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URBAN PEST CONTROL ANNOTATED BIBLIOGRAPHY:

III - PEST ANTS

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FOREWORD

This compilation presents current publications pertaining to urban pest control of ants.

Control papers are a decided minority in this list because of changing regulations and labeling restrictions. Review papers are cited where possible, and papers which summarize new methods or materials are cited in preference to obsolete publications. Control personnel must check with the appropriate authorities to stay abreast of changing regulations and labeling restrictions. Correct identification is crucial in the choice of control methods in pest management; specimens should always be collected (in alcohol) and forwarded to identification specialists for confirmation.

Papers and books summarizing the biology, ecology, medical and economic importance, identification, or control of ants are listed under the following categories, which are not mutually exclusive:

Reference Texts	p. 1
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Be sure to examine texts, monographs, and reviews for appropriate information in addition to consulting citations arranged by taxonomic group.

REFERENCE TEXTS

- Bennett, G.W. & J.M. Owens [eds.]. 1986. *Advances in Urban Pest Control*. Van Nostrand Reinhold Co., New York.
- Bennett, G.W., J.M. Owens & R.M. Corrigan. 1988. *Truman's Scientific Guide to Pest Control Operations*, 4th Edition. Edgell Communications, Duluth.
- Campbell, S.H.B. 1991. Ants: Formicidae, Hymenoptera, pp. 207-215. *In* J.R. Gorham [ed.], *Ecology and Management of Food-Industry Pests*. Food and Drug Administration, Technical Bulletin 4.
- Ebeling, W. 1978. *Urban Entomology*. Division of Agricultural Sciences, University of California, Berkeley.
- Haack, K.D. & T.A. Granovsky. 1990. Ants, pp. 415-479. *In* K. Story [ed.], *Mallis Handbook of Pest Control* [7th ed.]. Franzak & Foster Co., Cleveland.
- Hedges, S.A. No Date (1992). *Field guide for the management of structure-infesting ants*. Pest Control Technology series, Franzak & Foster Co., Cleveland.

Olkowski, W., S. Darr & O. Olkowski. 1991. Common-sense pest control. The Taunton Press, Newton, CT.

GENERAL REFERENCES - MONOGRAPHS and REVIEWS

Brian, M.V. 1983. Social Insects: Ecology and Behavioural Biology. Chapman and Hall Ltd., London.

General reference covering many aspects of biology, behavior, and ecology of all social insects. Information on pest species is integrated into the detailed discussions of each topic.

Creighton, W.S. 1950. The Ants of North America. Bulletin of Museum Comparative Zoology 104: 1-585, plates 1-57.

Contains keys to the subfamilies of ants and the genera in North America. Each genus (illustrated) has a key to species along with summarized description, distribution, and biology. Only reference to all North American species (but must be modified with revisions detailed in Smith's 1979 catalog and more recent revisions).

Hölldobler, B. & E.O. Wilson. 1990. The Ants. Belknap Press, Cambridge, MA.

The single most important major review through 1989 of all aspects of ant biology, behavior, and ecology. Major discussion of ant taxonomy, including key to subfamilies and keys to all genera of ants by zoogeographic region. Every genus is illustrated with a habitus drawing. Information on pest species is integrated into the detailed discussions of each topic.

Schmidt, J.O. 1986. Chemistry, pharmacology, and chemical ecology of ant venoms, pp. 425-508. *In* T. Piek [ed.], Venoms of the Hymenoptera. Biochemical, Pharmacological, and Behavioural Aspects. Academic Press, London.

Review of the biochemistry of ant venoms covers all aspects including effects on vertebrates and allergies in man.

Smith, D.R. 1979. Family Formicidae, pp. 1323-1467. *In* K.V. Krombein, P.D. Hurd, Jr., D.R. Smith, B.D. Burks [eds.], Catalog of Hymenoptera in America North of Mexico, Vol. 2. Smithsonian Institution Press, Washington, DC.

Catalog of all species present in North America through mid-1975; a brief synopsis of the literature on each species is given. Important starting point for information on each species.

Sudd, J.H. & N.R. Franks. 1987. The Behavioural Ecology of Ants. Tertiary Level Biology, Blackie, Glasgow, U.K.

General reference covering many aspects of biology, behavior, and ecology of ants. Information on pest species is integrated into the detailed discussions of each topic.

Vander Meer, R.K., K. Jaffe & A. Cedeno [eds.]. 1990. Applied Myrmecology, a World Perspective. Westview Press, Boulder, CO.

Collection of 67 (mostly) review papers through 1988-89, divided into 7 sections, including ant pests of the world, applied ecology, and control. Weighted heavily to fire ants and leaf-cutter ants but includes papers on most urban pest ants.

Wheeler, W.M. 1910. Ants, Their Structure, Development, and Behavior. Columbia University Press, New York.

Classic work (some outdated taxonomy) covering all aspects of the systematics, morphology, biology, behavior, and ecology of ants. Information on pest species is integrated into the detailed discussions of each topic.

Wilson, E.O. 1971. *The Insect Societies*. Belknap Press, Cambridge, MA.

Review (through 1970) covering all aspects of systematics, morphology, biology, behavior, and ecology of ants and other social insects. Information on pest species is integrated into the detailed discussions of each topic.

GENERAL REFERENCES - CURRENT LITERATURE

Akre, R.D. & A. Antonelli. 1987. Identification and habits of key ant pests of Washington. Washington State University Cooperative Extension Bulletin EB0671 (revised): 8 pp.

Keys and illustrations for the identification of workers of the major pest ants, with summaries of their biology and development.

Akre, R.D. & A. Antonelli. 1987. Common ant pests of Washington: identification of reproductive forms (winged). Washington State University, Cooperative Extension Bulletin EB1400: 6 pp.

Keys and illustrations for the separation of ants from termites and for the major genera of pest ants.

Ayre, G.L. 1977. Exotic ants in Winnipeg. *Manitoba Entomologist* 11: 41-44.

Nine species of ants were found in Winnipeg, Manitoba, Canada. The infestation and biology of each species is briefly discussed. Insecticides could not be used in the zoo building.

Bieman, D. & L. Bloomcamp. 1987. Ant key for over-the-phone identification. *Pest Management* 6(11): 25, 27.

Simple, over-the-phone key with characters that laymen can use. Major Gainesville, Fl, house-infesting species found in 1985-86 listed.

Bieman, D.N. & D.P. Wojcik. 1990. Tracking ants in Florida: The results of a Florida ant survey and a key to common structure-invading ants. *PCO, FPCA Service Magazine* (April): 11-13.

Species collected inside structures in Broward Co., Florida. Key and illustrations given for the common structure-invading ants collected.

Cokendolpher, J.C. & O.F. Francke. 1990. The ants (Hymenoptera: Formicidae) of western Texas. Part II. Subfamilies Ecitoninae, Ponerinae, Pseudomyrmecinae, Dolichoderinae, and Formicinae. *Special Publications, Museum of Texas Tech University* 30: 76 pp.

Contains keys to the subfamilies of ants and the genera in the included subfamilies, along with records of ant collections from western Texas.

Cokendolpher, J.C. 1990. The ants (Hymenoptera: Formicidae) of western Texas. Part III. Additions and corrections. *Special Publications, Museum of Texas Tech University* 31: 19 pp.

Contains a revised key to the genera of Myrmicinae, along with new and corrected records of ant collections from western Texas.

Deyrup, M., C. Johnson, G.C. Wheeler & J. Wheeler. 1989. A preliminary list of the ants of Florida. *Florida Entomologist* 72: 91-101.

Distribution by county is given for all ant species recorded from Florida.

Haack, K. & T. Granovsky. 1991. Food and feeding habits of ants. *Pest Control Technology* 19(5): 74

Many of the groups of ants are sugar eating species. Ants in adult state do not eat solid food but lick, suck or crush the solid food and lap up the resultant liquids. They can store liquid in their crops and can at times regurgitate it and feed fellow ants. Thus a liquid containing a slow-acting poison can be conveyed to other ant members of the colony.

Haney, P. 1987. A key to the most common and/or economically important ants of California with color photographs. University of California, Cooperative Extension Service Leaflet 21433: 4 pp.

Illustrated key to the most common and/or economically important ants in California, with biological summaries.

Hedges, S. 1991. Management of ant infestations. *Pest Control Technology* 19(5): 70-73.

Main reason for poor ant control usually is lack of knowledge of identification, biology and habits. Successful control depends on correct identification, thorough inspection, treating colonies and not the foragers, correcting conducive conditions which might invite infestations later, and knowledge of possible ant colony locations.

Hedges, S. 1991. Management of ant infestations, Part II. *Pest Control Technology* 19(6): 40-43.

Case-histories of infestations of ghost, pavement, pharaoh, carpenter, and fire ants are given to illustrate flexibility required in detection of infestations, nest sites, and approaches to control. Successful control involves identification, thorough inspections, baiting for location of nest sites, and follow-up inspections in severe infestations.

Knight, R.L. & M.K. Rust. 1990. The urban ants of California with distribution notes of imported species. *Southwestern Entomologist* 15(2): 167-178.

Collections of urban ants and information from PCOs were used to define the pest species and their distribution from 4 regions in California. The most common urban pest ants over all regions were: Argentine ant (25.9%); southern fire ant (19.3%); odorous house ant (11.1%); carpenter ants (9.5%); pharaoh ant (4.9%). The remaining 19 ant taxa accounted for less than 30% of the total ants. The pest status and structural occurrence of the major species are discussed by region along with brief summaries of the control measures used.

MacKay, W.P. & S.B. Vinson. 1989. A guide to the species identification of the New World ants (Hymenoptera: Formicidae). *Sociobiology* 16: 3-47.

Annotated list through 1988 giving general references on ant identification and general distribution of all New World genera with pertinent references for species identification.

Moody, J.V. & O.F. Francke. 1982. The ants (Hymenoptera, Formicidae) of western Texas. Part 1: Subfamily Myrmicinae. *Graduate Studies, Texas Tech University* 27: 80 pp.

Keys to the subfamilies of ants and the genera of Myrmicinae, along with records of ant collections from western Texas.

Ross, H.H., G.L. Rotramel & W.E. Laberge. 1971. A synopsis of common and economic Illinois ants, with keys to the genera (Hymenoptera: Formicidae). *Illinois Natural History Survey, Biological Notes* 71: 22 pp.

Keys and illustrations to subfamilies and genera for workers, queens, and males found in Illinois. Includes a brief synopsis of each genus, with summaries of the biology and pest status.

Rotramel, G. 1990. Proper ant identification enhances control measures. *Pest Control Technology* 18(5): 36, 38-40, 44.

Discusses ant anatomy as used in identification. Illustrated generalized keys to the common genera of ants in the U.S. are workable, but use some obsolete nomenclature. Summary of control methods misleading and incorrect for several species.

Shattuck, S.O. 1985. Illustrated key to ants associated with western spruce budworm. *USDA, Agriculture Handbook 632*: 36 pp.

Keys and illustrations for field and laboratory use in identifying ants in mountainous western North America, particularly carpenter ants. Includes glossary and brief biology summary for the included species.

Smith, M.R. 1965. House-infesting ants of the eastern United States. *USDA, Technical Bulletin 1326*: 105 pp.

Keys to the subfamilies and species of ants considered major pests in eastern United States with a synopsis of the taxonomic characters, illustrations, biology, and economic importance of each species; includes glossary. Dated but very useful for identifications.

Thompson, C.R. 1990. Ants that have pest status in the United States, pp. 51-67. *In* R.K. Vander Meer, K. Jaffe, A. Cedeno [eds.], *Applied Myrmecology, a World Perspective*. Westview Press, Boulder, CO.

The pest status of the 16 ant genera with pest species in North America is reviewed through 1988, with brief synopses of their biology.

Walter, V. 1990. Ant problems creates more considerations. *Pest Control* 58(5): 74.

Insect growth regulators, used in bait formulations, do not affect the behavior of adult ants. Affected ants are not more likely to be found in the treated area.

Wilson, E.O. & R.W. Taylor. 1967. The ants of Polynesia (Hymenoptera: Formicidae). *Pacific Insects Monograph 14*: 1-109.

Includes keys and illustrations to subfamilies and species of ants found in Polynesia, including Hawaii, with distribution and brief ecological information. Useful in identifying exotics which may be introduced into the continental United States.

ARGENTINE ANT

Anonymous. 1986. Defeating those ant problems. *Pest Control* 54(9): 38, 40.

Recommends microencapsulated diazinon as a barrier treatment to prevent Argentine ants from invading residences. Treat outdoors and indoors.

Anonymous. 1991. The Argentine ant: new findings. *Pest Control* 59(6): 60, 62.

Contains comments on surveys for Argentine ants, control approaches, factors affecting Tempo and chlorpyrifos residual barrier treatments, and summary of biology.

Baker, T.C., S.E. Van Vorhis Key & L.K. Gaston. 1985. Bait-preference tests for the Argentine ant (Hymenoptera: Formicidae). *Journal of Economic Entomology* 78: 1083-1088.

In laboratory and field tests Argentine ants fed preferentially on 25% honey-water or sucrose-water. Sucrose-water containing Avermectin controlled laboratory colonies.

Grace, J.K., D.L. Wood & B.W. Grunbaum. 1986. Effect of Argentine ant contamination on ABO blood typing of human saliva samples. *Bulletin of the Entomological Society of America* 32: 147-149.

Argentine ants were involved in spurious results in forensic tests at a crime scene.

Knight, R.L. & M.K. Rust. 1990. Repellency and efficacy of insecticides against foraging workers in laboratory colonies of Argentine ants (Hymenoptera: Formicidae). *Journal of Economic Entomology* 83: 1402-1408.

Laboratory studies were used to evaluate 25 insecticides (carbamates, inorganics, organochlorines, organophosphates, natural pyrethrins, and pyrethroids) as potential barrier treatments. General repellency of formulations was ranked as granular < emulsifiable concentrate < dust < wettable powder. Mortality increased as the repellency increased.

Knight, R.L. & M.K. Rust. 1991. Efficacy of formulated baits for control of Argentine ant (Hymenoptera: Formicidae). *Journal of Economic Entomology* 84(2): 510-514.

Testing demonstrated the importance of delayed toxicity combined with a highly attractive and acceptable food attractant. Argentine ants fed predominately on sweets. Hydramethylnon formulated on granulated silkworm pupae provided faster control than granular diazinon.

Moreno, D.S., P.B. Haney & R.F. Luck. 1987. Chlorpyrifos and Diazinon as barriers to Argentine ant (Hymenoptera: Formicidae) foraging on citrus trees. *Journal of Economic Entomology* 80: 208-214.

Demonstrated effectiveness of chlorpyrifos EC and granular diazinon as barrier treatments against the Argentine ant.

Rust, M.K., & R.L. Knight. 1990. Controlling Argentine ants in urban situations, pp. 663-670. *In* R.K. Vander Meer, K. Jaffe, A. Cedeno [eds.], *Applied Myrmecology, a World Perspective*. Westview Press, Boulder, CO.

Review through 1989 of the insecticides used as barrier treatments and baits to control Argentine ants.

Ward, P.S. 1987. Distribution of the introduced Argentine ant (*Iridomyrmex humilis*) in natural habitats of the lower Sacramento Valley and its effects on the indigenous ant fauna. *Hilgardia* 55(2): 1-16.

Habitats invaded by Argentine ants have permanent water sources, tend to be environmentally disturbed, and show displacement of native species.

CARPENTER ANTS

Akre, R.D., & L.D. Hansen. 1990. Management of carpenter ants, pp. 693-700. *In* R.K. Vander Meer, K. Jaffe, A. Cedeno [eds.], *Applied Myrmecology, a World Perspective*. Westview Press, Boulder, CO.

Review through 1989 of carpenter ant species involved, description of damage, concerns with new construction, preventive maintenance, physical control, chemical control, and control with baits.

Akre, R.D., L.D. Hansen & A. Antonelli. 1991. Carpenter ants, their biology and control. *Washington State University, Cooperative Extension Bulletin EB0818 (revised)*: 6 pp.

Discusses biology, structural damage, identification (illustrated), cultural control and chemical control of carpenter ants in Washington.

Anonymous. 1983. Carpenter ants. Agriculture Canada, Insect Identification Sheet 92: 2 pp.

Brief summaries on the biology, damage, and control of *Camponotus herculeanus* infesting timbers and structures in Canada.

Berns, B. 1989. Properly pricing carpenter ant jobs. Pest Control Technology 17(5): 34, 36, 40.

Discusses the proper method of approaching the pricing of carpenter ant work. The size, location and time for treatment are very important factors.

Cannon, C.A. & R.D. Fell. 1990. Understanding the overwintering carpenter ant nest. Pest Management 9(2): 12-16.

Carpenter ants were studied in relation to the overwintering strategy they used. Relationships between colony size, production of sexuals, overwintering, and homeowner complaints are discussed.

Ehmann, N. 1988. Carpenter ants require careful detection. Pest Control 56(4): 16.

Control of carpenter ants in a structure can be a complicated problem, depending on the level of the infestation and the location of the nest. The ants follow trails which can often be followed to reveal the location of the nest. The entire house and surrounding area must be considered in an evaluation and treatment.

Fowler, H.G. 1990. Carpenter ants (*Camponotus* spp.): pest status and human perception, pp. 525-532. In R.K. Vander Meer, K. Jaffe, A. Cedeno [eds.], Applied Myrmecology, a World Perspective. Westview Press, Boulder, CO.

Review through 1989 of the human perception of the pest status, importance, and costs related to carpenter ant infestations. The number of requests for information or control correlates with mating flights of the ants.

Frishman, A.M. 1991. Before doing carpenter ant control: 15 questions. Pest Control 59(3): 22-23.

Details the questions a PCO should ask before a treatment can be started including: collection of specimens, presence of alates, location of ant trails and sawdust, water leaks or damage, utility egress into the structure, and past history of treatments and health problems.

Gibson, R.L. & J.G. Scout. 1989. Comparative toxicity of fourteen insecticides to two species of carpenter ants (Hymenoptera: Formicidae). Journal of Economic Entomology 82: 1121-1124.

Deltamethrin and diazinon were the most toxic of the 14 insecticides (3 carbamates, 7 organophosphates, 4 pyrethroids) tested with a residual bioassay against 2 carpenter ants, *Camponotus pennsylvanicus* and *C. novaeboracensis*.

Hansen, L.D. & R.D. Akre. 1985. Biology of carpenter ants in Washington State (Hymenoptera: Formicidae: *Camponotus*). Melanderia 43: 1-62.

Key and illustrations to *Camponotus* spp. found in the Pacific Northwest, with discussions on identification of carpenter ants attacking structures, nature of infestations, life history studies, nesting sites, and management of infestations.

Hansen, L.D., & R.D. Akre. 1990. Biology of carpenter ants, pp. 274-280. In R.K. Vander Meer, K. Jaffe, A. Cedeno [eds.], Applied Myrmecology, a World Perspective. Westview Press, Boulder, CO.

Review of the biology of *Camponotus* spp. (misspelled in text as *Componotus*) including mating flights, initiation of new colonies, established colonies, trails, foraging, and nesting sites.

Hedges, S. 1990. Carpenter ants: a case history. *Pest Control Technology* 18(3): 26-31.

The proper strategy for finding and eliminating a carpenter ant infestation is discussed based on a fictional client encounter. The questioning of the client, inspection of the house, noting sawdust, listening for ants in voids, and control measures taken are detailed.

Klotz, J.H. & R.D. Akre. 1991. Carpenter ants - fact or fiction. *Pest Control* 59(6): 54-56.

Importance can vary from severe damage to nuisance pest. Misconceptions about the damage, distribution, nesting habits, modes of entry into buildings, and control approaches are discussed for two northern species, *Camponotus pennsylvanicus*, and *C. modoc*.

National Pest Control Association. 1988. Carpenter ants. ESPC 052101A: 11pp.

Nickerson, J.C. & D.L. Harris. 1985. The Florida carpenter ant, *Camponotus abdominalis floridanus* (Buckley) (Hymenoptera: Formicidae). Florida Department of Agriculture and Consumer Services, Division of Plant Industry, Entomology Circular 269: 2 pp.

History, distribution, identification, biology, pest status, and control of the Florida carpenter ant, *Camponotus floridanus*.

Nor-Am Chemical Company. 1985. Carpenter ants. Pest Management Report 2: 8 pp.

Discusses ant biology, habits, nest locations, and economic importance. Lists areas for ant inspections, and mentions non-chemical as well as chemical measures for control and prevention.

Pinto, L. 1987. Controlling carpenter ants requires a war plan. *Pest Control* 55(7): 44, 73.

Emphasizes the importance of nest location and destruction of the colony to achieve successful carpenter ant control.

Pinto, L. 1990. Managing those difficult carpenter ant jobs. *Pest Control* 58(4): 70, 72.

Discusses the problems in controlling carpenter ants. Talking to the client is often very helpful in zeroing in on the nest and night inspection may be required. Check for wet spots as the ants prefer wood of 20% or more moisture content. Remove all vegetation contacting the house.

Robinson, W.H. 1989. Carpenter ants. Publication Virginia Cooperative Extension Service 425 (revised): 2 pp.

Briefly reviews biology, pest status, and control of carpenter ants, *Camponotus* spp. in Virginia.

Story, K. 1988. U.S. carpenter ant business is booming. *Pest Control Technology* 16(7): 54, 56, 60.

Carpenter ants dominate the NW market. Background and economic importance of these ants are discussed. Also mentioned are the habits, signs, the descriptions of the carpenter ants of the U.S., treatment strategies and pricing, likely places for location of infestation, and non-chemical measures for discouraging carpenter ants.

Tucker, J. 1991. Carpenter ants....a profile. *Whitire Pest Management Quarterly* 10(3): 8-9.

Summarizes the biology, and control of carpenter ants. Details control chemicals suitable for use in different situations and appropriate cultural controls.

FIRE ANTS

Anonymous. 1992. Treating fire ants in mounds. *Florida Grower and Rancher* 85(1): 46-47.

Reviews plant damage caused by fire ants. Fire ants controlled with Cessco injectable dursban.

Banks, W.A. 1990. Will multiple-queen fire ants mean more problems for Florida growers? *Citrus Industry* 71(6): 58-59.

Problems associated with multiple-queen red imported fire ants include easier dispersal by man, higher ant and mound density, greater economic damage, and difficulties in control.

Banks, W.A. 1990. Chemical control of the imported fire ants, pp. 596-603. *In* R.K. Vander Meer, K. Jaffe, A. Cedeno [eds.], *Applied Myrmecology, a World Perspective*. Westview Press, Boulder, CO.

Review through 1989 of the chemicals available for control of fire ants with baits or contact insecticides.

Banks, W.A., C.T. Adams & C.S. Lofgren. 1990. Damage to North Carolina and Florida highways by red imported fire ants (Hymenoptera: Formicidae). *Florida Entomologist* 73: 198-199.

Several instances are described where tunneling by red imported fire ants, *Solenopsis invicta*, caused pavement collapse. The ants also damaged the sealants between highway slabs.

Berger, J. & J.B. Tucker. 1990. Fire ants - the southern menace and controlling the beast. *Whitmire Pest Management Quarterly* 9(3): 8-10.

Discusses in detail fire ants, how they spread, life cycles, the mound, multiple queens, control approaches, the sting, damage, interior treatment, exterior treatment, baiting, and new ant control chemicals, especially abamectin, a sterilant/toxicant.

Bhatkar, A.P. & R.E. Gold. 1991. A mound of problems. *Pest Management* 10(5): 17-19.

Distribution appears restricted by annual minimum temperature 0-10°F. Multiple queen fire ants are spread easily by man and are rapidly becoming an urban problem. Fire ants can be very destructive inside structures and to electrical equipment. Difficulties of interior and exterior control discussed.

Carlton, C.E. 1987. Identification of Arkansas fire ant (Hymenoptera: Formicidae: *Solenopsis* spp.) workers. *Arkansas Agricultural Experimental Station Report Series* 301: 8 pp.

Key and illustrations for separation of fire ants from other ants and the identification of the fire ant species found in Arkansas. *Solenopsis richteri* is not found in Arkansas but is included in the key.

deShazo, R.D., B.T. Butcher & W.A. Banks. 1990. Reactions to the stings of the imported fire ant. *New England Journal of Medicine* 323: 462-466.

Review (through 1989) of the medical effects of imported fire ant stings, including death, anaphylaxis, and treatment of allergic reactions. Brief summaries of biology and control are included.

Diffie, S., R.K. Vander Meer & M.H. Bass. 1988. Discovery of hybrid fire ant populations in Georgia and Alabama. *Journal of Entomological Science* 23: 187-191.

Hybrids of red imported fire ants and black imported fire ants were found in Georgia, Alabama and Mississippi. Potential problems with quarantine and control are mentioned.

Drees, B.M., & S.B. Vinson. 1990. Comparison of the control of monogynous and polygynous forms of the red imported fire ant (Hymenoptera: Formicidae) with a chlorpyrifos mound drench. *Journal of Entomological Science* 25: 317-324.

Single (monogynous) and multiple (polygynous) queen mounds of red imported fire ants were treated by dursban drenches according to label directions. Both kinds of fire ant mounds were killed by the dursban, but areas with multiple queens returned quicker. More insecticide and labor was required to treat multiple queen areas because of much higher mound density.

Drees, B.M., & S.B. Vinson. 1991. Fire ants and their management. Texas Agricultural Extension Service Bulletin B-1526 (revised): 20 pp.

Reviews identification, biology, medical problems, and management of fire ants. Management options are summarized for various situations including lawns, ornamental turf, homes, structures, electrical equipment, and utility housings. Control techniques and application methods are detailed. All toxicants registered for ant and fire ant control are listed by chemical name, product name, toxicity, availability, formulation, and usage pattern.

Hedges, S. 1987. Imported fire ant: nemesis of the South. *Pest Control Technology* 15(5): 58-60, 84, 88, 90.

Discusses the distribution and spread of the fire ant, habits and nesting habits, mound description, medical importance, and treatments.

Jouvenaz, D.P., C.S. Lofgren & R.W. Miller. 1990. Steinernematid nematode drenches for control of fire ants, *Solenopsis invicta*, in Florida. *Florida Entomologist* 73: 190-193.

The nematode used gave some control of red imported fire ant colonies when compared to Amdro bait in field tests. Discussion includes problems encountered in the tests and suggestions for overcoming these problems.

Lemke, L.A. & J.B. Kissam. 1989. Public attitudes on red imported fire ant (Hymenoptera: Formicidae) infestations in homes and recreational areas. *Journal of Entomological Science* 24: 446-453.

Significant percentages of homeowners felt they had a fire ant problem and applied control measures. Fire ant complaints were important to PCOs.

MacKay, W.P., S.B. Vinson, J. Irving, S. Majdi, C. Messer. 1991. Control of the red imported fire ant, *Solenopsis invicta*, in traffic signal control cabinets (Hymenoptera: Formicidae). *Sociobiology* 19: 309-322.

Red imported fire ant damage to electrical traffic control equipment was prevented by sealing the relays and switches or treating with chlorpyrifos.

National Pest Control Association. 1987. Fire ants. ESPC 032154: 6 pp.

Discusses the different species, their habits and life cycles, colony development, identification, history, distribution, and first aid and control measures. Good references.

Thorvilson, H.G., S.A. Phillips, Jr. & A.A. Sorensen. 1989. An innovative thermofumigation technique for control of red imported fire ants (Hymenoptera: Formicidae). *Journal of Agricultural Entomology* 6: 31-36.

Control of 49 of 50 red imported fire ant mounds in 4 weeks was achieved with a subsurface, thermofumigation system delivering 1.0% resmethrin in a light petroleum oil vapor into individual mounds at ca. 427°C.

Thorvilson, H.G., S.A. Phillips, Jr., A.A. Sorensen & M.R. Trostle. 1987. The straw itch mite, *Pyemotes tritici* (Acari: Pyemotidae), as a biological control agent of red imported fire ants, *Solenopsis invicta* (Hymenoptera: Formicidae). Florida Entomologist 70: 439-444.

In field tests, the straw itch mite was not found to be an effective method for control of red imported fire ants. In addition, several researchers experienced severe dermatitis from the mites.

Trager, J.C. 1991. A revision of the fire ants, *Solenopsis geminata* group (Hymenoptera: Formicidae: Myrmicinae). Journal of the New York Entomological Society 99: 141-198.

Taxonomic revision of fire ants with key, figures, and biology summary for all species. North American species include *Solenopsis geminata* the native fire ant, *S. xyloni* the southern fire ant, *S. aurea* the desert fire ant, *S. amblychila*, *S. invicta* the red imported fire ant, *S. richteri* the black imported fire ant, and hybrids of the red and black imported fire ants.

Vinson, S.B. 1990. Fire ants in the urban environment. Proceedings of the National Conference on Urban Entomology: 77-87.

Review (through 1989) on the medical and economic problems caused by fire ants in urban environments.

Wojcik, D.P. 1986. Bibliography of imported fire ants and their control: Second Supplement. Florida Entomologist 69: 394-415.

Bibliography of imported fire ants and their control through October 1985, containing 373 references, including earlier bibliographies.

PHARAOH ANT

Anonymous. 1990. Persistent pharaoh ants take the bait. Pest Control 58(9): 52-53.

Significant control of the pharaoh ant in a hospital was achieved with boric acid in peanut butter injected into straws after spraying had proved ineffective.

Antonelli, A.L., & R.D. Akre. 1990. Pharaoh ant. Washington State University, Cooperative Extension Bulletin EB1514 (revised): 4 pp.

Summary of biology, identification, and control. Baits (methoprene = Pharoid and hydramethylnon = Maxforce pharaoh ant killer) should be applied before a spraying program is conducted.

Bolton, B. 1987. A review of the *Solenopsis* genus-group and revision of afrotropical *Monomorium* Mayr (Hymenoptera: Formicidae). Bulletin of the British Museum (Natural History) 54: 263-452.

Key and illustrations to included genera, *Monomorium* revision with keys and illustrations. Synonymies, biology and distribution are given for *Monomorium destructor*, *Monomorium floricola*, and *Monomorium pharaonis*.

Edwards, J.P. & L. Abraham. 1990. Changes in food selection by workers of the pharaoh's ant *Monomorium pharaonis*. Medical Veterinary Entomology 4: 205-212.

Foraging pharaoh ant workers switched from protein or carbohydrate foods after periods of exclusive feeding on a food source, alternating their feeding as necessary to meet the food requirements of the colony. This switching of food sources would explain some failures of food-baiting treatments and has clear implications in treatment programs for the control of this ant.

Edwards, J.P. & J.P. Short. 1990. Pharaoh's ant - an overview. Proceedings of the National Conference on Urban Entomology: 11-16.

Review through 1989 on the economic importance, biology, ecology, and control of pharaoh ant, *Monomorium pharaonis*.

Eichler, W. 1990. Health aspects and control of *Monomorium pharaonis*, pp. 671-675. In R.K. Vander Meer, K. Jaffe, A. Cedeno [eds.], Applied Myrmecology, a World Perspective. Westview Press, Boulder, CO.

Review through 1989 on the medical importance and control of the pharaoh ant, *Monomorium pharaonis*.

Haack, K.D. 1991. Elimination of pharaoh ants. Pest Control Technology 19(12): 32-33, 36, 38, 42.

Pro-control (sulfluramid) and Maxforce pharaoh ant killer (hydamethylnon) were used in field tests against the pharaoh ant. By 7 days, 90% control was achieved, with almost total control reached by 90 days posttreatment. Extensive monitoring indoors and outdoors revealed the presence of large populations outdoors. Migration of these outdoor populations and populations from untreated structures could result in reinfestation.

Mampe, C.D. 1990. Source of pharaoh ants might be neighbors. Pest Control 58(11): 12.

Pharaoh ants are primarily an indoor pest of structures, but PCOs should be aware that this ant may be found outdoors in the summer and may live outdoors year round in the sunbelt.

National Pest Control Association. 1986. Pharaoh ants. ESPC 032155: 6 pp.

Economic importance; description; habits; colony development; control strategy - pre-baiting, surveys, bait stations and placements; non-chemical control; and contract policy; many good references.

Newton, J. & D.S. Coombes. 1987. A comparison of a range of novel and conventional insecticides for Pharaoh's ant control. International Pest Control 29: 45-47.

In laboratory tests, amdro, avermectin, and boric acid were the most effective against the pharaoh ant.

Nickerson, J.C. & D.L. Harris. 1983. The pharaoh ant, *Monomorium pharaonis* (Linnaeus) (Hymenoptera: Formicidae). Florida Department of Agriculture & Consumer Services, Division of Plant Industry, Entomology Circular 256: 2 pp.

Reviews history, distribution, identification, biology, pest status, and control of the pharaoh ant.

Sheer, H. 1989. Know your enemy. Pest Control 57(6): 52, 56.

Proper identification, planning, and baiting controlled the pharaoh ant in a very large building.

Tucker, J. 1991. Feeding pharaoh ants. Pest Control Technology 19(6): 96, 102.

Where ants have only one food type, another type of food bait may be readily accepted. Always have an alternate bait available for their control. Carbohydrates and proteins are preferred food components, but these ants will also feed on dead insects and feces.

Williams, D.F. 1990. Effects of fenoxycarb baits on laboratory colonies of the pharaoh's ant, *Monomorium pharaonis*, pp. 676-683. In R.K. Vander Meer, K. Jaffe, A. Cedeno [eds.], Applied Myrmecology, a World Perspective. Westview Press, Boulder, CO.

Lard, peanut butter oil, and honey were the most acceptable foods to laboratory colonies of the pharaoh ant, *Monomorium pharaonis*. Fenoxycarb at concentrations of 0.5, 0.25, and 0.1% dramatically reduced brood production and significantly delayed alate production. Single applications did not eliminate small laboratory colonies.

Wisniewski, J. 1975. Pharaomeisenbekämpfung im Zoologischen garten mit *Bacillus thuringiensis*. *Angewandte Parasitologie* 16: 43-49.

Bacillus thuringiensis in ground meat was successfully used to control the pharaoh ant in a zoo.

HAWAII

Chang, V., & A.K. Ota. 1990. Ant control in Hawaiian drip irrigation systems, pp. 708-715. In R.K. Vander Meer, K. Jaffe, A. Cedeno [eds.], Applied Myrmecology, a World Perspective. Westview Press, Boulder, CO.

Review through 1989 of the problem of ants chewing holes in drip irrigation pipe. Chemical control with contact and bait insecticides, and the development of ant-resistant drip tubes is reviewed.

Huddleston, E.W., A.A. Laplante & S.S. Fluker. 1968. Pictorial key of the ants of Hawaii based on the worker forms. *Proceedings of the Hawaiian Entomological Society* 20: 71-79.

Pictorial key to the worker ants of Hawaii, includes glossary. Useful in identifying exotic species which could be (*Anoplolepis longipes*) or are (*Plagiolepis*, *Technomyrmex albipes*) introduced into the continental U.S.

Riemer, N.J. & J.W. Beardsley, Jr. 1990. Effectiveness of hydramethylnon and fenoxycarb for control of bigheaded ant (Hymenoptera: Formicidae), an ant associated with mealybug wilt of pineapple in Hawaii. *Journal of Economic Entomology* 83: 74-80.

Amdro and logic baits were found to be effective for the control of the bigheaded ant.

Reimer, N.J., J.W. Beardsley, Jr., & G. Jahn. 1990. Pest ants in the Hawaiian Islands, pp. 40-50. In R.K. Vander Meer, K. Jaffe, A. Cedeno [eds.], Applied Myrmecology, a World Perspective. Westview Press, Boulder, CO.

Review through 1989 on the pest ants of the Hawaiian Islands, with a brief listing of urban ant pests.

OTHER ANTS

Akre, R.D., & A. Antonelli. 1981. Thatching ants. Washington State University, Cooperative Extension Bulletin EB0929: 3 pp.

Summarizes biology, identification, damage, and control of thatching ants, *Formica* spp., which can damage lawns. Dursban sprays or dust and diazinon granules can be used for these ants.

Akre, R.D., & A. Antonelli. 1991. Odorous house ant. Washington State University, Cooperative Extension Bulletin EB1550 (revised): 2 pp.

Summarizes biology, identification, damage, and control of the odorous house ant, *Tapinoma sessile* which can be a nuisance pest in structures.

Akre, R.D., S. Collman & A. Antonelli. 1991. Moisture ants. Washington State University Cooperative Extension Service, Extension Bulletin EB 1382 (revised): 4 pp.

Summarizes biology, identification, damage, and control of *Acanthomyops* spp. and *Lasius* spp. which can damage moist wood.

KEY WORDS: moisture ants, *Acanthomyops*, *Lasius*, moist wood, insecticides, Washington

Anonymous. 1987. Acrobatic ants. Pest Management 6(1): 35-36.

Biology, identification, habits, and control are summarized for acrobatic ants.

KEY WORDS: acrobatic ants, *Crematogaster* spp., moist wood, insecticides, United States

Bolton, B. 1976. The ant tribe Tetramoriini (Hymenoptera: Formicidae) constituent genera, review of smaller genera and revision of *Triglyphothrix* Forel. Bulletin of the British Museum (Natural History) 34: 281-379.

Revision of *Triglyphothrix* with key and illustrations, *T. striatidens* synonymized with *T. lanuginosa*, which is occasionally found in structures in the southeastern United States; includes summaries of distribution and biology.

Bolton, B. 1979. The ant tribe Tetramoriini (Hymenoptera: Formicidae) the genus *Tetramorium* Mayr in the Malagasy region and in the New World. Bulletin of the British Museum (Natural History) 38: 129-181.

Revision of *Tetramorium* with key and illustrations, some of which are occasionally pests in North America. *T. guineese* synonymized with *T. bicarinatum*.

Bolton, B. 1985. The ant genus *Triglyphothrix* Forel a synonym of *Tetramorium* Mayr (Hymenoptera: Formicidae). Journal of Natural History 19: 243-248.

Triglyphothrix is synonymized with *Tetramorium*; therefore, *Triglyphothrix lanuginosa* becomes *Tetramorium lanuginosa*.

Deyrup. 1991. *Technomyrmex albipes*, a new exotic ant in Florida (Hymenoptera: Formicidae). Florida Entomologist 74: 147-148.

The newly introduced white-footed ant collected inside structures in south Florida is described, illustrated, and discussed. This ant, present in Florida, California, and Hawaii, is a potential future urban pest.

DuBois, M.B. 1986. A revision of the native New World species of the ant Genus *Monomorium* (*minimum* Group) (Hymenoptera: Formicidae). University of Kansas Science Bulletin 53: 65-119.

Revision providing keys, illustrations, and biology summaries for this species group, some of which are occasional structural pests in North America.

Harada, A.Y. 1990. Ant pests of the Tapinomini tribe, pp. 298-315. In R.K. Vander Meer, K. Jaffe, A. Cedeno [eds.], Applied Myrmecology, a World Perspective. Westview Press, Boulder, CO.

Review through 1989 of the history, biology, and pest status of *Azteca* spp., *Conomyrma* spp., *Iridomyrmex humilis* and *Iridomyrmex* spp, *Tapinoma melanocephalum*, and *Tapinoma sessile*. Omits *Technomyrmex*.

Hedges, S.A. 1990. The biology and control of the ghost ant. Pest Control Technology 18(6): 44, 48.

Discusses the identification, life cycle, habits and control of the ghost ant in Florida and northern greenhouses.

Hedges, S. 1991. Controlling pavement ants in and around structures. *Pest Control Technology* 19(5): 52-56.

Discusses identification of pavement ants, thorough inspections, can be inside nesters, principally night feeders, finding the foragers back to the nest for control measures. Methods of treating are discussed. Managing swarming problems and how the homeowner can handle large swarms.

Horwood, M.A. 1988. Control of *Pheidole megacephala* (F.) (Hymenoptera: Formicidae) using methoprene baits. *Journal of the Australian Entomological Society* 27: 257-258.

Control of bigheaded ants in structures was achieved in 20 weeks by using 0.5% methoprene in peanut butter bait.

Johnson, C. 1988. Species identification in the eastern *Crematogaster* (Hymenoptera: Formicidae). *Journal of Entomological Science* 23: 314-332.

Key, illustrations, diagnostic characters, geographic distributions, and habitats are given for the 6 species recognized east of the Mississippi River.

Little, E.S.C. 1984. Ants in electrical switches: Note. *New Zealand Entomologist* 8: 47.

The white-footed ant is reported shorting out light switches in New Zealand.

MacKay, W.P. 1990. The biology and economic impact of *Pogonomyrmex* harvester ants, pp. 533-543. In R.K. Vander Meer, K. Jaffe, A. Cedenio [eds.], *Applied Myrmecology, a World Perspective*. Westview Press, Boulder, CO.

Review through 1989 on the biology, ecology, economic importance (toxic venom, impact on plants), and control of *Pogonomyrmex* harvester ants.

Mampe, C.D. 1985. Treating velvety tree ants. *Pest Control* 53(9): 6.

Velvet tree ants, *Liometopum* spp., are occasional nuisance pest in structures in the southwestern U.S., particularly southern California. The biology and control are summarized with emphasis on nest treatment.

Mampe, C.D. 1989. Acrobat ants invade rotted garage roof. *Pest Control* 57(11): 8.

Acrobatic ants, *Crematogaster* spp., tunnel in moisture damaged wood. The situation should include correcting the moisture problem and injecting insecticide into the damaged wood.

National Pest Control Association. 1986. Leaf-cutting ant (*Atta texana*). Technical Release, ESPC 032150: 2 pp.

Discusses description, habits, biology, life cycle, and control measures.

Naves, M.A. 1985. A monograph of the genus *Pheidole* in Florida (Hymenoptera: Formicidae). *Insecta Mundi* 1: 53-90.

Revision with keys and illustrations to major and minor workers of the *Pheidole* spp. present in Florida with brief summaries of their distribution, biology, and ecology.

Nickerson, J.C. 1983. The little fire ant, *Ochetomyrmex auropunctata* (Roger) (Hymenoptera: Formicidae). Florida Department of Agriculture & Consumer Services, Division of Plant Industry, Entomology Circular 248: 2 pp.

Reviews history, distribution, identification, biology, and pest status of the little fire ant, *Wasmannia* (= *Ochetomyrmex*) *auropunctata*.

Ulloa-Chacon, P., & D. Cherix. 1990. The little fire ant *Wasmannia auropunctata* (R.) (Hymenoptera: Formicidae), pp. 281-289. In R.K. Vander Meer, K. Jaffe, A. Cedeno [eds.], Applied Myrmecology, a World Perspective. Westview Press, Boulder, CO.

Review through 1989 of the history, morphology, economic importance, and biology of the little fire ant, *Wasmannia auropunctata*. This ant is normally polygynous.

Ward, P.S. 1985. The Nearctic species of the genus *Pseudomyrmex* (Hymenoptera: Formicidae). *Quaestiones Entomologicae* 21: 209-246.

Revision with keys and illustrations to the workers, queens, and males of the North American species of *Pseudomyrmex* with worker diagnoses and distribution and biology summaries. These ants readily sting man and often found in and around houses.

Wegner, G.S. 1991. The small honey ant. *Pest Management* 10(9): 28-29.

Often misidentified, the small honey ant is becoming more than a nuisance pest. Habits and behavior are discussed. Baiting with hydramethylnon or boric acid gave the best results.

Williams, D.F., & P.M. Whelan. 1992. Bait attraction of the introduced pest ant, *Wasmannia auropunctata* (Hymenoptera: Formicidae) in the Galapagos Islands. *Journal of Entomological Science* 27: 29-34.

In field tests with the little fire ant, Amdro bait, hydramethylnon, was the most attractive substance followed by peanut butter, lard, and Raid Max Ant Bait. Amdro caused 100% mortality in small laboratory colonies in 20 days. Logic fire ant bait (fenoxycarb) was repellent to these ants.

AUDIO-VISUAL MATERIALS

Compiled by:
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ANTS

- BIOLOGY & CONTROL OF PHARAOH ANTS (1988)** 22 minutes
National Pest Control Association
Written by Dr. Ted Granovsky. This videotape covers the subject matter fully. It is informative, and gives the service technician a balanced knowledge on how to control pharaoh ants.
- MAXFORCE PHARAOH ANT KILLER (1988)** 20 minutes
American Cyanamid Co.
Written by Dr. Ted Granovsky. This videotape is well produced and easy to watch, but the tape unabashedly tells the viewer that Maxforce Pharaoh Ant Killer is better than the other types of baits. This tape crosses the line between being educational material and being a commercial.
- CARPENTER ANTS, BIOLOGY AND CONTROL** 20 minutes
National Pest Control Association
"The program gives detailed information on control, identification, biology and nest locations of carpenter ants." A slide to video transfer.
- GENERAL METHODS APPLICABLE TO ANTS**
- PERIMETER TREATMENT: KEY TO SUCCESSFUL INSECT CONTROL (1990)**
DowElanco.
A guide to exterior perimeter treatments, using power equipment, and promoting Empire insecticide.
- OUTDOOR PERIMETER PEST CONTROL, FOR THE PROFESSIONAL (1991)**
Mobay Corp.
A guide to exterior perimeter treatments, using power equipment, and promoting Tempo insecticide.
- STRUCTURAL PEST ELIMINATION: PROGRAM GUIDELINES** 12 minutes
B & G Equipment.
This tape starts off with a comparison of agriculture pest management with structural pest management. The key difference is that in structural pest management there are usually no pests tolerated in the target areas we treat. The application methods focus on the use of B & G's products. There are four application targets: exposed surfaces, cracks and crevices, enclosed air space, and exposed air space.
- PEST ELIMINATION IN HOMES (1985)** 30 minutes
Whitmire Research Laboratories, Inc.
With Jeffrey Tucker, R.P.E.
The subject of this video is residential pest control for single family homes. It is aimed at suburbia, south of the snowbelt. Throughout the tape, there is a strong emphasis on inspection before application and on safety.