: uva de mesa e manga. Embrapa Semiárido. Documentos, v. 222, p. 1-55, 2009.

LOPES, Eduardo Silva; OLIVEIRA, Felipe Martins; MALINOVSKI, Jorge Roberto; SILVA, Rafael Henique da. Avaliação biomecânica de trabalhadores nas atividades de poda manual e semimecanizada de pinus taeda. Março 2013. Disponível em:< https://revistas.ufpr.br/floresta/article/view/26953/20133 >. Acesso: 24 abr 2018.

MANDELLI, F.; BERLATO, M. A.; TONIETTO, J.; BERGAMASCHI, H. Fenologia da videira na Serra Gaúcha. Pesquisa Agropecuária Gaúcha, v. 9, n. 1-2, p. 129-144, 2003. MARTINS, Caroline de Oliveira. Ginástica laboral no escritório. Jundiaí (SP): Fontoura, 2001.

MASHIMA, Cesar Hideki. Descompactação dos cachos por meio de raleio de bagas da uva fina de mesa Black Star. Dissertação de Mestrado em Engenharia Agronômica – Programa de Pós-Graduação em Agronomia. UEL, 2014.

MELLO, L. M. R. de. Vitivinicultura brasileira: panorama 2011. Bento Gonçalves: EMBRAPA, n. 115,2012. 4p.

MENDES, L. R. Crise na Europa afeta uvas no Vale do São Francisco. Valor econômico online, São Paulo, 2012. Disponível em: <http://alfonsin.com.br/crise-na-europa-afeta-uvas-no-vale-do-so-francisco>. Acesso em: 26 mai 2018.

MOURA, Louisi Francis; XAVIER, Antonio Augusto de Paula. Abordagem sobre a relaçao entre as condições de trabalho e a legislação quanto ao conforto térmico das vestimentas de trabalho. Outubro 2010. Disponível em: <http://www.revistaespacios.com/a13v34n03/13340307.html>. Acesso: 29 abr 2018.

NACHTIGAL, J. C.; ROBERTO, S. R. Sistema de Produção de uva de mesa no norte do Paraná. Sistema de Produção: Embrapa Uva e Vinho, Bento Gonçalves, n. 10, dez. 2005. Disponível em: <http://sistemasdeproducao.cnptia.embrapa.br/FontesHTML/Uva/MesaNorteParana/ poda.htm>. Acesso em: 28 mai 2018.

PEEL, M. C.; FINLAYSON, B. L.; MCMAHON, T. A. Updated world map of the Köppen-Geiger climate classification. Hydrology and Earth System Sciences, European Geosciences Union, v. 4, n. 2, p. 439-473, 2007.

PROTAS, J. F. S.; CAMARGO, U. A. Vitivinicultura brasileira: panorama setorial de 2010. 1º ed. Bento Gonçalves: EMBRAPA, 2011. 110p.

SILVA, Ana Cláudia Colaço Lira e. Fatores de risco e prevalência de queixas musculoesqueléticas entre os técnico-administrativos em Educação: estudo realizado na Universidade Federal de Pernambuco. UFPE, Recife, 2016.

SILVA, P. C. G.; COELHO, R. C. C. Caracterização social e econômica da cultura da videira. EMBRAPA semiárido. 2010. Disponível em: < sistemas eproducao.cnptia.embrapa.br/FontesHTML/Uva/CultivodaVideira_2ed/Caracterizaca_social_ da_%20videira.html>. Acesso em: 12 mai. 2018.

TORRES, Manoel Gerônimo Lino; PINHEIRO, Francisco Alves. Impactos da atividade de raleio manual de bagas de uvas na saúde dos trabalhadores. Outubro 2009. Disponível em: < http://www.abepro.org.br/biblioteca/enegep2010_tn_stp_116_757_15902.pdf>. Acesso: 23 abr 2018.

VASCONCELLOS, Fernando Henrique de Miranda. Avaliação do método da análise ergonômica do trabalho como instrumento de identificação e análise de riscos à segurança e saúde no trabalho. João Pessoa, 2006, 143 p. Dissertação (Mestrado em Engenharia de Produção) UFPB/CT/PPGEP.

WISNER, A. A inteligência do trabalho: textos selecionados de ergonomia. São Paulo: FUNDACENTRO, 1994. 191 p. Tradução: Roberto Leal Ferreira.