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A Demonstration Project in New York and Virginia: Retrofitting Cost-Effective Roll-over Protective Structures (CROPS) on Tractors

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Abstract

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The NIOSH cost-effective roll-over protective structure (CROPS) demonstration project sought to determine whether three prototype roll-over protective structures (ROPS) designed to be retrofitted on Ford 8N, Ford 3000, Ford 4000, and Massey Ferguson 135 tractors could be installed in the field and whether they would be acceptable by the intended end users (farmers). There were a total of 50 CROPS demonstrators (25 in New York and 25 in Virginia), with 45 observers attending the New York CROPS demonstrations and 36 observers attending the Virginia CROPS demonstrations, for a total of 70 participants in New York and 61 in Virginia. The oldest retrofitted tractors were 77 to 62 years old, while the newest retrofitted tractors were 40 to 37 years old. The most frequently retrofitted tractor in the CROPS demonstration project was a Ford 3000 series tractor (n = 19; 38%), followed by Ford 4000 (n = 11; 22%), Massey Ferguson 135 (n = 11; 22%), and Ford 8N (n = 9; 18%). A major issue of CROPS retrofitting was the rear wheel fenders. The effort involved in disassembling the fenders (removing the old bolts was often faster by cutting them with a torch), modifying the fender mounting brackets, and then reinstalling the fenders with the CROPS generally required the most time. In addition, various other semi-permanent equipment attachments, such as front-end loaders, required additional time and effort to fit with the CROPS. Demonstrators were asked to rank the reasons why they had not retrofitted their tractors with ROPS until they had enrolled in the CROPS demonstration program. ROPS “cost too much” was ranked as the primary reason for participants in both states (80% for New York and 88% for Virginia). The second highest ranked reasons were “ROPS wasn’t available” for Virginia (80%) and “hassle to find ROPS” for New York (69%). The third highest ranked reasons were “not enough time to find ROPS” for New York (67%) and “hassle to find ROPS” for Virginia (79%). All demonstrators and observers indicated that they were glad to have participated in the CROPS project.

Keywords

Cost-effective roll-over protective structures (CROPS); Injury prevention; Roll-over protective structures (ROPS); Tractor safety

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U.S. agriculture has historically been in the top three industries for workplace deaths, with both a high rate and high number of fatalities according to the Bureau of Labor Statistics. The agriculture, forestry, and fishing (AgFF) industry sector has the dubious distinction of having the highest rate of work-related deaths over the past three years: 27.9 deaths per 100,000 full-time equivalents (FTE) in 2010, 24.9/100,000 FTE in 2011, and 21.2/100,000 FTE in 2012. In addition, the AgFF sector ranked third in the total number of work-related deaths: 621 occupational deaths in 2010, 566 in 2011, and 475 in 2012 (BLS, 2011, 2012, 2013a). While overall the number and rate of work-related fatalities have been showing a small general decline, the AgFF sector has been at the top for the highest rate of work-related fatalities, which is an indication of the risk of death for these workers. The subsector of production agriculture is most closely affiliated to the occupation of farming. As an occupation, farming is considered high risk, with a work-related death rate of 21.3 per 100,000 workers and 216 deaths in 2012 (BLS, 2013b).

The single largest source of fatalities in farming is associated with tractors (roll-overs, runovers, and entanglements). Tractor roll-overs are the largest category of tractor fatalities

(NIOSH, 2004, 2014a, 2014b). The risk of death due to tractor roll-overs has been found to be reduced considerably when roll-over protective structures (ROPS) are used in conjunction with seat belts (MMWR, 1993; Pana-Cryan and Myers, 2000). The agriculture manufacturing industry adopted a voluntary safety standard issued by ASAE in 1985, which required practically all new tractors sold in the U.S. to be equipped with ROPS and seat belts as standard equipment (ASABE, 2009). Generally, tractors manufactured before the mid-1960s were not designed for ROPS (Cole and Westneat, 2012). Usually, the tractors that were designed for ROPS were construction tractors due to the increasing interest in roll-over protection shown by some government contracts (Arndt, 1971; MacCollum, 1984). In 1967, the National Safety Council, Farm Division, published a "Resolution on overturn protection for farm tractor operators," the Society of Automotive Engineers (SAE) approved "Minimum performance criteria for rollover protective structures for rubber-tired, self-propelled scrapers," and ASAE published standards for "Operator protection for wheel-type agricultural tractors" and "Protective frame for agricultural tractors: Test procedures and performance requirements" (MacCollum, 1984).

Others have divided tractors into three chronological groups: pre-1969 tractors are pre-ROPS tractors, tractors made in 1970 and later were designed for ROPS (but the ROPS were sold as optional equipment), and tractors made since 1985 were designed for and sold with ROPS as standard equipment (Myers, 1998). The concern raised for the pre-ROPS tractors is that they were not designed or engineered for ROPS; thus, the axle housings (where two-post ROPS are generally attached) might not be of sufficient strength to absorb the impact or withstand the loads that could be applied in a tractor roll-over. However, research has shown that the axle housings of several of these tractor models are strong enough to support a ROPS and withstand an overturn (Li and Ayers, 1997; Ayers, 1997; Wen et al., 1994). Additionally, some of these pre-ROPS axle housings are not square, making a compression attachment of the ROPS to the axle difficult. Some promising work has been done in this area indicating that engineering plastics could be a solution, but additional research is needed (Comer et al., 2007). Two of the tractors used in the NIOSH cost-effective roll-over protective structure (CROPS) demonstration project, the Ford 8N and Massey Ferguson 135, both have round axle housings. However, where the rear fenders mount, there is a flat surface flange on both the top and bottom of the axle housing, which is part of the casting. It was at this point that the CROPS brackets were mounted.

The most recent statistics indicate that about 41% of the tractors on U.S. farms do not have ROPS (NIOSH, 2014a). Prior international work on reducing tractor fatalities due to roll-overs has indicated that a significant reduction in these deaths does not occur until 75% to 80% of the population of tractors have ROPS (Springfeldt, 1996; NIOSH, 2004; Thelin, 1998; Hard and Myers, 2011). Thus, to reduce tractor roll-over fatalities, it is imperative that tractors have ROPS, either through replacement with newer ROPS-equipped tractors or retrofitting of older tractors with ROPS.

In 1990, NIOSH initiated a comprehensive national program to prevent occupational injuries and diseases in agriculture through direction from Congress and OSHA's goal to "assure so far as possible every working man and woman in the nation safe and healthful working conditions and to preserve our human resources" (NIOSH, 1992). NIOSH undertakes

scientific efforts to enable this goal to be achieved. These research efforts are both etiologic and intervention-oriented and are carried out by NIOSH investigators through intramural efforts, by extramural research grantees, and through the extramural NIOSH regional network of Agricultural Health and Safety Research Centers (Myers, 1998). In order to address the primary work-related fatalities of farmers, research into various aspects of ROPS was conducted. These efforts ranged from gathering information on the population and models of tractors, anthropological evaluation of the farm population, cost and prevention effectiveness of ROPS, auto-deployable ROPS and cost-effective ROPS, and testing of ROPS designs (Etherton et al., 2004, 2007; Hard and Myers, 2011; Myers, 2003; Hsiao et al., 2005; Powers et al., 2000, 2001; Harris et al., 2002, 2004, 2005; McKenzie et al., 2001, 2003; Pana-Cryan and Myers, 2000, 2002; MMWR, 1993; NIOSH, 2004).

One of these efforts was the NIOSH cost-effective roll-over protective structure (CROPS) program, consisting of multiple design, testing, and demonstration projects. This program was an attempt to develop a retrofit ROPS that would be less costly to make, less costly to ship, easier to retrofit, and that could be retrofitted by one person (NIOSH, 2013). One of the criteria was that the program should address a meaningful number of the tractors that need ROPS. Designs were developed that would fit Ford 8N, Massey-Ferguson 135 (these two tractor models have similar axle housings and weight), Ford 3000 series, and Ford 4000 series tractors, for a total of three CROPS designs for three makes and four models of tractors. All CROPS were fabricated and tested in accordance with the criteria outlined in SAE Standard J2194 (SAE, 2009). The test results are available at www.cdc.gov/niosh/topics/aginjury/crops/. The following is a descriptive analysis of the activities in the CROPS demonstration project.

Aims

The purpose of the CROPS program was to determine whether the CROPS designs could be field retrofitted and whether they would be acceptable by the intended end users (farmers). A demonstration project was undertaken to accomplish this assessment.

Methods

Program Description

The NIOSH demonstration project was conducted in two states (Virginia and New York) that had ROPS retrofit programs in order to take advantage of state-level infrastructures that could recruit tractor owner/operators and that had a database of farm tractor owner/operators who had previously expressed an interest in retrofitting a tractor with a ROPS but had not yet done so. The state organization partnered with in New York was the New York Center for Agricultural Medicine and Health (NYCAMH), also known as the Northeast Center (NEC), which is affiliated with the Bassett Healthcare Network. The Virginia state partner was the Virginia Farm Bureau Safety Program.

The state partners were to identify and enroll CROPS retrofit demonstrators, schedule the retrofits, and coordinate the travel arrangements. In their initial contact with potential demonstrators, the state partners were to inform the potential demonstrators that they would

need to review and sign an informed consent form developed by NIOSH and approved by the CDC-NIOSH Human Subjects Review Board (contact numbers were provided for any questions); complete a pretest, test, and posttest regarding the CROPS retrofit demonstration program; allow press coverage; and allow access to the retrofit site by NIOSH personnel. Demonstrators were also asked to recruit three to five other participants, known as observers, to watch the demonstration.

Prior work by a NIOSH technician to mount CROPS on the axle housings of test tractors and later on an actual subject tractor resulted in an installation time of 2.5 to 3 hours. However, the technician had been involved in the development of the CROPS designs and thus was very familiar with how the CROPS were installed. In addition, the tested tractors had no fenders to be removed from the axle housings. Considering these factors, an installation time of 4 hours was suggested, with the recommendation that the demonstrator have an assistant to help install the CROPS. When possible, two CROPS retrofits were scheduled each day in the field, with generally no more than an hour drive time between them.

Demonstrators

Twenty-five farm tractor owner/operators, identified as CROPS retrofit demonstrators, were recruited by the New York partner in 2010 and by the Virginia partner in 2011 for a total of 50 demonstrators.

In return for the demonstrator's participation, NIOSH provided a CROPS (all mounting hardware and a new seat belt) to the demonstrator free of charge (an estimated $700 retail value) along with printed installation instructions. In addition, NIOSH personnel were on-site to assist with the installation and provide tools if needed. The latter was accomplished with a work trailer outfitted with hand and power tools, a generator, and an oxy-acetylene torch. Due to the importance of the tractor operator's seat for proper seat belt anchorage and operation, many demonstrators also received a new tractor seat, provided by NIOSH.

The CROPS retrofit demonstrations were conducted in New York from September 14 through October 19, 2010. In Virginia, the CROPS retrofit demonstrations were conducted from May 23 through June 23, 2011, with a final week from August 28 to September 2, 2011, to finalize the demonstrator retrofits.

Observers

The observers were other farmers, community leaders, and/or local fabricators invited to attend the CROPS retrofit demonstration by the tractor owner. The rationale was to generate interest in CROPS/ROPS among other farmers and community leaders and spark the interest of local fabricators in building CROPS. The observers were asked to provide an assessment of the value of the CROPS retrofit demonstration and whether watching the demonstration had an impact on their decision to retrofit their own tractors or changed their knowledge, attitude, or behavior toward ROPS and other selected safety behaviors. In New York, 45 observers attended the CROPS demonstrations, and 36 observers attended the Virginia CROPS demonstrations.

Results

A total of 50 CROPS demonstrators participated: 25 in New York and 25 in Virginia. Participants included 45 observers who attended the New York CROPS demonstrations and 36 observers who attended the Virginia CROPS demonstrations, for a total of 131 participants: 70 in New York and 61 in Virginia. Of the 25 New York CROPS demonstrations, 18 had observers in attendance, ranging from 1 to 5 observers. In Virginia, 12 of the 25 CROPS demonstrations had observers, ranging from 1 to 9 observers.

The retrofitted tractors in New York ranged from a 1937 Ford 8N to a 1974 Ford 4000, with a median model year of 1967 (mean = 1962). The retrofitted tractors in Virginia ranged from a 1952 Ford 8N to a 1977 Ford 4000, with a median model year of 1970 (mean = 1970). The oldest retrofitted tractors were 77 to 62 years old, while the newest tractors were 40 to 37 years old (table 1). Because the Ford 8N and Massey-Ferguson 135 have similar weight and axle housings, they used the same type of CROPS. This type of CROPS was the most frequently used (n = 20). The most frequently retrofitted tractor in the CROPS demonstration project was a Ford 3000 series (n = 19; 38%), followed by a Ford 4000 series (n = 11; 22%), Massey Ferguson 135 (n = 11; 22%), and Ford 8N (n = 9; 18%), for a total of 50 tractors retrofitted. In Virginia, 15 Ford 3000 tractors were retrofitted, compared to 4 in New York. In New York, the most frequently retrofitted tractor was the Ford 8N (n = 8), compared to one Ford 8N in Virginia.

The youngest CROPS demonstrator in New York was 26, and the oldest was 76; for observers, the age range was 21 to 76 years. In Virginia, the youngest CROPS demonstrator was 32, and the oldest was 83; for observers, the age range was 10 to 78 years.

The CROPS participants were compared to selected demographic variables from their state 2007 agriculture census as well as the 2007 national agriculture census. The New York demonstrators and observers (table 2) compared to their state and national agriculture census had the following results. The average ages of the demonstrators and observers were similar to that reported in the state's agriculture census. The observers' gender ratio was similar to the New York state agriculture census, but the demonstrators' gender ratio was not. The New York average farm size was smaller for both the demonstrators and observers compared to the state agriculture census. The number of days worked off the farm for demonstrators was similar to the state agriculture census, but the number of days worked off the farm was quite different for observers. The percentage of participants with gross farm income <$10,000 was also similar to the national agriculture census for observers but slightly more for demonstrators.

In comparing the Virginia demonstrators and observers to the Virginia state agriculture census, the following results were found (table 3). The average age of the demonstrators was similar, but observers were younger than reported in their state's agriculture census. The gender ratios of demonstrators and observers were both skewed toward males. The farm size was larger for both demonstrators and observers compared to the Virginia state agriculture census. The number of days worked off the farm for demonstrators and observers was slightly higher than the state agriculture census, while the percentage of participants with

gross farm income <$10,000 was less for demonstrators and much less for observers compared to the state agriculture census.

In comparison to farmers in the rest of the U.S., the Virginia demonstrators were older, and both New York and Virginia observers were younger. Both states were skewed toward males in the participant sample, and both states had smaller farm sizes than the average for the national agriculture census. The New York demonstrators were very similar to the average U.S. farmer for number of days worked off the farm. The New York observers had the same percentage making less than $10,000 as the national sample of farmers; the Virginia demonstrators were similar, but the Virginia observers had a smaller percentage of farmers in this income category than the national agriculture census.

The demonstrators were asked to rank the reasons (six were provided with an “other” free field category) why they had not retrofitted their tractor with a ROPS until they had enrolled in the CROPS demonstration program (table 4). If an item received a ranking of 1 to 3, it was considered “important.” ROPS “cost too much” was ranked as the primary reason for both states (80% for New York and 88% for Virginia). The second highest ranking reasons were “ROPS wasn’t available” for Virginia (80%) and “hassle to find ROPS” for New York (69%). The third highest ranking reasons were “not enough time to find ROPS” for New York (67%) and “hassle to find ROPS” for Virginia (79%).

The free field answers were highly individualistic and were not easily grouped into a category. Eight were listed for New York (7 were ranked as 1 to 3), and 5 were listed for Virginia (4 were ranked as 1 to 3).

A survey consisting of five questions was administered at the end of each CROPS demonstration to the demonstrators and observers requesting their impressions of the CROPS demonstration process (table 5). Since the participants had usually been at the site for at least 4 hours, the questions were kept short and simple in order to take as little time as possible but still elicit feedback on the retrofit process. It was considered best to administer the survey at the site since it was believed there would be less loss to follow-up and the demonstration would still be fresh in the participants’ thoughts.

The majority (76%) of the New York and Virginia demonstrators indicated that the CROPS was “easy” or “somewhat easy” to install, including the level of physical effort required. However, almost 1/4 (24%) of the demonstrators felt that physically installing the CROPS was “somewhat hard” or “hard.” The vast majority (92%) of the demonstrators thought the amount of time needed to install the CROPS was “about right,” but three (6%) thought it took “too much” time to install, and two (4%) thought it took “too little” time to install. The majority of the observers (83%) indicated it was “easy” or “somewhat easy” to install the CROPS, while 9 (13%) indicated it was “somewhat hard” or “hard.” The level of physical effort perceived by the observers was “easy” or “somewhat easy” for 59 (84%) of them, while only 11 (16%) thought it was “somewhat hard” or “hard.” For the amount of time needed to install the CROPS, 68 observers (96%) indicated it was “about right,” with 3 (4%) indicating it took “too much” time to install the CROPS. All participants (demonstrators and

observers) indicated that they were glad they participated in the CROPS demonstration project.

Discussion

As has been found in other studies, cost is a major barrier for most farmers to retrofitting their tractors with ROPS. A recent study found that the cost of ROPS has been going up, with greater increases among aftermarket suppliers, negatively impacting farmers' decisions to retrofit their tractors (Sorensen et al., 2013). Until the cost barrier can be overcome, it is doubtful that many older tractors will be retrofitted with ROPS. It is even more unlikely that these older tractors will be replaced with newer tractors that have ROPS since replacement usually costs much more than retrofitting an older tractor. In addition to economic reasons, there are sometimes sentimental and personal reasons why older tractors are not taken out of service. As found in this study, if the cost is low for farmers (the CROPS were given to the demonstrators), then retrofitting is an option. However, some studies have found that even when ROPS were free to farmers, some farmers (12% to 40%) indicated that they would not be interested in retrofitting their tractors due to other factors (Hallman, 2005; Kelsey et al., 1996; Sanderson et al., 2006).

In this demonstration project, a major issue of CROPS retrofitting was the rear wheel fenders. The fenders required time to disassemble (removing 40 to 70 year old bolts was often done faster by cutting them off with an oxy-acetylene torch), modify or retool (in some cases) the fender mounting brackets, and then reinstall with the CROPS. In addition, various other semi-permanent equipment attachments, such as front-end loaders, required additional time and effort to fit with the CROPS. There were two scheduled retrofits that could not be done: one in New York in which a tractor had a mounting bracket for a backhoe welded onto the rear of the tractor that interfered with the CROPS mounting plates, and a European model Massey Ferguson 135 in Virginia that had fender skirting built into the rear wheel fenders that interfered with the CROPS mounting. Replacement retrofit demonstrators were found as alternates for these two cases.

Tractor seats that include a seat belt need to have holes drilled and tapped for seat belt attachment. In reviewing the tractor seats available at a local tractor supply store that is part of a national chain, it was noted that their universal-fit tractor seats had these threaded holes. However, in a bulk purchase of the universal-fit tractor seats, the holes were not present, and the company could not guarantee that any future seats purchased would have the required holes. Thus, a supplier was chosen that could guarantee that the universal-fit tractor seats would have threaded seat belt attachment holes. This highlights the importance of maintaining original equipment specifications and raises concern about whether current replacement tractor seats have the attachment points needed for proper anchorage and operation of seat belts.

Historical data from Sweden have shown a clear association between the prevalence of ROPS-equipped tractors and tractor overturn fatality rates (Springfeldt et al., 1998; Thelin, 1998), with other European countries having similar experiences (Springfeldt, 1996). The effectiveness of ROPS has also been reported in the literature (Lehtola et al., 1994; Myers et

al., 2008; Reynolds and Groves, 2000). The Swedish experience indicated that as ROPS prevalence rates increased, overturn fatality rates initially declined and then stabilized for ROPS prevalence rates between 40% and 75%. Only when ROPS prevalence rates reached 75% to 80% did tractor overturn fatality rates begin to fall near zero (Springfeldt et al., 1998; Thelin, 1998). Studies have indicated that, after 2015, we may begin to reach a point where we can expect to see a notable reduction in the number of tractor roll-over fatalities (Myers and Snyder, 1995; Hard and Myers, 2011). However, even then we may continue to see high rates in regional areas and not see a general downward trend until after 2020 (Hard and Myers, 2011).

Limitations

This study relied on self-selection by farmers to participate as CROPS demonstrators and observers, and this could introduce selection bias. Many of the demonstrators had indicated interest in a ROPS for their tractors through an existing state tractor retrofit ROPS program, so they may not be representative of their state's tractor operator population and thus could be a biased sample. However, many of the participant's demographic variables were similar to both their state and national agricultural census.

Summary

For most farmers, cost is a major barrier to retrofitting their tractors with ROPS. Until this barrier can be overcome, it is doubtful that many older tractors will be retrofitted. As found in this study, if the cost is low (the CROPS were given to the demonstrators), then retrofitting the tractor is an option. However, some studies have found that even when ROPS were free to farmers, some farmers (12% to 40%) indicated that they would not be interested in retrofitting their tractor due to other factors (Hallman, 2005; Kelsey et al., 1996; Sanderson et al., 2006).

It does not appear that the problem of retrofitting older tractors with ROPS will be overcome in the near term; it will likely occur through attrition and retirement of older tractors. However, as evidenced in this study, tractors are still being used 50 to 70 years after their manufacture, so the attrition or retirement rate will likely be low. In addition to economic reasons, there are sometimes sentimental and personal reasons for why older tractors are not taken out of service.

One potential ray of hope is to have a group of cost-effective roll-over protective structures (CROPS) priced low enough to move farmers who are willing to consider retrofitting their tractors to actually complete a retrofit. As has been seen in many other public health efforts, multi-faceted approaches are more likely to succeed (Green and Kreuter, 1992, 1999). A low-cost CROPS retrofit could be a needed component in a multi-faceted approach to a dramatic reduction of deaths due to tractor overturns.

Studies have indicated that, after 2015, we may begin to reach a point where we can expect to see a notable reduction in the number of tractor roll-over fatalities. However, we may continue to see high rates in regional areas and not see a general downward trend until after 2020. CROPS have the potential to offer a low-cost method for retrofitting older tractors.

This could, either by itself or in conjunction with additional public health actions, accelerate the use of tractors with ROPS by farmers, thereby reducing the most prevalent source of occupational fatalities in agriculture.

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Table 1

Tractor demographics for demonstrator retrofits.

		New York	Virginia
Tractor model:	Ford 3000	*n* = 4	*n* = 15
	Ford 8N	*n* = 8	*n* = 1
	Massey Ferguson 135	*n* = 6	*n* = 5
	Ford 4000	*n* = 7	*n* = 4
Average tractor age by model year		1962	1970
Median tractor age by model year		1967	1970
Tractor age range		1937 Ford 8N to 1974 Ford 4000	1952 Ford 8N to 1977 Ford 4000

Table 2

New York CROPS retrofit demonstrators and observers compared to selected demographics from the 2007 state and national agriculture census.

Source	Average Age	Gender Ratio	Farm Size (acres)	Days Worked off Farm[a]	Gross Farm Income <$10,000
New York demonstrators	59.5	96% (24) male 4% (1) female	90.6	None: 30% Any: 70% >200: 40%	65%
New York observers	54.6[b]	84% (38) male 16% (7) female	107.8[c]	None: 62% Any: 38% >200: 10%	58%[d]
2007 New York agriculture census[e]	56.2	82% male 18% female	197	None: 39% Any: 61% >200: 37%	54%
2007 national agriculture census[e]	57.1	86% male 14% female	418	None: 35% Any: 65% >200: 40%	58%

[a] The “Any” category includes >200 days worked; the percentage listed is for the “Any” category.

[b] 13% (6/45) were missing.

[c] 36% (16/45) were missing.

[d] 47% (21/45) were missing.

[e] From the 2007 USDA Census of Agriculture (USDA, 2007).

Table 3

Virginia CROPS retrofit demonstrators and observers compared to selected demographics from the 2007 state and national agriculture census.

Source	Average Age	Gender Ratio	Farm Size (acres)	Days Worked off Farm[a]	Gross Farm Income <$10,000
Virginia demonstrators	64	100% (25) male	243	None: 42% Any: 58% >200: 38%	55%
Virginia observers	50[b]	94% (34) male 6% (2) female	253[c]	None: 44% Any: 56% >200: 50%	30%[d]
2007 Virginia agriculture census[e]	58.2	83% male 17% female	171	None: 35% Any: 65% >200: 41%	67%
2007 national agriculture census[e]	57.1	86% male 14% female	418	None: 35% Any: 65% >200: 40%	58%

[a] The “Any” category includes >200 days worked; the percentage listed is for the “Any” category.

[b] 6% (2/36) were missing.

[c] 14% (5/36) were missing.

[d] 25% (9/36) were missing.

[e] From the 2007 USDA Census of Agriculture (USDA, 2007).

Table 4

Demonstrator reasons for not retrofitting tractor.[a]

State	Cost Too Much	Too Much Hassle to Find ROPS	ROPS Not Available	Not that Important	Not Enough Time to Find ROPS	Dealer Not Helpful	Other
New York	12/15 (80%)	9/13 (69%)	5/9 (56%)	0/9 (0%)	10/15 (67%)	2/7 (29%)	7/8 (87%)
Virginia	15/17 (88%)	11/14 (79%)	12/15 (80%)	7/14 (50%)	4/10 (40%)	1/8 (12%)	4/5 (80%)

[a]Responses are in *x*/*y* format, where *x* is the number of respondents who ranked the question as 1, 2, or 3, and *y* is the total number of respondents for the question.

Table 5

Analysis of CROPS retrofit demonstration (NY = New York; VA = Virginia).

Question		Response			
How was the CROPS to install?		Easy	Somewhat easy	Somewhat hard	Hard
	Demonstrators	NY: *n* = 8 VA: *n* = 9	NY: *n* = 11 VA: *n* = 10	NY: *n* = 6 VA: *n* = 6	-
	Observers	NY: *n* = 15 VA: *n* = 10	NY: *n* = 21 VA: *n* = 16	NY: *n* = 6 VA: *n* = 3	-
How were the directions for installing the CROPS?		Easy	Somewhat easy	Somewhat hard	Hard
	Demonstrators	NY: *n* = 13 VA: *n* = 11	NY: *n* = 10 VA: *n* = 10	NY: *n* = 2 VA: *n* = 4	-
	Observers	NY: *n* = 19 VA: *n* = 12	NY: *n* = 17 VA: *n* = 17	NY: *n* = 5 VA: *n* = 0	-
What was the level of physical effort to install the CROPS?		Easy	Somewhat easy	Somewhat hard	Hard
	Demonstrators	NY: *n* = 6 VA: *n* = 8	NY: *n* = 13 VA: *n* = 11	NY: *n* = 6 VA: *n* = 5	NY: *n* = 0 VA: *n* = 1
	Observers	NY: *n* = 12 VA: *n* = 9	NY: *n* = 24 VA: *n* = 14	NY: *n* = 4 VA: *n* = 6	NY: *n* = 1 VA: *n* = 0
What was the amount of time needed to install the CROPS?		Too much	About right	Too little	
	Demonstrators	NY: *n* = 1 VA: *n* = 1	NY: *n* = 24 VA: *n* = 22	NY: *n* = 0 VA: *n* = 2	
	Observers	NY: *n* = 3 VA: *n* = 0	NY: *n* = 39 VA: *n* = 29	NY: *n* = 0 VA: *n* = 0	
Would you be interested in retrofitting another tractor in the future?		Yes	No	Don’t know	
	Demonstrators	NY: *n* = 22 VA: *n* = 24	NY: *n* = 2 VA: *n* = 1	NY: *n* = 1 VA: *n* = 0	
	Observers	NY: *n* = 33 VA: *n* = 27	NY: *n* = 5 VA: *n* = 1	NY: *n* = 3 VA: *n* = 0	

J Agric Saf Health. Author manuscript; available in PMC 2015 September 17.

Question		Response	
Are you glad you participated in the CROPS demonstration?		Yes	No
	Demonstrators	NY: n = 25 VA: n = 25	NY: n = 0 VA: n = 0
	Observers	NY: n = 42 VA: n = 29	NY: n = 0 VA: n = 0