Calibration For Application of Microbial Mosquito Larvicides

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January 2006

Objective

Provide practical training in calibration for application of microbial mosquito larvicides for control of malaria vectors.

Agenda

- **The global malaria problem**
- Current strategies in malaria control
- Mosquito life cycle and control strategies
- Microbial mosquito larvicides
- Microbial mosquito larvicide formulations
- Application Equipment
- Calibration methods

A Global Problem

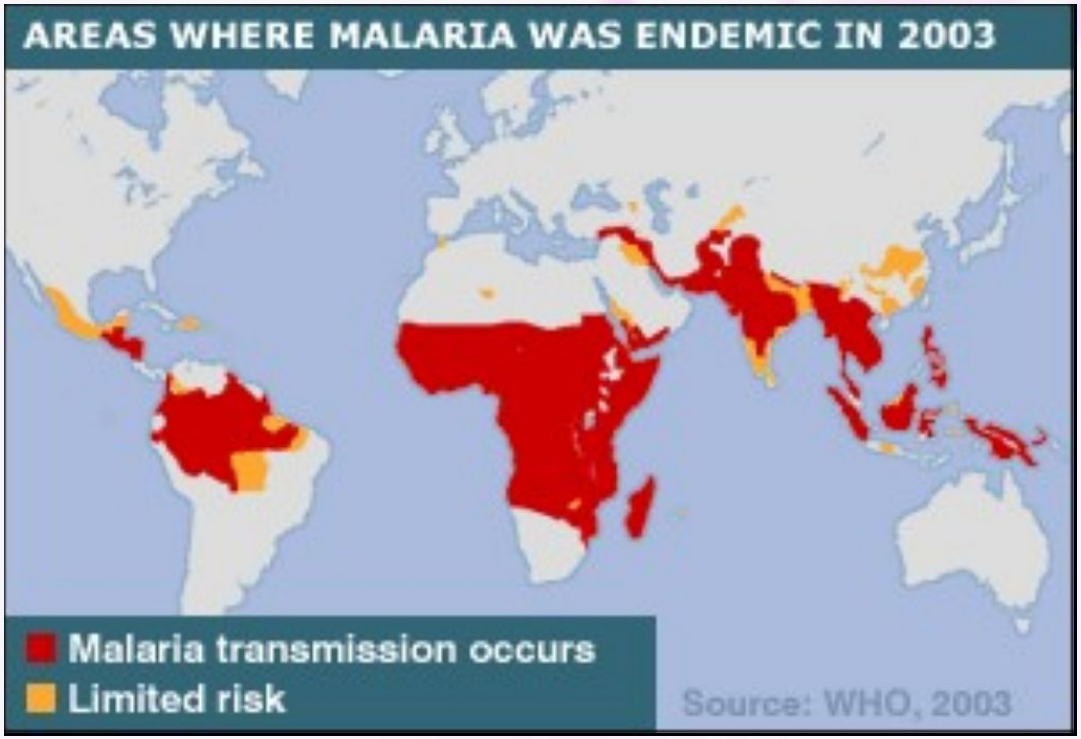

Image courtesy of The World Health Organization

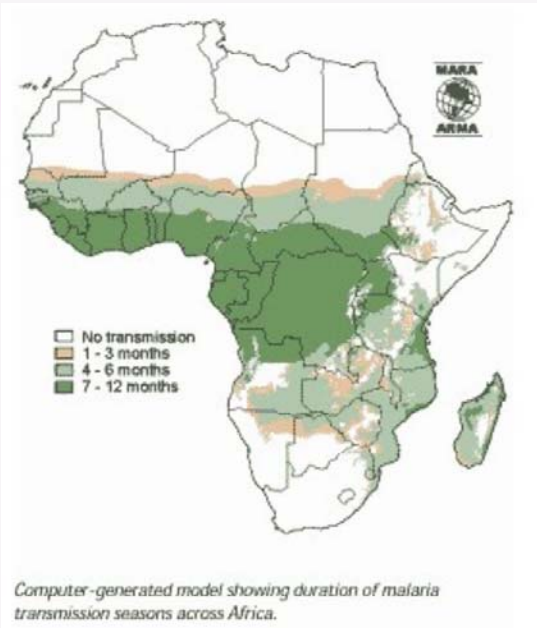

Image courtesy of Roll Back Malaria, World Health Organization

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Malaria in Sub-Saharan Africa

Annual global burden of malaria (2002 estimates):

- **1.1 million deaths (mostly children)**
- **300-500 million cases**
- **44 million disability adjusted life years (DALYs)**
- **Reduction of GNP of more than half in Malaria endemic countries**

Over 90% of the disease burden is in sub-Saharan Africa, and almost all deaths (due to Plasmodium falciparum) occur in Africa.

The Special Programme for Research and Training in Tropical Diseases (TDR)

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Malaria Control Challenges

- Vaccine not yet developed
- Multiple drug resistance
- Insecticide resistance
- Poverty (cause & effect)
- Infrastructure
- Local capacity

Image courtesy of The World Health Organization

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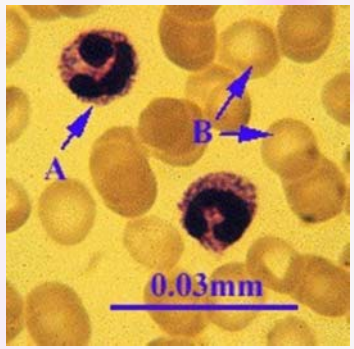

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Agenda

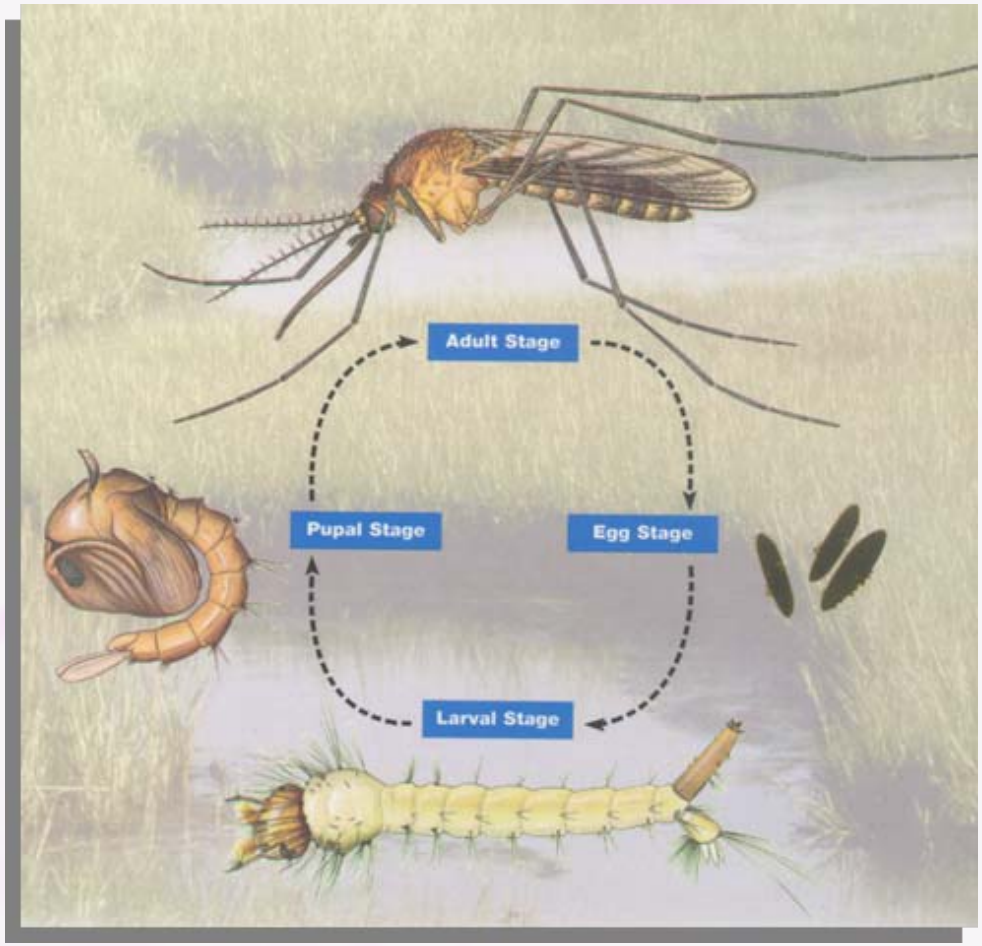
- ✓ The global malaria problem
- ❑ **Current strategies in malaria control**
- ❑ **Mosquito life cycle and control strategies**
- ❑ Microbial mosquito larvicides
- ❑ Microbial mosquito larvicide formulations
- ❑ Application Equipment
- ❑ Calibration methods

Malaria Control Strategies

- Treating the ill and preventing transmission
  - Drug chemotherapies
  - Insecticide treated nets (ITN's)
  - **Larviciding**

PHOTO COURTESY OF C.F. CURTIS - U of M Website

Mosquito Life Cycle



Methods of Mosquito Control

Source Reduction

Larviciding

Adulticiding

PHOTO COURTESY OF C.F. CURTIS - U of M Website

American Mosquito Control Association's Pesticide Environmental Stewardship Program Strategy Document

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Source Reduction

(Environmental Management)

- Removal or reduction of mosquito larval habitats
  - Drainage
  - Sanitation or hygiene
  - Community Participation

Larviciding

PHOTO COURTESY OF C.F. CURTIS - U of M Website

- Application of substances to kill mosquito larvae or pupae in water
  - Liquid spray, granular application, direct application
  - No loosers

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Adulticiding

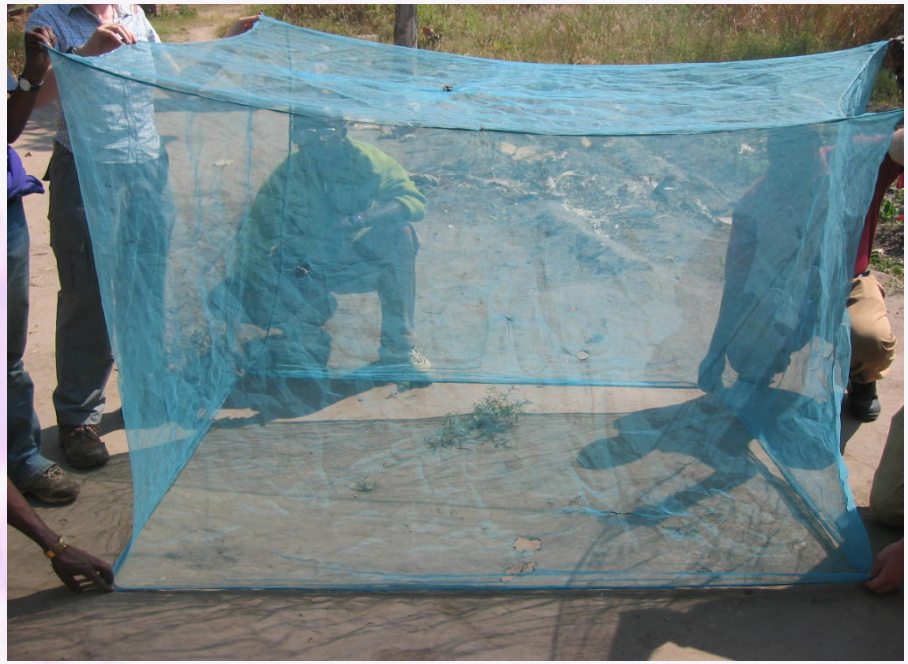

PHOTO COURTESY OF C.F. CURTIS - U of M Website

- Application of chemicals to kill adult mosquitoes
  - Residual spray & ITN.

Larviciding Philosophy (CIA)

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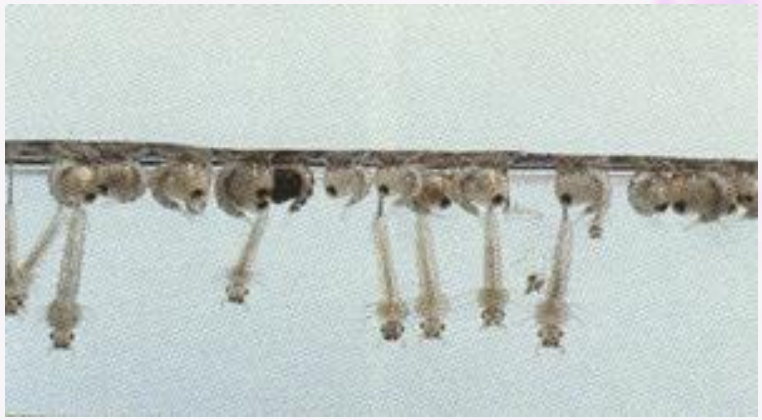
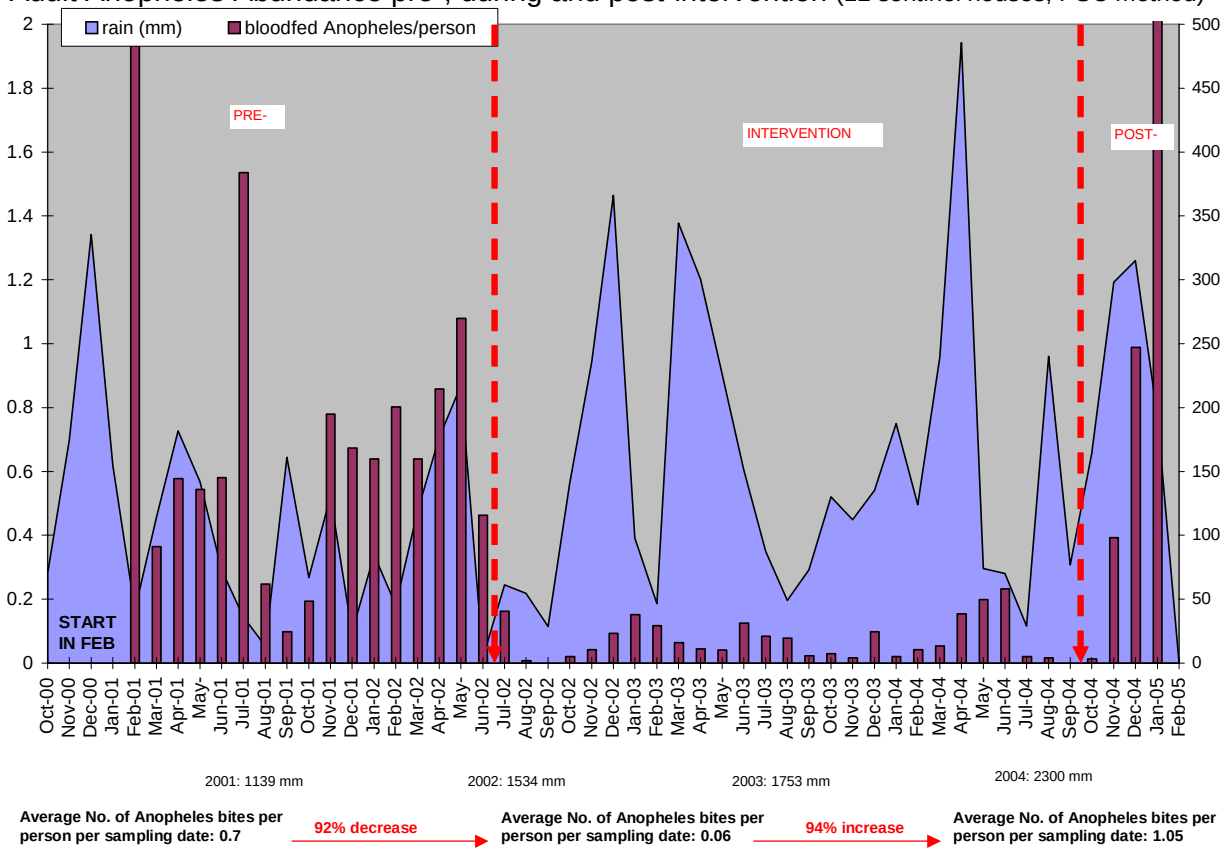


- Mosquito Larvae are generally:
  - **C**oncentrated
  - **I**mmobile
  - **A**ccessible
- Adult mosquitoes spread out over a much larger area.
- **CIA** = efficiency of larval control.

New Look at Environmental Management and Larval Control

Courtesy of U Fillinger



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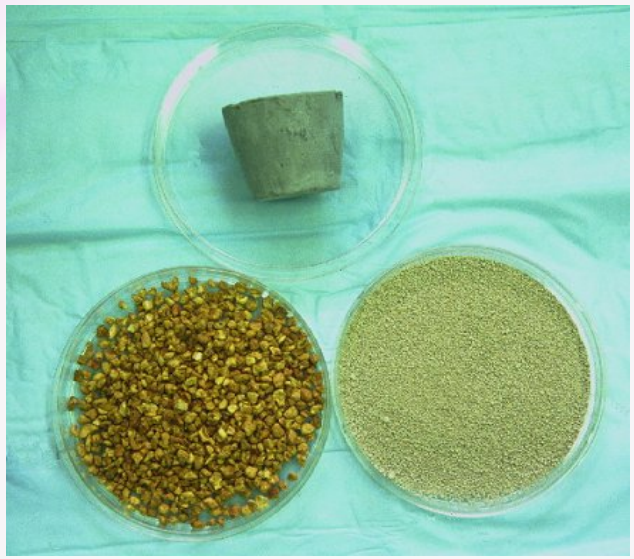
Agenda

- ✓ The global malaria problem
- ✓ Current strategies in malaria control
- ✓ Mosquito life cycle and control strategies
- ❑ **Microbial mosquito larvicides**
- ❑ Microbial mosquito larvicide formulations
- ❑ Application Equipment
- ❑ Calibration methods

Mosquito Larvicides

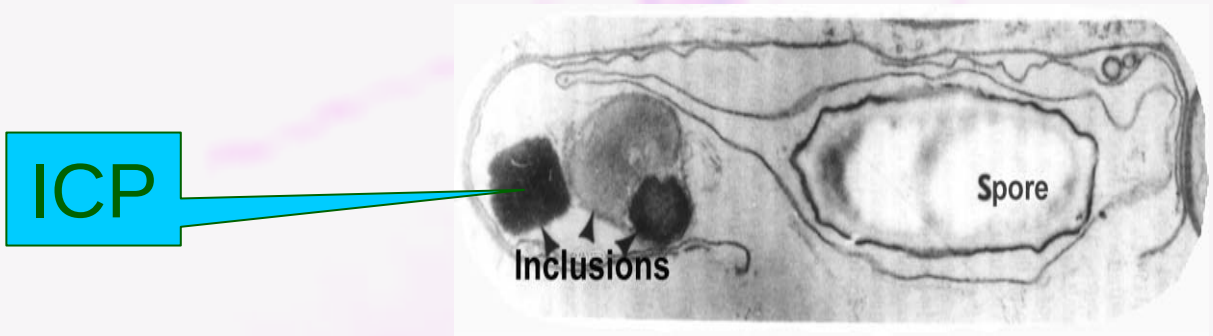


- Chemicals
  - OP's (temephos)
- Surface Agents
  - oils, monomolecular films
- **Microbials**
  - ***Bacillus thuringiensis israelensis (Bti)***
  - ***Bacillus sphaericus (Bs)***

B. thuringiensis subsp. *israelensis* (*Bti*)

VectoBac = *Bti*

Bacteria that produces 5 toxins (ICP)
ICP = Insecticidal Crystal Protein
Protein is not toxic until digested by larvae



Bti

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Bacillus sphaericus (Bs)

VectoLex = *Bs*

Bacteria that produces 2 toxins (ICP)
ICP = Insecticidal Crystal Protein
Protein is not toxic until digested by larvae

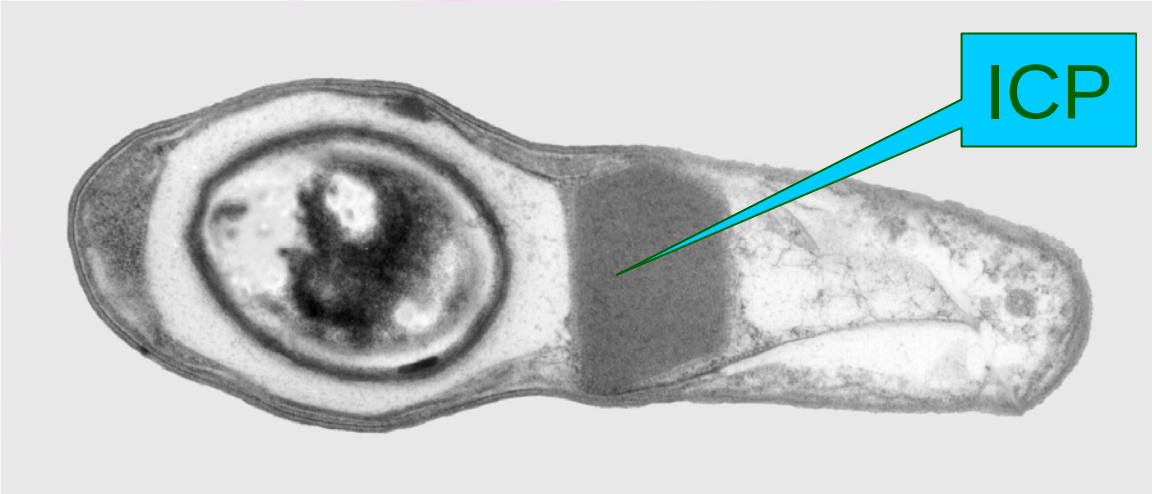

Figure courtesy of Jean-François Charles

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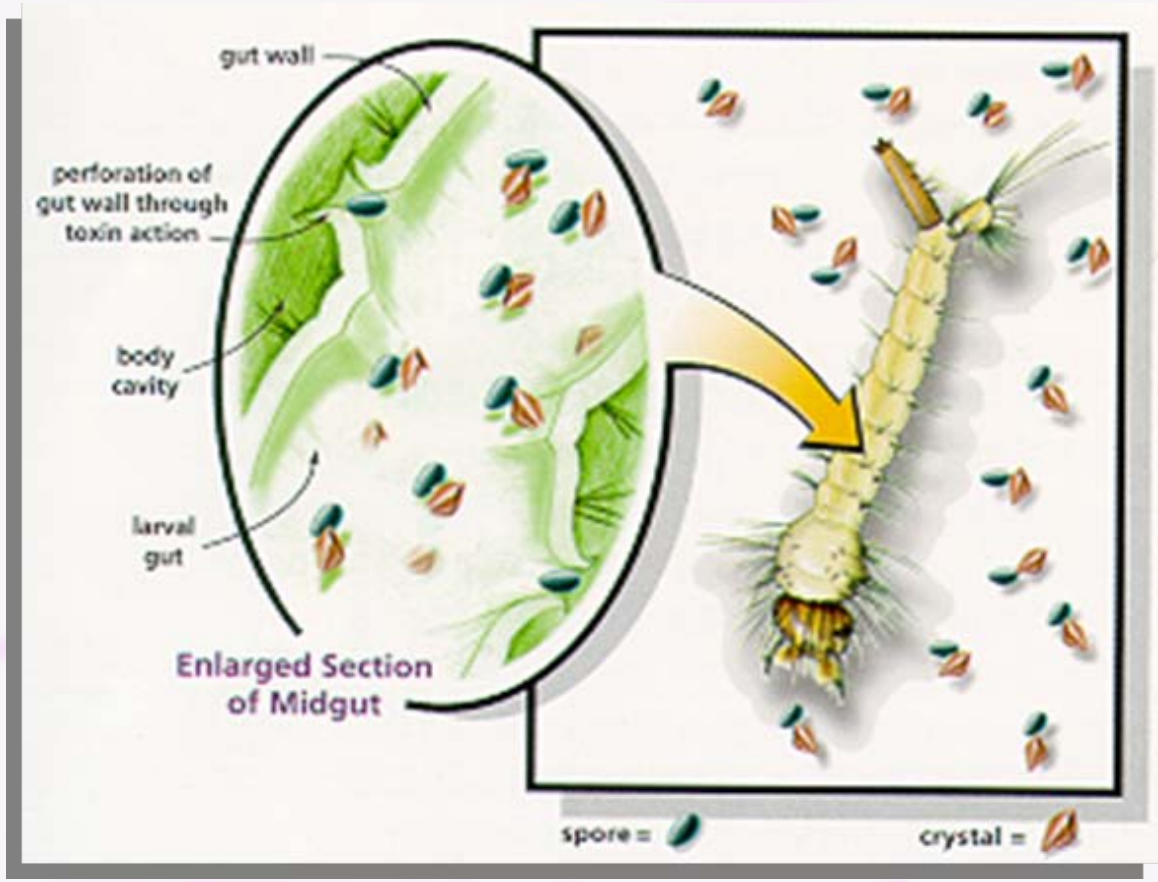
Mode of Action



ICP

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Insecticidal Crystal Protein

The larvae's Last Meal

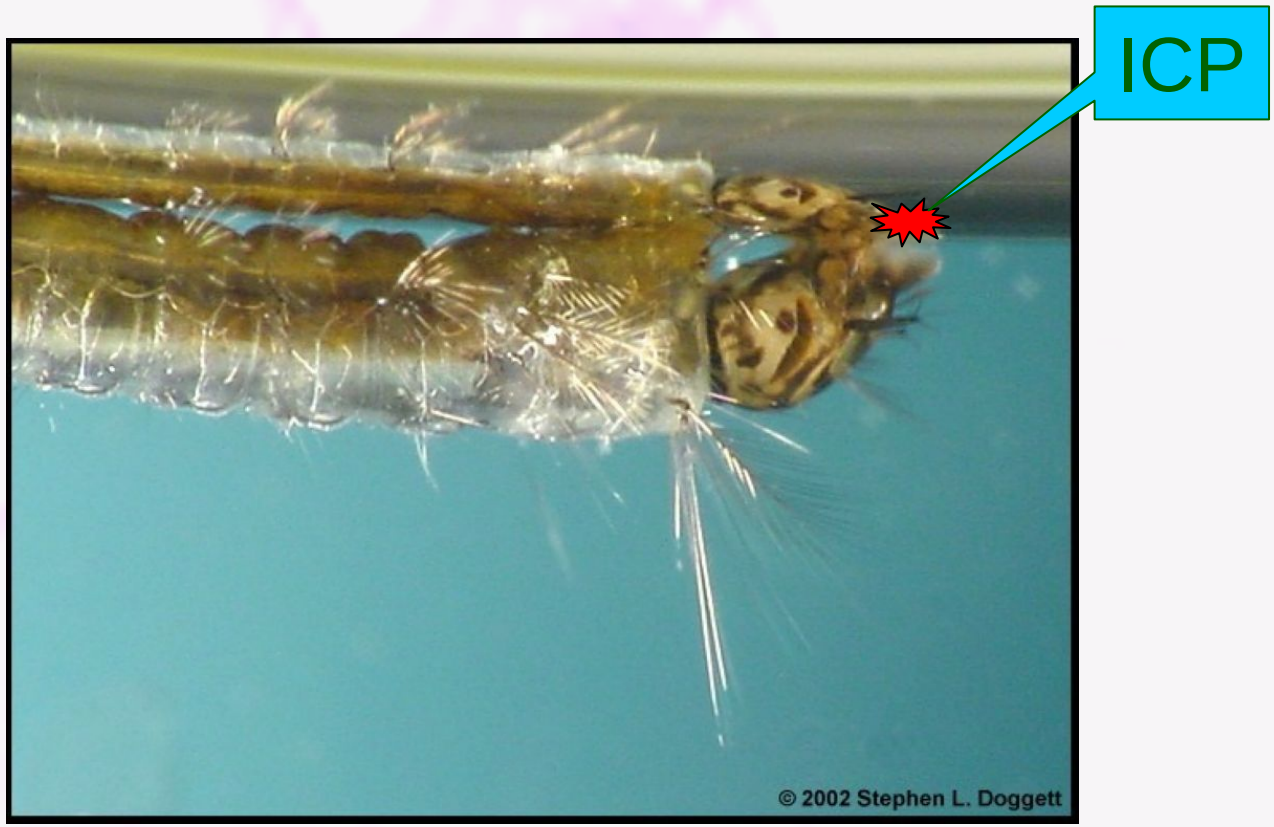

Figure courtesy of Stephen L. Doggett

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OUR GOAL
"Give all the larvae a good FINAL meal."

- ICP's are not contact poisons
- Effective dose must be eaten by all larvae
- ICP's are not water soluble
  - Will not move laterally (diffusion)
- Total area needs to be evenly treated
- Must penetrate vegetation

OUR GOAL
"Give all the larvae a good FINAL meal."

- KEYS TO OUR GOAL:
  - **FORMULATION**
    - Delivers ICP to the feeding zone
  - **APPLICATION**
    - Proper dose and even coverage

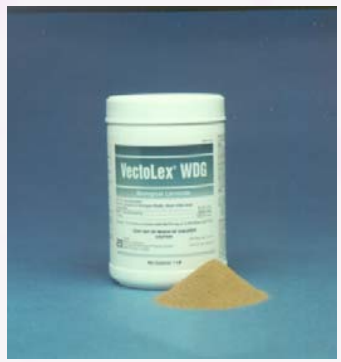
Agenda

- ✓ The global malaria problem
- ✓ Current strategies in malaria control
- ✓ Mosquito life cycle and control strategies
- ✓ Microbial mosquito larvicides
- ❑ **Microbial mosquito larvicide formulations**
- ❑ **Application Equipment**
- ❑ Calibration methods

MICROBIAL LARVICIDE FORMULATIONS

- **Granules (on corncob) - CG**
- **Water dispersible granules - WDG**
- Tablets - DT
- Water soluble pouches – WSP
- Aqueous suspensions - AS
- Technical powders - TP

VectoBac® and VectoLex® Formulations CG & WDG



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VectoLex® and VectoBac® CG

Granular formulations for dry application

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Why Choose CG Formulation?

- Stable formulations
- No mixing required
- Penetrates vegetation
- Can be hand applied to small areas easily by community members

Examples of Equipment for CG Application

Hand

Manual

Power

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Agenda

- ✓ The global malaria problem
- ✓ Current strategies in malaria control
- ✓ Mosquito life cycle and control strategies
- ✓ Microbial mosquito larvicides
- ✓ Microbial mosquito larvicide formulations
- ✓ Application Equipment
- ❑ **Calibration methods**

What is Calibration?

Why Calibrate?

Why Calibrate?

REMEMBER OUR GOAL

“Give all the larvae a good FINAL meal.”

- Accurate dose and even coverage of the larval habitat.
- Saves material, time and money.

VectoBac CG dose is 10 kg/ha

We aim to achieve this dose.

VectoBac® CG Calibration Method

How do we apply the right amount?

Rate is 10 KG per hectare.

Think of this as granules per square meter.

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Granules Are Applied By Hand

- Your hands and feet are the application tool.
- You must learn the weight of granules in your handful or measure with teaspoon.
- You must learn the distance of your step.
- Knowing these, you can develop the skill to make an even application at the correct dose.

Two Methods

Small Areas

(<3 meters x 3 meters)

Large Areas

(>3 meters x 3 meters)

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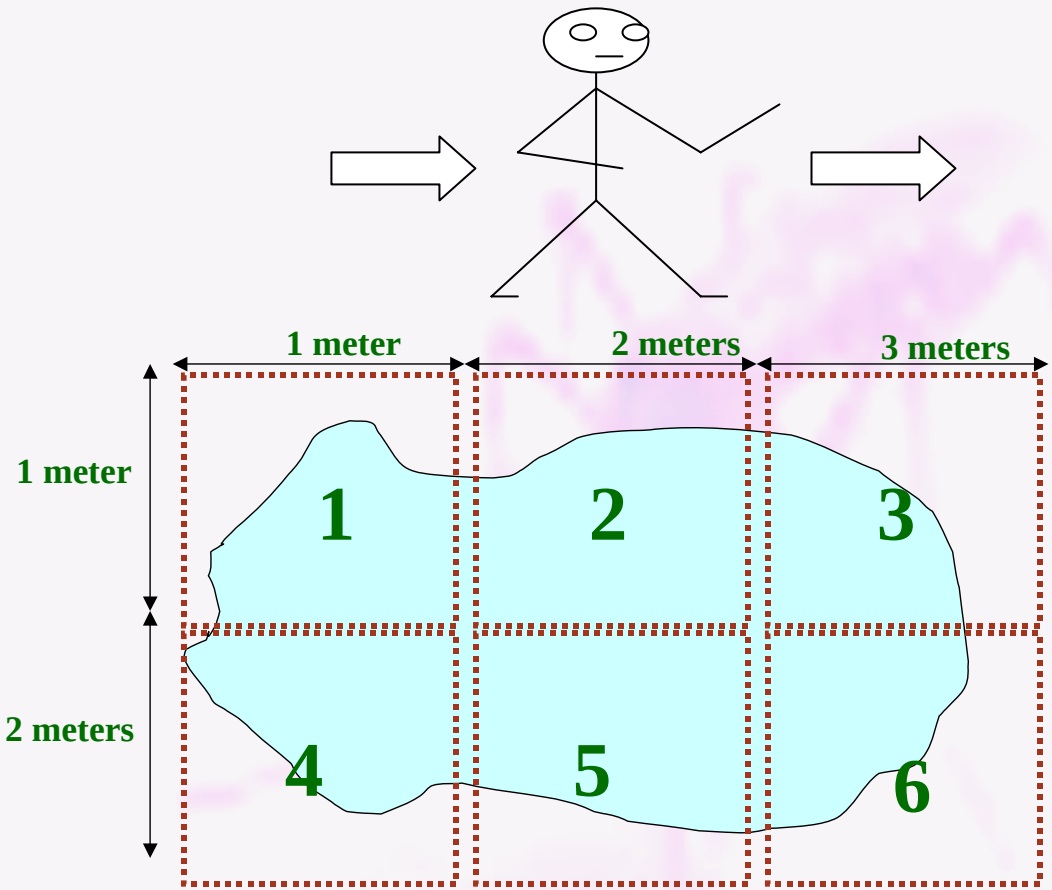
Hand Application of Granules

For Small Areas (< 3 meters x 3 meters)

- Rate = 1 gram per square meter (1/2 teaspoon)
- Know the size of the area
- Spread small amounts at a time to make application even.
- Was there enough to finish? (Was it too much?)
- Check if application “looks OK”



2 x 3 = 6 square meters

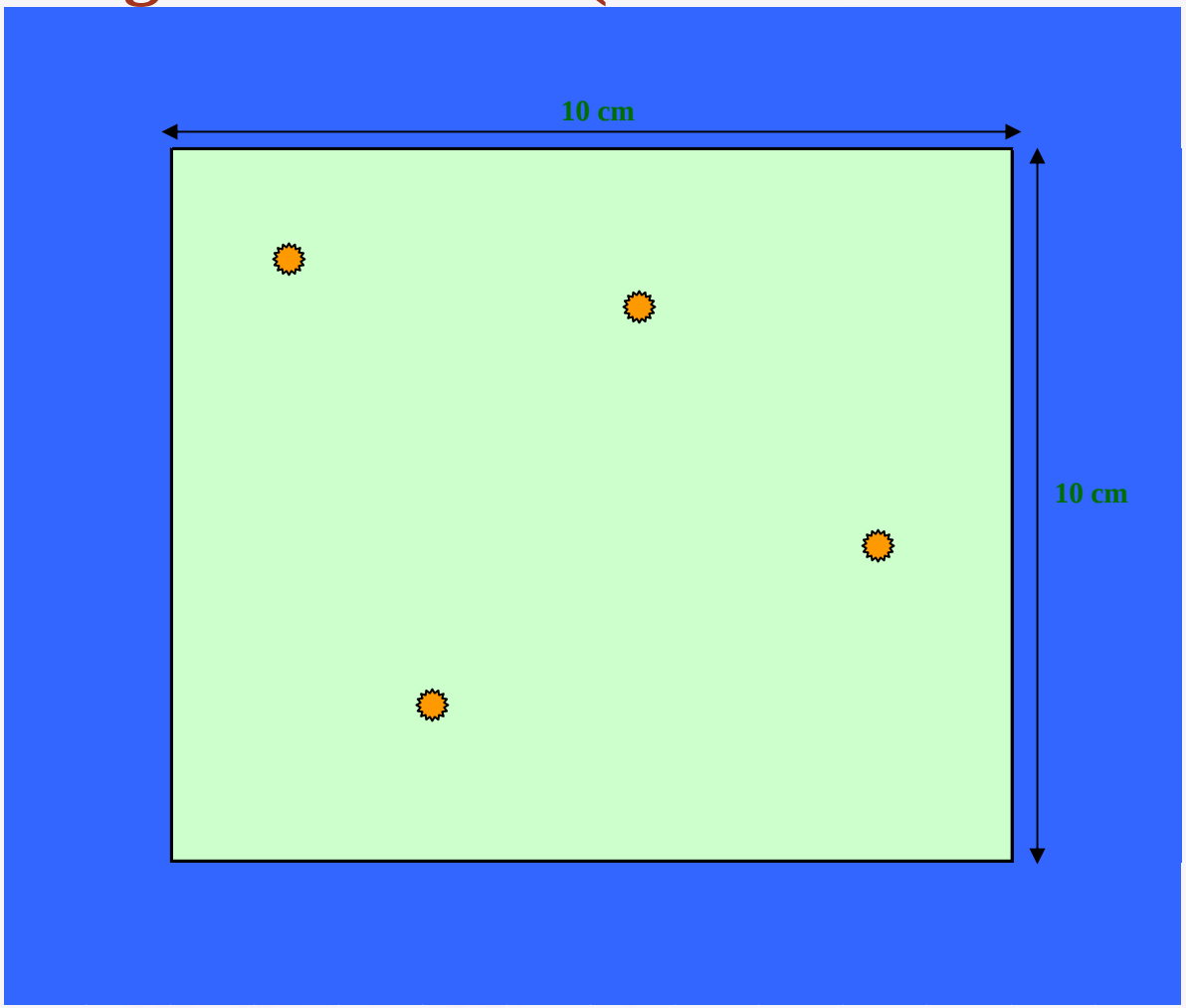
Needs 6 grams

Hand Application Rates

KG/HA	VectoBac CG 410 granules/gram	
	# PER M2	10 cm x 10 cm
5	205	2
10	**410**	**4**
15	615	6
20	820	8

Good Hand Application Rate

10 Kilogram/Hectare (AT LEAST FOUR)



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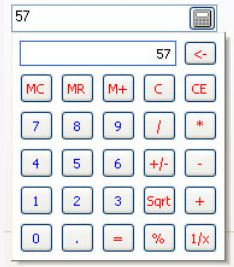
HAND APPLICATION RATES of CG

To Large Areas (> 3 meters x 3 meters)

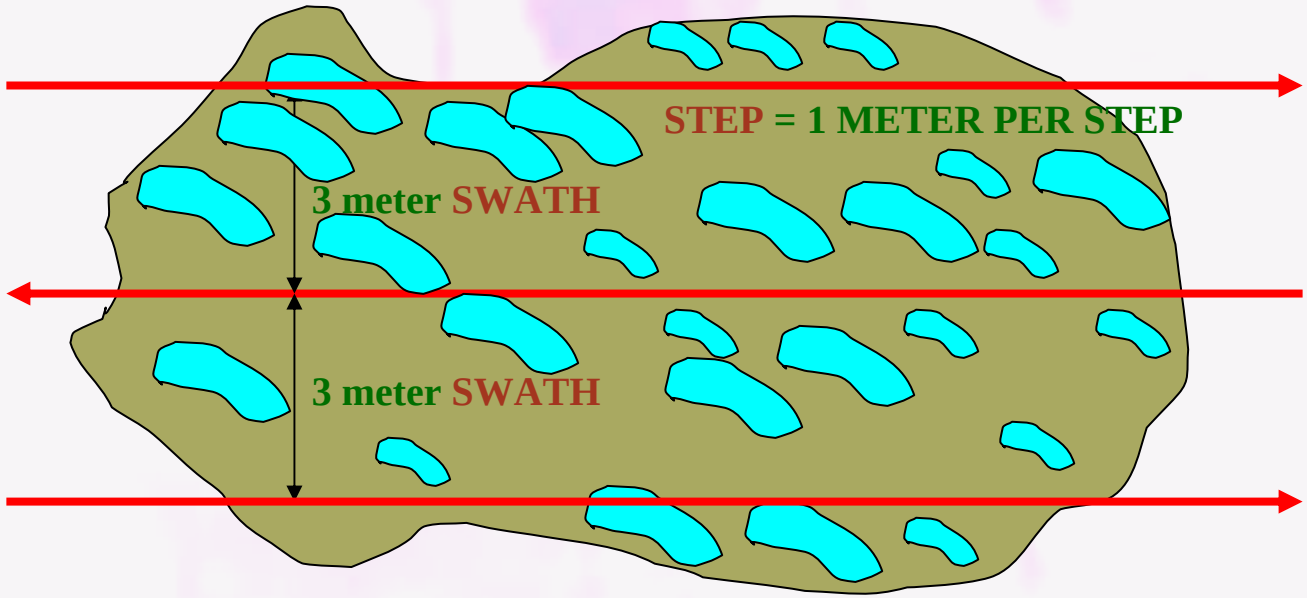
- Your Walking STEP (meters per step)
- SWATH (3 meters wide)
- Weight of your HANDFUL (of granules)

- How many steps do we take per handful?

Calibration Steps for CG Hand Application



- Measure your STEP
- Know your SWATH (3 meters)
- Know your HANDFUL WEIGHT
- Determine how many steps for each HANDFUL



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Hand Calibration for CG

RATE = (HANDFUL)/ (STEPS PER HADFUUL x SWATH x STEP)

STEPS PER HANDFUL = HANDFUL/(STEP x SWATH)

RATE = GRAMS PER SQUARE METER = 1 GRAM PER METER SQUARE
STEP = METERS PER STEP
SWATH = 3 METERS
HANDFUL = GRAMS PER HANDFUL

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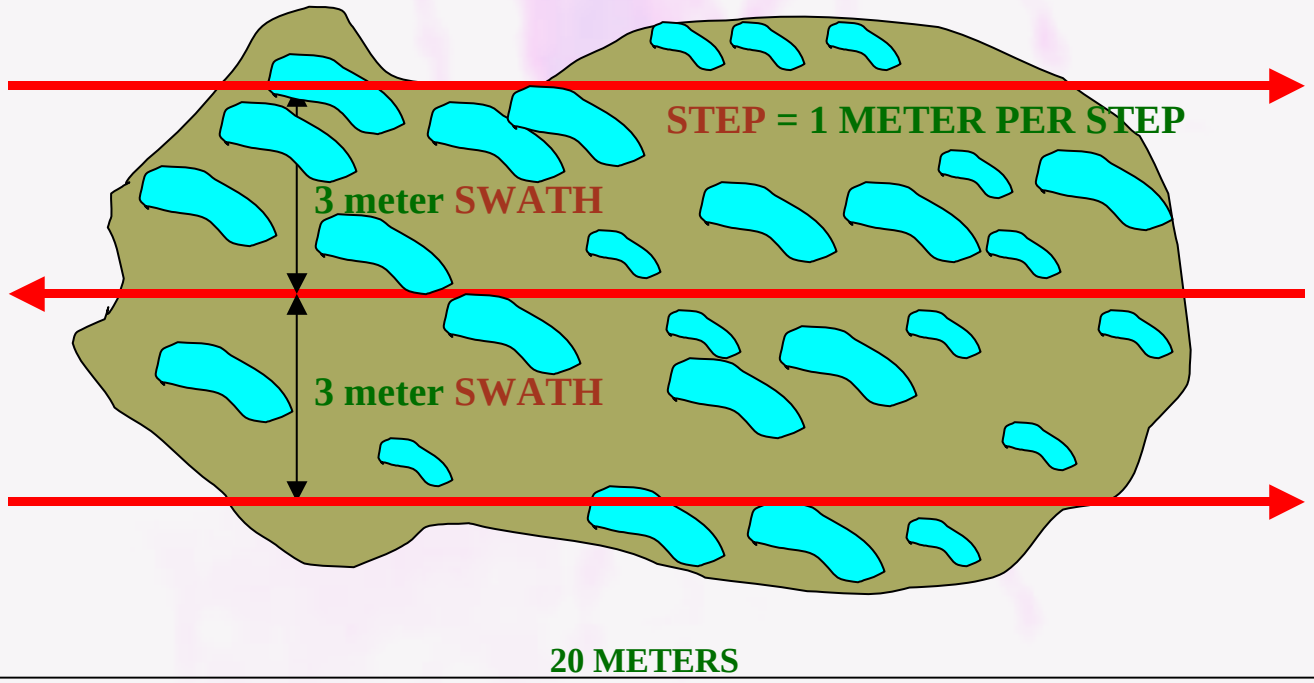
Example for VectoLex CG

RATE = GRAMS PER SQUARE METER = 1 GRAM PER METER SQUARE
STEP = METERS PER STEP = 1 METER
SWATH = 3 METERS
HANDFUL = GRAMS PER HANDFUL = 15

STEPS PER HANDFUL = 5
TOTAL HANDFULS = 12 HANDFULS



Verification of Application

- Does actual use match expected use.
  - Size of each area treated
  - Rates intended
  - Overall inventory vs use accounting
  - End of day match?
- Do the applications “look OK”

Spraying Strategies

- Responsibility for product & equipment
- Safety
- Team Work
- Material Transport – Backpack
- Start on edge
(Better to spray some land than miss water)
- Reporting material use

Take Pride in your work.
Every mosquito you kill could mean one less person getting malaria!

It will take teamwork roll back malaria.

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Let’s all push!

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Calibration For Application of VectoBac WDG

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Objective

Provide practical training in calibration for application of VectoBac WDG for control of malaria vectors.

Agenda

- **Microbial mosquito larvicide formulations**
- **VectoBac WDG**
- Application Equipment
- Calibration methods
- Verification

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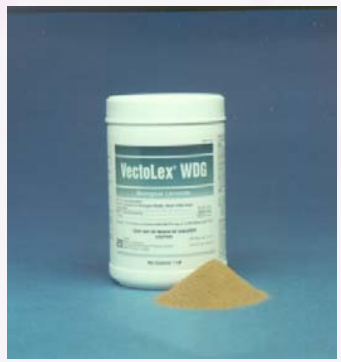
MICROBIAL LARVICIDE FORMULATIONS

- **Granules (on corncob) - CG**
- **Water dispersible granules - WDG**
- Tablets - DT
- Water soluble pouches – WSP
- Aqueous suspensions - AS
- Technical powders - TP

VectoBac® and VectoLex® Formulations CG & WDG



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VectoBac® WDG

The stability of a granule with the application flexibility of a liquid.

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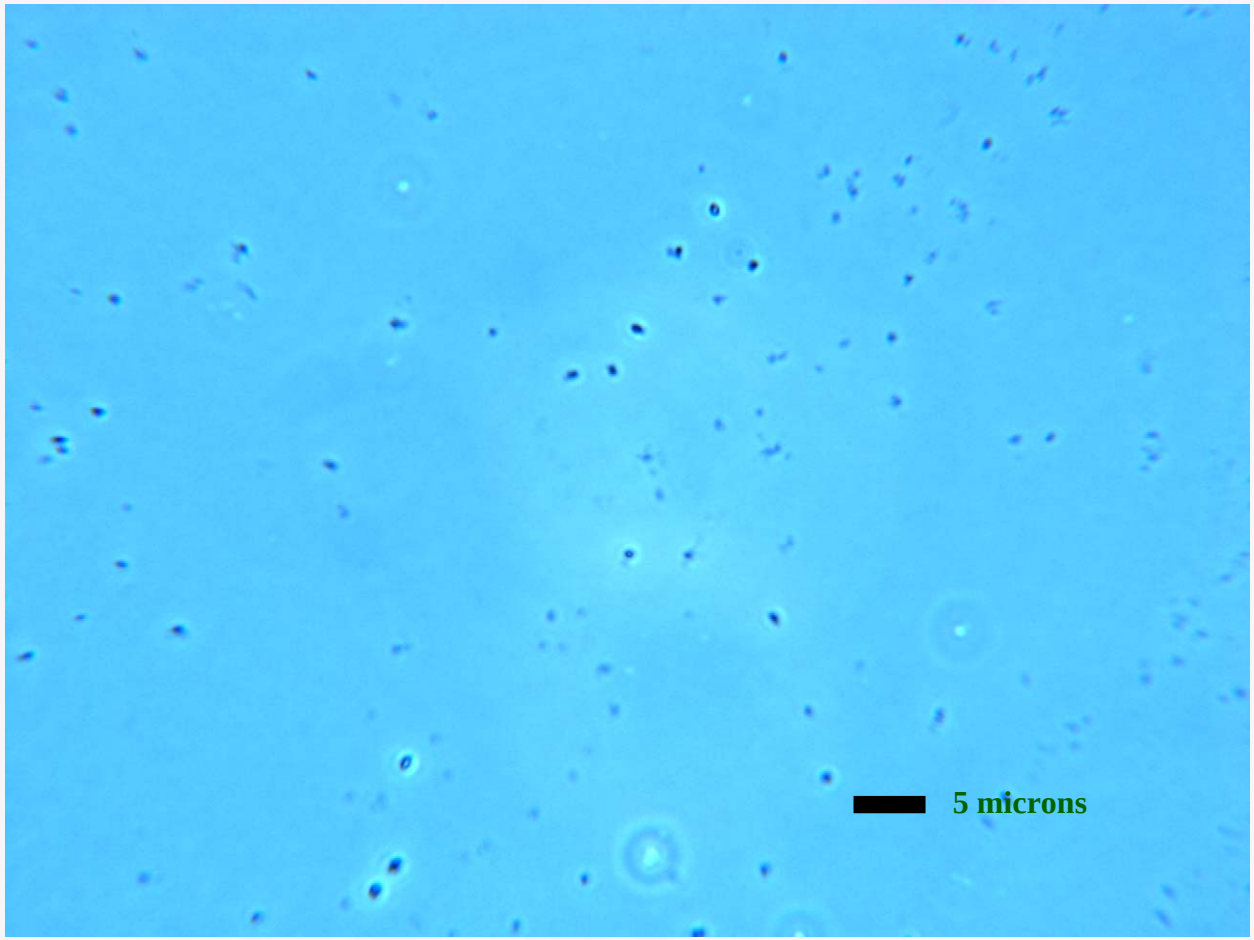
When Choose WDG Formulation?

- **Large areas with open water**
  - Breeding sites larger than 2000 sq meters (45m x 45m)
  - *Larger than 15 swaths x 15 swaths (granules)?*
  - Breeding sites requiring more than one pack (2 kg) of granules to treat
  - Inform Ward Supervisor and Inspector
- **Why?**
  - Less product to carry into the field
  - More area covered before returning
  - More economical
  - Backpack spray = wide swath

VectoBac WDG

Ideal particle size and suspension characteristics in water



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Insecticidal Crystal Protein - The larvae's Last Meal

Small particles suspend in feeding zone

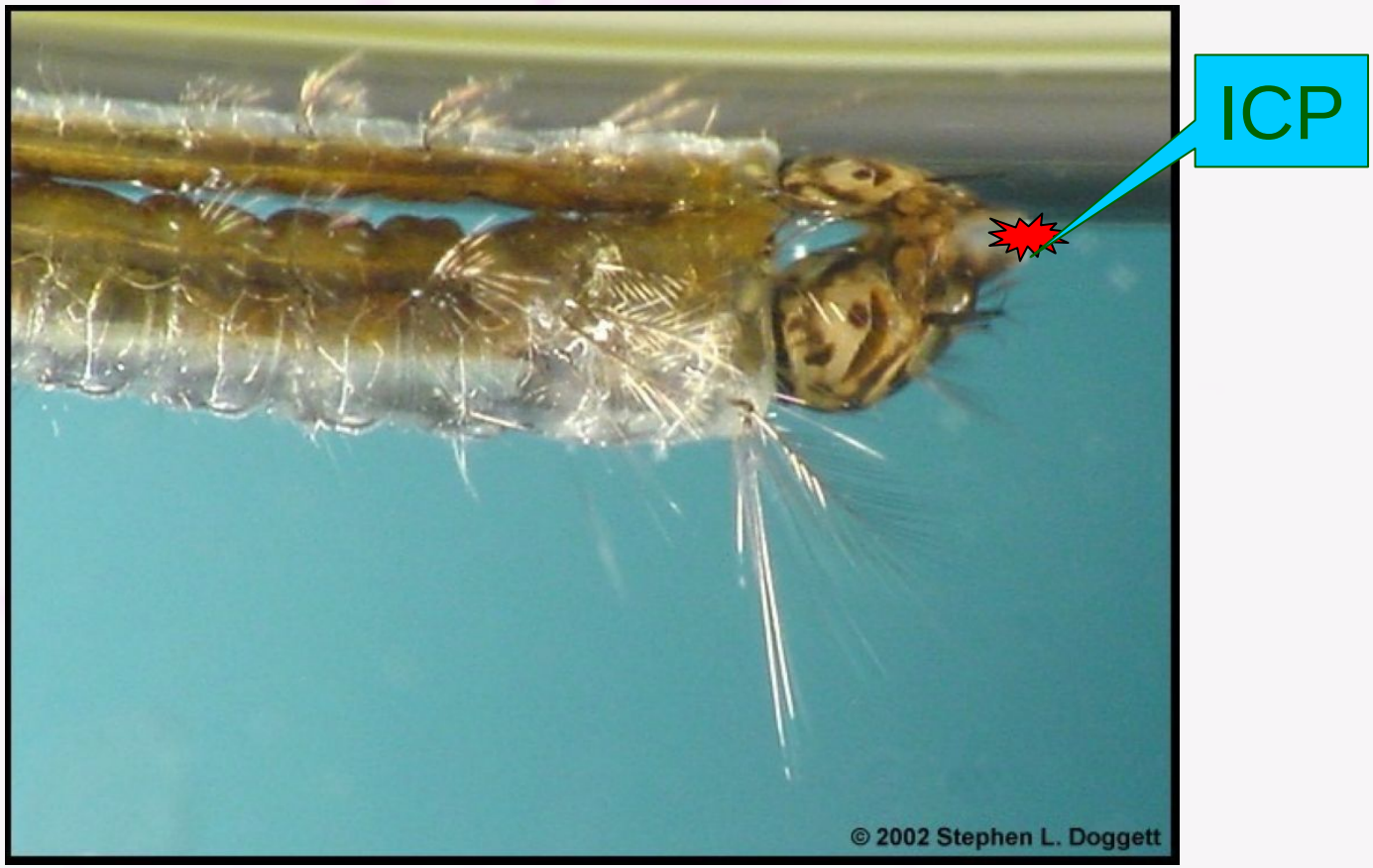

Figure courtesy of Stephen L. Doggett

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Agenda

- ✓ Microbial mosquito larvicide formulations
- ✓ VectoBac WDG
- ❑ **Application Equipment**
- ❑ **Calibration methods**
- ❑ Verification

Examples of Spray Equipment for WDG Application

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Why Calibrate?

REMEMBER OUR GOAL

“Give all the larvae a good FINAL meal.”

- Accurate dose and even coverage of the larval habitat.
- Saves material, time and money.

VectoBac WDG dose is 400 gm/ha

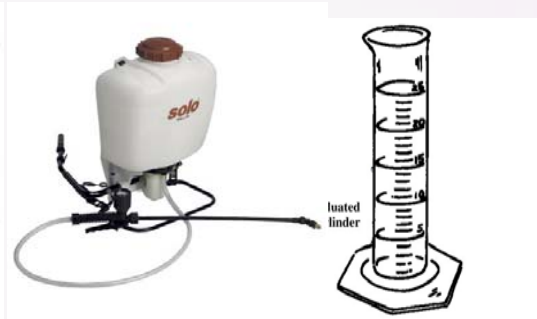
We aim to achieve this dose.

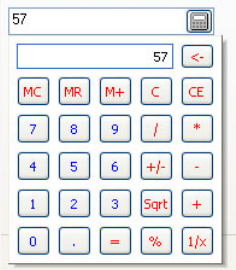
Factors That Determine Application Rate

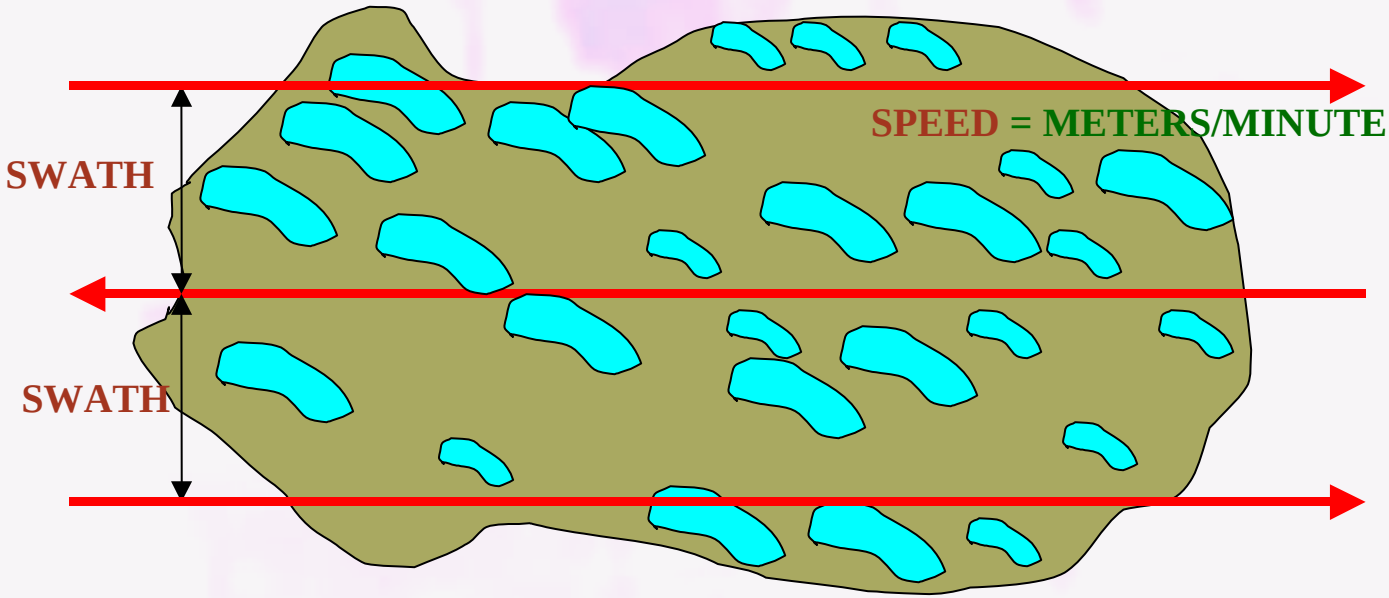
- SPEED of travel (meters per minute)
- width of SWATH (meters wide)
- FLOW rate of sprayer (liters per minute)
- DILUTION rate of product (grams per liter)

Calibration Steps for WDG

- Measure working SPEED
- Measure sprayer SWATH
- Measure sprayer FLOW
- Calculate DILUTION







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Calibration requirements

- 1 container of WDG
- 1 sprayer with D2 nozzle
- 1 Tape measure
- 1 Stop watch
- 1 Calculator
- Data forms
- Boots

Measure the distance

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Measure the walking speed to determine the required dilution

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Measure the flow rate

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Backpack Spray Calibration for WDG

APPLICATION RATE = SPRAY RATE x DILUTION

(GRAMS PRODUCT PER HECTARE) = (LITERS SPRAYED PER HECTARE) X (GRAMS PRODUCT PER LITER)

DILUTION = APPLICATION RATE / SPRAY RATE

SPRAY RATE = (FLOW x 10,000)/ SPEED x SWATH

APPLICATION RATE = GRAMS PRODUCT APPLIED PER HECTARE
SPEED = METERS PER MINUTE
SWATH = METERS
FLOW = LITERS PER MINUTE
SPRAY RATE = LITERS OF SPRAY MIX APPLIED PER HECTARE
DILUTION = GRAMS PRODUCT PER LITER OF SPRAY MIX

Measuring Swath Width

- Find a flat, clean surface such as a parking lot.
- Measure “Full Swath”
  - “Full swath” will be equal to two times the projection distance using a 180 degree sweep to distribute the material.
- Apply product with appropriate sweep while stationary and measure width covered
- Subtract 50% for overlap

Results of Swath Tests - Meters

10 METER SWATH

(10 STEPS)

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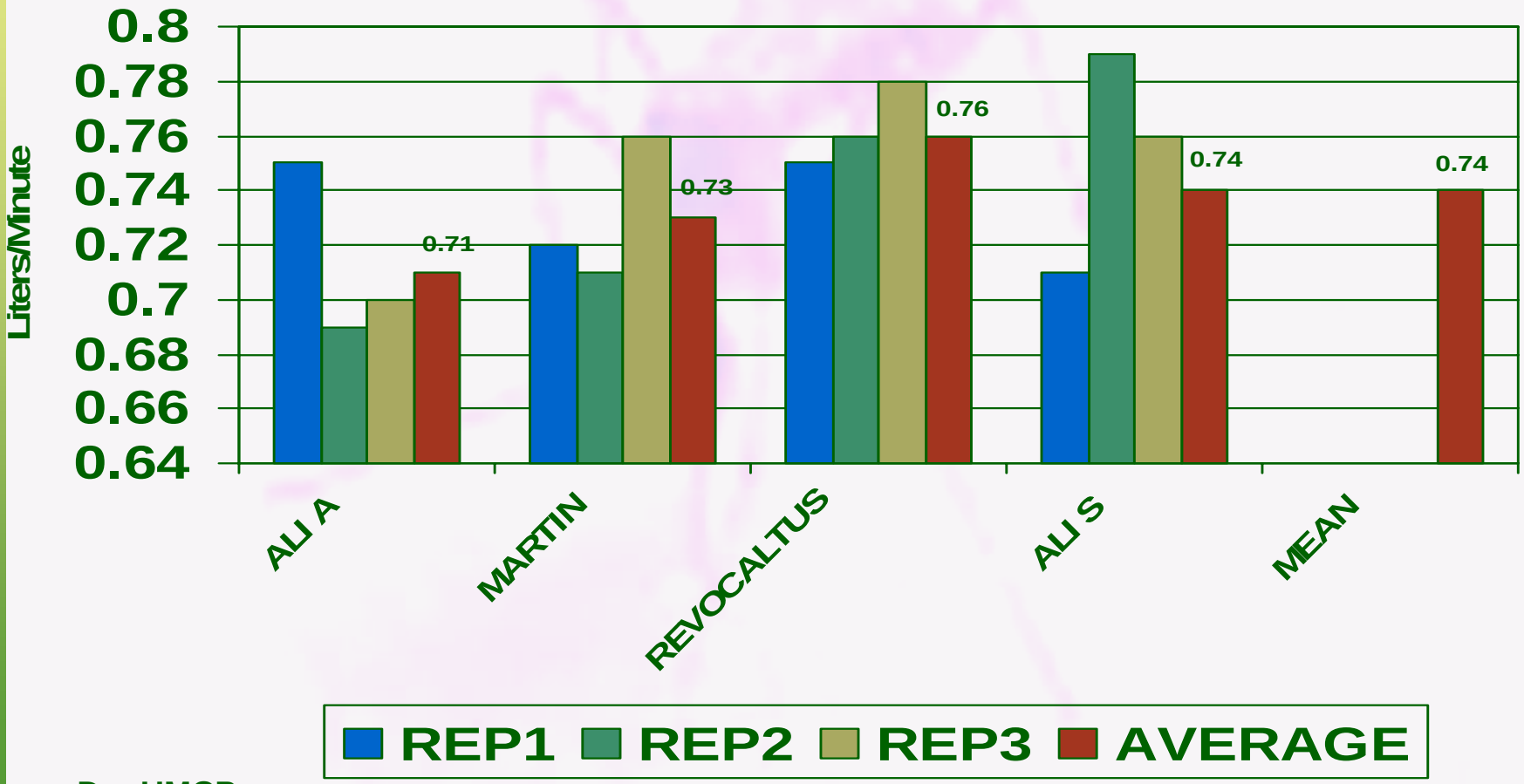
Measuring Flow Rates For WDG Sprays

- Flow rate of liquids measured with a graduated cylinder or other liquid measuring device.
- The spray pressure is maintained at a standard level, and spray is discharged into the cylinder for one minute.
- The flow rate per minute is determined by the volume of liquid in the cylinder.

Results of Flow Tests – Liters per Minute

AVERAGE = 0.74 LITERS PER MINUTE



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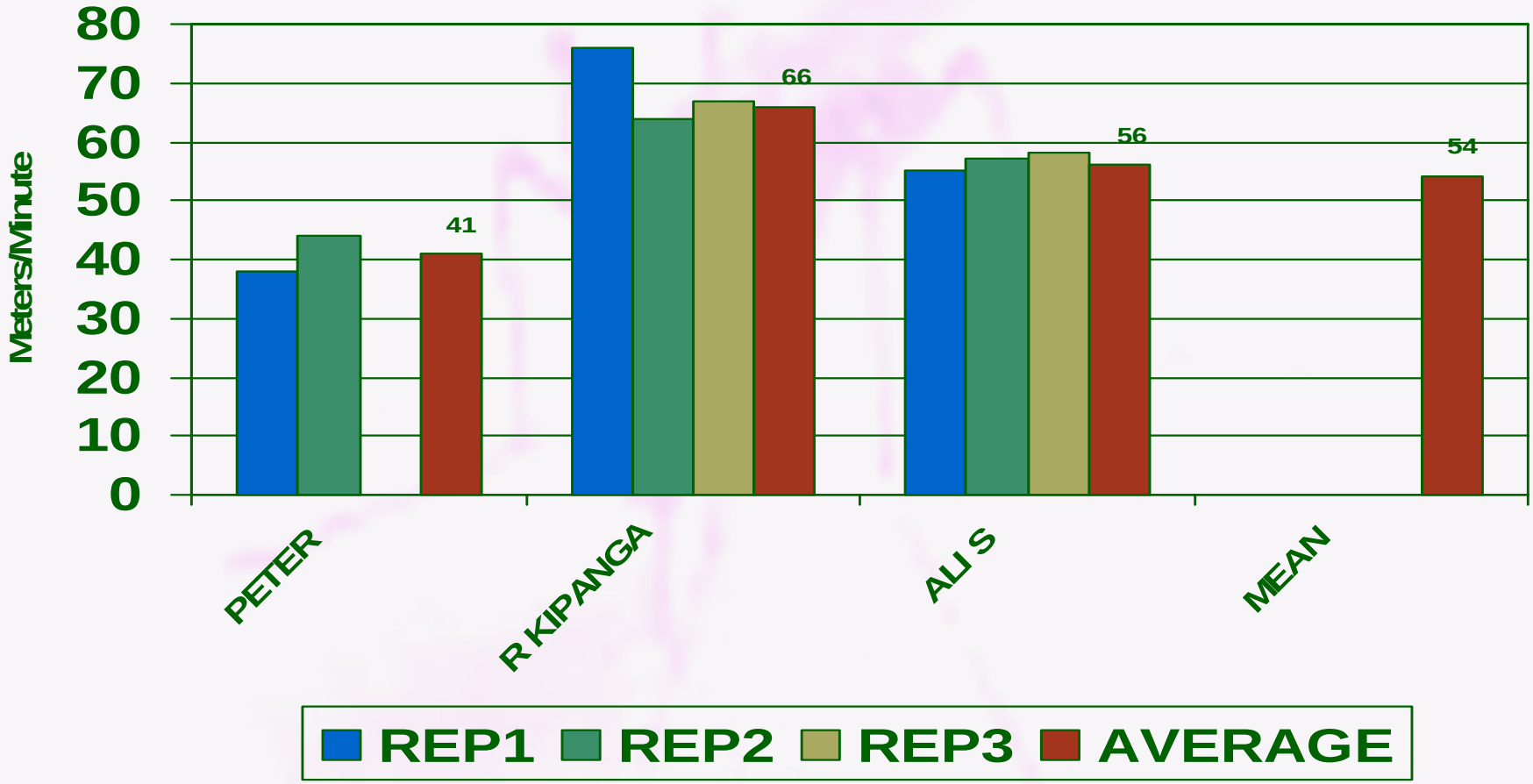
Measuring Your Working Speed

- Measure and mark 50 meters in typical habitat.
- Time how long it takes to walk 50 meters at a comfortable working pace while carrying equipment and pretending to spray.
- Repeat the measurement three times
- Make an average of your times
- 50 divided by average time = meters per minute

Results of Speed Tests – Meters per Minute

AVERAGE =



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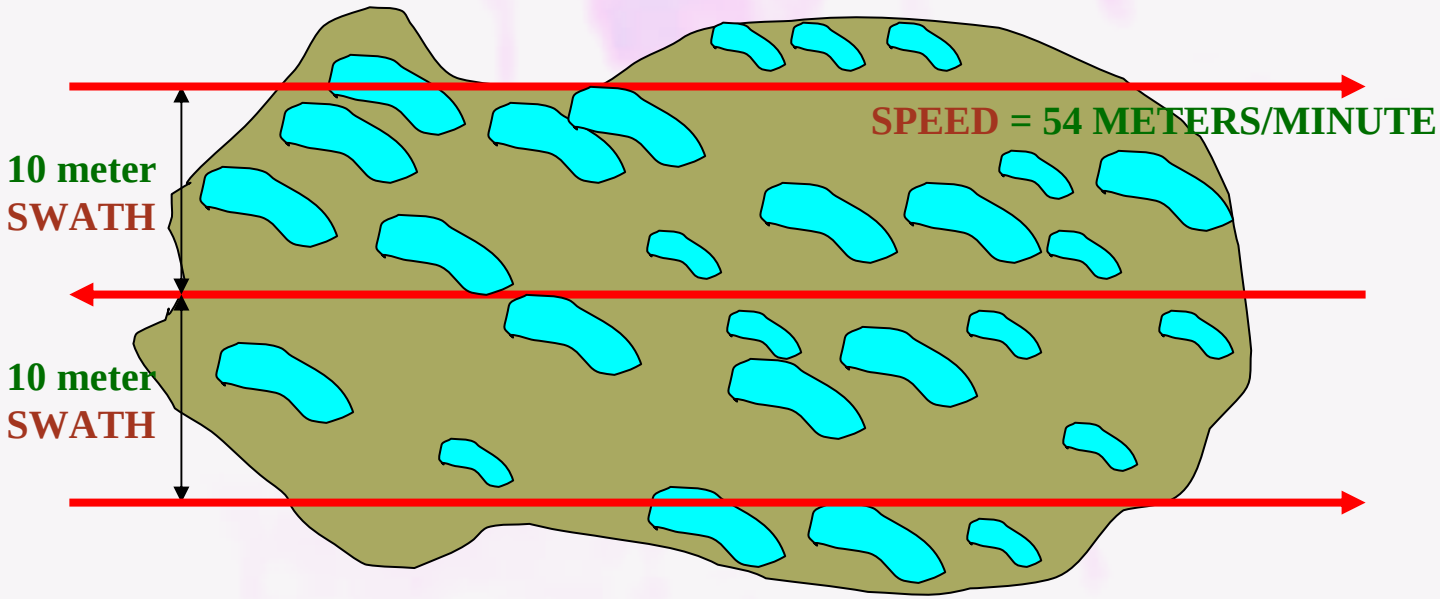
Calibration for VectoBac WDG

Solo Backpack with #2 disk (no core); On pressure setting #3 (approx 3 bar)

APPLICATION RATE = 400 GRAMS PER HECTARE
SPEED = 54 METERS PER MINUTE
SWATH = 10 METERS
FLOW = 0.74 LITERS PER MINUTE
SPRAY RATE = (0.74 x 10000) / 54 x 10 = 14 LITERS PER HECTARE
DILUTION = 400 GRAMS / 14 LITERS or 200 GRAMS / 7 LITERS



One Tank (14 l) = One Hectare

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Mixing instructions

1) Add half of the water
2) Add pre-measured WDG slowly while shaking/stirring as you add
3) Add the rest of the water
4) Shake vigorously for 2 minutes

Standardizing Calibrations

- Calibrate each sprayer
- Repeat calibration during season.
- When sweeping the spray wand, make a full swing.
- Make a fast enough sweep for even coverage.
- Standardize against expected use rates.
- Practice, Practice, Practice…

Mix carefully and thoroughly: Add and mix small amounts at a time

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Apply evenly and consistently

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Treat the entire surface area with 10 meter-wide swaths

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Verification of Application

- Does actual use match expected use.
  - Size of each area treated
  - Rates intended
  - Overall inventory vs use accounting
  - End of day match?