Noise in agricultural machinery: Modernization and workers' health

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ABSTRACT
The evolution of agricultural mechanization improved operational and productive performance, reducing human physical effort, and increasing productivity per area. However, the worker remains exposed to various occupational risks when operating an agricultural machine, whether physical, chemical, or biological, increasing the incidence of occupational diseases. The noise generated by agricultural operations is considered one of the main ergonomic factors harmful to the machinery operator and people close to the noise range, affecting not only hearing, but well-being and performance when carrying out work, increasing the possibility of accidents. In research carried out using a mechanized tractor-sprayer set with air assistance in the spray bars, as a way of evaluating the influence of implementing implements on the noise levels emitted by agricultural tractors, an increase in sound intensity was observed when air assistance was used. it was switched on, mainly, in places closer to the noise source, and when the tractor was operating at higher engine speeds. The effects of exposure to noise generated by machinery and agricultural implements are better perceived in the long run, when their effects become more severe. The modernization of the mechanization sector has made it possible to attenuate the noise perceived by operators using cabins, however, employees working in proximity are also exposed to sound emissions, making it essential to use personal protective equipment (PPE), such as ear protectors.

Keywords: Agricultural mechanization, Rural health and safety, Ergonomics.

1 INTRODUCTION

Agriculture has evolved since its beginnings, and after the Industrial Revolution, the intensification of the use of machinery led to production at scale. The restlessness generated by the imminent increase in population served as fuel for the continuous development of technologies.

The growing demand for food is directly linked to this world population increase, making the expansion of agricultural activity indispensable. With the evolution of agricultural mechanization, operational and productive performance has improved, reducing human physical effort and increasing productivity per area.

However, the worker remains exposed to several occupational risks when operating an agricultural machine, whether physical, chemical or biological, increasing the incidence of

occupational diseases. The operator's safety is also linked to his well-being, making the ergonomic factor of paramount importance during the performance of work activities.

The noise generated by agricultural operations is considered one of the main ergonomic factors harmful to the machinery operator and people close to the noise range, affecting not only hearing, but also well-being and performance in the performance of work, increasing the possibility of accidents (CHAIBEN NETO *et al*., 2020). The agricultural tractor is one of the most used vehicles on properties. Although noise levels have been reduced due to technological progress, excessive exposure, whether daily or weekly, can cause partial or complete hearing loss, especially when protective equipment is not used (BILSKI, 2013).

Regulatory Standard No. 15 establishes the tolerance limits for exposure to noise, continuous or intermittent, not exceeding 8 hours per day when the noise level is 85 dB (A), and 7 minutes for 115 dB (A). Levels above this limit do not allow the exposure of operators without the use of protective equipment (VEIGA *et al*., 2021).

Thus, it is pertinent to study the noise levels emitted by agricultural machinery and implements, to which rural workers are exposed, as a way to evaluate their effects on the human body, enabling the proposition of viable alternatives and adaptations, which guarantee the health and safety of workers.

2 THE MODERNIZATION OF THE AGRICULTURAL SECTOR

The development of agricultural tractors occurred through the modernization of the agrarian sector, thus, the wheeled agricultural tractor became the most used vehicle in rural properties around the world, with a fleet of about 29 million tractors, with Brazil being one of the world's largest producers of tractors, with 98% of the machines sold in the country of national manufacture (BAESSO *et al*., 2015; NUNES *et al*., 2016; FARIAS & SCHLOSSER, 2020). In 2020, of the total production of agricultural machinery, 70.9% were wheeled tractors, 11.3% backhoe loaders and 10.4% grain harvesters, according to data from the National Association of Automotive Vehicle Manufacturers – ANFAVEA.

Thus, agricultural mechanization provided efficiency and practicality to agrarian operations, replacing the work performed manually or by animal traction, with machines that perform from soil preparation to harvesting, ensuring greater productivity and precision, cultivation in extensive areas, in shorter periods, which, combined with favorable climate and vegetation, made Brazil a major exporter of agricultural products (CUNHA; DUARTE; RODRIGUES, 2009; BAESSO *et al*., 2015; SANTOS *et al*., 2020).

Despite the economic benefits for the sector, rural workers are now exposed to a harmful and unhealthy environment, mostly due to the noise emitted by agricultural machinery (SPADIM *et al*., 2015). In addition, there are ergonomic problems and exposure to weather conditions, dust and exhaust

fumes, showing that the design of tractors prioritizes the work, and not the worker (SOUZA; FERNANDES; VITÓRIA, 2003). Previously, the projects aimed to reduce production and equipment costs; however, customers in several markets are more sensitive to vibrations and noise, making the evolution of these factors a powerful aspect of marketing (SILVA *et al*., 2004; YILDIZ & TANDOGAN, 2013).

Productivity in agricultural operations depends not only on the machinery employed, but on the health and well-being of the operator and auxiliary workers (SILVA *et al*., 2004; GOMES *et al*., 2021). Thus, it is essential to identify the working conditions that generate higher noise levels, and the influence of engine power, year of manufacture, presence of cabin, and activation of implements (BAESSO *et al*., 2017; GOMES *et al*., 2021).

3 NOISE AND AGRICULTURAL MACHINERY

Although sound is part of the daily life of human beings and of agricultural mechanization, some sounds are unpleasant and undesirable, promoting physiological and psychological effects, since they exert a certain pressure on the eardrum membrane, causing a feeling of discomfort and gradual loss of hearing sensitivity; the so-called noises (CELEN & ARIN, 2003; SILVA *et al*., 2017; FARIAS & SCHLOSSER, 2020).

Noise is one of the most dangerous physical agents found in the workplace, as it is noise pollution, which leaves invisible traces of its influence on the environment, and occurs in most of the factory, civil, motor, machine, and tool processes (SANTOS FILHO *et al*., 2004; RINALDI *et al*., 2008; MION *et al*., 2009; YANAGI JUNIOR *et al*., 2012). It consists of three classes: continuous, intermittent, and impulsive. Continuous noise is one in which there is no interruption, while intermittent noise occurs in cycles, and the sound can increase and decrease rapidly; impulsive noise is brief and abrupt, usually caused by explosions or impacts (TIPOS DE, 2011). Tosin (2009) states that this unhealthy agent is present in more than 90% of human activities, being the main risk to which workers are exposed.

In agriculture, noise has its main origin in tractor operations, since the strong acoustic response induced by external excitation causes noise inside the cabin through the glass window and windshield, and the repeated reflection of sounds by the thin plates of the cabin produce reverberation (EGELA & HAMED, 2017; WANG *et al*., 2022). In addition, its intensity can increase with the use of implements, such as plows and brush cutters, wind speed, temperature, and relative humidity (BABALOLA *et al*., 2018; SANTOS *et al*., 2020).

Studies carried out with older generation agricultural tractors demonstrate that the noise generated by these vehicles is not within an adequate range of noise levels, exceeding the daily and/or weekly exposure limits, inducing hearing loss (BILSKI, 2013; YAMIN *et al*., 2021). With

technological progress, in recent years, there has been a reduction in the levels of audible noise perceived by agricultural tractor operators, largely due to the replacement of older machines with modern equipment, however, it was not possible to reduce noise to safe working levels without the use of ear protectors in non-cabin tractors (BILSKI, 2013; SPADIM *et al*., 2015).

Therefore, it is necessary to determine the spatial destruction of noise to assess the healthiness of the work environment of machine operators and workers who assist the agricultural operation (SANTOS *et al*., 2020).

4 NOISE LEVELS IN HISTORY

In 600 B.C., in the city of Sibaris, in Ancient Greece, noise disturbance began to be reported, because of the activity of blacksmiths in the city limits. The first causal relationship between noise exposure and hearing loss was made by Plínio the Elder, four centuries later, when he observed that residents near the Nile River waterfalls had hearing loss (SOUZA, 2010).

With the Industrial Revolution, in the eighteenth century, work began to be mechanized, mostly spinning and weaving, occupying warehouses and sheds, and together with the Green Revolution, agricultural production expanded, which resulted in unhealthy work environments, due to long exposures to noise (CHAIBEN NETO *et al*., 2020; MOURA *et al*., 2020).

At the beginning of the nineteenth century, the first self-propelled steam vehicles appeared and, at the end of the century, they were equipped with internal combustion engines, not pleasing the population due to the noise emitted by the vehicles (FERNANDES, 1996). From 1930 onwards, tractors began to be considered emitters of high noise levels, for this reason, studies related to the effects of machine noise on human beings, centered on hearing (TOSIN; SPEARS; ARAÚJO, 2015). The first existing study on machine noise in agriculture dates to 1937, in which the father of audiology, C. C. Bunch, found the bilateral hearing loss of a 26-year-old farm worker.

In the first half of the twentieth century, research developed in the military area related man and machine, with anthropometric analyses of work positions. evidencing the concern with the comfort of agricultural machinery; in the 1950s, this relationship was included in the other physiological effects of noise, pointing to the high levels of tractor noise as responsible for the workers' hearing loss (FERNANDES, 1996).

From the 1960s onwards, with the agricultural modernization in Brazil, the use of machinery was intensified, leading to a significant evolution in agricultural productivity (SCHLOSSER *et al*., 2002; BAESSO *et al*., 2017).

With technological advances and studies carried out in recent decades, the audible noise generated by the tractor engine and its components has been reduced, aiming to reach acceptable levels for exposed workers (BILSKI, 2013; FARIAS & SCHLOSSER, 2020). In a study conducted by

Ramos, Valero and Cañavate (1999), it was observed that the noise level in tractors with cabs decreased from 89 dB(A) in 1981 to 78 dB(A) in 1999; in tractors without cabs, there was a decrease from 95 to 86 dB(A). Evaluating the exterior of the tractor, there was an 11% reduction in the sound level (from 88 dB(A) to 78 dB(A)), evidencing the importance of determining noise sources and improving agricultural machinery.

5 NOISE LEVELS IN AGRICULTURAL TRACTORS

The time of exposure to continuous and intermittent noise emitted by agricultural machinery confers negative impacts on the health of rural workers and, despite technological developments, it has not been possible to reduce noise to safe levels without the use of hearing protectors (BAESSO *et al*., 2017; CARNEIRO, 2018).

Noise levels vary based on the type of tractor, engine speed and type of work performed by the machine, in addition to the dimensional and physical characteristics of the materials used in the components of the agricultural machine which, when operating at higher speeds, produces vibrations and noise at the operating station; climatic conditions, soil conditions, and driver skills also influence the fluctuation of noise levels (FERNANDES, 1991; OLDONI *et al*., 2010; BILSKI, 2013; GHOTBI *et al*., 2013; SILVA *et al*., 2017). Gonçalves *et al*. (2013), observed a reduction in noise due to the time change, due to temperature, wind speed and relative humidity.

The distance from the noise source influences its level, demonstrating a positive correlation in which the higher the sound level presented by a machine, the greater the radius of its distance must be, in order to remain in a safe area (SILVA NETO, 2017; VEIGA *et al*., 2021).

Older tractors, due to the materials used in their components and ergonomic deprivation, emit higher noise levels and, for the most part, do not have a cab for acoustic insulation (MION *et al*., 2009; BAESSO *et al*., 2017; CHAIBEN NETO *et al*., 2020; GOMES *et al*., 2021). The absence of a cabin causes an increase of approximately 15 dB(A) in the noise level, since noise occurs around the cabin above the recommended limit of 85 dB(A), indicating extremely uncomfortable working conditions (SANTOS FILHO *et al*., 2004; RINALDI *et al*., 2008; DAMASCENO *et al*., 2019; FARIAS & SCHLOSSER, 2020).

In addition, the presence of a cabin in agricultural machinery ensures protection in the event of an accident, reduces exposure to environmental factors such as heat and dust (RINALDI *et al*., 2008; WEDGE; DUARTE; SOUZA, 2012).

Agricultural operations, combined with the conditions of the work environment, demonstrate the need to adopt safety measures that ensure the comfort and well-being of workers, such as personal protective equipment (PPE) (ARCOVERDE *et al*., 2011).

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6 SOURCES OF NOISE IN TRACTORS

Noise meters, known as decibel meters, are an important tool for quantifying the noise levels to which workers are exposed, as a way to protect them from risks and employ the appropriate protections. The use of this device must occur continuously, as the environmental, climatic, and conservation conditions of agricultural machinery directly influence the emission and propagation of noise, intensifying the risks to the health of employees (VEIGA *et al*., 2021).

Agricultural machinery has different sources of noise, with exhaust being responsible for up to 60% of the total noise emitted, followed by aspiration, fan and vibration; the transmission and hydraulics also influence the values (GHOTBI *et al*., 2013; RAVANDI *et al*., 2016; MOURA *et al*., 2020). The origin of this noise comes from the combustion process of the engine and the mechanical action with the engine (DEWANGAN; KUMAR; TEWARI, 2005; YADAV *et al*., 2013). In the vicinity of the engine, it is possible to measure levels above 90 dB(A) (FERNANDES, 1996; VEIGA *et al*., 2021).

Correlating the noise levels with the position, the highest values are found on the left, since the exhaust of the agricultural tractor is in that position, and on the front of the tractor, where the engine is located; subsequent is the right and rear positions of the machine (MAGALHÃES; CORTEZ; NAGAHAMA, 2012; MISSIO *et al*., 2016; CARNEIRO, 2018; MARQUES FILHO & LANÇA, 2022).

However, the activation of implements driven or driven by power take-off (PTO) requires greater engine power, raising the noise levels emitted directly or indirectly (DAMASCENO *et al*., 2019). Due to the greater effort of the engine, required by the implements, soil preparation operations with plows, harrows, subsoilers and scarifiers, present the highest noise levels, exceeding the daily exposure limits established by NR-15, reaching a value above 96 dB(A), making the use of PPE necessary (ARCOVERDE *et al*., 2011; WEDGE; DUARTE; SOUZA, 2012; EGELA & HAMED, 2017). The increase in sound levels at the rear of the tractor is due to the activation of implements (SANTOS FILHO *et al*., 2004; GOMES *et al*., 2021).

In addition to the implements used for soil preparation, the activation of sprayers in the power take-off generates an increase in the noise levels emitted by the mechanized set. Baesso *et al*. (2008), when evaluating the influence of an air-assisted sprayer, demonstrated results of up to 104.85 dB(A) at the operating station, i.e., above the limit allowed for an eight-hour workday. The centrifugal fan present in the air assistance system in the spray bar distributes a high volume of air in an inflated duct during the displacement of the mechanized set; the turbulence formed by the volume and velocity of the air varies according to the rotation of the fan (MATTHEWS; MILLER; BATEMAN, 2014).

7 NOISE LEVELS AND WORKER HEALTH

Agriculture is an occupation that involves potentially excessive exposure to agents harmful to health, such as noise, despite agricultural modernization, since the focus is related to clothing and protective equipment against agrochemicals; therefore, it is necessary to carry out health and safety assessments of workers (CARNEIRO, 2018; FARIAS & SCHLOSSER, 2020; MOURA *et al*., 2020).

The centralization of agricultural tractor projects in increasing their efficiency, leaving the human factor in the background, makes the hearing of operators vulnerable, who develop pathologies caused by hearing injuries (ALVES *et al*., 2011; ARCOVERDE *et al*., 2011; MARQUES FILHO & LANÇA, 2022). By assessing the noise levels to which rural workers are exposed, manufacturers improve the ergonomic and safety designs of agricultural machinery, and raise awareness of these workers regarding the risks of their activity, and the importance of using hearing protectors (POJE *et al*., 2016; CARNEIRO *et al*., 2018).

The operator of agricultural tractors is in constant problems related to ergonomics and safety, due to the sound level, frequency and time of exposure to noise and vibrations, leading to an increase in accidents due to irritation and distraction caused by excessive noise in the workplace, especially near the operator's ear (PIMENTA JUNIOR *et al*., 2012; BAESSO *et al*., 2015; SOARES *et al*., 2015; CHAIBEN NETO *et al*., 2020).

Although the human ear can withstand certain levels of noise, constant exposure to levels above the recommended levels, without the use of hearing protectors, generates cumulative effects over time, leading to temporary or permanent hearing loss (RAMOS; VALERO; CAÑAVATE, 1999; ALVES *et al*., 2011; ANDERSSON *et al*., 2015; CARNEIRO, 2018). In a study developed by Karlovich *et al*. (1988), analyzing the effect of noise on the hearing of rural workers, observed that about 50% of the men evaluated had some degree of communication deficiency at 50 years of age, and 25% had at least the onset of a disability at 30 years of age; Only 18-25% of workers reported wearing hearing protectors.

The use of hearing protectors is capable of attenuating noise levels between 10 and 20 dB(A), however, their quality, form and time of use influence in such a way that, even with their use, there

may be damage to the health of workers operating tractors (CUNHA; DUARTE; RODRIGUES, 2009; WEDGE; DUARTE; SOUZA, 2012).

Technological progress aimed at speeding up production has reduced the physical workload of men, however, it has negative effects; in addition to accidents and diseases associated with the exposure of the agricultural population to pesticides, vibration and organic particles, exposure to excessive noise is common (KARLOVICH *et al*., 1988; CELEN & ARIN, 2003). Combined with inadequate postures, the noise emitted by agricultural machinery leads the operator to stress and fatigue, reducing their performance (MISSIO *et al*., 2016; CHAIBEN NETO *et al*., 2020; OLIVEIRA JUNIOR *et al*., 2022).

High noise levels can cause immediate headaches; dizziness, nervousness and stress, trouble sleeping, and loss of concentration; makes it more difficult to process complex information for difficult tasks (DEWANGAN; KUMAR; TEWARI, 2005).

Long-term exposure to tractor noise influences heart rate, blood pressure, respiration, and uric acid levels in the blood; there are reports of change in the size of endocrine glands, contraction of blood vessels, pupil enlargement, nausea and fatigue (RINALDI *et al*., 2008; YAMIN *et al*., 2021). It also influences motor, perceptual and cognitive behavior, triggering glandular, cardiovascular and gastrointestinal variations through the autonomic nervous system, and may increase the risk of depression, aggressiveness, stress and anxiety, negatively affecting the social life of a farmer or tractor driver, as it affects communicative ability (KARLOVICH *et al*., 1988; BILSKI, 2013; SOARES *et al*., 2015; YAMIN *et al*., 2021).

Fernandes (1991) found the unhealthy daily exposure to noise levels above 80 dB(A), demonstrating hearing loss in 59.8% of the tractor drivers evaluated, who were exposed to levels between 90 and 110 dB(A).

According to Baesso *et al*. (2008, p. 401), "people exposed to 82, 85, 88 or 92 dB(A) in a daily workday (8 hours) lose 2, 5, 10 or 20% of their hearing, respectively".

When verifying the relationship between noise exposure and blood pressure among operators, Egela and Hamed (2017) found that before the work shift, 57.4% of the operators had prehypertension, and 42.6% had normal blood pressure. After the shift, 64.5% had stage I hypertension, 28.4% had prehypertension, and 7.1% had stage II hypertension.

8 LEGISLATIONS RELATED TO NOISE EMISSION

Excessive exposure to noise is recognized as an occupational health problem, and it is essential to quantify its levels, a fact that has led to the development of regulations and standards on permissible exposure levels and times (KARLOVICH, 1988; OLIVEIRA JUNIOR *et al*., 2022).

To establish maximum noise levels in relation to the year of manufacture of machines and vehicles, in 1958 the first legislation was created in Germany; A few years later, the ISO R 362 Recommendation was published, considering a maximum noise limit of 85 to 89 dB(A) (ISO, 1964).

The hearing risk to which workers were exposed was defined in 1975, with the publication of the ISO 1995 and ISO 1999 Standards by the *International Organization for Standization* - ISO; while in 1977, in Brazil, Law No. 6,524 came into force, approving the Regulatory Standards (NR) focused on Occupational Safety and Medicine (FERNANDES, 1996).

From 1987 onwards, Brazil adopted the international method for measuring noise in the workplace of agricultural tractors, making it possible to carry out numerous studies on the subject; in the same year, the publication of the NBR 9999 Standard defined the value of background noise at 10 dB(A) below that recorded during the execution of tests (FERNANDES, 1996; SANTOS FILHO *et al*., 2004).

In 1990, the NBR 10152 Standard was published by the Brazilian Association of Technical Standards – ABNT, establishing noise limits for acoustic comfort, which vary between 30 dB and 55 dB, depending on the environment evaluated (FERNANDES, 1996). The maximum exposure times allowed to workers (Chart 1), at different noise levels, so that health problems such as hearing loss do not occur, were stipulated through NR 15, of 1990 (CARNEIRO, 2018).

Table 1 – Tolerance limits for continuous or intermittent noise

Noise level (dB)	Maximum permissible daily exposure
85	8 hours
86	7 hours
87	6 hours
88	5 hours
89	4 hours and 30 minutes
90	4 hours
91	3 hours and 30 minutes
92	3 hours
93	2 hours and 40 minutes
94	2 hours and 15 minutes
95	2 hours
96	1 hour and 45 minutes
98	1 hour and 15 minutes
100	1 hour
102	45 minutes
104	35 minutes
105	30 minutes
106	25 minutes
108	20 minutes
110	15 min
112	10 min
114	8 min
115	7 min

Source: adapted from Brazil (2022).

In 2017, ABNT publishes the NBR ISO 5131 and NBR ISO 7216 Standards, specifying the method for measuring noise in the position of operator of agricultural and forestry tractors, and the method for measuring the sound pressure level in agricultural and forestry tractors in motion, respectively.

9 INFLUENCE OF AGRICULTURAL IMPLEMENTS ON NOISE LEVELS

When using agricultural tractors, most of the time, implements are activated to carry out activities in the field. That said, below are the main results of a study that evaluated the influence of the activation of an air-assisted sprayer on the noise levels emitted by an agricultural tractor (Figure 1).

Figure 1 – Measurement of noise levels emitted by a tractor-sprayer mechanized assembly at the agricultural tractor operating station

Source: Authors.

The evaluations of the study were based on the methodology determined by the NBR ISO 5131 (ABNT, 2017) and NBR ISO 7216 (ABNT, 2017) standards, which refer to the measurement of noise at the agricultural tractor operator's station, and when the tractor is moving, respectively.

The treatments consisted of a combination of two air assist conditions (off and on), four engine speed (1400, 1600, 1800 and 2000 rpm) and two clearance radii (0.20 m away from the operator's ear, laterally, and 7.5 m away from the noise source).

Due to the operation of the centrifugal fan present in the sprayer model used, the air assistance in the spray bars generated an increase in the noise levels emitted when it was turned on. According to Table 1, the highest noise levels were quantified at a distance of 0.20 m from the operator's ear, due to their proximity to the noise source, in both air assistance conditions, while moving away from this

source, there was a decrease in the emitted sound intensity, demonstrating an inversely proportional behavior between distance and emitted noise.

Table 1 – Breakdown of the interactions between the factors radius of clearance and air assistance in the spray bar of an agricultural tractor

Clearance radius	**Air Assist**			
	Off		**Maxim**	
	Noise (dB)			
0,20 m	88,04	Off	89,79	aA
7,5 m	72,29	B	78,43	bA

Averages followed by the same letter, lowercase in the column, and uppercase in the row, do not differ significantly from each other by Tukey's test at 5% probability of error. Source: Authors.

In the evaluations of the influence of engine speed (Table 2), a linear behavior was observed in such a way that the increase in engine speed generated an increase in noise emissions.

Table 2 – Breakdown of the interactions between the factors engine rotation and air assistance in the spray bar of an agricultural tractor

Engine Speed (RPM)	**Air Assist**			
	Off		**Maxim**	
	Noise (dB)			
1400	78,18	b	80,43	the
1600	80,03	b	83,63	a
1800	82,32	b	86,66	a
2000	83,77	b	88,12	the

Means followed by the same lowercase letter in the column do not differ significantly from each other by Tukey's test at 5% probability of error. Source: Authors.

Thus, the engine revs of 1400 rpm and 1600 rpm had the lowest noise levels, as well as the revs of 1800 rpm and 2000 rpm had the highest noise levels, regardless of the operation of the air assist of the sprayer.

According to Regulatory Standard n° 15, for noise levels above 85 dB, the time of exposure of the worker to noise sources must be reduced and the use of ear protectors should be made as a way to mitigate the effects caused by such exposure.

It is important to emphasize that, when evaluating different distances, it is possible to know the sound intensities to which other employees working in a nearby location are exposed, not only those operating the agricultural machinery.

10 FINAL THOUGHTS

Exposure to noise during work activities affects the performance and health of workers, leading to the dispersion of attention due to increased stress and discomfort. The most severe effects of noise levels do not occur immediately, but in the long term, and can lead to cardiovascular complications, increased heart rate, and hearing loss.

As a result of technological advances and changes made in agricultural machinery and implements, there was attenuation of the noise emitted through the use of cabins and change of materials used to compose the machines. However, not all producers have the financial conditions to purchase cabin models available in the market, and it is necessary to adopt more viable measures.

Thus, regardless of the position of the workers in relation to the agricultural machinery in operation, it is important to use personal protective equipment (PPE) for health and safety during the working day, ensuring the well-being of employees.

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