Final Performance Report of the
Wisconsin Production Agriculture Intervention Evaluation

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1.0 ABSTRACT

This project evaluated the effectiveness of two production agriculture interventions intended to prevent or reduce traumatic and musculoskeletal injuries and other occupational health problems. We built on two on-going efforts:

1) an intervention in Wisconsin among 19% of the nation's 116,874 dairy operations, and
2) an intervention in Wisconsin, Michigan, Minnesota and Iowa among18% of the nation's estimated 30,000 fresh market vegetable operations

The project we report on here supported intervention years 4 and 5 of the dairy producer intervention and the associated evaluation. The project also supported intervention years 3 and 4 of the fresh market vegetable producer intervention and the associated evaluation. As described in our original application, we accomplished the following specific aims:

Specific Aim #1. Continued the two interventions for 24 additional months. The project attempted to reduce exposures to hazards (and thereby reduce injuries) by encouraging dairy producers in Wisconsin and fresh market vegetable growers in a four state region (WI, IA, MI, MN) to adopt safer and more profitable production practices. We continued two, specially-designed information dissemination efforts that conveyed information to managers via the information channels that they were already known to use to learn about new production practices (i.e. print media, public events, other farmers, university Extension, the Internet, etc.). We began continuing the interventions in the first year of this project when other funding for them ended (March 2000).

Specific Aim #2. Evaluated the effectiveness of the interventions. We continued, for two additional years, the administration of annual mail questionnaires and other evaluation procedures. The mail questionnaires were sent to separate, population-based probability samples from the dairy farmer treatment group and the fresh market vegetable treatment group. In addition, questionnaires were sent to a dairy farmer control group (Maryland dairy farmers), and a control group for the fresh market vegetable farmers (nursery managers in the same four state region). The purposes of the evaluation were to determine:

1) if our materials were reaching and being received well by the target audience,
2) if farmer adoption or awareness of each production practice or perceptions of relative safety or profit advantages were changing, and
3) if farmer-reported injuries or musculoskeletal discomfort or other outcomes associated with production practices were changing.

We also collected qualitative data from interviews with farm managers about barriers to adopting the production practices we were promoting and about how to make our intervention efforts more persuasive. We evaluated after each year of the two additional intervention years (February 2001, February 2002).

Specific Aim #3. Added new production practice innovations to each intervention. We sought out reports from farmers and others about emerging production practices that could improve both safety and profits. We undertook field studies to quantitatively evaluate the hazard-reducing and profit-enhancing aspects of the best practices. We developed materials and added a new practice to each intervention each year. This work began at the start of this project (September 1999).

2.0 SIGNIFICANT FINDINGS

The results of this work were successful and demonstrated that:

Specific Aim #1. Continued the two interventions for 24 additional months:

- new promotional materials were developed and additional resource people were enlisted and trained,
- work with pilot farms continued and pilot farms continued to provide demonstration sites to promote the intervention practices,
- we continued to provide our materials and present at public events including farmer field days, farm shows and expositions, conferences, and other meetings,
- our work with agricultural journalists was successful at resulting in dozens of articles and hundreds of column inches of coverage about the production practices and labor aids we were promoting that appeared in specialty publications intended for dairy producers and growers,

Specific Aim #2. Evaluated the effectiveness of the interventions:

- we administered mail questionnaires at the end of each intervention year to rolling, independent samples of the treatment and control groups and maintained or bettered our previous response rates from the sample subjects,
- we conducted a small qualitative study that interviewed a half dozen farm managers from each intervention treatment group to determine how the intervention materials were being received and reasons for adoption,
- our questionnaire results demonstrated that significantly more growers and dairy farmers saw, read, or heard about some of the production practices and labor aids we were promoting at public events, in production print publications, and in other venues we aided after the intervention compared to baseline, and compared to controls,
- the questionnaire results showed that dairy producer adoption increased significantly between the baseline and fifth intervention year for one production practice and that awareness was significantly increased for two practices.
- the questionnaire results showed that vegetable grower adoption did not increase over the two intervention years for any of the production practices and labor aids we promoted and that awareness increased for one.

Specific Aim #3. Added new production practice innovations to each intervention:

- we added two practices to the dairy intervention (calf grain bottles and a milking stool for stall barn operations),
- we added four practices to the fresh market vegetable intervention (a dibble drum for planting, a hands-free washer for post-harvest processing, a motorized cart for field work in the prone position, and a portable field stool for field harvest work).

3.0 USEFULNESS OF FINDINGS

The work we present in this report is innovative and advances the field for at least three reasons. First, interventions of this sort constitute efforts to translate research findings into standard practices throughout an industry. Interventions seeking to accomplish goals of this magnitude are rare in the occupational safety and health research literature.

Second, we conducted occupational safety and health interventions that were innovative in the type of information dissemination they accomplished. We attempted to convey research findings to an audience of farm managers using media, events and other sources that the farm managers were already known to rely on for information about new production practices and labor aids. This was also unusual for an injury intervention project, particularly in agriculture.

Finally, coupling safety and profit in the production practices that we promoted was innovative. Farm managers are oriented toward improving their operation's productivity and reducing costs. Safety interventions in agriculture and other industries have typically not incorporated this dual focus that emphasizes the value to an operation's bottom line of economic viability along with the health and safety protections.

4.0 SCIENTIFIC REPORT

4.1 Background

Dairy farming is associated with fatal and nonfatal traumatic injury rates that are higher than production agriculture as a whole and as much as three to six times the rates for all US private industry. Fresh market vegetable work is believed to be associated with high rates of musculoskeletal disorders. Difficulties with regulation setting, enforcement, and compliance, as well as the nature of the industry, have all been suggested to explain why dairy, fresh market vegatable, and other production agriculture injury hazards have resisted traditional prevention efforts. Individuals at greatest risk are believed to be those working on smaller dairy operations (eleven or fewer employees) that employ most of the workforce and where health protection and hazard prevention regulation have been least effective.

Previous agricultural research has shown that better information flow to farm managers can speed adoption of more profitable practices. We conducted intervention efforts that used all the information sources that dairy and fresh market farm managers had traditionally consulted to learn about new production practices. We wanted to determine whether increased information flow to farm managers could increase awareness and adoption of three practices that were more profitable and safer than traditional practices.

4.2 Specific Aims

We specified three specific aims to accomplish:

- Specific Aim #1. Continue the two interventions for 24 additional months
- Specific Aim #2. Evaluate the effectiveness of the interventions
- Specific Aim #3. Add new production method innovations to each intervention

4.3 Procedures

Our project continued on-going intervention efforts begun with other funding in the dairy and fresh market vegetable industries. Safer production method innovations that were already in use on some operations were promoted state-wide for the dairy intervention (all dairy farms in Wisconsin) and region-wide for fresh market vegetable operations (all fresh market vegetable operations in Wisconsin, Minnesota, Michigan and Iowa). The intervention disseminated information about the safer and efficient practices to farm managers though all the information sources they had traditionally turned to to learn about new production methods (trade publications and other print media, farm shows, producer meetings and other public events, university Extension agents, other farmers, the Internet, etc.). Additional detail can be found in Section 4.51.

4.4 Methodology

We evaluated the effectiveness of the interventions with annual mail questionnaires administered each winter (during the months of February through March). Questionnaires were mailed to rolling, independent samples of

the dairy and fresh market vegetable producers in the region where the interventions took place. Questionnaires were also mailed to comparison groups. Additional detail can be found in Section 4.52.

4.5 Results and Discussion:

4.51 specific aim #1. continue the two interventions for 24 additional months.

Overview of Accomplishments: Our first specific aim in this project was to continue two interventions for two additional years. The interventions were designed to persuade dairy producers in Wisconsin and vegetable growers in four states (WI, MN, MI, IA) to adopt a few especially promising (safer and more efficient) production methods. We attempted to convince more farm managers to adopt through a specially-designed information dissemination effort via the print media, public events, university Extension, the Internet, and other information channels. Previous research had established that producers and growers were already using these information channels to gather information about new production practices. We began continuing the interventions in the first year of this application when their other funding ended (Mar00). We delivered information to managers at dozens of public events each year and worked with agricultural journalists at dairy and vegetable trade publications to publish dozens of articles about the practices amounting to hundreds of column inches of coverage. We also continued to work with resource people and used other channels including the Internet to reach farm managers with information about the practices. The practices that we promoted are listed in TABLE 1.

TABLE 1. PRODUCTION METHODS AND LABOR AIDS PROMOTED EACH INTERVENTION YEAR

intervention year	production methods and labor aids promoted	total
DAIRY		
year 1 (Mar 97- Feb 98)	barn lights, bag silos, calf feed mixing site	3
year 2 (Mar 98- Feb 99)	all of above	3
year 3 (Mar 99- Feb 00)	all of above plus calf wagons, calf milk bottle holders	5
year 4 (Mar 00- Feb 01)*	all of above	5
year 5 (Mar 01- Feb 02)*	all of above plus calf grain bottles, stall barn milking stool	7
FRESH MARKET VEGETABLE:		
year 1 (Mar 98- Feb 99)	standard containers, mesh bags	2
year 2 (Mar 99- Feb 00)	all of above plus half pallet, sitting cart, packing shed	5
year 3 (Mar 00- Feb 01)*	all of above plus hands-free washer, dibble drum	7
year 4 (Mar 01- Feb 02)*	all of above plus laying prone harvest cart, portable field stool	9

* = NORA-funded years

PUBLIC EVENTS: During the two intervention years that this project supported, we distributed materials about the production practices and labor aids we were promoting at public events attended by dairy producers and vegetable growers (see TABLES 2, 4 & 6). At many of the events we delivered presentations or staffed exhibits at these events. We also encouraged dairy farmers and vegetable growers from our pilot farms to attend and present at these public events.

PRINT MEDIA: We continued to work with agricultural journalists to place articles in the specialty publications and agricultural newspapers read by dairy farmers and fresh market vegetable growers (see TABLES 3, 5 & 6). We were successful in that we assisted agricultural journalists in developing more coverage.

RESOURCE PEOPLE: We continued to maintain relationships with our pilot farms and resource people. As our project became more widely known, several people sought us out in hopes of participating. Our network of resource people included state Extension agents or specialists, USDA or university researchers, equipment dealers and suppliers, staff from producer associations, and a number of pilot farms that we enlisted who had practices in place and where managers volunteered to provide information and serve as a demonstration site for other farmers.

OTHER INFORMATION CHANNELS: We also provided extensive information about each practice through our Internet site (http://bse.wisc.edu/hfhp). Our website includes short format tip-sheets about each practice that we promoted. Some of the tip sheets were included in a NIOSH publication entitled "Simple Solutions" (NIOSH pub. no. 2001-119). This publication was awarded honorable mention in the 2002 NIOSH Alice Hamilton awards.

TABLE 2. DAIRY PUBLIC EVENTS: FIELD DAYS, FARM SHOWS, CONFERENCES, & WORKSHOPS 3/00-2/02

public event	date	attendance
Professional Dairy Producers Seminar	3/7-3/8/00	1500
Midwest Agricultural Expo, Madison WI	3/14-3/16/00	10000
Green Bay Farm Show	3/28-3/30/00	25000
Hispanic Farm Labor Workshop	4/4/00	100
Dairy Technology Update, Marshfield WI	6/22/00	40 ext
4 State Professional Dairy Management Seminar, Dubuque IA	7/11-7/12/00	60
WI Farm Progress Days, Fond Du Lac, WI	7/11-7/13/00	100
Calf Management Workshop, Sheboygan WI & Outagamie WI	9/14 & 9/19/00	90
Cow Comfort Conference, Appleton WI	9/14-9/15/00	150
World Dairy Exposition, Madison WI	10/4-10/8/00	15,000
Milking Systems Update for Professionals	11/2/00	55 inst
Women's Dairy Forum, Loyal WI	12/13/00	45
Dairy Operators Seminar, Appleton WI	1/10/01	150
Custom Heifer Raisers' Seminar, Apple Creek & Fond Du Lac WI	2/22 & 2/23/01	90
Custom Field Crop Operators Seminar	2/27/01	55
total dairy intervention yr. 4 (Mar00-Feb01)*	16 public events	over 50,000 farmers
Wisc. Farm Progress Days, Rock County	9/18-20/01	30,000
Calf Management Seminar, Kaukauna	9/26/01	40
World Dairy Expo, Madison	10/03-07/01	35,000
UW Extension ANR annual meeting, Wisconsin Dells	10/16-18	100
Midwest Herd Health Symposium, Eau Claire	11/13-15/01	120
4th Annual UW Arlington Dairy Day, Arlington	12/12/01	80
UW Extension, NW Staff in-service, Chippewa Falls	1/15/02	15
Dairy Herd Operators Seminar, Kimberly	1/17/02	90
WI Forage Council Annual Meeting & Seminar, Appleton	1/22-23	125
Dairy Nutrition Seminar, Manitowoc	2/07/02	30
Custom Heifer Raisers Seminar, Kaukauna/Fond du Lac	2/27-28	150
total dairy intervention yr. 5 (Mar01-Feb02)*	11 public events	over 50,000 farmers

* = NORA-funded years

TABLE 3. VEGETABLE PUBLIC EVENTS: FIELD DAYS, CONFERENCES, & WORKSHOPS 3/00-2/02

public event	date	attendance
Upper Midwest Organic Farming Conference, La Crosse, WI	3/15-3/17/00	>300
WI Farm Progress Days, Fond Du Lac, WI	7/11-7/13/00	100
Small Income Options Conference, Baraboo, WI	11/10-11/11/00	30
IL-IA Fruit and Veg. Growers Conference, Moline, IL	12/5/00	50
MI State Horticultural Society Annual Meeting., Grand Rapids, MI	12/5-12/7/00	300
WI School for Beginning Market Gardeners, UW-Madison, WI	1/11-1/13/01	30
Practical Farmers of Iowa Annual Meeting., Ames, IA	1/12-1/13/01	75
Upper Midwest Regional Fruit and Veg. Growers Conference, St. Cloud, MN	2/1-2/2/01	200
IL-WI Stateline Fruit and Vegetable Conference, Woodstock, IL	2/2/01	35
Value Added Conference, Eau Claire, WI	2/9/-2/10/01	40
WI Fresh Fruit and Veg. Conference, Oconomowoc, WI	2/18/-2/20/01	100
IA Fruit and Vegetable Growers Assoc. Meeting., Des Moines, IA	2/22-2/24/01	100
total fresh market vegetable intervention yr 3 (Mar00-Feb01)*	12 public events	1,360 farmers
WI Fresh Market Veg. Growers Assoc. Field Day, JenEhr Farm, Sun Prairie, WI	5/1/01	100
Practical Farmers of Iowa Field Day, Tedesco Berry Farm, central IA	7/14/01	20
Practical Farmers of Iowa Field Day, Brunk Farm, central IA	8/15/01	20
Practical Farmers of Iowa Field Day, Libbey-Landgraf Farm, central IA	9/15/01	20
WI Farm Progress Days Rock County, WI	9/18-20/01	~50
WI Fresh Market Veg. Growers Assoc. Field Day, WI Territories Farm, Rosholt, WI	11/1/01	77
Small Farm Income Options Conference, Baraboo, WI	11/9-10/01	100
Great Lakes Fruit and Veg Expo, Grand Rapids, MI	12/4-12/6/01	100
Acres, USA Conference, Minneapolis, MN	12/7-12/9/01	50
WI FVGA Conference, Green Bay, WI	1/6-1/8 '02	100
Michael Fields Ag Inst. Advanced Organic Vegetable Production Workshop for Small and Large-scale producers, Davenport, IA	1/10-1/12/02	50
Practical Farmers of Iowa Meeting, Ames, IA	1/12-13/02	20
FarmDirect Conference, Waukesha, WI	1/19/02	10
IL Specialty Crop Conf., Champaign, IL (growers from WI and IA attend)	1/17-1/19/02 (?)	50
WI School for beginning market gardeners	1/24-1/2602	20
Iowa Fruit and Vegetable Growers Association Conference, Marshall Town, IA	1/24/02-1/25/02	50
4th Annual Midwest Value Added Conference: Eau Claire, WI	2/2/02-2/3/02	30
Upper Midwest Regional F&VG St. Cloud, MN	1/31-2/2/02	130
IL-WI Stateline F&VG Conference, Charles, IL	2/4/02	75
MN Organic Conference, St. Cloud, MN	2/7-2/8/02	25
Michael Fields Ag. Inst. Advanced Organic Veg., Orriville, OH (+ MI, WI)	2/13/02-2/14/02	20
Central MN Sustainable Farming Wkshp, MN	2/17/02	30
Upper Midwest Organic Farming Conference, LaCrosse, WI	2/28-3/2/02	700
MI Organic Conference, E. Lansing, MI	3/3-4/02	80
Fresh Market IPM workshop re Food Quality Protection Act, Waukesha WI	3/18/02	35
Fresh Market IPM workshops re Food Quality Protection Act, Eau Claire, WI	4/8/02	35
total fresh market vegetable intervention yr 4 (Mar001-Feb02)*	26 public events	1997 farmers

* = NORA-funded years.

TABLE 4. DAIRY ARTICLES IN TRADE PUBLICATIONS ABOUT PRODUCTION PRACTICES

publication (number of WI subscribers)	date	column inches
long day lighting:		
Wisconsin State Farmer	12/20/96	15
Wisconsin State Farmer	1/24/97	15
total: 1 year prior to intervention (Mar96-Feb97)		**30**
The Country Today	4/16/97	1
The Country Today (2)	7/23/97	50
Dairy Herd Management (18,000)	10/1/97	31

The Country Today	10/1/97	7
Hoard's Dairyman	10/25/97	25
Agri-View	10/30/97	40
The Country Today (2)	1/14/98	68
total: intervention year 1 (Mar97-Feb98)		**222**
Agri-View	3/26/98	19
Wisconsin State Farmer	4/10/98	24
Dairy Herd Management	5/1/98	4
The Country Today	6/10/98	17
Hoard's Dairyman	10/10/98	29
Wisconsin State Farmer	12/11/98	10
Agri-View	12/17/98	29
Wisconsin State Farmer	1/15/99	16
Wisconsin State Farmer	1/22/99	16
total: intervention year 2 (Mar98-Feb99)		**164**
Dairy Herd Management (2)	10/1/99	98
Agri-View	1/27/00	59
Wisconsin State Farmer	1/28/00	15
Wisconsin State Farmer	2/18/00	6
total: intervention year 3 (Mar99-Feb00)		**180**
Dairy Herd Management	9/1/00	93
Dairy Today	10/1/00	41
total: intervention year 4 (Mar00-Feb01)*		**134**
Agri-View "Dairy Research Sheds Light on Production ..."	3/22/01	11.45
Agri-View "Light Shed on Managing 'Photoperiod'"	7/19/01	48.6
The Country Today "Supplemental lighting may boost profits"	8/15/01	20.475
Hoard's Dairyman "Deflector aims light on cows for long-day"	November-2001	6
The Country Today "Arlington Dairy Day offers latest in res..."	11/7/01	2.19
Wisconsin State Farmer "Long-day lighting barn meetings set"	11/30/01	7
Agri-View "Long-Day Lighting Fools Mother Nature"	12/13/01	31.5
Wisconsin State Farmer "Long day lighting can help increase"	12/14/01	15.25
Dairy Herd Management "Light guide available"	1/11/02	2.25
The Country Today "Cows and light manipulation"	1/16/02	8.75
total: intervention year 5 (Mar01-Feb02)*		**153.5**
silage bags:		
Wisconsin State Farmer	1/24/97	2
total: 1 year prior to intervention		**2**
The Country Today	4/16/97	2
The Country Today	7/9/97	22
Dairy Today	9/1/97	26
Dairy Herd Management	2/1/98	51
total: intervention year 1 (Mar97-Feb98)		**101**
Wisconsin Agriculturalist (20,000)	4/1/98	23
total: intervention year 2 (Mar98-Feb99)		**23**
Dairy Herd Management	3/1/99	72
Dairy Herd Management	6/1/99	73
The Country Today	2/9/00	41
total: intervention year 3 (Mar99-Feb00)		**186**
Hay & Forage Grower	5/1/00	34
total: intervention year 4 (Mar00-Feb01)*		**34**
Midwest Dairy Business "Bagged feeds as a storage option"	April-2001	10.5
Agri-View "Monitoring Silo Bags Is Key"	7/13/01	39.75
Agri-View "All Silo Storages Have Hazards"	9/13/01	23.65
Agri-View "Canadian company Recycles Silage Bags, Bales..."	12/6/01	32.7
Agri-View "Silos, Bunkers, Bags, Piles Compared"	1/3/02	21.9
The Country Today "UW study looks at forage storage system"	2/26/02	14
The Country Today "Silage bags are an idea worth considering"	2/26/02	8.73
total: intervention year 5 (Mar01-Feb02)*		**151**
calf care labor aids:		
Agri-View	8/7/97	17
Dairy Herd Management	10/1/97	16

total: intervention year 1 (Mar97-Feb98)		**33**
Hoard's Dairyman	1/10/98	7
total: intervention year 2 (Mar98-Feb99)		**7**
Dairy Herd Management	12/1/00	9
total: intervention year 3 (Mar99-Feb00)		**9**
Agri-View	1/25/01	36
total: intervention year 4(Mar00-Feb01)*		**36**
total: intervention year 5 (Mar01-Feb02)*		**0**

TABLE 5. VEGETABLE ARTICLES IN TRADE PUBLICATIONS ABOUT PRACTICES

Publication (no. of subscribers) & "Title"	date	column inches
Mesh bags:		
Great Lakes Vegetable Growers News (13,000) "Wi. Researchers study"	10/1/98	15
Johnny's Selected Seeds JSS Advantage (20,000) "Batch processing"	10/1/98	11.5
Growing forMarket (4,000) "Line harvest containers"	12/1/98	40
Total for mesh bags yr 1 (Mar98-Feb99)		**66.5**
WI Fresh Market Veg Grower Newsletter (200) "Mesh produce bags"	4/1/99	20
American Vegetable Grower (25,000) "Do it the easy way"	11/1/99	14
American Small Farm (7,000) "Work efficiency tips"	1/1/00	10
The Country Today (00,000) "Tips can help"	2/2/00	3
Total for mesh bags yr 2 (Mar99-Feb 00)		**47**
HortIdeas (900) "Healthy Farmers, Healthy Profits"	7/1/00	14
Organic Broadcaster (00,000) "Improve the 'shelf life'	7/1/00	9
Total for mesh bags yr 3 (Mar 00-Feb 01)*		**23**
Small Farm Today (00,000) "Labor Efficiency for..."	11/1/01	20
Total for mesh bags yr 4 (Mar 01-Feb 02)*		**2**
Standard containers:		
Growing for Market (4,000) "Right Harvest Containers"	1/1/98	37
Total for standard containers yr 1 (Mar98-Feb 99)		**37**
WI Fresh Market Veg. Grower Newsletter (200) "Standard Containers"	4/1/99	24
American Vegetable Grower (25,000) "Do it the easy way"	11/1/99	7
American Small Farm (7,000) "Work Efficiency Tips"	1/1/00	15.5
The Country Today (00,000) "Tips can help"	2/2/00	3
Total for standard containers yr 2 (Mar99-Feb00)		**49.5**
HortIdeas (900) "Healthy Farmers, Healthy Profits"	7/1/00	5
Organic Broadcaster (00,000) "Produce handling tips"	11/1/00	17
The Vegetable Growers News (13,000) "Standard Vegetable Containers"	12/1/00	30
Total for standard containers yr 3 (Mar 00-Feb 01) *		**47.5**
"Small Farm Today (00,000) "Labor Efficiency for..."		20.5
Total for standard containers yr 4 (Mar 01-Feb 02) *		**20.5**
Packing area:		
Growing for Market (4000) "Winter Work"	11/1/98	8.5
Total for packing area yr 1 (Mar98-Feb99)		**8.5**
WI Fresh Market Veg. Grower Newsletter (200) "Packing Shed Layout"	4/1/99	25.5
Vegetable Growers News (15,000) "Unorganized packing shed"	4/1/99	28.5
American Vegetable Grower (25,000) "Do it the easy way"	11/1/99	14.25
American Small Farm (7,000) "Work Efficiency Tips"	1/1/00	6.5
The Country Today (00,000) "Tips can help"	2/2/00	3
Total for packing area yr 2 (Mar99-Feb00)		**77.75**
HortIdeas (900) "Healthy Farmers, Healthy Profits"	7/1/00	.5
Organic Broadcaster (00,000) "Produce handling tips"	11/1/00	21
The Community Farm (00,000) "Packing Area Design"	12/1/00	16.25
Total for packing area yr 3 (Mar 00-Feb 01) *		**37.75**
Wisconsin State Farmer (00,000) "Grant program to help..."	6/15/01	1
Total for packing area yr 4 (Mar 01-Feb 02) *		**1**
Narrow pallet system:		

Great Lakes Vegetable Growers News (13,000) "Wisconsin researchers study"	10/1/98	15
Vegetable Growers News (13,000) "Narrow pallet system"	1/1/99	38
Total for narrow pallet system yr 1(Mar98-Feb 99)		**53**
WI Fresh Market Veg. Grower Newsletter (200) "Narrow pallet system"	4/1/99	28.5
American Vegetable Grower (25,000) "Do it the easy way"	11/1/99	10.5
The Country Today (00,000) "Tips can help"	2/2/00	3
Total for narrow pallet system yr 2 (Mar 99-Feb 00)		**42**
HortIdeas (900) "Healthy Farmers, Healthy Profits"	7/1/00	.5
Growing for Market (4,000) "Hand pallet trucks"	11/1/00	14.5
Organic Broadcaster (00,000) "Produce handling tips"	11/1/00	24
Total for narrow pallet system yr 3 (Mar 00-Feb 01) *		**39**
Small Farm Today (00,000) "Labor Efficiency for..."	11/1/01	27
Total for narrow pallet system yr 4 (Mar 01-Feb 02) *		**27**
Sit down non-motorized cart:		
Growing for Market (4,000) "Help for aching knees"	5/1/99	5.5
American Vegetable Grower (25,000) "Do it the easy way"	11/1/99	5
Johnny's Selected Seeds Advantage (00,000) "Sitting down on the job"	1/1/00	24
Growing for Market (4,000) "Specialized tools make work easier"	2/1/00	9.5
The Country Today (00,000) "Tips can help"	2/2/00	2
Total for seated cart yr 2 (Mar 99-Feb 00)		**46**
Pennsylvania Vegetable Grower News (00,000) "Harvest-Aid Cart"	5/1/00	18.5
American Small Farm (7,000) "Work Efficiency Tips"	7/1/00	28
HortIdeas(900) "Healthy Farmers, Healthy Profits"	7/1/00	.5
WI State Farmer (00,000)	9/1/00	
Organic Broadcaster (00,000) "Harvest Cart for Greens"	9/1/00	18.5
Small Farm Today (00,000) "Specialized harvest cart"	11/1/00	30.5
Vegetable Growers News (00,000) "Non-Motorized Field Carts"	2/1/01	16
Total for seated cart yr 3 (Mar 00-Feb 01) *		**96**
The Country Today (00,000) "Cart-building course..."	3/28/01	24
Wisconsin State Farmer (00,000) "Grant program to help..."	6/15/01	2
Total for seated cart yr 4 (Mar 01-Feb 02) *		**26**
Hands-free washer		
Wi Fresh Market Veg. Growers(00,000) "New tool to help..."	12/1/01	5
Total for hands-free washer yr 4 (Mar01-Feb 02)		**5**
Dibble drum		
Growing for Market (4,000) "Specialized tools..."	2/1/00	3.25
Total for dibble drum yr 3 (Mar 00- Feb 01)		**3.25**
American Vegetable Grower (25,000) "Dibble drum saves time"	3/1/00	17
Organic Broadcaster(00,000) "Easy transplant spacing..."	3/1/01	18
Farm Show (00,000) "Do-it-yourself drum marker..."	9/1/01	14
Total for dibble drum yr 4 (Mar 01-Feb 02)*		**49**
Motorized lay-down cart:		
Wi. Fresh Market Vet Growers (00,000)	12/1/01	9
Total for motorized carts yr 4 (Mar 01-Feb 02)*		**9**
Portable field stool:		
The Vegetable Growers News (15,000) "Strap-on stool..."	12/1/01	14
Wi. Fresh Market Veg Growers (00,000) "New tools to help..."	12/1/01	7
Total for portable field stool yr 4 (Mar 01-Feb 02)*		**21**

* = NORA-funded years.

TABLE 6. SUMMARY OF PUBLIC EVENTS CONDUCTED AND PRINT MEDIA COVERAGE (in column inches)

DAIRY	1997 baseline	1998 year 1	1999 year 2	2000 year 3	2001 year 4	2002 year 5
public events	00	00	00	00	16	11
print media						

barn lights	30	222	164	180	134	154
bag silos	2	101	23	186	34	151
calf feed site	0	33	7	9	36	0

FRESH MARKET VEGETABLE

	1998 baseline	1999 year 1	2000 year 2	2001 year 3	2002 year 4
public events	00	00	00	12	26
print media					
containers	0	37	49.5	47.5	20.5
mesh bags	0	66.5	47	23	2
half pallet	0	53	42	39	27
sitting cart	0	0	46	96	26
packing area	0	8.5	77.8	37.8	12
washer	0	0	0	0	5
dibble	0	0	0	3.3	49
prone cart	0	0	0	0	9
field stool	0	0	0	0	21

4.52 specific aim #2. evaluate the effectiveness of the interventions.

Overview of Accomplishments: Our second specific aim in this project was to refine and continue, for two additional years, an annual mail questionnaire-based evaluation method. We successfully administered the questionnaires to separate, population-based probability samples from each of the study groups and to controls. The control group for the Wisconsin dairy farmers was Maryland dairy farmers (who were likely to be exposed to the same print media as the Wisconsin farmers but unlikely to be exposed to our dairy public events and resource people). For the fresh market vegetable growers, we used a population of nursery growers in the same four states (who were unlikely to be exposed to our vegetable print media, public events, etc). We have collected and entered the questionnaire information into a database. We have just begun data quality control and analysis activities. We present tentative findings, subject to later revision, below.

Naturally, the evidence we present here for the effectiveness of our interventions cannot be construed as causal. Instead, the results suggest that our interventions are associated with strong, positive improvements in many of the evaluation results. The consistency of year by year results along with the comparisons to each group's baseline and to unexposed controls strengthen the evidence. For both the dairy and fresh market vegetable interventions, we have much more data than we can adequately describe here. We have selected those findings we felt were most relevant to our application's design and hypotheses

4.521 evaluation of the dairy intervention

We present below selected results from the questionnaires administered in Feb-Mar 2001and 2002 and prior years (under previous funding). The tables show results from just the operations in Northeast Wisconsin because we have a longer data set from them than the state as a whole. These findings remain tentative pending further data checking but suggest that the ages of the dairy managers in each sample as well as their years of experience as a dairy manager were comparable. In addition, the distribution of operation sizes (as reflected by size of the milking herd) was also comparable across years and between Wisconsin and Maryland (see TABLE 7).

TABLE 7. DAIRY SUBJECT DEMOGRAPHICS FOR NORTHEAST WISCONSIN VS MARYLAND

	Northeast Wisconsin						Maryland			
	1997	1998	1999	2000	2001	2002	1999	2000	2001	2002
	n=420	n=423	n=305	n=295	n=270	n=260	n=116	n=115	n=114	n=110
ques. mailed	597	587	422	446	385	383	300	241	200	202
received	427	428	306	308	277	269	158	132	116	124
response %	72%	73%	73%	69%	72%	70%	53%	55%	58%	61%
age	45±11	46±11	46±10	46±10	48±11	47±11	47±12	47±13	47±13	48±12
yrs in dairy	29±13	30±12	31±12	30±12	32±13	31±14	33±13	32±14	34±14	33±16
herd size (00)	1.0±.97	1.2±1.2	1.3±2.0	1.0±1.8	1.0±1.6	0.9±1.4	0.9±0.8	1.0±1.0	0.9±.66	1.0±.8

Our results in TABLE 8 show that the intervention was reaching its target audience with information about three production practices we have been promoting. For example, there were significant increases over the five years

in the percent of Northeast Wisconsin dairy managers who recalled seeing, hearing or reading about barn lights in print media, at public events, from other farmers, from equipment dealers, from private agricultural consultants, and from electrical suppliers. For bag silos, there were significant increases over the five intervention years in seeing, hearing or reading about them from equipment dealers (along with a significant decrease in getting information from Extension agents). For the calf feeding site practice, there were no significant differences in Northeast Wisconsin between the baseline and the fifth intervention year.

Compared to Maryland controls, in 2002 more barn lights information was reported received by farm managers in Northeast Wisconsin from public events and electrical suppliers, more bag silo information from public events, and more calf feed site information from other farmers.

TABLE 8. DAIRY: PERCENT OF MANAGERS WHO REPORTED SEEING INFORMATION ABOUT PRACTICES

	Northeast Wisconsin						Maryland			
	1997	1998	1999	2000	2001	2002	1999	2000	2001	2002
	n=420	n=423	n=305	n=295	n=270	n=260	n=116	n=115	n=114	n=110
barn lights										
print media	79%	82%	90%	90%	82%	90%*	90%	85%	87%	87%
public events	12%	25%	38%	43%	44%	50%**	10%	14%	19%	14%**
other farmer	24%	30%	39%	42%	39%	51%**	27%	40%	40%	34%
extension ag.	18%	24%	19%	16%	18%	25%	3%	6%	4%	11%
equip. dealer	6%	9%	20%	25%	26%	27%**	15%	19%	29%	20%
ag consultant	8%	17%	18%	19%	16%	19%**	6%	6%	8%	14%
elec. supplier	9%	10%	24%	35%	34%	32%**	2%	6%	6%	3%**
bag silos										
print media	79%	89%	90%	84%	81%	80%	87%	87%	83%	83%
public events	38%	39%	52%	48%	44%	40%	23%	27%	26%	19%**
other farmer	67%	53%	70%	80%	77%	73%	63%	65%	61%	65%
extension ag.	16%	19%	12%	7%	8%	8%*	5%	6%	8%	5%
equip. dealer	17%	22%	35%	31%	25%	27%*	31%	39%	45%	35%
ag consultant	9%	14%	18%	15%	14%	11%	10%	16%	10%	11%
calf feeding site										
print media	76%	72%	79%	82%	77%	81%	88%	93%	83%	85%
public events	20%	20%	29%	30%	30%	23%	16%	13%	19%	2%
other farmer	42%	33%	42%	41%	38%	41%	8%	14%	4%	6%*
extension ag.	9%	13%	9%	2%	4%	7%	2%	10%	0%	2%
equip. dealer	3%	5%	4%	5%	8%	9%	9%	12%	11%	6%
ag consultant	4%	7%	6%	3%	6%	6%	5%	10%	6%	2%

* = significant at the ≤ 0.01 level ** = significant at the ≤ 0.001 level

Our intervention was associated with increases over the five intervention years in Northeast Wisconsin adoption of bag silos (30% vs. 45%) (see TABLE 9). However after intervention year 5, the adoption percentages in Northeast Wisconsin were not significantly higher than in Maryland for any of the three practices (although barn lights approached significance at $p \leq 0.056$).

Second, our intervention was associated with increases over the five intervention years in awareness for two of the three practices (barn lights 48% vs. 76% aware, and the calf site 39% vs. 54% aware). Bag silo awareness

was over 90% at baseline so no increase was possible. However, there were no significant differences in either adoption or awareness for any of the three practices between Northeast Wisconsin dairy farm managers and those of Maryland managers.

TABLE 9. DAIRY: PERCENT OF MANAGERS REPORTING ADOPTION AND AWARENESS OF PRACTICES

	Northeast Wisconsin						Maryland			
	baseline 1997	year 1 1998	year 2 1999	year 3 2000	year 4 2001	year 5 2002	year 2 1999	year 3 2000	year 4 2001	year 5 2002
barn lights										
adopted	43 (10%)	92 (22%)	74 (24%)	51 (17%)	67 (25%)	58 (22%)	14 (12%)	21 (18%)	16 (14%)	15 (14%)
aware	159 (38%)	211 (50%)	174 (57%)	170 (58%)	14 (54%)	140 (54%)	54 (47%)	50 (44%)	59 (52%)	58 (53%)
unaware	216 (52%)	116 (28%)	56 (19%)	73 (25%)	56 (21%)	62 (24%)**	48 (41%)	43 (38%)	38 (34%)	37 (33%)
total	418 (100%)	419(100%)	304 (100%)	294 (100%)	268 (100%)	260 (100%)	116 (100%)	114 (100%)	113 (100%)	110 (100%)
silo bags										
adopted	126 (30%)	26 (30%)	133 (44%)	118 (40%)	114 (43%)	117 (45%)**	39 (33%)	42 (37%)	54 (48%)	51(46%)
aware	271 (65%)	281 (66%)	165 (54%)	165 (56%)	41 (53%)	135 (52%)	74 (64%)	66 (59%)	52 (46%)	56 (50%)
unaware	21 (5%)	15 (4%)	7 (2%)	11 (4%)	10 (4%)	7 (3%)	3 (3%)	4 (4%)	7 (6%)	3 (3%)
total	418 (100%)	422(100%)	305 (100%)	294 (100%)	265 (100%)	259 (100%)	116 (100%)	112 (100%)	113 (100%)	110 (100%)
calf mixing site										
adopted	20 (5%)	33 (8%)	32 (11%)	15 (5%)	26 (11%)	19 (8%)	5 (5%)	4 (4%)	9 (8%)	11 (11%)
aware	136 (34%)	172 (43%)	134 (47%)	120 (44%)	119 (48%)	112 (46%)	38 (35%)	42 (40%)	49 (45%)	46 (44%)
unaware	246 (61%)	196 (49%)	121 (42%)	141 (51%)	101 (41%)	110 (46%)**	67 (60%)	60 (56%)	51 (47%)	47 (45%)
total	402 (100%)	401(100%)	287 (100%)	276 (100%)	241 (100%)	241 (100%)	110 (100%)	106 (100%)	109 (100%)	104 (100%)

* = significant at the $\leq$ 0.01 level ** = significant at the $\leq$ 0.001 level

4.522 evaluation of the fresh market vegetable intervention

On the pages that follow, we present only the results for all four states. In 1998 and 1999 we collected results from only a small group of vegetable growers in Wisconsin. Our preliminary findings from fresh market vegetable growers in the four state region suggest that operation manager ages, years in farming, and total acres in our samples were all comparable: 1) between 2000 and 2002 for the four state fresh market vegetable farmers, and 2) between the vegetable farmers and the nursery control group for 2002 (see TABLE 10).

TABLE 10. VEGETABLE SUBJECT DEMOGRAPHICS: TREATMENT GROUP VERSUS NURSERY CONTROLS

	WI, MN, MI, IA VEGETABLE			WI, MN, MI, IA NURSERY	
	2000	2001	2002	2001	2002
ques. mailed	848	851	851	660	660
ques. received	526	534	533	381	390
response %	62%	63%	63%	58%	59%
ques. FMV managers	244	233	210	223	205
age	50±13	51±12	51±12	51±11	51±11
yrs in farming	27±16	18±15	20±15	19±11	21±12
total acres	89±677	71±324	74±238	39±122	47±173

* = significant at the 0.01 level ** = significant at the 0.001 level

TABLE 11. VEGETABLE: PERCENT OF MANAGERS WHO REPORTED SEEING INFORMATION ABOUT PRACTICES

	WI, MN, MI, IA VEGETABLE				WI, MN, MI, IA NURSERY		
mesh bags	2000	2001	2002	p	2001	2002	p
print	63%	58%	67%	0.586			
public event	27%	23%	24%	0.618			
another farmer	26%	22%	31%	0.409			
radio or TV	4%	3%	4%	0.951			
Internet	2%	4%	1%	0.586			
thought of it on my own	8%	13%	8%	0.854			
don't know	10%	13%	4%	0.113			
standard containers							
print	62%	69%	67%	0.354			
public event	21%	25%	27%	0.369			
another farmer	42%	28%	38%	0.547			
radio or TV	1%	0%	0%	0.209			
Internet	4%	3%	1%	0.110			
thought of it on my own	11%	13%	12%	0.693			
don't know	9%	8%	7%	0.511			
narrow pallet system							
print	46%	63%	50%	0.653	53%	52%	0.855
public event	17%	26%	28%	0.129	12%	0%	0.006
another farmer	35%	15%	25%	0.185	30%	10%	0.006
radio or TV	2%	1%	1%	0.942	0%	0%	
Internet	2%	8%	1%	0.942	3%	0%	0.154
thought of it on my own	17%	8%	10%	0.213	15%	14%	0.822
don't know	11%	15%	20%	0.149	18%	32%	0.092
packing area							
print	46%	74%	58%	0.122	44%	42%	0.889
public event	22%	30%	35%	0.085	6%	9%	0.617
another farmer	37%	31%	35%	0.831	24%	12%	0.223
radio or TV	0%	2%	1%	0.346	0%	0%	
Internet	2%	5%	1%	0.929	0%	0%	
thought of it on my own	38%	28%	18%	0.007	12%	12%	0.964
don't know	7%	5%	12%	0.378	32%	46%	0.271
seated cart							
print	68%	74%	61%	0.336	58%		
public event	21%	32%	31%	0.145	8%		
another farmer	23%	13%	14%	0.133	8%		
radio or TV	2%	1%	5%	0.431	3%		
Internet	4%	5%	4%	0.964	3%		
thought of it on my own	6%	10%	4%	0.437	6%		
don't know	7%	7%	12%	0.329	36%		
prone cart							
print		59%	66%	0.445	47%	44%	0.849
public event		20%	26%	0.475	6%	6%	0.965
another farmer		25%	17%	0.319	12%	0%	0.157
radio or TV		0%	3%	0.205	0%	0%	
Internet		0%	0%		0%	0%	
thought of it on my own		4%	5%	0.890	0%	6%	0.295
don't know		18%	14%	0.512	53%	44%	0.598
field stool							
print		41%	67%	0.010	23%	46%	0.135
public event		14%	22%	0.343	7%	8%	0.903
another farmer		16%	16%	0.930	13%	0%	0.167
radio or TV		2%	0%	0.305	3%	8%	0.533

Internet	0%	2%	0.325	0%	0%	
thought of it on my own	31%	12%	0.021	23%	0%	0.057
don't know	20%	12%	0.239	33%	54%	0.206
<u>washer</u>						
print	58%	51%	0.570			
public event	18%	39%	0.032			
another farmer	30%	37%	0.530			
radio or TV	3%	2%	0.986			
Internet	3%	0%	0.308			
thought of it on my own	25%	5%	0.011			
don't know	13%	12%	0.967			

The results in TABLE 11 show the percent of fresh market vegetable and nursery control managers who reported seeing, hearing or reading information about the practices we promoted after each year of the intervention. There were no significant differences for any of the practices that we promoted between the four state treatment group baseline in 2000 and the second intervention year in 2002 aside from:
1) an increase for seeing information about the field stool in print media of 41% versus 67%, $p < 0.010$, and
2) an increase for getting information about the hands-free washer at public events 18% vs. 39%, $p<0.032$, and
3)reductions in "thought of it myself" for the field stool, hands-free washer, and the packing area.

Statistical tests comparing the 2002 year experience of the treatment group with the 2002 results from the nursery control group showed that more treatment group than control group managers reported getting information about the narrow pallet system practice from public events (28% vs. 0%, $p < 0.006$) and from other farmers (25% vs. 10%, $p < 0.006$). Statistical comparisons for all the other practices were unremarkable.

The results in TABLE 12 show that our intervention was not associated with increases over the two intervention years in the adoption of any of the practices we promoted.

However, comparing the results after the 2002 intervention year between the vegetable treatment group and the nursery controls showed that adoption of the packing area (12% vs. 2%, $p<0.015$) was more likely in the treatment group.

Second, our intervention was not associated with increases over the intervention years in the awareness of any of the practices that we promoted.

However, comparing the results after the 2002 intervention year between the vegetable treatment group tne the nursery controls showed that awareness of the packing area was more likely in the treatment group (61% unaware vs. 82%, $p<0.000$).

TABLE 12. VEGETABLE: PERCENT OF MANAGERS REPORTING ADOPTION AND AWARENESS OF PRACTICES

	WI, MN, MI, IA VEGETABLE				WI, MN, MI, IA NURSERY		
	2000	2001	2002		2001	2002	
mesh bags							
adopted	16 (7%)	9 (4%)	25 (12%)	0.162			
aware	81 (33%)	92 (40%)	73 (36%)				
unaware	146 (60%)	127 (56%)	109 (52%)	0.113			
total	243 (100%)	228 (100%)	207 (100%)				
standard containers							
adopted	88 (36%)	79 (35%)	66 (32%)	0.738			
aware	87 (36%)	72 (32%)	71 (35%)				
unaware	67 (28%)	73 (33%)	67 (33%)	0.260			
total	242 (100%)	224 (100%)	204 (100%)				
narrow pallet							
adopted	19 (8%)	10 (4%)	18 (9%)	0.578	14 (7%)	15 (8%)	0.957
aware	51 (21%)	66 (29%)	54 (26%)		50 (24%)	47 (24%)	
unaware	170 (71%)	151 (67%)	132 (65%)	0.203	137 (70%)	135 (69%)	0.480
total	240 (100%)	227 (100%)	207 (100%)		210 (100%)	200 (100%)	
packing area							
adopted	33 (14%)	31 (14%)	25 (12%)	0.022	5 (3%)	4 (2%)	0.015
aware	38 (16%)	59 (26%)	54 (27%)		29 (15%)	32 (16%)	
unaware	164 (70%)	136 (60%)	124 (61%)	0.056	167 (83%)	158 (82%)	0.000
total	235 (100%)	226 (100%)	203 (100%)		201 (100%)	194(100%)	
seated cart							
adopted	6 (2%)	5 (2%)	9 (4%)	0.508	2 (1%)		
aware	78 (33%)	88 (39%)	77 (38%)		36 (17%)		
unaware	153 (65%)	134 (59%)	118 (58%)	0.149	174 (82%)		
total	237 (100%)	227 (100%)	204 (100%)		212 (100%)		
prone cart							
adopted		1 (0%)	4 (2%)	.ns	1 (0%)	0 (0%)	.?
aware		49 (22%)	62 (30%)		16 (7%)	18 (9%)	
unaware		177 (78%)	139 (68%)	.ns	198 (92%)	181 (91%)	.?
total		227 (100%)	205 (100%)		215 (100%)	199 (100%)	
field stool							
adopted		5 (0%)	1 (1%)	.ns	3 (1%)	1 (1%)	.?
aware		45 (20%)	50 (24%)		28 (13%)	13 (7%)	
unaware		176 (78%)	155 (75%)	.ns	184 (86%)	186 (93%)	.?
total		226 (100%)	206 (100%)		215 (100%)	200 (100%)	
hands-free washer							
adopted		11 (5%)	7 (3%)	.ns			
aware		33 (15%)	34 (17%)				
unaware		181 (80%)	164 (80%)	.ns			
total		225 (100%)	205 (100%)				

4.53 specific aim #3. add new production method innovations to each intervention.

Overview of Accomplishments: Our third specific aim in this project was to seek out reports from farmers and others about emerging production practice innovations that could improve both safety and profits. We then undertook field studies to observe the practices and to quantitatively evaluate some of the hazard-reducing and profit-enhancing aspects of the best practices. Later, we added one or more of the new practices to each intervention each year and developed materials about the practices (TABLE 13).

TABLE 13. PRODUCTION METHODS AND LABOR AIDS PROMOTED EACH INTERVENTION YEAR

intervention year	new production methods and labor aids	total
DAIRY		
year 1 (Mar 97- Feb 98)	barn lights, bag silos, calf feed mixing site	3
year 2 (Mar 98- Feb 99)	all of above	3
year 3 (Mar 99- Feb 00)	all of above plus calf wagons, calf milk bottle holders	5
year 4 (Mar 00- Feb 01)*	all of above	5
year 5 (Mar 01- Feb 02)*	all of above plus calf grain bottle holders, stall barn milking stool	7
FRESH MARKET VEGETABLE:		
year 1 (Mar 98- Feb 99)	standard containers, mesh bags	2
year 2 (Mar 99- Feb 00)	all of above plus half pallet, sitting cart, packing shed	5
year 3 (Mar 00- Feb 01)*	all of above plus hands-free washer, dibble drum	7
year 4 (Mar 01- Feb 02)*	all of above plus laying prone harvest cart, portable field stool	9

* = NORA-funded years

4.531 new dairy production practices and labor aids

For the dairy production methods, we present below results from field studies and general information about calf grain bottles and milking stools.

4.5311. CALF GRAIN BOTTLES are a commercially available product which hold about 4 lbs of grain each and are made of clear plastic. They mount on the front wire fence or on separate supports and feature a screw-type top. The calf eats starter through a chewing nipple at the bottom of the bottle.
Early weaning can save labor and milk replacer but requires early consumption of calf starter to be successful. Present recommendations to achieve early grain consumption include feeding starter free access from day 4, cleaning out grain pails daily and discarding leftover grain. Only a few studies compare grain bottles to grain pails. Researchers have noted that calves tend to eat starter feed earlier when using bottles. The manufacturer's own feeding trials also indicate earlier and higher consumption of starter feed when using grain bottles. No study, so far, has demonstrated a statistically significant difference in terms of feed consumption or weight gain when using bottles or pails to feed calf starter.

Easier. Since the bottles protect grain from rain and snow, it is possible to do all feeding at the front, so you won't have to use side doors or enter the hutches. Since the container is see-through, it is easy to monitor grain consumption. Also, you won't need to clean out pails and discard the leftovers daily.

Better Hygiene. Feeding calf starter in closed bottles makes it possible to achieve a high standard of cleanliness, without the need to clean out pails and dispose of leftovers daily. The feed is also protected from rain, insects and birds.

Saves labor. Proper use of grain bottles may allow 1.5 weeks earlier weaning, which reduces labor per calf by 54 minutes. Time studies and modeling data suggest modest labor savings (about 6 hrs/year for a 10 calf operation) as a direct result of feeding grain at the front of the hutches. An operation with an average of 10 preweaned calves may raise 74 calves/year (weaning at 7 weeks). For this size of operation, the total labor savings are estimated at 6.0 hr + (74 x 54 min) = 6.0 hr + 3996 min = 6.0 + 66.6 = about 73 hr/yr. This corresponds to a labor cost savings of about $730/yr. Other potential labor differences depend on individual farm routines. It does take more time to fill a grain bottle than it does to fill a bucket, which may offset the labor saved by not needing to clean and refill buckets daily. Therefore, the time to clean and refill pails was not included in our estimates.

Saves feed costs. Starter feed is routinely discarded when cleaning out grain pails and when the feed is soiled with manure. The total amount is estimated at about 13 lbs per weaned calf. Valued at about $0.16/lb, this is a loss of about $2.08 per calf. Assuming that proper use of grain bottles makes it feasible to wean calves 1.5 weeks earlier, calves consume about 10 lbs less of costly milk replacer and about 15 LB more of the less expensive calf starter. This corresponds to an estimated savings of $5.08 per weaned calf when using grain bottles.
The estimated feed cost advantage for using grain bottles = $2.08 + $5.08 = $7.16/weaned calf. For a 10-calf operation, this corresponds to a total feed cost savings of 74 x $7.16 = $530/yr.

SAVINGS WITH CALF GRAIN BOTTLES*

	Less walking only	Less walking plus earlier weaning
Labor saving	$60	$790
Feed saving	$154	$530
Total saving	$214	$1,320
Grain bottle cost	$102	$102
Net savings/yr	$112	$1,218

* = for herd w/ 10 pre-weaned calves at all times

Conclusions. Grain bottles facilitate efficient working while feeding calves in hutches and may allow earlier weaning. Potential disadvantages include increased time required to refill the bottles compared to refilling grain buckets and the potential for bridging in the bottle if the molasses content of the feed is high. More research is needed to document the advantages and disadvantages of using grain bottles. Farmers interested in early starter feed consumption, high cleanliness and feed quality may want to give grain bottles a try.

4.532 new fresh market vegetable production practices and labor aids

4.5321 HANDS-FREE WASHER: **M**arket gardeners have few inexpensive mechanical devices for washing produce by hand. They often wash produce at a spray table with a garden hose and hand held spray nozzle. For under $50, you can make a simple sprayer that does not need to be held or squeezed by hand. With both hands free, you can process produce faster and more efficiently with less strain on your body.

What's wrong with a garden hose and nozzle?
Usually people use their dominant hand to grasp the spray nozzle and direct it at the produce, and their other hand to turn the produce as it gets washed and to move it to a box for packing. This can cause hand, wrist and arm fatigue from gripping the nozzle and holding the hose, and awkward postures as you move your body to reach the produce. Most garden hose nozzles spray water at higher pressure than needed to wash vegetables. This wastes water, and may also damage produce, resulting in shorter shelf life and wasted effort.

Benefits of using fixed sprayers:
Less stress on the body. A hands-free washer allows you to wash the produce comfortably and efficiently. For most right-handed workers, this means moving the produce through the stream from your left hand to your right. Since you eliminate the need to hold, squeeze and direct the hose, your hands and arms are less likely to fatigue.

Faster. Using a hands-free washer can be nearly 40% faster than using a hose and nozzle. Faster washing means higher quality produce and savings in labor time.

Less damage to crop. You can choose a nozzle with the right spray pattern for your job. For example, use a strong spray for roots and a gentle spray for leafy greens.

Will using a fixed sprayer save me money?
Total cost for parts to make a fixed sprayer ranges from $25-$70, depending on what type of nozzle you buy. This investment will be quickly made up in labor savings. You will also indirectly save money by improving product quality and preventing stress and strain on your body.

4.5322 DIBBLE DRUM: Hand transplanting seedlings into the field can be tedious and time-consuming. Some growers lay a tape measure or knotted string on the planting bed to space transplants evenly. Others just estimate plant spacing with their eyes. Many growers then use a hand trowel to dig holes for the transplants. A rolling dibble marker, or dibble drum, is a tool that helps you transplant seedlings faster and more accurately. The hand-pulled tool rolls across the planting bed, punching or scooping transplant holes into the soil at regular intervals.

How does it work?
You walk down the path beside the prepared planting bed, pulling the dibble drum behind you by its handle. As it rolls along, "dibbles", or scoops which are screwed into a PVC drum at regular intervals, create indentations in the soil for transplants. In loose soil, the dibble drum will dig holes but in heavy or compact soil it will mark locations for transplant holes. After rolling the dibble drum along your planting bed, plant transplants into the holes or scoop marked holes with a trowel.

Why use a dibble drum?
Saves time. You can set out, plant and water in transplants 24% faster when using a dibble drum to space and dig holes, compared to visually estimating spacing and using a

More accurate. If you mark your planting bed with a dibble drum, you will ensure exact spacing of your transplants in a grid pattern, even when the task is performed by inexperienced workers. Consistent spacing makes weeding easier, since you can use a hand hoe or wheel hoe in two directions or use a mechanical cultivator. Accurate plant spacing will conserve bed space and maintain plant quality. Even experienced growers tend to overestimate plant spacing, which can waste productive land. If growers underestimate spacing, plants can be crowded and yield might suffer.

Easier on the body. Using a dibble drum to space transplants lets you stand instead of stooping or kneeling to mark transplant spacing.

Simple. It can be complicated and time-consuming to explain how to space transplants to inexperienced field hands. With a dibble drum, you can instruct workers to simply roll the drum down the planting bed and set one plant in each hole.

How do I make one?
This rolling dibble marker, designed by Bob Meyer, is made from readily available hardware, lumber, and PVC pipe. The drum is a section of 12" dia. PVC pipe ($45-$50) commonly used for sewer connections. Check with plumbing supply stores and ask for a section as long as your bed is wide. Parts for the dibble drum will total approximately $100.

4.532 PORTABLE FIELD STOOL: **S**toop labor is unavoidable on berry and vegetable farms, since at times the plants and soil need to be tended by hand. If you spend too much time stooping, kneeling or squatting, you may experience fatigue, muscle soreness or injuries. One alternative is to use an adjustable, strap-on stool that lets you sit while you work.

How does it work?
The one-legged stool features a nylon belt that fastens around your waist, and has straps extending from the belt to the seat of the stool that adjust to fit your body. Once you have fastened the belt and adjusted the straps, the stool moves with you and is easy to sit down on again in a new location. The seat is made of durable hard plastic, and the single metal leg is adjustable to three different heights for performing a variety of tasks. The lightweight stool features a 3 ½" wide, spring-like base, so that you do not sink into the ground.

Strap-on stool benefits:
Less fatigue and discomfort. Prolonged stooping or kneeling to harvest and weed are some of the activities which put vegetable and berry growers in one of the highest risk groups for occupational injuries. If you do these tasks while sitting, you eliminate knee strain and lessen strain on your back, hamstrings, and torso. Your body doesn't get tired as quickly and you can comfortably work for a longer time.

POSTURES WHILE HARVESTING STRAWBERRIES*

	with stool	without stool
Time spent in unacceptable postures	82%	65%
Time spent in marginal postures	16%	34%
Time spent in acceptable postures	2%	1%

* as evaluated with the OVAKO work analysis system

Lets you change positions. Using a strap-on stool lets you move from sitting to standing, and then back to sitting, and then forward-leaning sitting, and then to kneeling. If you change your position often, you can alleviate muscle stress and prevent pain. The strap-on stool lets you give your knees or back a rest. Customers at Pick-Your- Own (PYO) farms might enjoy using strap-on stools. They might find the harvest experience more fun and comfortable with a stool, and possibly pick for a longer time in the process. Both hands free. Some growers sit on an upturned five-gallon plastic bucket or use a padded kneeling stool to give their backs and knees a break. The disadvantage of these types of seats is that every time you move to a new place in the bed or row, you need to pick up your seat and reposition it. Since the strap-on stool fits snugly to your body and moves with you, you have both hands free to harvest, weed, or carry your harvest container.

Affordable. The price for a strap-on stool ranges from $22-$38. If the stool saves you the cost of just one visit to the chiropractor, or enables a handful of U-Pick customers to stay in your fields for longer, then it will pay for itself very quickly.

4.5324 LYING PRONE HARVEST CART: There has got to be a better way" is a thought that has gone through nearly every small farmer's mind after stooping, squatting or crawling for hours in berry or vegetable rows. An alternative is to use a motorized lay-down work cart that lets you lie face down while you work. Lying down instead of stooping or bending is less tiring and easier on your body. The work cart also holds your harvest container, so it moves along with you. This tip sheet will focus on the Swedish-made Drängen, and on the Finnish-made Crawler (Ryömijä).

How does it work?
Drängen and Crawler each look like a massage table mounted on snowmobile treads or wheels, powered by a small motor. One or more workers lie on padded supports that suspend them over the crop row. Both hands are free to pick, weed, or tend plants while the rest of the body rests comfortably. One person steers and adjusts speed with foot controls. Padded supports and framework can be adjusted to fit individual workers. The frame also adjusts, so you can position both the worker and the tracks or wheels right where you want them.

Benefits:
Less fatigue and discomfort. Prolonged kneeling or stooping to harvest and weed puts vegetable and berry growers in one of the highest risk groups for occupational injuries. If you do these tasks while lying down, you eliminate knee and leg strain and reduce strain on your back and torso. You don't get tired as quickly and you can comfortably work for a longer time. In a Finnish study of the Crawler, strawberry pickers' pulse rates were on average 10% lower when working on the lay-down cart than without it. With Drängen, the small motor is behind you so you don't breathe fumes, and it is quiet enough to listen to a radio or talk as you work. The Crawler is battery powered, which eliminates exhaust and further reduces noise.

Faster. Using a motorized lay-down cart can increase your speed, since both you and the crop you've picked move together along the row. Faster harvesting and quicker time to the cooler maintains high crop quality. In our field trials, farmers using Drängen harvested up to 24% faster and weeded up to 23% faster compared to similar work by hand.

Improves profits. Cutting harvest or weeding time can save labor costs. Compared to using a tractor-pulled harvest platform you will not need an extra person to drive the tractor. You may also save on medical costs or miss less work due to injury.

Weather protection. You can outfit a lay-down cart with a canopy that shelters you from sun and rain.

Safer. A motorized lay-down tractor with foot controls and hydrostatic transmission is safer than a regular tractor because it cannot spring forward without an operator. There is no PTO (Power Take Off) in which to risk entanglement.

Tips for using carts. Lay-down carts are most efficient when the task at hand is slow, steady and consistent, such as picking beans or de-blossoming strawberries. You need to take time to adjust the machine to your body. A poor fit can give you aches and pains. Some carts drive slowly from field to field, and may be faster to move on a trailer.

4.6 Conclusion

Production practices that are both more efficient and safer are especially interesting for high hazard industries such as production agriculture, where no effective workplace safety rules or enforcement exist for tens of thousands of small to mid-sized operations. When production practices which are marginally more efficient and relatively easy to adopt become available, many if not most firm managers are likely to eventually adopt them, given adequate information flow and sufficient time. We investigated whether better information flow could increase the speed of adoption and the extent of a practice's eventual spread throughout two large populations of farm managers. Each practice provided some efficiency advantages along with strong safety and health benefits.

The work we present in this report is innovative and advances the field for at least three reasons. First, interventions of this sort constitute efforts to translate research findings into standard practices throughout an industry. Interventions seeking to accomplish goals of this magnitude are rare in the occupational safety and health research literature. Second, we conducted occupational safety and health interventions that were innovative in the type of information dissemination they accomplished. We attempted to convey research findings to an audience of farm managers using media, events and other sources that the farm managers were already known to rely on for information about new production practices and labor aids. This was also unusual for an injury intervention project, particularly in agriculture. Finally, coupling safety and profit in the production practices that we promoted was innovative. Farm managers are oriented toward improving their operation's productivity and reducing costs. Safety interventions in agriculture and other industries have typically not incorporated this dual focus by emphasizing the value to an operation's bottom line of economic viability along with the health and safety protections.

Our field work research results suggest that the production practices and labor aids we are promoting in these two interventions are viable strategies for reducing exposures to workplace hazards and thereby capable of preventing at least some of the occupational injury and disease suffered by the workforce. Both interventions are continuing and we plan to gather and analyze additional process and outcome evaluation data in future years. The findings about our interventions have been (or are being) written up and submitted to peer review publications. Some of the production practices we have reported on here are already on their way to being widely accepted practices in many if not most workplaces (i.e. silo bags and barn lighting in dairy; standard containers, mesh bags, and half pallet systems in fresh market vegetable production). Furthermore, the increases in adoption rates for the production practices and labor aids (coupled with the process outcomes verifying that farmers saw the sources where we improved information) show that these two interventions, funded by the NIOSH NORA initiative, are likely to have already made some difference in the control of dairy and fresh market vegetable workplace hazards and, potentially, reductions in the injuries suffered by people at work in these industries.

5.0 LIST OF PUBLICATIONS AND PLANNED PUBLICATIONS

Scientific Publications:

Chapman LJ, Newenhouse AC, Meyer RH, Taveira AD, Karsh B, Ehlers J, Palermo T. An evaluation of a one year intervention to reduce musculoskeletal hazards in fresh market vegetable growers. (accepted by *Applied Ergonomics*, in press August 2003).

Chapman LJ, Taveira AD, Josefsson KG, Hard DL. Effects of a one year intervention among Wisconsin dairy farmers. *Journal of Agricultural Safety and Health* 2003;9(3):197-209. **(enclosed)**

Josefsson KG, Chapman LJ, Taveira AD, Holmes BJ, Hard D. A hazard analysis of three silage storage methods for dairy cattle. *Human and Ecological Risk Assessment* 2001;7(7):1895-1908. **(enclosed)**

Meyer RH, Newenhouse A, Miquelon M, Chapman LJ. Tip Sheets on Specialized Harvest Cart, Rolling Dibble Marker, Mesh Bags, Standard Containers, Narrow Pallet System, Packing Shed Layout. In Baron S, Estill C, Steege A, Lalich N. (Eds.): Simple Solutions: Ergonomics for Farm Workers. NIOSH Publication No. 2001-111. Cincinnati OH: NIOSH, 2001.

Planned publications:

Chapman LJ, Karsh B, Taveira A, Josefsson KG, Hard DL. Effects of a two year, profit-improving, occupational injury intervention among Wisconsin dairy farmers. Madison WI: University of Wisconsin Biological Systems Engineering Department, 2001 (in preparation).

Oral Scientific Presentations and Posters:

Chapman LJ, Josefsson KG, Meyer RH, Newenhouse AC, Karsh B, Miquelon M. Intervention research to reduce injuries on dairy, berry, and fresh market vegetable farms. (abstract and oral presentation) Presented at the NIOSH conference "Agricultural Safety and Health in a New Century" on April 28-30, 2000 in Cooperstown NY.

Goldenhar LG, Chapman LJ. "How to Do Intervention Evaluation" (abstract and oral presentation) delivered at the American College of Occupational and Environmental Medicine, Philadelphia PA: May 18, 2000.

Chapman LJ, Meyers J. "Ergonomics and Musculoskeletal Injuries in Agriculture" (abstract and oral presentation) delivered at the conference "Using Past and Present to Map Future Actions" on March 3 in Baltimore MD, 2001.

Taveira A, Karsh B, Chapman LJ, Jossefson KG. Perceptions of safety and profitability as predictors of farmers' intention to adopt an alternative feed storage technology (abstract and oral presentation). International Society for Occupational Ergonomics and Safety XV Annual Conference. 2001.

Chapman L, Josefsson G, Brunette C, Meyer R, Miquelon M,. A four year intervention to promote safer, more profitable production practices to 4,300 dairy farmers (abstract and poster). Delivered to the annual meeting of the National Institute for Farm Safety. Ponte Vedra Beach FL: June 23, 2002.

Newenhouse A, Miquelon M, Josefsson, KG, Brunette C, Chapman L. Healthy Farmers, Healthy Profits Project (abstract and poster) National Small Farm Conference, Albuquerque New Mexico, Sept. 17-20, 2002.

Chapman L, Josefsson G, Brunette C, Miquelon M. A five year intervention to promote safer, more profitable production practices to dairy farmers (abstract and oral presentation). Delivered to the NIOSH-sponsored meeting entitled "Best Practices in Occupational Safety and Health Education, Training and Communication: Ideas that sizzle". Baltimore MD: October 28, 2002.

Publication awards:

Honorable mention for US NIOSH Alice Hamilton Awards, Educational Materials Category, for Baron S et al., Simple Solutions: Ergonomics for Farmworkers. US NIOSH Pub. No. 2001-111 which contains six of our tip sheets and eight others that were reconfigured to match our tip sheet format.

Honorable mention for National Small Farm Conference, Poster Category, for Newenhouse A, Miquelon M, Josefsson, KG, Brunette C, Chapman L. "Healthy Farmers, Healthy Profits Project", (poster) National Small Farm Conference, Albuquerque New Mexico, Sept. 17-20, 2002.

Materials

Meyer RH, Newenhouse A, Chapman LJ. Work Efficiency Tip Sheet on Produce Washing Facilities. Madison WI:University of Wisconsin Biological Systems Engineering Department [http://bse.wisc.edu/hfhp/], 1999.

Meyer RH, Newenhouse A, Chapman LJ. Work Efficiency Tip Sheet on Specialized Field Carts. Madison WI:University of Wisconsin Biological Systems Engineering Department [http://bse.wisc.edu/hfhp/], 1999.

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Josefsson KG, Miquelon M, Chapman LJ. Work Efficiency Tip Sheet on Using Silage Bags. Madison WI:University of Wisconsin Biological Systems Engineering Department [http://bse.wisc.edu/hfhp/], 1999.

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Josefsson G, Miquelon M, and Chapman L. Use grain bottles for preweaned calves: A Work Efficiency Tip Sheet. University of Wisconsin Dept. of Biological Systems Engineering, 2002.

Josefsson G, Miquelon M, and Chapman L. Artificial insemination: Still profitable! A Work Efficiency Tip Sheet. University of Wisconsin Dept. of Biological Systems Engineering, 2002.

Selected Educational Articles in Vegetable or Dairy Trade Publications

Healthy Farmers, Healthy Profits Project, "The diamond hoe: a great gift idea for your favorite market gardener" (article). *Growing for Market,* December 2001.

Miquelon, M. "Non-motorized field carts alleviate pain and save time" (article) *The Vegetable Growers News.* February 2001.

Meyer RH, Miquelon M, Newenhouse A, and Chapman LJ. "Easy Transplant Spacing with a Rolling Dibble Marker" (article). *Organic Broadcaster*, March-April 2001.

Miquelon, M. "Hand pallet trucks can save your back,"(article) *Growing for Market*, November 2000.

Miquelon, M. "Sitting down on the job: Specialized carts,"(article) *Johnny's Selected Seeds Advantage*, January, 2000.

Miquelon, M. "Standard vegetable containers save time and storage space" (article) *The Vegetable Growers News.* December 2000.

Mooney R. Let there be light. *Dairy Today.* October 2000. p. 14-16.

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DEPARTMENT OF HEALTH AND HUMAN SERVICES

Public Health Service
Centers for Disease Control
and Prevention (CDC)

Memorandum

Date: September 30, 2003

From: Susan B. Board, Program Official SBoard
Office of Extramural Programs, NIOSH, E-74

Subject: Final Report Submitted for Entry into NTIS for Grant 5 R01 OH003953-03.

To: William D. Bennett
Data Systems Team, Information Resources Branch, EID, NIOSH, P03/C18

The attached final report has been received from the principal investigator on the subject NIOSH grant. If this document is forwarded to the National Technical Information Service, please let us know when a document number is known so that we can inform anyone who inquires about this final report.

Any publications that are included with this report are highlighted on the list below.

Attachment
cc: Sherri Diana, EID, P03/C13

List of Publications

Chapman LJ, Newenhouse AC, Meyer RH, Taveira AD, Karsh B, Ehlers J, Palermo T. An Evaluation of a One Year Intervetion to Reduce Musculoskeletal Hazards in Fresh Market Vegetable Growers. In press, August 2003

Chapman LJ, Tavira AD, Josefsson KG, Hard DL: Effects of a One Year Intervention Among Wisconsin Dairy Farmers. Journal of Agricultural Safety and Health 2003;9(3):197-209. 2003

Meyer RH, Newenhouse A, Miquelon M, Chapman LJ: Tip Sheets on the Specialized Harvest Cart, Rolling Dibble Marker, Mesh Bags, Standard Containers, Narrow Pallet System, and Packing Shed Layout. Simple Soultions: Ergonomics for Farm Workers, (eds. Baron S, Estill C, Steege A, Lalich N), Cincinnati, OH, NIOSH Publication No. 2001-11, 2001

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Josefsson KG, Chapman LJ, Tavira AD, Holmes BJ, Hard D: A Hazard Analusis of Three Silage Storage Methods for Dairy Cattle. Human and Ecological Risk Assessment 2001;7(7):1895-1908. 2001

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Baker R, Brockhous A, Boucier D, Chapman L, Collins J, Goldenhar L, Heaney C, Katz T, Landsbergis P, Matonik K, Most I, Schneider S, Scharf T, Sinclair R: May 2000 Supplement on Preventing Occupational Injuries. American Journal of Preventive Medicine 20(4):308-309, 2001

Chapman LJ: Intervene More Often, Evaluate More Carefully, Do More of What Works. Journal of Agricultural Health and Safety 6(3):175-177, 2000

Title:	Wisconsin Production Agriculture Intervention Evaluation
Investigator:	Larry J. Chapman, Ph.D.
Affiliation:	University of Wisconsin
City & State:	Madison, WI
Telephone:	(608) 262-7408
Award Number:	5 R01 OH003953-03
Start & End Date:	9/30/1999–9/29/2002
Total Project Cost:	$648,000
Program Area:	Intervention Effectiveness Research Methods
Key Words:	prevention

Final Report Abstract:
This project evaluated the effectiveness of two production agriculture interventions intended to prevent or reduce traumatic and musculoskeletal injuries and other occupational health problems. We built on two ongoing efforts: 1) an intervention in Wisconsin among 19% of the nation's 116,874 dairy operations, and 2) an intervention in Wisconsin, Michigan, Minnesota and Iowa among 1 8% of the nation's estimated 30,000 fresh market vegetable operations.

The project we report on here supported intervention years 4 and 5 of the dairy producer intervention and the associated evaluation. The project also supported intervention years 3 and 4 of the fresh market vegetable producer intervention and the associated evaluation. As described in our original application, we accomplished the following specific aims:

Specific Aim #1. Continued the two interventions for 24 additional months. The project attempted to reduce exposures to hazards (and thereby reduce injuries) by encouraging dairy producers in Wisconsin and fresh market vegetable growers in a four state region (WI, lA, MI, MN) to adopt safer and more profitable production practices. We continued two, specially-designed information dissemination efforts that conveyed information to managers via the information channels that they were already known to use to learn about new production practices (i.e. print media, public events, other farmers, university Extension, the Internet, etc.). We began continuing the interventions in the first year of this project when other funding for them ended (March 2000).

Specific Aim #2. Evaluated the effectiveness of the interventions. We continued, for two additional years, the administration of annual mail questionnaires and other evaluation procedures. The mail questionnaires were sent to separate, population-based probability samples from the dairy farmer treatment group and the fresh market vegetable treatment group. In addition, questionnaires were sent to a dairy farmer control group (Maryland dairy farmers), and a control group for the fresh market vegetable farmers (nursery managers in the same four state region). The purposes of the evaluation were to determine:
1) if our materials were reaching and being received well by the target audience,
2) if farmer adoption or awareness of each production practice or perceptions of relative safety or profit advantages were changing, and

3) if farmer-reported injuries or musculoskeletal discomfort or other outcomes associated with production practices were changing.

We also collected qualitative data from interviews with farm managers about barriers to adopting the production practices we were promoting and about how to make our intervention efforts more persuasive. We evaluated after each year of the two additional intervention years (February 2001, February 2002).

Specific Aim #3. Added new production practice innovations to each intervention. We sought out reports from farmers and others about emerging production practices that could improve both safety and profits. We undertook field studies to quantitatively evaluate the hazard-reducing and profit-enhancing aspects of the best practices. We developed materials and added a new practice to each intervention each year. This work began at the start of this project (September 1999).

Publications

Meyer RH, Newenhouse A, Miquelon M, Chapman LJ: Tip Sheets on the Specialized Harvest Cart, Rolling Dibble Marker, Mesh Bags, Standard Containers, Narrow Pallet System, and Packing Shed Layout. Simple Soultions: Ergonomics for Farm Workers, (eds. Baron S, Estill C, Steege A, Lalich N), Cincinnati, OH, NIOSH Publication No. 2001-11, 2001

Josefsson KG, Chapman LJ, Tavira AD, Holmes BJ, Hard D: A Hazard Analusis of Three Silage Storage Methods for Dairy Cattle. Human and Ecological Risk Assessment 2001;7(7):1895-1908. 2001

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Baker R, Brockhous A, Boucier D, Chapman L, Collins J, Goldenhar L, Heaney C, Katz T, Landsbergis P, Matonik K, Most I, Schneider S, Scharf T, Sinclair R: May 2000 Supplement on Preventing Occupational Injuries. American Journal of Preventive Medicine 20(4):308-309, 2001

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