Functions, Evolution, and Benefits of State Integrated Pest Management Programs

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The purpose of the Land Grant University Integrated Pest Management (IPM) Program has been to minimize economic, health, and environmental risks by establishing sustainable pest management systems in rural and urban environments (T. Fuchs, personnal communication, Professor and Extension IPM Coordinator, Texas A&M University (retired)). These programs have become highly productive and cost effective, consistently delivering valuable benefits to university administrations, key clientele groups, and the citizens of the states in which they operate. IPM is the coordinated use of pest and environmental information, along with available pest control methods, to prevent unacceptable levels of pest damage by using the safest and most economical means (adapted from Bajwa and Kogan 2000).

Each state IPM program is uniquely structured to effectively manage available resources through cooperative planning, priority setting, and accountability. Partnerships are established and maintained among researchers, who are the source of new technologies, and extension personnel, who deliver new information and training. Typical clientele-oriented products include pest management guides, training aids, scientific and trade journal articles, newsletters, displays, lectures, and workshops. These state IPM programs make up a powerful national IPM network with 56 individual state and commonwealth programs organized into four geographical regions. This network provides an essential mechanism for coordinating inter-state and multidisciplinary IPM research and educational projects that deliver much-needed information and technologies. Therefore, to have the most effective and efficient pest management capabilities and capture the benefits of the national IPM network, every land grant university should consolidate its IPM activities into an identifiable, coherent statewide program. In this article, we describe the functions, development, and extraordinary benefits of robust and comprehensive state IPM programs.

Primary Functions of a State IPM Program

A state IPM program that encompasses all of the primary functions (Table 1) must have a full-time state IPM coordinator[1] who manages the Smith-Lever Act, Section 3(d) [S-L 3(d)] formula funding for IPM (USDA, CSREES 2008). Strong state programs (i.e., those with full-time coordinators who manage the 3(d) funds) operate highly successful minigrant programs that generate new, innovative IPM projects. State IPM programs almost always obtain extramural funding. A reasonable goal is to augment the federal 3(d) funds with at least an equal amount from other sources to ensure adequate technical support, facilities, equipment, and other resources necessary for a successful program.

An effective state IPM program serves as the primary contact point for communication about and consultation on pest management activities. Currently, this kind of facilitation is accomplished by maintaining a Web site and list of stakeholders who continuously receive and comment on current information electronically. Examples of useful information include grants and other

[1]The 1862 Land Grant university in each state receives Smith-Lever Act, Section 3(d) formula funding for IPM. Beginning in federal fiscal year 2009, 1890 Land Grant institutions also became eligible for these funds. Thus, some states now may have more than one IPM coordinator.

Table 1. Functions for state IPM programs and current number of states with a criterion.

Program Management	
Designated coordinator	18
Manage the Smith-Lever 3(d) funds	26
Obtain extramural funding	41
Adequate technical support	24
Adequate Facilities and Equipment	41
Program management structure	53
Planning/priority setting process	45
Assure IPM program recognition	53
Professional development opportunities	45
Program Delivery	
Communication system (e.g., Web site, list-serv)	51
Grants program	22
Produce extension materials, manuals, guides, etc.	49
Provide IPM consultation	34
Seek funding for cooperators	28
Conduct education & training activities	52
Means of measuring benefits (e.g., surveys, statistics)	53
Program Involvement	
Cooperative extension collaboration	53
Research collaboration	52
Clientele collaboration	51
Interdisciplinary scope	53
Inter-institutional collaboration	52
Statewide involvement	52
Regional, national & international liaison	43
Program Support	
USDA, CSREES	54
Regional IPM Center	54
University administration	30
Unit leader	30
Clientele	20

54 state IPM coordinators responded, adapted from information provided by Mike Fitzner , USDA, CSREES.

sources of funding, extension resources, pest management alternatives, opportunities for collaboration, announcements of education and training events, the availability of employment, and communications forwarded by the university administration, regional IPM center, and USDA, CSREES (now the National Institute of Food and Agriculture, NIFA). A Web site is ideal for showcasing IPM success stories, archiving reports and publications, and serving as a repository for extension materials (e.g., links to current IPM information, training projects, Master Gardener and Master Naturalist resources, and presentations). It is essential to position a state IPM program to support IPM activities throughout the state, recognize its role and contributions, and measure its benefits.

State IPM coordinators typically provide statewide interdisciplinary and interunit coordination and assistance among faculty members and stakeholders to protect various combinations of agriculture, communities, and natural areas from pests and diseases. To accomplish this goal, each coordinator eventually develops a unique state IPM program, while retaining a high proportion of the primary functions. This level of organization is achieved best by an active state IPM coordinator, rather than a regional or national administrator, because most IPM opportunities and activities occur locally. Sustained progress in adopting IPM depends on the "people on the ground" having face-to-face, on-site interactions with clientele (e.g., demonstrations, educational programs, and training at farms, schools, nurseries, orchards, timber lots). An effective state IPM coordinator must be well trained, highly motivated, and appropriately compensated. There also must be program continuity, coordinators who have the experience and network of contacts to gain the respect and confidence of clients, current and potential. State IPM coordinators are usually members of advisory committees, for which they provide connectivity and guidance. They operate as entrepreneurs who, as interdisciplinary members of the scientific community, are positioned to identify and mobilize the best available researchers. Often, the state IPM coordinator leads the effort to obtain funding for research and extension projects conducted by the partners. This involvement assures that joint projects are well organized, productive, and monitored for accountability (Hoffman and Grabowski 2004).

The state IPM coordinator helps to identify and establish priorities for managing pest problems and develops and implements new pest management technologies to solve them in collaboration with public and private organizations, thereby improving agricultural productivity and profitability, safeguarding human and animal health, and preserving natural resources (National IPM Symposium 2003). The coordinator identifies local needs and accesses problem-solving resources in the region, nation, and world. This work requires scientific, entrepreneurial, and administrative skills beyond the requirements of a typical faculty assignment. Specific duties include:

1. Support and encourage county extension faculty and agricultural and urban clientele in planning, developing, and implementing IPM projects;
2. Form collaborative partnerships composed of faculty and clientele group members to enhance the development and delivery of IPM practices;
3. Serve as the state contact for IPM information and coordinate this activity with pest management discipline specialists;
4. Serve as a focal point for institutional IPM issues and a link between clientele and the land grant university;
5. Keep current and support faculty IPM research, extension, and teaching programs and activities;
6. Encourage the development of grant proposals by faculty teams to submit to agencies and organizations funding IPM;
7. Promote the state IPM program in local, regional, and international settings;
8. Document and disseminate information on achievements in IPM; and
9. Maintain close working relationships with land grant university administrators, including department chairs, center directors, and district extension directors, in advancing IPM research, extension, and teaching.

2008 Survey of State IPM Programs

We conducted a survey of the national IPM network in 2008 to determine the level of development of the primary functions for each state IPM program (Table 2). Almost every state (98.1%) had some level of coordinated state IPM program versus a set of independent IPM activities. Most of these programs had been in place for >10 yr (86.8%); however, several were established during the past 5–10 yr (9.4%). Only one was started in the past 3–5 yr and another within the past 1–3 yr.

Although state IPM programs had much in common, each was tailored to meet the needs of its specific stakeholders. Some programs were highly organized, structured, and proactive, whereas others were informal and responsive to more immediate situations. Often the level of formalization was determined by available resources and the pest management needs of cooperators. Consequently, most state IPM programs had identified clientele (94.3%); but more than half operated according to a mission statement (60.4%) and written objectives (64.2%). All of the programs emphasized agriculture, but most also were active in community IPM (60.4%), and many included natural areas (37.7%). These programs were expanding in the areas of school IPM, urban agriculture, urban forestry, parks and recreation, invasive species, and regulatory agriculture. Liaison was increasing with the National Plant Diagnostic Network and associated regional networks.

State IPM programs were funded primarily by federal S-L 3(d) funds (100%) and state appropriations (32.1%). In federal fiscal year (FY) 2008, 16 states leveraged S-L 3(d) funds to obtain $4,733,500 in state appropriations (r = $3,000–1,500,000/state). Other sources of funding were grants (62.3%), contracts, cooperators, and in-kind contributions, such as Master Gardener time. Beginning in FY 2008, S-L 3(d) funding was subject to the Grants.gov submission process (Grants.gov is a program for finding and applying for federal government grants (http://grants.gov/), to assure that all administrative requirements were met and the funds were used exclusively for IPM activities. The S-L 3(d) funds were managed by the state IPM coordinator in only half of the states (50.0%) and <10% were available in >20% of the states (Fig. 1). Most state IPM coordinators received some level of state support for personnel, facilities, and equipment associated with their faculty positions. For example, state appropriations were a major source of funding for state IPM coordinator salaries (44.4%), whereas S-L 3(d) funds supported 27.8%, and grants made up 5.6%. In some cases, a mixture of state and S-L 3(d) funds paid the salary of a state IPM coordinator and, in other cases, base extension Hatch funds were used. Hatch Act funds are provided by the USDA for agricultural research on an annual basis to the State Agricultural Experiment Stations (http://www.csrees.usda.gov/business/awards/formula/hatch.

Table 2. Summary of 2008 Survey of State IPM Programs. Responses for the category "Other" are described in the text.

	Response %	Response count
1. Do you have a coordinated state IPM program? *(54 responses)*		
Yes	98.1	53
No	1.9	1
2. How long has your state had a state IPM program? *(53 responses)*		
1–3 yr	1.9	1
3–5 yr	1.9	1
5–10 yr	9.4	5
10+ yr	86.8	46
3. Are you accomplishing these activities for your program? *(53 responses)*		
Have a mission statement	60.4	32
Identify your clientele	94.3	50
Have objectives for clientele	64.2	34
Have resources for objectives	83.0	44
Producing outcomes	86.8	46
Other	17.0	9
4. What type of planning and priority setting process do you use? *(50 responses)*		
Monthly meetings with staff	36.0	18
Meetings with deans	14.0	7
Advisory committee meetings	60.0	30
Other	38.0	19
5. How do you assure IPM program recognition? *(53 responses)*		
Logo	39.6	21
Web site address	58.5	31
IPM-labeled extension materials	50.9	27
Publications	60.4	32
Brochures	43.4	23
State reports	69.8	37
Federal reports	88.7	47
Other	13.2	7
6. List the USDA, CSREES "Areas of Emphasis" for your state (max. 15). See Table 3.		
7. What is the scope of your IPM program? *(53 responses)*		
Agriculture	100.0	53
Communities	60.4	32
Natural areas	37.7	20
Other	17.0	9
8. Are you located on the main campus of the university? *(53 responses)*		
Yes	75.5	40
No	24.5	13
9. Do you have adequate facilities and equipment? *(53 responses)*		
Yes	77.4	41
No	22.6	12
10. What is the source of funding for your state IPM program? *(53 responses)*		
3(d) funds	100.0	53
State appropriations	32.1	17
Grants	62.3	33
Other	20.7	11
11. What percentage of the 3(d) funds do you manage? *(52 responses)*		
0%	11.5	6
<10%	9.6	5
10–25%	1.9	1
26–50%	7.7	4
51–75%	9.6	5
76–99%	9.6	5
100%	50.0	26
12. How long have you been the State IPM Coordinator? *(54 responses)*		
<1 year	5.6	3
1–3 yr	9.3	5
3–5 yr	16.7	9
5–10 yr	24.1	13
10–15 yr	20.4	11
15–20 yr	7.4	4
20+ yr	16.7	9
13. Are you a full-time State IPM Coordinator? *(54 responses)*		
Yes	35.3	18
No	66.7	36
14. What percentage of your work is a State IPM Coordinator? *(36 responses)*		
<10%	22.2	8
10–25%	41.7	15
26–50%	30.6	11
51–75%	5.6	2
15. What is the primary source of your salary? *(54 responses)*		
3(d) funds	27.8	15
State appropriations	44.4	24
Grants	5.6	3
Other	22.2	12
16. Do you have a faculty position? *(54 responses)*		
Tenured professor	53.7	29

Table 2 continued

html). State IPM coordinators often had teaching, research, administrative, or county extension appointments that provided their salaries. Combinations of federal, state, and university funds were used for salaries at various times, including partial funding from state departments of agriculture.

In addition to state IPM coordinators, personnel in the state IPM programs included associate or assistant coordinators (32.7%); extension agents (44.2%); graduate students (21.2%); volunteers, such as Master Gardeners, (11.5%); and cooperators, including extension specialists, research associates, information technologists, staff writers, administrative assistants, technicians, hourly employees, undergraduate students, and farmers. S-L 3(d) funds supported 30.4% of the additional personnel, whereas 26.0% were paid with state funds. Grants provided support for 30.4%; and 13.0% were funded from base extension, state, or federal sources. Personnel from the land grant universities (e.g., information technologists, graphic arts, and clerical assistants) were available to 44.4% of the state IPM coordinators. However, many coordinators expressed a need for additional staff to meet the increasing demand for extension activities in the field, education and training, technical and report writing, educational programming, pest and disease diagnostics, IPM coordination, technical assistance in the laboratory and field, and office support.

State IPM coordinators tended to remain in the position for many years, some 20 or more (Fig. 2). The duration of time in service was 20 yr or more (16.7%), 15–20 yr (7.4%), 10–15 yr (20.4%), 5–10 yr (24.1%), 1–5 yr (26.0%) and <1 year (5.6%). Only 35.3% of the coordinators spent their full time on IPM activities, declining to 5.6% for 50–75% of their time, 30.6% for 25–50%, 41.7% for 10–25%, and 22.2% for <10%. Most coordinators were tenured professors (53.7%) with some tenured associate professors (3.7%), tenure-track assistant professors (3.7%), and nontenured faculty (24.1%). Curiously, 14.8% were not faculty members. State IPM coordinators typically were located on the main campuses of land grant universities (75.5%), which is preferred; but about a quarter were housed off-campus (24.5%). Generally, their facilities and equipment were deemed adequate (77.4%); but some improvements were needed in research facilities and equipment, particularly diagnostic instruments

Table 2. Summary of 2008 Survey of State IPM Programs. Responses for the category "Other" are described in the text.

	Response %	Response count
Tenured associate professor	3.7	2
Tenure-track assistant professor	3.7	2
Nontenured faculty	24.1	13
Not faculty	14.8	8
17. What faculty or staff members work in your IPM program? *(52 responses)*		
Asst. State IPM Coordinator	32.7	17
Graduate students	21.2	11
IPM extension agents	44.2	23
Volunteers	11.5	6
Other	38.5	20
18. What is the source of funds for faculty and staff members? *(46 responses)*		
3(d) funds	30.4	14
State appropriations	26.0	12
Grants	30.4	14
Other	13.0	6
19. Do you have adequate support personnel? *(54 responses)*		
Yes	44.4	24
No	55.6	30
20. What kind of support do you need? *(29 responses)*		
Responses summarized in text.		
21. Is your IPM program the main state contact for IPM? *(54 responses)*		
Yes	90.7	49
No	9.3	5
22. What type of communication systems do you have? *(54 responses)*		
Web site	87.0	47
List-serv	50.0	27
Mailing	48.1	26
Newsletter	53.7	29
Other	18.5	10
23. Do you have a mini-grants program? *(53 responses)*		
Yes	41.5	22
No	58.5	31
24. What is the avg. annual funding for your mini-grants program? *(22 responses)*		
$25,000 or less	45.5	10
$25,000–$50,000	27.2	6
$50,000–$100,000	13.6	3
$100,000 or more	13.6	3
25. What is the average number of mini-grants each year? *(18 responses)*		
1–5 grants	38.9	7
6–15 grants	50.0	9
16–25 grants	11.1	2
26+ grants	16.7	3
26. What is the source of funding for your mini-grants? *(22 responses)*		
3(d) funding	81.8	18
State appropriations	9.1	2
Grants	4.5	1
Other	4.5	1
27. Do you design, write, or compile IPM materials? *(52 responses)*		
Manuals	61.5	32
Guides	65.4	34
Brochures	53.8	28
Posters	55.8	29
Fliers	46.2	24
On-site training materials	73.1	38
On-line training materials	48.1	25
None of the above	5.8	3
Other	21.2	11
28. Do you provide IPM consultation? *(54 responses)*		
Yes	63.0	34
No	37.0	20
29. To what clientele groups do you provide consultation? *(34 responses)*		
Extension agents and specialists	91.2	31
Commodity groups	79.4	27
General public, growers	82.4	28
News media	67.6	23
Other	20.6	7
30. What kind of consultation do you provide? *(34 responses)*		
Pest management	97.1	33
Disease management	73.5	25
Educational information	94.1	32
Referrals to specialists	82.4	28
Other	5.9	2
31. Do you seek funding for cooperators? *(54 responses)*		
Yes	51.9	28
No	48.1	26

Table 2 continued

and computers. Professional development opportunities were provided for state IPM coordinators, especially participating in scientific meetings (93.5%), enrolling in formal courses (13.0%), and attending or presenting seminars (82.6%). Technical meetings, workshops, short courses, and tutorials were available, along with supervisory training and leadership development.

Generally, state IPM programs were highly coordinated and well managed; most operated statewide (96.3%), as well as regionally, nationally, and internationally to enhance their ability to serve identified clientele (81.1%). Inter-institutional collaboration was common, and constant IPM consultation was expected. Collaboration was primarily with the Cooperative Extension (98.1%), research faculty (96.3%), clientele (94.4%), federal institutions (68.5%), state departments of agriculture (94.4%), and departments of environmental protection (50.0%). Federal cooperators often were the USDA (ARS, APHIS, CSREES, IR-4, and NRCS) and EPA. Significant intrastate interactions occurred with environmental groups, such as the Nature Conservancy and Ducks Unlimited; the Farm Bureau; scientific societies; commodity groups; state departments of education and health; water management and soil conservation districts; and so forth.

Regionally and nationally, state IPM coordinators typically interacted with their IPM center and USDA, CSREES 1–5 times per year (50.0%, 77.8%) but a significant number collaborated 6–10 times (18.5%, 7.4%) and more than 10 times annually (22.2%, 5.6%). They conducted multistate research projects, served on grant proposal review panels, helped with plant clinics and regional and national distance diagnostics, hosted education and training workshops and teleconferences, prepared joint publications (e.g., pest management guides and insect identification photographs), worked with commodity groups (e.g., potato, cotton, fruit and other groups; produced pest management strategic plans), established regional IPM priorities, developed multistate training materials, cooperatively conducted pest and disease surveys (e.g., invasive species), provided information on pesticide use, participated in the cooperative agricultural pest survey and other important activities, and served on regional and national IPM coordinating committees.

State IPM coordinators contributed valuable IPM consultation in other countries.

Table 2. (continued) Summary of 2008 Survey of State IPM Programs. Responses for the category "Other" are described in the text.

	Response %	Response count
32. What type of funding do you seek for cooperators? *(28 responses)*		
Grants	89.3	25
Contracts	28.6	8
Donations	32.1	9
Other	10.7	3
33. Do you conduct education and training activities? *(54 responses)*		
Yes	96.3	52
No	3.7	2
34. What education and training activities do you conduct? *(52 responses)*		
Extension in-service training	88.5	46
Clientele group meetings	84.6	44
Field days	86.5	45
University classes	63.5	33
Other	15.4	8
35. How do you measure the outcomes and benefits of your work? *(53 responses)*		
Surveys	83.0	44
Statistics	50.9	27
Attendance, education, and training	92.5	49
Other	20.8	11
36. With which groups do you collaborate? *(54 responses)*		
Cooperative extension	98.1	53
Research faculty	96.3	52
Clientele	94.4	51
Federal institutions	68.5	37
State Department of Agriculture	94.4	51
Department of Environmental Protection	50.0	27
Other	18.5	10
37. What disciplines are involved with your program? *(54 responses)*		
Entomology	100.0	54
Nematology	61.1	33
Plant pathology	96.3	52
Weed science	81.5	44
Agronomy	70.4	38
Environmental studies	27.8	15
Horticultural science	72.2	39
Soil science	50.0	27
Other	13.0	7
38. Is your IPM program statewide? *(54 responses)*		
Yes	96.3	52
No	3.7	2
39. Is your IPM program involved in the region, nation, global? *(54 responses)*		
Yes	81.1	43
No	18.9	10
40. Involvement in the region, nation, global? *(41responses)* Responses summarized in text.		
41. Who provides administrative guidance to your program? *(53 responses)*		
Unit leader (academic depart.)	56.6	30
University administration	56.6	30
Advisory committee	39.6	21
Clientele	37.7	20
Other	18.9	10
42. Do you have professional development opportunities? *(53 responses)*		
Yes	84.9	45
No	15.1	8
43. What are your professional development activities? *(46 responses)*		
Scientific meetings	93.5	43
Formal courses	13.0	6
Seminars	82.6	38
Other	17.4	8
44. How often do you interact with your regional IPM center? *(54 responses)*		
Never	9.3	5
1–5 times/year	50.0	27
6–10 times/year	18.5	10
10+ times/year	22.2	12
45. How often do you interact with USDA, CSREES IPM? *(54 responses)*		
Never	9.3	5
1–5 times/year	77.8	42
6–10 times/year	7.4	4
10+ times/year	5.6	3
46. Is your IPM program developing, stable, or increasing? *(51 responses)* Responses summarized in the text.		

They participated in the U.S. AID IPM Collaborative Research Support Program (CRSP) and worked with international scientific societies, organizations, and companies.

State IPM coordinators and their staff members were the primary sources of leadership and advocacy for their state IPM programs. However, fewer than half of the coordinators held monthly meetings with their personnel (36.0%), probably because most of these groups were small or dispersed across the state. Astute state IPM coordinators identified opportunities by participating in relevant activities and gleaning useful information. Some of the best ideas for advancing state IPM programs came from annual meetings of state IPM coordinators, USDA, CSREES regional research projects, Extension in-service training, and seminars on topics related to IPM. Guidance and administrative support was provided by a variety of stakeholders, often advisory committees (60.0%) comprised of extension partners, agricultural and community leaders, natural resource managers, and others formed to help establish priorities. Other sources of guidance for state IPM programs (38.0%) included meetings with department heads, cooperating faculty members, extension agents and administrators, university groups involved in IPM, growers, grower groups, crop consultants, county advisory groups, and agri-businessmen. Stakeholders formed working groups that planned individual projects and ranked associated goals. IPM priorities also were gleaned from pest surveys and pest management strategic plans. Administrative guidance was deemed excellent, but state IPM coordinators met with university deans infrequently (14.0%). Appreciation of state IPM programs was almost universal from department chairs, higher level administrators, and clientele groups.

Productivity of state IPM programs depended on effective mechanisms for establishing research and extension partnerships, and delivering IPM information and technologies (94.1%) or referring clientele to specialists (82.4%). Most state IPM coordinators were goal-oriented problem solvers who sought to produce useful outcomes from their cooperative efforts; for example, managing pests (97.1%) and diseases (73.5%). This cooperation was facilitated by obtaining and distributing competitive grant funds, operating IPM grants programs, developing and guiding project workgroups, meeting periodically with clientele groups

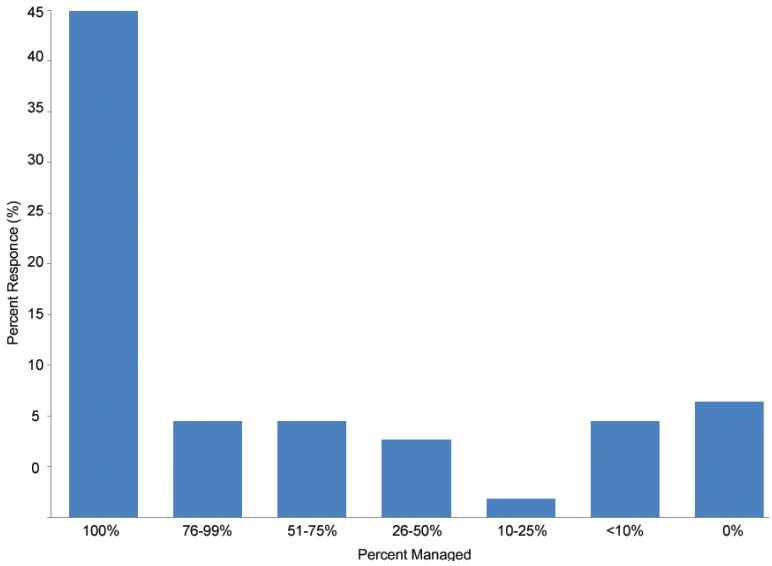

Fig. 1. Percentage of 3(d) funds managed by the state IPM coordinator.

to determine priorities, posting information and outcomes on Web sites, coordinating with programs and initiatives of the university and allied institutions that pertain to IPM, and requiring accountability for resources provided through the efforts of the state IPM coordinator. Interdisciplinary activities were considered essential; and the disciplines most involved in IPM were entomology (100%), plant pathology (96.3%), weed science (81.5%), horticultural science (72.2%), agronomy (70.4%), nematology (61.1%), and soil science (50.0%) (Fig.3). Across the national IPM network, information was delivered by Web sites (87.0%), e-mail list-servers (50.0%), mailing lists (48.1%), newsletters (53.7%), telephone, meetings, displays, and news releases.

IPM program grants were used to encourage partnerships between researchers and extension agents in 41.5% of the states, and the average number per year was 13.5 (r = 1–60). The average annual funding committed to this function was $1,865,000 (r = $5,000–570,000 per state); 81.8% came from S-L 3(d) funds, 9.1% from state revenue, 4.5% from extramural grants and 4.5% from other sources.

State IPM programs typically produced manuals (61.5%), guides (65.4%), brochures (53.8%), posters (55.8%), fliers (46.2%), and on-site (73.1%) and on-line (48.1%) training materials. Journal articles, books, reports, and fact sheets were contributed by 21.2% of the states; however, 5.8% did not generate IPM materials. Consultation was provided by 63.0% of the states to extension agents and specialists (91.2%), commodity groups (79.4%), the general public (82.4%), news media (67.6%), farmers, students, and pest control professionals, e.g., pest control operators and applicators (PCOs and PCAs).

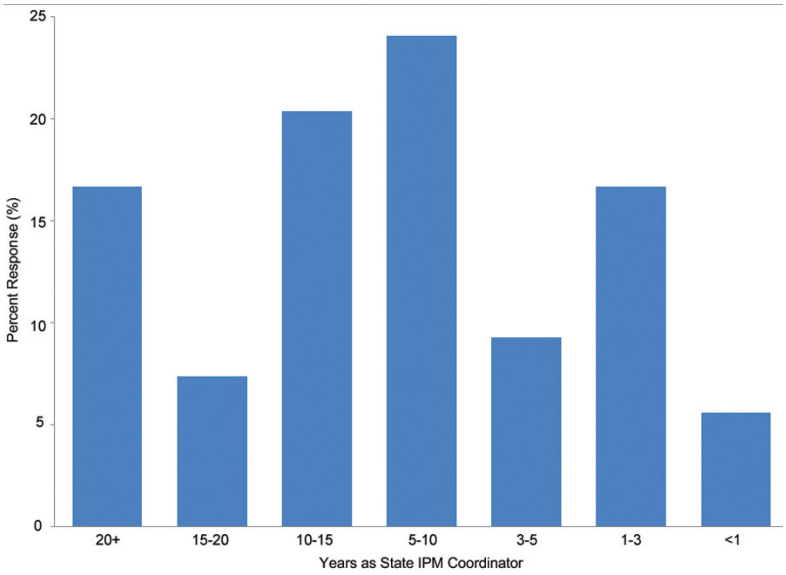

Fig. 2. Number of years as state IPM coordinator.

State IPM coordinators sought funding for cooperators (51.9%) from grants (89.3%), contracts (28.6%), donations (32.1%), and state sources (10.7%).

Almost all conducted education and training activities in cooperation with extension agents and specialists (96.3%). These activities included extension in-service training (88.5%), clientele group meetings (84.6%), field days (86.5%), university classes (63.5%), public workshops, Master Gardener programs, site visits, field demonstrations, distance education, telephone and on-site conferences, non-university courses, and one-on-one training. The state IPM program was the main point of contact for IPM in 90.7% of the states.

Few state IPM coordinators were satisfied with the means available to measure and indicate the benefits of their programs, but 40% had at least a rudimentary mechanism in place. The outcomes and benefits of their programs were measured by surveys (83.0%); statistics (50.9%); number of farm visits and grower meetings and their attendance (92.5%); and feedback from clientele (20.8%), including written evaluations; personal interviews, pesticide use reporting, acres infested, environmental impact, and the results from research projects.

Recognition was achieved by using a state IPM program logo (39.6%); providing information for newspaper articles; partnering with public and private institutions; displaying exhibits at trade shows, state fairs, and other events; building pest management centers; volunteering to speak at extension and scientific meetings; and participating in regional organizations of state IPM coordinators and regional IPM centers. Because recognition of the contributions of state IPM programs was essential, coordinators maintained branded Web sites and produced program-labeled extension materials (50.9%), publications (60.4%), brochures (43.4%), and state (69.8%) and federal (88.7%) reports.

The USDA, CSREES, Performance Planning and Reporting System (PPRS) requires state IPM coordinators to report annual accomplishments for their states under "Areas of Emphasis" derived from a classification manual used for the Current Research Information System (CRIS), *Manual of Classification for Agricultural and Forestry Research, Education, and Extension* (USDA, CSREES 2005. Each state had a unique set of Areas of Emphasis that, combined, indicated the scope of their IPM activities (Table 3).

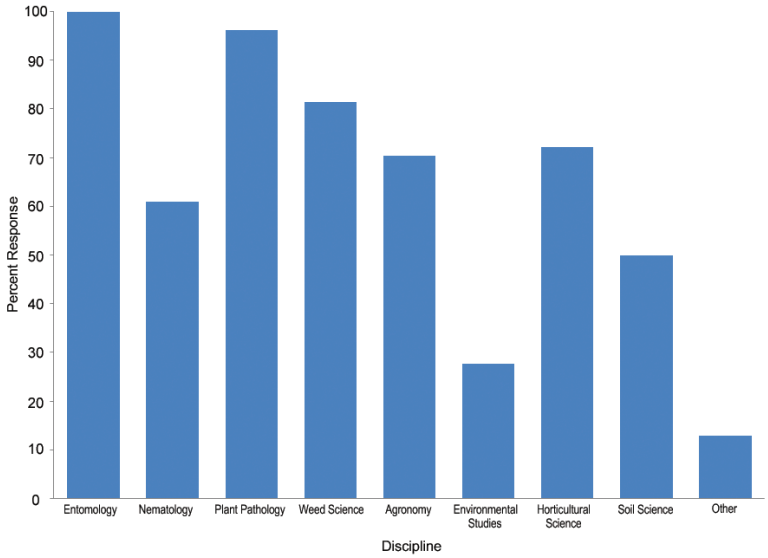

Fig. 3. Percentage of state IPM coordinators who are involved with indicated disciplines.

State IPM programs varied widely in their development and stability, even though federal S-L 3(d) funding has been provided to establish and maintain them since the 1970s (Jacobsen 1997). Some state IPM programs have continued to develop (15.6%), whereas others have remained stable (62.7%) or been reduced, but not eliminated (21.6%). Those that increased have added additional funding from competitive grants and formed partnerships with other parties, particularly state institutions. Although these kinds of efforts sustained the IPM programs, long-term continuity may have suffered. One state established a pest management center and others expanded into new Areas of Emphasis. Stable IPM programs have consistently augmented S-L 3(d) funding declines due to inflation and adjusted to changing priorities (e.g., needs for community IPM, problems with invasive species, and new crops and associated pests). Even stable programs required considerable effort to delay the inevitable declines that occur without an increase in S-L 3(d) funds. For currently decreasing programs, S-L 3(d) funding has been reduced with a concomitant loss of personnel and productivity.

Previous Surveys of State IPM Programs

The first national survey of state IPM coordinators was conducted about 20 yr after they were established (Gray 1995). It addressed some of the same questions as the current survey and provides a clear indication of how state IPM programs have advanced. The 45 states for which IPM coordinators responded received federal funding for an average of 17.4 yr (r = 7–22 yr), and about half received some level of state support (55.6%). Federal funds were used to support faculty salaries (75.6%), most for nontenure track positions (57.8%).

The primary goal of state programs was to "minimize pest damage, while being cognizant of the importance of environmental and sociological consequences." Reduction in pesticide use was not the primary emphasis; rather, most projects were intended to provide educational programs and resources to clientele (91.1%). Advisory committees were established to assure that projects addressed IPM priorities (48.9%). The state IPM coordinators believed that they had delivered on expectations (75.6%).

In a reassessment of state IPM programs, Gray (2001) described the disruptive cycling of funding support and suggested solutions. This paper characterized the diverse opinions about pesticide reduction as the measure of successful state IPM programs. A follow-up survey (Ratcliffe and Gray 2004) was sent to all of the state IPM coordinators following a Government Accounting Office report (GAO 2001) that stated, "IPM has resulted in some environmental and economic benefits but use of the riskiest pesticides remains substantial." The survey indicated that the average number of years a state IPM coordinator had served was 9.1 (r = 1–29 yr). Most of the coordinators were entomologists working in field, fruit, and vegetable crops, but turf, structural, and ornamental pest management were well represented. Of the 48 state IPM coordinators who responded, most did not believe that the chief goal of an IPM program should be to reduce pesticide use (62.5%). However, 60.4% indicated that IPM had not delivered on the expectation of the early 1970s that pesticide use would decline if IPM prac-

Table 3. USDA, CSREES Areas of emphasis for state IPM programs and current number of states that include each area (47 state IPM coordinators responded).

Natural Resources and Environment	
Soil	
Appraisal of soil resources	1
Water	
Conservation and efficient use of water	1
Plants and Their Systems	
Plant production	
Plant management systems	1
Plant production	
Weeds affecting plants	1
Integrated pest management systems	1
Natural Resources and Their Products	
Watersheds and River Basins	
Watersheds and river basins, general	2
Atmosphere	
Atmosphere, general/other	1
Trees, Forests, and Forest Products (excluding edible tree nut crops)	
Short rotation woody crops, including holiday trees	2
Trees, forests, and forest products, general	1
Rangelands and Grasslands	
Rangelands, other	1
Rangelands and grasslands, general	3
Wildlife and Natural Fisheries Management, Endangered Species	
Wild animals	1
Plants and Their Products	
Citrus	
Citrus, general/other	2
Tropical/Subtropical Fruit	
Banana	3
Tropical/subtropical fruit, general/other	1
Deciduous and Small Fruits	
Apple	8
Cherry	1
Peach	3
Deciduous tree fruits, general/other	2
Cranberry	2
Strawberry	2
Berries and cane fruits, general/other	1
Wine grapes	1
Grapes, general/other	2
Deciduous and small fruits, general/other	5
Edible Tree Nuts	
Pecan	2
Edible tree nuts, general/other	2
Vegetables	
Potato	5
Beans (dry)	2
Melons	4
Cucurbits, other	3
Greens and leafy vegetables	1
Cole crops	4
Sweet potato	2
Onion, garlic, leek, shallot	1
Tomato	2
Peppers	2
Sweetcorn	4
Vegetables, general/other	13
Grain Crops	
Corn	11
Grain sorghum	3

Table 3 continued

Table 3. (continued)

Rice	1
Hard red winter wheat	3
Wheat, general/other	5
Grain crops, general/other	4
Pasture and Forage Crops, general/other	3
Cool season perennial grasses	1
Perennial grasses, other	1
Alfalfa	7
Forage legumes, general/other	2
Fiber Crops	
Upland cotton	6
Long fiber cotton	1
Cotton, other	5
Oilseed and Oil Crops	
Soybean	14
Peanut	3
Lesquerella	1
Sugar Crops	
Sugar beet	3
Ornamentals and Turf	
Ornamental trees and shrubs	7
Herbaceous perennials and decorative greens	1
Potted plants	1
Bedding/garden plants	1
Turf	6
Ornamentals and turf, general/other	5
Miscellaneous and New Crops	
Tea	1
Herbs and spices	1
Guayule	1
Miscellaneous and new crops, general/other	1
Weeds	6
Plants	
Cross-commodity research—multiple crops	2
Animals, including Invertebrates, and Their Products	
Bees, Honey, and Other Pollinators	
Honey bees	2
Invertebrates	
Insects	5
Spiders, mites, ticks, and other arthropods	4
Invertebrates, general/other	1
Cattle	
Beef cattle, live animal	1
Dairy cattle, live animal	1
Swine	
Swine, live animal	1
Microorganisms	
Microorganisms, general/other	1
Food and Manufactured Resources	
Structures, Facilities, and Equipment	
Houses (human residences)	1
Structures, facilities, and equipment, general/other	1
Human Resources, Organizations, nd Institutions	
People and Communities	
Individuals	2
Communities, areas, and regions	8
People and communities, general/other	11
Other Technologies	
General technology	1

tices were implemented. Even though the controversy about pesticide reduction being a primary goal continued, there since has been general agreement that state IPM coordinators adhere to the IPM roadmap with the goals of economic improvement and reduction in potential risks to human health and environment.

Another survey conducted to characterize the position of state IPM coordinator in the Southern Region (Herbert 2001) evaluated some of the criteria included our 2008 study. The survey compared the missions, appointments, and job and reporting expectations of 12 state IPM programs. State IPM coordinators were most closely associated with the extension mission, but they typically had split appointments that also included teaching or research responsibilities. They usually were tenure-track faculty members who specialized in entomology and did not have actual appointments as state IPM coordinators. Fewer than half had written position descriptions emphasizing IPM, but expectations for all of their positions included typical IPM accomplishments: coordinating and facilitating grant writing, developing IPM research and extension programs, serving as spokespersons for IPM-related issues, planning and conducting IPM training, preparing IPM reports, etc.

Criteria for success were essentially the same as for any faculty member, particularly writing publications and grant proposals. Special consideration, however, was given to maintaining meaningful interactions with stakeholder groups, addressing community and agricultural IPM, and documenting IPM adoption and impact. Some of the most important accomplishments included coordinating working groups to develop projects, facilitating grant writing, and increasing competitive funding. Nevertheless as for other faculty members, university tenure and promotion evaluations for state IPM coordinators favored individual accomplishments, particularly when it was difficult to determine the contributions of each team member. Annual evaluations were conducted by combinations of university administrators, usually unit leaders and deans.

The survey also considered levels of funding, operations, and accomplishments of the 12 state IPM programs. About half of the state IPM coordinators had access to at least part of the S-L 3(d) funds, and all of them obtained significant support from other sources. Faculty and staff support for IPM was obtained by three main avenues: 1. Personal interaction, 2. In-house competitive grants, and 3. Cooperation in obtaining extramural funding. The state IPM coordinator had to convince potential cooperators that it would benefit their programs to form partnerships with the state IPM program. All of the coordinators had some form of advisory committee that met at least annually and helped them garner resources. Satisfaction with the position of State IPM Coordinator appears to have been related to the proportion of time committed; those with greater commitments being more satisfied with their progress and accomplishments. Time allocated to IPM varied widely from 100% to almost none, and only the busiest coordinators received increased technical and secretarial support. None of the coordinators were given extra compensation specifically for their efforts to advance IPM. Regardless, all of them recommended that every state would benefit greatly by having a full-time state IPM coordinator.

Benefits of State IPM Programs

IPM is still in its infancy, despite the achievements of the past 30 yr (Kogan 1998). To fulfill the promise of IPM in the United States, every state will require a well-organized, highly coordinated statewide IPM program with a full-time coordinator who manages the federal S-L 3(d) funds and is responsible for performing most of the management and delivery functions. Guidance, approval of the annual budget, and rigorous oversight of IPM activities can be provided by the land grant university administration and the USDA, CSREES IPM program. Part-time state IPM coordinators who manage the S-L 3(d) funds can facilitate important activities, but they will not have the time to manage and deliver a full-scale program. Part-time state IPM coordinators who do not have access to the S-L 3(d) funds will only be able to facilitate important but limited activities. All of the current state IPM coordinators are committed to establishing the best possible IPM program in their state or commonwealth; most would like it to be comprehensive and a source of pride for their land grant university. States without an adequate IPM program can make the transition by establishing the position of IPM coordinator, assigning all of the S-L 3(d) funds to the program, and assuring that IPM grants are made available. It also is essential to maintain a high level of administrative support and develop ways to

measure and communicate the benefits (Hoffman and Grabowski 2004). Administrators have become more involved with state IPM programs because plans of work and annual reports to USDA, CSREES must have required approval before S-L 3(d) funds can be released. This investment in state IPM programs can vastly increase cooperation among scientists, extension agents, pest consultants, progressive farmers, farm workers, and consumers (Ehler and Bottrell 2000).

State IPM programs comprise an extremely cost-effective network that delivers essential pest management information and technical support to clientele involved with agriculture, communities, and natural areas. These unique programs are structured to fit the needs of their clientele, emphasizing agriculture but including the other areas of pest management. All of the states receive S-L 3(d) IPM funding administered by the USDA, CSREES through the extension Directors and state IPM coordinators of the land grant university system. The $9,791,000 per year in S-L 3(d) IPM funds are leveraged to yield several times that amount to finance a wide variety of high priority pest management projects. In FY 2008, for example, $4,733,500 was obtained just from state appropriations.

Typically, state IPM coordinators are highly educated and experienced; they have remained in the position for 5 or more yr with small, less permanent staffs. The number of personnel for the national IPM network is about 176, but there are many more full partners, including extension faculty members, students, and unpaid volunteers. Salaries for paid staff are derived primarily from S-L 3(d) funds, and state and federal contracts and grants. State IPM coordinators help to organize, finance, conduct, and communicate the benefits of projects within their states and regions; they also serve as contact points for public and private institutions. Most coordinators provide competitive grants, maintain active communication mechanisms, and participate in education and training activities. They offer consultation locally, nationally, and internationally on a range of IPM-related topics. Most of the work is in entomology, plant pathology, weed science, horticulture, and agronomy, but significant interactions involve other agricultural sciences. Program guidance and evaluation come from being engaged with university administrators and clientele.

There would be many more robust state IPM programs if their basic organization, functions, and benefits were understood and more universally accepted. This description and associated survey data are offered to provide this understanding and encourage the development of stronger state IPM programs. This strengthening can be accomplished by instituting the general structure and primary functions of well-developed programs, and by sharing IPM responsibilities with other members of the extension community. Incrementally increasing financial and technical support for state IPM programs, as needed, will pay dividends in financing and conducting more and higher quality research and extension projects. Thus, a comprehensive and at least stable state IPM program would benefit every land grant university, as agriculture, communities and natural areas are increasingly difficult to protect from pests and diseases without unacceptable risks to human health and the environment.

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