

# **Green Tobacco Sickness in Minority Farmworkers**

R01 OH/ES03648

National Institute for Occupational Health and Safety  
National Institute of Environmental Health Sciences

## **Final Report (Option 2)**

Thomas A. Arcury, Ph.D., Principal Investigator  
Department of Family and Community Medicine  
Wake Forest University School of Medicine  
Winston-Salem, North Carolina

Sara A. Quandt, Ph.D., Co-Principal Investigator  
Section on Epidemiology  
Department of Public Health Sciences  
Wake Forest University School of Medicine  
Winston-Salem, North Carolina

John S. Preisser, Ph.D., Co-Investigator  
Department of Biostatistics  
University of North Carolina at Chapel Hill  
Chapel Hill, North Carolina

Deborah Norton, M.D., M.P.H., Co-Investigator  
Wake County Human Services  
Raleigh, North Carolina

**Department of Family and Community Medicine  
Wake Forest University School of Medicine  
Winston-Salem, NC 27157-1084  
336-716-9438**

## Abstract

The overall goal of this study was to understand the nature of Green Tobacco Sickness (GTS) and the social and biologic factors that influence minority farmworkers' risk for this occupational disease. GTS is acute nicotine poisoning following dermal contact with mature tobacco plants, *Nicotiana tabacum*. It results in weakness, nausea, vomiting, and dizziness. In most cases, workers lose 1 or 2 days of work as a result of GTS; in severe cases, dehydration resulting from GTS can be life threatening. Clinicians are increasingly concerned about GTS among minority farmworkers. However, information on the incidence of this occupational disease or the level of exposure to tobacco needed to produce GTS symptoms is very limited. GTS risk factors and the means to prevent GTS are only partially known.

Much of the tobacco in North Carolina and an increasing amount in other states (Kentucky, Ohio, South Carolina, Virginia) is harvested by migrant and seasonal farmworkers, who must endure the disability and loss of work that results from GTS. Migrant and seasonal farmworkers in the U.S. are almost exclusively minority -- Hispanic (78%), African American (2%), and other groups (Asian, Native American) (2%). During the growing season, the North Carolina Employment Security Commission estimates that there are over 140,000 migrant farmworkers and dependents in the state, with approximately twice this number of seasonal farmworkers. Almost all of the migrant farmworkers, and 90% of the seasonal farmworkers in North Carolina are Hispanic, with the remainder being almost exclusively African American.

To achieve the proposed study goal, this study addressed 5 specific aims. These were to:

1. Estimate the incidence of GTS in seasonal and migrant farmworkers employed in tobacco production in North Carolina.
2. Determine the risk factors for GTS, including (1) *physical environmental* (temperature, humidity, precipitation, plant harvest stage) and (2) *social environmental* (ethnicity, work experience, the organization of work) risk factors, as mediated by (3) *biological* (body size, sex, health status) and (4) *behavioral* (tobacco use, fluid consumption, use of protective clothing) variability.
3. Measure the association of tobacco exposure biomarkers (e.g., cotinine and other nicotine metabolites) with GTS symptoms and with work related exposure to tobacco plants, as modified by such GTS risk factors.
4. Understand farmworker and health care providers interpretations of GTS symptomatology, self-care behaviors, and barriers to prevention and treatment seeking.
5. Disseminate findings concerning GTS risk factors to farmworkers and to those providing services to farmworkers (e.g., health care providers, outreach workers, labor organizations).

The research design for this study included 4 major components: (1) surveillance in farmworker labor sites in which interview and biomarker (saliva) data were collected to estimate incidence and indicate risk factors for GTS symptoms; (2) a clinical-based, case-control comparison in

which interview and biomarker (urine) data were collected to specify risk factors for severe GTS; (3) in-depth interviews with farmworkers, farmers and health care providers were conducted to delineate interpretations of GTS symptomatology, self-care behaviors, and barriers to prevention and treatment seeking; and (4) a program to disseminate findings about GTS risk factors directly to farmworkers and those who provide services to farmworkers was implemented. The conceptual model that organized this research design was based on the PRECEDE-PROCEED planning framework for developing community health interventions, and incorporated Kleinman's concept of Explanatory Models of Illness and current theory on self-care.

## **Significant Findings**

### Incidence, Prevalence and Risk Factors

Green Tobacco Sickness (GTS) prevalence was 24.2%, while Incidence Density was 1.88 days/100 days worked. Prevalence and incidence density increased across the agricultural season. Greater work experience (5+ years, ID=.87; first year ID=2.41) and tobacco use (ID of 1.18 versus 2.39) were negatively associated with GTS. Task (e.g., "priming", ID=4.04; "topping," ID=of 1.86; "barning," ID=.62), and working in wet clothing (25% or more of work days, ID=2.97; fewer than 25% of work days, ID=1.29) had the largest effect. GTS cases were much less likely to have worn rain suits while working in wet tobacco than were controls.

### Biomarkers

Salivary cotinine increased across the agricultural season, independent of smoking status. Multivariate analyses identified a model ( $R^2=.68$ ) in which predictors of cotinine included greater age, later season work, wet working conditions, smoking, and work task. Harvesting ("priming") tobacco was associated with higher cotinine levels than other tasks. This study demonstrates that tobacco workers experience substantial work-related exposure to nicotine. The long-term effects of such exposure should be investigated.

Examining four regression models in which salivary cotinine was evaluated as a mediator between behavioral risk factors and GTS, we found that nicotine causes GTS. 25 workers had 31 occurrences of GTS. Among non-smokers, each increment increase in the natural log of cotinine increases the odds of GTS 2.11 times, adjusting for task and wet conditions. Treatment of GTS must address nicotine poisoning. GTS affects laborers with limited resources.

### Interpretations of Green Tobacco Sickness

Minority farmworkers generally attributed the symptoms to other aspects of working in tobacco, such as pesticides or heat, rather than nicotine. They cited many of the same risk factors identified in the biobehavioral mode of GTS, such as wet work conditions and inexperience with tobacco work. Prevention and treatment by farmworkers included a combination of exposure avoidance and common medications. The symptoms of most importance to farmworkers were insomnia and anorexia, both of which impaired the ability to work. This jeopardized their

income, as well as their work security. If health care providers understand the explanatory model held by farmworkers, they will be more effective at diagnosing and treating it, and better prepared to teach patients how to prevent future episodes.

Tobacco farmers were generally knowledgeable about GTS. However, their explanatory models for this occupational illness often mis-identified its causes (heat and bending rather than nicotine) and minimized its seriousness (estimating several hours of illness versus the several days of illness reported by farmworkers). These models included methods of prevention that are not proven (e.g., use of anti-nausea drugs) or are more harmful than GTS (smoking cigarettes). The need for medical treatment was also discounted. Addressing each of these beliefs is important in any program to prevent GTS among farmworkers. Documenting and understanding the beliefs and knowledge of agricultural employers is an important undertaking in our efforts to reduce occupational injury and illness among farmworkers.

### **Usefulness of Findings**

These findings have been disseminated to farmworkers and health care providers. They have been used to develop health education materials for farmworkers that are being used to help reduce the incidence of GTS. They have also been used to develop continuing education materials for health care providers so that they can better recognize, diagnosis, and treat GTS in minority farmworker patients.

### **List of Publications**

#### **Journal Articles**

Quandt SA, Arcury TA, Preisser JS, Norton D, Austin CK: Migrant farmworkers and green tobacco sickness: new issues for an understudied disease. *American Journal of Industrial Medicine* 37:307-315, 2000

As specified in Specific Aim 1, this paper provides an estimate the incidence of GTS in seasonal and migrant farmworkers employed in tobacco production in North Carolina.

Arcury TA, Quandt SA, Preisser JS, Norton D: The Incidence of Green Tobacco Sickness among Latino Farmworkers. *Journal of Occupational and Environmental Medicine* 43:601-609, 2001.

As specified in Specific Aims 1 and 2, this paper provides an estimate the incidence of GTS in seasonal and migrant farmworkers employed in tobacco production in North Carolina, and it determines the risk factors for GTS, including (1) physical environmental risk factors, (2) social environmental risk factors, (3) biological risk factors, and (4) behavioral risk factors.

Quandt SA, Arcury TA, Preisser JS, Bernert JT, Norton D: Behavioral and Environmental

Predictors of Salivary Cotinine in Latino Tobacco Workers. *Journal of Occupational and Environmental Medicine* 40:844-852, 2001.

This analysis primarily addresses Specific Aim 3 by measuring the association of salivary cotinine, a tobacco exposure biomarker, with GTS symptoms and with work related exposure to tobacco plants, as modified by such GTS risk factors. It also addresses Specific Aims 1 and 2.

Arcury TA, Quandt SA, Preisser JS: Predictors of Incidence and Prevalence of Green Tobacco Sickness among Latino Farmworkers in North Carolina, U.S.A. *Journal of Epidemiology and Community Health* 55:818-824, 2001.

This paper provides an estimate of the incidence and prevalence of GTS among seasonal and migrant farmworkers employed in tobacco production in North Carolina (Specific Aim 1). The analysis also determines risk factors for GTS (Specific Aim 2).

Quandt SA, Preisser JS, Arcury TA: Mobility Patterns of Migrant Farmworkers in North Carolina: Implications for Occupational Health Research and Policy. *Human Organization* 61:21-29, 2002.

This paper presents an analysis that goes beyond the specific aims. It documents the patterns of mobility and migration of farmworkers during an agricultural season, and the impact of this mobility for standard research designs attempting to understand occupational injuries among migrant and seasonal farmworkers.

Arcury TA, Quandt SA, Garcia DI, Preisser JS, Norton D, Rao P: A Clinic-Based Case-Control Comparison of Green Tobacco Sickness among Minority Farmworkers. *Southern Medical Journal* 95:1008-1011, 2002.

This analysis examines the risk factors for GTS by comparing farmworkers who present at clinics with GTS to those who present for other reasons (Specific Aim 2).

Rao P, Arcury TA, Quandt SA: Hispanic farmworker interpretations of green tobacco sickness. *Journal of Rural Health* 18:503-511, 2002.

As stated in Specific Aim 4, this analysis addresses farmworker interpretations of GTS symptomatology, self-care behaviors, and barriers to prevention and treatment seeking.

Arcury TA, Quandt SA, Preisser JS, Bernert JT, Norton D, Wang J: High Levels of Transdermal Nicotine Exposure Produce Green Tobacco Sickness in Latino Farmworkers. *Tobacco & Nicotine Research* in press.

This analysis focuses on Specific Aim 3 by showing the association of salivary cotinine, a tobacco exposure biomarker, with the occurrence of GTS and proving that GTS is

nicotine poisoning.

Arcury TA, Quandt SA, Simmons S: Farmer health beliefs about an occupational illness that affects farmworkers: the case of green tobacco sickness. *Journal of Agricultural Safety and Health* in press.

This analysis addresses farmer interpretations of GTS symptomatology, self-care behaviors, and barriers to prevention and treatment seeking. This is an expansion of Specific Aim 4.

Preisser JS., Arcury TA, Quandt SA: The Spatial Clustering of an Occupational Illness: Green Tobacco Sickness among Latino Farmworkers. Under review.

This analysis examines an additional set of environmental risk factors (Specific Aim 2) for GTS by considering how this occupational illness occurs in clusters.

Spangler JG, Arcury TA, Quandt SA, Preisser JS: Tobacco Use among Mexican Farmworkers Working in Tobacco: Implications for Agromedicine. *Journal of Agromedicine* in press.

This paper presents an analysis that goes beyond the specific aims. It documents the prevalence and risk factors of tobacco use among Mexican farmworkers in the eastern US.

### **Dissertation/Thesis**

Klein M: Preventive Measures Taken against Green Tobacco Sickness by Farmworkers in North Carolina. Master's Paper, Department of Health Behavior and Health Education, School of Public Health, University of North Carolina at Chapel Hill, 2000.

This analysis examines the preventive measures taken to prevent GTS by comparing the behaviors of those who get GTS to those who do not get GTS (Specific Aim 2).

### **Other**

Each of these documents was developed to disseminate the results of this study to farmworkers and health care providers, as stipulated in Specific Aim 5.

Two documents are brief reports published in newsletters directed at health care providers who work in clinics serving migrant and seasonal farmworkers. These reports are also directed at other farmworker service providers and advocates.

Arcury TA, Quandt SA: Green Tobacco Sickness: Incidence and Risk Factors for Farmworkers. *Migrant Health Newsline* 8(4):1-2.

Arcury TA, Quandt SA, Norton D: Green Tobacco Sickness among Farmworkers in North Carolina. *The Network Practitioner: A Journal for Primary Care Providers in Community Health Centers*. Autumn/Winter:7-9, 2001.

The results of this research were also used to develop a continuing education workshop for health care providers. This workshop was presented on six occasions. It remains available as a web-based course available through the Area Health Education Center network:

Arcury TA, Quandt SA, Norton D, Neal S, Davis S, Sherertz E: Green Tobacco Sickness: An Agricultural Health Hazard.

Southern Regional Area Health Education Center, Fayetteville, NC, May 12, 2001.

Area L Area Health Education Center, Rocky Mount, NC, May 19, 2001.

Wake Forest University Baptist Medical Center, Winston-Salem, NC, June 2, 2001.

NC Farmworker Health Outreach Training, Raleigh, NC, June 8, 2001.

Community Care Center, Winston-Salem, NC, August 6, 2001.

Southwest Virginia Area Health Education Center, Marion, VA, April 12, 2002.

The final set of documents includes health education materials developed for farmworkers. All of these materials are in Spanish. They include a fotonovela, a patient education brochure, and a video.

Quandt SA, Arcury TA: Aprenda sobre la enfermedad del tabaco verde: la experiencia de Juan – una fotonovela / Learning about Green Tobacco Sickness: Juan's Experience. – A Photonovel. Winston-Salem, NC: Department of Family and Community Medicine, Wake Forest University School of Medicine, 2001.

Arcury TA, Quandt SA, Norton D: [drawings by Tim Rickard]. El Monstruo Verde: La Enfermedad del Tabaco Verde [Spanish language green tobacco sickness safety comic]. Winston-Salem, NC: Wake Forest University School of Medicine, 2002.

Arcury TA, Quandt SA, Lane, CM. Jr., Marin T, Rao P: El Terror Invisible: Pesticide Safety for North Carolina. [Spanish language pesticide safety education video.]

a. Safety with Pesticides: Pesticide Risk and the Invisible Terror (Seguridad con pesticidas: Riesgos de los pesticidas y el terror invisible): 27 minutes

b. Pesticide Handler: What's Important to be a Pesticide Handler (Manipulador ¿Qué significa ser un manipulador de pesticidas?): 17.5 minutes

c. The Green Monster: Green Tobacco Sickness (El monstruo verde: Enfermedad del Tabaco verde): 9 minutes

Winston-Salem, NC: Wake Forest University School of Medicine, 2002.



## Memorandum

Date: February 7, 2003

From: Adele M. Childress, Ph.D., Program Official   
Office of Extramural Programs, NIOSH, E-74

Subject: Final Report Submitted for Entry into NTIS for Grant 5 R01 OH003648-04.

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

Arcury TA, Quandt SA, Norton D: El Monstruo Verde: La Enfermedad del Tobacco Verde .  
Winston-Salem, NC: Wake Forest Univ School of Med, 2002

Spangler JG, Arcury TA, Quandt SA, Preisser JS: Tobacco Use Among Mexican Farmworkers  
in the Eastern US, in press

Arcury TA, Quandt SA, Simmons S: Farmer Health Beliefs About an Occupational Illness that  
Affects Farmworkers: The Case of Green Tobacco Sickness. Journal of Ag Safety & Hlth, in  
press

Arcury TA, Quandt SA, Preisser JS, Bernert JT, Norton D, Wang J: High Levels of Transdermal  
Nicotine Exposure Produce Green Tobacco Sickness in Latino Farmworkers. Tobacco &  
Nicotine Research, in press

Rao P, Arcury TA, Quandt SA: Hispanic Farmworker Interpretations of Green Tobacco  
Sickness. Journal of Rural Hlth, 18:503-511, 2002

Arcury TA, Quandt SA, Garcia DI, Preisser JS, Norton D, Rao P: A Clinic-Based Case-Control  
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29, 2002



## Memorandum

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Arcury TA, Quandt SA, Preisser JS: Predictors of Incidence and Prevalence of Green Tobacco Sickness Among Latino Farmworkers in North Carolina, USA. Journal of Epidemiology & Community Health, 55:818-824, 2001

Quandt SA, Arcury TA, Preisser JS, Bernert JT, Norton D: Behavioral & Environmental Predictors of Salivary Cotinine in Latino Tobacco Workers. Journal of Occupational & Environmental Medicine, 40:844-852, 2001

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Klein M: Preventive Measures Taken Against Green Tobacco Sickness by Farmworkers in North Carolina. Master's Paper, Dept of Health Behavior & Health Education, School of Public Health, University of North Carolina at Chapel Hill, 2000

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**Title:** Green Tobacco Sickness in Minority Farmworkers  
**Investigator:** Thomas A. Arcury, Ph.D.  
**Affiliation:** Wake Forest University  
**City & State:** Winston-Salem, NC  
**Telephone:** (336) 716-9438  
**Award Number:** 5 R01 OH003648-04  
**Start & End Date:** 9/30/1998–9/29/2002  
**Total Project Cost:** \$891,533  
**Program Area:** Special Populations  
**Key Words:** nicotine poisoning, farmworkers

### **Final Report Abstract:**

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### Publications

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