I had the privilege to give the Founders’ Memorial Lecture honoring Dr. Leo Dale Newsom in December of 2000 at the joint meeting of the Entomological Societies of America and Canada in Montreal. For most of my professional life, I shared with Dale Newsom both an interest in soybean IPM and the belief that “integration” was the key factor in the IPM concept; those topics were the focus of my original presentation. Much has changed in soybean IPM in the intervening 12 years since that event, and integration still remains a remote goal in IPM teaching, research, and extension. Last year marked the 25th anniversary of Dale Newsom’s death. By rekindling the message conveyed in that lecture, I hope to reassert principles that, in my view, remain critical for the future of IPM, and, in so doing, provide a more lasting tribute to this admirable entomologist.

In the historical path of a branch of science, technology, or the humanities, there are moments when a new finding, invention, idea, or worldview brings about a qualitative leap. Andrew Grove, former CEO of the Intel Corporation, called these occurrences “strategic inflection points,” further describing them as “those moments when new circumstances alter the way the world works, as if the current of history goes through a transistor and our oscilloscopes blip” (Grove 1996).

During the lifetime of Dr. Leo Dale Newsom, crop protection was transformed by two such inflection points: the discovery of DDT and the rise of Integrated Pest Management (IPM). DDT, as a single discovery, was a tactical weapon that drastically changed the fight against insect pests in the second half of the 20th century.

IPM as an idea, a process, and a collection of technological advances was a significant strategic inflection point in the agricultural sciences of the fourth quarter of the century (Kogan 1998, Kogan and McGrath 1994).

Newsom was an active participant in the early days and throughout the expansion of those two strategic inflection points in crop protection’s history. When DDT began to be used for peacetime applications in 1946, Newsom was a graduate student at Cornell University. He tested the new insecticide in agricultural pest control and was one of the first to call attention to DDT’s destruction of natural enemies. When the concept of
Integrated Control was formulated in the early 1960s, Newsom became one of its leading advocates.

**Newsom's Life and Work**

Newsom's father was a cotton farmer and his mother was a teacher. They moved from South Carolina to Northern Louisiana in ox-drawn wagons and settled near an Indian settlement named Shongaloo, meaning “cypress tree” according to Dale's first cousin, Mrs. Myrtis Newsom Young, a former mayor of the village (population: 160). Dale was born there on 23 February 1915. Three brothers followed: Douglas, Donald, and Darrell. Another brother died in infancy.

Mrs. Newsom started early home schooling for her sons. Dale was already reading when he began grade school. He graduated from Shongaloo High School at 15 and helped his mother with the younger brothers’ schooling. The rural setting of Shongaloo instilled in the Newsom boys a passion for the woods and hunting, mainly birds—quail and woodcock—as well as a love for bird-dogs. This love continued throughout his adult life. His dogs Sunday, Moses, and Shiloh were trusted companions. Newsom's three younger brothers remained to the end his best friends and his favorite hunting and fishing companions.

Although education was a priority for his parents, six years passed before Newsom attended college. His cousin Myrtis related that Dale left home in 1936 with $21.00 in his pocket and two pairs of overalls. In Ruston, Louisiana, about 60 miles from Shongaloo, he studied at Louisiana Technological University, where one of his courses opened his mind to the idea of pursuing entomology as his life's work. Outside of classes, he worked in the school's dairy and still found time to practice amateur boxing. He transferred to Louisiana State University in 1938, obtaining his bachelor's degree in 1940. While there, he won a Louisiana State University collegiate boxing championship, and his boxing skills earned him considerable reputation and respect from his fellow graduate students when he went on to Cornell University. This training also served him well in the soybean fields: with his powerful wrists, no one could match him in handling the sweep net (Fig. 2).

Newsom's graduate studies at Cornell were interrupted when he joined the U.S. Army Medical Corps in 1942 and served in Europe during World War II. One of the functions of the Corps during the war was the delousing of the troops and control of mosquito vectors of malaria using DDT. (Whether that was his first encounter with DDT for the control of an insect pest could not be ascertained.)

Returning to Cornell in 1946, Newsom completed his Ph.D. in 1947. His graduating class at Cornell was quite remarkable. Among others, it included Ed Smith, later to become department head at Cornell; Floyd Miner, who became head of entomology at the University of Arkansas; Willard Whitcomb, who made a distinguished career in biological control at the University of Florida; and Robert L. Metcalf, perhaps one of the best-known American entomologists of the 20th century.

Newsom's thesis, “The Biology and Economic Importance of the Clover Root Borer, Hylastinus obscucus (Marsham)” focused his early career on the study of the biology and control of forage pests. After graduation, Newsom moved back to Louisiana State University as an assistant professor in cotton entomology. He remained at LSU throughout the rest of a scientific career that spanned for four decades, making significant contributions to the knowledge of the biology of major pests of clover, cotton, rice, sweet potato, pasture, and soybean.

**Overwintering of the Boll Weevil.** One of Newsom's valuable contributions to basic insect biology was his research on boll weevil diapause. With Jim Brazzel and other co-workers, Newsom identified the critical relationship between fat accumulation and survival of diapausing populations. Fat accumulation depended on adult feeding on squares and bolls (Brazzel and Newsom 1959). These findings were later incorporated into the reproduction-diapause system of boll weevil control; in Newsom's own words, “A combination of insecticide application, defoliation, and rapid harvest and stalk destruction is employed to achieve the objective of starving or killing outright the weevils that otherwise would accumulate enough fat to overwinter” (Newsom 1974). This system of reduced insecticide use, coupled with cultural control practices such as early crop maturation and rapid destruction of crop residues, greatly decreased outbreaks of secondary pests such as the bollworm; it also became a component of the pink bollworm IPM program in Texas (Bottrell and Adkisson 1977). The Newsom/Brazzel system remains a highly effective component of boll weevil management programs of most cotton-producing states and was incorporated into the boll weevil eradication program in the Southeast.

**Transitions.** While continuing to spend as much time in field research as possible, Newsom became department head at LSU in 1954. He helped make it one of the prime departments of entomology in the nation. In 1966, he was named Boyd Professor, the University's
highest professorial rank, bestowed for the first time on a faculty member in the College of Agriculture. He stepped down as department head in 1977 and retired in 1984 to live in Magazine, Arkansas, where his wife Alma was born. He remained active in research and was editing a book on soybean IPM when he died on 10 October 1987. That book, a multi-authored volume on the results of the soybean program under the Huffaker Project, was never published.

**The Birth of Soybean Entomology in the U.S.**
Dale Newsom was a gifted naturalist. A field trip or a hunting outing with him was a learning experience about the local fauna and flora (Fig. 3). He was totally dedicated to applying his understanding of nature to solution of insect pest problems in agriculture. Although he contributed extensively to the knowledge of the biology of insects in cotton and a variety of other crops, he is best known for his leadership in pest management of soybean insects.

Soybean acreage in the United States doubled between 1961 and 1974, with the most dramatic increases occurring in the South. Newsom was determined that the relatively new crop would not follow cotton on the pesticide treadmill. He was instrumental in the inclusion of soybean as a subproject of the federally funded, multi-state Huffaker project: *Principles, Strategies, and Tactics of Pest Population Regulation and Control in Major Crop Ecosystems* (Huffaker and Smith 1972). Before this project began in 1970, research on soybean insect pests had received little financial support. Despite some groundbreaking work conducted by Larry Pedigo at Iowa State University on the green cloverworm, and by Sam Turnipseed at the Edisto Station of Clemson University in South Carolina on the Mexican bean beetle, the pest status of most insect species that attacked soybean was poorly understood. In a chapter in *New Technology of Pest Control* (Newsom et al. 1980), Newsom and his coauthors described the unique opportunities offered by soybean farming in the South for the development of effective, economical, and safe pest management systems: no key pests had developed yet; there was little degradation of soybean ecosystems as a result of previous pesticide use; and many soybean growers were experienced cotton producers, acutely aware of the need to avoid the catastrophic results of

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**Chronology of the Evolution of Concepts in Fight Against Pests**

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**Introduction of Practices or Concepts**

1. From initial stages of agriculture to early 1980s
2. Empirical period — introduction of inorganic pesticides
3. Michelbacher (1935)
4. Michelbacher and Bacon (1952)
5. Smith and Allen (1954)
7. Newsom and Brazzel (1968)
The “Meme Pool” of scientific pest control concepts had its origins in early 1880s. It coalesced into the “integrated control” meme in the 1940s.

**1880s**: C. V. Riley and Stephen Forbes laid the scientific foundations for classical biocontrol. There was a need for ecological information in applied entomology.

**1890s**: C. W. Woodworth (a student with Forbes) pioneered UC Berkeley’s first insect ecology courses and introduced “executive control,” precursor of “integrated control.” C. H. T. Townsend and E. A. Schwartz (USDA) were sent to Texas to study the boll weevil; with L. O. Howard’s support, they proposed legislation to establish no-cotton buffer zones to contain spread of the weevil.

**1900s–1920s**: W. D. Hunter, B. R. Coad, W. D. Hinds, and W. D. Pierce expanded work on the boll weevil. They proposed planting early-maturing varieties of cotton; forcing crop to early harvest; and clearing cotton standing in field by end of harvest (sanitation). H. S. Smith and Paul DeBach, his student, working at the Riverside Citrus Experiment Station, represented the California center of excellence in biocontrol. Blair (Bud) Bartlett joined the biocontrol team in 1950, and approached integration from an insecticide angle.

**1930s**: Dwight Isely (Arkansas) advanced a multi-tactical (“integrated”) boll weevil control system. Isely had a strong influence on Dale Newsom’s approach to pest control.

**1940s**: A. E. Michelbacher (Woodworth), UC Berkeley, was among the first to endorse the idea of “supervised control.” R. F. Smith (student of Michelbacher), implemented with K. S. Hagen the first “supervised control” programs in California. C. B. Huffaker (Ph.D., Ohio State University) worked at UC Riverside (1948) and later at UC Berkeley to strengthen insect ecology; R. van den Bosch was his student.

**1950s–1960s**: In the early 1950s, A. E. Michelbacher was the first to use the expression “integrated control.” His students V. W. Stern and K. S. Hagen co-authored with R. F. Smith and R. van den Bosch the seminal paper on “integrated control” (Stern et al. 1959). R. F. Smith embraced the “integrated control” concept and became its spokesperson in the 1960s. P. L. Adkisson and J. C. Gaines (Texas) published an extensive integrated control program for cotton insect pests (Adkisson and Gaines, 1960). J. M. Franz (1961) suggested that similar “integrated control” practices had been used in forest pest control in Europe for over 25 years (an example of a non-U.S. member of the meme pool). In 1968, L. D. Newsom (Louisiana) and J. Brazzel published the first record of the “Integrated Pest Management” expression.

(Bibliography of members of this “meme pool” found in Howard, 1930; Bottrell and Adkisson, 1977; and Kogan, 1998)

excessive use of pesticides. Through the activities of the Huffaker project, research on the crop intensified, making soybean IPM one of the world’s success stories. Newsom can rightfully be considered the father of soybean entomology in the U.S.

It was with the inception of the Huffaker project that I began my association with Dale Newsom, because Illinois was one of six states that collaborated in the soybean sub-component of that project. Like his former students and associates, my own professional career was deeply influenced by Dale Newsom. Our interests and approaches to soybean entomology and IPM converged in many fundamental areas. We believed that integration was the key factor of the IPM equation. While Newsom did not invent the concept of integration in pest control, he was one of its staunchest proponents.

In fact, the concept of integration of tactics into workable pest control systems sprouted from a fertile pool of ideas among plant protection specialists of the latter part of the 19th and early 20th centuries. In my Annual Review of Entomology paper on the history of IPM, much was devoted to the origin and evolution of integrated pest control (Kogan 1998). Fig. 4 summarizes the chronology presented in that paper, adjusted to new findings after its publication.

I suggest that the integrated control concept arose and developed as a “meme” within the community of people connected with the protection of crops against pests. A meme is a postulated unit or element of cultural ideas, symbols, or practices, and is transmitted from one mind to another through writing, speech, gestures, rituals, or other expressions that can be repeated or imitated (which relates to the Greek root of the term). Richard Dawkins (1976) proposed the term as a cultural analogue of genes, in that a meme self-replicates and responds to selective pressures. It was meant as a basis for discussion of evolutionary principles in explaining the spread of ideas and cultural phenomena. Evolution of the integrated control meme led to the emergence of Integrated Pest Management. Fig. 5 maps the personal and intellectual relationships among key participants in the early stages of the “integrated control meme pool.”
Integration: The Key Term of the IPM Equation

Dale Newsom was a promising young agricultural entomologist when DDT was introduced as a miracle drug to control insect pests. Like most entomologists of his generation, he was intrigued with the possibilities of the “new” pest control chemicals. His first paper, co-authored with H. H. Schwartd (his major advisor at Cornell) and L. B. Norton, reported positive results of applications of DDT and BHC on red clover yields. The treated hay was then fed to a cow and the concentrations of DDT in the milk, blood, and urine were measured. Although they found no direct toxic effects to the cow at the DDT levels detected, they stressed that “while a 0.92 ppm is a relatively small DDT content, it should be remembered that butter made from this milk might contain nearly 30 times that figure, or about 26 ppm of DDT” (Schwardt et al. 1947).

As he switched from forage crops to cotton pest control, Newsom soon found out that insecticides also destroyed important natural enemies. He was among the first to point out that destruction of natural enemies in cotton led to outbreaks of secondary pests, most noticeably cotton bollworm, cotton aphid, and spider mites. Meanwhile, misuses of insecticides in commercial food production were pervasive. As late as the mid-1970s, abuse and neglect dominated the use of toxic chemicals in agriculture around the world.

During the first two decades of his research on insects affecting cotton, rice, and sweet potato in Louisiana, Newsom recognized the benefits of pesticide use in increasing yields of food and fiber crops, but he also documented the major problems that resulted from their overuse. In his often-cited papers for the *Annual Review of Entomology* (Newsom 1967) and *The Careless Technology* (1972), Newsom stressed the detrimental impacts of insecticide misuse with considerable emphasis on adverse effects on non-target organisms; e.g., increased fish mortality in rivers and ponds adjacent to treated crop fields, and the environmental pollution attributable to persistent residues of toxic chemicals.

Since the beginning of his professional career, Newsom also demonstrated deep appreciation for the importance of a multidisciplinary approach to pest control. He undertook cooperative research projects with nematologists, agronomists, plant pathologists, and other biologists. Some of his papers in the 1950s and 60s dealt with the interactions of insects, nematodes, and plant diseases, and he persistently stressed consideration of the impact of pest complexes. He championed
the need for coordination among members of the crop production and crop protection disciplines toward development of truly integrated control systems. In his 1979 Founders' Memorial Award Lecture dedicated to Dwight Isely, a pioneer of integration in pest control, Newsom warned:

Despite general acceptance of IPM concepts, too frequently we continue to think as agronomists, ecologists, entomologists, modelers, nematologists, plant breeders, plant pathologists, and weed control specialists. Even worse, we continue to think as either basic or applied scientists in the still more narrowly specialized subdivisions of our respective disciplines. Obviously, we cannot continue to go our separate ways within the confines of narrowly proscribed, artificial disciplinary boundaries if we expect to move up the pest management ladder. What we do in one discipline is too likely to influence the chances of success in another to permit us to continue as in the past (Newsom 1980).

This paper, “The Next Rung up the Integrated Pest Management Ladder,” stressed the need for collaborative research on the impact of pest complexes on crop losses. While producers must cope with the concurrent effect of insect pests, diseases, and weeds on the crop, research provides only information on single pests or, at best, on pests within the same guild. The next rung up the IPM ladder was consideration of these combined, multiple (integrated) pest effects. Inspired by Dwight Isely’s approach to pest control, Newsom used his own early experience with insecticides for cotton to promote development of multi-tactical pest control systems. Advancement of truly integrated pest management systems became a cornerstone of his professional life.

In 1966, a symposium co-sponsored by the Chevron Chemical Company and the National Cotton Council of America was held in Dallas, Texas. The papers presented at the symposium were compiled in Advances in Production and Utilization of Cotton: Principles and Practices (F.C. Elliot, M. Hoover, and W.K. Porter, Jr., eds.) published in 1968. Dale Newsom and Jim Brazzel co-wrote the chapter “Pests and Their Control.” This chapter was probably overlooked by those writing about the history of IPM, including myself, because the title of its last section, “Integrated Pest Management System,” marks the first time (to my knowledge) that the full IPM expression appeared in print. The date of that publication was four years ahead of 1972, which until now was considered the date of the expression’s origin (Kogan 1998).

The runsgs in Newsom’s IPM ladder led me to consider more formally the question of integration as the fundamental, but also the controversial, element in the IPM concept. Entomologists in the 1960s used the expression “integrated control,” introduced by Michelbacher and Bacon in 1952, to mean mainly the compatible use of chemical and biological methods. Later, the integrated control concept was expanded to encompass all relevant tactics: host-plant resistance and physical, cultural, and behavioral controls. Beyond that, Newsom’s second rung called for consideration of all pests (i.e., arthropods, vertebrates, plant pathogens, and weeds) in their interactions as targets for integration under IPM. Finally, at the highest level of integration, pest management systems are conceived as essential components of regional crop production systems.

In a series of papers published since 1988 (Kogan 1988, 1998; Kogan and McGrath 1993; Prokopy and Kogan 2003; Kogan and Hilton 2009), I proposed that IPM with ecology as its theoretical foundation formed the logical nexus for consideration of three basic levels of IPM integration:

Level I – integration of control tactics into management systems for single pests or pest complexes within a category (vertebrate and invertebrate pest animals, plant pathogens, or weeds). Pest populations within single crop fields are the operational unit, and population ecology is the theoretical foundation for level I integration.

Level II – integration into the management system of multiple pests, their interactions, and the tactics for their control. Crop communities are the operational units and community ecology is the theoretical foundation.

Level III – integration of multiple pests and management tactics within the context of the entire regional agricultural production system. The theoretical foundation for level III integration is ecosystem ecology; the operational units are agroecosystems, and beyond those, the ecological region or ecoregion. Ecoregions are defined as a mosaic of agricultural and ecological systems unified by geographical and socio-economic affinities (Omernik 1995, 2004). Fig. 6 depicts the basic elements of the continuum from non-IPM pest control to level III IPM, using elements from a fruit crop IPM system (modified from Prokopy and Kogan 2003 and Kogan and Hilton 2009).

Ron Prokopy and Brian Croft proposed a fourth level of integration: integration of psychological, social, political, and legal constraints to IPM (Prokopy and Croft 1994). These constraints, however, impinge (albeit at different scales of intensity and complexity) upon all three levels of an IPM system’s integration. Similarly, another overarching component is integration of information. Integrated information management has become a powerful IPM tool made possible by the Internet and the World Wide Web. Electronic delivery of IPM information is essential in advanced decision support systems for IPM, and thus provides the criteria for the Y axis in the graph of the IPM continuum (Fig. 6).

Reconciling the multiple meanings of integration remains a challenge. In a letter to the National Academy of Science, Les Ehler and Dale Bottrell (2000) warned that the mere use of multiple tactics does not qualify a program as IPM, and contended that there must be
a clear understanding of the interactions among those tactics within the context of the ecology of the crop and the pests for true integration to be achieved. They concluded that “a…policy that promotes IPM without proper understanding of IPM is doomed to failure.” Commenting on this paper, Ron Prokopy (2000, personal communication) suggested that lack of true integration in most IPM systems, as practiced in the U.S., stems from the nature of modern American agriculture increasingly dominated by large corporate producers. I believe that another major constraint has been the inherent complexity of the research base necessary to advance IPM to higher levels of integration. Close interdisciplinary cooperation in IPM, one of Newsom's repeated pleas, is essential to addressing this constraint.

Integration of Crop Protection Disciplines
The need for disciplinary integration is illustrated with data from one of the last pieces of research conducted in Illinois before I moved to Oregon in 1991 (Kogan et al. 1999). Economic production of most major crops relies on varieties that have been improved through breeding over long periods of time. Undoubtedly, plant breeding is the backbone of modern agriculture. The work of breeders has ushered in significant changes in agriculture, from hybrid corn to the high-yielding wheat and rice varieties of the green revolution. Soybean breeders played a key role in the success of the crop in North and South America. Soybean breeding, however, usually proceeded with a focus on the most obvious limiting production factors. Intent on maximizing yields in breeding lines, breeders often sprayed their nurseries as a matter of routine. In so doing, they eliminated the chance to detect some less obvious limiting production factors (such as susceptibility to herbivores), often losing genes related to soybean natural defenses against those herbivores. Consequently, many current IPM programs must operate with improved cultivars inherently vulnerable to herbivores, except when breeding was specifically targeted to introduce genes for resistance.

To test the hypothesis that anti-herbivory defenses gradually declined in improved cultivars, we used the pedigree of the soybean cultivar 'Williams' (Fig. 7). Fourteen plant introductions, selections, and varieties were identified as ancestral lines of 'Williams.' Those genotypes with seed still available were planted in the field and in the greenhouse and tested for both constitutive and induced resistance. Results suggested a negative correlation between yield potential and resistance level (Fig. 8). Although a definitive answer of the working hypothesis would require further rigorous experimental work, evidence from those preliminary tests was sufficient to reaffirm the need for breeders, entomologists, and plant pathologists to establish a much closer team approach in the development of varieties suitable for higher levels of IPM integration. Multidisciplinary integration at the breeding level is fundamental for IPM development.

Integrity in IPM
In 1988, issue number 5, volume 81 of the Journal of Economic Entomology was dedicated to the memory of Leo Dale Newsom (Eastman et al. 1988). A sizable file of comments and testimonials was compiled from former students, colleagues, and close associates for the lead article in that issue. Reading those testimonials provides a glimpse of the character of a remarkable man. The most frequent qualities described in those testimonials were candor, energy, courage, commitment, knowledge, and (principally) ethics and integrity. I could not think of a better way of remembering Dale Newsom than by stressing his dedication to the principles of integration, and the integrity of his principles.

With strong convictions regarding the application of good science to the practice of pest control, Newsom was a fearless activist for the cause of sound IPM. He decried the practice of recommending the application of pesticides based on plant growth stage or calendar date...
rather than on economic thresholds following careful monitoring of pest populations. His positions on massive programs for the eradication of the boll weevil and the imported fire ant throughout the Southeast often brought him into conflict with powerful groups that considered his work in IPM damaging to their vested interests. Despite threats to his career, Newsom stood by his convictions. Robert van den Bosh (1978) wrote about Newsom in his book *The Pesticide Conspiracy*:

Dale Newsom is a remarkable person: an outstanding scientist, a man of complete honesty who will battle for principle, and a person of warmth and good humor. We have often differed in matters of approach or style, but we are in strong agreement on a number of points regarding the problems of contemporary pest control. Life would be easier if there were more Dale Newsoms in the pest-control field.

In the past 10-15 years, IPM has received considerable criticism. Some critics express genuine concern about how slowly IPM concepts and approaches have been translated into practical implementation. Others attack the validity of IPM on the grounds that its ecological foundation is weak or because pesticides still play a significant role in most IPM programs. The resulting alternative paradigms proposed by some critics, however, only reiterate long-established IPM principles. As with any conceptual meme, IPM continues to suffer occasional mutations in its evolution. However, just as organic evolution eliminates most maladaptive mutations through natural selection, undesirable meme mutations are also eventually eliminated by human selection through logical reasoning and the test of reality.

There have been attempts to use various qualifiers as if doing so created new IPM paradigms without actually bringing anything new to the field. An Academy of Sciences report of 1996 offered "Ecologically Based Pest Management" as one such new paradigm in pest control, but because Woodworth (1908) and Forbes (1915) claimed ecology as the basis for scientific pest control, one cannot call a program IPM if it is not ecologically based. Furthermore, removing the term "integrated" only weakens the concept because it ignores other essential foundations of IPM: sound economics and an understanding of sociological realities. Integration in IPM subsumes these broad ecological and socioeconomic foundations.

Other qualifiers have been proposed, mostly to create interest in promoting new books rather than offering real, innovative constructs in pest control. These usually redundant terms emerge with certain frequency in publishers’ lists of new multi-authored texts on IPM: "bio-rational IPM" (is there IPM that is bio-irrational?); "bio-intensive IPM" (is there a chemoin-intensive IPM?); and "ecological pest management" (again, if it is not ecological, it is not IPM, and the qualifier is redundant). "Integrated" is the key term of the IPM expression. When the term is dropped in common usage, pest management becomes synonymous with old-fashioned pest control. Real progress in IPM will come from greater understanding of ecological processes in agroecosystems, and improvements in control tactics and decision making tools, not through superfluous changes in terminology.

Some critics of IPM decry any use of pesticides as a failure of the system, but let us remember that IPM must operate within an industrial production scale in which mono-crop fields dominate the landscape. Those mono-crops offer an almost unlimited resource for herbivores, thus often denying attempts to restore a natural balance of the herbivore populations. In the case of soybean, its ancestor, *Glycine soja*, is a puny early successional plant still found in disturbed areas in Northern China. The plant can hardly be seen amongst the grasses and other forbs growing along ditch-banks in Manchuria (Figs. 9 and 10). Herbivores have a difficult Fig. 9. Natural habitat of *Glycine soja*, the ancestor of the modern soybean (*Glycine max*). A ditch bank in the northern Chinese province of Heilongjiang. (Photo by the author, 1981.)

Fig. 10. *Glycine soja* growing in the midst of native grasses and other forbs (China, Heilongjiang): a very inconspicuous (non-apparent) food resource for herbivores. (Photo by the author, 1981.)
time finding it too. The soybean ancestor, in its natural environment, is a highly non-apparent resource and the ruderal plants produce few small seeds, just enough to perpetuate the species. However, three thousand years of domestication changed the plant radically. Where soybean is grown in mixed cropping, it becomes more apparent, but as a food resource for herbivores, it is not very concentrated. In a modern industrial production field in the midwestern U.S., however, it is totally apparent and an enormously concentrated food resource—a feast for all sorts of pest herbivores (Fig. 11).

Pest managers are thus challenged to restore natural balance where it has been drastically upset by modern production practices. Human interference will be necessary for as long as production systems are based on the industrial paradigm of an extensive, highly mechanized, mono-crop system, and pesticides will likely remain a necessary tool for that interference. This does not mean that IPM has failed. Where good science and ingenuity are used, IPM leads to remarkable results, even if growers are more readily inclined to adopt pesticide-based control programs for the reasons suggested in Table 1. IPM has already shown gains in systems for crops such as corn, cotton, rice, soybean, and some fruits and vegetables. No doubt IPM can deliver larger gains when the entire production system evolves from...
an industrial, strictly profit-driven paradigm to one that is based on equitable socio-economic realities and on sound ecological principles.

Dale Newsom was a staunch defender of IPM principles, but he was above all a realist and a man dedicated to improving the quality of life for all humans. For him, sustainable food production was the key to improving the quality of life. Although keenly aware of the risks involved in the indiscriminate use of insecticides, Newsom also was convinced that the level of agricultural production needed to feed and clothe an exploding human population could not be sustained without the sensible use of pesticides. He defended the rational use of pesticides, and believed that without them, the needed levels of food production could not be sustained under prevailing farming systems. In a chapter for David Pimentel’s book Insects, Science and Society (Pimentel 1975), Newsom wrote:

Public criticism of insecticides during the last decade (since publication of Rachel Carlson’s Silent Spring in 1962) has been partially responsible for badly eroding research efforts devoted to discovering new and more effective conventional chemical insecticides...The result has been that research on conventional insecticides has continued to decline, in spite of the fact that conventional chemical insecticides are the backbone of insect control and will likely remain the backbone in the foreseeable future. (Newsom 1975).1

This statement is particularly meaningful because it comes from a man who fought for 20 years against vicious attacks by representatives of chemical companies. Newsom’s arguments were reaffirmed 25 years later in a report from a special committee of the National Research Council on the Future Use of Pesticides in U.S. Agriculture (NRC 2000). It is regrettable that critics of IPM focus on the persistent (and at times too prominent) role of pesticides in many IPM programs without crediting IPM for the significant changes that it has brought about at all levels of crop protection.

Enter the GMOs

With the advent of genetically modified crops, we approach the brink of a third strategic inflection point in crop protection. The need for Newsom’s honesty and integrity has never been greater than in the current heated polemic about the role of these crops in IPM. Cotton, potato, corn, and other major crop plants genetically modified to incorporate δ-endotoxin-producing genes of the bacterium Bacillus thuringiensis were heralded by some as the next silver bullet in agricultural pest control. The level and tone of the antagonism to the release of GMOs, however, was as high as the euphoria of their seed industry supporters.

If Dale Newsom were alive today, would he see a place for GMOs in IPM systems? It is questionable whether he would consider GMOs the next silver bullet. Surely, he would have been intrigued by the technology and would have liked to sort out the data. He would have demanded the most rigorous testing. If satisfied by the results of solid field data, he would likely see the role for GMOs as another tactic in the IPM arsenal that, if used wisely, should open potentially useful strategic options. He would remind us, yet again, that integration is the key term of the IPM equation. If GMOs are carefully integrated within IPM systems, taking into account resistance management prescriptions, interactions with other control tactics, and rigorous monitoring of undesirable side effects, all within the context of ecosystem integrity, I believe he would have been reservedly supportive of the adoption of GMOs in IPM systems.

Newsom: The Conscience of the Profession

Dale Newsom is best remembered by his fortunate students, coworkers, or friends as a considerate, ethical, and fair human being who had immense personal integrity and indomitable courage. He led by example, being the first to rush to the field with the sweep net and the last one to leave. He was forthright and honest, and based his opinions on what he believed was right without regard for how his views would be assessed by others. Newsom was never afraid to take an unpopular stand, but he would not make uninformed challenges of the positions of others. Armed with data, he was a relentless adversary. To him, loyalty to one’s profession carried with it the responsibility to question objectively that profession’s conventional wisdom.

Newsom made outstanding contributions to the field of entomology in teaching, research, extension, and administration. However, in the words of Ed Smith, “his greatest contribution did not fit neatly in any of these categories. It was as the conscience of the discipline that his vision, wisdom, and courage towered above his contemporaries and had greatest impact.”

In his own Founders’ Memorial Lecture, Leo Dale Newsom included this prophetic quote:

It appears that the time has come seriously to consider development of pest management as a discipline for training the personnel required to work effectively in the broadly interdisciplinary area of integrated pest management. I recommend taking this drastic approach for your serious consideration. Who knows? He who is so bold and aggressive as to initiate such an approach may be honored at some future meeting of our Society as we have honored the father of integrated insect control, Professor Dwight Isely, today (Newsom 1980).

Dale Newsom boldly and aggressively initiated this drastic approach and, 20 years later, he was thus honored.

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1 Since that time, the chemical industry has generated a steady stream of new insecticides, some with novel modes of action. Many are moderately compatible with biological control and, if used rationally, will continue to have a place in IPM systems.
years of Dale Newsom; and Stephen Griggs, of Seattle, WA, for helping make the paper more readable.

References Cited


van den Bosch, R. 1978. The pesticide conspiracy. Doubleday, Garden City, NY.


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