



White Grub Control in Turf: An IPM Approach

蟥蟲的控制: 縱合病蟲害處理方法

Gerald Henry, PhD
Associate Professor
University of Georgia

**Please note that Chinese subtitles are for
reference only.**

請注意：中文翻譯謹作參考用

Outline 大綱

- Define IPM

IPM的定義

- Pesticide Resistance

農藥的抗性

- IPM Components

IPM的組成部分

- Cultural Control

草地護養方法防治

- Biological Control

生物方法防治

- Chemical Control

化學方法防治

- IPM Rewards

施用IPM的獎賞



Integrated Pest Management

- An ecosystem-based strategy
一個以生態系統為基礎的策略
- Focus – long-term prevention of pests/damage
- Combines cultivar selection, modification of cultural practices, and biological control
焦點 — 長期預病害蟲/損壞. 結合品種選擇、更改耕作方法和生物控制
- Pesticides are used **only** after monitoring indicates they are needed
只有經監察後在有需要時才使用殺蟲藥
- Pest control materials are selected and applied in a manner that **minimizes** risks to human health, beneficial and non-target organisms, and the environment

選定殺蟲藥，以儘量減少對人類健康風險、有益的和非目標生物和環境的方式應用

Adoption and Purpose of IPM



IPM 的採用及目的

- **Adoption has been slow**

IPM 的採用一直都很緩慢

- Due to the abundance of inexpensive, effective, synthetic pesticides

因為有大量便宜及有效的合成農藥

- Limited knowledge of long-term effects of pesticides on organisms and the environment – organophosphates, endocrine disruptors, etc.

對農藥對生物與環境的長期影響的知識有限 - 有機磷農藥、內分泌干擾素等。

Adoption and Purpose of IPM

IPM 的採用及目的

- Several factors have led to an **increased interest** in IPM programs

幾個因素導致增加對 **IPM** 興趣的方法

- **pesticide resistance**

農藥抗性

- **effect of pesticides on non-target organisms**

農藥對非目標生物的影響

- **increased regulation**

監管的增加



Pesticide Resistance

農藥抗性

Pesticide Resistance

農藥抗性



- Defined as the change in the sensitivity of a pest population to a pesticide

定義為害蟲種群對農藥的敏感性的改變

- Results in the failure of a correct application of the pesticide to control the pest

未能正確使用的農藥控制害蟲的結果

- Pests do not change or mutate to become resistant

害蟲沒有改變或發生變異，成為耐藥

Pesticide Resistance



農藥抗性

- When a pesticide is applied to turf, a tiny proportion of the pest population (ex. 1 insect or weed in 10 million) may survive exposure to the pesticide

當農藥應用於草坪,只有極微小量的害蟲 (如 1 / 1000 萬昆蟲或雜草) 可能倖存.

- Due to the genetic makeup of the pest
 - 因為害蟲的基因組合
- When the pests that survive breed, some of their offspring will inherit the genetic trait that confers resistance

當殘存害蟲繁殖時,一些他們的後代將繼承這些抗性的遺傳特性

Pesticide Resistance

農藥抗性



- These pests will not be affected the next time a similar pesticide is used

這些害蟲不會受下一次使用類似的農藥影響

- If the same pesticide is applied often, the proportion of less-susceptible individuals in the population will increase

如果經常應用相同的農藥，具抗性個體的比例將會增加



Pesticide Resistance

農藥抗性



- Higher rates and more frequent applications of the pesticide are often used until eventually the pesticide provides little or no control

直到最終往往使用更高濃度和更頻繁的應用該農藥殺蟲將變為完全無效。

- At this point, the population become resistant....

至此時，整個族群已成為具抗性...



Turfgrass IPM Components

草地IPM的組成部分

- **Detection and monitoring**
偵查及監控
- **Gathering site data**
資料收集
- **Developing local pest backgrounds**
建立當地害蟲的背景
- **Developing pest tolerance levels**
建立害蟲耐藥的程度
- **Evaluating pest management practices**
評估蟲害管理方法
- **Implementing proper management**
實施正確的管理方法

Detection and Monitoring

探測及監管

- Proper pest ID is critical
正確的害蟲鑑定是關鍵
- Monitoring (**Scouting**) allows you to:
 - Identify the pest
鑑定該害蟲
 - Identify pest natural enemies
鑑定該害蟲的天然敵人
 - Apply preventative methods
採用預防方法
 - Determine if treatment is needed
決定是否需要處理
 - Determine where, when, and what type of treatment is needed
確定在何處，何時以及需要何種類型的治療
 - Evaluate and fine-tune your program
評估和微調您的程式

Scouting 偵查



- **Benefits: 好處**
 - **Early detection of pest problems**
早期檢測到病蟲害問題
 - **Improved treatment**
改良處理方法
 - **Reduction in number and cost of pesticide applications**
減少農藥應用的次數和費用
 - **Enhanced long-term control**
增強長久的控制



Scouting

偵查

- Adult Sampling 成蟲抽樣
- Grub Sampling 蟥蟲抽樣



Adult Sampling

成蟲取樣



- Light traps can be used
可以用光陷阱
 - May/June beetles
 - Masked chafers
 - Asiatic garden beetles
- Traps should be monitored 1 to 2 times per week
陷阱應每周察視的1到2次
- Plot number of beetles collected over time
定時收集及紀錄甲蟲數目
- Once # of beetles drops over 7 days in a row, peak emergence and oviposition has occurred
當甲蟲數目連續7天以上下跌,高峰期及出現產卵期已發生



Adult Sampling

成蟲取樣



- Most eggs hatch in 14 to 21 days

大多數卵在**14** 至 **21** 天內孵化

- Insecticides can be applied 3 to 4 weeks after peak adult activity

成蟲活動的高峰期後的
3 到 **4** 周可以應用殺蟲劑



Grub Sampling

取樣



- Grub populations assessed when they are large enough to be seen

當他們都足夠大及肉眼能看到時評估蟥蟲的數目

- Sample a 1 ft² area

在 1 平方呎面積

- Use a shovel or 4-inch cup cutter

用鏟或 4 吋的打洞器

- Take samples in a zigzag pattern

以之字形形式中抽取樣本



Pest Background

害蟲背景



- **Become familiar with local turfgrass pest insects**

熟悉當地的草坪害蟲

- **Understand their biology, reproduction, etc.**

瞭解他們的生物學、生殖等

- **Pest information can be obtained from University Extension Services**

蟲害資料可從大學推廣服務中心取得

- **Also important to recognize natural enemies of common pests**

此外認識到的常見害蟲的天敵亦很重要



Developing Pest Tolerance Levels

建立蟲害的容忍度

- **Economic (agronomic) thresholds (developed from research) are based on three main factors:**

經濟 (農藝) 的極限值 (從研究得悉) 基於三個主要因素：

1. physical damage caused by the presence of the pest at a known infestation level

由於害蟲的存在已知感染程度所造成的物理損壞

2. the revenue losses resulting from that damage

這種損害所引起的收入損失

3. the cost of treatment

治療的費用

- **Can these vary or even apply to turf management?**

這些可否改變，或甚至適用於草坪管理嗎？





Developing Pest Tolerance Levels

建立蟲害的容忍度

- Most turf can tolerate some pest presence without compromising appearance or function
- 大多數草坪可以容忍一些害蟲存在不影響其外觀或功能



Evaluating Pest Management Practices



評估蟲害管理方法

- Document management practices (previous and current)

文檔的管理方法(以往和當前)

- Monitor the effectiveness of newly implemented practices

監察新實施的做法成效

- Did pest numbers decrease enough to prevent damage?

害蟲數量的減少足以防止損壞嗎？

- Were treatments cost effective?

治療成本有效嗎？

- Is the problem likely to recur?

問題會復發嗎？

Implementing Proper Management

實施正確的管理



- When pest numbers threaten to exceed tolerance levels, there are a wide variety of strategies and tactics available to solve pest problems

當害蟲數量要超出容忍度時，可有各式各樣的戰略和戰術以解決蟲害問題



1st Step - Maintain Healthy Turf

第一步 - 維持健康的草地



- **Use the right turfgrass species/cultivar**
使用正確的草坪草種類/栽培種
- **Reduce soil compaction/thatch**
降低土壤板結/死草層
- **Maintain proper mowing height**
保持適當的割草高度
- **Deep, infrequent irrigation to encourage rooting**
深及不頻密的灌溉以鼓勵生根
- **Conduct soil tests to improve fertility practices**
進行土壤測試提高肥力

Influencing Factor

影響因素



- Grubs attack turf areas irregularly from year to year

每年蟥蟯不規則地攻擊草坪區。

- Two major factors influence grub numbers and severity of damage:

兩個主要因素影響蟥蟯的數位和損害的嚴重性：

- Soil Moisture

泥土溼度

- Rainfall

雨量



Influencing Factors

影響因素



- In years with normal or above normal rainfall, grub populations increase
年降雨量如正常或高於正常蟥螭數目亦增加
- Turf next to ornamental plants favored by the adults are more commonly attacked
草坪在觀賞植物旁邊更易受到成蟲的攻擊
- Black turfgrass ataenius and green June beetle adults are attracted to turf with decaying thatch layers
Black turfgrass ataenius及成蟲的green June beetle adults通常為具腐敗死草層的草地所吸引

Cultural Control

以草地護養方法防治



Host Plant Modifications

改用另一草品種

- **Water/Irrigation Management**

水/灌溉管理



Host Plant Modifications

改變寄主植物



- Certain species of adult beetles prefer specific host plants

某些種類的成蟲甲蟲喜歡某些特定的寄主植物

- Ex. Where Japanese beetles are common, do not plant roses, grapes, and linden trees around turf

例1: 在Japanese beetles多的地方，不要在種植玫瑰, 葡萄和 linden trees 周圍種草.

- Ex. May/June beetles prefer oaks

例2: May/June beetles 喜愛 Oak Tree

Ex. June beetles feed on ripening fruit such as peaches

例3: June beetles 喜歡成熟的果實例如桃子.

- Fine and tall fescues are not as severely attacked as KBG and perennial ryegrass

細羊茅亦較 KBG 和多年生黑麥草不受嚴重攻擊.

Water Management

水的管理



- All white grubs require moist soil for their eggs to hatch

所有蟥螋都需要潮濕的土壤以孵卵

- Young larvae are also very susceptible to desiccation

年輕的幼蟲也是非常容易脫水

- Some areas can stand a little moisture stress

一些地方可以抵受小量的水分壓力

- Do not water in July and early August

不要在7月及8月澆水

- White grubs and young larvae are present

蟥螋和年輕的幼蟲是在這期間存在

Water Management

水的管理



- On the other hand, moderate grub infestations can be grown out

另一方面，適量的蟥蟲感染可以回復

- Adequate water and fertilizer applied in August through September and again in May
- Peak grub feeding at this time

最高飼食期

- This strategy is usually not preferred

通常不會採用這策略

- Mammals may dig up the turf searching for larvae

哺乳動物可能挖掘草皮尋找幼蟲

- Irrigation bans may occur

不準淋水

Direct Pest Suppression

直接抑制害蟲

- When previous methods are not sufficient to solve the pest problem, direct suppression methods can be employed

當以前的方法不足以解決蟲害問題
方法

- Biological

生物

- Chemical

化學



Natural/Biological Controls

自然/生物方法防治

- Parasites

寄生蟲

- Milky Spore Disease

乳孢子菌病

- Parasitic Nematodes

寄生線蟲

Parasites

寄生蟲

- Several parasitic wasps (*Tiphia* spp.) and scoliids attack white grubs

幾種寄生蜂 (*Tiphia* spp.) 和 Scoliids 攻擊蟻蟥

- Masked chafers and green June beetles are most commonly attacked

Masked chafers and green June beetles 最常受攻擊

- Parasitic wasps may take 2 to 3 years to build up effective populations

可能需要 2 至 3 年才能建立起有效的寄生蜂數量

– Turf damage may be extensive by this point

在這期間草肥的損壞可能很大

Parasites

寄生蟲



Milky Spore Disease

乳孢子菌病

- Several strains of bacterium, *Bacillus popilliae*, may attack white grubs

幾類的*Bacillus popilliae*，可能攻擊蛴螬

- Most active against Japanese beetle grubs

對Japanese beetle的幼蟲的侵襲最有效

- Picked up by feeding grubs

由蛴螬飼食時侵入

- Causes the body fluids to turn a milky-white before death

– 導致體液在死亡之前變為乳白色

Milky Spore Disease

乳孢子菌病

- Fresh bacterial preparations should be used

應使用新鮮製的細菌製劑

- 3 to 5 years are needed to provide lasting controls

需的 3 至 5 年以達到持久的控制

- Recent University research indicates that current products available have not performed well

大學最近的研究表明當前可用的產品有不錯表現

- Populations are environmentally sensitive

蟲的數目對環境很敏感

Milky Spore Disease

乳孢子菌病



Parasitic Nematodes

寄生線蟲

- Parasitic nematodes in the genera *Steinernema* and *Heterorhabditis* are effective against white grubs

*Steinernema*及*Heterorhabditis*兩屬的寄生性線蟲可有效防治蟥蟯

- Nematodes do not seem to be effective from one season to the next

對線蟲的藥效似乎不可能有效地傳到下一個季節

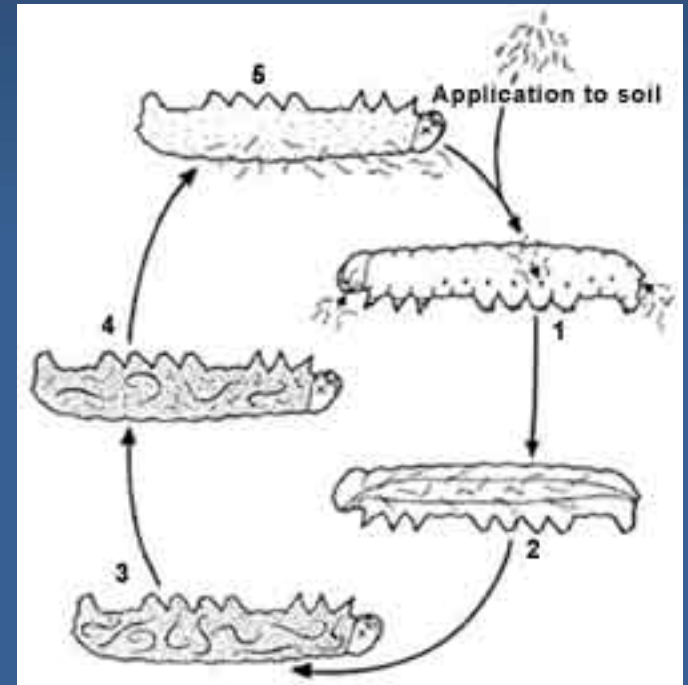
- 80% control was observed with *H. heliothidis*

- Nematodes burrow into the grub, feed, and reproduce

80% *H. heliothidis*線蟲可鑽入蟥蟯體內,侵食及繁殖

Parasitic Nematodes

寄生線蟲



Chemical Control

化學防治



- Preventive Applications
預防性施用
- Early Reactive Applications
預早針對性施用
- Late Season Reactive Applications
季晚針對性施用
- Spring Applications
春季施用



Preventive Applications

預防方法



- Typically, applying pesticides for the control of anticipated grub populations is not recommended

通常情況下，不建議應用農藥作預期的蟥螞控制

- Occurrence is rather sporadic

其出現是較零星的

- In areas where adult activity has been observed or perennial infestations have occurred, preventive applications may be warranted

在出現過成蟲活動或常年蟲災發生的地區，可能需要預防性控制方法

Preventive Applications

防治方法



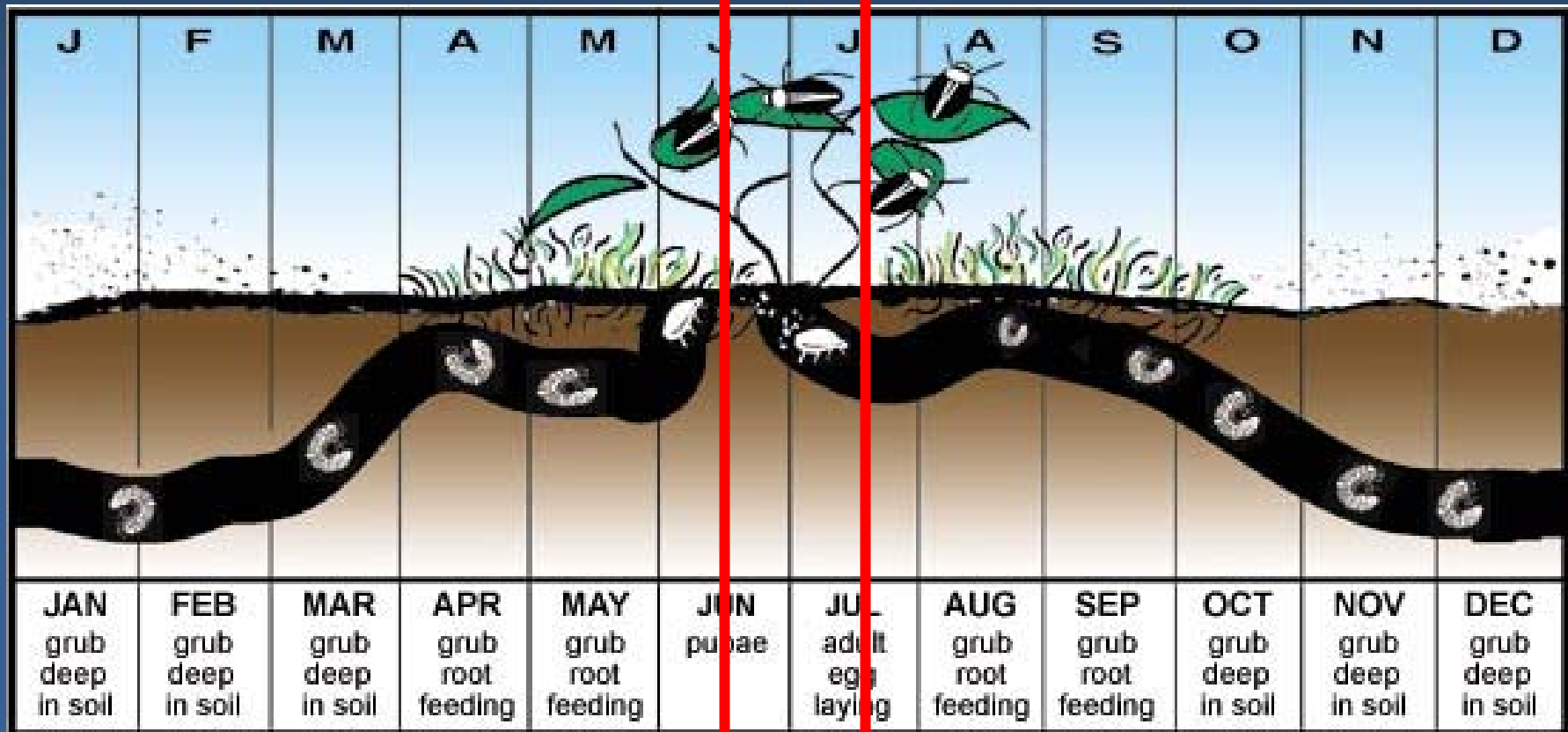
- **Registered Products**

- 註冊農藥(US)

- Chlorantraniliprole (Acelepryn)
 - Imidacloprid (Merit)
 - Thiamethoxam (Meridian)
 - Clothianidin (Arena)
- **Optimal timing is mid-June to mid-July**
最佳施用時間是6月中至7月中

Preventive Applications

預防方法



Preventive Research

預防研究



- **Location: Tall fescue home lawn**
地點: 高羊茅居屋草地
- **App. Timing: May 27th**
時間: 5月27日
- **White Grub Species: Masked Chafer**
蟥蟮品種: **Masked Chafer**
- **Insecticide treatments:**
選用農藥
 - Acelepryn (6.7 or 10 fl oz/A)
 - ImidaPro (20 fl oz/A)
 - Merit (20 fl oz/A)
 - Arena (80 or 120 lbs/A)

Preventive Research

預防研究



- In mid-October a 1 ft² area was excavated from each plot and grubs were counted

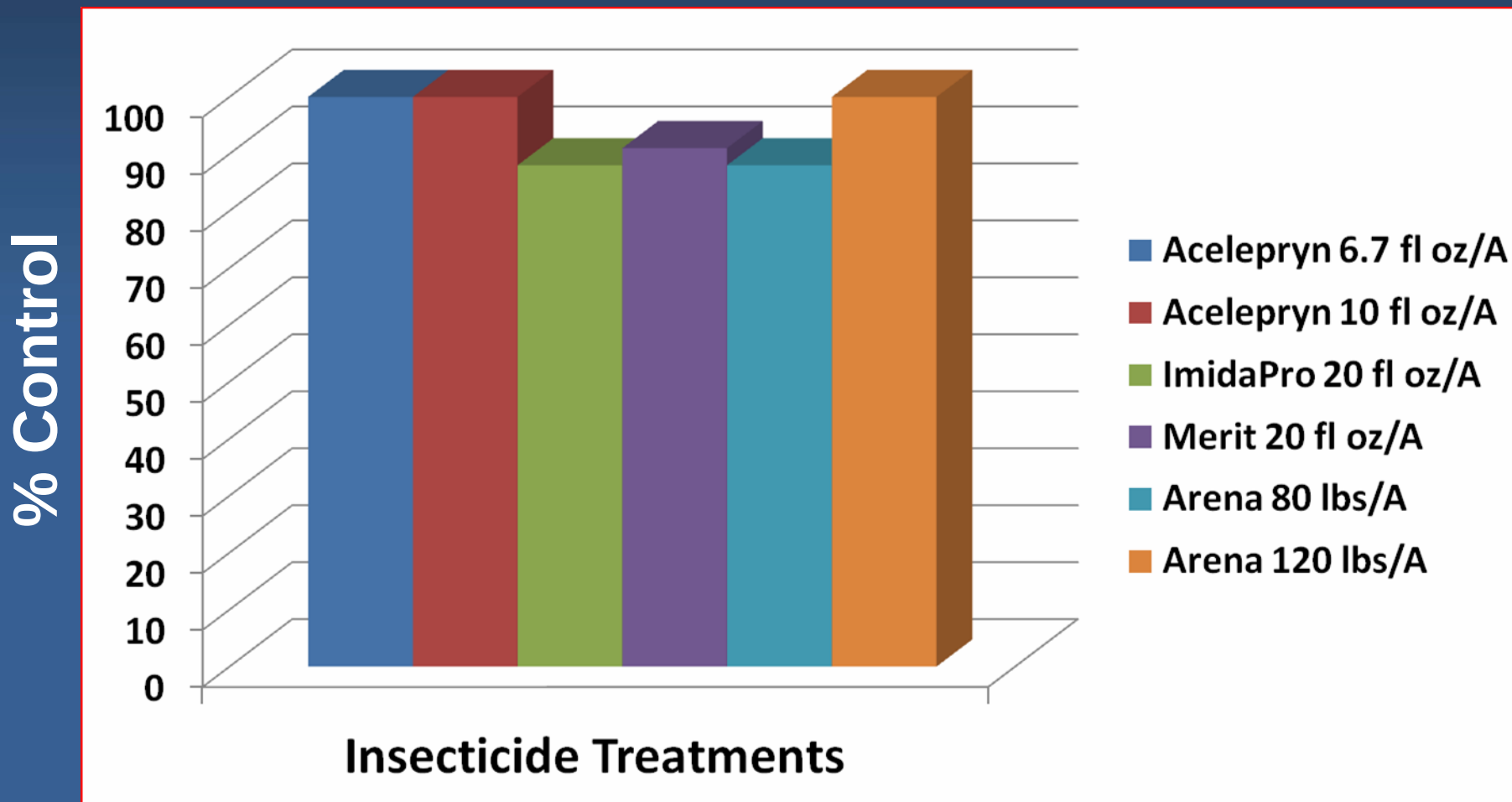
在 **10** 月中旬, 在每一地塊掘起**1**平方面積泥土和記錄蟥螞數目

- Untreated check plots averaged 18 grubs/ft²

未經的處理的地塊平均 **18** 蟥螞/ft²

Preventive Research

預防研究



Masked Chafer Control 20

Early Reactive Applications



預早針對性施用

- **Most insecticides have a short active residual period**
大多數殺蟲劑有一短暫的殘存活力期
 - **3 weeks or less**
三或小於三星期
- **Must be used when grubs are actively feeding**
必須在蟥蟯積極餵養時施用
- **Apply late enough to catch all of the population**
儘遲施用以捕捉所有的族群
- **Usually observe 75 to 90% control**
通常可達**75-90%**控制
- **Reapplication may be necessary when populations are high**
當蟲的數目仍高時,須再施藥

Early Reactive Applications

預早針對性施用



- Registered Products

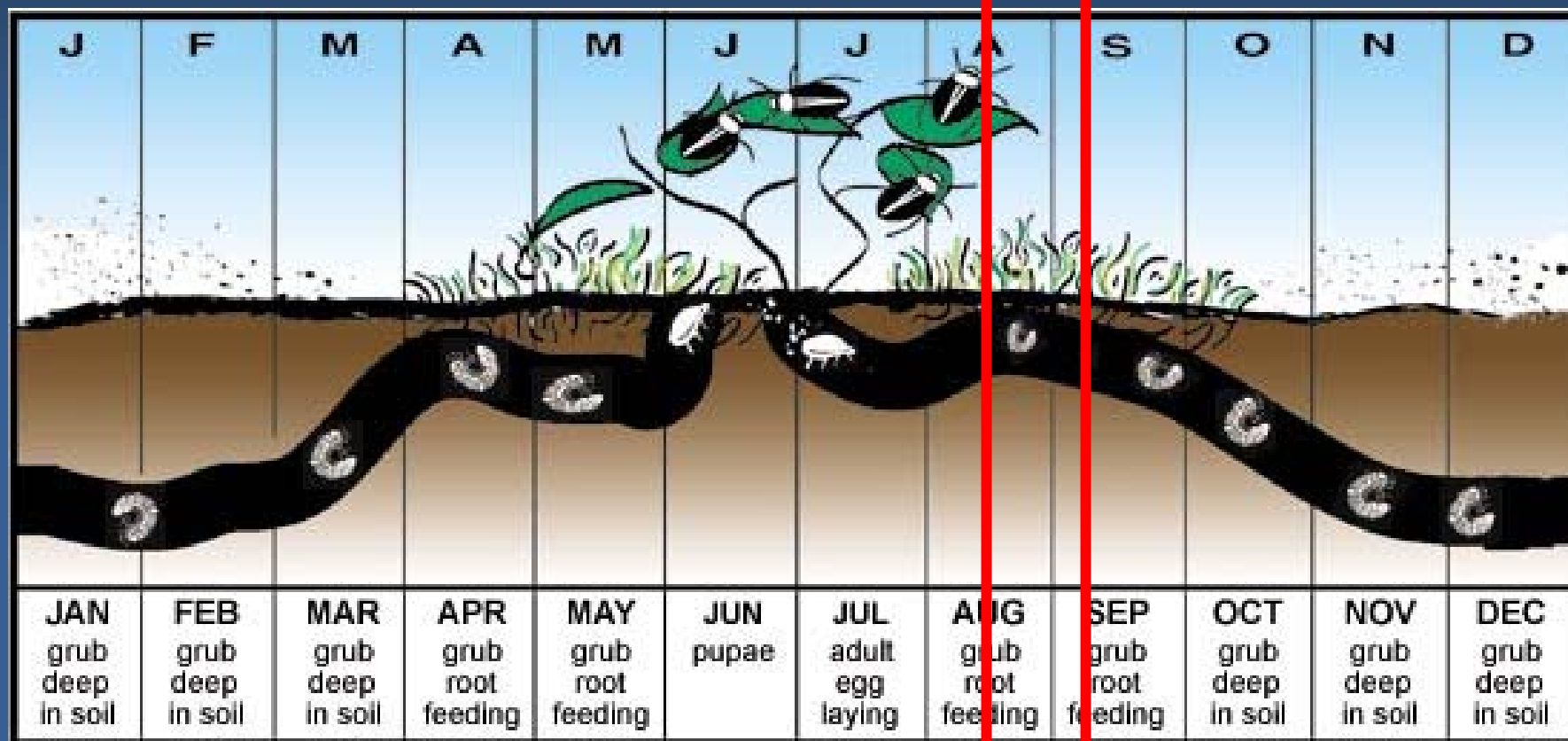
註冊農藥

- Thiamethoxam (Meridian)
- Clothianidin (Arena)
- Trichlorfon (Dylox)
- Carbaryl (Sevin)
- Optimal timing is mid-August to early September

最佳施用時間是月中至9月初

Early Reactive Applications

預早針對性施用



Late Season Reactive Applications



季晚針對性施用

- Sometimes populations go undetected until September or October

其存有時在要直到 9 月或 10 月才查覺

- Grubs are usually third instars and may be 70 to 80 times the body weight of a newly hatched grub

三齡蟥蟯通常可能是 70 至 80 倍的新孵出的幼蟲身體重量

- Chemical control is difficult

化學防治是很難

Late Season Reactive Applications



季晚針對性施用

- **Most successful insecticides:**

最有效的農藥

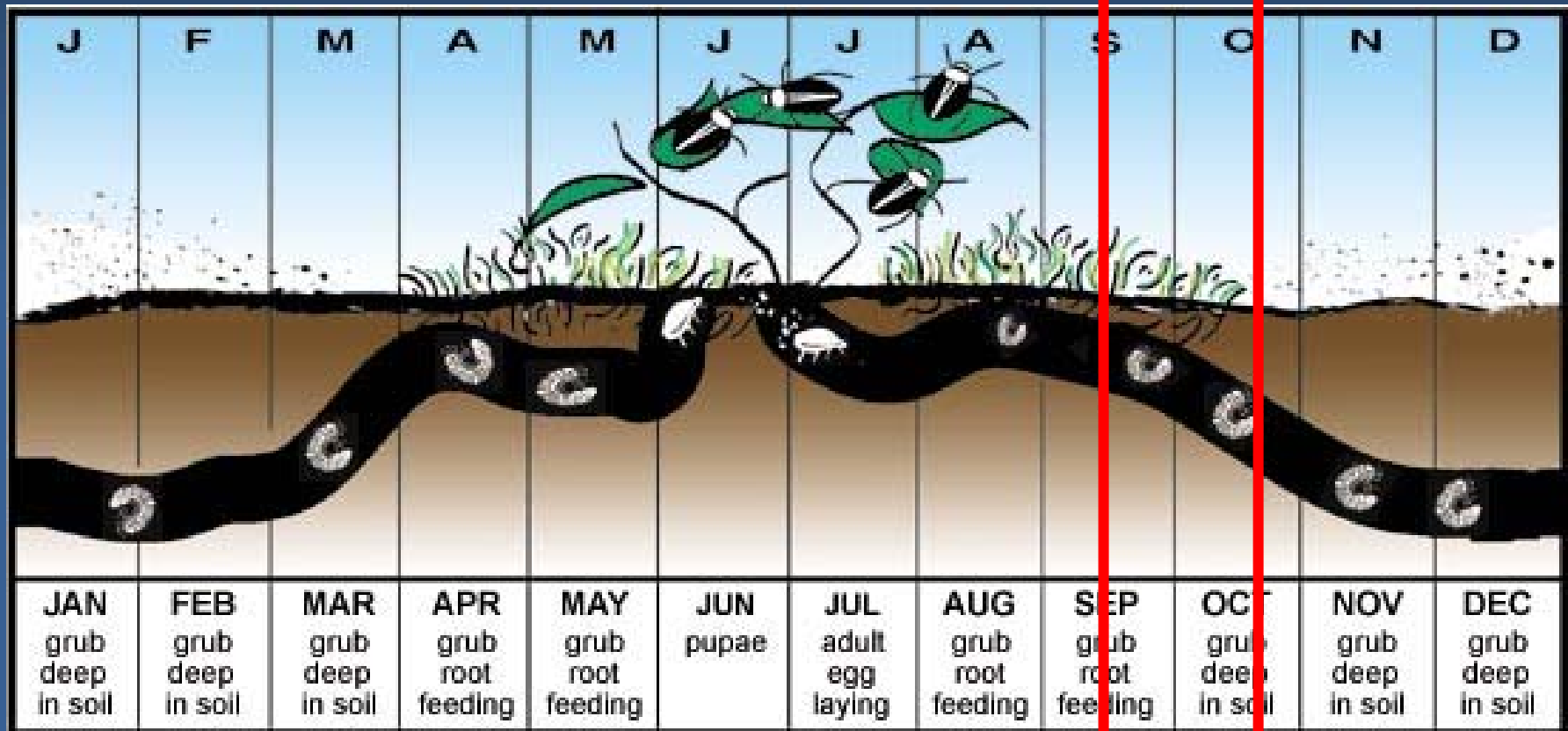
- Carbaryl (Sevin)
- Trichlorfon (Dylox)
- Clothianidin (Arena)

- **Irrigation after application will help keep grubs near the soil/thatch interface and wash in the pesticide**

施藥後灌溉後有助保持蟥蟮存在於土壤/死草層介面和帶進農藥

Late Season Reactive Applications

季晚針對性施用



Late Reactive Research

季晚針對性研究



- **Location: Tall fescue pots (greenhouse)**
地點: 長有高羊茅小鉢 (溫室)
- **White Grub Species: Masked Chafer**
蟻糟品種: Masked Chafer
 - 20 grubs were placed in each pot prior to seeding
將20 蟻糟被放置在每個鉢
- **Insecticide treatments:**
選用的農藥
 - Acelepryn (8 or 10 fl oz/A)
 - Arena (80 or 120 lbs/A)
 - Meridian (17 oz/A)
 - Dylox (300 fl oz/A)

Late Reactive Research

季晚針對性研究



- Each pot was destructively harvested 1 month after treatment and grubs were counted

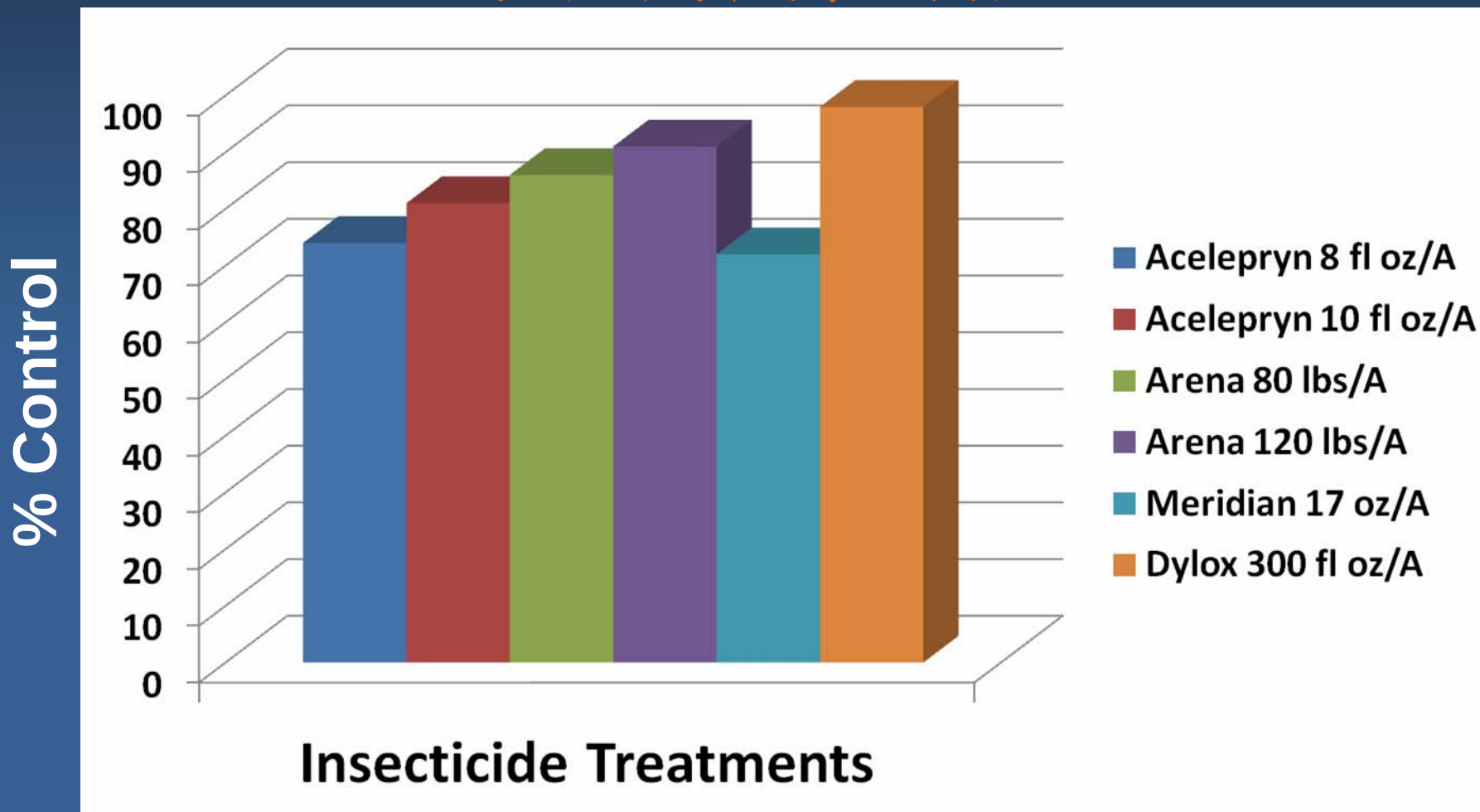
1 個月治療後在每個鉢內點計蟥蟯數目

- Untreated check plots averaged 16 grubs/pot

未經的施藥者平均為 16 蟥蟯/鉢

Late Reactive Research

季晚針對性研究



Masked Chafer Control 4

Spring Applications

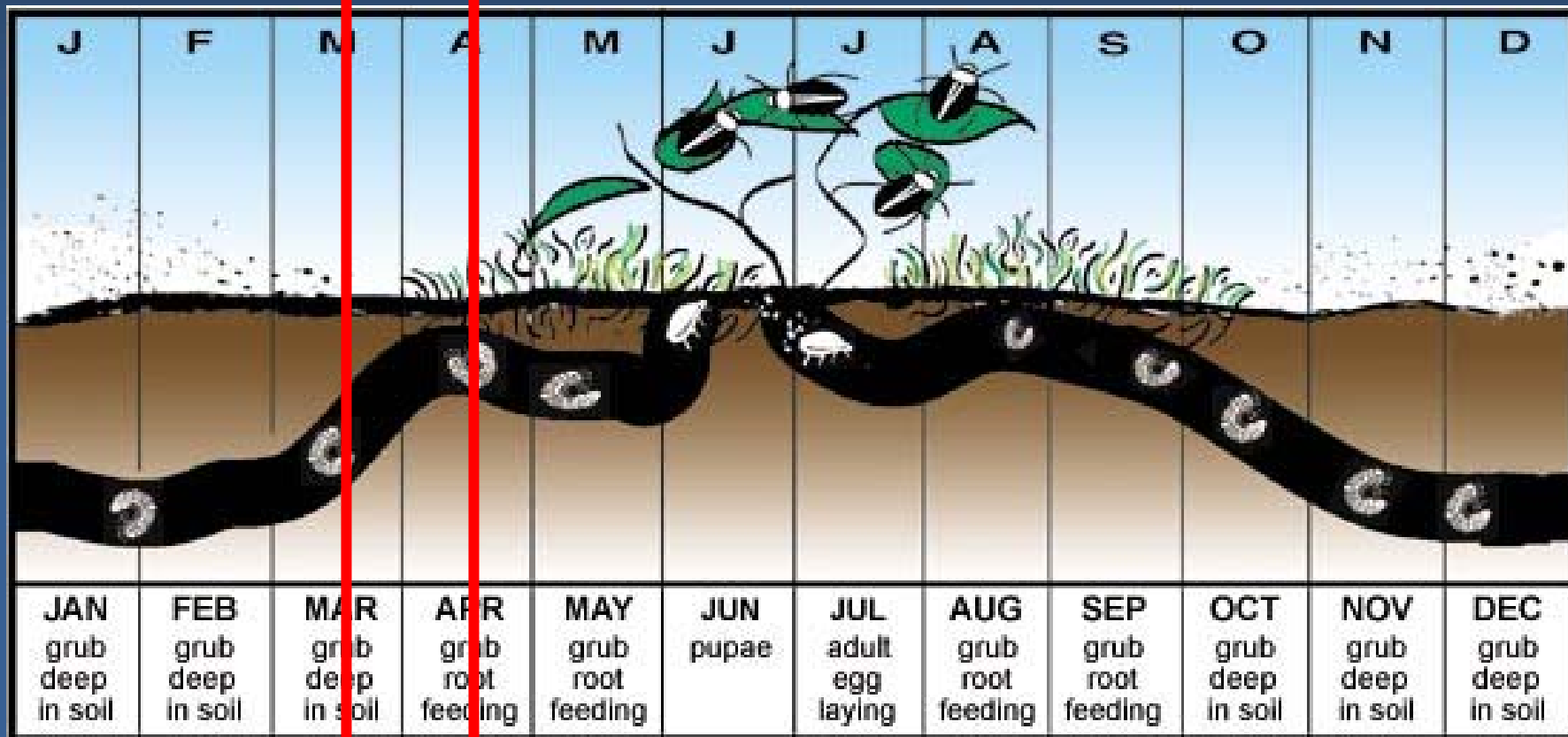
春季施藥



- **Spring treatments are often ineffective**
春天施藥往往成效不大
- **Grubs feed during the spring**
蟥螋在春天進食
 - very large
體型很大
 - time for treatment is very small
施藥的時間是非常短
- **Make sure grubs are actively feeding at the soil/thatch level before application**
請確保施藥前蟥螋在泥土/死草層積極進食
- **Most effective insecticides:**
最有效的農藥
 - Carbaryl (Sevin)
 - Trichlorfon (Dylox)
 - Clothianidin (Arena)

Spring Applications

春季施药



Turfgrass IPM – Rewards

草地IPM - 獎賞

Environmental consequences and costs of IPM

IPM對環境的後果和成本

- initially more expensive due to time, purchase of specialized equipment, training, and reference material

最初由於時間, 購買專門的設備, 培訓和參考材料而較為昂貴

- long run - reduce pesticide use, better decision making and timing of applications

長遠而言-減少農藥的使用, 更好的決策和應用的時間

- Avoid pesticide resistance

防止對農藥產生抗性

A photograph of a golfer's lower leg and foot in a white shoe, standing on a lush green golf course. A golf club head is positioned near a white golf ball on the grass. In the background, there are rolling green hills and mountains under a clear sky.

Questions ?

問題？