

DEER DAMAGE CONTROL PREFERENCES AND USE DECISIONS
OF NEW YORK ORCHARDISTS

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ABSTRACT

Previous studies in New York, the nation's second leading state in apple production, have contributed much to deer management decisions that give consideration to orchardists' concerns about crop damage. Little information, however, has been reported about orchardists' reasons for adopting or not adopting particular types of deer damage controls or their preference for various forms of possible damage control assistance. Two complementary studies, conducted in early 1987 by the Human Dimensions Research Unit, Department of Natural Resources, Cornell University, have addressed these information needs. A mail survey of orchardists in an important fruit-producing region of southeastern New York indicated that the frequency of deer damage and orchardists' efforts to control damage had increased markedly in the last 5 years. Personal interviews with an independent group of orchardists indicated that most growers were motivated to begin using damage controls when they experienced substantial damage in a young block of trees, which made the rewards of damage prevention more immediate and real. Interviews suggested that damage control choices are influenced not only by orchardists' perception of need, but also by personal characteristics and perceptions of control characteristics. Implications for damage control assistance programs are that assistance efforts are unlikely to gain wide acceptance among orchardists unless they (1) meet salient existing needs, (2) have clear relative advantage over other methods, (3) are compatible with the user's beliefs and values, and (4) are consistent with the user's communication behavior.

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INTRODUCTION

Over the last decade, many insights have been gained about the impacts of deer damage to agriculture in New York. An extensive series of studies (Brown and Decker 1979, Brown et al. 1977, 1978, 1980, Decker et al. 1981) has contributed data for deer management decisions that give consideration to farmers' interests in deer and their concerns about crop damage.

Orchardists have been of special interest due to their relatively greater amounts of estimated economic loss from damage and lower levels of tolerance (Decker and Brown 1982).

In recent years, large deer populations coupled with increased plantings of apple trees (New York's most important commercial fruit tree [White 1985]) having size-controlled rootstock has intensified orchardists' concerns about deer damage. For orchardists with deer damage complaints, the New York State Department of Environmental Conservation provides technical assistance and, in certain situations, permits for shooting nuisance deer (Berchielli 1983). Furthermore, management decisions about appropriate levels of deer populations in important agricultural areas are expected to continue to reflect growers' concerns (Purdy 1987). Those decisions, however, must also consider the interests of other constituencies such as hunters who typically desire larger deer populations than do orchardists. Because of such competing interests and the continuing trend to controlled rootstock trees that are highly susceptible to deer damage, orchardists can be expected to continue to require special consideration for site-specific deer damage control assistance.

Decker and Brown (1982) documented the need for special consideration of orchardists in southeastern New York's important fruit-producing region known as the Hudson Valley. They showed that compared to other farmers in the

region, orchardists reported greater incidences of deer damage, perceived greater economic impacts to their farming operations from deer damage, and were more apprehensive about deer and deer damage generally. Although nearly all indicators suggested an audience quite intolerant toward deer, few (<20%) had employed deer damage controls.

More recent studies have investigated how orchardists assess deer damage to make decisions about the use of damage controls. Tatro (1986) suggested that damage control efforts among New York apple growers are practiced not because growers believe they are particularly effective, but because growers sense the need to take action. Others have also noted that the lack of standardized techniques for assessing deer damage to crops severely limits decisions about the cost effectiveness of various forms of damage control (McAninch et al. 1985, Scott and Townsend 1985).

Yet, even in the absence of such techniques, orchardists and other farmers are making, or attempting to make, damage control decisions. How, and based on what information? Which type(s) of controls are chosen (in the absence of cost/benefit data) for given situations? And, how might answers to these questions facilitate agency efforts to evaluate existing options and consider additional ones for deer damage control programs? This paper provides findings from 2 recent studies that addressed these questions by focusing on the nature of deer damage control decisions and preferences for control assistance among New York orchardists.

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METHODS

Two complementary procedures were used to acquire the information reported herein. In early spring of 1987 self-administered, mail-back questionnaires were sent to all 162 commercial orchardists in 3 Deer Management Units

where orchardists' attitudes toward deer management were of particular interest to the DEC. The management units are within Orange, Ulster, and Columbia Counties in the Hudson Valley region of southeastern New York. Names of orchardists were identified from the comprehensive lists of county Cooperative Extension agents. A portion of the questionnaire was developed to determine orchardists' recent deer damage experiences, deer damage control efforts, and preferences for damage control assistance. Multiple follow-up mailings were used to maximize response and post-survey telephone interviews with nonrespondents were conducted to assess possible nonresponse bias.

In a separate, but related study, detailed personal interviews were conducted in late spring 1987 with 59 orchardists. These growers were selected through a purposeful (nonrandom) sampling strategy to obtain information from orchardists who differed in several characteristics, including: size, income, location, and damage control use. Orchardists' names were drawn from Cooperative Extension mailing lists, DEC nuisance deer harvest permit application lists, and grower references. Personal interviews facilitated the in-depth questioning required to determine the factors influencing orchardists' decisions about deer damage control. Several decision-making models were evaluated to identify types of variables likely to affect damage control decisions. Based on these evaluations, an innovation-adoption model (Rogers 1983) was selected to provide a framework for examining the series of decisions an orchardist makes in evaluating a damage control method and deciding whether or not to incorporate that method into ongoing practice.

RESULTS

Survey Response

The mail survey of orchardists in the Hudson Valley elicited useable responses from 61% of all farmers receiving questionnaires. Comprehensive follow-up telephone interviews with nonrespondents

indicated that survey results were unbiased by nonresponse. Assessment of several key characteristics including those related to income from fruit production, deer damage experiences, and damage control efforts showed no statistical difference between respondents and nonrespondents at the 95% confidence level.

For the corresponding study involving personal interviews, interview requests were granted by 83% of all orchardists contacted. Interviewees represented users of a wide range of damage control methods, from homemade devices to deer fence enclosures.

Deer Damage Estimates

Respondent reports of deer damage reconfirmed that orchardists constitute a key constituency for resource professionals dealing with deer damage issues. Fully 90% of all respondents indicated they had experienced deer damage to their crops during 1986; over twice the incidence reported for orchardists in the region 5 years earlier by Decker and Brown (1982). Nearly two-thirds of those reporting damage described it as moderate (45%) or severe (18%). Fifty-four percent of all crops affected by damage involved apples, the predominant fruit grown in the region and in New York generally. Orchardists possessed about the same acreages of size-controlled apple trees (\bar{x} =78 acres) and standard trees (\bar{x} =74 acres). Size-controlled trees, however, were reported no more frequently than standard trees as the object of deer damage; about 94% of growers of either crop type reported damage. Nevertheless, the evidence suggested that the impact of damage on crop production was greater for size-controlled trees than for standard trees. Considering all crops damaged, the amount of production estimated to be lost or substantially delayed as a result of damage averaged about 20% (S.D.=18.36). Comparisons with earlier reports of $\leq 10\%$ crop impact among orchardists (Decker and Brown 1982) suggests that deer damage has intensified within the region. Based on recent data for the dollar value of apple production (only) in New York

State (White 1985), a rough translation of the reported percent of crop damage to monetary terms implies an annual production loss of over \$15,000 per grower.

Damage Control Efforts and Methods

Orchardists' efforts to control deer damage to their crops were largely consistent with their perceptions of widespread damage and had increased dramatically since the previous study by Decker and Brown (1982); 83% reported using damage controls in the preceding 12 months, compared to less than 20% in 1981. Control users reported over twice the level of crop damage as nonusers (\bar{x} =22% vs. \bar{x} =9%, respectively; $P \leq 0.10$, $t = -1.83$, 64.0 df), and differed from nonusers in important attitudinal characteristics (Table 1). Those orchardists who depended upon fruit production as a source for $>50\%$ of their income, however, were no more likely to attempt damage control than were individuals who were less reliant on fruit-related income ($\chi^2=0.40$, $P > 0.05$, 1 df).

Among the control methods used, those classed as repellents appeared most popular; home-made bar soap repellents were used most frequently (Table 2). Allowing hunters to harvest deer on orchardists' properties was also common. However, direct reduction of deer numbers by obtaining out-of-season permits for shooting nuisance deer was less utilized. Deer fences were used by only about 1 in 6 growers.

Few orchardists were relying on only 1 method of control. The median number used per grower was 2 and nearly 30% were using ≥ 4 methods. Analysis of the combinations of controls used by orchardists showed clearly that use of bar soap repellents and provision of deer hunting access were predominate means of control, regardless of any other methods that may also have been used by each individual. Singularly, however, neither of those most-used methods was believed most effective. Of all methods in use, only 2 were reported by a majority of their users as being most effective: deer fencing (82%) and permits for shooting nuisance deer (78%). (Recall that both methods

Table 1. Orchardists' attitudes toward deer by use of deer damage controls.

<u>Appreciation of deer:</u>	<u>Control Users (%) (n=66)</u>	<u>Non- Users (%) (n=13)</u>
Enjoy deer and their presence is worth risk of crop loss (or) presence of deer does not matter	15.1	38.5
Enjoy deer but their presence is not worth risk of crop loss (or) regard deer as nuisance	<u>84.9</u> 100.0	<u>61.5</u> 100.0
<u>Perception of deer population level:</u>		
Too low	0.0	0.0
Just right	28.0	61.5
Too high	<u>72.0</u> 100.0	<u>38.5</u> 100.0

Table 2. Percentage of orchardists using deer damage controls.

<u>Repellents:</u>	
bar soap	70.1
commercial chemicals	43.3
hair bags	40.3
Allowed hunting	61.2
Deer fencing	16.4
Nuisance deer harvest permits	13.4
Scare devices	11.9
Other	6.0

Preferences for Damage Control Assistance

Additional assessments focused on orchardists' preferences for types of assistance that might be provided in an expanded deer damage control program. Although no such expansion of existing assistance is currently intended in New York, these data provide an information base for making such control-assistance considerations if deemed necessary in the future. The options from which orchardists were asked to indicate their preferences were:

1. *Technical information about deer control.*
2. *On-site advice/assistance from deer damage specialists.*
3. *Provision of damage control materials (e.g., deer-fencing supplies).*
4. *Cash payments or reimbursements for deer damage.*
5. *Permits for on-site destruction of nuisance deer.*

Options 1, 2, and 5 did not represent "expanded" programming due to their current availability to New York landowners. Those options were included, however, to enable assessments of relative demand when considered along with other types of assistance that might be perceived as more appealing to recipients (i.e., 3

were used by fewer than 20% of growers attempting damage control.) The single control type least reported as most effective was chemical. About 12% of all control users indicated that no method they had used had been effective; a finding supported by their significantly higher percent of crop impact ($\bar{x}=37\%$) as compared to users of controls reported as effective ($\bar{x}=21\%$) [$P \leq 0.05$, $t = -2.07$, 42 df].

and 4). Furthermore, respondents were informed that options 3 and 4 were likely to involve "some cost to the recipient" in order to place these options in a more realistic context.

Results showed that 95% of all orchardists surveyed indicated that ≥ 1 type of assistance was generally needed and that assistance currently offered is capable of meeting much of their need (Table 3). Of all types indicated, 2 of the 3 most frequently mentioned are already available in New York; permits for shooting nuisance deer and technical information regarding deer damage control. When asked to indicate the type of assistance most needed, no single type was clearly preferred by a majority of respondents. Instead, preferences were equally split between harvest permits for nuisance deer and provision of damage control materials. Respondents indicated the least needed type of assistance was on-site advice/assistance with cash reimbursements faring only slightly better.

Personal Interviews: Understanding the Influences of Control Use

Reflecting briefly, results of the mail survey indicated that deer damage to crops remains a concern to orchardists in the Hudson Valley. Furthermore, the impacts of deer damage to fruit production appear to have increased dramatically over the last 5 years, as have the attempts of orchardists to control damage. Yet, it remains unclear how orchardists evaluate damage situations to determine when controls are necessary, which controls will be used, and which will be accepted.

Deciding whether to use a damage control -- Innovation-adoption theory suggests that orchardists have little motivation to adopt a preventive innovation (e.g., damage control methods) until the rewards of its use become immediate and real in the user's mind (Rogers 1983). The data from our interviews reflect this adoption pattern. Most orchardists implemented damage controls only after sustaining a large damage event, and developing the belief that such an event was very likely to recur. Frequently,

orchardists began implementing controls when planting a new orchard block, or replanting trees in a heavily damaged young orchard block.

Deciding which controls to use -- Damage control choice appears to be influenced by (1) the orchardist's perceived need for damage controls, (2) personal characteristics, and (3) perception of the traits of the control method. According to the innovation-adoption model, these individual variables typically exert different degrees of influence at different stages of the adoption process (Figure 1).

1. Perceptions of damage control need -- Factors related to perceived need for damage control(s) appear to be most influential in the initial stages of control adoption. Interviews suggest that orchardists' commitment to vulnerable trees (i.e., young; size-controlled), and perceptions of damage cost and severity are important in deciding both when and how to control damage. Orchardists using enclosure fencing, for example, were more likely than orchardists using less costly controls (e.g., soap, hunting, nuisance permits) to report a large commitment to size-controlled trees (i.e., $\geq 50\%$ of orchard), and a high rate of deer damage (i.e., $>10\%$ loss of annual production). Though perceptions of damage severity and cost appear to be important determinants in decisions of when and how to control damage, interviews indicated that most individuals did not, or could not, make detailed estimates of the production or dollar loss associated with deer damage.

2. Characteristics of the orchardist -- Orchardists' characteristics exert important influence early in the adoption process, when a grower is becoming aware of a control and how it functions. Innovation-adoption theory suggests that even at the same level of perceived need, growers may selectively learn about, or ignore, a control option due to their previous experience, information sources, innovativeness, or socioeconomic circumstances. The influence of orchardist characteristics on control

Table 3. Orchardists' preferences for deer damage control assistance.

Assistance type:	Generally needed (n=84) ^{1/}	Most needed (n=84)
Technical information	42.9	19.7
Nuisance deer harvest permits	50.0	24.2
Damage control materials	41.7	24.2
Cash reimbursements	39.3	15.2
On-site advice or assistance	28.2	<u>10.6</u>
		100.0

^{1/} Percentages do not total 100.0 due to multiple response.

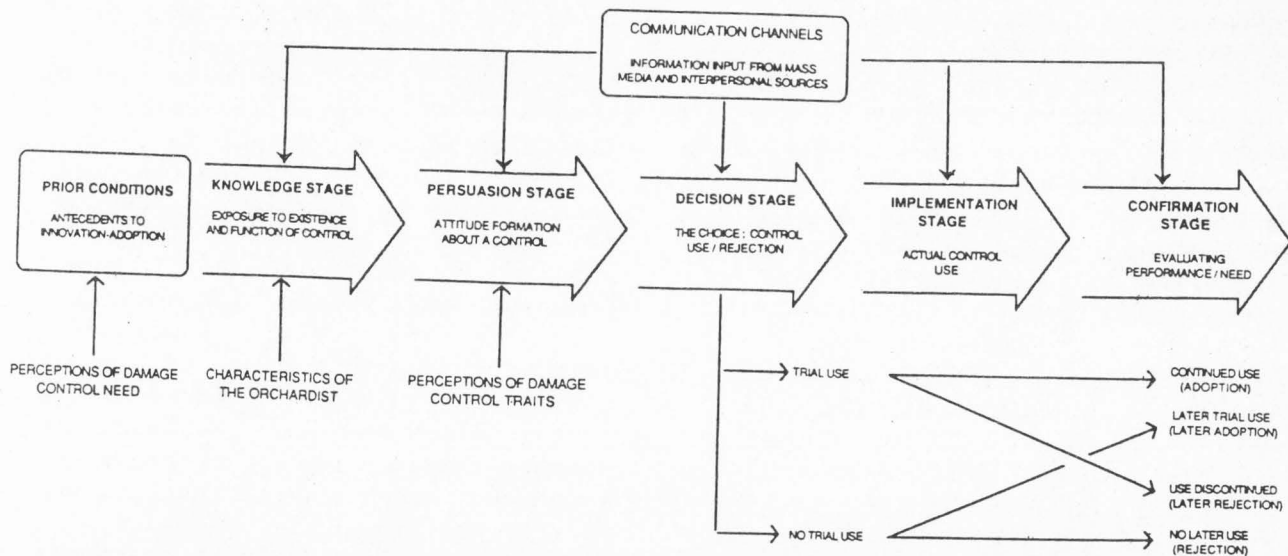


Figure 1. A model of the innovation-adoption process (Rogers, E. M., 1983, p. 165) adapted to depict the primary variables influencing orchardists' deer damage control decisions.

choice were most readily observed in their adoption or rejection of deer fence. Individuals using deer fence exclosures were likely to maintain contacts with specialized communication sources (e.g., sales representatives, pomologists). Nonfencers were likely to depend more on Cooperative Extension or neighbors for their damage control information. Further, the comparatively high number of fence users with a large orchard and a large investment in high density plantings indicate that fence users may also have higher production goals than nonfencers.

3. Perceptions of damage control traits -- The traits of damage controls appear to be very important in the "persuasion stage" of adoption, when attitudes are being formed about a control. Of the 5 basic control traits outlined by innovation-adoption theory (i.e., relative advantage, compatibility, complexity, trialability, observability), relative advantage (i.e., the degree to which one damage control is perceived to be better than others) appeared to be most important to control adoption. Interview results were consistent with the general tenets of innovation-adoption theory, which hold that the most quickly and widely adopted innovations are those with a low initial cost, immediate rewards, and clear savings in time, money, or effort. Perceived control cost and cost effectiveness were very important considerations in control choice, despite the fact that most growers said they did not calculate exact dollar estimates of damage.

In addition to relative advantage, the characteristics of the most widely used damage controls (i.e., soap and hunting) were: low application costs; simplicity in application; compatibility with existing beliefs, values, and needs; trialability on a limited basis; and clear observability of results. The least used damage controls (i.e., nuisance permits, deer fencing, and scare devices) were not generally perceived to hold all of these traits. Special deer harvest permits, for example, were perceived to have a number of disadvantages. Orchardists indicated that they are time consuming, reactive

(not proactive), have short-term effectiveness, and are more complex to use than regular season hunting. Similarly, deer fencing was widely perceived by nonfencers to hold a number of disadvantages, including a high initial cost, unknown effectiveness, complex installation and maintenance, and slow rate of monetary return. Fence use was also inconsistent with the past experience of many orchardists, whose perceptions of deer fence cost and maintenance stem from experience with more traditional livestock fencing or early deer fence designs.

IMPLICATIONS FOR DAMAGE CONTROL ASSISTANCE

The factors influencing current damage control choices are likely to influence orchardists' acceptance of damage control assistance programs. Based on results of this study, we believe the following reflect reasons for orchardists' likely reaction to existing and potential assistance programs.

Technical Information

Both studies indicate that orchardists will continue to support and accept programs designed to disseminate technical damage control information. Information programs are likely to find acceptance for 3 main reasons: (1) many orchardists perceive the need for information on new, more effective controls, (2) it is compatible with their trust in and use of traditional information sources (e.g., Cooperative Extension), and (3) it is comparatively easy and inexpensive to obtain printed or oral technical information. Although wide support for information programs is suggested, uniform benefits from such programs are not likely because orchardists exhibit a wide range of communication behavior, especially in their use of specialized sources (e.g., sales representatives, arborists).

On-site Assistance

Both studies indicate that on-site damage assistance or advice would find lower acceptance by orchardists than

less intrusive information programs. Orchardists do not presently appear to feel a strong need for on-site advice; only 28% of those surveyed by mail said they need such assistance. Interviews suggested that most growers feel capable of adequately assessing their damage situations, and gathering information on appropriate control alternatives, without on-site visits. Furthermore, interviews suggest that on-site assistance may not be compatible with the fruit producer's strong desire for self-sufficiency, independence, and minimum interference.

Monetary Reimbursements

Both studies indicate that monetary damage reimbursements, like on-site assistance programs, are unlikely to experience wide or rapid acceptance among orchardists because they are incompatible with important needs, beliefs, and values. Interviews suggest that the majority of orchardists attach a stigma of "government handouts" to such payments, reflecting an inability to resolve damage problems on their own. Orchardists commonly voiced concerns that such a program would only increase government interference, become susceptible to frequent abuse, and support orchardists who should leave the industry anyway. Furthermore, cash payments may find limited acceptance because they fail to meet an important need: the prevention of damage. Orchardists appear to feel that damage reimbursements are somewhat counterproductive to what they believe is the most needed damage control program, population reduction.

Special Harvest Permits

Although few (<15%) orchardists currently use special nuisance deer harvest permits, and interviews suggest mixed feelings about their effectiveness, our findings indicate that orchardists will continue to regard permits as a necessary damage control option. Interviews indicate that such a special permit system is accepted because it meets an existing need: the opportunity to remove deer in problematic years or orchard blocks. Despite a number of perceived

disadvantages (e.g., short-term effectiveness, time consuming) nuisance deer harvest permits appear to be accepted because they afford low cost control with relatively quick and observable (if short term) effects. Special harvest permits appear to be compatible with orchardists' beliefs that, on their own land they should retain the right to remove animals that threaten their economic well-being. Several respondents suggested that regardless of long-term control or overall effectiveness, the harvest permit is important because its absolute, observable results (i.e., deer removal) afforded the psychological comfort that something positive was being done about the problem.

Providing Damage Control Materials

Currently no program exists in New York by which damage control materials (e.g., fence) are provided to farmers. A number of impediments to the acceptance of such a program in the future are suggested by this study. Chief among these impediments is perceived need. Despite marked increases in deer damage statewide, both studies indicated that the majority of orchardists feel little need, if any, to implement these costly controls. Furthermore, one of the most important variables in control choice--relative advantage--is not clearly established in the minds of most orchardists. Interview results showed that a great deal of uncertainty still exists about fence cost, maintenance, effectiveness, and economic rate of return. The complexity of fence installation and its incompatibility with traditional orchard management practices pose further impediments to the success of a materials distribution program.

SUMMARY AND CONCLUSIONS

A survey of orchardists in the Hudson Valley region of New York indicated that the frequency of deer damage and individual efforts to control damage increased markedly in the last 5 years. Personal interviews with an independent group of

orchardists indicate that most growers are motivated to begin using damage controls when they experience substantial damage in a young block of trees, which make the rewards of damage prevention more immediate and real. Interviews suggest that damage control choices are influenced not only by perception of need, but also by personal characteristics and perceptions of control characteristics. Based on these findings, we believe that hunting and soap are the most frequently used controls because they: (1) meet orchardists' perceived needs, (2) can be used without specialized communication sources, and (3) are perceived to have low complexity, and high relative advantage, trialability, observability, and compatibility.

These findings have 2 primary implications for damage control assistance programs. First, although existing assistance programs (e.g., technical information services and nuisance deer harvest permits) may not fulfill all of the needs expressed by orchardists, new forms of assistance (e.g., cash payments, on-site assistance, fence material distribution) are not clearly warranted. Second, the data suggest that if future assistance programs are going to gain wide acceptance among orchardists, they should (1) meet salient existing needs, (2) have clear relative advantage, (3) be compatible with the user's beliefs and values, and (4) be consistent with the user's communication behavior.

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