

Topic 7

“Occupational Health”

Oral Presentation

Work related stress in horticultural nursery: risk assessment and identification of the preventive measures

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Abstract

The horticultural nursery crops are today produced in large greenhouse farms with structures, equipments, machines, heavy work cycle and organization that may cause work related stress. This research has set out to assess the risk of work related stress under the Italian Legislative Decree n° 81/2008 and provide parameters to activate a project of prevention and promotion of well being at work. The work was carried out in a Tuscany big greenhouse nursery. The stress assessment methodology followed the procedures mentioned in the manual INAIL (National Institute for Insurance against Accidents at Work - ed.2011) by use of companies and the guidelines of the Tuscany Region. Data were collected from homogeneous workers groups and the results have showed a low level of risk for all groups so this has showed that the method of preliminary evaluations is sufficient to evaluations work related stress in horticultural nursery.

Keywords: work safety, management standards, greenhouse nursery

Introduction

The horticultural nursery crops are today produced in large greenhouse farms with structures, equipments, machines, heavy work cycle and organization that may cause work related stress. The research has set out to assess the risk of work related stress under the Italian Legislative Decree 81/2008 and provide parameters to activate a project of prevention and promotion of well being at work in this area. The work was carried out in a large Tuscany greenhouse nursery that carries out its activities on an area of more than five hectares.



Figure 1. Greenhouse crops



Figure 2. Nursery machines

Materials and methods

The study has been conducted in a horticultural nursery selected for his dimension and organization. The related farm has been submitted to visits aimed to acquire informations

around structures, plants, machines and instruments employed. Also the level of mechanization and automation of plants has been investigated.

The analysis have permitted to define the work cycle, number of involved workers and their duties. Work cycle is schematically represented in the flow chart below.

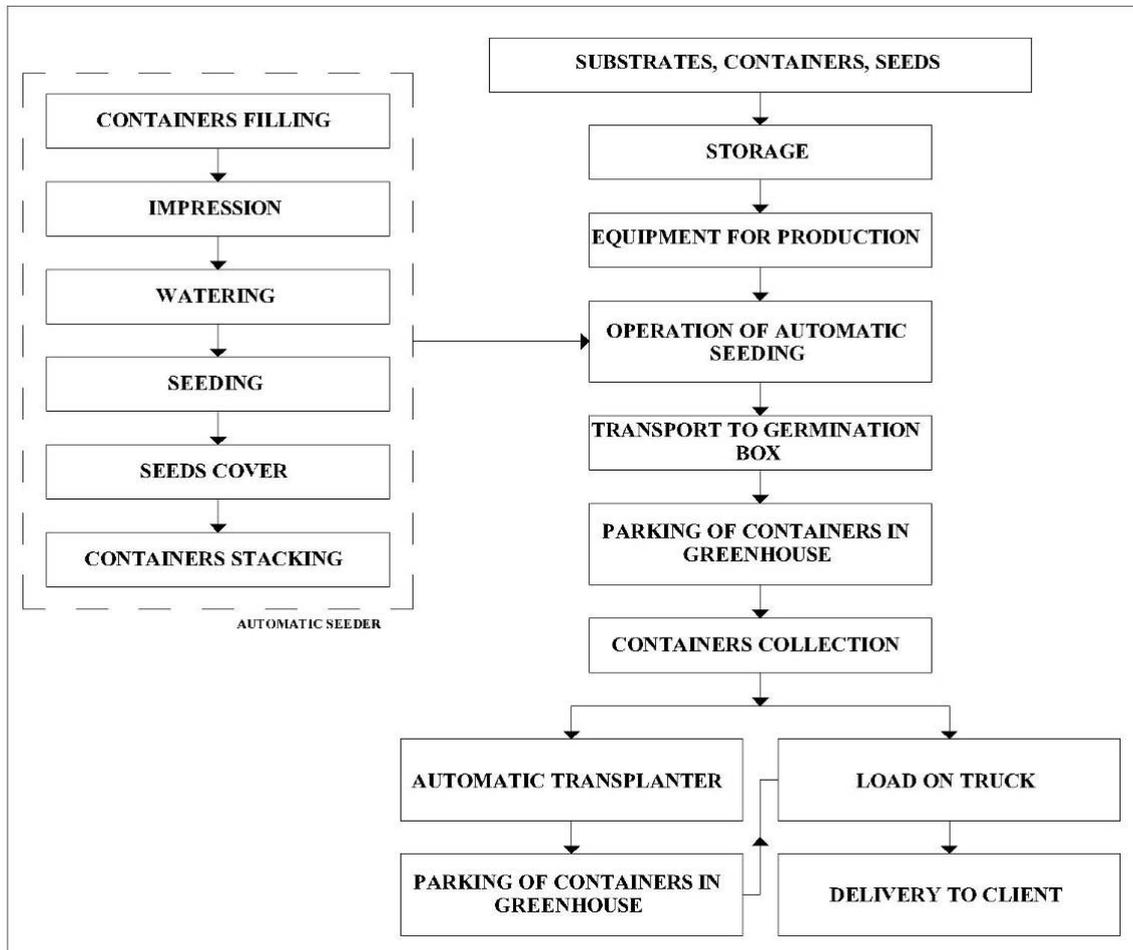
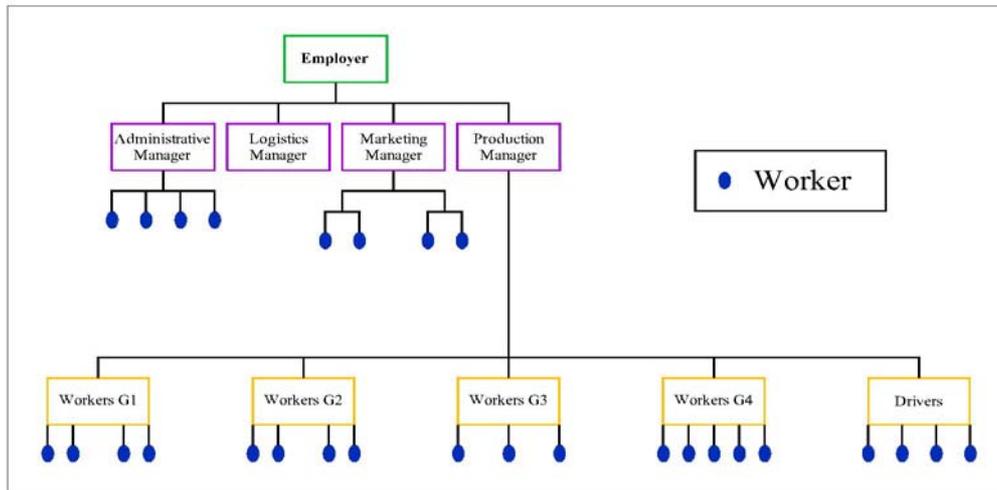


Figure 3. Containers storage

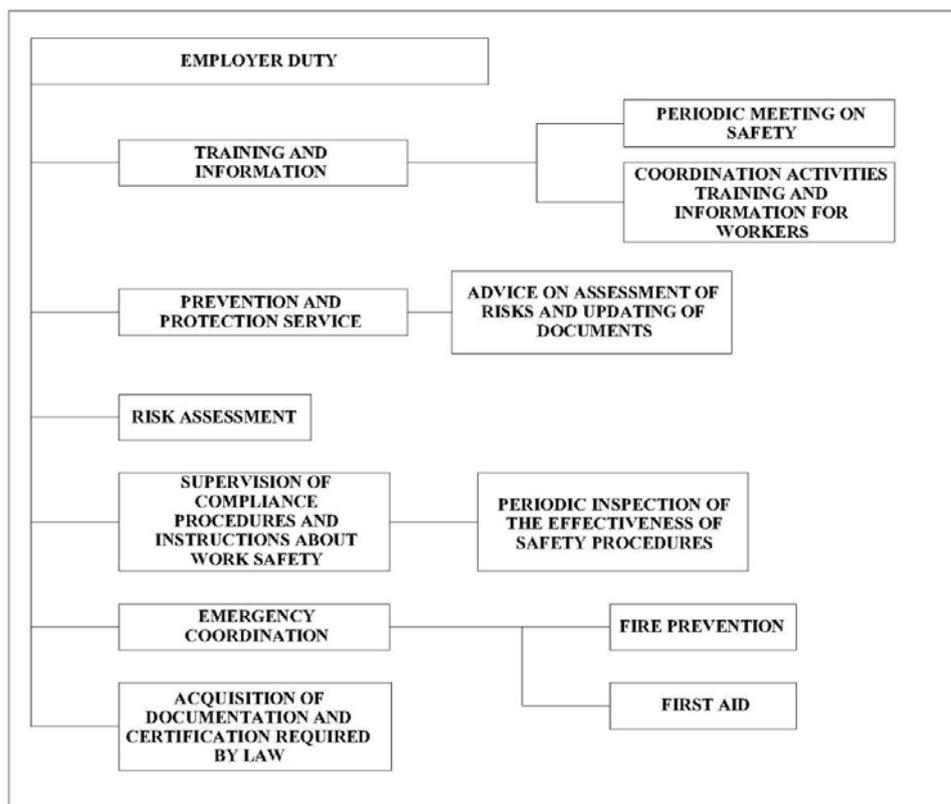


Figure 4. Trolleys

Work organization is related in the scheme below.



Also the structure of the work safety organization of the nursery has been investigated and is related in the scheme below.



The applied stress assessment methodology followed the procedures related in the INAIL (National Institute for Insurance against Accidents at Work) manual by use of companies (ed. 2011) and the guidelines of the Tuscany Region.

In spite of these rules, it was conducted the identification of groups of workers that have been selected for homogeneous duties and exactly:

GROUPS	DUTIES
Managers	Organization, meeting, briefing, work office
Employee	Work office
Workers G1	Seeding, container handling, grafting, micro propagation, generic work
Workers G2	Seeding, container handling, pest treatment, generic work
Workers G3	Automated seeding and transplanting, container handling, laboratory activities, generic work
Workers G4	Manual transplanting and seeding, container handling, generic work
Drivers	Production transport, container handling and small plants, generic work

All the groups were investigated using the related methodology that include two types of evaluation, a preliminary and, if necessary, a detailed one.

Preliminary Evaluation of risk was carried out with checklists of the following indicators:

1. Business Indicators/Sentinel Events area (accidents, absenteeism, turnover, medicals)
2. Work content area (environment, microclimate, equipment, workload, etc.)
3. Work context area (roles, careers, independence, relationships, interfaces, etc.)

At the end of the preliminary evaluation it was determined the level of risk for the selected homogeneous groups of workers; in the case of groups with high level of risk it has been programmed to conduct the next **Detailed Evaluation** of the subjective perception of risk by means of questionnaires and Focus Groups.

Evaluation of indicators was conducted with checklists showed below. Data analysis was conducted with free internet software from INAIL.

BUSINESS INDICATORS/SENTINEL EVENTS AREA

N°	INDICATORS	DECREASED	UNCHANGE	INCREASED
1	Injury index			
2	Absences due to illness (not maternity, nursing, marriage leave)			
3	Absences from work			
4	% Unused vacations			
5	% Internal transfers required by staff			
6	% Staff rotation (left-entered)			
7	Procedures / disciplinary			
8	Number of medical visits on request (D.lgs. 81/2008, art.41 letter, c2, c c2)			
		ABSENT		PRESENT
9	Reports of medical conditions of stress at work			
10	Judicial instance dismissal/demotion			

WORK CONTENT AREA

WORK ENVIRONMENT AND WORK EQUIPMENT

N°	INDICATORS	YES	NO
1	Exposure to noise above the second level of action		
2	Inadequate acoustic comfort (non-industrial environment)		
3	Risk Cancer/chemical treatment not irrelevant		
4	Suitable microclimate		
5	Adequate lighting to work with high visual engagement (VDT work)		

	purposes, etc..)
6	Risk handling movement load
7	Availability adequate and comfortable DPI
8	Jobs at risk of physical assault / solitary work
9	Safety signs clear, immediate and relevant to the risks
10	Exposure to the higher vibration action limit
11	Adequate maintenance equipment
12	Exposure to ionizing radiation
13	Exposure to biological risk

PLANNING TASKS

N°	INDICATORS
1	The work has frequent interruptions
2	Adequacy of equipment resources necessary to accomplish the tasks
3	Boring work
4	Task requires multiple tasks simultaneously
5	Clear definition of tasks
6	Human resources for task

YES	NO

WORK LOAD – PATTERN OF WORK

N°	INDICATORS
1	The workers have autonomy in the execution of tasks
2	There are unpredictable variations in the amount of labor
3	There is no task for long periods in the work shift
4	work characterized by high repeatability
5	Fixed work rate for the execution of the task
6	worker can not act on the rhythm of the machine
7	Workers must make quick decisions
8	Working with the use of dangerous machinery and equipment
9	work with high responsibility for others, and production facilities

YES	NO

WORKING HOURS

N°	INDICATORS
1	Working hours exceeding 8 hours
2	Played overtime
3	Not flexible hours of work
4	Frequent changes in planning time
5	Work breaks are clearly defined
6	Shift work
7	Night shift work
8	Fixed or rotating night shift

YES	NO

WORK CONTEXT AREA

FUNCTION AND ORGANIZATIVE CULTURE

N°	INDICATORS
1	Diffusion of the chart of organization
2	Business procedures
3	Company procedures for workers
4	Diffusion Company procedures for workers
5	System of enterprise security management. SA8000 Certification and BS OHSAS 18001:2007
6	Business communications system (bulletin board, Internet, flyers)
7	Meetings between management and workers

YES	NO

8	Training plan for professional growth of employees		
9	Company communications to all staff		
10	Code of ethics and conduct		
11	Systems for implementation and management of the business cases of hardship		

ROLE INSIDE ORGANIZATION

N°	INDICATORS	YES	NO
1	Workers know the company's hierarchy		
2	Roles are defined		
3	Different roles on the same people (shift supervisor / charge / Quality Manager)		
4	Executives/responsibles provide conflicting information about the job		

EVOLUTION OF CAREER

N°	INDICATORS	YES	NO
1	Defined career advancement		
2	Reward systems for the proper management of staff by managers / leaders		
3	Reward systems for achievement of safety objectives		

DECISION MAKING - CONTROL OF WORK

N°	INDICATORS	YES	NO
1	Work depends on tasks previously done by others		
2	Workers have sufficient autonomy to carry out the tasks		
3	Workers have access to information on business decisions relating to the Working Group		
4	Workers' participation in decision-making tools for business choices		
5	Supervising the work		

RELATIONSHIPS AT WORK

N°	INDICATORS	YES	NO
1	Possibility of communication between leaders and workers		
2	Misconduct on the part of superiors and colleagues are managed		
3	Reporting of conflicts / disputes frequently		

INTERFACE HOME-WORK

N°	INDICATORS	YES	NO
1	Meal break in a suitable place		
2	Opportunity to work flexible hours		
3	Opportunity to get to work by public transport / shuttle company		
4	Opportunity to perform work part-time vertical / horizontal		

Results

The evaluation of stress risk has regarded all the selected groups. The results are related below. For every group with duties in nursery organization it was valued the stress risk level. Low, medium, high are the levels considered in according with INAIL's guidelines.

RISK ASSESSMENT (homogeneous group 1: manager)

BUSINESS INDICATORS/ SENTINEL EVENTS	0
WORK CONTENT AREA	2
WORK CONTEXT AREA	4
TOTAL	6



RISK ASSESSMENT (homogeneous group 2: employee)

BUSINESS INDICATORS/ SENTINEL EVENTS	0
WORK CONTENT AREA	2
WORK CONTEXT AREA	4
TOTAL	6



RISK ASSESSMENT (homogeneous group 3: workers G1)

BUSINESS INDICATORS/ SENTINEL EVENTS	0
WORK AREA CONTENT	2
WORK AREA CONTEXT	4
TOTAL	6



RISK ASSESSMENT (homogeneous group 4: workers G2)

BUSINESS INDICATORS/ SENTINEL EVENTS	0
WORK CONTENT AREA	3
WORK CONTEXT AREA	10
TOTAL	13



RISK ASSESSMENT (homogeneous group 5: workers G3)

BUSINESS INDICATORS/ SENTINEL EVENTS	0
WORK CONTENT AREA	1
WORK CONTEXT AREA	6
TOTAL	7



RISK ASSESSMENT (homogeneous group 6 workers G4)

BUSINESS INDICATORS/ SENTINEL EVENTS	0
WORK CONTENT AREA	3
WORK CONTEXT AREA	10
TOTAL	13



RISK ASSESSMENT (homogeneous group 7: drivers)

BUSINESS INDICATORS/ SENTINEL EVENTS	0
WORK CONTENT AREA	1
WORK CONTEXT AREA	9
TOTAL	10



LOW RISK	The analysis of the indicators does not reveal specific conditions that can determine the presence of work-related stress. Repeat evaluation in case of corporate changes in organization, or every 2 years.
MEDIUM RISK	The analysis of the indicators shows the conditions that can determine the presence of work-related stress. For each identified risk condition should take actions to improve target. Annual monitoring of indicators. If these do not result in improvement within a year, you will need to proceed to the second level of assessment.
HIGH RISK	The analysis of the indicators show the presence of certain conditions with work-related stress. You must make an assessment of perceived stress for workers. And is necessary, in addition, to monitoring the conditions of stress to test the effectiveness of improvement actions.

Conclusions

The above related procedure of risk assessment has permitted to determine the level of risk for each selected homogeneous group operating in the horticultural nursery. The risk level is related in the table below.

GROUP	RISK LEVEL ASSESSMENT
Manager	LOW
Employee	LOW
Workers G1	LOW
Workers G2	LOW
Workers G3	LOW
Workers G4	LOW
Drivers	LOW



The table shows that the risk level is low for all groups and so the ***Preliminary Evaluation*** was sufficient to assess the risk. Investigations have showed that in modern horticultural nursery no ***Detailed Evaluation*** is necessary. This fact is due to modern structures and ergonomic machines conjuncted with rational and efficient work organization. Also information and training of workers are resulted important to increase the wellbeing in the horticultural nursery sector.

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Analysis of accidents with self-propelled agricultural machines from 2008 to 2010 in Austria

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Keywords: accident, protection, farm machinery, injuries, database analysis

Objectives

The increased levels of mechanizations and time and cost pressures are main reasons for serious accidents in agriculture. In addition, large tractors and self-propelling harvest machines for load transportation are more intensively used in agriculture. The main objective is to analyse recognized accidents of these machines and to identify accident reasons, information and safety gaps. Prevention measures, acts and technology-based solutions, especially to close safety gaps on constructive and ICT-based level should be found out, based on these results or of further studies.

Methods

A database with all approved occupational accidents with tractors, self-propelled agricultural machines and with load carrying machines from 2008 to 2010 in Austria was investigated. The evaluation results were shown with crosstabs and their dependences were checked by chi-square-tests. A literature and internet research was used for discussion and verification of the found out results.

Results

The analysis of the database showed that 785 approved occupational accidents with tractors, self-propelled agricultural machines and with load carrying machines occurred from 2008 to 2010 in Austria. More than 40% of the accidents happened during driving the vehicle due to a loss of control. The biggest share of the accidents took place on fields, grasslands and on the yard area. The majority of the victims were male, Austrian citizen and at the age of 41 to 50. Accidents with tractors, self-propelled agricultural machinery and transportation industries had similarities. Causes, processes, and effects were similar in certain cases. Therefore, certain preventive measures can be applied to all categories. Additionally, special measures are needed for each category to achieve a high safety status.

Use of sunscreen as protective personal equipment (PPE) in a population of Italian gardeners

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Aim

High levels of exposure to ultraviolet (UV) radiation increase the risk of all three common forms of skin cancer, and approximately 65%-90% of melanomas are caused by exposure to UV radiation. Behaviours that can reduce skin cancer risk are wearing protective clothing; or using appropriate sunscreen protection. In Italy the incidence in period 1998-2002 of non melanoma skin cancer is 87,2/100000 in male and of 54,2 /100000 in female, with a report of 6411 new cases every years. Gardeners as others agricultural workers spend the mayor part of their working time during spring and summer outside exposed to sun rays.

Methodology

We started a study evaluating the possibility of using sunscreen as protective personal equipment (PPE) in a population of gardeners. We enrolled a group of gardeners of a small Italian company, in which use of shirt during spring and summer is mandatory by company policy. Sunscreen used is Eriofonae cream containing pholitisias that in 2009 received the European approval in using in prevention of attinic Keratosis and non melanoma skin cancers. The study was divided in 3 phases, first an information to all the workers about UV protection, than we give free samples of cream, and at the end a dermatological screening.

Results

We enrolled 32 workers (1 female and 31 males). 26 agreed to try in using cream and 15 of them for all the three summer months of test. Workers that stopped in using cream almost referred problems during activity of major swelling. We recovery also an allergic reaction in a subject that report previous dermatological problems in sunscreen use. Stratifying workers by photo type 4,2% belongs to type1, 20,8% to type2 and respectively 62,5% and 12,5% to type3 and 4. The adherence to the program decrease from 100% of type1 to 50% of type3 and 4 workers. We found differences between who use or don't use the cream in Work Ability Index (WAI) with a mean of 42,8 in uses versus 41,2 in don't users ; no differences were found in age or scholarship between the two groups.

Conclusions and Perspectives

Our data suggest that the chance of using sunscreen as PPE is not refused by workers but is important to improve the absorption of cream especially in activity that cause consistent swelling. Extend the intervention in other companies expanding the populations tested will give more data about the compliance of sunscreen use as PPE.

Immunomodulatory effects of alpha-cypermethrin on cytokine production in greenhouse workers

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Keywords: pyrethroid, interleukin, 3-phenoxybenzoic acid

Objectives

Cypermethrin (CYP) belongs to type II synthetic pyrethroid insecticides and is widely utilized for agricultural and environmental applied.

Synthetic pyrethroids are neurotoxins: they affect axons of the neurons of the peripheral and central nervous system.

Pyrethroids, and particularly CYP, induced cytotoxic and genotoxic effects both singularly and in synergy with other pesticides and/or contaminants.

Aim of the present study was to evaluate the effects of Alpha-cypermethrin (α -CYP) on plasma levels of IL-1 β , IL-2, IL-4, IL-5, IL-6, IL-8, IL-10, IL-12p70, TNF- α , TNF- β and interferon- γ (INF- γ) from occupationally exposed greenhouse workers (GhW). Urinary levels of 3-phenoxybenzoic acid (3-PBA), a metabolite of Alpha-CYP, were also determined.

Methods

The study population consisted of 30 GhW specialized in pesticide spraying who worked for companies located in the Ragusa province of Sicily and 30 control, office workers. GhW typically manipulate various pesticides (mostly pyrethroids) throughout the year, depending on the season and on cultivation type in the greenhouse. GhW were exposed to α -CYP during the mixing, loading and spraying of insecticides and during the cleaning of the nozzles, servicing of the devices and reentry to treated areas

Results

Urinary 3-PBA levels in GhW were significantly ($p < 0,01$) higher than control. In fact, the mean urinary 3-PBA level in GhW was 7.8 ± 2.1 $\mu\text{g/g}$ creatinine; while the concentration of 3-PBA in control group was always below the LOD.

The mean plasma IL-1 β , IL-4, IL-5, IL-6, IL-10, IL-12p70, TNF- α and TNF- β levels were not significantly different between the two groups of workers in the study. Mean plasma INF- γ and IL-8 levels were significantly ($p < 0,05$) different between GhW and control group; mean plasma IL-2 level was more significantly ($p < 0.001$) higher in GhW than control. No correlation was found between urinary 3-PBA levels of GhW and plasma levels of cytokines detected.

Horticultural Therapy for Burnout Patients at Farms

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As the numbers of people who are suffering anxiety disorders, depression or burnout are reaching a new peak and the risk to get a temporary incapacity to work caused by a mental disorder lies by about 25 percent for the average European (vs. European Commission 2008, BKK 2008), it is necessary to force appropriate ways of treatments. One of these treatments, apart from client-centered therapy, is horticultural therapy at farms which combines individual and group therapy, ergotherapy and physiotherapy.

Keywords: mental health, rehabilitation, farm works, nature

Burnout

According to the present knowledge, the attention paid to the burn out syndrome is higher than in the last few years. The number of mentally affected people is increasing and requires modern and alternative therapies. Burn out patients and patients with *depression* or *anxiety disorders* (both are strongly associated with the burn out syndrome) are conventionally treated with drugs and/or client centered therapy. The therapy garden offers a modern, alternative and nature-based kind of therapy. It is important to analyze the background of burn out and horticultural therapy, as well as the potential implementation, in order to offer horticultural therapy at farms.

Since burn out is not a disease but a *syndrome* (a group of symptoms that collectively indicate or characterize a disease, *psychological disorder*, or other abnormal condition), the clinical picture is extremely variable. The following three characteristic features of burn out can be observed very early and easily visible for laymen (vs. Braun, 2011): emotional exhaustion, depersonalization and declining performance. A standard treatment, like for purely physical or purely mental "illnesses" are almost impossible to do. However, patients who are affected with burn out should get a special patient centered treatment from psychologists or psychiatrists, as the administration of various drugs, such as *antidepressants* and *muscle relaxants* relieve the symptoms significantly. During the treatment process, the attending physician, psychologist or psychiatrist will decide on further procedures that may include a temporary downlaying of the patients' profession. In general, "prevention" should be seen as prophylaxis, but this form of expression is unfortunately not applicable in the same breath with burn out. However, the symptoms or changes in behavior should be recognized as early as possible and be treated as fast as possible to avoid the complete exhaustion or incapacity to work. The simplest treatments to prevent burn out are the following three strategies, which can be used in combination or separately. Anyway, they must be customized and selected for any concerned. These strategies are: the social strategy, the organization orientated strategy and the person centered strategy (vs. Beimrohr, 1995).

Horticulture and Care Farming as Therapy

"Results from happiness research show, that people are very happy if they can merge with nature. Forest walks, sunsets and the changing seasons are repeatedly described as a happy-making experience. The American researcher Mihaly Csikszentmihalyi discovered, that people feel very comfortable when they can merge into an activity. It is possible that these people can experience a flow. Especially gardening belongs to that." (vs. Michell-Auli, 2010). The aim of horticultural therapy is of course to increase the patient's general condition, to train fine and gross motor skills and above all to promote social interaction. Wells (1997) defined his aims as followed:

- * Stimulate the senses and experiences with plants
- * Allow social contacts and encourage communication
- * Obtain skills and make meaningful experiences
- * Facilitate reality orientation and nature experiences.

Care farming describes a form of therapy that is applied to everyday activities, depending on the physical or mental condition of the performer (patient). A related phenomenon, which replies especially to burn out patients, is that, if they have to quit their everyday profession, it leads not to a resignation of any work activity. Those patients do not have to feel like "useless" or "unsatisfactory", because they are still "working". Care farming is suitable for all age groups, providing that the use of certain work equipment and risks can be understood. This form of individual and group therapy is not suitable for people who work in "green" professions, like (landscape) gardeners, florists, farmers and foresters. Horticultural therapy is not responsive for people whose profession is too similar to the tasks of the therapy. With all its benefits to use farms as facility for therapy treatments, there are still some demands: The general rule is, that each family or the manager has to be open, tolerant and durable, must possess knowledge of human nature, since such a task - open their own business for "strangers" and such treatment programs - a tour de force is and which is connected with many common hours of planning and organization. Basically, many companies are capable to operate care farming. It is advantageous if the "guests" can stay right on the court (depends on group size, severity of the treatment program and the illness). But still, not every person is made for farm work, knowledge as well as physical fitness are playing a certain role. The following table should make clear, which selected work is more or less physically demanding or how much prior knowledge is necessary for certain work processes. Many of these steps require continuous and random checks, as they may require special knowledge or are bringing potentially serious hazards to themselves (eg. timber felling operations involve increased risk of injury).

Conclusion

As every 4th average European is suffering a *mental disorder*, at least once in his life, the health care system has to react to the increasing need of treatments and rehabilitations. This increased necessity needs to have a well-functioning health care system, which is not given in every European nation. Horticultural therapy is an inexpensive way of treatment and is affordable for health insurance companies and for private patients. To proactively antagonize burnout, it needs a rethink from company leaders that horticultural therapy should be accessible for each employee. The sessions, for example, could be held at green areas like an employee garden or a greenhouse with a cafeteria located inside.

There are no figures how many people in Austria or Europe is in treatment, because of the special form of depression or burnout. Unfortunately, burnout is often stamped as "*nervous breakdown*", but it is still a serious disease and has to be treated adequately. With horticultural

therapy as therapeutic instrument burnout could be treated preventive. Despite preventive measures are occurring, the patient has to act quickly and consider a burnout specialized psychologist or psychiatrist to counteract the depression as early as possible. The prescribed ways, like drug treatment (of which, except in very severe cases, is not recommended), local therapy including a stationary therapy, should ideally take place in nature. Whether individual or group therapy is successful, depends on the personal character of the patient. However, it should – especially, if horticultural therapy is considered - be worked out to return the patient, who is in a depression or burnout, to his normal working life. In the case of treatment by horticultural therapy on a farm, it is important to address the individual needs of each patient. Is a general dislike of "clean air", the "farm smell" or animals given, patients should not be confronted with this type of therapy. People who respond particularly well to animals should get assigned to work which has to do with animals and people who draw their strength from the mental movement, should do physical work.

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Topic 7

“Occupational Health”

Poster Presentation

Health and safety aspects during pesticide application in Iranian rice growers'

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Keywords: Iran, acute poisoning, applicator safety

Objectives

Due to generally simple-to-use, fast-acting, and effective attributes to manage the majority of pest problems, Chemical pesticides, have a key role in agricultural production systems. These products were made to alter life cycles of living pest organisms and improper handling of them is dangerous to involved people. However, acute poisoning during spraying operation is an important health problem among farm workers and operators, but there is a substantial lack of data and studies from Iran to investigate unsafe acts and conditions, poisoning frequencies and factors could be effective in fostering pesticide application safety.

Methods

Data were collected on 110 rice farm households using surveys and field experiments in Fars Province of southern Iran. Based on WHO possible acute pesticide poisoning definition, the acute poisoning prevalence and unsafe acts and conditions affecting it were investigated. A composite indicator, translating unsafe acts and conditions into score was developed. The correlation between composite unsafe indicator and acute poisoning were examined. Chi-square test also was performed to assess the association of acute pesticide poisoning with pesticide applicator characteristics and unsafe acts and conditions.

Results

This study revealed that 12.7% of pesticide applicators suffered acute pesticide poisoning. The results showed rice farmer acute poisonings can be traced to unsafe practices in handling pesticide. Safety knowledge, personal protective clothing, gloves and boots worn in the field and equipment malfunction had statistically significant effects on acute poisoning. The results also showed expired, banned and illegally imported pesticides were utilized in large scale. This unreasonable utilization not only increases health risks but also reduces chemical effectiveness.

Conclusion

This study suggests that pesticide safety education and use of protective application methods could be effective in reducing the risk of acute pesticide poisoning. Safety training on proper and safe pesticide handling could minimize chemicals risk factors. Different effective training modes, preferably, oral presentations and storytelling programs should be developed and enforced. In addition to safety training, improving maintenance and repairment status of spraying equipments, preparing and distributing complete packages of personal protective appliances among pesticide applicators. is necessary. Health and safety aspects of applicator family should be also focused.

Safety aspects in the use of agricultural tractors

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Abstract

The Italian legislative decree of April 9, 2008, No 81 established a series of obligations for the employer (Article 71) and the self-employed (Article 21), that request the implementation of measures ensuring that work equipment is properly maintained, in order to ensure the continuity of the safety requirements of Article 70 and the correct keeping and update of the audit log. The purpose of this paper is to provide organizational solutions and/or procedures capable to support the industry in the verification and maintenance of safety requirements for agricultural or forestry tractors intended as work equipments. 27 agricultural tractors, different per class of power, mass and type of propulsion (22 wheeled and 5 tracked tractors), have been examined. Through a series of detailed and targeted inspections, the main shortages and non-compliances have been identified. A plan for the adjustment and the correct management of the machines has been activated with the aim of raising the level of safety during the work and of protecting the physical integrity and the health of the workers. During the inspections, checklists have been adopted, referring to the main tractor components. The results of the audits show that 15% of the inspected tractors lacks a protective device in case of overturning. As to the driver's seat, 29% is in excellent conditions, 15% is sufficiently preserved, while the remaining 56% is in poor conditions. 74% of the seats has no seatbelt. As regards the protections from mobile and hot elements, 41% of tractors has no guard against accidental contacts.

Keywords: maintenance, control, driver safety

Introduction

The legislative decree of 09 April 2008, no. 81 and subsequent modifications and additions, established a series of obligations on the employer (Article 71) and the self-employed (Article 21) which also include the implementation of measures necessary to ensure that the agricultural and forestry tractors are being properly maintained over time to ensure the permanence of the safety requirements of Article. 70 and the care for the keeping and updating of the control register. The purpose of this paper is to provide organizational solutions and/or procedures that support the operators of the sector (employers and self-employed) in the verification and maintenance of safety requirements of agricultural and forestry tractors, considered as work equipment, in accordance with the requirements of the article 71, paragraph 4, letter a) point 2, letter b) of Legislative Decree 81/08.

Materials and methods

37 agricultural tractors were examined, different for power class, mass and type of propulsion units (29 wheeled and 8 tracked tractors). As to the registration year, in 5 cases it was not possible to obtain such an information and the corresponding circulation certificate. The remaining 32 tractors were registered between 1960 and 2010, with the distribution described in Fig. 1.

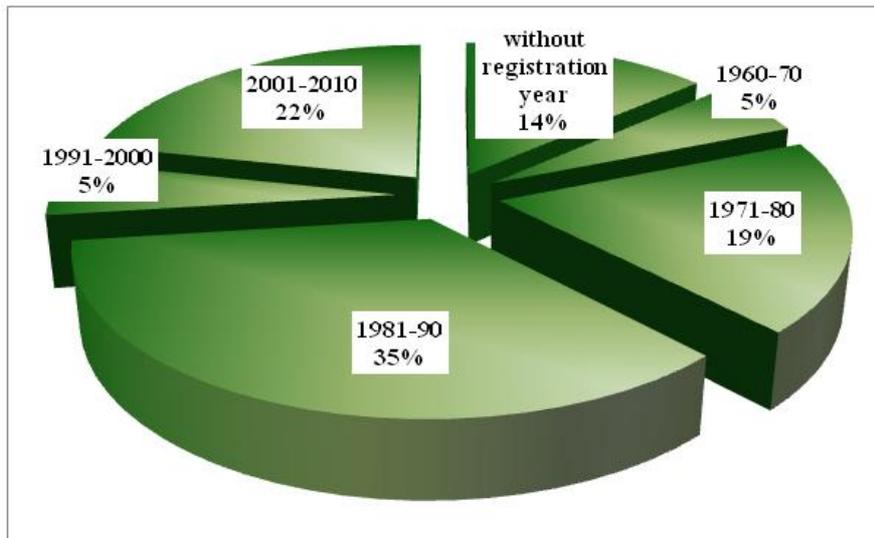


Figure 1. Division of the tested tractors by year of registration

Through a series of detailed and targeted surveys it was possible to identify the main deficiencies and non-compliance. Then, an adaptation and management plan started in order to raise the safety standards under work conditions and to protect the physical integrity and health of the workers. During the inspections, checklists were used, derived from technical standards normally used in the process of construction of new tractors, and related to the main parts of the machines. The topics dealt in the checklists were the following: technical data and documentation of the tractor; presence of pictograms; access to the cockpit; controls; lighting and signalling devices; rear-view mirror; propulsion and support; protective device in case of overturning; the driver's seat and restraint system; protections of moving parts; protections of hot parts; electrical equipment; tubes and hydraulic jacks. The topics listed above are not exhaustive of all the safety requirements needed in agricultural tractors. The subjects were excluded from the survey, although of fundamental importance for the safety of the operator: state of efficiency of the braking system; correct operation of the lighting system and of the visual and audible warning systems; inhibition of the engine start with gear and/or PTO inserted; correspondence between tyres' size and the details on the registration certificate.

Results

Access to the driving position

The access to the driving position must be secured by means of a suitable ladder to avoid any danger of slipping and falling for the operator. The ladder must have the platforms fitted with a device to prevent foot slipping. Moreover, handles and/or handrail must be present in order to ensure always three points of contact. Finally, all parts of the means of access and their attachment points to the tractor frame must be in good condition and, in particular, must not have breaking points, permanent deformations or corrosion that may compromise their structural functionality (Fig. 2).



Figure 2. Left: access to the driving position without handle. Right: ladder platforms with evident corrosion and deformation

Commands

A command is any device enabling to change the status or the operation of the tractor or of the equipment connected to the tractor (paragraph 1.2 of Annex I to Directive 86/415/EEC). The commands of the tractor movements must be designed to automatically return to the initial position, after the release. In addition, they must be located outside the danger zone and must be preserved by the intervention of unauthorized persons. When the operator leaves his seat, he must use protective shields or key operated switches.

The controls are commonly of visual type and are designed to verify that the commands and their engagement lights (indicating that the device is operating) are reliable and that the phenomena of wear of the components do not affect the reliability of the command, mainly in order to avoid accidental grafting of those commands directly connected to the safety (eg. controlling the PTO, front or back hydraulic lift, etc.). Among the 37 inspected tractors, only one showed problems in the command/controls.

Lighting and light signalling devices

The tractor shall be fitted with the following lighting and light signalling devices:

- parking lights and rear red reflected light devices;
- white or yellow (or white and yellow) low beam light;
- blinking light indicators of direction;
- red stop lamps;
- white front and red rear outline marker lamps for tractors of exceptional dimensions;
- number plate lights;
- additional blinking devices with yellow or orange light must be available when the tractor circulates under exceptional conditions or with equipments.

In this case, the inspection regarded the presence of breaks and/or damages on the light sources, on the bright surfaces (parabolic structures, mirrors), on the supporting frames (lighthouse cans, glasses, etc.), indicators of grafting and operation, electric system (Fig. 3).



Figure 3. Example of tractor with broken lighting devices

Rear-view mirror

The inspection on the rear view mirror had exclusively visual nature and aimed at verifying their state of preservation (the mirror should not have lost its original properties of reflection, should not be dull, broken, etc.) and the correct anchoring and positioning on the tractor (the supports, the arms and the articulation system of the mirror must not be loosened) (Fig. 4).



Figure 4. Example of tractor without rear view mirror.

In the chart of Fig. 5 the following devices are considered: access to the driving position (ladder platforms, handles and/or handrails), lighting and visual signalling devices and rear view mirror. For each of them, the label report the number of tractors equipped with it on the total of 37 tractors inspected.

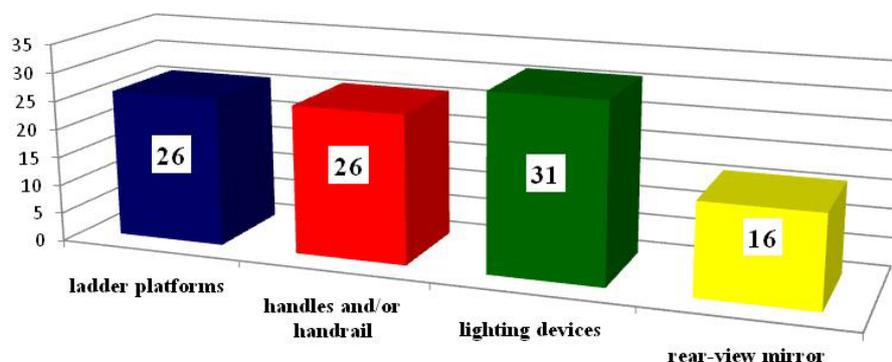


Figure 5. Results of the inspection on the 37 tractor of the devices for the access to the driving position, of lighting and light signalling devices and of rear view mirrors.

Protective device in case of overturning

All agricultural and forestry tractors, with wheels or tracks, must be equipped with a protective device in case of overturning as cab or frame (ROPS), to ensure an adequate "safety volume" surrounding the driver's seat with the aim of keeping the operator inside it during the entire phase of overturning. In this way, the risk for the operator to be crushed between the constituent parts of the tractor and the soil can reasonably be ruled out. The protective structure must always be suitably labelled. The label must be visible and report information about the compliance of the safety frame with the safety requirements.

The checks carried out on ROPS devices were exclusively of visual type. In particular, they regarded the following aspects: presence of corrosion in progress; presence of cracks detectable by visual analysis (Fig. 6).



Figure 6. Left: protective frame with evident signs of corrosion in progress. Right: four-post frame without identification label. The points of anchorage to the tractor frame are in poor condition.

In the graphs of fig. 7, the various types of protective structures (cab, frame) present on the 37 tractors are taken into consideration. Finally, in the presence of a protective structure, the presence of suitable label was examined.

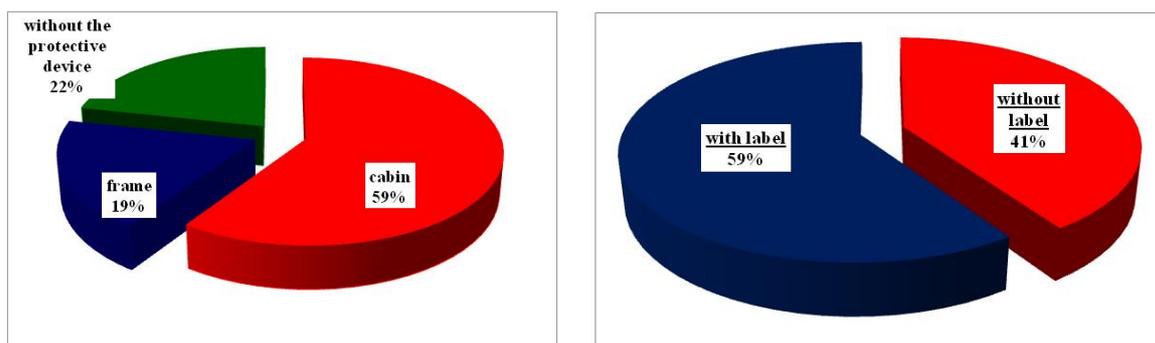


Figure 7. Left: type of protective frame against overturning on the 37 tractors. Right: presence (59%) or absence (41%) of metallic label

Driver's seat

The driver's seat is a seat available for a single person identified as the driver when driving the tractor (point 1 of Annex I to Directive 78/764/EEC). The driver's seat must be in possession of general and specific requirements identified in Chapter 1 and 2, respectively, Annex II of the said Directive (Fig. 8).



Figure 8. A seat intact, equipped with a system of retention of the driver (seat belt).

The checks on the driver's seat are aimed at ensuring over time the maintenance of technical and functional characteristics of the seat and of the seat belt. In addition, the belt must not have frayed, torn, heavily worn areas, or tampering, failures and unoriginal seams. The seat must be firmly anchored to the frame of the tractor and must be intact. It must not have any failure or breakage in its frame, padding, and in the eventually present systems for vertical and longitudinal adjustment and for shock absorption (suspensions) (Fig. 9).



Figure 9. Examples of driver's seats with damaged padding and without seat belt

In the charts of Fig. 10, the seats of the checked tractors are classified using the following evaluation criteria:

- good: no sign of failure or breakage in the structure and padding, perfectly intact;
- sufficient: some sign of weakness or failure in the structure and padding;
- poor: serious evidence of subsidence and cracks in the structure and padding.

Moreover, the presence (or absence) of seat belt has been verified.

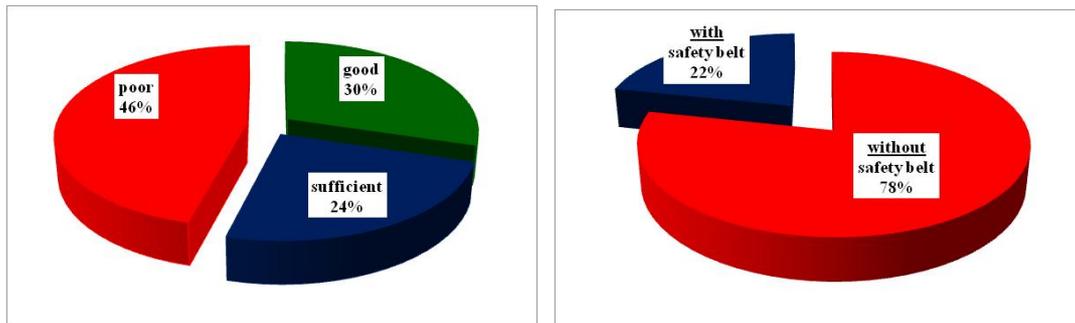


Figure 10. Left: classification of the seats of the 37 checked tractors. Right: presence (22%) or absence (78%) of seat belt.

Propulsion and support (tyres, tracks)

Visual checks on the tyres of tractors under study were intended to verify that their wear were such as to ensure the safety during tractor driving. From the point of view of safety, the wear of an agricultural tyre becomes critical when at any point of the tread, the original design (lugs) is no longer visible, with the resulting consumption of the rubber located in the bottom of the notches.

As to the tracks, the checks were focused on the structural integrity of the chain and of the shoes bolted on them.

Protection of mobile elements

The moving parts of the tractor that potentially represent a source of danger in the event of unintentional contact are (Fig. 11): the power take-off, the belts for the transmission of the motion, the fan of the cooling system, the driving shaft transmitting the motion to the front wheels.

The controls are visual and are intended to ensure that both the technical and functional characteristics of the protections originally installed by the tractor manufacturer and the protections installed later as a result of adaptation to the safety requirements set out in paragraph 6, Part I, Annex V of D. Decree 81/08, are maintained over time. The controls aim at verifying that said protections are firmly attached to the tractor and that their structural parts and points of anchorage to the tractor are in good state, not broken, without permanent deformations and corrosion that could affect the characteristics of structural resistance.

Protections of hot parts

The outer surface of some parts of the tractor can reach temperatures above 80° C, with a consequent risk of skin burns. Such parts may be external surfaces of the components of the exhaust gas system (silencer, collector) and of the engine (cylinders and heads) (Fig. 11). The inspection, only visual, aims at verifying the technical and functional characteristics of the guards installed, their correct anchorage to the tractor (screws enough tightened, anchor points intact), the good condition of all their structural parts that, in particular, must not be broken, with permanent deformations or corrosion that may compromise the structural resistance.



Figure 11. Left: transmission shank without any protective shield or shelter covering the terminal outlet of the PTO. Centre: the transmission belt of the fan and large part of the engine compartment do not have protections against accidental contacts on both sides. Right: a pipe for exhaust gas without protection against accidental contacts. It is located very close to the access to the tractor cab

The chart of Fig. 12 reports the results of the inspection on tyre wear, protection of the PTO, guards of the transmission belts, protection of the cooling fan. The numbers on the labels indicate the tractors equipped with such devices among the 37 examined tractors.

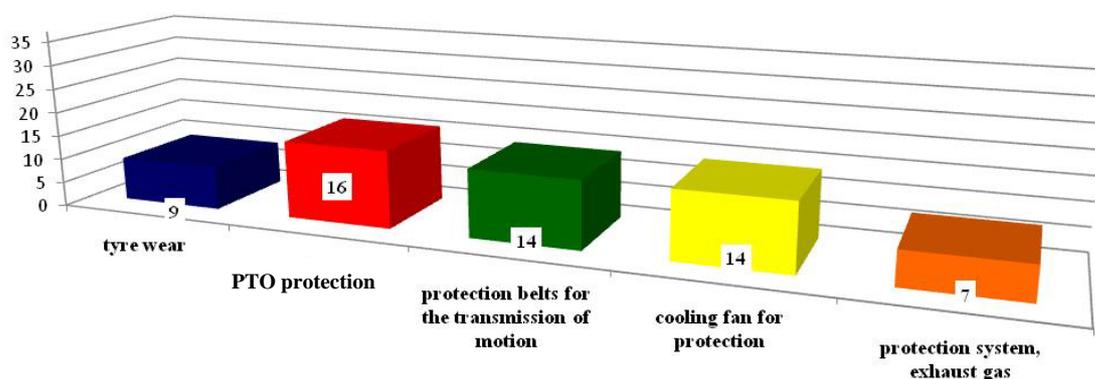


Figure 12. Results of the inspections on tyre wear (left) and on the protections of: PTO, transmission belt, cooling fan, exhaust gas system.

Conclusions

The issue of safety in the workplace strongly emerged in recent years because of the high frequency of accidents, sometimes very severe, affecting various productive sectors of our country. The agricultural sector is one of those at highest risk because of the frequent use of mechanical equipment to which severe and highly frequent accidents are connected, in addition to a series of occupational diseases that are often not recognized as such. One of the major contributors to such risks, in Italy, is represented by the composition of the machinery fleet, where the presence of machines older than 10 years is predominant. The injury statistics (INAIL), relating to agriculture, show that the tractor is mainly responsible for 10% of the accidents occurred and for 35% of fatal accidents.

As regards the mode of occurrence, although no significant statistical data are available, the greatest risk for the operator is certainly represented by the transverse and/or longitudinal

overturning of the tractor, caused by excessive slopes, overloading, excessive towing load, abrupt manoeuvres. The analysis of results shows that several of the inspected tractors have no seat belts (78%) and have rather old and worn seats (46%). In addition, 22% of them is devoid of protective device in the event of overturning (cab or frame), capable of ensuring an adequate safety volume in correspondence of the driver's seat. As the risk of overturning is intrinsic in the use of agricultural tractors, it seems appropriate that its consequences are analyzed and evaluated already in the design and construction phases and not only during the utilization, thereby protecting the product end-user.

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UNI EN ISO 4254-1 Agricultural machinery – Safety - Part 1: General requirements.