



Factors affecting the implementation of an electronic Pest Recommendation Network for pesticide applicators in Montana
by William Thomas Lanier

A thesis plan submitted in partial fulfillment of the requirements for the degree of Master of Science in Agricultural Education
Montana State University
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Abstract:

The problem is how to deliver pest management information to pesticide applicators, where they live and work, in a manner that does not intimidate them. The delivery structure must allow for the effective use, safety and hazard information to be incorporated into the daily decision-making process.

The objectives of this study were to determine the factors that may enhance or prohibit use of the Pest Recommendation Network (PRN) and how valuable selected pest control topics are to pesticide applicators in Montana Pesticide Applicator Training (PAT) Region 2. The six factors that may have affected a participants use of the WWW were lack of hardware, software, monthly service provider charges, familiarity with what the WWW offers, lack of computer technical assistance or training and/or high telephone line charges. The selected pest control factors were chemical control information, economic thresholds, crop variety susceptibility information, and pest life cycle conditions favoring susceptibility, typical infestation pattern in fields, symptoms and look alike symptoms, cultural control information and knowing required scouting frequency.

The survey group (n = 497) was randomly divided into two groups. Each group received a take-home worksheet that provided step by step instructions on how to access and receive information from the PRN. In addition to the worksheet, one group received training that included verbal explanation of 11 Power Point text slides and 3 PRN screen images from the PRN application. The purpose of the mini-lecture slides were to motivate and familiarize subjects to the availability and value of the PRN. The control group saw only one text slide referring to the PRN. To use the PRN, the control group would have to rely on the worksheet instructions.

In summary, the amount of training the participants received at the Region 2 PAT re-certification program did not significantly affect their access of the PRN. Ranking of the results of the survey showed that people with access to the Internet found familiarity with what the Internet offers, lack of computer technical assistance or training, high telephone line charges as the factors that affected their use of the Internet the most. Participants also ranked chemical control information, economic thresholds, crop variety susceptibility information, pest life cycle as most valuable to their pest control decision making. The results of the demographic section of the survey revealed that over half of the surveyed participants had access to computer hardware, over half used it for farm business and over half had either access to the Internet or email.

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This thesis has been read by each member of the graduate committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the college of Graduate Studies.

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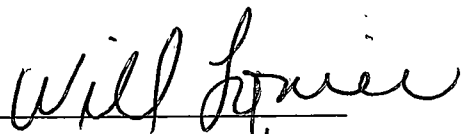
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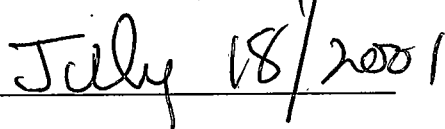
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ABSTRACT

The problem is how to deliver pest management information to pesticide applicators, where they live and work, in a manner that does not intimidate them. The delivery structure must allow for the effective use, safety and hazard information to be incorporated into the daily decision-making process.

The objectives of this study were to determine the factors that may enhance or prohibit use of the Pest Recommendation Network (PRN) and how valuable selected pest control topics are to pesticide applicators in Montana. Pesticide Applicator Training (PAT) Region 2. The six factors that may have affected a participants use of the WWW were lack of hardware, software, monthly service provider charges, familiarity with what the WWW offers, lack of computer technical assistance or training and/or high telephone line charges. The selected pest control factors were chemical control information, economic thresholds, crop variety susceptibility information, and pest life cycle conditions favoring susceptibility, typical infestation pattern in fields, symptoms and look alike symptoms, cultural control information and knowing required scouting frequency.

The survey group (n = 497) was randomly divided into two groups. Each group received a take-home worksheet that provided step by step instructions on how to access and receive information from the PRN. In addition to the worksheet, one group received training that included verbal explanation of 11 Power Point text slides and 3 PRN screen images from the PRN application. The purpose of the mini-lecture slides were to motivate and familiarize subjects to the availability and value of the PRN. The control group saw only one text slide referring to the PRN. To use the PRN, the control group would have to rely on the worksheet instructions.

In summary, the amount of training the participants received at the Region 2 PAT re-certification program did not significantly affect their access of the PRN. Ranking of the results of the survey showed that people with access to the Internet found familiarity with what the Internet offers, lack of computer technical assistance or training, high telephone line charges as the factors that affected their use of the Internet the most. Participants also ranked chemical control information, economic thresholds, crop variety susceptibility information, pest life cycle as most valuable to their pest control decision making. The results of the demographic section of the survey revealed that over half of the surveyed participants had access to computer hardware, over half used it for farm business and over half had either access to the Internet or email.

CHAPTER 1

THE PROBLEM AND ITS SETTING

Since the beginning of the nationally recognized Pesticide Applicator Training (PAT) program in 1975, rapid changes in pest control practices and public opinion have caused constant refinement of pesticide safety and applicator practices. Gilmore (1994) stated that , “There continues to be increasing attention given to food related issues in our society as the public becomes more aware of the benefits and risks associated with food production, distribution and preservation, preparation, and consumption patterns” (p. 1). Some of this concern is substantiated by facts. “Recent reports from the Food and Drug Administration and Centers for Disease Control indicate that about 33 million people, or 14% of the U.S. population, become ill each year from microorganisms in foods, leading to 9,000 deaths annually” (Barton, 1992, p. 1).

The Environmental Protection Agency (EPA) enforces strict control on pesticide licenses. Farm Worker Protection Standards are strictly enforced, even on family farms. Banks investigate pesticide disposal practices before they accept agricultural land as collateral. On August 3, 1996, President Clinton signed the Food Quality Protection Act (FQPA) into law. This act allowed greater protection for consumers, particularly infants and children by using a comprehensive, integrated approach to risk assessment and risk management using consistent, health based standards. A positive effect of this

perception, from an agricultural point of view, is that the public is very supportive of programs that make their food supply safer.

Montana agriculture has been recognized as a source of abundant safe food and still is, but public perception has changed. Whitford (1993) says negative public opinion is due mostly to how people perceive risk. While farmers are familiar with the costs and benefits of pesticide use, the public, removed from the damage crop pests can cause, is not. The nonagricultural population perceives pesticides as risky because others apply them, are doubtful of the real value and are concerned about unknown or delayed health problems. As a result of scrutiny by the customer, producers of food have responded with scientifically accountable methods of managing pesticide use.

Integrated Pest Management (IPM) is one of these methods. Dr. Sue Blodgett, the IPM coordinator at Montana State University, suggests IPM practices include; 1) applying chemical pest control based on a set of decisions other than pest presence or absence; 2) Scientific thresholds that require knowledge of pest identification and life cycles; 3) Non-chemical or cultural pest control practices that weigh future agronomic considerations with the economic realities of arid crop production; and 4) Chemical control considerations that not only include cost, timeliness and efficacy but also far reaching legal considerations regarding mammalian toxicity, ground water contamination, and pest resistance and used container disposal. This diversity and unprecedented increase in "need to know" information has created a demand for pesticide education information delivery (PAT) to where people live and work.

Thus, as production agriculture in Montana adjusts to meet the demands of a wary public, the need for technically trained employees who are accountable for their actions has increased. National and state governments and land grant colleges like Montana State University (MSU) have responded by formalizing programs, such as PAT, which train people who apply agricultural chemicals. MSU Extension, the information source for PAT, has a database developed through interactions with the MSU Insect, Weed and Disease Diagnostic Labs. The database contains the daily recommendations made by Extension specialists and staff. These recommendations are made for homeowners and producers involved with agriculture in Montana. Recommendations include pest identification and life cycles and non-chemical cultural controls. The recommendations are the results of national research and weigh agronomic considerations regarding arid crop production. The chemical control recommendations entered not only include cost, timeliness, and efficacy, but also are scrutinized for legal considerations regarding mammalian toxicity, groundwater contamination, pest resistance and used container disposal.

Currently, private and commercial PAT sessions use traditional delivery methods during the fall and winter that include demonstrations, slide-illustrated talks, and use of videotapes. In the case of PAT meetings and correspondence courses, three criteria affect the acceptance or use of the PAT program. Acceptance of information delivered by either traditional means or distance delivery technology is, Bauder (personal communication, January 1998) said, affected by three criteria: They are; 1) how much participant comfort is affected by travel, scheduling and personal commitments; 2)

Presentation quality and how the information is formatted and given relevancy to the audiences concerns; and 3) Level of promotion.

While traditional delivery methods provide basic pest information on the major crops to a significant portion of Montana producers, the three criteria and their negative effects on PAT education will increase. Solutions to problems affecting PAT attendance are available.

It has been proposed to deliver an innovative education program to PAT participants. This educational program would provide a novel electronic resource accessible by pesticide applicators when pest information is required and management decisions are being made. In other words, this program would deliver information to where people live and work, increasing their personal comfort. DeYoung, et al. (1995) reported that "a pilot effort (Oregon) revealed ways that networked computers can facilitate communication between diverse audiences and how university extended education can be electronically delivered to participants upon demand" (page 1). To dramatically reduce the costs of delivering this information (incurred by MSU Extension) through traditional means, PAT participants could be provided with improved and individualized information using technology like the World Wide Web (WWW) and methods of distance education. Rossman (2000) defines distance education by saying:

"Distance education is planned learning that normally occurs in a different place from teaching and as a result requires special techniques of course design, special instructional techniques, special methods of communication by electronic and other technology, as well as special organizational and administrative arrangements" (p. 1).

Perfect candidates for distance education are the three politically diverse and geographically separated groups discussed previously: A suspicious public worried about their food supply, agricultural producers who employ scientific practices to produce food and sources of research based information like national and state governments and land grant institutions like MSU.

The WWW and distance education methods could act as the synchronization that correctly meshes the gears moving researched based information from government agencies charged with training to those who produce food for a demanding public.

Experience suggests that as with traditional methods there are criteria that will negatively affect participation in the PRN. Research methods are available to discover the factors which could prohibit or enhance the implementation of the PRN for use by Montana pesticide applicators.

Statement of the Problem

The problem is how to deliver pest management information to Montana pesticide applicators, where they live and work, in a manner that does not intimidate them. The delivery structure must allow for the effective use, safety and hazard information to be incorporated into the daily decision-making process.

Statement of Need

Increasing public pressure and reluctance to fund the traditional Montana educational system suggested that priorities, like remote information delivery, need to be

realigned. These priorities will be the result of public pressure, "No longer passive, members of the nonagricultural public are demanding the farming community, as well as state and federal regulatory agencies, provide greater accountability in identifying and preventing risks associated with pesticide use" (Whitford, 1993, p. 1). Thus, the PAT program is charged with providing pesticide use, hazards, safety, and pest management information to new licensees and re-certification applicants.

Strong participation in an effective PAT educational system is vital to successful delivery and implementation by the user community and acceptance of the food supply by the public. As providers of information to the PAT program, MSU Extension agents and specialists are being called on to provide information about safe and effective management techniques. These recommendations require information about pest identification and life cycles, non-chemical, cultural control methods and they weigh future agronomic considerations regarding the economic realities of arid crop production. Chemical control recommendations need to include cost, timeliness, and efficacy of control, but also legal considerations regarding mammalian toxicity, groundwater contamination, pest resistance and used container disposal. Pesticide education programs supplied with information by MSU Extension specialists and staff are unique in providing a research-based source of pesticide information and application practices for various pest management situations.

An important part of the information gathered by Extension specialists and staff is done by the MSU insect, weeds and disease diagnostic labs. A software application, the Pest Diagnostic Database (PDD), has been developed to log submitted samples,

incorporate recommendations, and report making. The database contains over five years of insect and disease occurrences. The database provides recommendations, which are continually updated as new information is developed and are dynamic and historically accurate with respect to problem severity, crop stage, location in state and time of year. Presently staff delivers information to remote users including pesticide applicators via phone, mail and computer modem using the MSU Outreach Network. Written sources (books, Extension fact sheets) are often not updated annually, tend to be more generic. They do not include localized or very recent information. Recommendations for pest management are more likely to be updated, especially for local situations, but may not include detailed information about pest monitoring, life cycle and non-chemical management strategies. In other words, current information exists; a structure for delivery does not.

In an effort to solve the problem of delivery, the PDD has been incorporated into a networking software program, the Pest Recommendation Network (PRN). The PRN has been deployed on the web at <http://Scarab.msu.montana.edu/PRN1>, since March 1998 and allows remote users access via Web browsers. Users can access PDD information and apply it to their situation by a method of data organization called Case-based Reasoning. Recommendations in a case-based format can also be linked or integrated across subject areas. The resulting recommendations are integrated based among subject areas accessed. Users of the database are presented with a ranking of situations or solutions similar to theirs. The user obtains a list of possible management options, implications for potential pesticide hazards, safety aspects and environmental

concerns. The PRN integrates pest management expertise of Extension agents, consultants, and specialists with pest information and seasonal occurrence from the Insect and Disease Diagnostic Lab database.

Users of the PRN are presented with a ranking of Pest situations or solutions similar to theirs. The resulting PRN compliments pesticide education by providing an extensive database of localized or regionalist pest occurrence information, incorporating information about safety and appropriate pesticide use, and improves the ability of the manager to incorporate safety issues into decision-making.

The gears, a suspicious public worried about their food supply, Agricultural producers who employ scientific practices to produce food and National and State governments and Land Grant institutions are in place. What is needed is knowledge about factors allowing or prohibiting these gears from meshing.

Objectives

The goal of Pesticide Applicator Training (PAT) is to deliver research based information about pest control to participants who produce a nutritious food supply. This study was conducted to evaluate the factors affecting the implementation of an electronic pest recommendation network (PRN) for PAT in Montana. The findings reported in this paper were determined using a pre-survey, training, control and post-survey of a portion of the population. Participants in the study were pesticide applicators (n = 497) in Montana PAT Region 2 (Choteau, Teton, Cascade, Toole and Pondera) counties.

Participants were randomly assigned to one or two groups: trained or control. The intent of this study was to determine the following:

- (1) If Pesticide Applicator training (PAT) influences a participants level of PRN use;
- (2) If lack of hardware, software, monthly service provider charges, familiarity with what the WWW offers, lack of computer technical assistance or training and/or high telephone line charges influence if a participant uses the PRN; and
- (3) If the relative value of the following topics were a factor in PRN use:
 - (a) Crop variety susceptibility information
 - (b) Conditions favoring susceptibility
 - (c) Symptoms and look alike symptoms
 - (d) Economic thresholds
 - (e) Pest life cycle
 - (f) Knowing required scouting frequency
 - (g) Typical infestation pattern in fields
 - (h) Cultural control information
 - (i) Chemical control information

Assumptions

The assumptions for this study were:

- (1) Producers want useful pesticide application and hazard information.
- (2) Useful pesticide application and hazard information exists to distribute to Montana producers.

- (3) A time lag exists between when the pesticide information is published in a useful format and when it reaches the producer in a useful format.
- (4) Pesticide applicators who answer questions regarding the usefulness of recommendation previously supplied via the PRN then they are incorporating information into the daily decision making process.
- (5) Pesticide applicator who owned computer hardware also knew how to use it.
- (6) The factors affecting the use of Distance Education technology by college students would also affect PRN use by growers.
- (7) Producers did not know that the PRN exists.

Limitations

The population for the study was limited to 1757 Montana residents who participated in Pesticide certification and re-certification programs in PAT Region 2 (Choteau, Teton, Cascade, Toole and Pondera counties). This group of producers was meant to serve as a sample, and considering limits to external and internal validity, allow inferences to other PAT regions. The collection of data was to be completed within two PAT training seasons.

Definition of Terms

The following definitions are for terms contained in this study:

Distance Education (DE) The separation of teacher and learner during at least a majority of the instructional process. The influence of an educational organization, including the provision of student evaluation. The use of educational media to unite teacher and learner and carry course content. The provision of two-way

communication between teacher, tutor, or educational agency and learner

(Verduin and Clark 1991, p. 11)

Pesticide Recommendation Network (PRN) Computer software that allows the user to access the Pest Diagnostic Database of recommendations in a Case-based Reasoning format and use the information in pest management decision making.

Pesticide Applicator Training (PAT) Statewide delivery of National Pesticide use and safety information.

Case-based Reasoning (CBR) A method of reasoning that solves new problems by adapting solutions that were used to solve old problems.

CHAPTER 2

REVIEW OF LITERATURE

This literature review focuses on the adoption of computer technology, adult and distance education applicable to the Montana Pesticide Applicator Training (PAT). A definition, brief history, and underlying principles (types, delivery, evaluation) of each are included.

Androgogy and PAT

Androgogy is the mechanism of adult learning, the conditions for effecting a permanent change in an adults behavior (Zemke and Zemke, 1981). When conditions warrant (career changes, birth, marriage, retirement etc) adults seek out and demand learning experiences. Ideally, androgogy is the facilitation of this experience. Adult educators encourage an adults' natural motivation to learn. This is especially true when the adult believes they need to learn. Educating adults who are not instinctively motivated to learn requires outside motivation and incentives. So confronted with the impossibility of ordering adults into a classroom, prodding them into seats and forcing them to learn, USDA funded educators, especially those dealing with restricted use agricultural chemicals employ an economic incentive. The incentive is "Learn to apply pesticides (an important component of agricultural profit) according to the label or they

will not be available for purchase” (Reeves Petroff, personal communication, Great Falls, January 2000).

In addition to the lack of motivation, problems with presentation quality and the perceived relevance of complex scientific information can also confound ideal androgyny during PAT sessions. Lacefield (1998) suggests a lecture may be the best way to teach an inexperienced, fresh-behind-the-ears, recent high school graduate and it may also be the best way to teach an older adult with limited self-directed learning experience. The PAT audience is a cross section of the agricultural population and it includes “adults in the first stage of intellectual and ethical development (a group which is not restricted to the young) see the world in polar terms of right vs. wrong” (Lacefield, 1998, p. 3). If the presentation does not portray information in “do this” or “do that” terms it may cause intimidation. Dr. Lacefield (1998) goes on to add that “These students have little tolerance for gray areas. When faced with uncertainty in a course, these learners will often perceive the instructor as poorly qualified and this lack of qualification as the reason for the uncertainty” (p. 3).

Petroff, the PAT coordinator for Montana, observed that two out of 30 PAT participants might be motivated to learn, the rest are there to receive credit so they can purchase chemical pesticides necessary for agricultural production and the lack of motivation to learn and apply PAT information professionally results in poorly calibrated spraying equipment (Reeves Petroff, personal communication, Great Falls, January 2000). Based on continuing problems occurring with pesticide application the portion of the audience that makes right or wrong decisions may be large. Weaver, a MSU stored

grain specialist, agrees and noted the number of instances of misapplied stored grain fumigants that occur every year (David Weaver, personal communication, Bozeman, May 2001). Jones (2001) a MSU soil scientist, reports in the Montana Crop Health Report that the active ingredient in the herbicide Assert has been detected in groundwater under the agriculturally productive Fairfield bench. In extreme cases Petroff (2001) suggested that even deaths occur when chemicals are applied incorrectly.

USDA funded PAT is not the only program employing incentives to motivate agricultural producers. In Denmark, agricultural units collect detailed data from grower's clubs. The economic incentives (bulk discounts) to be a member of a growing club are large. The data collected from the growers clubs are published in a report. This report allows comparison of the amount of fuel, pesticides and fertilizers used to grow a unit of production. Each member knows their own identification number, but not the identification numbers of the other members. With this type of information exchange it is easy for a club member to compare the effectiveness of different operations, gauge trends across the membership and adjust their practices. On the other hand, it is easy for the administrator to do the same and initiate trends and suggest best management practices.

Even though, ideal androgogy may not be completely effective at educating a PAT audience motivated by an economic incentive, androgogical literature does offer guidelines to discuss factors affecting the implementation of information, like PAT, by adults. The purpose of this study was to identify what factors could augment or impede the incorporation of effective use, safety and hazard information via the delivery

structure of the PRN, a decision support system. Following are some of the important androgical factors applicable to PAT.

Adult Memory in Androgogy

Is adult memory a factor that should be addressed when educating the PAT audience? Merriam et al. (1991) stated, "That adult intelligence appears relatively stable, at least until the sixth or seventh decade" (p. 158). It seems that adults can remember and that a more important consideration is how the information to be remembered is structured. Lacefield (1998) says that "accommodating changes occurring in adult memory and experiences requires consideration, especially when adults are faced with meaningless learning, learning that involves reassessment of old knowledge, and pure memorization" (p. 1). Dixon (1994) said that "the more ways a meaningful structure is connected to our existing knowledge, the more likely we will be able to retrieve it" (p. 16). Literature addressing the implications of adult memory frequently include terms suggesting that information structured in away that connects or relates the information to previous knowledge and experience will be most successful.

Course Design and Androgogy

After memory considerations Knowles (1980) believed, that a second factor is designing courses that include information that allows the adult to apply their experiences to problems rather than subjects and these problems should reflect the concerns that adults have experienced or foresaw. So in order to design the course

around the concerns of the student it is important to identify the motivation of the adult student. In other words, if adults want information to help them find a new job, an effective course design would include problems requiring job hunting tactics and strategies. Often, individual learners each have a myriad of reasons for attending courses which makes identification of concerns more difficult. Lacefield (1998) suggested that a learner may be motivated by the following:

1. Intention of using the knowledge or skill for a particular job or completion of a particular task;
2. Imparting the knowledge and skill in order to teach or share it with others who plan to use the skill;
3. Future understanding or learning in order to understand something which has not yet occurred;
4. Pleasure and self-esteem from possession of a skill or knowledge.
5. Learning for credit and not because the skill is important to the learner (p. 3).

Another attempt to define types of motivation categorization by Houle (Merriam, 1991 et al.) separates the motivations of learners into three types generalized to encompass the diversity. These are:

1. Goal-oriented learners who use education as a means to an ends;
2. Activity-oriented learners who participate for the sake of the social interaction;
3. Learning-oriented learners who seek knowledge for knowledge's sake (p. 83).

Knowing the motivation of the participants will allow their concerns to be identified. Addressing these concerns leads to effective course design and content. If motivation and level of concern of the participants are lacking what can be done?

Course Structure and Androgogy

Historically PAT programs bring training to community centers. The training structure uses lecture as the important activity. While this is a practical activity, there are problems, when lecturing to adults, especially adults whose motivation and concerns do not lend itself to learning. Brookfield (1992) has found;

“that these learners often complain that facilitators are abdicating their role by forcing learners to take responsibility and make judgments they are not equipped to make. Instead of being pleased about opportunities to form their own opinions and judgments, they may be confused and intimidated by this reversal of their expectations about education” (p. 13).

Experience has identified that a level of motivation below what is required by the course or lecture increases participant intimidation. Motivation and the concerns of the participants is a factor in the acceptance of PAT information. Concerns about pesticides are low and participants only have a certain amount of time and energy to expend learning about pesticides before they see the effort as impractical. Much of this motivation is expended traveling to the session. So changing the structure (less intimidating) and delivery (less travel) the motivation required to participate in the course could be applied, more effectively, to learning PAT.

A typical PAT lecture attempts to address the motivation levels of all participants at once. Thus a participant who is more motivated to learn is forced to attend for the same period as a participant who is less motivated, increasing the chances that at some time the effort expended will be perceived as impractical by some of the participants.

Following is a discussion of what type of computer systems might be structured to deliver PAT information to a audience with diverse levels of motivation. However, before investigating how to structure a course addressing multiple levels, the problems of delivery to users who are removed from the teacher in time and space should be discussed. This literature review will now present information about Distance Education and PAT.

Distance Education Defined

The advent of technology brought attention to the possibility of education in situations where the teacher and student are at a distance. It is interesting and informative to see how the definition evolved from the inception to the present. The first attempt in English to define distance education and to articulate a theory appeared in 1972 and in 1980 was named by Moore as the theory of transactional distance. In a reflective editorial Moore (1991) said,

“It is a distance of understandings and perceptions, caused in part by the geographic distance, that has to be overcome by teachers, learners and educational organizations if effective, deliberate, planned learning is to occur (p. 1).

Another version of this definition made by Verduin and Clark in 1986 acknowledged the use of computers and audio video equipment to unite teacher and learner. It also suggested that two way communication distinguishes distance education from other uses of technology in education. Finally, this version placed emphasis on the separation of teacher and learner during at least a majority of the instructional process.

Almost 14 years later, Rossman (2000) further defined distance education as follows:

“Distance education is planned learning that normally occurs in a different place from teaching and as a result requires special techniques of course design, special instructional techniques, special methods of communication by electronic and other technology, as well as special organizational and administrative arrangements” (p. 1).

Distance Education History

Organized mail delivery in Britain allowed the first distance education efforts, and Verduin and Clark (1991) believe that, “The History of education at a distance may have started with a course in shorthand. Isaac Pitman used the British Penny post system to receive Bible passages his students had copied in shorthand. This course was the first to include formal grading” (p. 15).

This type of correspondence course has dominated the distance education scene from 1880's to present and most distance education in this form occurs through organizations other than colleges or universities. The Distance Education and Training Council (DETC), formerly the National Home Study Council, estimates that today more than 2.5 million Americans are enrolled in DETC-accredited institutions (DETC, 2001). It is estimated that since 1890, some 130 million Americans have taken distance study/correspondence courses. Other applications are emerging and prospering, especially in colleges and universities.

Distance Education Types

Paulsen (1995) categorizes Distance Education types into predominant communication paradigms: (1.) One-alone: Online Resources Paradigm which is a model in which the student is a self-directed learner, often only interacting with online resources like online databases, journals, interest groups, and interviews. These activities will tend to be heavily structured but they require minimal interactivity, on the part of the instructor; (2.) One-to-One: the Email Paradigm: Email instructional methods are characterized by individual and individualized instruction and learning. Often these techniques (learning contracts, apprenticeships, correspondence studies) rely heavily on the personal relationship between the student and the teacher; (3.) One-to-Many: the Bulletin Board Paradigm a model in which the students are exposed to one or more experts in a given subject area. Usually these methods (lectures, symposia, skits) imply passivity on the part of the learner; (4.) Many-to-Many techniques: the Conferencing Paradigm is a technique "that all participants have the opportunity to take part in the interaction (discussion groups, debates, simulations, case studies, role plays, brainstorming, group projects).

However, it is important to realize that new technology may for the short term seem like new methods of distance education. Often the new methods are merely media developments and "Although the introduction of a new media system usually brings with it a novelty effect...media are mere vehicles that deliver instruction but do not influence

student achievement any more than the truck that delivers our groceries causes changes in nutrition” (Verduin and Clark, 1991, p. 11).

The introduction of new technology will continue. Currently, the best example is the World Wide Web (WWW). On one hand, novelty is high and content is lacking in many of the home pages. On the other, it has taken the Library of Congress over a hundred years to collect 14 million books and catalogue them. The WWW collected ten million documents, cataloged them and made them available without respect to physical location in less than five years.

Distance Education and PAT in Montana

Previous to the discussion of distance education, was a discussion of how low levels of motivation and concern increase the possibility of intimidation and cause the information to be deemed impractical. A PAT participants motivation is low and so are their concerns, making it hard to develop effective programs. Currently a PAT participant’s motivation must equal or exceed the effort, outlined below, required for re-certification. To become certified an applicator has two options:

1) Attend an approved 6 hour initial pesticide training program AND complete an Initial Quiz at the end of the session. The PAT coordinator should go over the quiz with individuals that answered less than 70% of the questions correctly. OR 2) Complete an open book Private Applicators Certification Exam (Exams 1 or 2) and answer at least 70% of the questions correctly. Note that Initial Quizzes are different from Certifying Exams!

Once an individual has received their private pesticide license they are termed as re-certifying applicators. In order to be eligible to renew their farm licenses for another 5 year cycle, re-certifying applicators must either:

Accrue 6 pesticide re-certification credits (points) over the course of the 5 year re-certification cycle for their district; OR Take a closed book Exam (Exam 3) during the re-certification year (5th year) and answer 70% of the questions correctly. The accrual of the 6 points does not need to take place all in the re-certification year, but can be spread out over the 5 year period (Montana Pesticide Education Program, 2001 p. 1).

Early in 1998 online quizzes were made available in an attempt to match course structure to the motivational level of a Montanan seeking to accrue pesticide re-certification credits. By completing a Web quiz either in the home or County Extension office a participant can decrease the price of attending a presentation. It is unknown if the quizzes reduce intimidation or increase the acceptance of PAT information. It is known that the quizzes are becoming more popular. The quizzes were made available late in 1998. From August 1998 – January 2000, two quizzes were completed. From 2000 – 2001, 38 quizzes were completed by Montana PAT participants.

Would PAT participation become more effective if the PRN could be used to deliver complete PAT training required for certification requirements? The Case-based reasoning structure of the PRN matches user input (describing past experiences) to database information and develops a checklist of possible solutions. Unlike a lecture, user input or motivation to find an answer drives the Case-based reasoning to a solution. The PRN can be delivered to the users workplace or home and so what motivation is available is applied to getting an answer and not to, for example, travel. To learn more about factors affecting the acceptance of software like the PRN the following literature was reviewed.

Factors affecting Adoption of Computer Software or Decision Support Systems in
Agriculture

PAT structure that does not intimidate and can be delivered to the participant for completion, at their discretion, of PAT certification should consider the following. As Lacefield (1998) and others suggest, that while we want to move our students toward independence and ability to direct their learning, we must be aware that not all will embrace the opportunity. In the early stages of this process, many will struggle, complain, and be very uncomfortable. Facilitation should be balanced with structure. We should aim to be a guide on the side but we may want to avoid requiring students to blaze their own trails.

If structure appropriate to a PAT participants concerns would help those confused and intimidated with the gray areas of complex scientific practices, might computer software deliver such structure? Could intimidation be reduced and participant motivation applied more effectively using software delivered on the WWW? Many Land Grant Universities believe this to be a possibility and are developing a type of computer software named Decision Support software. Literature delving into the "why" of computer adoption and decision support software is considered next.

In a recent study of the adoption of computers and the software that runs on them, producer age and innovative behavior was studied. It is believed that younger producers adopt computers to make up for lack of experience. Ascough, et al. (1999), found that: "non-adoption of computers among farmers can be explained as a rational decision. It appears that computers are being adopted more frequently by less experienced producers

to compensate for lack of experience” (p. 203).

Another factor affecting adoption of computer technology is innovative behavior. Five categories describe innovative behavior. They are adopters; innovators; early adopters; early majority; late majority; and laggards. Lewis (1998) says, “Adopter category groups tend to be normally distributed and on average there are: 2.5% innovators; 1.3% early adopters; 34% early majority; 34% late majority; and 16% laggards” (p. 234).

In summary, the literature review above suggests computing will be adopted by younger producers at a rate determined by their adopter category and that the average audience includes persons from each category. As this literature review progresses it seems to be increasingly apparent that addressing a diverse audience could improve effectiveness of PAT.

Decision Support Systems

If structured PAT computer software addressing varied levels of motivation and innovative behavior could improve implementation of PAT, what kind of software tool would work? Decision support systems are models developed to improve the decision-making process or in other words decrease the grey area of decision making inherent in complex scientific information. First, a discussion of the basic idea behind decision support systems or models. Attonaty et al. (1999) believes that, models are considered as “only a means to an end, which is to have a well structured and coherent debate about a problematical situation in order to decide how to improve it” (p. 42). He adds that

“Deliberate strategies” combine with “emergent strategies” to produce “realized strategies.” Deliberate strategy refers to a project formulated in a stable, foreseeable or controllable environment. Emergent strategy refers to a strategy learned from action experience. Attonaty et al. (1999) stresses that trials and failures, experiments and apprenticeship are part of the process.

Several successful efforts have been detailed that have utilized Case-based reasoning, an artificial intelligence approach, to problem solving. Schank and Leake (1998), from the Artificial Intelligence Project, Yale University, said that:

“When people encounter new situations, they often explain them by remembering old explanations, and adapting them to fit. We believe that this case-based approach to explanation holds promise for use in AI systems, both for routine explanation and to creatively explain situations quite unlike what the system has encountered before” (p. 1).

Decision support systems using Case-based reasoning projects, other than the MSU PRN, have been developed by Land Grant Universities. At Virginia Tech University, CFACTOR (A Case-based Reasoning Approach to Evaluating Crop Rotations) is a program to evaluate crop rotations for the risks associated with soil erosion and pesticide pollution in a farming system. The applicability of a case-based reasoning approach has been developed to solve agronomic and entomological problems including erosion and pesticide-free pest management. Indiscriminate land use promotes erosion that leads to severe problems in the future. Crop rotation is one of the several approaches to contain erosion losses and offers mitigation of some crop pests. Some crop rotations may result in negative impacts on the environment. The pesticide pollution risk of a crop rotation is evaluated based on suitability of the rotation as a pest

management practice and on evaluating criteria like possible pest outbreaks in a rotation, the available control options and the environmental risks associated with these control options (Virginia Tech University, 2001).

A University of Wyoming project, CARMA, produces advice about the most economical responses to Wyoming grasshopper infestations. CARMA does this by predicting the proportion of available forage that will be consumed by grasshoppers and estimating the economic returns of various treatment options. The information required to make the forage loss prediction includes the date, the infestation location on a Wyoming map, the range value and infestation history of the location, the number of grasshoppers per square yard, the grasshopper type and age distribution, the relative recent precipitation and temperatures, and the total area infested, including adjacent neighbors' lands (Hastings, 1996).

Possible Methods for Increasing Adoption of Computers by Montana Producers

Research into adoption suggests that maybe PAT is not accessing potential partners in the adoption process. Attonaty, Chatelin and Garcia, (1999) looked at adoption of computers by producers early in there use for farm management and found that consultants who had knowledge of computers played an important role in guiding the producer, who had knowledge of farming goals to useful solutions.

How decision support software delivered over distance could act as a means to amplify interaction is expressed by Attonaty et. al. (1999).

“The farmers reconsidered the use of the optimization tool in various ways not predicable at the beginning. They agreed on the process of building generic patterns as a means to increase their intelligence of possible solutions. To design their own solution, they adopted an iterative and incremental attitude to attain a satisfying solution and they use the optimization tool as a what-if calculator. In fact, despite the lack of interactivity in computer terms, the tool proved it interactive in that it encouraged the different people involved in the process to make a dialogue, to ask questions, and to re-assess their ideas” (p. 159).

Interaction about specific problems using selected variables agreed upon by those involved is probably the most valuable aspect of decision support or modeling projects. Decision support systems like the PRN rarely supply the exact right answer, what they do is to allow the concerned user to address what is important, discard what is not and arrive at a well informed decision. In addition, allowing low risk “what if” opportunities to participants during and after the formal discussion allows those requiring clarification or interested in other facets of the problem to return or delve deeper into the problem and solution to their satisfaction creates an valuable learning tool. The model coordinates opinions, experience and expertise for problem solving. Applying this process to the PAT problem, would accommodate different levels of participant motivation and concern.

Changing Agriculture and Changing Extension

The term agriculture suggests research, engineering, banking and education, it no longer means just farming. Information about agriculture is becoming more and more important. Concerns about agriculture and its impact on society are driving public perceptions and competition for resources.

The Smith-Lever Act, 1914, act helped define the beginning of federal efforts in agricultural education. Since this beginning change and innovation has been a inevitable burden. The alarm for change and innovation has often been delivered by a reduction or lack of increase in public funding and is causing Extension systems in many states to consider program restructuring. Extension administrators and personnel are examining program content to ensure that critical needs are being met.

Besides changes, discussed previously, in consumer perception of agriculture, life in agricultural communities is being reassessed by those living it. A child and family development specialist, DeBord (1991) says that,

“Family farms, typically associated with rural areas, no longer support immediate or extended family members. Farms are being sold, women are taking more lucrative positions, and community service agencies are realizing the need to change traditional programming methods to meet the needs of traditional rural clientele” (p. 1).

Changes in how those in agriculture value their quality of life will affect the motivation to continue living with agriculture and the practicality of PAT.

Agriculture and Pesticides

Pesticides are very important to production agriculture and a study cited in a Hudson Institute paper by Avery (1996) suggests just how important:

“yield in crops would drop between 24 percent and 57 percent without pesticides. Wheat yields would be harmed the least, at 24 percent, and corn yields would be cut by 32 percent and rice by 57 percent. One study on fruit and vegetable production concluded that yields would drop from between 50 percent and nearly 100 percent depending on the crop and location. Another study concluded that fruit and vegetables consumption

would decrease by 11 percent because of high prices and that acreage required for production would increase by 44 percent” (p. 10).

The value of pesticides to agriculture can be discovered, as many a gardener knows, with very little first hand experience.

Extension Pesticide Applicator Training: History and Mission

The safe use of pesticides has been a major focus of Cooperative Extension Service (CES) programs since 1960. Concerns about pesticide use and effects on the environment prompted Extension to formalize its educational programs on pesticides, based on this need, and the concern for the health of those who use pesticides, including homeowners and commercial applicators, as well as farmers and ranchers.

The Pesticide Applicator Training (PAT) program was begun in the mid 1970's, in order to train applicators in the safe use of restricted use pesticides. On an annual basis, Extension trains over 500,000 pesticide applicators (USDA, 1995). CES also provides pesticide education to a diverse audience, ranging from rural to urban settings. In 1994, “CES reported making almost 4 million contacts via training programs, educational displays, news articles, radio and TV and one-on-one communication” (USDA, 1995, p. 1). Topics such as homeowner use, proper storage and disposal, ground and surface water concerns, endangered species, worker protection, food safety, integrated pest management and risk/use reduction are covered.

The Pesticide Applicator Training program provides educational opportunities and information to people who use pesticides as part of their livelihood, to consumers

with questions about the use and impact of pesticides in their everyday lives, to students at Montana State University and at other institutions, and to decision-makers such as local, state and federal government regulators and legislators.

Our mission is to improve pesticide use practices to protect humans and the environment by providing information on IPM concepts, pesticide use data, laws and regulations, and environmental stewardship leading to a sound understanding of pesticides and their responsible use.

The philosophy is that PAT is in the business of pesticide education to teach people to:

- (a) evaluate when pesticides are needed
- (b) apply pesticides safely
- (c) understand the impact of pesticide use
- (d) know and understand the impact of pesticide-related laws and regulations” (Montana PAT Program, 2001, p. 1).

Pesticide applicators have improved their knowledge and attitudes about materials. In 1994, there were 292,613 private applicators in training programs designed for certification as users of restricted use pesticides. This represented an increase of over 20,000 applicators over 1993. There were also 215,885 commercial applicators that were trained during 1994, an increase of several thousands since 1993. Almost 4 million individuals took part in educational programs on pesticide safety. There were 206,755 pesticide applicator trainees who adopted improved pesticide use practices as a result of PAT in 1994 (USDA, 1995).

Major PAT Accomplishments and Highlights

It is hard to quantify the contribution of PAT to the quality of the food supply, it is easier to judge the programs contribution based on the results of scientific research. If we use risk as a guideline, food scientists rate the risk to our health from pesticide

residues less than the risks associated with microbial contamination, nutritional imbalance, environmental contaminants and naturally occurring toxicants. Many other activities are considered riskier than consuming food.

CHAPTER 3

METHODOLOGY

This section describes the procedures used in completing this study. Included is a description of the design and rationale of the study, population, how the population was sampled, a description of the study instruments, and the methods by which data were collected and analyzed.

Rationale for Research Design

The design for this study was a pre-survey of the entire sample and post survey of the portion of the sample who accessed the Pest Recommendation Network (PRN). Included in the design was an opportunity to explore the effect that training had on Montana pesticide applicators use and application of the WWW resources.

Design of the Study

The objectives of this study were to determine the factors that may enhance or prohibit use of the PRN by pesticide applicators. To this end, the design for this study used a pre-survey (S), training (RT), control (RControl) groups determined at random and post survey of those trained participants who accessed the PRN (PRN S).

S	RTrain	PRN S

	RControl	

In addition to the "Survey of Pesticide Applicators accessing the Web" (S and PRN S), both trained (RT) and control (RControl) groups received the take-home worksheet (Appendix C) that provided step by step instructions on how to access and receive information from the PRN. In addition to the worksheet, training (RTrain) included verbal explanation of 11 Power Point text slides and 3 PRN software screen images, screen #1, screen #2 and results screen from the PRN application (Appendix D). The purpose of the mini-lecture and slides were to motivate and familiarize subjects to the use of the PRN. The control (RControl) saw only one text slide (Appendix E) referring to the PRN. To use the PRN the control group had to rely on the worksheet instructions.

The major dependent variable of this study was the number of each group (RTrain or RControl) that would access the PRN in the future. The moderator variables were applicator type (Private, Commercial, Restricted), Career type (Producer, Certified Crop Advisor, County Agent, Agricultural business), lack of hardware, software and/or high telephone line charges, service provider charges, lack of computer technical assistance or training, and familiarity with what the WWW offers. The perceived value by the PRN user of: crop variety susceptibility information, conditions favoring susceptibility, symptoms and look alike symptoms, economic thresholds, pest life cycle, knowing required scouting frequency, typical infestation pattern in fields, cultural control information, chemical control information. The independent variable was amount of PRN training received.

Threats to Internal Validity

Gall et al. (1996) discuss eight threats to the internal validity of designs with control groups that were identified by Stanley and Campell in 1963. These threats are: history, maturation, testing, instrumentation, regression, selection, mortality and interaction effects.

Over time activities unrelated to the experiment may affect the performance of the dependant variable. These activities are regarded as history. The public is experiencing a rapid increase in awareness of the WWW and this could have affected the results of this survey. A control group was used to help gauge the effects of history and aid in the identification of the reason survey participants accessed the PRN.

Threat of maturation refers to changes, mental or physical that occur over time to the subjects. So, if the duration of the study occurs over a long period of time as this survey did (greater than 1 year but less than 2 years) other reasons and factors could affect the use of the PRN other than the amount of training received by each group. A control group and randomization should have controlled this threat to internal validity.

Internal validity is also threatened by surveying. Often the survey itself forces the subjects to organize their thoughts or perceptions and epiphanies may occur. This mental and emotional development may cause the subject to enter different answers on the post survey. The reason for the different answers may not be related to the training. The topics on the survey were only slightly related to the PRN subject matter and a control group, like the untrained group, has proven a good method to account for the threat of

testing.

All data were entered and sorted using MS Access and Excel software. The SPSS Base 10 statistical package was used to analyze the data. Reliability of the instrument was determined to be significant at the $\text{Alpha} = .9040$ (Section 1) and $\text{Alpha} = .8837$ (Section 2) level using the Cronbach's Alpha statistical method. This reliability test measures a lower bound indicating the true reliability of the survey. It measures the amount of variability that is a result of the participants opinions rather than a confusing survey design.

Statistical regression occurs whenever a test-retest procedure is used to assess change as an effect of the experimental treatment, there is the possibility that statistical regression accounts for observed gains in learning (Gall et al., 1996). The design of this survey did not include testing, which reduces the possibility that this threat affected the dependant variable. Survey results from both groups were compared using a Mann-Whitney, Wilcoxon and Freidman (for Likert-type scale questions) comparison tests useful for non-randomized populations. No statistical difference was evident between the control or trained group so it is unlikely that statistical regression affected internal validity.

Differential selection of subjects usually occurs when already formed groups are used. Thus, the groups may be different before the study began. The survey was administered on two different days to people who needed credits to meet the 5 year cycle certification requirements. There were no indications of any factor(s) like poor weather or other meetings that might have prevented a representative portion of the population

from attending either session. Survey results from both groups were compared using a Mann-Whitney and Wilcoxon, and Freidman (for Likert scale questions) comparison tests useful for nonrandomized populations. No statistical difference was evident between the two session days so it is unlikely that statistical regression would affect generalization to the Region 2 PAT population.

Mortality or attrition refers to subjects who drop out of a study due to illness, or resentment that the treatment is demanding or threatening. Those subjects who drop out of a study may possess characteristics such that their absence has a significant effect on the results. If this attrition was not similar across treatments it might have inflated the percentage of people accessing the PRN.

The last threat to internal validity is selection-maturation interaction. This broad category refers to the situation where one group, possibly the group receiving the training, is more mature in a given area than another group. If for some reason a more mature group attended a session on one day than the other this could have affected the dependant variable.

Threats to Population Validity

Population validity concerns the extent to which the results of an experiment can be generalized from the sample that was studied to a specified, larger group. Gall et al. (1996) discuss threats distinguished by Bracht and Glass in 1968 to population validity. The threats to population validity that are applicable to this study are: selection-treatment interaction, specificity of variables, experimental effects, and reactive arrangements.

Selection-treatment interaction occurs when subjects are not randomly selected, reducing the ability of the results to accurately predict characteristics of the population. Randomization was not used to select the subjects for this survey, so the survey has good internal validity, and could be generalized to the Region 2 PAT population. On the other hand generalizations made to the entire Montana PAT population would be weak. The nonparametric statistical tests, Mann-Whitney and Freidman, were used since they do not assume that the population is normally distributed (SPSS, 1999).

Specificity of the variables or when the post survey is administered also threatens the population validity of the results. The major factor that could have threatened the results was the threat of time measurement and treatment effect. It was the PAT participants decision to take the post session survey and this decision could have been made as much as a year past the survey date. In addition, during the growing season priorities may change and information valuable at one time may not be valuable at another. The particular period in the growing season might allow the subject to assess the PRN, a new source of information, when during another it may not be feasible and the participant may access historical sources of pest information.

Experimental effects could have affected the response of the subjects and resulted in less external validity. Any passive elements (age, race, anxiety), active bias, and evaluation bias that the researcher exhibited during the research process could have affected the subjects responses. These experimental effects could have affected the number of the subjects that accessed the PRN since the researcher developing the PRN was also the lecturer.

An important threat to external validity are reactive arrangements. This threat refers to a number of factors associated with the way a study is conducted and the feelings and attitudes of the subjects involved. In other words the Hawthorne effect may have affected results of the survey. Neither the trained group or the control group knew they were receiving a different lecture so the Hawthorne effect would not have affected the number of participants who accessed the PRN. On the other hand, mandated Government training like PAT is very often perceived as a chore or unnecessary infringement on the subjects life. So a participant, who might have been interested if information about the PRN had been delivered by the "Paul Harvey" radio message, or "early adopter neighbor" may have paid less attention because of the mandate. It is possible that the participants may also have been affected by a lecture suggesting they would have to make decisions using technology. Learners without a recent history of education often complain that facilitators are abdicating their role by forcing learners to take responsibility and make judgments they are not equipped to make. Instead of being pleased about opportunities to form their own opinions and judgments, they may be confused and intimidated by this reversal of their expectations about education (Brookfield ,1992).

Sensitization or awareness of the surveyed issues may cause a subject to react differently since they are suddenly aware of the problem. This threat could be a factor as subjects may develop a negative reaction to supplying a third party, especially local and federal governments, with information about how they make decisions, or that they do

not use computers when it is popular to do so. Historically and currently prevalent in Montana is a ground swell of mistrust directed at the government (Stern, 1996).

Population Description

Approximately 8,000 private pesticide applicators are licensed in Montana. For re-certification purposes, the state is divided into 5 regions with rotating programs offered among region to obtain credits necessary for license renewal. In addition, many applicators become new licensees each year either by attending an Extension Service sponsored pesticide-training program or through a self-study program available at county Extension office.

A private applicator may be certified in one of two ways:

“1. Obtain at least six credits of approved training over a five-year period. This training can be obtained during the five-year re-certification period or all in the last year of re-certification. It is recommended that applicators have the opportunity to obtain some training in each of the five years during the re-certification period.

2. Re-certification requirements may change to 12 credits with some training occurring during each year.

OR

3. If six credits are not obtained by the end of the fifth year and the applicator wishes to re-certify, he/she must take a closed book written exam and answer 70% or more of the questions correctly. The applicator cannot enter the system as an initial certified applicator for a period of two years from the date of re-certification” (Montana Pesticide Education Program 2001, [Online]).

Sample and Time Line Description

In 1997, the PRN project received USDA funding to develop an electronic pest recommendation network for pesticide applicators in Montana. Grant objective 1,

programming of the software application and Grant objective 2, development of the initial case information was also completed in 1998. On the other hand, delivery of training allowing PAT participants to use the WWW based PRN, proved difficult because the Montana 1998 - 1999 PAT training was underway in Western Montana or Region 1. The PRN contains cases that reflect situations common to small grain pest management. However, Western Montana or Region 1 includes very little small grain production. Therefore, delivery of PRN training to PAT workshops in Region 1 would have been ineffective. In 1999 - 2000, PAT was underway in Region 2, an area that contains suitable small grain production. Small grain producers were likely to find the cases in the PRN useful and so the study was scheduled for delivery to PAT workshops in Region 2 during the 2000 season.

Results of Survey Instrument Testing

To improve the over all design, return rate, validity, and readability, the survey was pilot tested by faculty in the Education Department, and during the Gallatin and Granite Counties Pesticide Applicator re-certification session in December 1999. Seventy four participants (possible 220) were surveyed in the instrument test.

The results of survey section II indicated that greater than 50% of the participants have or lease a computer or Web TV, have access to email, and access to the Web or the Internet. Survey Section III asked the participant what factors affected their use of the Internet. Familiarity with what the WWW offers ranked as having the most effect on the participants use of the WWW, followed by lack of technical assistance or training.

Telephone and monthly telephone charges ranked last. In order to align the format and structure of information included in the PRN the survey asked participants to rank the value of selected pest control factors to their pest control decision making. Chemical control information, pest life cycle, conditions favoring susceptibility and economic thresholds ranked above typical infestation patterns, cultural control information, symptoms and look alike symptoms. These results served to support the assumption that producers had access to computers and the Internet.

Following the survey test, the instrument was discussed with advisors and people experienced with conducting surveys and portions were revised where necessary.

Following the testing and revision process the instrument was approved .

Using the tested instrument, 540 pesticide applicators were surveyed from a Region 2 population of approximately 1757. Forty three surveys were discarded so in the study, the total sample was made up of 497 new and returning pesticide applicators attending the 2000 Region 2 PAT re-certification session in Great Falls, Montana. No attempt was made to determine gender or minority.

Table 1. Frequency of PAT participants responding to pre-training paper survey.

County	Area Total	Attendees	Surveys	
			Returned	Completed*
Region 2 survey	1700	540	540	497

* 43 surveys were incomplete and discarded.

Participants were asked to circle terms (Private, Commercial or Restricted) that described their PAT Applicator type most accurately. The PAT session was designed

and advertised as suitable for private applicators and the data in Tables 1 and 2 indicated that the private applicator (437) and producers (413) were a large majority of attendees.

Table 2. Types of Pesticide Applicators Participating in Survey.

Applicator Type	Number	%
Private Applicators	437	88
New Applicators	40	.08
Restricted	10	.02
Commercial	6	.01
Private and Commercial	4	.008

Table 3. Types of Careers Participating in Survey.

Career Type	Number	%
Producers	413	83
Agricultural Business	16	3
Both a Producer and Ag. Business	16	3
Certified Crop Advisor	1	.1
Career type not indicated	51	10

Similarity of the Samples

To determine if the control and trained groups were from the same population a Mann-Whitney and Wilcoxon Test was applied using the SPSS Base 10.0 package.

Differences in the two groups were not significant at .05 (except for Variable 4

“Economic pest control thresholds” in Section I), so the groups were treated as similar.

Instrument Design: Pre-session Survey on Paper

A list of factors that might affect a pesticide applicator's decision to use electronic methods to access PRN, were collected and identified from the literature, and through conversations with agricultural educators and researchers in the Department of Agricultural and Technology Education. A Likert-type scale, employing responses ranging from zero (0) to eight (8) for section I (Pest Control Information Needs) and zero (0) to five (5), with a "Not applicable" option (Factors Influencing Your Current use of the World Wide Web Network). A zero indicated that a factor had no Pest Control value to the participant or effect on a PAT participants use of the PRN. Eight to five indicated that the factor had high value for pest control or a "strong effect" on the PAT participants use of the PRN.

The survey instrument consisted of different sections (Appendix A). The first section asked questions to determine the value of pest control factors in the PAT participants pest control decision-making. For this section, the "Not Applicable" response was not included. This approach forced respondents to make a decision regarding the potential impact of each factor on the future implementation of PRN information in pest management decisions.

The second section (Internet Access) asked participants about what kind of computer resources they had and the third section (Factors Influencing Your Current Use of the World Wide Web) contained questions about the value of selected factors that may

affect their decision to use the WWW in day to day activities. The fourth (IV) and final section contained questions about demographic data.

Instead of a mailed survey, convincing cover letter, and postcard reminders an opportunity was identified during which the survey could be administered to a large captive audience. PAT sessions have evolved in many counties from many small meetings throughout the season to one or two large meetings on different dates. In the large meeting situation a suitable date and central location that has auditorium facilities are chosen. Notices are sent out to all persons requiring PAT recertification. Two large meetings were planned for Region 2 (Choteau, Teton, Cascade, Toole and Pondera) counties. The attendees of two large meetings were given the pre-test survey instrument (Appendix A), one of the meetings, chosen at random, received PRN training slides and lecture.

Instrument Design: PRN Post Session Survey on the WWW

An on-line feedback survey (Appendix B), for PAT trainees was designed and implemented. The PRN online survey was conducted to evaluate the effectiveness of PRN training and determine what aspects of the PRN attracted users. This on-line electronic survey determined if a certified pesticide applicator would incorporate regionalized pest occurrence, safety and appropriate pesticide use information into decision-making. In other words, the more a factor is valued the more it would be used by the participant. This in turn would allow the researcher to design recommendations to address the factors that are of most value to the user. On the other hand, it would identify

those factors important to the correct application of pesticides, but not perceived as important by the applicators to the correct application of pesticides. Identification of these factors will allow PAT educators to design information to stress the importance of factors under-rated by applicators.

Upon accessing the PRN the following three steps are initiated by the PRN. Step 1 requested the user name. If the name was new to the PRN, demographic information was requested. Step 2 requested information or feedback regarding the users last PRN session. At this step the returning user can decide to evaluate the results of their last session or continue to access the database and view recommendations. This opportunity for the user to enter feedback is repeated at the beginning of each session. If the name does not match the PRN user list, the new user is asked to fill out the online survey of Pesticide applicators accessing the web. This new user would then be asked for feedback at the beginning of their next session. Step 3 allowed a new or returning user to submit request for pest management information.

Using the reporting abilities of the PRN software, a report of user feedback can be generated. The report data were then entered into Access and Excel software for analysis in this study.

CHAPTER 4

FINDINGS

Results of the PAT on PRN access

The “Survey of Pesticide Applicators Accessing the Web” and PRN Training for Region two (Choteau, Teton, Cascade, Toole and Pondera) counties was completed in January 18 – 19, 2000. A tally of the number of participants accessing the PRN was gathered using the online survey during the 2000 growing season. The results are displayed in Table 4. Of the 497 persons that completed the PRN training and electronic “Survey of Pesticide Applicators Accessing the Web.” Seven first, last and city names matched the list of participants completing the paper survey administered at the Region 2 PAT re-certification session. In addition, partial electronic information (last name and city) matched paper survey demographics information. It is difficult to determine where and how these partial matches received the PRN worksheet. It is possible that the surveyed Region 2 PAT program attendees passed the PRN worksheet on to a relative who was perceived as the family computer person.

The data in Table 4 reveal that a possible 150 non survey persons received the PRN worksheet during the Extension Crop Pest Management Schools. One hundred and six individual that were not from Region 2 accessed the PRN once during the 2000

growing season. None of these 106 persons who accessed the PRN during the 2000 growing season responded to the "Online Feedback Survey".

Table 4. Differences between those responding to the On-line survey with no PRN training and those with PRN training.

Training	Possible	PRN Access	% PRN Access	Users Completing feedback form
Worksheet and PRN Training, Region 2	273	6	.02	0
Worksheet but no PRN training, Region 2	243	1	.0004	0
Others who received the worksheet and training.	150	106	70	0

Results of the Paper

The presentation of the survey results will begin with Section II which describes the population's level of Internet access. Section III which illustrates the factors influencing the populations current use of the WWW. Finally, the results of Section I which asked, "How valuable selected pest control factors are to the surveyed population's pest control decision making?"

Rankings of factors were calculated for section I and III. A Friedman test, in which the scores for each variable are ranked and the mean ranks of each variable are compared was applied using the SPSS Base 10.0 package. The Friedman test determines if there is no difference between the groups, each subject's rankings would be random and there would be no difference in the ranks across the variables. Differences in the

ratings were statistically significant at .05 (SPSS Asymptotic Significance range was from - .00 to - .036) so the null hypothesis, that there is no difference in preferences, was rejected. The results are displayed in Tables 6 and 7.

Section II

Participants were asked to describe themselves, their computer resources and their access to the Web. Of the 497 responses displayed in Table 5, 68% lease a computer or Web TV, 68% have easy access to a computer or Web TV, 55% use the computer or Web TV for farm business, 60% have access to the Web, 58% have access to email and 56% have access to the Internet.

Table 5. Percentage of participants with and without computer resources.

Computer Resources	n	% with*	n	% without*
Own or lease a computer or Web TV	339	68%	158	31%
Have easy access to a computer or Web TV	340	68%	157	32%
Use the computer or Web TV for farm business	272	55%	225	45%
Have access to the Web	298	60%	199	40%
Access to email	288	58%	209	42%
Access to the Internet	279	56%	218	44%

*497 participants responded to the survey

Section III

Included in the survey were questions aimed at identifying barriers encountered by the participants when trying to access information on the Web. The respondents ranked the factors in Table 6 as, 0 having no effect on their use of the web and 5 as

having the strongest effect on their use. Table 6 data reveal the respondents ranking of factors that affect their use of the WWW. The highest ranking factor (3.90) was familiarity with what the WWW offers, while the lowest ranking, lack of hardware (3.01) indicates the relative effect the factors had on use of the WWW.

Table 6. Ranked Factors affecting PAT participants accessing information on the web.

Factors	Ranking*
Familiarity with what the WWW offers	3.90
Lack of computer technical assistance or training	3.79
High telephone line charges	3.64
Lack of software	3.47
Monthly service provider charges	3.17
Lack of hardware	3.01

Friedman test results, N = 325, Chi-square = 97.492, DF = 5, Asymptotic Sig = .000.

*The scale was No Effect 0, 1, 2, 3, 4, Very Strong Effect 5.

Section I

In an effort to prioritize the content of the PRN for potential users, participants of the survey were asked to rank (0 least valuable – 8 most valuable) selected pest control factors to their pest control decision-making. The data in Table 7 reveal the respondents ranking. The highest ranking factor (6.39) was chemical control information, while the lowest ranking factor (4.13) knowing required scouting frequency, indicates the relative value of these factors.

Table 7. Pesticide Applicators rank the perceived value of nine factors to their decision making.

Factors	Ranking*
Chemical control information	6.39
Economic thresholds	5.37
Crop variety susceptibility information	5.25
Pest life cycle	5.14
Conditions favoring susceptibility	4.97
Typical infestation pattern in fields	4.68
Symptoms and look alike symptoms	4.60
Cultural control information	4.47
Knowing required scouting frequency	4.13

Friedman test results, N = 433, Chi-square = 275.742, DF = 8, Asymptotic Sig = .000.

*The scale was Least Valuable 0, 1, 2, 3, 4, 5, 6, 7, 8 Most Valuable.

Do people in PAT Region 2 with access to computers and Internet prioritize factors affecting their use of the Web to a similar degree of importance as those without access to computers or the Internet? Table 8 and Table 9 data shows how those without access and those with access to a computer ranked factors affecting their use of the WWW. The means for those with computer access varied from 3.73 to 3.20. While the range was 3.77 to 3.11 for those without access. The Friedman test revealed that the ranking of the factors were significant and those without computers ranked lack of hardware (3.17) and software (3.75) and technical assistance (3.63) as the factors most affecting their use of the WWW. Those with access to computers ranked familiarity with what the WWW has to offer (3.73) as the factor that most affected use of the WWW.

Table 8. How participants with access to computers rank factors affecting their use of the WWW.

With Access	Ranking*
Familiarity with what the WWW offers	3.73
Lack of hardware	3.73
Lack of software	3.46
Lack of computer technical assistance or training	3.46
High telephone line charges	3.41
Monthly service provider charges	3.20

Friedman Test N = 258, Chi-Square = 27.733, Df = 5, Asymptotic Sig. = .000

*The scale was No Effect 0, 1, 2, 3, 4, 5 Very Strong Effect.

Table 9. How participants without access to computers rank factors affecting their use of the WWW.

Without Access	Ranking*
Lack of hardware	3.77
Lack of software	3.75
Lack of computer technical assistance or training	3.63
Familiarity with what the WWW offers	3.50
High telephone line charges	3.24
Monthly service provider charges	3.11

Friedman Test N = 44, Chi-Square = 11.942, Df = 5, Asymptotic Sig. = .036.

*The scale was No Effect 0, 1, 2, 3, 4, 5 Very Strong Effect .

Do people in PAT Region 2 with access to computers prioritize pest control factors to a similar degree of importance as those in the same area without access to computers or the Internet. In other words, are people with computers looking for different information than those without computers? Table 10 and 11 data shows that if participants with computers are looking for different information than those without computers it was not revealed in the data. Rankings of factors most valuable to pest control decision making by both those with and those without computers were the same.

Table 10. How participants with access to computers rank factors valuable to pest control.

With Access	Rank*
Chemical control information	6.36
Economic thresholds	5.42
Crop variety susceptibility information	5.27
Pest life cycle	5.12
Conditions favoring susceptibility	4.94
Typical infestation pattern in fields	4.71
Symptoms and look alike symptoms	4.68
Knowing required scouting frequency	4.45
Cultural control information	4.43

Friedman Test $N = 288$, Chi-Square = 183.667, Df = 8, Asymptotic Sig. = .000.

*The scale was Least Valuable 0, 1, 2, 3, 4, 5, 6, 7, 8 Most Valuable.

Table 11. How participants without access to computers rank factors valuable to pest control.

Without Access	Rank*
Chemical control information	6.62
Economic thresholds	5.33
Crop variety susceptibility information	5.13
Pest life cycle	5.08
Conditions favoring susceptibility	4.91
Typical infestation pattern in fields	4.66
Cultural control information	4.52
Knowing required scouting frequency	4.45
Symptoms and look alike symptoms	4.30

Friedman Test N = 102, Chi-Square = 73.907, Df = 8, Asymptotic Sig. = .000.

*The scale was Least Valuable 0, 1, 2, 3, 4, 5, 6, 7, 8 Most Valuable.

Rankings of factors least valuable to pest control decision making did reveal some differences. Participants with access ranked Symptoms and look alike symptoms (4.68) above Knowing required scouting frequency (4.45) and Cultural control information (4.43). Participants without access ranked Symptoms and look alike symptoms (4.43) last. Cultural control information (4.52) was ranked above Knowing required scouting frequency (4.45).

CHAPTER 5

SUMMARY, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Summary

Pesticide Applicator Training (PAT) educators will face a continual challenge as they respond to a public becoming more aware of the benefits of nutritious food and how it is grown and delivered. Complex scientific information will continue to be an important and complex component of producing and delivering a nutritious food supply. Perceptions and acceptance of this research based information will continue to depend on how the information is related to what the producer already knows and believes to be practical.

The goal of Pesticide Applicator Training (PAT) is to deliver research based information about pest control to participants who produce a nutritious food supply. This study was conducted to evaluate the factors affecting the implementation of an electronic pest recommendation network (PRN) for PAT in Montana. The findings reported in this paper were determined using a pre-survey, training, control and post-survey of a portion of the population. Participants in the study were pesticide applicators (n = 497) in Montana PAT Region 2 (Choteau, Teton, Cascade, Toole and Pondera) counties. Participants were randomly assigned to one or two groups: trained or control. The intent of this study was to determine the following:

- (1) if PAT influences a participants level of use of the PRN;
- (2) if lack of hardware, software, monthly service provider charges, familiarity with what the WWW offers, lack of computer technical assistance or training and/or high telephone line charges influence if a participant uses the PRN; and
- (3) the perceived value by the PRN user of:
 - (a) Crop variety susceptibility information
 - (b) Conditions favoring susceptibility
 - (c) Symptoms and look alike symptoms
 - (d) Economic thresholds
 - (e) Pest life cycle
 - (f) Knowing required scouting frequency
 - (g) Typical infestation pattern in fields
 - (h) Cultural control information
 - (i) Chemical control information

Data were collected using a three part survey instrument; 1) Pest control information needs; 2) Factors influencing use of the WWW; and 3) demographic information. Reliability coefficients were calculated for the instruments and Cronbach's alpha was found to be at the Alpha = .9040 for Section 1) and Alpha = .8837 for Section 2).

Based on the analysis of data presented in Chapter 4, the following statements summarize the findings. Results of the demographic section of the survey revealed that over half of the surveyed participants at the Region 2 PAT re-certification session had

access to computer hardware, over half used it for farm business and over half had either access to the Web or email. Participants ranked chemical control information, economic thresholds, crop variety susceptibility information, and pest life cycle as most valuable to their pest control decision making. Less valuable were conditions favoring susceptibility, typical infestation pattern in fields, symptoms and look alike symptoms, cultural control information and knowing required scouting frequency.

Conclusions

Based on the findings of this study, the following conclusions about factors affecting the use of an electronic pest recommendation network by pesticide applicators in Region 2 of Montana were drawn:

1. The amount of training participants at the 2000 Region 2 PAT re-certification program underwent did not significantly affect their accessing of the PRN. Participants use of an electronic pest recommendation network is essentially equal when trained by a 15 minute lecture, that included slide images of the software application and a supporting worksheet or by a worksheet alone.
2. Participants with access to a computer found familiarity with what the WWW offers and lack of computer hardware and software affected their use of the WWW more than technical assistance, training, high telephone line or service provider charges;
3. People without access to a computer find lack of computer hardware and software, technical assistance affected their use of the WWW more than

familiarity with what the WWW offers training or high telephone line and high service provider charges.

4. Chemical control information, economic thresholds, crop variety susceptibility information, pest life cycle, conditions favoring susceptibility, typical infestation patterns in fields were ranked as most valuable by participants regardless of their access to a computer.
5. The results suggest a large portion of the Region 2 population was aware of and were using computers and the WWW for farm business.

Implications

On one hand, the results of the training implied that applicators regard historical information sources as far more practical and trustworthy than the PRN. The PRN did not offer enough advantages for participants to test it. On the other hand, participants motivation and concerns about the effective and professional use of pesticides are low. The motivation required to access and apply PAT information delivered by an unknown source like the PRN may not match the concerns of the participant. In other words, a participant has already expended effort in attending a PAT session and it would be impractical to expend further effort in accessing the PRN for the same information and less credit. If these participants encountered a situation that increased motivation, like a high crop value or a new pests, a positive response to training might be more likely.

Currently, the PRN, and Case-based reasoning is not as adept at delivery of chemical control information as it is at comparing tillage methods, long range rotations

and risk of pest damage. Chemical information ranked as most valuable to pest control decision makers. The lack of specific chemical control information may have contributed to the low PRN access rate by participants.

People are conditioned to expend a certain amount of effort to attend PAT sessions every five years. They attend for PAT credits and not to learn about new sources of information like the PRN. Over half of these same participants have access to computers and the WWW which suggests they are interested in information and the savings available through application of technology. To this researcher, this implies that if the effort that participants expend attending PAT for credit could be shifted to accessing the PRN for PAT credit, participant comfort and use of PAT information in the daily decision-making process would be increased. The increasing prevalence and access to computers and their use for farm business will decrease the effort required to access and use the information available on the WWW.

Recommendations

The findings of this investigation, revealed the comparative effectiveness of PRN training delivered using a worksheet plus fourteen slides and accompanying fifteen minute lecture, to the same worksheet plus 1 slide and accompanying 1 minute lecture. Based on these findings, the following recommendations were made.

1. Further research is needed into how methods of delivery like the PRN can be used to supplement or replace traditional PAT. Recertification credits awarded for application of the PRN would help shift effort expended, physically attending

PAT, to effort expended studying and applying PAT. Since PAT via the PRN is easier to attend, use of the PRN should increase.

2. Research should identify a software structure that would respond to the users level of concern and be less intimidating. A method of delivery that is less intimidating will increase the acceptance of effective pesticide application techniques and use of the PRN.
3. Research should identify what influence a decrease in face to face interaction and increased global interaction using the advantages of e-mail and "chat" groups would have on pesticide applicators who use the WWW for re-certification credits instead of attending PAT sessions.
4. Research should look at the impact of consultants who facilitate the use of the PRN to allow their clients to make decisions.
5. Research should look at the impact that in session use of the WWW has on applicator access of the PRN.

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APPENDICES

APPENDIX A:

SURVEY OF PESTICIDE APPLICATORS ACCESSING THE WEB

Survey of Pesticide Applicators accessing the Web.**Section I: Pest (Weeds, Insects, Plant Diseases) Control Information Needs: -----**

Please use the following scale to rate how valuable the selected pest control factors are to your pest control decision making. Please circle your choice.

How valuable for pest control is: -----0 being least valuable and 8 being most valuable-----

Crop variety susceptibility information	0	1	2	3	4	5	6	7	8
Conditions favoring susceptibility	0	1	2	3	4	5	6	7	8
Symptoms and look alike symptoms	0	1	2	3	4	5	6	7	8
Economic thresholds	0	1	2	3	4	5	6	7	8
Pest life cycle	0	1	2	3	4	5	6	7	8
Knowing required scouting frequency	0	1	2	3	4	5	6	7	8
Typical infestation pattern in fields	0	1	2	3	4	5	6	7	8
Cultural control information	0	1	2	3	4	5	6	7	8
Chemical control information	0	1	2	3	4	5	6	7	8

Section II: Internet Access: -----

In an effort to better supply you with timely pest control information we are considering putting more IPM resources on the World Wide Web. You can help us determine how best to present information on the Web by describing who you are and what kind of computer resources you have now. Please circle your choice.

1. Do you (the operator) own or lease a computer or Web TV? Yes Don't Know No
2. Do you (the operator) have easy access to a computer or Web TV? Yes Don't Know No

If you answered **No** or **Don't Know** to either 1 or 2 go to section III.

3. Do you (the operator) use the computer or Web TV for farm business? Yes Don't Know No
4. Do you have access to the Internet? Yes Don't Know No
5. Do you have access to email? Yes Don't Know No
6. Do you have access to the Web? Yes Don't Know No

Section III: Factors Influencing Your Current use of World Wide Web (WWW) Network: -----

Please rate, using the following scales the degree to which the following factors have affected your decision to use the WWW in your day to day activities. Circle the appropriate number of the degree to which the factor affected your decision. Please circle your choice.

How does this affect your web use: 0 being **No Effect** and 5 being a **Very Strong Effect**.

Lack of hardware	0	1	2	3	4	5	NA
Lack of software.	0	1	2	3	4	5	NA
High telephone line charges.	0	1	2	3	4	5	NA
Monthly service provider charges	0	1	2	3	4	5	NA
Lack of computer technical assistance.	0	1	2	3	4	5	NA
Familiarity with what the WWW offers.	0	1	2	3	4	5	NA

Other. _____

Section IV: Demographic Information: -----

Name or Applicator license number: _____

Please circle the terms that describe you most accurately:

Applicator type: Private Commercial Restricted.

APPENDIX B:

PEST RECOMMENDATION NETWORK SURVEY

During your last PRN session on 09-28-2000, you entered case: 10463

The tactical and strategic advice you received in your last session was: No Risk

If you DID NOT follow this advice, please choose from the following list the term that most closely reflects the control method you DID use.

Follow up information entered by:

The recommendation you received during your last session was the result of many years of research and effort, it has been proven effective in other situations. Please tell us about the advice you received during your last PRN session.

	0 - No Effect	1 - Very Weak Effect	2 - Weak Effect	3 - Moderate Effect	4 - Strong Effect	5 - Very Strong Effect	NA
Factor	0	1	2	3	4	5	NA
Was the PRN information you received in your last query effective?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Was the information you received from the PRN effective in determining the correct use of cultural or chemical controls?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Was the information you received from the PRN timely enough to be effective?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Would you rate the usefulness of the PRN information you received in your last PRN session more effective than information you received through other workshops, meetings, PAT sessions you attended this year?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please enter any additional information that you think would be helpful in evaluating your situation.

On-line Survey of Pesticide Applicators accessing the Web.

First Name:

MI:

Last Name:

Address:

City:

State: Zip Code:

Email:

Information you request during this session will be used primarily in the following situation:

Producer Certified Crop Advisor County Agent Ag Business

Are you a Certified Pesticide Applicator?: No Yes - Private Yes - Restricted

How did you find out about the MSU Pest Recommendation Network?:

Pest Control Needs

Please rate how valuable the selected pest control factors are to your pest control decision making. Check your choice on the supplied scale of 0-8 (8 being most valuable).

How valuable for pest control is: -----0 being **least** valuable and 8 being **most** valuable-----

Crop variety susceptibility information	0	1	2	3	4	5	6	7	8
Conditions favoring susceptibility	0	1	2	3	4	5	6	7	8
Symptoms and look alike symptoms	0	1	2	3	4	5	6	7	8
Economic thresholds	0	1	2	3	4	5	6	7	8
Pest life cycle	0	1	2	3	4	5	6	7	8
Knowing required scouting frequency	0	1	2	3	4	5	6	7	8
Typical infestation pattern in fields	0	1	2	3	4	5	6	7	8
Cultural control information	0	1	2	3	4	5	6	7	8
Chemical control information	0	1	2	3	4	5	6	7	8

Factors Influencing Your Current use of World Wide Web (WWW) Network

Please rate the degree to which the following factors have affected your decision to use the WWW in your day to day activities. Check the appropriate number of the degree to which the factor affected your decision.

How does this affect your web use: 0 being **No Effect** and 5 being a **Very Strong Effect**.

Lack of hardware	0	1	2	3	4	5	NA
Lack of software.	0	1	2	3	4	5	NA
High telephone line charges.	0	1	2	3	4	5	NA
Monthly service provider charges	0	1	2	3	4	5	NA
Lack of computer technical assistance or training.	0	1	2	3	4	5	NA
Familiarity with what the WWW offers.	0	1	2	3	4	5	NA

Other.

APPENDIX C:

PEST RECOMENDATION NETWORK WORKSHEET

MSU IPM Pest Recommendation Network

Get Advice - Weeds	Get Advice - Insects	Get Advice - Diseases
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You will be asked for demographic information and a description of your current problem.

Will Lanier, Martha Mikeleson and Dave Struefert developed this worksheet for potential PRN users.

Small Grain production is a complex and dynamic process. Management of Small grain pests is an important aspect of this process. Recommendations based on correct identification of agronomic pests is the first and most important step in timely pest management. The MSU Weed, Insect and Disease diagnostic services provide Montana producers' pest identification services. A database, the Pest Recommendation Database (PRD), contains the daily recommendations made by Extension specialists and staff for production agriculture concerning pest management in Montana conditions. Recommendations include pest biology, life cycles, and cultural controls for individual situations. The recommendations are the results of research and agronomic considerations regarding the economic realities of arid crop production. The chemical control recommendations include cost, timeliness, and efficacy as well as safe guidelines for use. Historically this information has been delivered to producers via Extension presentations, the postal service and personal communication via phone and fax systems. In an effort to explore novel methods of delivering diagnostic information the Pest Recommendation Network (PRN) has been developed. The PRN is a new method of delivering management information contained in the PRD for small grain pests on the World Wide Web. This information delivered by the PRN is organized in a way that allows agriculturists to investigate effects of basic crop production variables on common small grain pests. The PRN gives situation-specific advice for control. The steps and examples in the following worksheet describe the PRN attributes.

WWW access

You will need access to the WWW and a recent version of a WWW browser and a computer operating at least Windows 95.

Organization

The PRN employs a novel organization method called case-based reasoning. Cases describing situations are created from a list of factors and related conditions. An example of a factor is "Forecast." Conditions that might describe this factor are "Cool and wet" and "Warm and dry". The same list of factors and related conditions are used to describe insect, plant disease, and weed situations. The common list of factors allow

specialists and users to view the implications of for example, a Weed control, and the implications of that same control measure in the context of insects and plant disease management.

For more information contact Will Lanier, 422 Leon Johnson Hall, Montana State University, Bozeman Montana, 59717 (406) 994-5690, email: wlanier@montana.edu. To view project information visit the MSU IPM home page at <http://scarab.msu.montana.edu/ipm/>, choose "Pest Recommendation Network".

Task 1.

Your first task is to determine the possible plant diseases you might encounter in the current growing season, an example is described below. The second task (exercises 1 to 4) is to determine the implications if any, the recommended plant disease control practices, if implemented, will have on possible weed and insect pests.

Using a WWW browser go to <http://scarab.msu.montana.edu/PRN1/> This is the home page for the "Pest Recommendation System" (PRS). Overviews and project descriptions are available below the heading by choosing "Progress Report, Slide explanation" or "Poster Style explanation".

MSU IPM Pest Recommendation Network

You will be asked for demographic information and a description of your current problem.

Once you are at the PRN home page, choose "Get Advice - Diseases" and you will see:

This Pest Recommendation Network (PRN) is the result of many years of research and hard work on complex problems.

If you are a new user to the system, please [tell us about yourself](#) so we can focus our future efforts to meet your needs.

If you have previously used the PRN system, please identify yourself by entering your name below.

Name:

(enter your name as originally entered in the system, ie John Q. Public)

Now you are presented with a list of 4 factors. Each factor has a drop down list of conditions to choose from. Use the worksheet suggestions listed below to tour the systems' attributes. This will facilitate information retrieval and "what if" queries in following sessions.

Please describe your situation by filling in each of the following conditions:

Disease Common Name:

Dryland, Irrigated, Range or Storage:

Crop Type:

Location in State:

Now you are presented with another longer list. This information helps the PRN rank solutions to situations matching yours. Enter the conditions in each factor as indicated below. Hint: If you receive this worksheet electronically, size the word processing and browser windows so they are side by side, easing data entry.

Information exists that is related to your situation. Please further describe your situation using the following conditions. Leave blank any that you are unable to answer.

Factors

Enter these Conditions

Identification Confidence:

Current Crop Stage:

Seedling

Previous Crop (last year):

wheat, spring

Previous Crop (2 years ago):

wheat, spring

LOW - Threshold (% Tillers affected):

HIGH - Threshold (% Tillers affected):

LOW - Threshold (% Area affected):

HIGH - Threshold (% Area Affected):

Pattern of Pest in Field:

Scouting Frequency:

annual, spring

Seeding Date:

Row Spacing:

Seedbed Preparation:

Yield Potential:

high

Potential Crop Loss:

Crop Prices:

low

Volunteer Present after Seeding (Fall):

Volunteer Present After Seeding (Spring):

Presence of Wheat Curl Mites:

Proximity of Suitable Hosts:

Soil Moisture at Seeding:

Forecast:

cool and wet

History in Field/Crop:

Weed Control in Summer Fallow:

Herbicides Available:

Fungicides Available:

Seed Treatments Used:

Rescue Pesticide Available:

Nitrogen Levels Used:

Phosphorous Levels Used:

Previous Crop Residue Levels: moderate

Symptoms:

When you have entered the above conditions choose "Continue".+

After a pause, you will see a results screen. In the top portion of the screen, above the table are two recommendations. Below the recommendations are instructions on uses of the information contained in the table.

Overall System Recommendation: Tank mix, Apply foliar pesticide

This solution was used in many situations (cases) that resemble yours.

The System also considers a recommendation based on the single situation (case) with the best match to yours.

That recommendation is to: Apply foliar pesticide, if economics are good.

If you desire, you may use your own judgement to select a recommendation. Listed below are cases that matched some of the conditions in your case. You may obtain further information about each case by clicking on the case name.

[View Solution Scores](#)

[Done](#)

Results screen explanation:

Comments.

The "Overall System Recommendation" is determined by counting the solutions appearing most frequently in the result screen you are viewing.

The second recommendation is based on a single situation, appearing in the solutions table, matching yours.

Following the result summaries is a table ranking the solutions to cases matching yours. An explanation of this table follows.

Similarity Score (how well the situations match yours)	Solution used in Situation	Disease Common Name	Specialist	Case Name	Date Entered
760.20	Apply foliar pesticide, if economics are good.			10276	02-25-1999
713.70	Apply foliar pesticide, if economics are good.	Tan Spot		9193	05-01-1998
690.20	Apply foliar pesticide, if economics are good.			10275	02-25-1999
469.20	Apply foliar pesticide, if economics are good.	Tan Spot	Martha Mikkelsen	Tan Spot 01 0	04-17-1998
469.20	Tank mix, Apply foliar pesticide	Tan Spot	Martha Mikkelsen	Tan Spot 07 0	04-17-1998
469.20	Tank mix, Apply foliar pesticide	Tan Spot	Martha Mikkelsen	Tan Spot 09 0	04-17-1998
469.20	Tank mix, Apply foliar pesticide	Tan Spot	Martha Mikkelsen	Tan Spot 11 0	04-17-1998
457.10	Rotation	Tan Spot	Martha Mikkelsen	Tan Spot 03 0	04-17-1998

Table Explanation.

The first column, Solution Scores, contains values that were determined by case-based reasoning or simply weighting and matching the factors that were entered in the second

screen (top of page 3). The Similarity Scores are relative values and not absolute. The second column contains "Tactical Advice" or what to do now. Each case also contains general advice or what to do over time or next season. To view the general advice, click the mouse twice on any case name. This is the best way to see if your description, the entries you made, was sufficiently detailed and if it matched other cases resembling yours. In other words, examine the cases with the highest values and compare it with yours. View the general and tactical advice in a couple of high-ranking cases. Note: Often viewing a case in detail will remind the user of other important factors. Choosing cases that include a textual "Case Name" and "Specialist" over cases that only have a high "Similarity Score." Cases with numbers for names are automatically generated by the Diagnostic Lab databases and will be covered in another worksheet.

Task 1 Summary

The PRN compares each case to the one you described. Treat these recommendations as "Check Lists" of important factors concerning pests, to remember in the cropping situation you described. Note the differences and decide if you can add conditions to better describe your situation and thus improve the PRN's ability to list important factors. The worksheet examples will cause similarity scores suggesting that the disease "Tan Spot" could occur in your cropping situation. On the other hand, "Wheat Streak Mosaic" is not as likely to occur as it has a lower similarity score (examine a Wheat Streak Mosaic case to see what conditions favor it compared to Tan Spot). You have completed the introductory tasks to the PRN, if you would like to know more continue to Task 2.

Task 2.

To increase your knowledge of what the PRN has to offer, complete the exercises below by examining a Tan Spot case with a high similarity score by choosing the "Case Name" and reading the "General and Tactical Advice".

Exercise 1.

Summarize the Disease control recommendations in your own words.

Disease Name:

General control (strategic advice or long term solutions)

Tactical control (immediate or short term solutions)

Return to the results by choosing the "Return to Results" button.

Often the "Overall System Recommendation" and the "Single Situation" recommendations will differ. You can see another tally of the rankings by choosing "View solution Scores." This tally might help you decide whether to follow the solution

determined by the "Single situation (case) with the best match" or the "Overall System Recommendation:"

Exercise 1, additional study:

If you wanted to refine/view the Disease recommendations, return to the list containing "Disease Common Name:" by using your browser "Back" menu option. Choose and enter the Tan Spot in the Common Name field. Choose continue and re-enter conditions specific to the situation (page 2). The PRN will rank a list of cases more specific to the disease and situation. Print these list screens for extra credit.

Exercise 2

To determine the risk of potential insect and weed problems under the same conditions, hide the "Get Advice- Disease" window and click on the desktop browser icon again, this will cause a second browser window to appear. Go to <http://scarab.msu.montana.edu/PRN1/>. In this window choose "Get Advice - Insects." Enter your name, and choose "Continue". Then in the "Get Advice - Insects" window enter the same condition examples listed on page 2 of this worksheet.

Due to the nature of different pests, the factors evaluated for a Disease are not the same as those evaluated for a Insect or Weed problem. Enter the conditions that are common to the Insect and the worksheet list (see page 2). Do not be worried if the work sheet list does not match the Insect factors displayed by the PRN.

What are the Insect pests that are most likely to occur in the example-cropping situation?

- a.)
- b.)
- c.)

Summarize the insect control recommendations by viewing a few high-ranking cases. Compare the insect recommendations to the Plant disease recommendations you summarized in Step A.

Insect Name:

General control (strategic advice or long term solutions)

Tactical control (immediate or short term solutions)

Plant disease:

General control (strategic advice or long term solutions)

Tactical control (immediate or short term solutions)

a.) Do any of these Insect recommendations conflict with the Disease control recommendations?

b.) Do any of these recommendations compliment the Disease control recommendations?

An optional exercise with weed factors instead of Insect or Disease.

Exercise #3

To determine the risk of potential weed problems under the same conditions, open a third browser window and go to <http://scarab.msu.montana.edu/PRN1/>, and choose "Get Advice Weeds." Enter the Weed conditions that are in common with the examples on page 2 of this worksheet.

What are the Weed pests that are most likely to occur?

- a.)
- b.)
- c.)

Summarize the Weed control recommendations by viewing a few high ranking cases. Compare the Weed recommendations to the Insect and Plant disease recommendations you summarized in Exercise #2.

Weed name:

General control (strategic advice or long term solutions)

Tactical control (immediate or short term solutions)

Insect name:

General control (strategic advice or long term solutions)

Tactical control (immediate or short term solutions)

Plant disease name:

General control (strategic advice or long term solutions)

Tactical control (immediate or short term solutions)

Questions

a.) Do any of these Weed recommendation conflicts with the Insect or Disease control recommendations?

b.) Do any of these recommendations compliment the Insect or Disease control recommendations?

Exercise 4

Complete your Pest Recommendation Network session by comparing your summaries of control recommendations. Investigate the common control practices for the highest-ranking pests. Enter these conditions in each of the Insect, Weed, and Plant Diseases browser windows.

For example; the beginning case description (page 2) entered the same crop (Wheat, spring) in "Previous Crop last year" and "Previous Crop 2 years ago". The recommendation for Plant Disease advises rotation into another crop. Enter a possible rotation crop and see if the resulting recommendations are those for a less risky situation.

Refine the Insect and Weed rankings by using the browser "Back " menu option and adding the respective "Common Name" and re-entering the conditions.

In addition to a check list of pests ranked by factors, the PRN can help a producer foresee situations when changing a management practice for one pest could allow other pests to become established. Often resources are limited and applying them to control one pest means resources are not available for management of another. Look for threshold information that might help you decide when a switch from a practice, which controls a disease, but encourages an insect or weed pest would be appropriate. For example rotations are a cultural way of controlling pests, but often they are less profitable.

Exercise 4, Additional study

Using the "No Risk", "Medium Risk" and "High Risk" Tactical recommendations try to decide for either an insect, disease and weed situation when it is economical to switch from a rotation or back to a monoculture. List the case names you based your decisions on for extra credit.

Hint: Change the Previous Crop (last year) and Previous Crop (2 years ago) and see the controlling effects this has on different Pests.

You have completed Task 2 and should be well acquainted with what the PRN has to offer.

APPENDIX D:

PEST RECOMMENDATION NETWORK TRAINING GROUP SLIDES

Monitoring: Who to ask?

- ▶ Compare records with state survey's and observations.
- ▶ specialists (Land Grant U's)
- ▶ newsletters (MCHR)
- ▶ online databases (PRN)

Monitoring: Where to look

- ▶ Online databases available from IPM programs at Land grant universities.
- ▶ net-worked (WWW) decision support information available to desk top computers.

Monitoring: Where to look

- ▶ WWW
- ▶ WWW software that makes finding and viewing distant information easy.
- ▶ using the WWW, remote users (producers, agents, specialists) can access databases.

Monitoring: Where to look

- ▶ WWW databases
 - ▶ static databases, MSU Extension staff or the Diagnostic Lab listing database.
 - ▶ dynamic database Pest Recommendation Network (PRN) handles sorting, report generation, and "what if" scenarios.

Monitoring: Where to look

- ▶ Pest Recommendation Network examples:
 - ▶ three or four questions creates a report based on current information.
 - ▶ Big Deal! so do newspapers.

Monitoring: Where to look

- ▶ Well the big deal is that this report is not only specific to crops, areas, seasons, locations but also across subjects.
- ▶ more than one expert contributes
- ▶ OK, it's better than a newspaper, but I need expertise that knows which way the wind blows in Montana.

Monitoring: Where to look

- ▶ Ask the PRN what pests are occurring in Barley and you can view reports of Weeds, Insects, and Diseases.
- ▶ current or this time last season
- ▶ compare severity
- ▶ consider the implications of one pest control measure in the context of other pest control measures.

Step #1

Please describe your situation by filling in each of the following conditions:

Insect Common Name: Russian Wheat Aphid

Dryland, Irrigated, Range or Storage: Dryland

Crop Type: wheat, winter

Location in State: [dropdown menu open]

Buttons: Continue, Return To Home

CBR Research Tool Developed
http://bridgerlink.com

Step #2

Information exists that is related to your situation. Please further describe your situation using the following conditions. Leave blank any that you are unable to answer.

Identification Confidence: high

Current Crop Stage: seeding

LOW - Infestation Levels (% Tillers affected): [dropdown]

HIGH - Infestation Levels (% Tillers affected): [dropdown]

LOW - Infestation Levels (% Area affected): [dropdown]

HIGH - Infestation Levels (% Area affected): [dropdown]

Pattern of Pest in Field: moderate patches

Scouting Frequency: 1 time/week

Seeding Date: [dropdown]

Yield Potential: [dropdown]

Results

Overall System Recommendation: Chemical
This solution was used in many situations (cases) that resemble yours.

The System also considers a recommendation based on the single situation(case) with the best match to yours.
That recommendation is to: Spot Spray

If you desire, you may use your own judgement to select a recommendation. Listed below are cases that matched some of the conditions in your case. You may obtain further information about each case by clicking on the case name.

Similarity Score (How well the situations match yours)	Solution used in Situation	Specialist	Date Entered	Case Name	Insect Common Name
549.60	Spot Spray	Greg Johnson	03-18-1998	RWA Chemical 46	Russian Wheat Aphid
524.70	Tank mix, Apply foliar spray	Greg Johnson	03-18-1998	RWA Chemical 46.1	Russian Wheat Aphid

Step #2

Information exists that is related to your situation. Please further describe your situation using the following conditions. Leave blank any that you are unable to answer.

Identification Confidence: high

Current Crop Stage: seeding

LOW - Infestation Levels (% Tillers affected): [dropdown]

HIGH - Infestation Levels (% Tillers affected): [dropdown]

LOW - Infestation Levels (% Area affected): [dropdown]

HIGH - Infestation Levels (% Area affected): [dropdown]

Pattern of Pest in Field: moderate patches

Scouting Frequency: 1 time/week

Seeding Date: [dropdown]

Yield Potential: [dropdown]

Results

Overall System Recommendation: Chemical
This solution was used in many situations (cases) that resemble yours.

The System also considers a recommendation based on the single situation(case) with the best match to yours.
That recommendation is to: Spot Spray

If you desire, you may use your own judgement to select a recommendation. Listed below are cases that matched some of the conditions in your case. You may obtain further information about each case by clicking on the case name.

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524.70	Tank mix, Apply foliar spray	Greg Johnson	03-18-1998	RWA Chemical 46.1	Russian Wheat Aphid

Monitoring: Where to look

- ▶ The problem an Extension agent or specialist has is their ability to gather research based information from remote areas, process it for patterns that suggest economic damage and deliver it in a timely manner to clients.

Monitoring: Where to look

- ▶ Extension agents or specialists can only have so many phone conversations.
- ▶ PRN
 - ▶ raises (incrementally) the level of question that can be answered without direct interaction.
 - ▶ allows for multiple interactions on specific topics without the problems of direct communication.

APPENDIX E:

PEST RECOMMENDATION NETWORK CONTROL GROUP SLIDE

Monitoring: Who to ask?

- ▶ Compare records with state survey's and observations.
- ▶ specialists (Land Grant U's)
- ▶ newsletters (MCHR)
- ▶ online databases (PRN)

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