
Does Unauthorized Status Reduce Exposure to Pesticides? Evidence From the National Agricultural Workers Survey

Work and Occupations
36(4) 367–399
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DOI: 10.1177/0730888409347599
<http://wox.sagepub.com>



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Abstract

Ample scholarship suggests that unauthorized immigrants are more likely to face occupational hazards because their lack of legal status makes them more vulnerable to workplace abuse. Despite much research documenting how legal status affects wages, employment, and job stability, few studies have empirically analyzed impacts of legal status on the employment conditions of hired farmworkers. In this article we examine whether unauthorized farmworkers are more likely to handle pesticides and receive pesticide training. We use the National Agricultural Workers Survey, a data set that distinguishes between unauthorized, authorized, and citizen workers. Results from descriptive statistics and multivariate analyses suggest, contrary to expectation, that unauthorized legal status is associated with a reduced likelihood of handling pesticides or receiving training for pesticides. This finding is bolstered by results for control variables associated with unauthorized status, such as age and U.S. agricultural employment experience. Taken together, the results are consistent with labor market segmentation theory that suggests jobs encompassing occupational hazards

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are allocated to or held by more experienced workers who are better compensated for the risks they undertake.

Keywords

farm labor, agriculture, immigration, legal status, pesticides

Estimates suggest that the United States employs several million hired farmworkers and their family members each year (Kandel, 2008). Yet because they represent small proportions of both the U.S. workforce and the immigrant population, hired agricultural laborers and the work they perform are not well understood. Most studies acknowledge that agricultural work is relatively difficult with only marginal incentives at best, but little is known about the conditions workers face on the job. Studies of the demographics of this labor force profile the hired agricultural workforce as young, Mexican born or Hispanic, and many work without legal authorization (Carroll, Samardick, Bernard, Gabbard, & Hernandez, 2005; Kandel, 2008). Moreover, their presence largely reflects a strong consumer demand for year-round fresh fruits and vegetables, most of which involve labor-intensive production (Oliveira, 1993).

Studies of immigrant workers in other industrial sectors suggest that unauthorized status translates into substantial workplace disadvantage. Undocumented status restricts geographic mobility (Hotchkiss & Quispe-Agnoli, 2008), limits recourse against unscrupulous labor practices (Rothenberg, 1998), and reduces earnings (Donato, Aguilera, & Wakabayashi, 2005; Donato, Durand, & Massey, 1992; Donato & Massey, 1993; Donato, Wakabayashi, Hakimzadeh, & Armenta, 2008; Isé & Perloff, 1995; Kossoudji & Cobb-Clark, 1996, 2000, 2002; Massey, 1987; Phillips & Massey, 1999; Rivera-Batiz, 1999; Taylor, 1992). Few studies, however, have examined how legal status affects agricultural working conditions. Therefore, despite their marginalized socioeconomic status and large proportion in this industrial sector, we know little about differences in employment conditions of unauthorized foreign-born workers compared with legally authorized and naturalized citizen workers.

In this analysis, we extend the limited scholarship about the effects of legal status on immigrant employment by examining pesticide exposure among seasonal agricultural workers. We rely on data from the National Agricultural Workers Survey (NAWS), a nationally representative survey that includes a measure of legal status. During the second half of the 20th century, despite declines in their absolute numbers, hired crop farmworkers have increased as a percentage of all farmworkers, from 23.5% to 35.4%

between 1950 and 2000. In recent decades the proportion of farmworkers lacking authorized legal status has also increased substantially, from about 12% in 1989 to just more than 50% by the mid-2000s (Carroll et al., 2005; Kandel, 2008). With such a large proportion of unauthorized workers in a small but critical industrial sector, the hired farm labor force is ideal for studying linkages between legal status and occupational outcomes.

The present analysis attempts to disentangle the relationship between legal status and on-the-job pesticide exposure by modeling the likelihoods of pesticide handling and training among authorized and unauthorized immigrant workers. Using descriptive statistics and a multivariate analytic framework that controls for work experience, socioeconomic status, crop types, and geographical regions, we find, contrary to expectations, support for the “skilled-job” hypothesis. Specifically, being an authorized or a naturalized citizen immigrant worker increases the likelihoods of both pesticide handling and pesticide training. These findings highlight the importance of employment context for understanding the occupational disadvantages of legal status.

Theoretical Underpinnings of Labor Force Differences

Although no specific theory directly addresses the role of immigrant legal status in the American workplace, labor market segmentation theory offers an insightful theoretical construct to examine the effect of legal status on agricultural working conditions. As originally outlined in various forms by political economists (Doeringer & Piore, 1971; Reich, Gordon, & Edwards, 1973) and further articulated as dual labor market theory for the case of immigrant workers in industrialized societies by Piore (1979), labor market segmentation theory argues that attributes such as individual human capital, such as education, and social or cultural characteristics, such as occupation prestige, allocate workers to opposing employment trajectories. One consequence is that labor markets gradually bifurcate into “primary” sectors characterized by stable, well-paying jobs with defined occupational mobility structures and “secondary” sectors characterized by unstable, poorly paid, “dead-end” employment. This arrangement directs workers into specific mobility paths, limits worker aspirations, preempts worker organizational efforts, and legitimates workplace inequalities (Peck, 1996). For this study, labor segmentation theory suggests that legal status is a key attribute that allocates agricultural workers to particular working conditions and yields different economic opportunities.

Currently, legal status is oddly situated as an achieved characteristic (as opposed to one that is ascribed). Because it is extremely difficult to attain,

especially for unauthorized low-skilled workers from Latin America, legal status may serve—like postgraduate education in most labor markets—to delineate immigrant workers into primary or secondary sectors within agricultural employment. Workers able to demonstrate their legal status would signal to employers not only work authorization but also a range of other associated characteristics, including greater U.S. work experience and English fluency, that are interpreted positively for labor market productivity and investments in training. They also become more attractive candidates to employers by reducing the risks they face when hiring unauthorized workers.

These theoretical perspectives inform how social and economic mechanisms affect the likelihood that employees would handle pesticides or receiving pesticide training. If pesticide handling is seen as a hazardous task, immigrants with work authorization may be of greater value to employers and be less likely to have the “bad jobs” at the lower end of the occupational pecking order than recent immigrants with little U.S. experience and unauthorized status. If employers view pesticide handling as a critical and hazardous task whose precise application has substantial financial implications, those who handled pesticides would receive higher compensation. Therefore, legal status, which usually reflects greater U.S. work experience and English language ability, would increase the likelihood that farmworkers receive both pesticide tasks and investments in pesticide training (Knoke & Ishio, 1998; Sørensen, 1996).

Pesticide Hazards and Training in Agricultural Work

Specific pesticide hazards facing hired farmworkers remain difficult to ascertain. Prior studies about pesticide hazards in agricultural work suggest a prolific scholarship on illness related to pesticide exposure, which itself is widely underreported. According to a 1997 Environmental Protection Agency (EPA) estimate, between 10,000 and 20,000 U.S. agricultural workers experience pesticide-related illnesses that are classified as acute¹ each year (Blondell, 1997). This estimate, extrapolated from physician-reported cases in California, likely understates the actual number of illnesses for several reasons. Official reporting requires not only that workers both identify the illness and seek treatment but also that physicians correctly diagnose and report the illness to an appropriate poison control center. Partly as a consequence, the EPA is unable to compute viable national incidence rates of agriculturally related pesticide illness (U.S. General Accounting Office [GAO], 1993).

Underreporting affects incidents of not only pesticide poisoning but also pesticide treatment, more than two thirds of which is not reported to poison control centers according to several studies (Chafee-Bahamon, 1983, as cited in Calvert et al., 2003; Veltri, McElwee, & Schumacher, 1987). Underreporting of pesticide-related illnesses occurs because of misdiagnosis and the lack of state surveillance programs and because reporting is voluntary and/or affected persons do not seek either medical care or services from poison control centers (Calvert et al., 2003). Moreover, the GAO (2000) reports that growers routinely ignore regulations stipulated in the Worker Protection Standard implemented by the EPA in 1992, which sets standards for industrial hygiene related to agricultural pesticides.

Moreover, although the EPA's Worker Protection Standard mandates that workers entering areas where agrichemicals have been applied within the past 30 days must be trained within a week of work and receive subsequent training every 5 years,² existing studies portray gaps between legal stipulations and everyday practices. Research from the California Agricultural Workers' Health Survey indicates that only 57% of farmworkers surveyed in seven California communities reported receiving pesticide safety training (Villarejo et al., 2000). A recent study of Texan adolescent farmworkers found that only one in five received training and that men who worked for commercial growers/contractors and those who worked on corn and potato crops had the highest chances of receiving training (Shipp et al., 2007). Several reasons are offered for the lack of training. An extensive report on the topic suggests that enforcement and penalties for lack of training remain relatively weak in California, the state that happens to possess the most well-established pesticide regulatory and monitoring infrastructure in the United States (Reeves, Katten, & Guzmán, 2002). Moreover, relatively few educational materials are geared toward the current supply of agricultural workers, many of whom are younger than 18 years, speak indigenous languages, and/or are illiterate in Spanish and English (Durand, 2007; McCauley, Sticker, Bryan, Lasarev, & Scherer, 2002). In contrast, other studies about on-the-job pesticide training emphasize its effectiveness and the determinants of safe practices adoption (Arcury, Quandt, Austin, Preisser, & Cabrera, 1999; McCauley et al., 2006; McCauley et al., 2002; Quandt, Austin, Arcury, Summers, & Saavedra, 1999; Strong, Thompson, Koepsell, & Meischke, 2008). In sum, given the inconsistent way in which pesticide health incidents are reported, the danger pesticides pose and their widespread use, the utility of pesticide training for ameliorating the worst types of pesticide accidents, and the need for greater and more extensive education efforts, pesticide training may be seen as a scarce resource. As such, it is likely to be allocated by

growers according to both its cost in time and expense to workers who merit the investment and who are likely to eventually handle pesticides.

Legal Status and Exposure to Occupational Hazards and Pesticides

Pesticide exposure is the most common occupational hazard for crop farmworkers, followed by heat exposure, injuries, and poor field sanitation (Sakala, 1987). It is also the most widely analyzed (see Villarejo, 2003, for a review of this literature). Emphasizing legal status is important, given that legal status is a proxy for a host of individual attributes such as age, experience, and English language ability. Moreover, estimates from NAWs data indicate that roughly 50% of all hired crop farmworkers are currently unauthorized, a figure some consider conservative (Lowell & Suro, 2002).

Studies that address the relationship between legal status and exposure to occupational hazards suggest that undocumented workers face higher risks than authorized workers. In particular, unauthorized legal status may increase exposure to occupational hazards along four distinct pathways. First, unauthorized workers tend to be younger than authorized workers and consequently possess less U.S. work experience and English language proficiency. As such, they may be less likely than legal farmworkers to be aware of health hazards associated with their conditions of work (Omishakin, 1983). Second, unauthorized workers are more likely to cluster in hazardous occupations, such as in agriculture and construction, jobs that often have loose barriers to work entry, informal employment arrangements, and inadequate training and provision of safety measures and equipment (Mehta, Theodore, Mora, & Wade, 2002; Passel, 2006; Richardson, Ruser, & Suarez, 2003; Valenzuela, 2003). Moreover, some industries are more hazardous for certain types of workers than others. For example, Dong and Platner (2004) used data from the Census of Fatal Occupational Injuries to show that among construction workers, Hispanics were almost twice as likely to be killed by occupational injuries as non-Hispanics.

Third, immigrants' preferences for risky jobs may differ from those of native workers. Poorer immigrants may be more willing to trade health risks for higher wages. Support for this hypothesis is mixed. Although Berger and Gabriel (1991) offer evidence that suggests that immigrants are less likely than native workers to prefer employment in more hazardous industries, other studies contradict these findings (Loh & Richardson, 2004; Richardson et al., 2003). Finally, if faced with hazardous conditions, unauthorized immigrants may be in a weak position to register grievances because of fears of

deportation and relatively limited job opportunities compared with authorized workers. Given such labor market limitations, they may be more likely to engage in hazardous tasks or work in hazardous industries (Hotchkiss & Quispe-Agnoli, 2008).

Therefore, prior studies offer clues about how legal status may affect pesticide exposure. For example, because they are significantly more likely than authorized workers to “follow the crop,” unauthorized workers may be less likely to permanently settle in one destination, which would help them acquire greater U.S. work experience. As a result, unauthorized workers who face disadvantaged employment conditions because of their legal vulnerability may be more likely to encounter similar disadvantages with respect to pesticide handling. Assuming that pesticide application is understood by workers as hazardous, we would expect those with greater work experience to reduce their exposure to this risk.

In contrast, authorized status among workers is often a function of length of time spent in the United States. Persons with greater U.S. experience are more likely to have better English language skills and greater specialized work experience. Because pesticides are also a relatively costly input that, depending on its correct application, may substantially affect the value of a grower’s crop (Fernandez-Cornejo, Jans, & Smith, 1998), growers would be expected to allocate pesticide-related tasks to more experienced workers who would then be compensated at a higher level than farmworkers who did not handle pesticides. Therefore, legal status may be associated with greater exposure to occupational health hazards because authorized workers may be more likely to possess the necessary linguistic skills and work experience to undertake hazardous tasks than their presumably less experienced and more linguistically challenged unauthorized counterparts.

To summarize, findings about legal status effects on pesticide exposure suggest two competing hypotheses. The “lousy job” hypothesis posits that pesticide handling is a dangerous task shunned by experienced and established workers and relegated to the newest and most exploitable farm labor job entrants. According to this perspective, worker characteristics related to relative labor market disadvantage—such as less schooling, less U.S. experience, less English language ability, and unauthorized status—are positively associated with pesticide use. In contrast, the “skilled-job” hypothesis assumes that pesticide handling involves more cost and economic risk from grower’s potential legal expenses from crop failure and employee health problems. According to this perspective, growers would hire workers with relatively more agricultural labor experience, English language skills, and legal status,

and would pay them higher wages. Pesticide handling would then represent a sought-after task by immigrant workers seeking higher compensation.

Data and Method

Data for this analysis come from the NAWS, a nationally representative and stratified random survey of hired farmworkers conducted by the U.S. Department of Labor (<http://www.doleta.gov/agworker/naws.cfm>). Every year since 1989, the department has surveyed crop farmworkers at work sites using a multistage sampling procedure that chooses a sample of counties to reflect the major agricultural regions in each state and randomly selects agricultural employers who are then approached to request participation. Once permission is granted, interviewers go to work sites to randomly sample and interview farmworkers. Workers are surveyed three times a year to account for seasonal variation, and sample size ranges from a maximum of 3,612 cases in 1999 to a minimum of 1,518 cases in 2006. Note the sample excludes secretaries, mechanics, and H2-A program guestworkers but includes field packers and supervisors. Since 1989, when the survey began, nearly 50,000 workers have been interviewed.

The data set contains demographic and literacy information, short-term employment histories including earnings and other work conditions, and basic employment information for all household members. It also contains extensive information on health outcomes and exposure to hazardous risks, including sanitary conditions at the work site, injuries, mixing and applying pesticides, self-reported health, and use of health care. Most important, for our purposes, it differentiates respondent's legal status according to citizen, authorized (several categories of which are grouped together), and unauthorized.

We pooled NAWS data collected from 1989 through 2006 into one file, which yielded a total of 46,568 cases. Of this total, we removed 569 cases where legal status was not determined and, to focus our analyses exclusively on immigrant workers, we also removed all U.S.- and Puerto Rico-born farmworkers (who comprised 26.7% of the total sample). This leaves a sample of 33,604 farmworkers who fall into one of three legal status groups: *naturalized citizen*, occurring through naturalization; *documented*, indicating that workers have permanent residency (i.e., a green card) or other legal visa to work in the United States; and *undocumented* or *unauthorized* to work. In the following analysis, we use NAWS postsampling weights that adjust the relative value of each interview for deviations from the sampling plan so national estimates can be obtained from the sample (U.S. Department of Labor, 2008).

Although the NAWS remains the only national data set on agricultural workers with information on legal status, it poses several challenges for researchers. First, the data only represent hired crop farmworkers rather than all agricultural workers, including those working with livestock. We do not expect this issue to limit the conclusions of our analysis because pesticide handling occurs primarily in crop and not livestock agriculture. Second, because of changes in the survey instrument, a number of questions have been discontinued and others added at various points since the survey was begun in 1989. Consequently, the time series for several variables we use in this analysis refer to different time periods. Consider two of our dependent variables. Between 1993 and 1999, NAWS respondents were asked if they had “ever mixed pesticides in the preceding 5 years.” Between 2000 and 2001, no questions were asked about pesticide application. Then, between 2002 and 2006, the last year for which we have data, a new question asks respondents “in the last 12 months, have you loaded, mixed, or applied pesticides?” Together, the question differences in time frames for recall, for example, 5 years versus 12 months, and in the nature of pesticide exposure, for example, mixed versus applied versus used, suggest caution for how we use these data (see the appendix for exact question wording).³

Descriptive Analysis

We focus on two dependent variables we subsequently use in the multivariate analysis: pesticide exposure and training. Because the nature of worker exposure varies across years of the survey, from mixing to applying pesticides, we use the term pesticide “handling” to summarize both in one concept. Figures 1A and B describe pesticide handling among hired farmworkers by legal status in the prior 5 years (Figure 1A) or 12 months (Figure 1B). Recall that between 1993 and 1999, the NAWS asked farmworkers about mixing pesticides in the prior 5 years, a risk period 5 times that of farmworkers surveyed from 2002 to 2006 who were asked about pesticide application in the prior 12 months. Despite this difference and annual fluctuations because of NAWS sample variation, Figures 1A and B show lower pesticide handling rates for unauthorized workers than for authorized and naturalized citizen workers. They also show a legal status gap that has grown larger over time. In 1993, 26% of naturalized citizens and 15% of unauthorized immigrants handled pesticides in agricultural work during the preceding 5 years, with the rate for authorized migrants falling between these two. By 1999, however, the gap grew and ranged from 10% for unauthorized migrants to a high of 28% for naturalized citizens. With respect to the handling of pesticides during the past

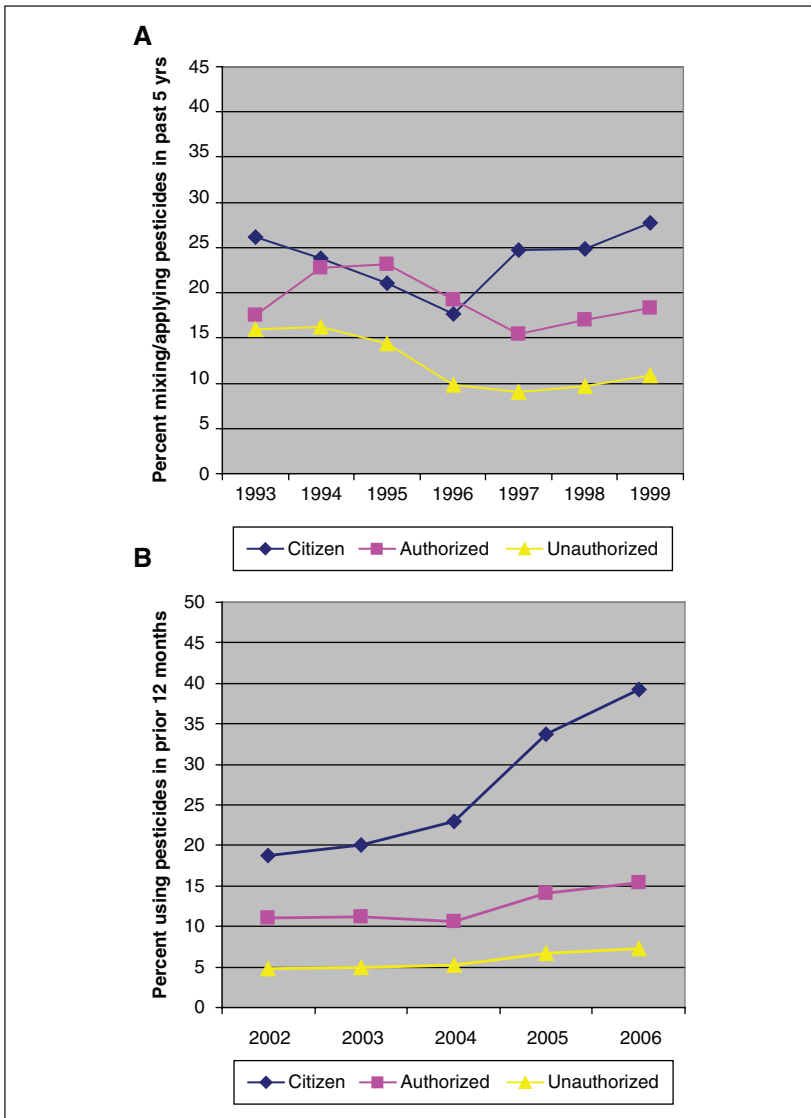


Figure 1. Pesticide handling of immigrant workers in (A) past 5 years (1993-1999) and (B) Prior 12 months (2002-2006) by legal status
 Note: Values are averaged over 3 years to smooth fluctuations.

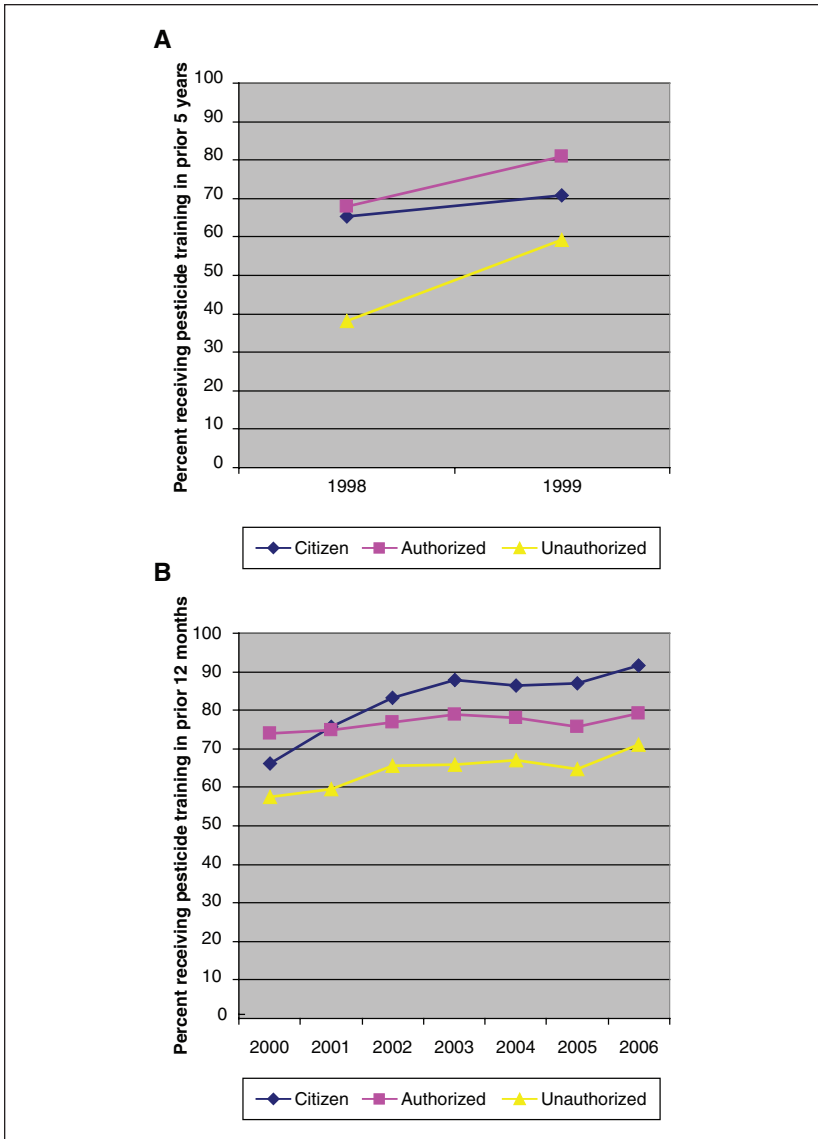


Figure 2. Pesticide training of immigrant workers in (A) past 5 years (1998-1999) and (B) prior 12 months (2000-2006) by legal status
Note: Values are averaged over 3 years to smooth fluctuations. The NAWS data contain information for this variable for 1999 as well, but for illustrative purposes, we omit that year to maintain continuity between Figure 2A and B. In the regression models described, both models contain data for 1999.

Table 1. Mean Hourly Wages of Immigrant Workers (in Constant 2006 \$) by Pesticide Handling and Years of U.S. Agricultural Experience: 1993-1999 and 2002-2006

Years of U.S. Agricultural Experience	1993-1999						2002-2006					
	Handled Pesticides			Did Not Handle Pesticides			Handled Pesticides			Did Not Handle Pesticides		
	Average Wage	Percentage Increase	Average Wage	Percentage Increase	Average Wage	Percentage Increase	Average Wage	Percentage Increase	Average Wage	Percentage Increase	Average Wage	Percentage Increase
0-1	5.16		5.17		7.30		6.96		7.30		6.96	
2-5	5.33	3.3	5.37	3.9	7.73	7.73	5.9	7.11	7.73	7.11	2.0	2.0
6-14	5.98	12.2	5.53	2.9	8.36	8.36	8.1	7.57	8.36	7.57	6.5	6.5
15+	6.13	2.5	5.68	2.8	8.85	8.85	5.8	8.02	8.85	8.02	5.9	5.9
Total	5.76	18.8	5.40	9.9	8.43	8.43	21.2	7.41	8.43	7.41	15.1	15.1

Note: Seventy-seven percent of respondents to the National Agricultural Workers Survey questions on pesticide use between 1993 and 1999 were paid on an hourly basis. For respondents surveyed between 2002 and 2006, the figure was 82%.

12 months, the rates ranged from 5% to 19% in 2002, and by 2006, the gap varied from a low of 6% for the unauthorized to a high of 40% for naturalized citizens, with 15% for authorized migrants.

Similar but less pronounced patterns appear for pesticide training. Figure 2A and B shows the percentage of hired farmworkers who received training by legal status during 5 years prior to the year of the survey (Figure 2A)⁴ or in the last 12 months (Figure 2B). Findings reveal that (a) the chances of receiving pesticide training are much higher than exposure or use of pesticides, and (b) unauthorized farmworkers have consistently lower rates of training than authorized and naturalized citizen farmworkers. In 2006, approximately 70% of unauthorized migrants, 80% of authorized workers, and 90% of naturalized citizens received training in the prior 12 months. Trends in these figures provide some evidence for the skilled-job hypothesis because they suggest that pesticide exposure is likely higher among workers legally authorized to work (via naturalized citizenship or employment visas). Generally speaking, this group of workers has more U.S. agricultural experience and better English language skills than the unauthorized.

Corroborating evidence is found when examining wage data for farmworkers by years of U.S. experience. Table 1 presents mean hourly wages in constant 2006 dollars for farmworkers using pesticides in the past 5 years or 12 months prior to the survey by years of work experience. Two key findings emerge. First, wages earned by workers who handled pesticides exceed those without such experience. Among all farmworkers in 2002-2006, those who worked with pesticides earned an hourly wage of \$8.43 and those who did not earned \$7.41. This difference persists in each category of years of work experience. Second, rates at which wages increased were often greater for those who handled pesticides than for those who did not. For example, between 2002 and 2006, farmworkers with 2 to 5 years of experience and pesticide application earned an hourly wage of \$7.30 compared with \$7.73 for those who did not; their wages increased by 5.9% and 7%, respectively. Hence, these data support the "skilled-job" hypothesis, suggesting that relatively more hazardous work involving pesticide handling represents higher paying employment that yields better returns to agricultural employment experience.

Table 2 also offers some, albeit mixed, support for the "skilled-job" hypothesis. We examine pesticide handling in the prior 5 years and past 12 months according to four human capital variables that measure English-speaking and reading ability, U.S. experience, and education. With respect to English ability and work experience, farmworkers who handle pesticides possess greater human capital than farmworkers without such experience.

Table 2. Selected Human Capital Characteristics of Immigrant Workers by Pesticide Handling in Prior Year

	Pesticide Handling in Previous 5 Years (1993-1999)		Pesticide Handling in Previous 12 Months (2002-06)	
	Handled Pesticides	Did Not Handle Pesticides	Handled Pesticides	Did Not Handle Pesticides
English speaking ability				
Not at all	33.4%	53.8%	26.9%	56.9%
A little	43.7%	33.2%	46.7%	32.4%
Somewhat	15.5%	7.9%	20.9%	6.7%
Well	7.4%	5.1%	5.6%	3.9%
English writing ability				
Not at all	48.2%	64.9%	42.7%	66.8%
A little	34.4%	24.2%	37.7%	24.9%
Somewhat	11.4%	6.1%	14.7%	4.8%
Well	6.1%	4.8%	4.9%	3.5%
Educational attainment				
<6 years	37.1%	36.8%	27.4%	32.0%
6-8 years	37.3%	37.8%	43.9%	37.5%
9-11 years	15.5%	16.9%	20.9%	21.6%
12+ years	10.1%	8.5%	7.9%	8.9%
U.S. agricultural experience				
0-1 years	14.2%	30.3%	4.6%	21.7%
2-5 years	24.3%	26.8%	18.1%	27.6%
6-14 years	31.1%	27.1%	28.0%	27.8%
15+ years	30.4%	15.8%	49.3%	22.9%

Among respondents to the 12-month question, workers applying pesticides are more likely to speak and read English well and have 15 or more years of agricultural experience. In contrast, however, pesticide handlers are no different from nonusers who have completed 12 or more years of schooling. This finding is consistent with Kandel (2008) who reported that among foreign-born Hispanics, who constituted roughly three fourths of all hired crop farmworkers in 2006, relatively higher levels of human capital correlated strongly with greater U.S. experience and authorized or citizenship status.

In sum, descriptive analyses offer mixed support for the “skilled-job” hypothesis. We find substantially less pesticide handling for unauthorized farmworkers compared with citizen farmworkers and that workers who handle pesticides receive higher wages and exhibit higher levels of some human capital compared with those who lack such experience. The exception is for years of formal schooling: those who did not handle pesticides reported more years of schooling than those who did. This finding supports the “lousy-job” hypothesis which posits that their disadvantaged position relegates unauthorized workers to the most difficult and hazardous on-the-job tasks.

Multivariate Analysis of Pesticide Handling and Training

We now extend our analysis to control for a range of characteristics that existing research indicates affects farmworker employment outcomes. Table 3 presents descriptive statistics for the analysis. The four outcomes that we model encompass pesticide handling and training, measured either as having occurred during the 12 months or during the 5 years prior to the survey. However, because of the considerable time gap between characteristics measured at the time of the survey and a dependent variable occurring up to 5 years prior to the survey, we emphasize findings from the two dependent variables that measure pesticide handling and training within 12 months of the survey.

The analysis emphasizes legal status as our critical variable of interest and treats those *undocumented* or *unauthorized* to work as the reference category. In addition, we control for four categories of individual-level characteristics. Demographic attributes include age, age squared, and being female, indigenous, not born in Mexico, and married. We include an indicator variable for indigenous background based on widespread evidence of indigenous disadvantage in Latin America, the extension of status hierarchies among foreign-born Latinos into U.S. labor markets, and potential language challenges with both English and Spanish (McCauley et al., 2002). For similar reasons, we control for foreign birth outside of Mexico. Human capital is also expected to strongly influence the likelihood of pesticide handling and pesticide training. Four dummy variables capture total accumulated educational attainment, with 0 to 5 years of schooling as the reference category. We also include a variable indicating that respondents either spoke English or read English well, the highest proficiency option among four possible responses for both questions.

Table 3. Descriptive Statistics

Dependent variable	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Handled pesticides during prior 12 months	0.09	0.28						
Handled pesticides during prior 5 years			0.14	0.35				
Received pesticide training during prior 12 months					0.69	0.46		
Received pesticide training during prior 5 years							0.58	0.49
Legal status								
Naturalized citizen	0.03	0.18	0.03	0.17	0.03	0.17	0.03	0.17
Documented	0.31	0.46	0.37	0.48	0.30	0.46	0.33	0.47
Unauthorized (reference)	0.66	0.47	0.60	0.49	0.66	0.47	0.64	0.48
Demographic characteristics								
Age	33.32	11.86	31.09	11.36	32.43	11.66	31.32	11.42
Age squared	1,250.82	900.79	1,095.54	845.62	1,187.78	877.62	1,111.01	855.03
Female	0.21	0.40	0.16	0.37	0.20	0.40	0.19	0.39
Indigenous	0.11	0.31	0.06	0.23	0.10	0.30	0.10	0.30
Non-Mexican-born	0.04	0.21	0.07	0.25	0.04	0.19	0.03	0.18
Married	0.62	0.49	0.56	0.50	0.59	0.49	0.54	0.50
Human capital								
0-5 years (reference)	0.32	0.47	0.37	0.48	0.32	0.47	0.34	0.47
6-8 years	0.38	0.49	0.37	0.48	0.39	0.49	0.39	0.49
9-11 years	0.21	0.41	0.17	0.37	0.21	0.41	0.19	0.39
12+ years	0.08	0.28	0.09	0.28	0.07	0.26	0.08	0.27
Good English ability	0.04	0.20	0.07	0.25	0.04	0.20	0.05	0.21
Employment								
0-1 years average experience	0.20	0.40	0.27	0.44	0.23	0.42	0.28	0.45
2-5 years average experience	0.26	0.44	0.26	0.44	0.27	0.44	0.29	0.45
6+ years average experience (reference)	0.54	0.50	0.46	0.50	0.50	0.50	0.41	0.49

(continued)

Table 3. (continued)

	Mean	SD	Mean	SD	Mean	SD	Mean	SD
International shuttler	0.32	0.47	0.45	0.50	0.37	0.48	0.47	0.50
Contractor employer	0.21	0.40	0.26	0.44	0.24	0.43	0.32	0.47
Fieldworker	0.77	0.42	0.00	0.00	0.66	0.47	0.00	0.00
Earns below minimum wage	0.02	0.14	0.08	0.27	0.03	0.16	0.08	0.27
Geography								
Northeast	0.12	0.33	0.17	0.38	0.12	0.33	0.16	0.36
Southeast	0.10	0.30	0.14	0.35	0.11	0.31	0.12	0.33
Midwest	0.13	0.33	0.14	0.35	0.13	0.34	0.13	0.34
Southwest	0.08	0.26	0.07	0.26	0.07	0.26	0.07	0.26
Northwest	0.14	0.34	0.11	0.31	0.13	0.34	0.12	0.32
California (reference)	0.44	0.50	0.37	0.48	0.43	0.50	0.40	0.49
Crop								
Field crops (reference)	0.11	0.32	0.17	0.37	0.12	0.32	0.15	0.36
Fruits and nuts	0.38	0.48	0.40	0.49	0.39	0.49	0.41	0.49
Vegetables	0.30	0.46	0.28	0.45	0.29	0.45	0.27	0.44
Horticulture	0.17	0.37	0.09	0.29	0.15	0.36	0.11	0.31
Other crops	0.05	0.22	0.06	0.23	0.05	0.21	0.05	0.23
NAWS data years								
1992-1994	—	—	0.39	0.49	—	—	—	—
1995-1997	—	—	0.29	0.45	0.30	0.46	1.00	0.00
1998-2000	0.40	0.49	—	—	0.36	0.48	—	—
2001-2003	0.60	0.49	—	—	0.34	0.47	—	—
2004-2006	—	—	—	—	—	—	—	—
N		8,507		14,549		14,977		4,650

Note: NAWS = National Agricultural Workers Survey.

Other employment-related variables address occupational factors likely to influence pesticide exposure. To control for agricultural employment experience in the United States, we include two indicator variables for 0 to 1 year and 2 to 5 years of experience. Because extensive U.S. agricultural experience is closely correlated with legal status, we use 6+ years of experience as the reference category. Additional employment-related variables include whether the respondent is an international shuttler, defined as someone who crosses an international border and migrates more than 75 miles to find employment within the preceding 12 months of the survey. Because a substantial body of evidence points to greater likelihood of economic disadvantage and occupation hazards for farmworkers who are often employed by farm labor contractors (Das, Steege, Baron, Beckman, & Harrison, 2001; Martin, 2003; Rothenberg, 1998), we also control for contractor employment. Moreover, exposure to pesticides may be influenced by the specific work performed by farmworkers. To capture this attribute, we include a dummy variable where 1 = *fieldwork* and 0 = *otherwise* because fieldwork is the most prevalent work type. As an added measure of disadvantage that might signal differential exposure to occupational hazards, we also control for whether farmworkers earned below the minimum wage on their current job.

Our analysis includes features of agricultural experience affecting pesticide exposure beyond individual characteristics. Geography affects pesticide handling and training in two ways. First, pesticide handling is based on the quantity and type of agricultural production, which varies from region to region. Second, regions have various strengths of pesticide regulation by state, which affect utilization and training, and in some states, rates of both may exceed federal regulations. California, which regulates pesticides to the largest extent and has an enormous agricultural industry, serves as the reference category. However, note that region and crop indicator variables possess a timing shortcoming with respect to the dependent variables. Geography and crop variables are measured at the time of the survey, and as a result, they can easily change as farmworkers migrate, whereas pesticide handling and training were measured in the last 12 months and 5 years. Two factors mitigate this concern. Across the entire time span of NAWS data collection, the majority of farmworkers surveyed reside permanently in their communities (Kandel, 2008). In addition, a substantial proportion of follow-the-crop farmworkers migrate within the same region during their work spells (e.g., the Midwest or California). Finally, to control for changes over time in agricultural production and pesticide exposure, we include indicator variables for survey years, aggregated to 3-year intervals, with 1989-1991 serving as the reference group.

Because the dependent variables are binary, Tables 4 and 5 present results from logistic regression models of pesticide handling and training. Almost all coefficients in the models in Table 4 provide support for the “skilled-job” hypothesis. We begin by reviewing results in the first two columns on the left-hand side of Table 4 for pesticide application during the past 12 months between the years 2002 and 2006. Results for legal status, our key variable of interest, indicate that, controlling for all other characteristics, unauthorized workers were significantly less likely to have applied pesticides during the year than legally authorized and citizen workers. Translated into exponents of the natural log, the coefficients indicate that authorized worker status increases the odds of handling pesticides by a factor of 1.5. For citizen farmworkers, the odds of handling pesticides compared with unauthorized workers is 3.6 times higher.

Results for the demographic and human capital characteristics in the model are consistent with the skilled-job hypothesis. Older workers, those who are men, those who are not indigenous or born in Mexico, and those who are married are more likely to have handled pesticides. Moreover, farmworkers with greater levels of education and a strong command of English are more likely to apply pesticides than those with less than primary school education or who do not read or speak English well.

Similarly, farmworkers with relatively less agricultural experience are less likely to handle pesticides. For instance, having less than 2 years of experience reduces the odds by about one third compared with the reference group of workers with at least 6 years of agricultural experience. International shuttlers, who clearly possess less residential stability or attachment to the United States, are significantly less likely to handle pesticides. The same is true for farmworkers employed through contractors, a labor market arrangement rife with abuse and often undertaken by persons with relatively little social capital and U.S. work experience (Rothenberg, 1998). In contrast, results for those employed as fieldworkers and those earning less than the minimum wage were statistically no different in pesticide application than those not employed in fieldwork and those earning above the minimum wage.

Results also suggest that pesticide handling varies significantly by crop type. Consistent with data on pesticide use that indicate field crops accounted for more than 85% of all pesticide application in the United States in 1996 (Fernandez-Cornejo & Jans, 1999), Table 4 shows that farmworkers in fruit and vegetable production are significantly less likely to handle pesticides than farmworkers in field crops (the reference group). This difference does not suggest that seasonal workers harvesting fruits and vegetables are unexposed to pesticides. On the contrary, Fernandez-Cornejo et al. (1998) and Galt (2008) document greater intensity of pesticide use in fruit and vegetable

Table 4. Logistic Regression Predicting Pesticide Handling of Immigrant Workers: 2002-2006 and 1993-1999

	Handled Pesticides During Prior 12 Months (2002-2006)		Handled Pesticides During Prior 5 Years (1993-1999)	
	B	SE	B	SE
Legal status				
Naturalized citizen (reference = undocumented)	1.293***	0.187	0.409***	0.135
Documented	0.378***	0.106	0.183***	0.066
Demographic characteristics				
Age				
Age squared	0.083***	0.026	0.007	0.013
Female	-0.001***	0.000	0.000	0.000
Indigenous	-1.839***	0.177	-0.783***	0.081
Non-Mexican-born	-0.329*	0.179	-0.385***	0.122
Married	0.621***	0.187	0.106	0.109
Human capital	0.269***	0.107	0.254***	0.059
6-8 years (reference = 0-5 years)	0.468***	0.107	0.159***	0.060
9-11 years	0.397***	0.130	0.078	0.082
12+ years	0.294*	0.175	0.324***	0.096
Good English ability	0.340*	0.180	0.063	0.101
Employment				
0-1 years average experience (reference = 6+ years)	-1.083***	0.224	-0.780***	0.092
2-5 years average experience	-0.536***	0.127	-0.221***	0.073
International shuttler	-0.648***	0.121	-0.270***	0.058
Contractor employer	-1.056***	0.166	0.218***	0.061
Fieldworker	0.173	0.152	—	—
Earns below minimum wage	-0.181	0.414	-0.103	0.114

(continued)

Table 4. (continued)

	Handled Pesticides During Prior 12 Months (2002-2006)		Handled Pesticides During Prior 5 Years (1993-1999)	
	B	SE	B	SE
Geography				
East (reference = California)	-0.271	0.170	0.255***	0.094
Southeast	0.810***	0.150	0.374***	0.090
Midwest	-0.497***	0.169	-0.449***	0.099
Southwest	0.842***	0.154	0.208**	0.102
Northwest	0.601***	0.122	0.354***	0.083
Crop				
Fruits (reference = field crops)	-0.384***	0.130	0.503***	0.091
Vegetables	-1.210***	0.158	-0.069	0.093
Horticulture	0.008	0.185	0.791***	0.109
Other crops	0.156	0.178	0.694***	0.119
NAWS data years				
1992-1994			reference	—
1995-1997			-0.267***	0.062
1998-2000			-0.212***	0.066
2001-2003	reference	—		
2004-2006	0.087	0.091		
Constant	-3.723***	0.533		
Nagelkerke R ²	0.238			
-2 log likelihood	3,974.1		-2.155***	0.271
N	8,321		0.095	
			10,683.8	
			13,883	

Note: NAWS = National Agricultural Workers Survey.

*p < .1. **p < .05. ***p < .001.

Table 5. Logistic Regression Predicting Pesticide Training of Immigrant Workers: 1999-2006 and 1998-1999

	Received Pesticide Training Within Past 12 Months (1999-2006)		Received Pesticide Training Within Past 5 Years (1998-1999)	
	B	SE	B	SE
Legal status				
Naturalized citizen (reference = undocumented)	0.506***	0.142	-0.112	0.210
Documented	0.262***	0.055	0.542***	0.098
Demographic characteristics				
Age	0.015	0.010	-0.008	0.018
Age squared	0.000	0.000	0.000	0.000
Female	-0.087*	0.051	-0.256***	0.091
Indigenous	0.048	0.070	-0.087	0.117
Non-Mexican-born	0.104	0.100	0.148	0.200
Married	0.096**	0.046	0.071	0.079
Human capital				
6-8 years (reference = 0-5 years)	0.271***	0.049	0.241***	0.083
9-11 years	0.333***	0.059	0.038	0.104
12+ years	0.193**	0.084	0.344**	0.147
Good English ability	-0.171*	0.100	0.184	0.182
Employment				
0-1 years average experience (reference = 6+ years)	-0.925***	0.065	-0.941***	0.110
2-5 years average experience	-0.317***	0.055	-0.031	0.098
International shuttler	-0.109**	0.048	-0.381***	0.081
Contractor employer	-0.064	0.054	-0.126	0.082
Fieldworker	0.475***	0.053	—	—
Earns below minimum wage	-0.624***	0.118	-0.865***	0.151

(continued)

Table 5. (continued)

	Received Pesticide Training Within Past 12 Months (1999-2006)		Received Pesticide Training Within Past 5 Years (1998-1999)	
	B	SE	B	SE
Geography				
East (reference = California)	-1.364***	0.070	-0.673***	0.124
Southeast	-1.470***	0.070	-0.746***	0.127
Midwest	-1.018***	0.070	-0.506***	0.131
Southwest	-1.571***	0.080	-0.766***	0.152
Northwest	-1.100***	0.065	-0.372***	0.123
Crop				
Fruits (reference = field crops)	0.327***	0.069	1.138***	0.125
Vegetables	0.153**	0.068	1.089***	0.120
Horticulture	0.808***	0.083	1.344***	0.149
Other crops	0.257**	0.104	1.343***	0.176
NAWS data years				
1992-1994	reference	—		
1995-1997	0.159***	0.053		
1998-2000	0.226***	0.055		
2001-2003	0.683***	0.208		
2004-2006	15.731.2		0.122	0.358
Constant	0.193		5,069.7	
-2 log likelihood	14,600		0.261	
Nagelkerke R ²			4,540	
N				

*p < .1. **p < .05. ***p < .001.

crops, compared with field crops. However, field crops comprise a much greater proportion of agricultural territory.

Results from this model are consistent with those noted above. They show that authorized and naturalized citizen farmworkers with legal status have a significantly greater likelihood of having handled pesticides in the prior 5 years than unauthorized farmworkers, controlling for variation in individual demographic, human capital, and employment characteristics as well as for differing geographies and crops. That these results generally conform to those for pesticide handling in the past 12 months for 2002-2006 is especially striking because of the potential for timing incongruity between the dependent variable and the independent covariates.

Table 5 displays logistic regression results for the dependent variables: whether farmworkers had received pesticide training during the past 12 months for respondents of 1999-2006 or during the past 5 years for respondents of 1998-1999. The results indicate that the profile for farmworkers who handle pesticides is similar to those likely to receive formal or informal pesticide training. Most notably, authorized and citizen farmworkers were significantly more likely to receive such training than unauthorized farmworkers, controlling for the other individual and macro-level characteristics in our model. Farmworkers who are more likely to receive pesticide training include those with greater levels of education, more employment experience, stable U.S. residence, and earnings above the minimum wage, all characteristics that correspond to more established, better prepared employees. As with the models for handling pesticide, the results also indicate a gender divide with women significantly less likely to receive pesticide training than men, although why this occurs remains unclear (see also Shipp et al., 2007). Therefore, on the whole, these results continue to support the "skilled-job" hypothesis regarding pesticide handling. Only results for good English ability in the first model in Table 5 deviated from the above pattern, appearing negatively associated with pesticide training.

Results from both models reveal that farmworkers in California (the reference category) are far more likely to receive pesticide training than those in any other region. This finding is consistent with previous research indicating a relatively high level of pesticide regulation and larger relative size of fruit and vegetable farming in that state (Aguirre International, 2005). Moreover, our results suggest that workers employed in all crops—fruits, vegetables, horticulture, and other crops—are more likely to receive training than those working in field crops, which are less labor intensive (Kandel, 2008). Finally, results for the year variables indicate that pesticide training has become more prevalent in more recent years.

Discussion

This analysis extends prior research that examines the effect of legal status on employment conditions to those faced by hired farmworkers. Specifically, we examined whether and how legal status affected farmworkers' handling of pesticides and receiving training for their application. Because it ranks at or near the bottom of occupational prestige scales and includes many unauthorized workers, hired farm labor is often figuratively and literally hidden from public view and difficult to study. Yet studying workers in hired farm jobs represents an opportunity to understand a type of employment characterized by weak regulation enforcement, occasionally unscrupulous employment practices, and hazardous working conditions (Kandel, 2008).

Our findings suggest that pesticide exposure in agricultural production is strongly related to legal status. Although some expect unauthorized farmworkers, who possess very little, if any, labor and economic bargaining power, to face the greatest likelihood of handling pesticides and receiving pesticide training, results suggest the opposite and provide consistent support for a "skilled-job" perspective whereby pesticide-related farmwork yields higher pay and greater returns to U.S. agricultural experience than nonpesticide farmwork. Furthermore, seasonal farmworkers who are relatively older, more educated, more experienced in U.S. agriculture, more proficient in English, and more settled in the United States are more likely to handle pesticides and receive pesticide training. After controlling for these and other characteristics, authorized and naturalized citizen legal statuses remain important correlates for both outcomes.

Other findings are also noteworthy. First, women and indigenous farmworkers were significantly less likely to handle pesticides. Although female farmworkers show greater economic disadvantage within the hired farm labor force (Kandel, 2008), it is not clear whether this finding stems from concerns of employers over their assessment of worker characteristics or whether farmworkers themselves make decisions about exposing pesticide health risks to women and to their children. In his analysis of the H2-A farmworker program, for instance, Griffith (2006) documents how cultural norms among immigrant workers dictate to a large extent which industrial sectors men and women work in as well as what tasks within sectors men and women undertake. Therefore, workers' own decisions about which tasks are appropriate and for whom are as critical as employer assessments of worker characteristics for allocating tasks such as pesticide handling among farmworkers. Second, of the six geographic regions considered in our analysis, California, as the nation's leading agricultural producing state, was exceptional. After

controlling for crop type and fieldworker status, farmworkers in California exhibited a lower likelihood of handling pesticides and a greater likelihood of receiving pesticide training compared with farmworkers in other regions. Third, crop type also affected pesticide outcomes although the results for pesticide handling were more ambiguous than for pesticide training. Field crops employment exposed farmworkers to a greater likelihood of handling pesticide than working in fruits, nuts, and vegetables, a finding consistent with agricultural statistics nationwide. In contrast, results for pesticide training suggest just the opposite, although this may result from differences in the reference period, for example, 5 years for pesticide training compared with 1 year for pesticide handling. Both models, however, indicate that workers in field crops are less likely to receive pesticide training than workers in other crops even though pesticides are used largely for field crops in the United States.

We caution readers to understand our findings in light of the limitations embedded in our analysis. First, we use cross-sectional data that limit our ability to disentangle causality. Hence it may be that legal status signals to employers the limited experience of a given employee or, alternatively, that unauthorized farmworkers may be less likely to use pesticides because of personal characteristics related to their recent arrival—less U.S. agricultural experience, fewer English language skills—compared with those with authorized or citizen farmworkers. Similarly, although higher levels of training may also lower pesticide exposure, our interpretation is that less training reduces exposure to mixing and handling pesticides. Another limitation is that our data derive from workers' self-reports, which are subject to biases stemming from accurate recall over 12-month or 5-year periods, and from their perceptions of risk and how much control they had over such risks in their work environment (Arcury & Quandt, 2003). Moreover, pesticide training and application may not always be clearly delineated conditions because the NAWS asks respondents if they received formal or informal training, and the latter may, by definition, include haphazard instructions. Finally, there is the issue of legal status itself and what it means for participation in the NAWS. Because most unauthorized immigrants are reluctant to participate in official surveys or reveal their legal status, we do not know the extent to which unauthorized respondents in the NAWS represent a unique population and are different from those who chose not to participate in the NAWS.

Nevertheless, given how little is known about how unauthorized legal status affects working conditions and specifically exposure of farmworkers to pesticide-related tasks, these findings merit attention. Pesticides represent an

occupational hazard that promises positive economic benefits to agricultural producers if applied correctly. Because their hazardous properties have been scientifically demonstrated, pesticides are widely regulated and exposure is reported to medical registries that garner attention from farmworker advocates and others concerned about farmworker health and well-being. Growers may therefore implement economic incentives to minimize conditions that would lead to pesticide-related health problems among their workers and insure that those applying pesticides are competent and experienced—a motivation that favors more established workers with authorized status or citizenship.

Conclusion

More broadly, our results suggest that unauthorized status limits pesticide exposure among seasonal agricultural workers in the United States. Although this is a new finding, it requires two important caveats. First, all agricultural workers are exposed to pesticides, whether or not they directly handle them on the job. Exposure occurs in a variety of ways, from applying pesticides to crops, to picking crops that have been sprayed, to drinking water from wells that have absorbed pesticides—even in trace amounts. For example, a review of pesticide incident data for Washington State indicates that roughly 40% of all pesticide incidents in 2006 occurred because of *indirect* contact with pesticides from workers who did not explicitly handle pesticides (Washington State Department of Health, 2008). Second, if skilled farmworkers are those who handle pesticides and earn higher pay, then agricultural labor markets are segmented (see Hodson & Kaufman, 1982; Peck 1992, 1996; Riech et al., 1973, Tolbert, Horan, & Beck, 1980). Under this scenario, legal status allocates documented and undocumented immigrant workers to different agricultural labor segments. Therefore, the most marginalized immigrant agricultural workers, for example, those without legal authorization to work, are less likely to handle pesticides, a finding that suggests employers allocate particular jobs to workers with particular skills. Higher paid jobs involving pesticide-related tasks are, then, the sought-after “good jobs.”

Together these results illustrate how legal status affects the conditions of hired crop farmwork, an occupation that has been central to debates about U.S. immigration policy. Throughout history, agricultural employment has played key roles in these debates, whether in the form of the temporary worker programs sponsored by the U.S. government from 1942 to 1964 or the 1986 amnesty program that offered legal permanent residency to migrants who documented prior agricultural work in the United States (Martin, 1998; Thomas, 1987). In

general, agricultural growers have either resisted immigration restrictions or supported changing the current H-2A visa program, which only has a limited capacity to offer legal visas to temporary agricultural workers. Last year, just 64,000 H-2A visas were granted, representing 3% of the almost two million agricultural workers employed (Kandel, 2008). Although the U.S. Department of Labor is currently reviewing regulations that implement the H-2A program, it is too soon to know whether this effort will lead to real change. Some data suggest that agricultural employment is shifting from seasonal work to year-round employment as the demand for year-round fresh fruits and vegetables continues to grow (Kandel, 2008). Should these trends continue we expect that hired farmworkers' employment conditions, especially those related to the pesticide exposure, will improve.

Appendix

NAWS Questions on Pesticides

Questions on Pesticide Handling

1993-1999

“Have you mixed or applied pesticides in the last 5 years?”

2002-2006

“In the last 12 months, have you loaded, mixed, or applied pesticides?”

Questions on Pesticide Training

1998-1999

“When was the last time you received instructions for pesticides?”

2002-2006

“In the last 12 months, with your current employer, has anyone given you training or instructions in the safe use of pesticides (through video, audio, cassette, classroom lectures, written material, informal talks, or by any other means)?”

Authors' Note

Please direct all commentary to William Kandel at wkandel@ers.usda.gov. This article does not reflect the views of either the Economic Research Service or the U.S. Department of Agriculture.

Acknowledgments

We are grateful to Steven Zahniser, Michael Livingston, Daniel Carroll, and an anonymous reviewer for *Work and Organizations* for their insightful comments.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interests with respect to the authorship and/or publication of this article.

Funding

The authors received no financial support for the research and/or authorship of this article.

Notes

1. According to Reeves and Schafer (2003, p. 31), “symptoms of acute pesticide poisoning occur shortly after exposure . . . followed by relatively rapid recovery. Acute effects may result from a single exposure to one substance or from multiple exposures over a short time period.” They can also lead to death.
2. Note that pesticide handlers must complete additional training (GAO, 2000).
3. Agricultural workers are exposed to pesticides through a variety of routes. In addition to mixing and applying pesticides, agricultural workers face additional exposure when they pick crops after pesticide application in a field or when they drink water drawn from local wells. Unfortunately, the NAWS data contain no information on these additional types of exposure.
4. NAWS data for 1998-1999 distinguish between training not received, received within the past 12 months, and received 1 to 5 years prior. More than 96% of farm workers who received pesticide training indicated that they had received it within the prior 12 months.

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Bios

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