

**NIOSH**  
**Agricultural Safety and Health Centers**



**NATIONAL  
AGRICULTURAL TRACTOR SAFETY  
INITIATIVE**

JUNE 2004

*If we cannot develop a US model for a proven intervention on the single most important cause of agricultural mortality—tractor overturns—how can we succeed in addressing the less dramatic yet still important causes of agricultural diseases and injuries?*

**Dr. James Merchant**, Dean, College of Public Health, University of Iowa,  
addressing the Surgeon-General's Conference on Agricultural Safety and Health, 1991



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### **Partial list of tractor-related fatalities in 2003**

Amidst the statistics and recommendations of this initiative, let us not forget what it is all about.

Date	Location	Age/Sex	Description of incident
1/13/03	Santa Mararita, CA	75 M	Overturn on steep slope
1/15/03	Anderson, SC	61 M	Overturn into gully
1/18/03	Glengary, WV	73 M	Overturn on embankment
1/25/03	Gilman, MN	41 M	PTO entanglement
2/8/03	Eminence, MD	72 M	Overturn spreading hay
2/8/03	Twin Falls, ID	10 M	Runover after fall
2/11/03	Salem, MO	61 M	Overturn skidding logs
2/12/03	Dublin, GA	50 M	Overturn in field
2/15/03	Edison, WI	10 M	Overturn into ditch
3/5/03	Giles County, TN	68 M	Overturn on creek bank
3/9/03	Nickelsville, VA	75 M	Runover inspecting tractor
3/10/03	Rex, GA	75 M	Runover working on tractor
3/11/03	Independence, MO	60 M	Overturn pulling post
3/11/03	Pine River, MN	50 M	PTO entanglement
3/12/03	Graysville, AL	49 M	Overturn tilling
3/16/03	Calvert City, KY	39 M	Overturn pulling logs
3/24/03	Richmond, MN	75 M	Overturn in pasture
3/24/03	Oakland Twp., PA	54 M	Runover
3/26/03	Seagrove, NC	52 M	Pinned between tractor and tree
3/26/03	Polo, IA	56 M	Overturn pulling log
3/27/03	Salem, SC	56 M	Overturn clearing trees
3/28/03	Bybee, TN	77 M	Runover opening cattle gate
4/15/03	Milton, WI	66 M	Overturn on steep hill
4/20/03	Windsor, SC	3 F	Runover after fall
4/21/03	Stanley, WI	15 M	Overturn pulling stuck vehicle
5/5/03	Jay, OK	76 M	Overturn on hill
5/11/03	Wentzville, MO	49 M	Overturn pulling vehicle
5/12/03	Albertville, AL	71 M	Collision with car
5/12/03	Koshonong, MO	64 M	Overturn then fire
5/14/03	Marietta, WV	69 M	Overturn mowing grass
5/14/03	Bryant, AL	69 M	Overturn over cliff
5/15/03	Tolu, KY	60 M	Overturn in field
5/22/03	Lisbon, ND	50 M	Overturn off roadway
5/23/03	Holland, MI	73 M	Overturn towing truck
5/23/03	Jonesville, MI	13 M	PTO entanglement
5/24/03	Carrolton, KY	9 M	Overturn pulling tractor
5/26/03	Bethel Springs, TN	2 M	Runover after fall
5/26/03	Pleasant Grove, NC	55 M	Overturn pulling tree
5/27/03	Garrison, IA	51 M	Collision on farm
5/27/03	Hospers, IA	6 M	Runover
5/30/03	Wayland, MI	59 M	Runover after fall
5/31/03	El Campo, TX	75 M	Runover along creek bank
6/3/03	Decatur, TN	64 M	Overturn on steep ridge
6/4/04	Fordyce, NE	71 M	Overturn mowing roadside
6/4/03	Yabasso, MN	12 F	Overturn moving bales



## SUMMARY

This document calls for a well-coordinated, sufficiently funded, national initiative to significantly reduce agricultural tractor-related injuries and fatalities in America. The regional (National Institute for Occupational Safety and Health) agricultural centers and the NIOSH-funded National Children's Center for Rural and Agricultural Health and Safety would spearhead this campaign, directed by a lead center chosen from the existing centers.

Overturns, runovers, entanglements, and highway collisions involving agricultural tractors kill approximately 250 people a year and are by far the leading cause of death and serious injury in agriculture. Overturns consistently account for more than half this total, despite the fact that a simple solution is available and has been for years. Evidence from Europe and elsewhere shows that overturn deaths and serious injuries are virtually eliminated when rollover protective structures (ROPS) are installed on all tractors.

Countless individuals and organizations have made considerable investments over the decades to reduce tractor accidents in the US, but these efforts have largely failed to make a real dent in the number of tractor-related injuries and fatalities that plague us year after year. We believe the National Agricultural Tractor Safety Initiative can succeed beyond previous attempts because:

- All nine NIOSH regional agricultural centers and the National Children's Center will act on this initiative and enlist the wide support needed to ensure its success. Never before has such an infrastructure and level of coordination been applied to the problem.
- A well-planned and adequately funded national campaign using a broad range of media and promotional means will drive the initiative. Earlier efforts have not had such a component.
- Recent engineering advances, such as automatically deploying ROPS, put essential new tools in our hands.

These elements give us confidence that we can make a difference by acting on such key recommendations as:

- Establishing a range of incentives to retire older tractors or retrofit them with ROPS.
- Increasing the use and maintenance of preventive and protective technologies.
- Mounting a social marketing campaign aimed at safer tractor use.
- Building private and public sector (especially legislative) support for the initiative.

**Partial list of tractor-related fatalities in 2003 (continued)**

6/4/04	Luzerne, IA	74 M	Overturn clearing trees
6/5/03	Greenville, OH	7 M	Runover after fall
6/6/04	Clay, PA	55 M	Overturn down hill
6/6/03	Carreyville, KY	67 M	Overturn bailing hay
6/8/03	Florenceville, SC	43 M	Overturn into pond
6/10/03	Kinsman, OH	80 F	Runover after fall
6/10/03	Trumbull, OH	70 F	Runover after fall
6/10/03	Hopewell, NJ	75 M	Overturn pulling tree
6/11/03	Rockyridge, MD	72 M	Runover after fall
6/12/03	Galveston, TX	58 M	Overturn into pond
6/14/03	Bad Axe, MI	57 M	Overturn into tree
6/15/03	Tell City, IN	74 M	Overturn hauling hay
6/17/03	Blenheim, SC	55 M	Overturn cutting weeds
6/18/03	Clearlake, IA	69 M	Runover doing maintenance
6/18/03	Thurman, IA	14 M	Overturn pulling post
6/20/03	Lamar, MO	33 M	Runover doing maintenance
6/20/03	Norfolk, NE	74 M	Runover mowing
6/23/03	Clarence, MO	76 M	Overturn into ditch
6/23/03	Stoney Creek, TN	91 M	Overturn moving hay
6/23/03	Greer, SC	75 M	Overturn on ramp
6/28/03	Tobias, NE	56 M	Overturn into trash pit
6/29/03	Heburn, NY	68 M	Overturn then fire
6/29/03	Mckee, MY	42 M	Overturn off roadway
7/1/03	Cook, PA	68 M	Runover while moving
7/3/03	Jackson County, KY	42 M	Overturn
7/3/03	Lamesa, TX	44 M	Runover doing maintenance
7/6/04	Hutchinson, KS	69 M	Overturn into ditch
7/7/03	Cedar Rapids, IA	68 M	Collision with van
7/8/03	Ansley, NE	57 M	Overturn down bank
7/10/03	Auburn, NE	49 M	Overturn mowing
7/10/03	Edenboro, PA	62 M	Runover after fall
7/12/03	Turtle Creek Twp., OH	74 M	Overturn into pond
7/14/03	Pomeroy, OH	78 M	Overturn into ditch
7/15/03	La Casita, TX	15 M	Runover after fall
7/20/03	Sommerset County, PA	21 M	Runover raking hay
7/21/03	Corinth, MS	52 M	Collision/overturn
7/23/03	Excelsior Springs, MO	64 M	Overturn into pond
7/24/03	Glenmore, WI	76 M	Runover doing maintenance
7/25/03	Long Grove, IL	52 M	Overturn grading
7/27/03	Flinthill, VA	84 M	Overturn off rock wall
7/27/03	Barker, NY	46 M	Overturn cutting brush
7/28/03	Bataria Twp., MI	77 M	Overturn into ditch
7/29/03	Cayuga, IN	71 M	Runover mowing
7/29/03	Francisco, IN	65 M	Overturn mowing
7/30/03	Mount Ayr, IA	45 M	Overturn pushing tree
8/6/03	Galdwin, MI	34 M	Runover restarting from ground
8/6/03	Dutch Fork, SC	45 F	Fall from tractor

## INTRODUCTION

### Preventing Tractor-related Injuries and Fatalities

The tractor-related incidents addressed in this initiative—overturns, runovers, entanglements in power drivelines, and highway collisions—account for around 250 deaths annually, more than a third of the agriculture-related fatalities that occur each year in the United States. The full costs of these accidents are difficult to calculate. How do you measure the effect of losing a father, a husband, a child? What is the true cost of losing the farm, as is frequently the case after the death of or long-term injury to the owner? Certainly some of the damages can be reckoned, but others are immeasurable.

Cost benefit analyses of installing ROPS on existing tractors indicate they are comparable to other public health safety interventions considered acceptable by society. Mandatory air bags offer one recent example. Installing ROPS on all US ROPS-less tractors in use would cost \$1,000 or more per tractor for a total of about \$2.5 billion but would save 1,000 lives over the next 10 years. If the value of a life saved is approximately \$3 million, our nation could save the equivalent of \$3 billion. The estimated values are comparable to those used by the Federal Aviation Administration (\$3 million for lost life avoided in a plane crash) and the National Highway Traffic Safety Administration (\$3.4 million for each life saved from a fatal crash).

A combination of practicing basic safety and using ROPS, seat belts, machine guards, and other engineering controls would prevent most fatalities and serious injuries tractor operators suffer. Yet for a variety of reasons—custom, cost, and convenience among them—these preventive measures aren't widely adopted. It is essential to both better understand why people resist practices that literally save their lives, and then to devise the means to overcome this resistance.

#### Leading Causes of Agricultural Fatalities

1. Tractors
2. Non-tractor machines
3. Confined spaces  
(entrapment & suffocation)
4. Livestock
5. Electrocution

Source: National Safety Council



## Preventing Tractor-related Injuries and Fatalities

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To reduce tractor-related injuries significantly, a combination of interventions—from engineering to policy to education—needs to be implemented. Engineers can design changes in tractors to reduce hazards and incorporate passive injury prevention measures, as well as develop retrofit safety devices. Policies and incentives are needed to promote the use of existing tractor safety features and to address the problem of operators not using or maintaining them. Education of farm families, not just tractor operators, is needed. Social marketing can help make these tractor-related deaths and injuries no longer acceptable within the agricultural community. Our initiative calls for all these measures.

**Overturns** (also called rollovers) usually result in massive traumatic injuries to operators and, with about 130 deaths annually, account for more than half of all tractor-related fatalities. ROPS and seat belts prevent fatalities and injuries when tractors overturn, yet half of the 4.8 million tractors in the United States don't have them, although retrofitting is available for many of them. Newer, ROPS-equipped tractors can replace tractors too old for retrofitting.



**Runovers** generally cause about 60 fatalities a year and occur when operators fall from moving tractors and are crushed under the tractor or attached equipment, or operators are run over while standing on the ground and starting the tractor. If the tractor is in gear, it moves suddenly and runs over the operator.

Bystanders near tractors are run over by tractors or attached equipment when they are unseen by the operator or they slip or fall under the equipment wheels. Extra riders on moving tractors fall from and are crushed under the tractor or attached equipment. Children under 15 account for almost 90% of all such fatalities.

Tractor runovers can be prevented in a number of ways, including using ROPS and seat belts that prevent operators from falling or being ejected from the tractor, adding or leaving bypass shields on starters and keeping electrical systems in good working condition, and prohibiting extra riders. People entering areas not visible to the tractor operator or children running to the tractor to “hitch a ride” are not in the operator’s control. Certainly, children can be prohibited from these dangerous rides, but studies suggest that 80% of farm children routinely ride along on tractors with family members.





**Collisions** with motor vehicles or trains account for around 50 tractor-related fatalities annually and occur when operators move equipment on public roadways. This number does not include fatalities to occupants of other vehicles involved in the collisions. As the population shifts from urban to rural areas, traffic increases on rural roads. Crashes result when vehicles round a turn or top a hill and cannot stop in time, or when they attempt to pass slow-moving or turning equipment.

Collisions between agricultural equipment and other motor vehicles pose special problems. ROPS and seat belts on the tractors and a no-extra-rider policy protect operators and others, if they are used. Proper lighting and placement of slow-moving vehicle signs and other reflective markings and flashers increase visibility, but many operators fail to use these protective measures. Often drivers on rural roads exceed speed limits, are impatient with agricultural equipment, and are in a hurry to pass, so even the best marked equipment may be struck. Preventing collisions must involve a community-wide effort targeting motorists as well as tractor operators.



**Entanglements** in power take-off (PTO) drivelines are responsible for about 10 deaths annually. This number does not include entanglements in attached agricultural machines but only the PTO drivelines that power shafts, pulleys, belts, chains, and gears on these machines. Machine shields or guards covering these moving parts prevent entanglement, but can be damaged during agricultural work or removed for maintenance or “convenience.” Inspections reveal that the majority of operators routinely drive tractors and equipment with missing or damaged guards despite federal laws, safety messages, and educational programs.

In other industries, some educational programs have been effective in teaching workers to maintain proper machine guards, lowering both injury risk and rates. The effectiveness of similar approaches for increasing tractor safety has not been determined. Applicability of such programs to farms, ranches, and horticultural operations, where owners make their own decisions and are not subject to supervision, is problematic.

## **The Essential Intervention: Rollover Protective Structures**

Rollover protective structures, or ROPS, are protective frames securely attached to a tractor for the purpose of preventing the operator from being crushed if the tractor overturns. ROPS must meet strict engineering performance standards. They support the weight of the tractor and create a protective zone for the operator during an overturn. A seat belt is used to prevent the operator from being thrown from the protective zone. In addition, ROPS typically limit overturns to 90 degrees. Using ROPS and seat belts is estimated to be 99% effective in preventing death or serious injury in an overturn.



Enclosed cab (cab frame serves as ROPS)



Open-station four-post



Open-station two-post



Foldable or manually adjustable  
(two-post ROPS that fold or telescope for low clearance)

## **Recent ROPS Developments**

NIOSH is advancing the development and commercialization of new ROPS in several ways. In 2003, the Institute field-tested the prototype of a new ROPS designed to overcome the problems encountered in low clearance settings such as orchards, where standard ROPS can't be used. Some tractors have manually adjusted ROPS that can be raised or lowered, but operators often forget to adjust them or simply don't take the time to do so. The new system, called Auto-ROPS, has a sensor that detects when a tractor is tilting and deploys a rollover bar to a level higher than the operator's head. NIOSH and FEMCO, a ROPS manufacturer, are working on bringing the new technology to market.

NIOSH has also signed a letter of agreement with FEMCO to produce different cost-effective ROPS (CROPS) designs. The goal is to make CROPS available for the most popular tractors currently without a ROPS. The project will focus on tractor models that either don't have a retrofit ROPS available or where retrofit costs would exceed \$850. The project is studying a variety of these tractors to learn if current designs can be modified to fit them.



## Background to the Initiative

Early attempts to reduce deaths from tractor overturns in the US began in the 1930s. They resulted in the development of ROPS during the 1950s. The 1985 revision of the American Society of Agricultural Engineers (ASAE) voluntary ROPS standard, calling for all new tractors to have ROPS, was a landmark for tractor safety. Subsequently, manufacturers placed ROPS on nearly all new tractors sold in the nation. The ASAE standard is the driving force behind the increased use of ROPS, but it fails to deal with the more than two million tractors in the US without ROPS.

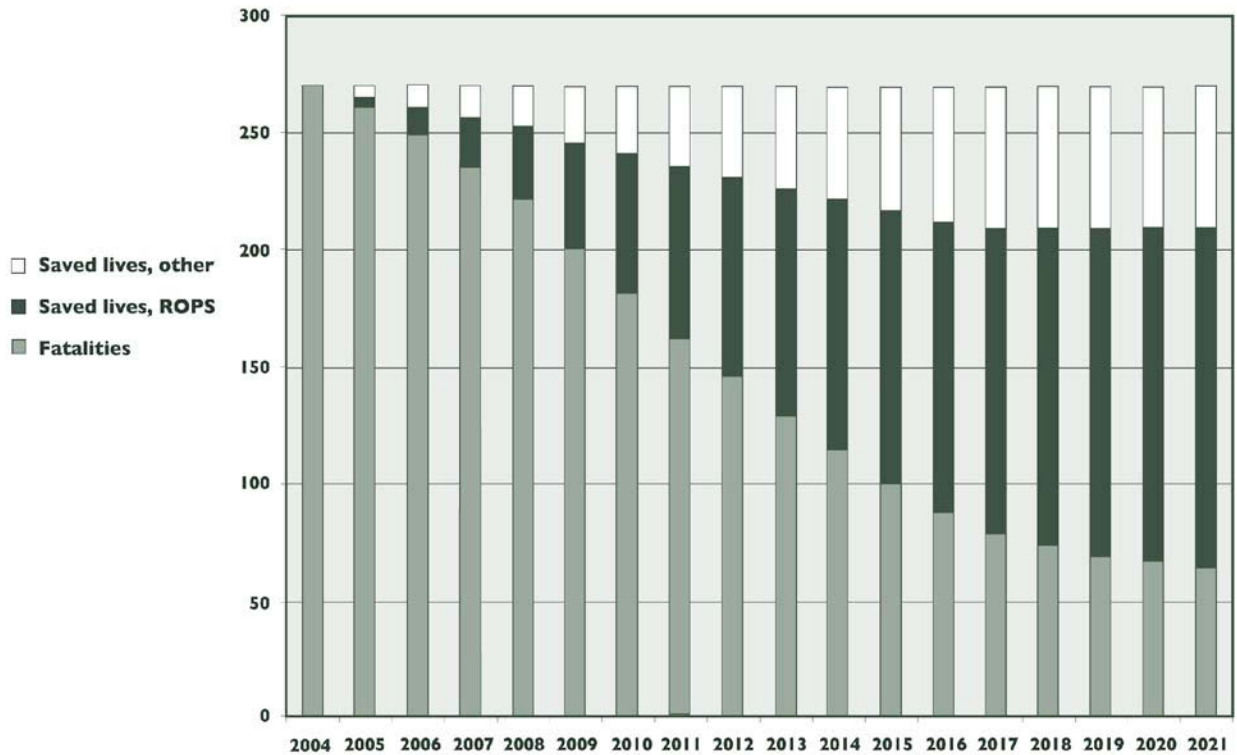
In 1988, the policy process began that led to a major conference, “Agricultural, Occupational, and Environmental Health: Policy Strategies for the Future.” The results were published in *Agriculture at Risk: A Report to the Nation*, which was followed by a year-long policy education process led by the National Coalition of Agricultural Safety and Health. One result was congressional funding for the creation of the NIOSH Agricultural Health and Safety Program launched in 1991.

Then in 1995, a national Tractor Risk Abatement and Control (TRAC) committee was formed to plan a national TRAC Policy Conference, which was held at the University of Iowa in 1997. While there had been several locally successful tractor injury intervention programs based on education and behavior change, a nationally integrated, sustained, and institutionalized program committed to reducing tractor-related injuries was lacking. The TRAC policy process attempted to remedy this deficiency.

Both *Agriculture at Risk* and the TRAC report recommended policy changes to promote tractor safety, including plans to require ROPS on all agricultural tractors and to share the cost of retrofitting or retiring tractors. Many parts of the centers’ initiative restate and update conclusions the TRAC group made in 1997. Their report presented the framework of a “progressive national plan...that will save more than 2,000 lives of farm workers and farm family members over the next 15 years.” The hope of the centers in presenting this initiative is no less ambitious. We are challenged by our national failure to reduce injury and fatality involving tractors. Our record contrasts sharply with the success achieved by other countries.

Scandinavia leads the world in tractor-related injury and fatality reduction. In 1957, Sweden passed laws requiring ROPS to be phased in over the coming decades. Between 1960 and 1990, their mortality rate decreased 56-fold. During that same period, Norway reduced their fatalities six-fold. Other European countries, Australia, New Zealand, and several Canadian provinces have also passed ROPS-related regulations and seen significant declines in death and injury rates (see Appendix B: International Tractor Safety Regulations and Standards for further discussion).

**Potential Lives Saved by ROPS and Other Means**



If ROPS requirements were phased in over the next 18 years, 2,000 lives could be saved in the United States.

*Adapted from Tractor Risk Abatement and Control: The Policy Conference*



## The NIOSH Agricultural Centers

The agricultural safety and health centers that NIOSH began establishing in 1991 now number nine and are located in every region of the nation. There is also a NIOSH-funded National Children's Center for Rural and Agricultural Health and Safety (NCCRAHS) in Wisconsin. Together, we are uniquely situated to serve as nuclei in a coordinated campaign to drive this initiative. Most centers have already undertaken tractor safety projects; all of them are poised to act individually and collectively on this initiative.

### RECENT NIOSH CENTER TRACTOR SAFETY PROJECTS

**ROPS design for older and hybrid tractors and GPS-based stability mapping**

*High Plains Intermountain Center*

**Tractor lighting and marking** to reduce road injuries

*Great Lakes Center*

**Tractor stability sensors** to provide operator hazard level feedback

*Northeast Center*

**Effect of financial incentives** on farmers' decisions to retrofit ROPS

*Northeast Center*

**Young drivers** Anthropometric research to evaluate tractor mismatches for children

*Western Center*

**Community trials and cost effectiveness analyses** of education programs to promote farmers' obtaining ROPS-equipped tractors

*Southeast Center*

**Evaluation of the impact of Wisconsin state law** on youth tractor crashes

*National Children's Center for Rural and Agricultural Health and Safety*

In addition, NIOSH research has assisted the centers in developing engineering controls to reduce injury from tractor overturns through AutoROPS, an automatically deployable ROPS for low clearance and orchard operations, and CROPS (cost-effective ROPS) for less expensive retrofits.

In 2003, the centers focused increasing attention on tractor safety. Representatives from the agricultural centers and NCCRAHS, NIOSH, and various stakeholders convened in Pittsburgh in February for a Tractor Death and Injury Prevention Workshop. Participants developed short- and long-term objectives to lower the rates of tractor-related injuries. These goals were combined and refined at an August meeting of the centers and NIOSH in Chicago and at a subsequent meeting in Saskatoon. The result is this document and our commitment to realizing its goals.

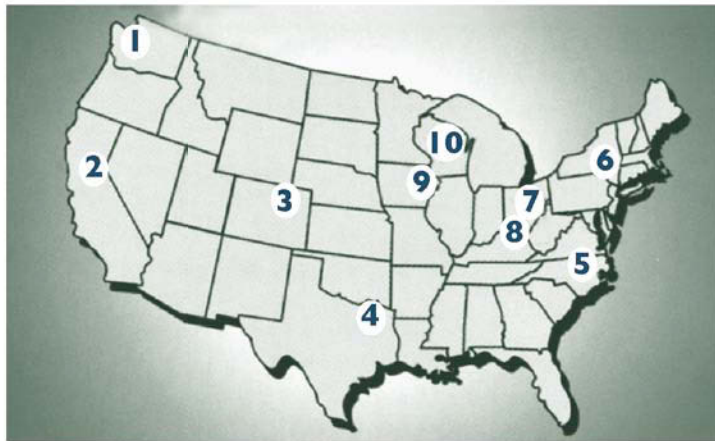
The centers believe they can help put into action a comprehensive and effective plan to surmount the tractor safety problem because the campaign will capitalize on three new and critical elements:

- All nine NIOSH agricultural centers and NCCRAHS are prepared to act on this plan and enlist the wide support needed to ensure its success. We reach into every part of the country and have an established, collegial relationship among the centers, strong advantages in coordinating the campaign. Never before has such an infrastructure and level of coordination been applied to the problem.
- A well-planned and sufficiently funded national campaign using a broad range of media drives the initiative. It will use known, effective techniques of risk communication, community-based education, and social marketing.
- Recent engineering advances, such as automatically deployable ROPS, put new tools in our hands.

The centers are ready to lead and seek the means and partners to reach out across America and coordinate the National Agricultural Tractor Safety Initiative outlined in the pages that follow.

### **NIOSH Centers Collaborating on the Initiative**

1. *Pacific Northwest*
2. *Western*
3. *High Plains Intermountain*
4. *Southwest*
5. *Southern Coastal*
6. *Northeast*
7. *Great Lakes*
8. *Southeast*
9. *Great Plains*
10. *National Children's Center*



## NATIONAL AGRICULTURAL TRACTOR SAFETY INITIATIVE GOALS AND RECOMMENDATIONS

To reduce the number of tractor-related injuries and fatalities in the US, we must:

- Improve surveillance and increase epidemiological information available regarding tractor incidents.
- Increase the number of older non-ROPS tractors retrofitted with ROPS and seat belts or replaced by ROPS-equipped tractors.
- Increase the number of tractor operators who regularly wear seat belts on ROPS-equipped tractors.
- Decrease the frequency of inappropriate extra riders on agricultural tractors.
- Increase the use of properly maintained machine guards on PTO drivelines and the equipment they power.
- Improve lighting and marking of tractors and other slow-moving agricultural machines on the road.
- Decrease the number of collisions between such machines and motor vehicles.

The NIOSH agricultural centers and NCCRAHS recommend action in four areas to achieve these goals:

### **Leadership**

Starting with the centers and NIOSH, the initiative offers a plan for organizing and directing a sustained and well-coordinated nationwide effort with NIOSH serving as the lead federal agency on reducing tractor injuries and fatalities.

### **Policy and Funding**

Our initiative recommends careful consideration of all forms of public and private policies and incentives, positive and negative, including financial and regulatory. Protecting youth and employees is a priority.

### **Partnerships and Promotion**

Promotion and marketing have too often been neglected in injury prevention efforts. We aim to prepare materials for diverse, targeted audiences using the most effective methods of public health campaigns, risk communications, and social marketing.

### **Research**

Research to reduce the risk of tractor-related injuries/fatalities should encompass policy, economics, intervention cost-effectiveness, epidemiology, behavior, and human factors, as well as engineering and technology.



**Partial list of tractor-related fatalities in 2003 (continued)**

8/9/03	Lunden, IN	73 M	Runover after fall
8/10/03	Red Oak, OK	46 M	Overturn over bluff
8/11/03	Marion, KS	97 M	Overturn into ditch
8/12/03	Reidsville, NC	85 M	Overturn off road
8/15/03	Belton, SC	59 M	Overturn pulling trailer
8/19/03	Allenhurst, GA	32 M	Overturn/drowning
8/19/03	Coleman, MI	71 M	Overturn unloading hay
8/21/03	Walter Mill, TN	50 M	Runover starting from ground
8/23/03	Nancy, KY	69 M	Overturn hauling tobacco
8/24/03	Memphis, TN	33 M	Overturn mowing grass
8/30/03	Grand Junction, MI	75 M	Overturn plowing
9/4/03	Dayton, TN	78 M	Runover doing maintenance
9/6/03	Warrenville, PA	67 M	Overturn loading bales
9/6/03	Fredericktown, OH	75 M	Overturn mowing
9/8/03	Wabash, IN	47 M	Runover mowing
9/9/03	Woodfield, OH	87 M	Runover exiting tractor
9/10/03	Meredith, NY	67 F	Runover after falling
9/11/03	Dysart, PA	69 M	Runover making repairs
9/14/03	Roland, OK	60 M	Overturn after hitting stump
9/18/03	Washington Twp., PA	63 M	Runover after fall
9/23/03	Cadiz, KY	84 M	Runover after fall
9/23/03	Ukiah, CA	40 M	Overturn on road
9/26/03	Flower Mound, TX	62 M	Runover while starting
9/26/03	Brainerd, MI	70 M	Overturn on road
9/29/03	Vienna, MO	90 M	Runover after fall
10/1/03	McKenzie, TN	21 F	Runover after fall
10/7/03	Brookfield, MO	47 M	Overturn hauling bales
10/18/03	Mt. Pleasant, NJ	34 M	Overturn on incline
10/20/03	Mt. Gilead, OH	77 M	Runover after rider fell
10/21/03	La Ray, KS	63 M	Collision with train
10/23/03	Orange, AL	59 M	Overturn pulling tree
10/25/03	Harrodsburg, KY	59 M	Overturn pulling truck
10/31/03	Washington, IN	69 M	Overturn hauling concrete
11/1/03	Richardsville, IA	69 M	Overturn on highway
11/3/03	Monroe, IN	75 M	Highway collision
11/4/03	Alliance, OH	24 M	Highway collision
11/4/03	Cogkeville, TN	31 M	Overturn clearing brush
11/8/03	Ashland, OH	57 M	Highway collision
11/10/03	Grant City, MO	53 M	Runover unhooking mower
11/15/03	Golden Gate Estates, FL	7 F	Runover
11/17/03	Riverhead, NY	64 M	Overturn on driveway
11/17/03	Hartington, NE	33 M	Highway collision
12/4/03	Papillion, NE	66 M	Overturn hauling wood
12/12/04	Murfreesboro, NC	52 M	Runover after restarting
12/21/04	Grainfield, KS	37 M	Highway collision
12/28/04	Halifax, VA	11 M	Overturn dragging logs





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### Leadership

The NIOSH agricultural centers and NCCRAHS aim to achieve significant new reductions in agricultural fatalities and injuries through a nationwide initiative coordinated by the centers. A current agricultural center will be designated as the lead center and will begin directing a two-stage process to accomplish the recommendations of the initiative.

The work of the lead and other centers will be aided by an Initiative Leadership Council and an Interested Party Network. Critical tasks for the Council include securing long-term funding for the initiative and identifying and confirming congressional champions (and supporters in other venues) to advance the initiative.

We call upon NIOSH to serve as the lead federal agency to address agricultural tractor injury prevention and to designate an internal representative to serve as liaison to other agencies and promote cooperation.

## DISCUSSION

The lead center will direct activities during the transition to (Stage 1) and implementation of (Stage 2) the initiative.

**Stage 1** – Coordinate the launch of the tractor safety initiative and promote its adoption

- Form an Initiative Leadership Council including representatives from regional centers
- Direct the distribution of the tractor safety initiative document
- Develop plans to raise awareness of the initiative in the agricultural community
- Develop plans to cultivate support of the initiative among key stakeholders
- Develop plans to secure adequate interim funding for the initiative
- Serve as primary liaison with NIOSH for the tractor safety initiative
- Develop plans to improve surveillance and epidemiological information
- Inventory current projects and activities as a foundation for development of proposals

**Stage 2** – Implement the recommendations of the national initiative to reduce tractor-related fatalities and injuries

- Develop an Interested Party Network
- Lead and coordinate a national effort in tractor safety research, education, and policy
- Identify long-term funding for the initiative

The first major tasks for the initiative leadership are to formalize the collaborative relationship of the NIOSH agricultural centers and to engage key stakeholders as partners in the initiative.

Our organizational structure includes a lead center, an Initiative Leadership Council, and an Interested Party Network. The Council will be composed primarily of directors from the NIOSH Regional Agricultural Centers and NCCRAHS. It will also include representatives from CDC/NIOSH and USDA, the two key federal agencies involved in agricultural safety, and others.

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The Leadership Council will guide implementation of the initiative's recommendations. It will also engage key stakeholders from such groups as tractor manufacturers and dealers, commodity groups, organizations representing farmers and ranchers, organizations representing hired agricultural workers, and organizations dedicated to agricultural safety. These interactions will result in the formation of an Interested Party Network that will work in partnership with the NIOSH agricultural centers to achieve the goals of the initiative.

A specific example of leadership activity will be project portfolio development. During Stage 1, the council will inventory current work and guide assembly of project proposals to fill gaps in our current understanding of tractor safety. These projects will then be forwarded to the appropriate funding agency for review. The council will focus on the integration and coordination of an open portfolio of ideas, activities, and practices. The lead center will assist projects that are successfully funded and help develop new ones.

Initiative leadership will also need to gain wide, bipartisan support by identifying and confirming champions of both parties in Congress, state legislatures, and elsewhere. This support will be essential in funding the initiative.

NIOSH should commit to serving as the lead federal agency to oversee the reduction of agricultural tractor injuries and fatalities. It should designate an internal representative to coordinate with other federal agencies. Critical recommendations of this initiative will require a high level of cooperation with agencies such as the USDA.

## RECOMMENDATIONS

Designate a lead center for the National Agricultural Tractor Safety Initiative from within the existing agricultural centers program and formalize the relationship between centers.

Create a Leadership Council for the initiative with representatives from each of the agricultural centers and NCCRAHS, CDC/NIOSH, and USDA, adding members of the Interested Party Network when it is established.

Develop an Interested Party Network of key stakeholders who will work in partnership with the agricultural centers to promote the initiative.

Identify and nurture public and private sector champions to support the initiative.

Secure bridge and long-term funding for the initiative.

Establish NIOSH as the lead federal agency for tractor safety.

Designate an internal representative at NIOSH to coordinate tractor safety efforts with other federal agencies.





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### Policy and Funding

A critical element to the success of this initiative will be developing and implementing effective incentive strategies for tractor owners to install ROPS or retire tractors. We recommend a full range of options, including federal cost-sharing programs. Agricultural cost-sharing programs have long helped to protect natural resources, and human resources deserve no less consideration.

We should study the success of tractor safety programs in other countries where a mix of incentives and regulations has significantly reduced or virtually eliminated tractor-related injuries and deaths. Our initiative endorses careful consideration of all forms of public and private policies and incentives.

Other policy recommendations include learning what state OSHA programs or their equivalent are doing about tractor safety and reviewing OSHA tractor safety enforcement activities and the appropriations rider that effectively created an enforcement exemption for farms with fewer than 11 employees.

We recommend federal funds be allocated for incentive and cost-sharing programs for tractor safety improvements or retirement of tractors that cannot be retrofitted with ROPS. To further the initiative, the centers will seek additional support from the private sector in the short term and build support for federal action, including new funding, in the future.

## DISCUSSION

Incentives are a critical factor for tractor owners when considering whether to retrofit or retire their still-useful tractors. These may include income tax credits, direct subsidies, and insurance discounts. All options should be identified and the most promising ones researched and developed.

We recommend that federal cost-sharing or other financial incentives for ROPS retrofitting and other tractor safety projects be provided along the lines of natural resource conservation programs administered by the USDA and energy tax credits. Such programs are long established, dating back to soil erosion and conservation programs of the 1930s. Ironically, improvements to protect human resources have not yet been funded.

We should consider the success of tractor safety programs in other countries for applicability to ours. A broad program of incentives and regulations, such as has been implemented in Scandinavia and most of Europe, is the only *proven* way to significantly reduce injuries and deaths from tractor accidents. In the absence of such regulations, operators often disable or bypass safety features, ignore safe work practices, or, most importantly, fail to eliminate or control hazards. Our initiative endorses careful consideration of all forms of public and private policies and incentives, positive and negative, financial and regulatory. In conjunction with a comprehensive cost-sharing plan to install ROPS on tractors without them or to retire tractors that can't be retrofitted, we recommend consideration of requiring ROPS to be installed on all agricultural tractors with a multi-step, phase-in period over several years.

In addition to new policy, it is important that enforcement and extension of current policy be studied. The US Department of Labor's enforcement of Hazardous Occupations Order for Agriculture regulations regarding farm youth safety should be evaluated to measure performance and effectiveness. These regulations specify that youth under the age of 16 cannot operate tractors or most other agricultural machinery on farms other than those operated by a parent or guardian, unless the youth are at least 14 years of age and have completed prescribed safety training. We lack information on how often these regulations are actively enforced.

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OSHA has specific regulations regarding tractors operated by employees that require annual review of safe operating practices on farms. OSHA farm inspection and enforcement activities should be reviewed to determine if they are being performed and are effective. Some 90% of US farms, however, have fewer than 11 employees, and an appropriations rider effectively constrains federal enforcement activities on these farms. The effect of this rider should be studied.

Roughly half the states have their own OSHA programs or the equivalent in place of federal OSHA. State plans are not restricted by the federal OSHA exemption/appropriations rider relating to farms with fewer than 11 full-time employees as long as no federal monies are spent regulating these smaller farms. It is important to determine what these state OSHA programs are doing in regard to tractor safety, whether their programs are successful, and whether such programs can be applied to reduce injuries and fatalities in other states. Washington state, for instance, has mandated ROPS on tractors operated by all employees on farms regardless of the number of employees. The procedures and results of this mandate should be studied.

The initiative leadership will seek short term funding from the private sector—manufacturers, insurance companies, farm organizations and commodity groups, food processors, foundations, and others—especially for outreach and promotional activities. At the same time, we will build congressional support for new funding and recommend that NIOSH, USDA, and other agencies such as the Department of Transportation earmark funds for tractor safety in future funding cycles.

## RECOMMENDATIONS

Create federal incentives for tractor safety similar to accepted, efficient, current incentive programs, such as for natural resource conservation.

Consider regulations requiring ROPS on all tractors over a multi-step, multi-year period.

Review the OSHA appropriations rider relative to farms with fewer than 11 employees.

Evaluate federal enforcement activities relative to youth tractor safety and the Hazardous Occupations Order for Agriculture.

Evaluate the success of current federal and state OSHA tractor safety programs.

Study tractor safety programs in other countries to learn how they might apply to the US.

Seek immediate funding for the initiative from the private sector.

Build support for new federal funding.

Earmark funds for tractor safety in future NIOSH, USDA, and other agency funding cycles.





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### Partnerships and Promotion

Developing partnerships and building coalitions are essential parts of preventing tractor-related injuries and deaths. Fortunately, there are recent successful models of coalition building over agricultural safety and health issues that the tractor safety initiative can emulate. A partnership development workgroup from within the centers will identify and enlist the broad matrix of stakeholders needed for this initiative to succeed.

Promotion and marketing have too often been neglected in efforts similar to ours. We aim to prepare materials for diverse, targeted audiences using the most effective methods of public health campaigns, risk communications, and social marketing.

### DISCUSSION

Over the past two decades, progress in agricultural safety and health has often depended upon joint efforts by a number of collaborating individuals and organizations. Key examples include:

- The National Coalition for Agricultural Safety and Health (NCASH) work to raise the consciousness of federal legislators
- The ASH-Net coalition, backed by the Kellogg Foundation, instituting a 15-year review of progress on the NCASH initiative
- The National Committee for Childhood Agricultural Injury Prevention forming to define the extent of child agricultural injury and to devise a national action plan for addressing this problem
- A broad project team assembling to develop the North American Guidelines for Children's Agricultural Tasks

Generally, these coalitions have focused on a specific aspect of the agricultural safety and health problem for a defined period of time. The tractor initiative fits this pattern well, as it aims to engage a broad matrix of partners in developing and implementing a national tractor injury prevention plan.

The potential purposes of such partnerships vary. One specific task should be improving access to descriptive data, proven recommendations, consensus-generated suggestions, and listings of effective resources important to a number of the functions of the initiative. This information is essential to epidemiologists and evaluators. Access to related information is useful for farmers and ranchers, their advocates and insurers. Any political initiatives will depend upon ready availability of accurate and understandable information about the magnitude of the problem and the effect of various interventions. Most partners would participate in promoting the initiative.

Effective promotion is an essential part of the overall tractor strategy and has often been the weakest or missing link in agricultural safety efforts. The educational elements of this initiative will be effective only if they are widely and successfully disseminated. The policy recommendations can succeed only if strong advocacy is accompanied by general acceptance of any proposed changes. Some of these proposals are likely to meet with opposition by some in the agricultural community, reflecting concerns about both cost and regulation. Advocacy of federal cost-sharing incentives is needed to alleviate such concerns. An effective campaign is required to convince people that ignoring these issues has led to the needless loss of thousands of lives, both adults and children, with huge associated social and financial costs. The agricultural community, of course, is the one most affected by unsafe tractors and tractor operators. Farm families have traditionally accepted tractor-related tragedies as an inevitable risk of agriculture. We recommend social marketing be used to help change these attitudes.

Precedent for this type of challenge can be seen in several of the public health successes of recent years. Community attitudes and individual behavior regarding cigarette smoking, automobile seat belts, and family violence have all changed substantially over the past two decades. Mixed results have been achieved by other efforts such as motorcycle helmet use and ATV safety. Louisiana, for instance, repealed its helmet safety laws two years ago. Since then, helmet use has declined by half and fatalities have doubled.

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We aim to make previous cultural norms regarding tractor safety unacceptable to a majority of community members. Often such changes have been accompanied by new regulations. However, it is not the regulations that have transformed the public's perception of the problems. Rather it has been a combination of compelling data, skillful framing of a message, attractive and clear advertising, and adept use of media resources that has effected change of community attitudes and behavior and led to the adoption and acceptance of regulations.

Reliable and effective promotional materials need to be developed for several different audiences. Some heightened awareness in the general public is desirable but may not be realistic considering efficacy versus cost of competing for the public's attention. Competition for interest within the agricultural community seems considerably more feasible and productive. It is important that farmers, ranchers, their families and advocates, insurers, lenders, and legislators and their aides learn about tractor injuries and fatalities. A wide range of people need to understand the magnitude of the problem, the complexity of the engineering challenges, and the difficulty of behavioral solutions.

Skills for this component of the tractor initiative are not readily available in many of the research centers. Here the assistance of Cooperative Extension Services may prove valuable, given their expertise in developing informational and promotional materials for agricultural audiences. The CDC and other agencies can advise us on the promotion of public health campaigns and social marketing techniques. The centers may also tap the resources of their own or neighboring campuses. One university might have a successful Center for Health Promotion while another might have an outstanding School of Communications that could help.

Key partners need to be drawn from both the agricultural media and the general media, including journalists identified because of a specific interest in agricultural safety and health. In addition to print media, radio can play an important role here. Resources such as the Ad Council may be tapped for its expertise in crafting public health and other campaigns. Once specific interventions have been determined, a national tractor injury prevention campaign can be mounted using a broad range of media, including the Internet.

## **RECOMMENDATIONS**

Develop a plan for building partnerships with key stakeholders.

Build regional and national partnerships to support agricultural tractor safety.

Increase and improve national access to information through these partnerships.

Translate current scientific knowledge into clear tractor safety messages.

Develop a national tractor safety campaign and create effective promotional materials for it.

Enlist experienced media partners to mount the tractor safety campaign.

Pre-test and evaluate the promotion/social marketing effort.

Promote greater cooperation between NIOSH and USDA on tractor safety.





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### Research

Research to reduce the risk of tractor-related injuries and fatalities should encompass policy, economics, intervention cost-effectiveness, epidemiology, behavior, and other human factors, as well as engineering and technology. Surveillance and epidemiology are critically needed to provide the basis for development and evaluation of interventions for all types of tractor hazards. With baseline injury/fatality rates and continued injury/fatality surveillance, specific goals can be established by which to assess progress in reducing hazards and injuries.

We recommend research on a full range of topics. Because ROPS are a proven technology, many of our proposed initial projects involve them. We also suggest researching non-ROPS options, such as vehicle out-riggers and advanced tractor seat belt design, among other engineering controls. Research on non-engineering solutions is also needed. The effectiveness of all recommended projects should be evaluated.

## DISCUSSION

Surveillance and descriptive research studies have been conducted to define the extent of injuries and fatalities and risk factors associated with tractors and other agricultural machinery. Recent agricultural injury-tracking studies provide information about risk factors and rates of tractor-related fatalities. Much less is known about rates of non-fatal injuries and close-call, non-injury events, most of which are not even reported.

Unfortunately, tractor-related injury information collected by various state and federal agencies is incomplete and uncoordinated, and comes in a variety of data coding forms, making it difficult to aggregate injury data across states and regions. At the national level, groups such as the National Safety Council (NSC) and the Bureau of Labor Statistics (BLS) collect and publish annual statistics for occupational injuries. Reported rates of agricultural fatalities by category vary substantially across these national databases. Depending on what sources are used, for instance, estimates of fatalities per year due to tractor incidents range from 250 to 375 (this document uses the lowest estimates). The need for continued surveillance studies is clear.

The initiative should facilitate partnerships to coordinate case- and rate-based injury/fatality surveillance across states, regions, and nationally. Databases for this information must be developed and made available to the researchers who design and evaluate preventive interventions. Trauma registries, death certificates, police and newspaper reports, and other sources should be systematically collected and tabulated in data files accessible to all who need them.

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Acceptance and installation of ROPS retrofits for older tractors has been poor. Some owners have even removed ROPS from their newer tractors. Understanding and overcoming barriers to adopting ROPS is essential for engineering controls to be effective. We should evaluate the effectiveness of incentives to install ROPS. Research in effective, acceptable, low-cost ROPS designs and proper ROPS-mounting techniques is also needed. Web-based ROPS designs allow fast implementation of new and innovative designs.

Non-ROPS options, such as vehicle out-riggers and auto-stability systems, also need to be explored. These designs and their effectiveness for reducing tractor overturns and operator injury should be evaluated. Development of advanced tractor operator restraints and improvements in access-egress can also play a vital role in tractor operator protection.

Intervention efforts across the spectrum of engineering/environmental, policy/regulation, and behavioral/educational approaches should be based upon the surveillance data collected. Once developed, the effectiveness of interventions for reducing injury risk and injury rates should be evaluated using epidemiological studies that compare target samples to control samples from members of the same at-risk populations.

**Note:** Other specific research projects are listed on the following page, but are not described in this section.

## RECOMMENDATIONS

Develop a comprehensive tractor-related injury surveillance system and promote standardized reporting.

Make the surveillance databases available to those with a legitimate need for them.

Assess the potential impact of regulations that restrict youth from operating tractors without ROPS/seat belts or in the absence of a valid driver's license.

Assess the impact of federal cost-sharing, tax-based incentives or other incentive programs to motivate adoption of ROPS and seat belt safety standards by agricultural owners/employers.

Assess agricultural organizations' and agricultural employers' potential resistance to federal/state regulations requiring ROPS.

Develop effective, acceptable, and low-cost ROPS and ROPS-mounting techniques for older tractors.

Research why adoption of retrofit ROPS is low and evaluate strategies to overcome barriers.

Develop and evaluate

- alternative tractor overturn prevention technologies
- safety systems for new tractor designs
- community education programs to promote tractor safety
- national education curricula addressing tractor injury prevention

Identify "full costs" of injuries/fatalities to farmers, ranchers, employers, employees, families, and communities.

Summarize workers' compensation coverage and practices for farmers and ranchers by state.

Conduct risk-benefit analyses of safety interventions and new technologies.

Develop accurate risk profiles for special populations.

Evaluate the efficacy of interventions recommended by the initiative.



## Appendix A: Selected References and Resources

### PUBLICATIONS

A Guide to Agricultural Rollover Protective Structures. A publication of the National Farm Medicine Center, Marshfield, WI.

(Available at <http://research.marshfieldclinic.org/resources/rops/default.asp>)

Agriculture at Risk: A Report to the Nation. Merchant J, Kross B, Donham K, Pratt D (eds). The National Coalition for Agricultural Safety and Health, Iowa City, IA, 1989.

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Donham K, Osterberg D, Meyers M, Lehtola C, Rautiainen R, Loveless L, Bedford L (eds). Tractor Risk Abatement and Control: The Policy Conference. Iowa's Center for Agricultural Safety and Health, and The Great Plains Center for Agricultural Health, The University of Iowa, Iowa City, IA, 1997.

(Available at <http://www.public-health.uiowa.edu/ICASH/TRACreport.pdf>)

Jenkins S, Marlenga B. Introduction to the W.K. Kellogg Agricultural Safety and Health (ASH) Initiative. *J Agromedicine* 1998; 5(2):3-7.

Lee B, Marlenga B (eds). Professional Resource Manual: North American Guidelines for Children's Agricultural Tasks. Marshfield Clinic, Marshfield, WI, 1999.

Meyers M, et al (eds). Papers and Proceedings of the Surgeon General's Conference on Agricultural Safety and Health. DHHS (NIOSH) # 92-105. National Institute for Occupational Safety and Health. Cincinnati, OH, 1992.

Myers J, Snyder K. Roll-over Protective Structures Use and the Cost of Retrofitting Tractors in the United States, 1993. *J Agr Saf Health* 1995; 1(3):185-197.

Pana-Cryan R, Myers M. Prevention Effectiveness of Rollover Protective Structures-Part III: Economic Analysis. *J Agr Saf Health* 2000; 6(1):57-70.

Reynolds S, Groves W. Effectiveness of Roll-Over Protective Structures in Reducing Farm Tractor Fatalities. *Am J Prev Med* 2000; 18(4S):63-69.

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## **WEB / VIDEOS**

Cyber-Tractor

<http://safety.coafes.umn.edu/tractor/purpose.htm>

Institute of Agricultural Rural and Environmental Health.

Tractor Rollovers and Run Overs: Can You Prevent One On Your Farm?

<http://www.iareh.usask.ca/rhep/teaching/trr.htm>

Kentucky Community Partners for Healthy Farming ROPS Project: A Program of Materials and Activities to Preserve Farmers' Health, Way of Life and Money, 2000.

<http://www.cdc.gov/nasd/docs/d000901-d001000/d000997/9.html>

National Agricultural Safety Database

<http://www.cdc.gov/nasd>

There are about 20 tractor safety videos listed in the National Agricultural Safety Database.

<http://www.cdc.gov/nasd>

For recent video clips showing Auto-ROPS in field tests, visit the NIOSH Web site at

<http://www.cdc.gov/niosh/updates/autorops.html>

High Plains Intermountain Center for Agricultural Health and Safety

Tractor Safety Research and Field Test Videos at

<http://www.hicahs.colostate.edu/research/researchframe.htm#tractorsafety>

Springfeldt B. Sweden's Thirty-year Experience with Tractor Rollovers.

<http://www.ceps.nu/rappporter/tractors.htm>

## Appendix B: International Tractor Safety Regulations and Standards

Several of the world's nations have taken determined steps to ensure the safety of tractor operators. Those most successful at protecting their workers, especially from overturns, have used a combination of regulations and incentives to encourage or require the use of ROPS.

Generally, proposed ROPS regulations have met considerable resistance from employers and agricultural groups opposed to plans requiring them to retrofit ROPS on existing tractors or mandating manufacturers to equip new tractors with ROPS. This automatic rejection of ROPS regulations appears to be softening in places, however.

In the Australian state of Victoria, for instance, the Victorian Farmers Federation passed a resolution in 1996 that called for ROPS on all tractors within two years. With this kind of cooperation, solid safety gains have been made. In 1996, approximately 24% of working tractors in Victoria lacked ROPS. By 1998 the figure had dropped to 7%, with a corresponding decline in tractor overturn fatalities.

The success of tractor safety programs in Australia seems contagious. New tractors are regulated by national standards for rollover protection, while laws pertaining to older tractors are advancing state-by-state. ROPS are now generally required on all tractors in most states and territories, although specific regulations and exceptions differ.

New South Wales recently implemented an initiative to assist farmers to install ROPS. More than 8,000 rebate applications were made and \$1.5 million distributed to farmers by the end of 2003. Again the results were quick and impressive. Between 1990 and 2000 there were 45 tractor fatalities in New South Wales, 17 from tractor overturns. Within the first year of the ROPS rebate there was a 29% drop in serious tractor-related incidents from the preceding nine-year average. The 2000-01 figure represents the lowest number of incidents in the past decade.

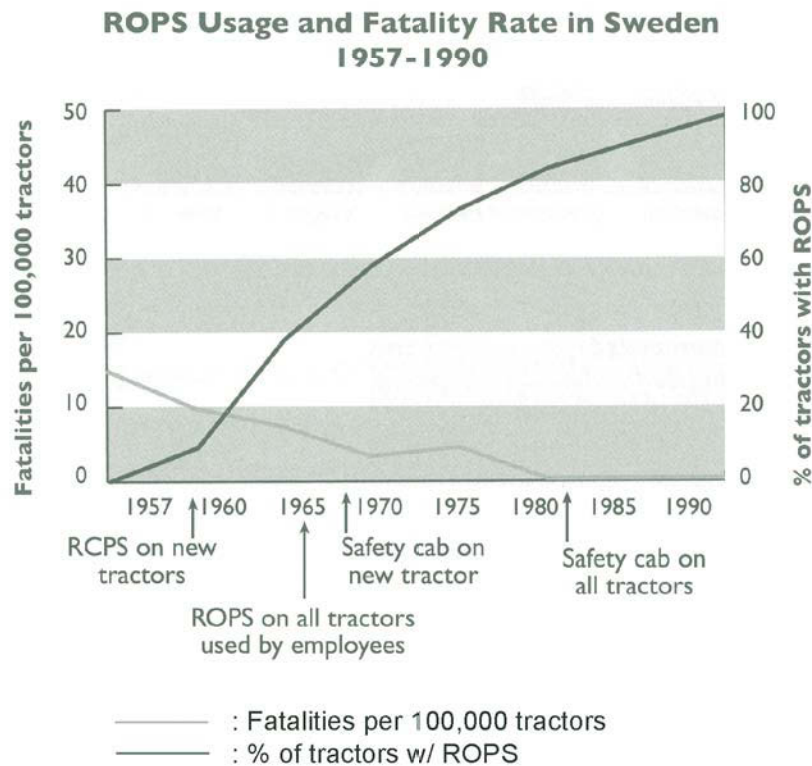
Neighboring New Zealand began developing and testing ROPS during the 1950s, and they have been required on all new tractors since 1970. While use of ROPS is not compulsory, the Health and Safety in Employment Act of 1995 establishes "approved codes of practice" and requires employers to take "all practicable steps" to control workplace hazards. The codes may be used as evidence of good practice in court. The act specifically addresses ROPS, and, in addition to the requirements it places on employers, it also establishes duties for tractor designers, manufacturers, and dealers.

Sweden was the first country to require ROPS on all new tractors, starting in 1959. Within the next decade, the rest of Scandinavia had followed Sweden's lead. The European Economic Community issued its first directives concerning agricultural tractors in 1974 and followed up three years later with additional directives concerning ROPS. By the end of the 1980s, several countries, including Switzerland, West Germany, and Spain, required ROPS for new tractors. These nations later extended ROPS rules to retrofitting older tractors.



The ability of ROPS to turn around death and injury rates is well documented. In Sweden, the number of fatalities per 100,000 tractors was reduced from approximately 17 to 0.3 between 1960 and 1990 at the same time as the number of tractors in use rose 275%. By 1990, about 98% of the tractors in Sweden were fitted with ROPS, mainly in the form of a crush-proof cab. In Norway, fatalities were reduced from about 24 to 4 per 100,000 tractors during a similar period. Similar statistics are found throughout Europe. The proportion of tractors with ROPS in countries with many old tractors and without mandates for retrofitting, however, is still low. Progress is being made, however. Turkey, for instance, hoping to join the EU, is bringing its tractors standards into accordance with European nations.

While it remains to be seen if the political will and resources are available in the US to impose regulations or offer financial incentives for retrofitting ROPS on older tractors, it's clear that many countries have achieved results we might envy and emulate.



Source: <http://turva.me.tut.fi/loagri/natu/rollo.htm>



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