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The Plant Pathologist in Private Practice

Opportunities for the Present and Challenges for the Future

Total world food production grew steadily from 1961 to 1992. During that same time, global food prices dropped steeply (4). The steady increase in food production and corresponding decline in prices was influenced by many factors, including fewer barriers to global trade (20) and the implementation of better agricultural technologies (4). Both the public and private sectors contribute to the development of new agricultural technologies, and institutions such as the Cooperative Extension Service and their disease diagnostic services are essential information sources for progressive crop producers and their advisors. However, there is growing recognition of the significant contributions of the private sector to the implementation of environmentally sound cropping systems (31,32). Private-sector advisors have continuous, ongoing access to their clients and often more directly influence the design and implementation of site-specific production programs for individual crop producers than do public-sector researchers. Thus, the transfer of technology from the laboratory to the field is largely a privatized process involving the input of many businesses and independent crop consultants.

As agricultural producers better understand technologies such as integrated pest management (IPM), they will become strategically and tactically more sophisticated. They will increasingly rely on expertise from the private sector to assist them with making complex production decisions, including constantly changing regulatory issues (2,3). Consulting plant pathologists represent a critical component of the private-sector talent bank. Significant opportunities exist for trained and experienced plant disease practitioners in specialties such as forensic pathology, contract research, grant sharing, diagnostic field and laboratory services, and support services for environmental professionals. However, in spite of these opportunities, consulting plant pathologists as a group are relatively disorganized compared to professions such as medicine, law, and environmental science. There remain numerous organizational challenges for the consulting profession if it is to better serve its clientele and become more valued for its contributions to world society.

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Except for general articles in focused trade journals, comparatively little has been published in which practical issues of the agricultural professional in private practice are addressed. Further, academic studies generally do not acknowledge the roles of privately practicing agricultural professionals in implementing crop production programs. This article represents an attempt to collate a broad base of information about the roles of agricultural consultants, with several specific references to the private practice of plant pathology. Although much of this information was drawn from general surveys of the agricultural industry, the content applies equally well to plant pathologists, especially those considering practice independent of public institutions or large corporations. (Thus, the terms "consultant," "advisor," and "plant pathologist" are used interchangeably throughout this article.) Because of the relative lack of published articles dealing with the practice of agricultural consulting, a fair portion of this information was obtained from interviews with numerous agricultural producers, practicing consultants, and communications internal to their professional societies. The observations and data are presented in each of the following sections, and discussion of the significance of the information is reserved for the Future Outlook and Conclusions section. It is not the intent of this article to provide specific answers to the issues being raised; rather, its purpose is first to familiarize others with the commercial consulting profession. It seeks to generate discussion of important issues and to stimulate further thought regarding the future of the profession and how best it might continue to develop in concert with the public sector. This article presents general background regarding the private practice of agricultural consulting; however, readers should not act upon any information presented here without first consulting competent legal and other professional advisors for assistance in applying this information to their own circumstances.

Consultants and Consulting Firms

Many public-sector plant pathologists are employed by organizations such as colleges, universities, state and federal governments, and international organizations such as the United Nations Food and Agriculture Organization. Private-sector pathologists, however, may be employed either by large international corporations or by firms with as few as one to several employees. Based on this arbitrary division, private consultants may be classified

either as associated or independent. Associated private consultants represent those employed by firms specializing in the manufacture, sale, or distribution of agricultural products. Many public and associated private-sector plant pathologists consult at some stage of their careers, as in the part-time work performed by university professors. In contrast to associated private consultants, independent consultants represent those that derive no financial benefit from the manufacture, sale, or distribution of agricultural products. Independent consultants may operate alone, with several partners, or with a large firm; so independent does not necessarily imply isolated.

It is not clear what percentage of general commercial agricultural consulting firms provides plant pathology–related services, since disease and insect control inquiries are usually grouped together in industry surveys. For example, Doane Agricultural Services Company received 449 responses out of 1,000 surveys mailed to names obtained from the *Ag Consultant* magazine mailing list. Of the 449 responses, 38% indicated that they were not actively involved in crop consulting, leaving a core survey group of about 276 currently practicing crop consultants (11). Unfortunately, the specialties and responsibilities in which the consultants were engaged (e.g., entomology, pathology, horticulture, etc.) were not noted. Nevertheless, the survey showed that most fee-based crop advisory services pertained to nutritional recommendations (76%). Plant inspection and pest management recommendation services were provided by 75 and 73% of the consultants, respectively. Contract research was provided by 29% of the respondents. Most consultants participating in this survey were 31 to 45 years old (47%), 34% were 46 to 65, and only 12% were 21 to 30 years old. The highest level of education attained by 51% of the respondents was a 4-year college degree. Twenty-five percent had attained a master's degree, 17% a doctorate, and 6% had a high school–level education or less. Salaries reportedly ranged from less than $25,000 to more than $50,000 per year (Fig. 1), but it is not clear from the survey data whether higher education levels corresponded to higher salary.

A survey of 160 members of the National Alliance of Independent Crop Consultants (NAICC) revealed that 74% of the consulting firms derived 90% or more of their income by directly serving farmers (19). Almost 6% of the firms obtained as much as 90% of their income from contract research, and the remaining 20% derived most of their income from both farmers and research. The consulting firms ranged from 1 to 45 years old, but were on average about 13 years old. The firms employed an average of about 10 people, but had as few as one and as many as 120 employees. Approximately half of the employees at most consulting firms were seasonal, being employed for about half the year while crops were developing. Most consultants (61%) felt that a firm size of two to four employees was an optimum size that allowed for maximum efficiency of operation. The strongest limiting factor to firm size was the belief that a good one-to-one relationship with clientele was essential for the success of the consulting operation. This one-to-one view was shared also by most crop producers. Although firm size varied based on geographical location, crops, and acres serviced, it was generally believed that too many employees could result in increased associated liability due to the inexperience of new employees.

Agricultural Producers' Opinions of Crop Consultants

Many agricultural producers are unclear about the distinctions among plant pathologists, entomologists, horticulturists, and other crop advisory professionals. A survey of 208 agricultural producers (22) indicated that most producers (67%) hired consultants who were self-employed. The Cooperative Extension Service provided direct consultation services to only 4% of the producers, while 17% of the crop producers used consultants provided by their pesticide or fertilizer dealers. By far the most common service provided to crop producers was for weed and insect control recommendations (83%), while crop inspection services were provided to 68% (Fig. 2). (The variance of these producer-based survey data from the consultant-based survey data is explained by the fact that the surveys were taken from different geographical regions and represent different cropping systems and producer populations.) Fifty percent of the surveyed producers used private consultants to provide integrated pest and crop management recommendations. The average number of hectares for producers who employed a crop consultant ranged from about 650 (1,600 A) in the Southeast to about 1,400 (3,544 A) in the West/Southwest. Nationwide, the average fee paid per hectare per year by producers to their consultants ranged from $10.03 ($4.06/A) in the Midwest to $19.34 ($7.83/A) in the West/Southwest. Nationwide, however, fees paid per hectare per year by producers for crop consultation services ranged from as low as $1.24 to as much as $123.50 ($0.50 to $50.00 per acre). The crop on which the largest percentage of producers

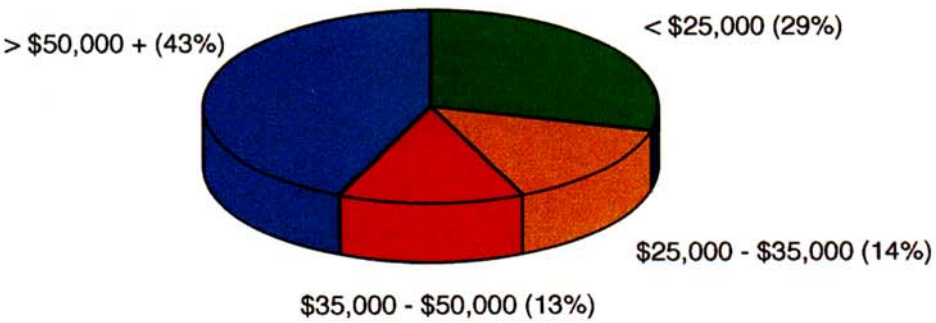

Fig. 1. Approximate income from crop consulting as reported by crop consultants. Salaries below $25,000 and greater than $50,000 were grouped into single categories. Data replotted from reference 11.

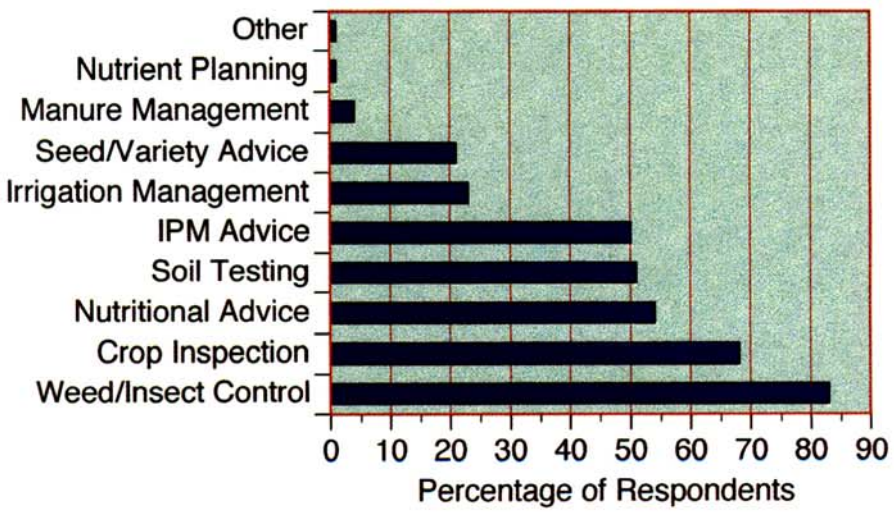

Fig. 2. Types of services performed by agricultural consultants and the percentage of producers receiving each. Data replotted from reference 22.

received advice was cotton (Fig. 3). Some regional variations observed showed that corn was the highest hectarage consultation crop in some regions of the country, such as the Midwest. Unfortunately, the study was not designed to determine the percentage of producers of each commodity specifically engaging the services of plant pathologists.

The same survey showed that agricultural producers rate a college education or professional certification as important, but not required in the consultants they hire (Table 1). The most important quality crop producers looked for in consultants was that they kept current with changing technologies. It was not clear from the survey results whether new technologies referred to chemical, sprayer, irrigation, and fertilization technologies, biologically intensive IPM strategies, or some combination of these. The second most important characteristic preferred by agricultural producers was that their consultants were easy to get along with. Seventy-six percent of the producers were very satisfied with their crop consultants, while 23% were somewhat satisfied. Only 1% were somewhat dissatisfied. Twenty-four percent of the agricultural producers always followed the advice of their crop consultants, and 71% followed the advice most of the time. The largest percentage of producers (36%) first learned about their consultants through a referral from another farmer. Twenty-five percent of the farmers were contacted first by their consultants, and 24% were recommended by their fertilizer or chemical dealers. Only 6% were recommended by the Extension Service, while advertisements led only 2% of the farmers to identify a suitable consultant.

Opportunities

Opportunities for plant pathologists generally exist in the areas of (i) field consultation, (ii) contract research, (iii) grant sharing, (iv) on-farm testing, (v) forensic pathology, (vi) diagnostic laboratory services, and (vii) support services for environmental professionals (Fig. 4). Each specialty has its advantages and disadvantages, but most private practitioners will likely find themselves working in more than one area during their careers.

Commercial field consultation. In general, there are two types of commercial production or field consultants: strategists and tacticians. Both types of consultants usually provide advice in multiple production areas, such as disease, insect, and weed control. Strategists are hired by agricultural producers to assess specific geographical sites, conduct ecological and economic assessments, and design disease control programs tailored to the producer's specific circumstances. Frequently, such strategic services relate to designing reduced-pesticide production programs. Tacticians, in contrast, would be responsible for conducting ongoing on-site investigations for determining how best to time pest-management operations. It is common for the strategist and the tactician to be the same person; however, strategists often engage the services of tactical surveillance personnel who collect ecological data and forward it to the strategist or the farmer, who is then responsible for rendering a final manage-

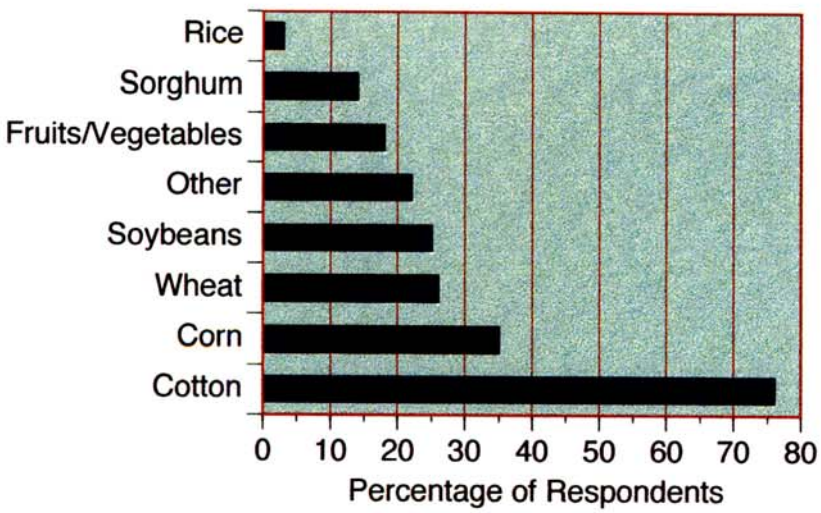

Fig. 3. Distribution of crops upon which consultants provide advice for producers. The "Other" category includes (in order of frequency) alfalfa, peanuts, almonds, sunflowers, tobacco, sugar beets, hay, barley, and popcorn. Data replotted from reference 11.

Table 1. Relative importance (RI) of crop consultant characteristics to their agricultural producer–clients (22). Scale: 1 = not important; 2 = somewhat important; 3 = important; 4 = very important

Characteristic	RI
Keeps up with changing technologies	3.80
Easy to deal with	3.58
Independence from specific product sales	3.51
Flexibility in considering individual cases	3.46
Positive image among farmers	3.17
College education	2.90
Certification by an accredited program	2.72
Membership in a professional society	1.92

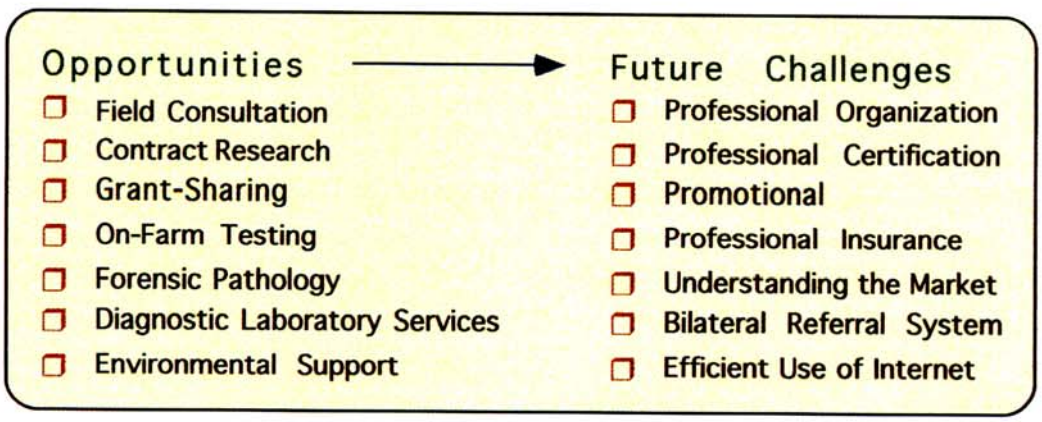

Fig. 4. Summary of various opportunities and challenges for plant pathologists. Present opportunities include those that may immediately lead to work. Future challenges relate to those aspects of the profession that may be pursued to help increase the awareness of potential clients and the general public about the contributions of privately practicing crop professionals to society.

ment decision. Neither the strategic nor the tactical consultant is directly responsible for carrying out proposed management actions, since that could introduce a conflict of interest on the part of the consultant from the sales of materials or services advised by their own recommendations. Because it substantially affects the degree of risk assumed by the consultant in the project, the division of pest-management decision duties between consultant and client is a critical consideration that should be clearly defined during precontract negotiations.

Commercial production consultants frequently have the challenge of designing strategies and implementing tactics for pest management in far less time than is common in academic settings. It is not unusual for a commercial-level pest problem to require some type of action in a matter of days (or even hours) after its initial recognition. This resolution action generally follows a six-step process (Fig. 5). First, there is recognition that a potential problem exists. Second, investigatory confirmation of the problem is obtained using visual, microscopic, laboratory diagnostic, or computer-based methods. Third, the economic, environmental, and sociological impact of a proposed tactical control action must be evaluated (such as proximity of the treatment site to houses, schools, or ecologically sensitive areas). Fourth, the management tactic decided upon is advised for execution. The fifth step is the implementation of the resolution action, which is carried out by the crop producer. The sixth step is the follow-up action to verify efficacy of the treatment. Although this protocol is generally applied to many management operations, the specifics of each step may only be decided upon by thoroughly understanding the client's interests, goals, and philosophies about crop production.

Commercial consultants sometimes encounter previously unrecognized problems and must make disease-control decisions to permit commodities to be marketed even if the diagnosis is incomplete. Occasionally, disease losses may not be preventable at all, so management tactics simply become a matter of reducing or recovering financial losses from crop damage already incurred. An example would be the aftermath of a damaging freeze. If a problem is very new and unusual, the consultant may be able only to help confirm that some element was *not* a significant contributing factor to the problem so that it may be prevented in subsequent plantings. It could be appropriate at that time for the private advisor to engage the assistance of university researchers or extension specialists so that the problem might be more thoroughly diagnosed and better management tactics devised. Thus, private consultants act simultaneously as researchers, educators, and farmers so that their clients may realize an economic advantage to engaging their services.

Contract research. Contract research represents another important opportunity for plant pathologists in private practice. Contract research consultants often have at least three distinct duties: experimental design and statistical analysis, data collec-

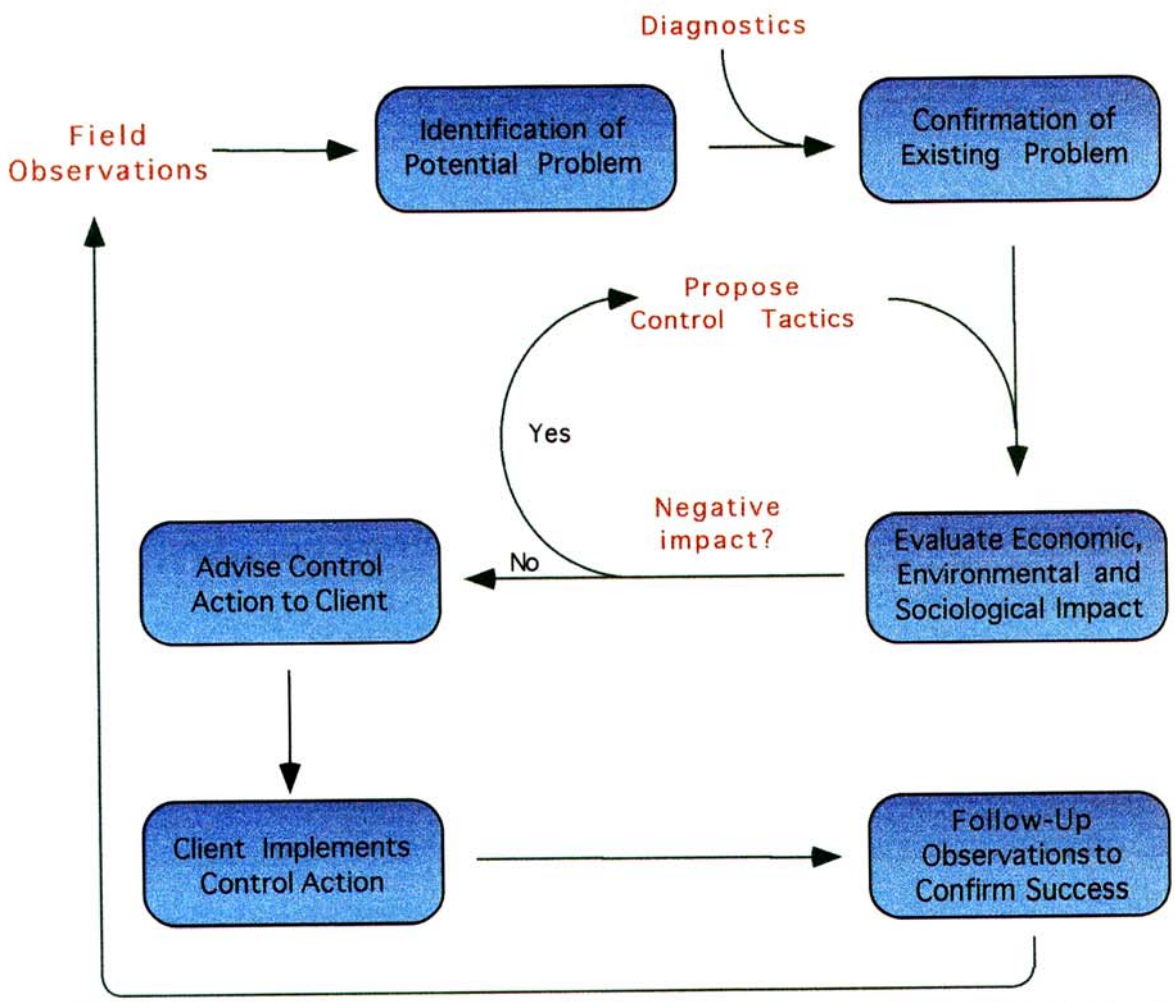

Fig. 5. A suggested six-step flowchart for making pest-management decisions. Field surveillance leads to the identification of potential crop production problems. Diagnostic protocols are engaged to confirm that the problem is real, after which possible control tactics are proposed. The economic, environmental, and sociological impact of the proposed tactics are evaluated. If there is a strong possibility of a negative impact caused by the tactics, alternative management tactics are proposed, then reevaluated. Once negative impacts are minimized, the clients are advised of their options, after which the control tactics are executed. Finally, follow-up surveillance is carried out to help ensure the success of the management program.

tion/performance analysis, and product consultation. Manufacturers sometimes prefer that public institutions (such as a university experiment station) conduct part of their research. This research may be at least partially subsidized (due to readily available experimental and laboratory resources), and it may also carry the impression of objectivity to the agricultural industry. However, results of such experiments generally must become public information. For proprietary reasons, confidentiality may be a critical issue, especially in the early developmental stages of a new project. Private consultants can usually perform objective experiments for manufacturers who may also desire to keep results confidential. A confidentiality agreement for these projects should be clearly outlined in the contract or letter of engagement for the consultant's services. Upon completion of the project, analysis of the research data, and delivery of the final report, it is often tempting for consultants to add discussions of possible new ways of using a tested product. Generally, it is preferable to avoid such discourse unless it is specifically outlined in the contract. The consultant who proposes innovative strategies for disease control initially unforeseen by a product manufacturer is providing a valuable service beyond that of simply testing the efficacy of a material in the field. It is easily possible to perform this additional service for a client, but along with other considerations (Table 2), fair compensation should be factored accordingly into negotiated contracts (15,17,28).

Grant sharing. The United States Department of Agriculture recently announced a national-level IPM Initiative based partly on the premise that farmers and other agricultural professionals all get involved in the development, assessment, and implementation of IPM programs (31). Achieving the goals of the IPM Initiative will require unprecedented cooperation between the public and private sectors with adequate support from federal and state agencies. However, neither public-sector researchers nor private consultants have historically sought out the contributions of the other to help develop projects that may be jointly submitted for the purpose of sharing grant funds. Often in agricultural research, IPM strategies and tactics for disease management are published with little or no mechanism in place to ensure more thorough field validation and the establishment of economic control thresholds. This problem is especially acute if the disease management program is service-oriented and does not involve the sale of a specific product, device, or plant cultivar. However, service-oriented IPM strategies offer some of the greatest potential for improving pest control in the future. Collaborative grant projects could be better designed to include not only the development of IPM strategies through public-sector research, but also to engage consultants to contribute to the commercial realization of the new strategies through private-sector evaluation and testing.

Conversely, another potential for grant sharing is the scientific validation of disease-control strategies and tactics developed by private consultants in the course of their professional engagements. In response to their clients' needs, consultants often innovate unique and effective approaches to the management of diseases, but the time constraints of the profession preclude them from preparing the results of their work for refereed publication. Sometimes for competitive reasons, consultants may opt to keep the results of their work confidential. If confidentiality is not critical, collaborations could be formed with researchers in the public sector to better understand the biology of new management technologies, to carry out more extensive field validations of the new management tool, and to carry the project to publication in peer reviewed journals.

On-farm testing. The IPM Initiative will eventually result in more farmers becoming interested in conducting their own tests to validate new strategies and production technologies. On-farm testing may thus represent one of the most attractive opportunities for consulting plant pathologists over the next decade or so, but farmers in general will have to become more convinced of the value of this service. Many individual and corporate farmers lack the in-house expertise to conduct their own field trials, so outside experimental design services could be a very powerful way for them to evaluate the usefulness of newly developed technologies at specific production locations. The consultant may then continue to help the farmer improve the strategies through continued on-farm testing and modification of the tactics as more data are obtained.

Forensic plant pathology. Forensic plant pathologists should first and foremost desire to serve the public interest by helping pursue a just resolution to a dispute. Beyond that, a forensic project generally could be engaged for one or more of several reasons: (i) to help confirm the causal agent of a disease resulting in damages to a crop, (ii) to help identify one or more significant contributing factors of a crop production problem, or (iii) to help exclude suspected biological or environmental factors from having contributed to crop losses. Forensic plant pathologists are, of course, entitled to fair compensation for their time, just as any comparable professional such as a health care physician or attorney would expect for their services rendered. Essentially, there are two types of forensic plant pathologist: the forensic investigator and the expert witness. The primary difference between the two specialists is that the forensic investigator may not necessarily testify under oath in depositions, arbitrations, or trials. The forensic investigator may serve as a consultant working confidentially for attorneys serving on a case or may be asked to support them with information to help prepare direct or cross-examinations. The expert witness, however, would usually be expected to take on the additional role of advocate and will likely be called to testify under oath as to his or her observations and conclusions. The expert witness will usually conduct a forensic investigation prior to presentation of the findings to the court.

Regardless of the capacity in which the consultant serves, the forensic plant pathologist may be called in during the early stages of a problem, while a problem is progressing, or after one or more crop seasons pass. If contacted in the early or progressive stages of a problem, the pathologist may have the opportunity to investigate current ecological conditions, visually inspect suspected diseased plant specimens, and perform laboratory analyses to help identify or exclude causal factors of the problem. However, if a case is engaged after a problem has already occurred, among the most important tools at the pathologist's disposal are the records of the agricultural producer. These records could include data from crop health inspections, disease and insect damage severities, weather, and all chemical applications. The observations and recollections

Table 2. Major goals to be achieved during precontract negotiations. The goals are outlined as guides for both parties to work toward during contract negotiations (28)

Goal	Contractual element
Avoidance of misunderstanding	Specify details of tasks to be performed Avoid assumptions
Independence and freedom in work	Design of tasks by consultant
Assurance of work	Dates and times tasks are to be performed Avoid giving away free advice
Assurance of payment	Scheduled due dates for receipt of payment Avoid extending credit to clients
Avoidance of liability Prevention of litigation	Specify contingencies beyond consultant's control Well-thought-out contract will go far toward avoiding unnecessary litigation

of the workers at the site may be obtained during depositions, but this information can often be further supported by continued investigation at the production site. Unfortunately, not all farmers keep detailed records of past production practices, so recordless forensic projects should be approached with caution. Recent regulations related to the U.S. EPA Worker Protection Standard should induce better record keeping in the future, however.

Diagnostic laboratory services. Plant pathologists may also serve the agricultural community by performing laboratory diagnostic services. Samples delivered to plant disease diagnostic clinics increased more than 900% during the last 10 years (5). Thus, farmers are discovering that treatments for a problem are best applied after confirmation that a problem actually exists. There are indications that the services of diagnostic clinics will continue to grow, and both public- and private-sector clinics may serve specialized niches. For example, public-sector clinics are usually more effective at diagnosing the cause(s) of newly recognized diseases, while private-sector diagnostic laboratories may be more efficient at turning around a greater number of samples in a shorter period of time. Public-sector diagnostic facilities, such as those managed by the Cooperative Extension Service, more often serve in the capacity of a true clinic, which involves a certain degree of educational duties. Private-sector laboratories often do not pursue the educational aspect of disease management and offer only diagnostic services. Private diagnostic facilities also must usually charge more for their service, since they may not be wholly or partially subsidized, as are many public-sector diagnostic clinics (5).

Environmental support services. A relatively unexplored opportunity for pathologists (and other crop advisory professionals) is the providing of agricultural support services for environmental professionals. Environmental professionals (such as geologists, hydrogeologists, and wildlife specialists) generally do not possess strong backgrounds in the agricultural sciences, but their services are increasingly being required by farming operations. For example, regulatory agencies may require projections of future land use for a new development. Environmental consulting firms are usually engaged to generate these projections. In such projections, crop professionals may work with environmental firms to outline general models of crop production and pesticide, fertilizer, and water usage at the site. This information may then be used by farmers to better manage natural resources in the vicinity and by regulators to help meet site-specific water and land-use permitting requirements. The rendering of professional services such as environmental support requires extreme care with regard to contract executions and the securing of appropriate general and professional liability insurance coverage.

Case Studies of Successful Private Practices

Systematic and scientific approaches to solving disease problems at specific sites can lead to benefits for the consultants, their grower–clients, homeowners located near agricultural developments, and the general public. Detailed services for individual clients such as those presented in the examples below cannot be provided on a large scale by the public sector. Herein lies one of the primary strengths of the private practitioner—the ability to provide what the public sector cannot. As illustrated by these case studies, progressive private IPM consultants often include crop inspection services and on-farm experimental design and testing in their projects. Further, they often must act simultaneously as economists, ecologists, researchers, educators, and social scientists during the course of their practice. Often, consultants may identify gaps in knowledge about certain diseases, and the results of on-farm testing programs may lead to innovative approaches to disease management. Unfortunately, many of these innovative strategies remain unpublished because time and resource constraints prevent consultants from preparing the results of their studies in a format suitable for peer review.

Glades Crop Care. Glades Crop Care, located in Jupiter, Florida, has a well-established record of helping clients design and implement economic IPM programs. For example, one grower–client with 730 ha (1,800 A) of tomatoes had a serious *Fusarium* crown and root rot problem (24). The grower was liberally applying fungicides to attempt to control the disease, but yield losses approaching 30% were often sustained. Glades Crop Care diagnosed the source of the problem as inadequate attention to water management at the site. Water tables rose for prolonged periods following heavy rains, thus helping disseminate the pathogen and hasten infection of the tomato plants. (The grower was not aware of the impact of water table management on the severity of diseases caused by this pathogen.) Changes in irrigation and water table management were advised, thereby reducing the likelihood of fungal dissemination and consequent plant infection. Thus, the consultant designed and implemented a site-specific disease control strategy that resulted in fewer fungicides being required to maintain economic control of the problem.

ECOSTAT, Incorporated. ECOSTAT, an international agricultural consultancy located in Florida, is often engaged to assist agricultural producers to design and implement quantitative and economic disease control strategies. For example, several clients were producing citrus crops within suburban areas located in a rapidly developing area of Central Florida (Fig. 6). The clients were concerned that fungicide applications for the control of citrus greasy spot disease (*Mycosphaerella citri* Whiteside) could intrude onto houses and schools,

Fig. 6. Agricultural production near schools, suburban housing developments, and natural wetlands. It is not uncommon in geographical areas such as these for residential areas to be located only several meters away from agricultural plantings. These types of intermixed developments represent special challenges to the consulting plant pathologist. Greater consideration must be given to the manner in which crop production practices (such as pesticide applications and drift) impact surrounding human activities and natural ecosystems compared to more remote agricultural operations.

some of which were located just several meters away from the agricultural plantings. ECOSTAT was contracted to evaluate the current state of disease in the plantings and design disease control programs in which fungicide applications could be reduced or eliminated. Unfortunately, the specific environmental and epidemiological conditions under which greasy spot fungicide applications could be reduced or eliminated was not defined in the published literature. Therefore, an epidemiological study was performed to quantify disease severities in relation to crop quality and yield. Several citrus groves were split into plots both treated and untreated for greasy spot disease. Over the following several seasons, populations of spores produced in both the treated and the untreated plots were not significantly different. Further, differences in economic losses resulting from disease in the two experimental treatments were not significant. Consequently, ECOSTAT advised the complete elimination of fungicide applications from those plantings. After 3 years on the specifically designed "zero-spray" programs, disease severities remain at low levels in the plantings and do not appear to be resulting in economic yield or quality losses to the client's crops. Further, the exposure of adjacent houses and schools to fungicide applications was dramatically reduced, significantly reducing the environmental and health risks assumed by the growers when treating their crops. Ongoing surveys for disease inoculum and severities permit ecologically and economically sound disease management decisions to continue to be made (26).

Certification Issues

Accreditation programs exist in most professions, and these programs are a symbol of quality in the marketplace. Physicians, attorneys, and accountants approach certification in different ways, but all have established a process for assuring the public that the members of their profession are competent (23). Several agricultural organizations have considered establishing or have established certification programs for their members, such as the National Alliance of Independent Crop Consultants (NAICC), the Registry of Environmental and Agricultural Professionals (REAP), the American Society of Agronomy, the American Phytopathological Society (30), and others. The Certified Crop Advisor (CCA) program was developed by the American Society of Agronomy. The CCA program consists of at least a high school education and 4 years of experience, a national and a state certification examination, a continuing education requirement, and an ethics pledge. Also, in 1991, the NAICC developed the Certified Professional Crop Consultant (CPCC) program. The CPCC requires a 4-year college degree, an examination, a continuing education requirement, and an ethics pledge. The ethics pledge is based on a statement that NAICC-certified independent crop consultants will derive no direct financial benefit from the manufacture, sale, or distribution of agricultural products.

Outlook

Survey results. Although the sample sizes were relatively small in the client and consultant surveys, they indicate that consulting is a strongly people-oriented endeavor, and that even the highest technical qualifications alone are not sufficient to guarantee success in the commercial marketplace. Clients generally believe that it is more important for their consultants to communicate in the client's language, which includes understanding the client's personal motivations and business needs, and nonverbal communication cues. Thus, it is not unusual for technically less qualified individuals to be selected as consultants over more qualified individuals based almost solely on their ability to get along with farmers. Some industry publications have addressed selection criteria for hiring competent consultants in several fields (1,10,12), but many farmers are not well acquainted with guidelines to help them choose the best consultant for their unique agricultural circumstances. Differences among the specialties of agricultural consultants from various disciplines are usually not discussed in trade publications (6,16,18); thus, some farmers may not realize whether they require the services of a disease, insect, or nutritional specialist or a horticultural generalist, for example.

Several important points become clear from the surveys. Since competition among consultants will likely increase in the future (7), consultants should continually develop their interpersonal skills and professional networks to better serve their clients and render themselves more marketable. Since personal referrals are the major source of new business for consultants, such referrals are more likely if public- and private-sector colleagues are aware of the identity of consultants and their areas of expertise. Agricultural producers must become more aware of various consultants' unique qualifications and insist that their advisors possess all necessary qualifications, including technical background, field experience, professional certifications, and reputation necessary to best serve their business interests.

The bilateral referral system. Advertising appears to be only minimally effective in helping consultants procure new projects. Most referrals are made to farmers by other farmers, and unfortunately only a very small fraction of new business is referred to consultants by the public sector, such as the Cooperative Extension Service. However, a critical component for the future practical realization of the IPM Initiative will be a better developed bilateral referral system between the public and private sectors. In such a system, the public sector would more readily refer crop producers to competent private practitioners when a need for assistance in the implementation of specific IPM tactics is perceived. For example, if a researcher develops a new method for the accurate detection and control of a disease, the researcher could refer crop producers to private consultants who may assist them with implementing the program at specific production sites. Industry-targeted publications about the new control method also could acknowledge the important role that private consultants play in assisting growers with implementing the program. Further, consultants should be more willing to engage the services of public-sector or other professionals if situations outside their areas of expertise are encountered. A well-developed bilateral referral system is an important way in which the value of the services of private plant pathologists to the agricultural community may be increased, and the goals of the National IPM Initiative may be better realized. The close contact private consultants maintain with their public-sector colleagues will help greatly in the transfer of new technologies from the laboratory to the field.

Certification issues. Cold contacts initiated by a consultant may be effective in securing new business if the impression of competence and expertise can be readily communicated. Herein represents one of the most important roles for certification programs for agricultural professionals. In the absence of a personal referral, a readily recognized professional certification is a powerful tool in conveying a consultant's abilities to potential clients. However, the most serious drawback to the certification of agricultural professionals at this time is the inability of potential clients and the public to recognize its significance. Most agricultural producers simply do not know how to interpret the certifications of their agricultural consultants. This is partly the result of the fact that there are several different certification programs and almost no promotional program to help convince crop producers that the preferred consultants are those who carry the appropriate professional certification. Further, different certification programs have widely varying requirements for their applicants. For example, some certifications are considered by some as "entry-level" programs with standards comparatively lower than those of the more involved certification programs such as those sponsored by the NAICC or REAP. Consequently, consultants with high school–level training or less may appear as qualified to be disease control specialists as those with Ph.D.s in plant pathology. Unfortunately, professional certifications currently are comparatively unimportant factors in crop producers' evaluations of their consultants,

so there is little or no economic benefit for consultants to attend what can be expensive and time-consuming certification programs.

One way to resolve these problems would be for the various professional organizations interested in certifying their members to work together toward a consistent high standard of certification, with allowances made for differences in geography and expertise. For example, the National Registry of Environmental Professionals (NREP) conducts 2-day certification programs tailored to the consultants' specific areas of interest and expertise. The programs for each level are followed by standardized examinations consisting of both a national and a state section. The national section includes topics related to federal-level environmental issues, regulations, and general chemistry and hydrogeological background, while the state section focuses on more local problems and issues. Upon successful completion of the NREP certification program, the consultant is entitled and encouraged to include the NREP seal and certification number on his professional correspondence. Further, the certification is valued by insurance carriers as an important qualification that is helpful in obtaining professional errors and omissions coverage. A similar high-standard program for agricultural consultants (possibly associated with a promotional campaign to communicate its importance) would eventually result in crop producers and the public recognizing and understanding the value of appropriate certification in agricultural consultants. Efforts toward the development of a well-established certification program would have the simultaneous benefit of addressing the problem of disorganization within the profession, since consultants would become increasingly involved in how they relate to themselves, their clientele, and the general public.

College and graduate-level educations and certification programs will become increasingly important as IPM practices become increasingly quantitative and sophisticated. Mandatory certification programs are sometimes discussed, but mandatory certification would be difficult to implement in the short term. Certification at first should be voluntary, then should become mandatory after a sufficient period of time has elapsed and after the programs have become sufficiently established as to confer both professional and economic advantages to those obtaining the certifications. A more standardized certification program than currently exists, along with a related promotional program, could go far toward increasing the credibility of the agricultural consulting profession in the views of potential clients and the general public.

Insurance. The lack of errors and omissions insurance for crop professionals is a potential need for the industry—not just for plant pathologists, but for all crop advisory professionals (21,29). Crop advisors are asked to assume risks with little or no mechanism of asset protection in the event of a real or alleged loss. It is far easier for health care physicians, environmental, dental, financial, and legal professionals to obtain this type of protection than for crop advisors (13,14), but the increasing complexity of agricultural consulting is a strong signal that it is time for this issue to be seriously addressed in this profession as well.

Communication standards. Standards for the written and verbal communication of commercial information need to be better developed, as crop advisors must become more aware of how their information might be interpreted. Standards for record maintenance should also be better defined (9). Specific language that is preferred and is best avoided should be better defined so that risks associated with providing agricultural advice may be better managed.

Crop consultants and the Internet. Professional crop advisors, like other agricultural professionals, generally need to become more resourceful in using the immense capabilities of the Internet (27). The Internet offers enormous potential for disseminating current crop advisory information to agricultural producers. Crop advisors could, for example, perform crop inspection services during the day. Data could be brought back to the laboratory in the evening and scanned into the consultant's computer. Disease control analyses could be carried out and, within minutes, forwarded by e-mail directly to a grower–client's Internet account. The following morning, growers could log onto their accounts to obtain their daily updated disease and insect newsletters, which could include graphs charting disease progress. Thus, the practice of IPM could be greatly advanced by the use of Internet resources. Although these kinds of communication systems are common in weather and financial market services, comparatively little effort is being devoted toward developing them for disease management in production agriculture.

Conclusion

It has been estimated that only about 16% of the agricultural acreage in the United States is under some form of direct consultation (11). If that estimate is close to accurate, then substantially less than 16% of U.S. cropland receives the direct attention of a plant pathologist. Unfortunately, market thresholds for the number of plant pathologists serving different crops are not known. Some consultants have expressed concern about why IPM is not more widely practiced (25). However, if the goals of the National IPM Initiative are to be realized, consulting plant pathologists must become more directly involved in production on a greater amount of acreage. This goal can best be achieved by the public and private sectors working together with efforts such as a well-established bilateral referral system. Efficient agricultural production forms the basic foundation of the current standard of living of our society, and many opportunities exist for private consultants willing to

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adapt and innovate for their client's benefit. Our challenges are to understand how professional organization can help us better serve our clientele and to help our clientele and world society become more appreciative of the value and quality of our professional services (8).

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