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Selecting Pesticides and Nonchemical Alternatives: Green Thumbs' Rules of Thumb Decision Tools

This study of a sample of home gardeners indicates that rules of thumb, or heuristics, are used to select between chemical pesticides and nonchemical alternatives. Such rules of thumb serve to simplify otherwise complicated choice decisions. Heuristics commonly used to choose pesticides include how safe, effective, efficacious, and economical they are, whereas for alternative products consumers more often take into account convenience, efficiency, competency, and handiness. Generally, in an overall ranking of 24 individual choice attributes, pesticides rank low on these attributes where alternatives rank high and vice versa. Gender, age, and years using pesticides are significantly correlated with pesticide selection.

In recent years, American consumers have increasingly expressed concern over the use of chemical pesticides. The 1990 nationwide case involving apples and the chemical Alar, along with the public's concern over pesticides in water and other environmental contamination, indicate that consumers are aware of their role in how pesticides are used and pesticides' potential for harm. The agriculturally focused debate has also expanded to include public concern over the use of synthetic chemical pesticides in the home (e.g., California Senate Office of Research 1988). American consumers regularly and frequently (some estimates indicate 91 percent of all U.S. households) use pesticides in the home (Savage 1980; Stimmann 1988). An estimated 42 million kilograms (46,200 tons) of pesticides are used annually in and around U.S. homes (Young 1987). Home and lawn pesticide products account for 18 billion dollars in annual retail sales in the United States (Stamen, Chambers, and Mamer 1989).

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Potential hazards associated with home use of chemicals exist and often become problematic, particularly when precautions and warnings are not heeded. Grieshop and Stiles (1989) found that over one-half of their urban California sample choose not to use protective clothing while applying pesticides and that two-fifths do not read labels before application. In addition they found that over one-fifth admit applying stronger-than-recommended pesticide mixtures while more than one-third of this group report pesticide-attributed illnesses. Finklea *et al.* (1969) reported a similar lack of care among South Carolina respondents. Even though minimum precautionary measures are not always taken, reported concern about pesticide use is high. A Philadelphia study (von Rumker *et al.* 1974) found great public concern over the potential side effects of pesticides. Hawkes and Stiles (1984) reported that a majority of sampled urban residents feel nonchemical alternatives should be tried before pesticides.

These findings suggest that notable discrepancies exist between what some urban homeowners say and/or believe (i.e., concern for use of nonchemical alternatives) and their actions (i.e., frequent use of chemicals with inadequate protection). These discrepancies suggest a need to systematically explore homeowners' choice behaviors related to the selection of chemical pesticides and nonchemical alternatives. Although many nonchemical alternatives are believed to be effective means of dealing with pest problems in and around the home, the issue of their value compared with pesticides has not been studied. An understanding of criteria consumers apply in deciding between alternatives is an important step for designing safer products and safety information. As well, such understanding should develop important information about consumers' choices related to other potentially hazardous products or practices.

Decision theory including consumer choice theory encompasses at least two major models (Mowen 1987). These theories describe how people use belief systems, attitudes, perceived product/item attributes, personal timeliness, and energy levels to make decisions. The more complex multi-attribute models describe choice behaviors used in high involvement choice situations where consumers' beliefs about a product come into play in forming attitudes toward various alternatives. The lower involvement or heuristic models describe cases in which consumers may be less interested in an optimal choice versus an adequate one. For instance, purchasing and other repetitive choice

behaviors fall into this category (Hoyer 1984). Einhorn and Hogarth (1981) contended that many decisions are made not to optimize or to make the best choice, but to save time, energy, and often money. Gross' (1987) research summary on the influence of time on decisions emphasized the importance of time as a precious consumer resource.

Decision theorists described choice as having three necessary criteria: (1) two or more alternatives or choices must exist; (2) choices must create a choice dilemma or conflict (i.e., a problem situation or uncertainty exists); and (3) cognitive processes must be activated in order to reduce the dilemma (Hansen 1972). Cognitive processes used in problem solving include weighing object attributes against the desired outcomes. In other words, choice among alternatives involves a problem-solving process the goal of which is to meet the needs of the decision maker. Within the context of this study, "conflicts" that arise may be choices among pesticides, among alternatives, or between pesticides and alternatives. Hansen (1972) suggested that evaluation and choice of a product, or in this case a pest control method, depend on the expectation that a certain level of utility will result from making that choice. Other theorists (Burdus 1973) postulated that an object that comes closest to possessing the ideal type and quantity of desired attributes is chosen. Other decision scientists, using an expected utility model, defined a decision problem by the options available to choose from, potential outcomes, and probability that outcomes will occur (Tversky and Kahneman 1981). In risk situations an expected utility model is used and rational decision makers select the option or the prospect offering the highest expected utility or greatest outcome. Inconsistencies of choice under risk conditions are attributed to variations or errors in framing or perceiving acts and outcomes. Heuristics can be used in framing situations and are rules of thumb that individuals use to simplify otherwise complicated decision events. Tversky and Kahneman (1981) also showed that decision heuristics, even though economical and effective, often lead to systematic and predictable errors especially under conditions of uncertainty. However, with activities common to an individual or a household, little uncertainty may be perceived. In this case, the activity becomes routine as do the decision processes leading to the act. This situation is likely the case for experienced home gardeners and consumers who use heuristics or rules of thumb in their selection of pest control methods (Bettman 1979).

The focus of this study was on user decision processes rather than on specific pests and pest problems. The study was intended as a first phase in a two-phase pilot investigation centered around the question of choice or decision factors used by homeowners/gardeners in selecting pest control products, especially chemical pesticides and nonchemical alternatives. Specifically, what pest control product attributes are associated with decisions to use one type or the other? In addition, questions focused on attitudes toward the use of these products from the perspective of safety and precautions and on safety and precaution behaviors reportedly followed while using the pest control products.

METHOD

The sample for this pilot study was drawn from a population of 415 Sacramento, CA homeowners who participated in a study conducted in 1986 (Grieshop *et al.* 1990). The current study, carried out in 1988-1989, was designed to involve homeowners/gardeners from the Sacramento metropolitan urban area in two distinct phases over a six-month period. The first phase entailed the completion of a mail survey, while the second phase was to consist of multiple home visits, interviews, observations, and experimentation with home pest control techniques. The intent of the second phase was to monitor pest problems and to evaluate effects of specific control methods. The purpose of the first phase, reported here, was to collect baseline information related to pest control methods and choice criteria. By a zip code analysis, it was determined that 320 of the original 415 households lived in the targeted urban area. A letter detailing the purposes of the study was mailed to the identified homeowners and explained that the study would consist of two phases. In the letter, potential respondents were asked to indicate whether they could participate in both phases or only the first or second.

Seventy-eight responses (a response rate of 24 percent) were received from individuals who indicated their readiness to participate in both phases. Participation in both phases carried with it the expectation of an ongoing time commitment, a factor which may have dissuaded a number of individuals from volunteering. In addition 27 responses were received from individuals who indicated willingness to participate in either the first or second phase, but not both. The self-selected participants were then sent a 120-item questionnaire along

with a cover letter which specified, among other points, the distinction between chemical pesticides and alternatives. This distinction was critical as it was used to define the parameters of the pest management approaches. Chemical pesticides were defined as synthetic chemicals easily obtained at nurseries, discount stores, etc. and used to control or eradicate pests including insects, weeds, snails, etc. Common names of some materials were included to identify the type of materials considered. Alternatives to chemical pesticides were defined as nonchemical pesticides, along with such techniques as insecticidal soaps, bacillus thuringiensis (Bt), etc.

The questionnaire was developed by the authors and other technical specialists and field tested with nonparticipating homeowners/gardeners in a nearby city. Final revisions were made before use. Question categories included respondent background and personal gardening information, methods and frequency of pest control, precautionary behavior during application, and attributes of pest control choices. For the precaution items respondents were presented with a list of personal protective behaviors (e.g., wearing gloves) and asked which ones they typically took while applying pesticides and alternatives. Such questions included attitudes toward personal illness due to use and exposure to pesticides and toward use of additional time and money to use safer alternatives. Also, several open-ended questions requested listings of commonly used chemical pesticides, nonchemical alternatives, and descriptive information on pest control practices. One section included closed-ended questions requiring dichotomous (yes/no) responses and another had four-point Likert-like response categories. Of primary importance were the two-part attribute items presented in a Likert-like format. An example illustrates:

My pest management material is (would be):

a. pesticides because they cost less than other methods	strongly disagree	disagree	agree	strongly agree
b. alternatives because they cost less than other methods	strongly disagree	disagree	agree	strongly agree

RESULTS

Of the original sample, seven households failed to return the

mailed questionnaire, leaving a final respondent group of 71, 41 males (58 percent) and 30 females (42 percent). They had lived and maintained gardens in the Sacramento area for an average of 19 years. Average age was 49 years. With an average of 15 years of education, nearly one-fourth (23 percent) had completed college. Most were married (83 percent), owned pets (64 percent), lived in two-person households (56 percent) with no one under the age of 12 years in the household (76 percent).

Demographic data from this study and the original 1986 study were compared with demographics from a 1988 statewide study on home gardening consumers (Stamen, Chambers, and Mamer 1989). This study sample proved to be representative of both the 1986 study and the statewide study in the distribution of males and females, age, education, years in residence, and gardening experience. Whether this group is representative of homeowners/gardeners found throughout the United States is a question. This sample nevertheless represents an important subgroup—home gardeners in at least one state.

Most respondents maintained flowers (97 percent), shrubs (94 percent), and lawns (92 percent). Ornamentals (86 percent), vegetable gardens (73 percent), and fruit trees (68 percent) were also common among respondents' gardening interests. This pattern of active gardening reflects the year-round gardening possibilities in the Sacramento area. On average, respondents had used pesticides twice as long (14 years) as alternatives (seven years). Few respondents (three percent) had never used pesticides, whereas nearly one-quarter (23 percent) claimed not to have used any alternatives. Alternatives were used more frequently than pesticides: 29 percent used alternatives once a week or more and 57 percent used alternatives monthly or less, whereas 14 percent used pesticides once a week or more and 83 percent used pesticides monthly or less. Respondents acknowledged awareness of almost double the number of alternative products in use, confirming that respondents knew of far more alternative pest control methods than they chose to try. Gender was associated with gardening experience and use of pesticides, but not with use of alternatives. Males had gardened longer ($x^2 = 6.74$, $p < .03$), used pesticides longer ($x^2 = 10.96$, $p < .01$), and used more of them ($x^2 = 6.74$, $p < .02$) than females. Though not statistically significant, women (46 percent) were more inclined to use alternatives than men (24 percent). Although more women than men felt it was best to use

no pesticides at all ($x^2 = 7.76$, $p < .05$), males (85 percent) and females (80 percent) agreed that they would pay more for alternatives if it meant using fewer pesticides.

PRECAUTIONARY ATTITUDES AND BEHAVIORS

Of particular interest were the homeowners'/gardeners' attitudes and behaviors about safety when using pesticides and alternatives. Several questions measured attitudes (as reflected in agreement/disagreement with propositions about pest control practices) toward use and safety. Notable was one result: 24 percent felt safe using no precautions with alternatives, compared to no one who felt safe without protection while using pesticides. Gender and experience influenced both safety and risk beliefs. A larger proportion of males than females denied that personal use of chemicals was dangerous. That is, males were significantly less risk averse regarding personal harm than females ($x^2 = 10.30$, $p < .02$). The longer respondents had gardened, the stronger the denial of risk associated with pesticides ($x^2 = 13.50$, $p < .04$).

Respondents were presented an extensive list of safety and precautionary behaviors often associated with homeowner pest control practices (Stimmann and Litewka 1979) and drawn from product labels and safety publications. Other items had been specified in focus group interviews conducted in a previous study (Grieshop, Bone, and Frankie 1990; Rucker *et al.* 1988). Although not all respondents answered every question, results suggested that far fewer safety, precautionary, and protective measures were being taken when using alternatives than when using pesticides (Table 1). Other measures included washing one's self after use (51 percent versus 91 percent), laundering clothing after use (25 percent versus 75 percent), wearing long pants (19 percent versus 74 percent), long sleeves (17 percent versus 66 percent), gloves (19 percent versus 50 percent), and goggles (17 percent versus 40 percent). Reading alternatives' labels before purchase and application was seen as unnecessary by a majority (68 percent), whereas more indicated they read pesticide labels at time of purchase (90 percent) and before application (93 percent).[1]

[1]This sample was more cautious in reading labels than those participating in the original study from which this sample was drawn. In that study almost 40 percent did not always read labels (Grieshop and Stiles 1989).

TABLE 1
Precautions Used while Applying Pesticides and Alternatives

Precaution and/or Behavior	Pesticides (N = 68) Using Percent	Pesticides (N = 68) Using N	Alternatives (N = 53) Using Percent	Alternatives (N = 53) Using N
Read Labels Before Using	93	63	32	17
Wash Self	91	62	51	27
Read Labels Before Buying	90	61	32	17
Launder Clothes	75	51	25	13
Long Pants	74	50	19	10
Long Sleeves	66	45	17	9
Gloves	50	34	19	10
Hose off Exposed Areas	44	30	15	8
Eye Protection	40	27	17	9
Boots	31	21	17	9
Mask	25	17	2	1
Other	12	8	9	5

These results are hardly surprising. Hand-weeding, salt applications, and rolled newspapers, for example, do not present a threat to the health of the user if precautions are not taken. Viewed as behavioral measures of perceived safety, the precautions used or more importantly not used with pesticides are notable.

ATTRIBUTES OF PESTICIDES AND ALTERNATIVES

A major section of the questionnaire focused on attributes of pesticides and alternatives. A list of 24 attributes (Table 2) was created and validated through a review by pest management specialists. Each attribute was stated as a proposition for both pesticides and alternatives as described. Mean response values were calculated for each attribute, summing across the four Likert-type responses from "strongly agree" (4) to "strongly disagree" (1). Higher mean values resulted in higher rankings. The higher rank implied that the attribute may serve as a choice consideration.

Different attributes appeared to be associated with pesticides and alternatives. Attributes on which pesticides ranked high tended to be those for which alternatives scored low (or lower) and vice versa. For example, attributes such as low toxicity to humans, children, and pets, personal safety, and no need for precautions ranked high for alternatives. Ease of cleanup, disposal, and application and easy-to-

TABLE 2
Mean Rankings of Attributes of Pesticides and Alternatives

Attribute	Pesticides (N = 70)		Alternatives (N = 60)	
	Rank[a]	Mean	Rank[a]	Mean
Works Fast	1	2.93	19	2.44
Widely Available	2	2.87	17.5	2.45
Needs Few Applications	3	2.83	17.5	2.45
Most Effective Way	4	2.80	20	2.42
Many Product Choices	5	2.73	22	2.39
Personal Experience	6	2.71	13	2.60
Kills Many Pests at Once	7	2.68	24	2.32
Covers Large Area	8	2.60	21	2.41
Covers Many Plant Hosts	9	2.57	16	2.46
Long Lasting Effects	10	2.53	23	2.37
Easy-to-Follow Directions	11	2.51	11	2.81
Covers Specific Pests	12.5	2.49	10	2.84
Long Shelf Life	12.5	2.49	12	2.65
Easy-to-Read Directions	14	2.46	9	2.85
Easy to Apply	15	2.42	14	2.58
Safe to Use	16	2.24	5	3.14
Easy Cleanup	17	2.13	6	3.10
Safe Disposal	18	2.06	4	3.17
Low Cost	19	2.00	15	2.48
Low Toxicity to Pets	20	1.98	2	3.30
Easy Disposal	21	1.93	7.5	2.91
Low Toxicity to Kids	22	1.92	3	3.18
Low Toxicity to Humans	23	1.91	1	3.35
No Protective Clothes Needed	24	1.77	7.5	2.91

[a]Scale: 1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree.

read and easy-to-follow directions also ranked high for alternatives. Pesticides received much lower rankings for these same attributes. On the other hand, pesticides received the highest rankings on the attributes labeled coverage of pests, area, and hosts, along with speed and duration of effect and fewer applications. Availability of and number of product choices were attributes valued by respondents in choosing pesticides. Alternatives were ranked much lower on these same attributes.

It appeared that the clustering of attributes, for example clustering of alternative-associated attributes around the dimensions of "safety" and "convenience," suggested the existence of factors. However, these ranking results alone did not permit generalization and did not justify the creation of factors. Factor analysis is a statistical tool that, appropriately used, can be utilized to determine the number and nature of factors or constructs that might underlie the

set of 24 attributes. For purposes of this study this procedure was helpful in reducing the 24 variables to a smaller number (eight) of statistically independent variables or factors, each linearly related to the original variables (Agresti and Finlay 1986).

Factors (or choice criteria) do not represent absolute values, rather they represent constructs underlying each set of variables (Hinkle, Wiersma, and Jurs 1979). The factor analysis identified eight separate factors or choice criteria—four were associated with pesticides and four with alternatives. In all cases the label names were derived from the nature of the items loading onto that factor. The four pesticide related factors were Hazard, Effectiveness, Efficacy, and Economy. The four alternative factors were Convenience, Efficiency, Competency, and Handiness. Table 3 shows the factor loadings of each attribute with factor labels.[2]

The assumption of equal variances was tested for males and females on all eight factors. No statistically significant gender-related differences were reported on the four pesticide factors. However, females scored significantly higher than males for each of the four alternative factors. As shown in Table 4, degrees of Convenience ($p < .003$), Efficiency ($p < .05$), Competency ($p < .03$), and Handiness ($p < .02$) were more important choice criteria to women than to men when making decisions about alternative pest control methods.

Pearson correlations were determined for the four pesticide factors with age and years using pesticides as variables. Significant positive relationships between age and the two pesticide factors of Hazard ($p < .009$) and Efficacy ($p < .05$) were found. Older gardeners (age 46 to 77 years) considered Hazard and Efficacy as the more salient choice factors than did younger homeowners/gardeners. No other significant relationships with age were found. Significant positive correlations were found between years using pesticides and degrees of pesticide Effectiveness ($p < .009$) and Efficacy ($p < .003$). Individuals with more years of pesticide experience considered these as major factors for choosing pesticides.

[2]Pesticide factors: degree of hazard, generally described by low toxicity and safe disposal; degree of effectiveness, characterized by range of pests, plants, and areas covered and directions; and degree of efficacy, which included fast and effective results and few applications. Choice criteria associated with alternatives were degree of convenience, including easy application, directions, cost, availability, and no need for protection; degree of efficiency, comprised of effectiveness, availability, number of applications, speed of effectiveness, and safety; degree of competency, including coverage of pests, area, and plants and length of effects; and, finally, degree of handiness, represented by shelf life and product choice.

TABLE 3
Rotated Factor Matrix for Pesticides and Alternatives

	Pesticide Factors				Alternative Factors			
	Hazard	Effectiveness	Efficacy	Economy	Convenience	Efficiency	Competency	Handiness
Attribute	Factor 1	Factor 2	Factor 3	Factor 4	Factor 1	Factor 2	Factor 3	Factor 4
Low Toxicity to Humans	.74							.65
Low Toxicity to Pets	.76					.68		
Safe Disposal	.62				.75			
Easy Disposal	.53				.79			
Easy Cleanup	.83					.50		
Safe to Use	.67					.67		
Low Toxicity to Kids	.81					.62		
No Protective Clothes Needed	.63				.82			
Kills Many Pests at Once		.63					.84	
Personal Experience		.71			.55			
Covers Large Area		.77					.76	
Covers Many Plant Hosts		.51					.58	
Long Shelf Life		.58						.57
Many Product Choices		.75						.68
Easy-to-Read Instructions		.60			.73			
Easy-to-Follow Directions		.60			.65			
Widely Available		.78			.69			
Works Fast			.71			.60		
Needs Few Applications			.79			.65		
Covers Specific Pests			.67			.78		
Most Effective Way			.70			.79		
Low Cost				.53	.50			
Easy to Apply				.68	.62			
Long Lasting Effects				.78			.75	

TABLE 4
Pesticides and Alternatives: Attributes Influencing Choice

Pesticides				Alternatives			
Factor	Gender	Mean	SD	Factor	Gender	Mean	SD
Hazard	Male	2.09	.585	Convenience	Male	2.56*	.578
	Female	1.92	.679		Female	2.96	.456
Effectiveness	Male	2.60	.551	Efficiency	Male	2.78*	.473
	Female	2.66	.492		Female	3.01	.463
Efficacy	Male	2.74	.562	Competency	Male	2.24*	.614
	Female	2.80	.532		Female	2.59	.578
Economy	Male	2.26	.594	Handiness	Male	2.73*	.435
	Female	2.41	.408		Female	3.00	.439

*$p < .05$ for t-tests.

In regard to alternatives and choice factors, positive significant relationships were found between years using alternatives and degrees of Convenience ($p < .008$) and Competency ($p < .01$). No other statistically significant relationships were revealed. The more experienced alternative users tended to stress these factors in pest control choices. Analysis of variance examined and paired these factors with frequency of use, which yielded significant differences between the frequent and infrequent users of alternatives on the Convenience ($p < .001$) and Competency criteria ($p < .01$). The more frequently respondents used alternatives, the more salient Convenience and Competency of the products became in choosing them. No other choice criteria were significant for frequent user groups.

DISCUSSION

This pilot study, which focused on homeowners/gardeners in one urban area, examined the bases for their choice behaviors in selecting between and among chemical pesticides and nonchemical alternatives. The risks and benefits of using pesticides are well known, especially in agriculture and industry. Use by homeowners is less well understood. Increased knowledge and understanding about attitudes and practices of the public, who itself "consumes" chemical pesticides, will be instructive for public officials and others concerned with consumer issues.

Beliefs and attitudes have been used to predict and describe consumer behaviors. Some researchers say how consumers make decisions often depends on how involved they are in the choice/purchase. That is, a consumer's decision process will differ if he/she has high or low involvement in the selection or choice (Mowen 1987). Two multiattribute high involvement models are the attitude-toward-object and the behavioral intention models. Both are complex decision procedures where consumers are engaged in extended problem solving. They involve mechanisms by which consumers combine beliefs to form attitudes toward specific product/item attributes eventually leading to consumption behavior. Low level involvement models are termed heuristic models. Consumer choices between and among pesticides and alternatives, as Bettman (1979) explained, may be achieved through use of these heuristic decision-making tools, sometimes called rules of thumb.

The use of heuristics offsets the decision maker's limited capacity to process all available information and provides a shortcut, simplifying decision tasks. Algorithmic decision processes, as distinct from heuristic ones, involve detailed, quantifiable methods assisting the decision maker in arriving at an optimal decision where the problems and the solutions are clearly defined (Hudson 1979). Comparing and selecting among products, such as pesticides and/or alternatives, potentially involves inputting and processing an almost infinite amount of information. The heuristics model appears to be the most likely choice process used by home gardeners, who, like other consumers, may use rules of thumb in decision choices regarding pest control methods. Heuristics are less detailed and rely on past experiences or situations representative of the problem set at hand. Over time habitual choice situations are created where decisions can be made quickly with little or no need for additional information searches and acquisitions, thereby lowering transaction costs. In consumer choice theory, rules of thumb, such as always buying the same brand or the cheapest product, or in this case the safest product or the one with the broadest spectrum of use reduce the necessity of comparing across hundreds of product labels. For this sample, the average number of years gardening was 19, a substantial length of time to establish rules of thumb by which to make quick and easy gardening decisions. In addition, when asked what pest control products they used most frequently, the sample primarily listed specific chemical names, a company's brand name, or a nonchemical alterna-

tive readily available in most households. This suggested that for specific pest problems the sample engaged in rules of thumb decision making.

The participating Sacramento-area home gardeners used pesticides successfully and regularly over the years and most had tried various alternative methods. It is clear that they viewed pesticides and alternatives in very different ways, suggesting distinct rules of thumb. Some general choice tendencies emerged. For instance, alternatives were viewed as safer and cheaper than pesticides, yet less effective, requiring more frequent applications. Women used fewer pesticides and more alternatives than men and were also more fearful of personal harm from pesticides. These gender differences are also supported by past studies (Grieshop and Stiles 1989; Hawkes and Stiles 1984).

Pesticide Rules of Thumb

When considering a pesticide, these respondents appeared to be concerned with hazard (toxicity) and effectiveness (ability to do the job) of the product as well as with efficacy (efficiency) and economy (time and money). That hazard was a concern is illustrated by the fact that most respondents believed pesticides were more toxic than alternatives. The economy factor in pesticide choices is as much an economy of time as it is a financial consideration, as most respondents felt pesticides cost more than alternatives yet last longer and are easier to apply. Effectiveness of pesticides as a decision heuristic includes thoroughness of action, and efficacy entails immediacy of effect. This fact and the low score of pesticides on individual items of safety and monetary cost can be viewed as the combination of traits which form the pesticide heuristics. It seems that respondents are willing to accept reduced safety and to pay more as tradeoffs to getting a highly effective and efficacious means of dealing with home garden pests, using pesticides.

Alternative Rules of Thumb

The absence of a safety or hazard factor for alternative methods may suggest that safety is an implicit characteristic for alternatives, thus eliminating the need for safety to be a conscious choice criteria or rule of thumb. The safety items are synthesized into other heuris-

tics, i.e., "convenience" where ease of use includes not having to wear protective clothing. This attitude about safety seems to be supported by respondents' reported precautionary behaviors during application.

Alternatives also have tradeoffs. Even though they are safe, convenient, and handy, their choice reduces speed and immediacy of effect. Economy of time is also sacrificed as alternatives are applied with more frequency and are less trusted as a means of eliminating versus controlling pests.

It appears that some subgroups use rules of thumb differently than others. For instance, as a rule of thumb older gardeners' pesticide choices take hazard and efficacy into consideration more than younger gardeners. Respondents who have used pesticides longer find effectiveness and efficacy ratings useful in decision making. Less frequent pesticide users, expecting longer and stronger effects, look for efficacious materials, more so than those who use pesticides frequently. Frequent alternative users, especially females, emphasize convenience and competency in pest control materials.

Another rule of thumb is the decision not to use precautions when applying pesticides. Some gardeners who use pesticides most are known to use them less safely (Grieshop and Stiles 1989). Slovic, Fischhoff, and Lichtenstein (1981) found that certain factors influence risk attitudes and behavior, one of which is imaginability, the ability to imagine consequences of an event. Frequent use of pesticides with no precautions and no ill effects can reduce the ability to imagine harm and serves to reinforce unsafe pesticide use.

These home gardeners did not choose one product over the other—the choice was not pesticides *or* alternatives. Rather their choice was to use both, recognizing costs, benefits, and utility of each. This finding is significant for many who are concerned with dealing with the consuming public. When preparing educational, informational, or marketing materials for the gardening public (as well as for others who use substances like pesticides), understanding the reasons why people make choices can be a valuable tool. If one claims awareness of the safety differential between pesticides and alternatives while at the same time acknowledging using no precautions, marketers, manufacturers, and extension educators may consider modifying label content to stress safe use, informing vendors to explicitly advise on precautions, and preparing informational leaflets for general use.

As more sophisticated pest control technologies enter the market,

heuristics can be expected to change. As the demand for safer products increases and safer substances are marketed, consumer expectations will change as will the criteria of choice. In this study, respondents reported that to reduce pesticide use they would pay more and spend more application time for more effective alternatives. The safety criterion may be a short-lived sacrifice in using the chemicals. Effectiveness will always be a major choice criterion—doing the job will always be the objective. And, as safety and health consciousness are raised, a non- or low-toxicity product may be the popular precaution taken by consumers.

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