IPM PROGRAM DESIGN SHEETS

for

GERMAN COCKROACH
HAIRY CRABGRASS
HEAD LOUSE

by

William Olkowski, Sheila Daar and Kathy Spalding

CENTER FOR THE INTEGRATION
OF APPLIED SCIENCES (CIAS)
1010 Grayson Street, Berkeley, California
(415) 540-8912

JMI Inc., a nonprofit research corporation
743 Wilson Street, Napa, California
(707) 252-8333
IPM PROGRAM DESIGN SHEET

THE GERMAN COCKROACH (GR)

Blattella germanica linneaus

by William Olkowski

DATA ELEMENT FILES

1. LIFE CYCLE (LC)

   Egg capsule (ootheca), nymph, 6-7 instars, adults, female carries
   ootheca for most of incubation period (28). 3-4 generations/year (28).

2. BIOLOGY (BIO)

   Average number of hatching nymphs = 30. Incubation period at 76°F 28
   days, at 85°F 23 days; at 88°F 16 days (but reduced number hatch).  
   Average development for nymphs to adult 103 days at 76°F, 74 days at
   85°F. Preoviposition period 11 days. Females live over 200 days,
   produce 4.4 capsules (144).

   Detailed analysis of seasonal changes in age structure in North
   Carolina (119). GR becomes most active 20-120 minutes after dark
   then increase activity to peak and ends before daybreak (154).
   Prefers food preparation areas. Mating, oviposition, aggregation,
   thigmotactic, habitat preference and movement behavior described (28).  
   List of types of structures found inhabited (88). Found in buildings
   in Alaska (24). Defense against predators, interspecific associations
   between roaches and other species (24). GR most common roach on ships
   and planes (86).

3. NATURAL ENEMIES (NEA)

   Egg parasitoid Brachygaster minutus (Hym.) world-wide distribution
   (266, 106). Nymphal predator Dolichurus corniculus (Hym.) (267).
   Adult parasitoid, Ripidius pectinicornis (Coleop) on ships in S.
   Pacific (268). Parasitic mite on nymphs and adults (Acarina: Pteryo-
   somidae) (269). For all roach species: lists of protozoa, helminths
   and reviews of viruses, rickettsiae, bacteria, fungi, arachnids, other
   arthropods and vertebrates (86). Extensive lists of natural enemies
   (24). Extensive list of pathogens (218).

(105) separates 73 spp. of parasites, predators and pathogens into 2
   groups: A & B; 37 spp. in group A are more important; erroneously
   listing of eulophid Tetrastichus hagenowii (see 10, 107); also lists
   evaniids Evania appendigaster and E. punctata as egg parasites.
   Hosts, biology, distribution, and development of E. appendigaster and
   notes on related species (106). Prosevania (= Evania) punctata attacks
   GR in Turkey (278). (279) says P. punctata is native to Mediterranean
   but naturalized in cities of eastern U.S.
4. IDENTIFICATION (ID)

Reference list of keys to Blattodea, families, subfamilies, genera and species—world-wide (270).

Illustrated keys to orthopteroids and 38 common species of N. America with excellent line drawings (264). Key to 26 known genera (39). Keys to 13 common pest roaches (26). Ootheca and adult key common pest roaches (162). Color and black and white photos (12, 15, 84, 90). Phylogenetic relationships (229, 20).

5. MONITORING/SAMPLING (M/S)

Sanitation grading system and checklists (116, 142, 69). Checklists and drawings of places to inspect (19, 21, 22). History of the use of traps (22). Traps more effective than flushing with 0.25% pyrethrum but not as effective as 3.34% pyrethrum (115). Flushing agents useful only when applied with aerosol generating equipment and directed into harborage sites; resmethrin more effective than pyrethrin (129, 115). Description of flashlight monitoring (142); use of "flashlight" sampling in evaluation of insecticides (125, 126). Night inspections (21); trapping provides a better indication of population sizes than visual counts (130).

Traps placed in corners or along walls collect most roaches (115). First instar nymphs in vicinity of female in trap not counted (142).

ZoeconR trap rated better than RaidR with or without attractant (142). RaidR roach traps most effective in lab tests vs. D-ConR, Roach CoachR, and Mr. StickyR. B. orientalis was most, Supella longipalpa least trap prone. Traps catch the most roaches the first 24 hours (166). Evaluation of trap design indicates a simple flat sticky surface with no sides is simplest effective trap design (167). Mr. StickyR traps used on military base (7). 2 qt. jars with sorptive clay used in monitoring for pesticide evaluations (157). Other trap designs (48, 92, 93, 83, 81, 244, 115).

6. INJURY/ACTION LEVELS (I/A)


90% of apartments sampled in N. Carolina housing project (118). 44% of the buildings in 3 cities in N. Carolina infested (122). 2.5 roaches/trap/night at Fort Dietrick bar and restaurant with Mr. StickyR traps used as treatment threshold for residual treatment. Traps used 1/3 week or in response to complaint (7). Shore leave granted in Japanese navy before 1924 for capturing 300 GR.
7. CULTURAL/HORTICULTURAL CONTROL METHODS (C/H)

GR readily disperses on cartons, sacks and containers (159, 158) and enter bottles (158). GR has widest distribution of all domestic roaches--readily found in dead leaves and rubbish heaps--invades from outdoor habitat in summer but not in winter. Reactions to GR vary greatly between student families. Detailed world-wide survey of human structures which harbor GR (22).

8. PHYSICAL MECHANICAL CONTROL METHODS (PME)

Thorough sanitation studies in progress (169). GR survives longer on water alone compared to food or nothing (44). Extensive water source list for homes (24). Use of fly swatter at night after turn lights on (87). Large vacuum collection systems used in research (53, 22). Negative phototaxis (154). Physical characteristics of preferred household environments (28). Sonic and ultrasonic sound ineffective as repellent for GR (168). Adult GR can hide in cracks as small as 1.6 mm wide (86).

9. BIOLOGICAL CONTROL METHODS (BC)

No deliberate manipulation of the natural enemies of GR are reported. Short review of work with other roach species (24). Recent work with Encyrtid parasitoid (Comperia merceti) of brown-banded roach (Supella longipalpa) indicates it is effective in inundative releases (8). Other work on C. merceti (101, 103, 104, 109, 110). Attempt at genetic control (112).

10. CHEMICAL CONTROL METHODS (CM)

History of the development and use of insecticides up to 1972 used against GR; formulating, applying and evaluating insecticides for GR control; history of development of resistance (22). More recent information on resistance (135, 82, 154, 265, 57, 120, 180, 185, 186, 188). Current review on insecticide evaluation methods (143, 178).

Importance of repellancy in insecticide effectiveness established using choice boxes; least repellent insecticides are boric acid and borax established in lab and field tests (14, 28). Mode of action of BA (127). BA hoped to substitute of pyrethrum (100). 25% powdered sugar, 10% phophyllite and boric acid (BA) produces 92% mortality in 4 days; BA used in liquid solutions (81). 90% confectioners sugar and 10% BA readily eaten and produces 100% mortality. BA mixed with chocolate (87) in 21 days (98). Other information about BA (60, 95, 99, 100).

Using baited and insecticide-treated cartons acephate and chlorpyrifos effective and not repellent but BA not tested (64). Similar tests indicate Baygon most effective (254). Lists toxicants most commonly used in cockroach control do not include BA (62, 19). PCOs dislike powders, do not give spectacular results (100). Evaluation of effectiveness of 4 (3 common and 1 experimental) insecticides shows chlorpyrifos produces 100% mortality at 6 months (188). Chlorpyrifos
produced highest mortality, 96.5%, at 4th week in field test vs. bendiocarb, diazinon and propoxur. Encapsulated diazinon shows highest mortality (92.6%) at 1 month with flashlight counts vs. chlorpyrifos (as Dursban\textsuperscript{R}) and vaporite, permethrin and carbaryl (as Sevin\textsuperscript{R}) (170).

BA dust tested with clay trap counts against common insecticides, produces highest mortality in comparison to micro-encapsulated diazinon, diazinon, baygon, carbaryl, sumithion (130). BA dust alone (100%) from local pharmacies tested against chlorpyrifos dust produces similar mortalities at 2 weeks, 1 month and 6 months using flashlight visual counts (137) in low income homes.

BA formulated with flowing agent and flavor adulterant by Copper Brite (see MAK) had highest mortalities; 91-96% at 4 to 12 weeks using trap counts in apartments vs. chlorpyrifos, diazinon, propoxur, carbaryl and sumithion (157).

Dri-Die\textsuperscript{R} and Drione\textsuperscript{R} used effectively in S.F. Housing Authority in 8000 apartments (45). Drione\textsuperscript{R} dust used in sewer treatments (46).

Synergized tetramethrin and BA (Pyrcitox\textsuperscript{R}) performed well in U.S. tests (164). BA can be used in treating electrical appliances (154).

1 3/4 lbs. BA used per married student housing apt.; dying roaches wander and become visible (180). BA used widely in apartments at 1/4 pt./apt., need to replace when removed or when becomes wet (184). BA dust resulted in better GR control than Baygon\textsuperscript{R}, diazinon, diazinon and dichlorvos and Drione\textsuperscript{R} (1% pyrethrins, 10% technical piperonyl butoxide, 38% amorphus silica aerogel, 2% ammonium fluorosilicate, and 49% petroleum base oil) or sodium fluorosilicate.

**Attractants**

Poisonous food baits more effective to use than sex pheromones which attract only adult insects (4). Differential attractiveness and stimulation of extracts of rice bran: Maltose most stimulating for GR (5). Glycerol is highly effective as a feeding stimulant and more effective than maltose (3). Starved roaches attracted to many kinds of fat soluble substances including fatty acids, their esters and related alcohols (6). Germacrene-D sex pheromone mimic of Periplaneta americana isolated (211).

Spraying liquid solutions (except with pyrethrum) not allowed in Denmark in places handling food (189). Odor of diazinon and dichlorvos results in many complaints and causes switch to other materials (180).

**Baits**

Boric acid bait (20% BA) tested, shows impact on GR (1).
BA roach tablets

Shown effective in lab (2). 20-50 tablets/room significantly reduces GR populations in laboratory complex (182). Harris roach tablets have low attractiveness (128).

Other baits

Chlorpyrifos and propoxur baits are repellent (128). Boiled raisins good attractant but not better than white bread (128). New bait announcement (141), propoxur bait better than 5% carbaryl vs. Bacillus thuringiensis (156). 2% Baygon bait may be repellent but shown effective in lab (14). Partly hydrolyzed flesh with trichlorfon (= kepone) attracts better than a commercial preparation with peanuts (147).

Repellants

Fumol 5-15 repels GR for 30 days, odorless non-toxic emulsion $0.55/100 cases; other repellants discussed (158), lab studies (199, 203).

Sorptive insecticides

Lab test indicates effectiveness (187).

Aggregation pheromone (AP)

Nymphs of GR aggregate on methanol extracts on filter papers (153). Aggregation pheromone used to decrease repellancy and significantly increase mortalities in choice tests with chlorpyrifos, propoxur, diazinon, and Dri-die 67 (91) and BA (133). AP first shown to be effective in increasing efficacy with various blatticides (132).

Growth hormones

Shown effective against GR (42).

11. NON-TARGET TREATMENT EFFECTS (NT)


BA: LD50 for BA is 3200 to 4100 mg/kg (130, 97). Absorption in unbroken skin is negligible, sublethal doses are excreted. Death has resulted in some adults within 40 hrs. from oral injection of 7.5 gms. (3.5 teaspoons), and in some infants with 3 gms. (97). Males engaged in formulation of BA suffered from weakened sexual activity, reduced seminal volume, low spermatozoide count, less sperm motility and elevated fructose content of seminal fluid. Male rats exposed to high concentrations of aerosols, 4 times/day were sterilized after 4 months with no other obvious effects. Gonadotropic effects considered major and specific effect of BA (13).
Chlorpyrifos: High mortality to male house flies held in cages 48 hrs. after crack and crevice applications at 0.5% (139).

Other: Effects of insecticides on allergic persons (163). Safety statistic used to evaluate hazard (130, 157). Sonic emitters affect lab personnel in tests (168).

12. ECONOMIC ANALYSIS (EA)

Implementation of trapping (Mr. Sticky$^R$) and action levels reduced yearly visits 64%, labor 52% and insecticide use by 73% (7).

Between 1973 and 1979 a 99% reduction in liquid insecticide use and a concomitant reduction in time and labor occurred in Biology Department laboratories at U.C. Berkeley and U.C. Medical School in S.F. (182).

13. PRODUCTS (PRO)

Roach Prufe$^R$ (see MAK). For others (276).

14. IPM PROGRAMS (IPM)

Description (49). IPM programs operating or instituted at Ft. Detrick, MD Officers Club and cafeteria (7), at U.C. Berkeley and U.C.S.F. in laboratories (182), in schools in Palo Alto (273), public housing in Pittsburgh (274), in Flint, MI (275).

15. EDUCATIONAL MATERIALS (EM)

Excellent black and white photographs of all life stages (15), color photographs (12). Cross section of parasitoid Evania appendigastor in egg capsule (25). Line drawings of floor plans and GR habitat (19, 181). Early popular article about GR control (90). Extension publication (94), in Spanish (96), use of BA (95) publication 95 translated into Spanish (96).

Attitudes about GR in public housing (113, 69). 46% of tenants in 16 untreated apartments thought fewer GR seen but trap catches indicate population increasing (135).

16. MANUFACTURERS (MAK)

Copper Brite, Inc., 5147 W. Jefferson Blvd., Los Angeles, CA 90016 (213) 933-9331. See also, 276.

17. SPECIALISTS (EXP) (United States)

Use (277) and names of investigators from their papers.

18. RESEARCH METHODS (RES)

REFERENCES


(57) Grayson, J. McD. 1954. Differences between a resistant and a non-resistant strain of the German cockroach. J. Econ. Entomol. 47(2): 253-256.


(62) Communicable Disease Center. 1964. 1964 Communicable Disease Center report on public health pesticides. Pest Control 32(3):11-12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32.

(64) Burden, G. S. 1975. Repellency of selected insecticides. Pest Control, pp. 16, 18.

(69) Gupta, A. P. 1975. Effectiveness of 3 spray-dust combinations and the significance of "correction treatment" and community education in the control of German cockroaches in an inner-city area. Pest Control 43(7):28, 30-33.


Office, USDA. 780 p.

Econ. Entomol. 6:327-329.


(94) Barnes, G. and B. F. Jones. 1975. Control roaches. Univ. of 
Arkansas, Coop. Ext. Service Leaflet #425.

(95) Ebeling, W. 1967. Boric acid powder for cockroach control. One 
Sheet Answers, #206 (August).

One Sheet Answers, #206s (September).

on boric acid deposits. National Pest Control Operators News 34(7).

(98) Bare, O. S. 1945. Boric acid as a stomach poison for the German 


(100) Barnhart, C. S. 1943. Aqueous solutions of boric acid for safe 

merceti (Compere) in Wisconsin (Hymenoptera: Encyrtidae). USDA 

(103) Gorga, G. 1973. Biological investigations on Comperia merceti 
(Compere), an encyrtid parasite of the cockroach Supella longipalpa 
(Serville). J. Entomol. (A) 47(2):115-123.

(Compere), (Hymenoptera: Encyrtidae). J. Kansas Entomol. Society 
27(4):128-142.

(105) Cameron, E. 1955-56. On the parasites and predators of the cockroach. 


(116) Wright, C. G. 1979. Survey confirms correlation between sanitation and cockroach populations. Pest Control 28 (Sept.).


(166) Moore, W. S. and T. A. Granovsky. 1982. Laboratory comparisons of sticky traps to detect and control five species of cockroaches. Unpublished (submitted to J. Econ. Entomol.).


IPM PROGRAM DESIGN SHEET

HAIRY CRABGRASS

Digitaria sanguinalis

by Sheila Daar

DATA ELEMENT FILE NAMES

1. LIFE CYCLE (LC)

Generally a summer annual, completing growth from seed through senescence in one season (13). In sub-tropical climates may germinate in fall and winter (22).

2. BIOLOGY (BIO)

Germinates when soil temperatures warm. Long germination season (3, 15). Mature plant grows approximately 18" tall, with many branches at base of plant. Stems spread by rooting at lower-most swollen joints. Seeds are prolific, ripen in late summer (15).

Competes well in compacted, droughty, low-fertile habitats. Pest of poorly managed turf and disturbed soil habitats such as cultivated gardens (5, 15). Seeds viable in soil up to ten years (4, 3, 8).

3. NATURAL ENEMIES (NEA)

Allelopathy from Euphorbia esula (7) and Festuca arundinacea (9).

4. IDENTIFICATION (ID)

Grass weeds key for subfamily panicoides (11), Digitaria genotypes (6).

5. MONITORING/SAMPLING (M/S)

No information available.

6. INJURY/ACTION LEVELS (I/A)

Tolerance levels for turf weeds depend on function of turf (e.g. putting green = low tolerance, picnic area = high tolerance) (16).
7. CULTURAL/HORTICULTURAL METHODS (CH)

Reduce soil compaction, improve watering practices, topdress, reseed with competitive turfgrasses (16, 17, 15, 21).

Correct fertilizer deficiencies, especially nitrogen, phosphorus; addition of lime @ 1000 lb/A may inhibit growth (19).

8. PHYSICAL/MECHANICAL METHODS (PME)

Aerate (15); verticut (15, 18, 2, 12); handweed (15); raise mowing height of turf (15, 21).

9. BIOLOGICAL (BC)

No information available.

10. CHEMICAL METHODS (CM)

Herbicides alone will not control crabgrass; must be combined with good overall turf culture (15, 27, 28, 14). Pre-emergent herbicides including bensulide (15, 18), benefin (15), sideron (15), DPCA (25), dactha (28, 30). Post-emergent herbicides, including MSMA, calcium arsenate (31).

11. NON-TARGET TREATMENT EFFECTS (NT)

Many turfgrasses are injured by herbicides used to control crabgrass (10, e.g. bensulide (26), sideron (24) benefin (23) calcium arsenate (26), trifluralin (28, 29), dactha (28), MSMA (28). Injury to turf may appear a short time after herbicide application (31) or may appear only after sequential applications over one or more seasons (24, 23).

12. ECONOMIC ANALYSIS (EA)

No information available.

13. IPM PROGRAMS (IPM)

Four steps in IPM program for turf weed control: monitoring, establishment of weed tolerance levels, reduction of turf stress, evaluation of program (16).
14. PRODUCT (PRO)
   (32).

15. EDUCATIONAL MATERIALS (EM)

   IPM Practitioner; NCAP News; Cooperative Extension publications.

16. MANUFACTURER (MAK)
   (32).

17. SPECIALISTS (EXP)

   S. Darr, CIAS/JMI, 1010 Grayson St., Berkeley, California 94710.

18. RESEARCH METHODS (RES)

   No information available.

19. MODELS (MOD)

   Model IPM programs, City parks; Eugene, Oregon; National Capitol Region, National Park Service, Washington, D.C.

20. COMMENT (COM)

   Development of healthy, vigorous turfgrass essential to crabgrass control: herbicides alone are ineffective.
REFERENCES


IPM PROGRAM DESIGN SHEET

HEAD Louse
Pediculus capitis Degeer
by W. Olskowsky and K. Spalding

DATA ELEMENT FILE NAMES

1. LIFE CYCLE (LC)
   Egg, 3 nymphal instars, adult.

2. BIOLOGY (BIO)

Factors most likely to affect embryonic development: temperature (T) and relative humidity (RH) (1). 30–35°C (86–95°F) -- hatch 5–10 days, most in 7 (1). Shortest incubation: 5–6 days at 36±2°C (96.8±3.6°F), RH 75–87% (7). Max.% emerging: 95–99% at 31±2°C (87.8±35.6°F), RH 52–90% (7). Longest incubation: 9–16 days at 27°C (80.6°F), RH approximately 45%, 13% hatch (7). RH greater than 90%: eclosion decreases dramatically regardless of T (7). Less than 10% of eggs exposed to 22°C (71.6°F) for 6 days hatch if T increases to optimal 30°C (76°F) (9). No eggs survive 6 days at 4°C (39.2°F) (9). Eggs may lie dormant 35 days (17). Many eggs/hair shaft in heavy infestation (7). 7–9 day nymphal development (1). Feed approximately 30 minutes after molting (7). Molt 4th and 6th day (17). Adult male 2mm; female 3mm (11). Adult male 1.5mm; female 2mm (17). Survival/starvation times at different T (1, 7, 9). Poor eyesight, highly developed tactile sense (19). Saliva prevents clotting, leads to itching (6). Feed 5 times/day, @ 35–45 minutes (17), feeding dependent upon host's activity; feed for longer periods during 1800–0600 hr. (7).

Female sexually mature within 1–3 days adult life (1). Male: larger forelegs, claws to hold females hind legs during copulation (19). Ratio female: male decreases with increase of total population. Estimates of number egg/female range from 50–200 (1) to 300 (15). 6–8 egg/24 hrs. Lay mostly at night (19). Production decreases with increased activity (perspiration and temperature) of host (7). Oviposition reported in hats (15). Nit approximately 0.8mm. x 0.3mm., oval, yellow opalescent; operculum comes off intact (11). Eggs greater than 1/4" from scalp not viable (6). Estimates of age range from 29–46 days (7, 15, 17). Seasonal abundance (7). Individuals in more susceptible condition conducive to infestation (4, 13). Greater prevalence in western world (19).
3. NATURAL ENEMIES (NEA)

Pathogens (46).

4. IDENTIFICATION (ID)

Diagrams of nits (1, 17); adults (1, 2); life cycle (1); oviposition (17); anatomical features of different varieties (14). Key to subgenera Pediculus (14). Description of differences between head and body lice and female and male head lice (8).

5. MONITORING/SAMPLING (M/S)

Eggs behind ears, occipital areas (denser hair here), few at temples (7). Bites—back of head, neck, behind ears (17). Crawling stages at temple near part (if present) or where hair thinner; First instar confined to scalp, crawls on hair shaft with difficulty (7). Undisturbed lice 3–6 mm from scalp surface—crawls to denser hair if disturbed (7). Further from scalp on perspiring hosts (7). Wood's light useful where eggs are few (7). Mistaken for nits: hair casts solidified hair spray globules (7); hair casts slide easily (10). May excrete dark red feces onto scalp when feeding (6); feces on hosts' shoulders with heavy infestation (7). Pediculosis rarely seen in U. S. after WWII; recent (1979) increases (2). Infestation distribution by sex, age, grade in Vancouver schools (1). Age, sex, race distributions, many locations (7). Buffalo, N. Y.: hair length, sex not factors (13). Socioeconomic status, race, crowding were factors (13).

6. INJURY/ACTION LEVELS (I/A)

No information at present. Tolerable numbers/host will vary considerably with different cultural groups.

Assoc. conditions (16, 17); potential for Rickettsia prowazekii transmission (27).

7. CULTURAL/HORTICULTURAL CONTROLS (C/H)

Cooperation of hosts and their families key to prevention, treatment—not always easy—lice tolerated in some families for generations (7).
8. PHYSICAL/MECHANICAL CONTROL (PME)

Prevention: Assigned hooks, individual lockers (7); hair dryers, hair oils and creams (7); sleeping alone (7); braiding of hair (16).

Treating fomites: machine wash clothing, linens, dry at high heat (6); non-washables: dry-clean (6, 9); seal in plastic bags 10 days (9); seal in plastic bag 30 days (10); soak combs, brushes 1 hr. in 2% Lysol solution, 5-10 min. in 150°F water if possible (6); limit cleaning to vacuuming; fumigation costly, safety and efficacy not evaluated (9); transmission through fomites unlikely (19).

Removal of nits: by hand, sandpaper, fine-toothed comb (16); louse has poorly developed defense mechanisms; comb is its worst enemy (19); Mellanby found less than 10 lice/host in majority--attributed low number to combing (7); more easily combed out if comb is warm (8); comb packaged with RidR--partial control in two London schools (1); DerbacR comb superior to those provided with RidR: A-200 (10). Space between comb teeth: from VonceRbox .381 mm; from RidR box .279 mm; from Triple Xbox .381 mm; Ace hard rubber fine combR .330 mm; Medi-comb-Al. fine tooth combR .152 mm. (11).

9. BIOLOGICAL CONTROL (BC)

Not feasible; sterile, genetically incompatible male not acceptable, and known pathogens lethal to lice are pathogenic to man (1).

10. CHEMICAL CONTROL (CM)

Systemics: toxic to host, unconfirmed experimentally (1). Synthetic juvenile hormones--experiments undocumented (1). Dehydrating dusts (i.e. silica aerogels) chemically inert. Dri-Die 67R successfully used on humans (1). Toxicology (1). Approved Canadian pediculicides, toxicity data (1). Data on some currently (1959) available pediculicides (11). Pediculicides currently (1971) available in California (12). Drugs: first choices and alternates (2). DDT resistance data (1). Lindane resistance data (1); ineffective in some California regions (10); lindane degrading to PCP (1); lindane: drug monograph (2, 17). Drug monographs for pyrethrins and piperonyl butoxide (A-200R, RidR) and petroleum ophthalmic ointment (2). A-200R low strength (10). Delphinium consoilla, D. staphisagria (3, 10, 15). Chemicals tested for nit and adult
control (4). Mean percentage mortality of eggs exposed to pediculicides for various periods (7); for 30 min. (7). Recommendation of shortening application time for Kwell® malathion dust; ovicidal in 2 hrs. (7). Ovicidal additives: dinitroanisole and chlorphenamidine (1). DDT and lindane resistant strains controlled with malathion—will control lice 3-4 weeks with one application (8). Lice resistant to organochlorines highly susceptible to propoxur, malathion, carbaryl (8). Body lice may become resistant to carbaryl; no resistance to malathion after 44 generations (8). Structural formulas, biochem aspects, LD50s of DDT, lindane, malathion, carbaryl (19). Three percent rotenone (15). Kerosene and olive oil or vinegar (15).

Barc® Cuprex®-sting on excoriated skin (10). Irritant contact dermitis assoc. with benzylbenzoate, lindane, pyrethrins (1). MYL powder—application ineffective (28). Treatment interval greater than ten days may allow some lice to mature, lay more eggs (2). If nymphs, adults are forms transmitted, risk eliminated with first treatment (9). Greasy hair may enhance insecticides in binding, accentuating residual effect (19). Treatment of entire family (19). Treatment of those with active infestation only (9).

11. NON-TARGET (NT)

For information on lindane, malathion, carbaryl propoxur (47).

12. ECONOMIC ANALYSIS (EA)

No information available

13. IPM PROGRAMS (IPM)

No programs known

14. PRODUCT (PRO)


Derbac comb (11) (see MAK 1).

15. EDUCATIONAL MATERIALS (EM)

Head lice public information (1).
16. MANUFACTURER (MAK)

Mak 1: Derbac comb: Ceral Soaps Co., Division of Johanson Manufacturing Corp., Box 329, Boonton, N. J. 07005 (201) 334-2676 (11).

17. SPECIALISTS (EXP)

Uncompiled at present.

18. RESEARCH METHODS (RES)

Method for rearing large number of head lice (7).
REFERENCES


