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SAFETY IN WINE CELLARS: THE SITUATION IN FRIULI-VENEZIA GIULIA, ITALY

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1. Introduction

Despite the improvements derived from the recent work-safety guidelines issued by the European Community, agriculture still remains one of the economic sectors in which accidents occur in a very high frequency level and the measuring index of the number of accidents per 1000 workers is higher than the one of any other sector [INAIL 2007] (Table 1). Our research shows also an accident frequency index between 82.0 and 394.1 in the vineyard area and between 49.1 and 99.1 in wine cellars [Gubiani 2002]. These values are higher than the ones recommended by ISPESL (Italian National Institute for Workers' Safety and Accident Prevention), which is around 20 [ISPESL 1998; ISPESL 2003]. The level of accidents is estimated through a frequency index the calculation of which is provided in Italy by the law UNI 7249 "Statistics of accidents at work", that relates the number of accidents to a million working hours.

Farming has been recognized since long time as a hazardous occupation, as many studies attest. Farmers are exposed to a variety of hazards dealing with tractors, machinery, enclosed structures. They often work long hours under severe time constraints and many of them use outdated farm equipment [De Roo 2000].

The highest number of injuries is mainly associated with the use of farm machineries, also because these are involved in most farm activities. The number of tractors in Italy has grown by 6.5 times in 40 years [Unacoma 2000] and in 2005 machinery was responsible of the 8% of all accidents and of the 32% (tab. 2) of all fatalities [Laurendi 2006].

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Another agent that causes (Table 2) a large portion of fatalities (16%), (particularly outdoors in the field, where different types of working processes are done) is represented by the workplace itself. The high number of accidents is also caused by non-classified material agents, and this remarks the low knowledge and the low control applied in this sector.

In Friuli-Venezia Giulia, wine production is particularly important, both from the economic and social point of view, but very little information is available concerning safety. Consequently, our work focuses on this specific agricultural sector. During wine production, the use of both field machinery and structures or winery implements create additional risks for workers in the vineyard and in the winery. In the winery, most of the machineries necessary for wine-making are mobile, and during vintage augers and crushers are used constantly.

In the vineyards we typically find: tractors, PTO driven pumps, pesticide units, planting machines, vine-tipper or hedging machines, harvesters, etc. In the cellars: refrigeration plant, crushers, presses, centrifuge and rotary filters, etc. Some wineries have often their own bottling line.

In addition to machinery, accidents are also associated to the working environment infrastructures and the open fields. Confined spaces are also very dangerous, because they can kill silently. They include wine storage tanks, tunnels, shafts and ducts, open topped spaces such as pits, wells, trenches and open fermentation tanks. Many victims are simply overwhelmed by the lack of oxygen or presence of high levels of toxic gases [Wine industry 1999].

The analyses of the accidents' dynamics are long and industrious and especially they are always done after the damage has occurred. In order to dispose of a quick tool, we have created a check-list, which allows us to get a detailed analysis of assessment of the risk factors on the bases of previous studies [Zappavigna 2002]. The goals of this work therefore are:

– a better understanding of the safety situation in viticulture;
– the creation of a fast and useful tool, to allow a detailed analysis of hazard factors;

Activity	2001	2002	2003	2004	2005
Agriculture	79.1	74.3	73.8	70.0	70.0
Industry	75.7	70.0	66.9	64.0	59.2
Facilities	31.6	31.7	31.1	31.5	31.5
Total amount	47.4	45.3	43.9	43.1	41.6

TABLE 1 - Total accidents per 1000 workers, from 2001 to 2005 (INAIL data, 2007).

– the set up of a method of analysis of safety levels in viticulture that can be used also by farmers.

2. Materials and methods

The research was carried out in 2004-05 and was divided into three steps.

The first step led to the creation of a check-list.

The list is organized in a frame (Figure 1): main area, sub area, topics and items. This division allows a better and deeper analysis of risk phenomena. Each item is made up of a specific question (Figure 2); the total amount of questions is 524.

The checklist analyses the whole wine-growing sector.

Within the sub-area "tractors", because of the use of a great number of very old tractors, we have decided to divide them into three different categories (or "topics"), corresponding to three different age ranges:
– class A, tractors registered before 1985;
– class B, tractors registered between 1985 and 1996;
– class C, tractors registered after 1996.

The same classification has been applied to the PTO shafts installed on the tractors.

Risk agents	accidents	% accidents	fatalities	% of fatalities
Machinery	5215	7.85	42	32.06
Distribution services	294	0.44	0	0.00
Implements	3144	4.73	1	0.76
Materials	3332	5.01	4	3.05
Workplace	14364	21.62	21	16.03
People, animals	4768	7.18	3	2.29
Tanks, vessels	681	1.02	0	0.00
Mechanical parts	1792	2.70	1	0.76
Undetermined agents	32859	49.45	59	45.04
Total amount	66449	100.00	131	100.00

TABLE 2 - Accidents and fatalities in agriculture per risk agent in 2005(INAIL data, 2007).

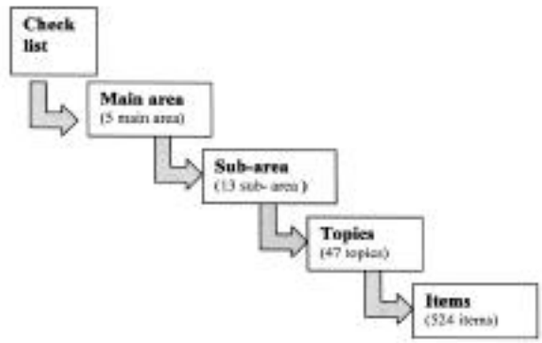

Fig. 1 - The frame of the check list.

The second step involved the creation of a score to classify different risk levels.

In order to calculate the score, every item provided only 2 possible answers: Yes or No, corresponding to 2 different points: 0 (no risk) or 1 (presence of risk). In this way we can associate an index of risk presence (0-1) to a specific danger situation of the farm.

Subsequently, this index is multiplied by a score (from 1 to 3) depending on the level of the potential damage that it can create, elaborated starting from both our own and bibliographical data:

1: low risk level (low danger level for the worker);

2: medium risk level (possible danger level for the worker);

3: high risk level (danger level for the worker).

A survey carried out in 2002 [Gubiani 2002] is where we started from: that work allowed a deeper analysis of the accident data and safety problems. From it we obtained a score calculated by multiplying the accident severity rate (that measures the number of work days lost as a consequence of an accident) and the accident frequency index (number of accidents per million working hours) of each individuated risk in the sampled wineries. Before using the check list, our co-workers have been trained about point's assignation; the time required to fill out the check list was about 3 hours.

During the third step, we surveyed the sampled wineries and we processed the collected data.

The sampled wineries were 30 in total, located in the Friuli-Venezia Giulia region. They cover all types of geographical areas (lowlands, high plain and hills),

Fig. 2 - Example of cascade in the frame of the check list.

$$\text{Main Area} = \sum^{s} sub-area / s$$

s = number sub-area

$$\text{Sub-Area} = \sum^{t} topics / t$$

t = number topics

$$\text{Topics} = \sum^{i} Items / i$$

i = number items

$$\text{Item} = \sum^{n} item / n$$

n = number samples

Fig. 3 - The equation to calculate the average for each group of check list frame.

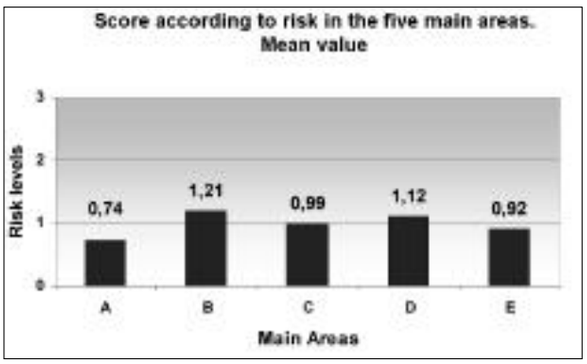

Fig. 4 - Scores according risk in the five main areas of the sampled wine cellars.
A: buildings & workplaces; B: machinery; C: logistics; D: boiler room, electricity plants, fire prevention; E: noise & vibrations.

they range in many production volumes (from 1,000 hl to 50,000 hl) and production quality levels (high or medium quality). The total area covered by these farms represents the 10% of the whole wine production area in Friuli-Venezia Giulia.

The collected data have been inserted into a Microsoft® Excel worksheet and then processed using the Cohort® ver.6 statistics software.

3. Results and discussion

The main results of this research are: the check list (a), the scoring system (b) and the analysis of the risk, from the check list data (c).

a) The check list created can become an important instrument for prevention and a useful tool to test safety levels of a working environment. The time it takes to fill it out is about 3 hours and it can be used very easily by the farmers.

b) Trough the study we also obtained a scoring system able to determine the possible risk levels. The system of attribution of the score allows a reasonably accurate evaluation and shows a good correlation with the level of risk in the wineries, but it's not always easy to attribute the check list values. In this case, it is necessary to train people to fill in the check list. The limited range of the available scoring scale (form 1 to 3) minimizes subjective decisions.

c) The risk analysis gives us a summary of the situation in wineries. This allows an overview of the main areas (Figure 4), especially over the sub area or topics (Tables 4 and 5).

The results in the main areas (Figure 4) show equality in the scores, without very critical risk levels. Only the Machinery score (area B) is a bit high but the general average doesn't enhance a safety problem.

The scores for sub-areas (Table 3) doesn't result much different from the ones of the main areas. Only the score regarding the fuel storage is very high, because old tanks are usually used for storage purposes, and retention tanks against possible leaks are missing as well as pumps required by these types of equipment.

The analysis of meaningful topics (Table 4) shows some aspects of interest because it is characterized by a greater level of detail. Regarding structure, doors have recorded a score of 1.16: this is mainly due to the lack of safety doors; stairs recorded a score of 0.92, because of the presence of inadequate hand bars.

Proceeding with the analysis, the data show a safety problem (score: 1.90) with tractors belonging to class A (Table 4). These are often not equipped with a roll-over protective structure (ROPS), disregarding the law in force. Big problems are also connected to the PTO: PTO accidents cause serious injuries: tractors classified in the class A show a medium risk level (score: 2.07, Table 4). Also PTO belonging to the class B record a high level of risk (score 2.03): dangerous rotating parts are not always covered and the integrity of shield is often missing (in addition, damaged or missing shields are often not immediately repaired or replaced); it is necessary to frequently be aware and check, to make sure that PTO shielding is in good conditions. Only the recent tractors (class C) have sufficient PTO safety. The other machines are

Sub area	Score
Access area	0.76
Buildings	0.66
Tractors	1.42
Other machines	1.25
Facilities	1.11
Workers	0.65
Electricity plant	1.08
Boiler room	0.86
Fuel storage	2.34
Fire prevention	1.02
Noise	0.93
Vibration	0.88

TABLE 3 - Score for sub-area.

Topics	Mean x score	standard deviation	Topics	Mean x score	standard deviation
Access to the farm	0.53	0.49	Trimmers	0.47	0.78
Internal road network	0.63	0.54	Grape-harvesting machines	1.59	0.95
Doors	1.16	1.17	Unloading area	2.30	0.77
Floors	0.50	0.66	External tanks	1.01	0.77
Staircases	0.92	0.92	Tanks	1.26	0.91
Ladders	0.63	0.76	Transport systems	1.05	0.78
Lighting	0.66	0.58	Grape processing area	1.22	0.83
Microclimate	0.77	0.58	Bottling	1.34	0.91
Bathrooms	0.49	0.47	Waste-disposal Area	0.67	0.64
Roofing	0.76	0.80	Toxic wastes	0.90	0.92
Tractors class A (registered before 1985)	1.90	0.43	Store room for plant protection products	0.98	0.85
PTO SHAFT in tractors class A (registered before 1985)	2.07	1.86	Workers area	0.73	0.70
TRACTORS class B (registered between 1985 and 1996)	1.03	0.98	Electrical system	1.03	0.70
PTO in tractors class B (registered between 1985 and 1996)	2.03	1.02	Water system	0.84	0.81
Tractors class C (registered after 1996)	0.43	0.78	Fuel storage	2.25	1.35
PTO in tractors class C (registered after 1996)	0.89	1.26	Fuel tank	1.49	1.13
Machines	1.95	0.76	Fire prevention	1.21	1.01
Powered cultivators	0.96	1.23	Noise	1.31	0.89
Crop sprayers	1.03	0.93	Vibrations	0.97	0.65
Workshops	1.77	0.69	Average	0.88	0.59

TABLE 4 - Average scores awarded for main topics.

Percentiles	Farms	Tractors class A (registered before 1985)	PTO SHAFT in tractors class A, (registered before 1985)	Machines	Harvesting machines	Unloading area	Fuel stock
0	0.14	0.35	0	0	0	0	0
10	0.46	1.72	0.27	1.07	0.40	0.55	0
20	0.70	1.77	0.81	1.50	0.79	2.06	0
30	0.77	1.94	2.58	2.38	1.17	2.20	0.24
40	0.91	1.97	2.67	2.38	1.70	2.75	1.74
50	1.05	2.03	2.67	2.38	2.29	2.75	2.09
60	1.14	2.03	2.67	2.38	2.29	2.75	2.43
70	1.27	2.16	2.67	2.38	2.29	2.75	2.43
80	1.36	2.16	2.67	2.38	2.29	2.75	2.43
90	1.46	2.16	2.67	2.38	2.29	2.75	2.43
100	1.74	2.16	2.67	2.38	2.29	2.75	2.43

TABLE 5 - Percentile values of main items.

not very safe and the score is 1.95. Also in this case this is due to their obsolescence and to poor maintenance. Although grape-harvesting machines are relatively new, total score is 1.59 (Table 4), because they work in a rugged environment.

People working in farm workshops are exposed to a medium risk level of injury and illness (Table 3, score: 1.77). We have noticed a range of hazards associated with tools, hand tools, air powered tools (that may cause hand or eye injuries), floors not kept clear (slipping and tripping hazards), wide steps without non-slip surface, inadequate lighting, areas not free from obstructions.

Regarding the area C (logistics), a certain level of risk has been recorded in the unloading area (Table 3, score 2.30). This area during vintage time can get extremely busy, creating significant tripping hazards. Crushers with augers are in wide use in this area; the received grape bins feeding the augers vary in size. Dangerous parts of crushers/augers are not always guarded to prevent access to the danger zones to persons who use the machineries and the auger is often not guarded with appropriate safety bar or grate to prevent people from falling into them. Moreover, often the auger doesn't present an emergency stop system.

A further medium risk area was the fuel storage (table 3, score 2.25) in main area D (boiler room, electricity plants and fire prevention systems). Sometimes, there are no fire prevention systems: smoke detectors are not installed or are not in good working order; the emergency exits, procedures and training are not adequate in the event of a fire; the appropriate fire-fighting equipment and trained personnel are not available in case of emergency. Furthermore, in this area where the exhaust oils are gathered, is often missing a system of retention in case of leaking.

At last, regarding main area E, noise presents a medium risk level (score 1.31) but higher than vibrations (score 0.97) because it is present both in cellar (bottling, centrifuge, etc.) and in field (tractors, trimmers, etc.). The vibrations are connected to some machines (trimmers, chainsaw, walking tractors) that cause a variety of significant health effects. These associated with occupational exposure to noise and vibrations, which are an integral part of many agricultural operations. Since vibrating surfaces represent one of the primary sources of noise, exposures to both types of physical stressors are commonly encountered. As a consequence, dealing with such a complex phenomenon makes access to health and safety information, medical care, and hazard control technology may be more difficult to approach and understand. As mentioned above, vibrations are often under-estimated and usually there is no effective system of protection against them. Many machines, disregarding the recent Italian Law n.187/2005 (concerning the minimum precepts for health and safety during exposure to vibrations at work) are lacking anti-vibrating systems.

The study of percentiles of some items shows (Table 5) that only 20% of farms record high risk levels, but if we analyse more in detail the situation, we can see that:

– the 90% of old tractors (class A) present high risk levels. The raising and lowering devices in the tractors are often inadequate: steps are missing non-slip surfaces and there aren't handles.
– the 70% of PTO (class A) is without shield: this represents a very dangerous situation;
– the 70% of other machines is not very safe: they are often lacking shields and suitable protections;
– the 60% of harvesting machines is lacking suitable protection for the workers;
– the 80% of the grape unloading area disregards Italian law concerning safety.

4. Conclusions

With this work we set up a method of analysis of safety levels in viticulture: this method is based on a check lists and can be also used easily by farmers for their own evaluation. The use of the check list allows finding the critical points in the winery and in the vineyard environment: this way, we can clearly individuate and elaborate a strategy to reduce or eliminate these critical points.

The elaboration of the collected data shows that highest accident rates in viticulture are caused by machinery used in the vineyard and in the wine cellars, because they are often very old and/or with poor maintenance. The case of the tractors manufactured before 1985 is typical for the understanding of a no-good management of safety issues. These old tractors are often not equipped with a roll-over protective structure (ROPS); they are often missing the seatbelt and the seat is often not suitable for vibration reduction. The lack of a cab exposes the operator, especially if no PPE (personal protective equipment) is used, to high levels of noise and to bad weather. Safety is neglected also for implement machines and in the moment of their connection to the tractors, often lack a safety lock, and the PTO protection is lacking or damaged.

Indoors, the most hazardous areas are the grape unloading area and the workshop, in which we can find a range of different hazards: it is absolutely necessary to keep floors very clean, equipping wide steps with non-slip surface, substituting inadequate lighting, keeping areas free from obstructions.

Another objective of this work and the check list is to promote culture and knowledge about safety, especially in the owners of wineries, that is one of the main goals to improve the safety at work.

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SUMMARY

The objective of the present work was to set up a method of analysis of the safety levels in the wine industry, using a check list to carry out a survey on 30 wineries located in the Friuli-Venezia Giulia region.

The checklist, based on previous studies, included more than 500 items, divided into 5 main areas: A) Buildings and workplaces; B) Machinery; C) Logistics; D) Boiler room, electricity plants and fire prevention systems; E) Noise and vibrations. The classification of each of the items was based on risk frequency and seriousness of damage. In order to obtain a value as a whole, different points were assigned to each of them. The results of this work shows that workers are exposed to a variety of hazards and one of the highest scores is connected to machinery. Some of these accidents occur because machines are used for a purpose for which they are unsuitable; others because security systems have not been provided or have been taken off. Other risk areas are the fuel tank or the exhaust oil stocking room. Indoors, the most hazardous areas are the grape unloading and the workshop one. Another result was that the older wine cellars are the most dangerous. The check list can become an important instrument for prevention and a useful tool to test safety levels of the working environment.

Keywords: checklist, safety, viticulture.