

## Varroa Mite Control Using APINOVAR Bottom Boards, Resistant Bee Stock and Organic Acids





by Jean-Pierre Chapleau  
Les Reines Chapleau inc  
February 2006

### LES REINES CHAPLEAU




Queen, nuc and honey production  
700 hives, 2100 mating nucs

**Research activities**

- ◆ Screen bottoms
- ◆ Breeding for resistance
- ◆ Formic (flash)
- ◆ IPM strategies

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### PLAN

**Generalities**


- ◆ Principles of IPM
- ◆ The relation bee-varroa and IPM

**Our IPM system**

- ◆ Components
- ◆ Monitoring
- ◆ Thresholds and treatments
- ◆ The flash method
- ◆ Oxalic
- ◆ Sampling and counting: technical aspects and tips



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### INTEGRATED PEST MANAGEMENT

- ◆ Different way of dealing with disease: medication is not the only answer
- ◆ Better understanding of the bee-varroa relation required
- ◆ Work more with the bee: recognise its defence capacity and support it
- ◆ Information system on the situation necessary (monitoring)
- ◆ Intelligent combination of measures. Synergy between components.
- ◆ As a result: less dependence on treatments

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### IPM and the Bee-Varroa Relation


**Winter is tough  
Varroa (and TM) represent an additional pressure at this critical stage**

**In relation with the new varroa infestation, our no 1 problem is:**

**WINTER LOSSES**

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### IPM and the Bee-Varroa Relation

To be successful, any IPM strategy should be aimed at:

**protecting our wintering colonies**


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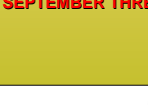
### IPM and the Bee-Varroa Relation

**Protection of the Wintering Colony: 2 aspects involved**




→ **WINTER THRESHOLD**

- ◆ Protection of the cluster during the winter



→ **SEPTEMBER THRESHOLD**

- ◆ Protection of the brood in late summer



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### IPM and the Bee-Varroa Relation

**We also have to protect the colony in summer**

Natural drop	Number of mites	EFFECT - OBSERVATION
-10	1000	No apparent effect. Hard to find.
30	3000	Economical damage. Still hard to find evidence except in drone cells.
50	5000	Very present in worker brood. Becoming a little more apparent.
100-150	10000+	Colony seriously injured. Easy to see live mites.
150-350	15000+	Colony near collapse.


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### IPM and the Bee-Varroa Relation

**Many factors affect how fast the varroa progresses in the colony?**

- ◆ Size of the colony
- ◆ Reinfestation rate
- ◆ Divisions
- ◆ Defense capacity of individual colonies
- ◆ Bee stock
- ◆ Others (temperature, etc)

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### IPM and the Bee-Varroa Relation

Practical observations from our own colonies

**Varroa population doubles at regular intervals... but how fast?**

Year	JD index (number of days for doubling the natural mite drop)
2002	12.5
2003	21.5
2004	22.2
2005	23.8

**In our case, breeding for varroa resistance immediately impacted on the JD index**


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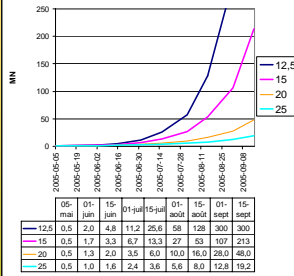
### IPM and the Bee-Varroa Relation

**Progression of varroa is logarithmic!**


- ◆ At the end of the season the progression accelerates
- ◆ In a matter of weeks the situation can change from « hardly eye detectable » to « major damage to the colony »



**Progression théorique de la MN selon la JD pour une MN de départ de 0,5**



JD	05 mai	01 juin	15 juin	01 juillet	15 juillet	01 août	15 août	01 sept	15 sept
12,5	0,5	2,0	4,8	11,2	25,6	58	128	300	300
15	0,5	1,7	3,3	6,7	13,3	27	53	107	213
20	0,5	1,3	2,0	3,5	6,0	10,0	16,0	26,0	46,0
25	0,5	1,0	1,8	2,4	3,6	5,6	8,0	12,8	19,2




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### Components of our IPM Strategy

**The Components of our IPM Strategy:**



- ◆ APINOVAR bottom boards
- ◆ Resistant stock
- ◆ Formic by the flash method

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### Components of our IPM Strategy





#### APINOVAR bottom boards



- ◆ Permanent easy and sensitive monitoring
- ◆ Access to easier, more versatile and more efficient treatments (flash, etc)
- ◆ Direct action on varroa... respects the bees grooming behaviour... adds value to breeding for resistance

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### Components of our IPM Strategy

#### RESISTANT STOCK means

- ◆ Slower build up of mites population
- ◆ Less treatments. (Spring treatment can be avoided if a stock with a high JD index used.)


Improvement resulting from 4 years of selection for resistance at Les Reines Chapeau

Year	JD index
2002	12.5
2003	21.5
2004	22.2
2005	23.8


Progression théorique de la MN selon la JD pour une MN de départ de 0,5

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### Components of our IPM Strategy



#### Another benefit of breeding for resistance

- ◆ Less variations in individual varroa levels
- ◆ => Easier planification and less treatments



Répartition des colonies selon leur niveau d'infestation de fin de saison en 2001


Répartition des colonies selon leur niveau d'infestation de fin de saison en 2002

Before selection

After selection

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### Components of our IPM Strategy

#### Importance of the Genetic Factor: natural drop curve for best and worst line (2003)



	1	2	3	4	5	6
FL	0.70	4.48	9.50	14.43	30.41	124.80
IX	1.41	5.83	7.54	9.20	18.36	40.69

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### Components of our IPM Strategy





#### TREATMENTS with ORGANIC ACIDS:

- ◆ Perspective of minimal treatment (fall only if possible)
- ◆ Mostly formic by the flash method (varroa and t. mite)
- ◆ Oxalic as a finishing treatment when needed only

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### Components of our IPM Strategy

#### Why this combination?

- ◆ Synergy between components
- ◆ Global efficiency
- ◆ Low cost
- ◆ Fast=> suits a commercial apiary


Practical results of this IPM strategy (+-250 doubles wintered outdoors)

	May (nd)	August	September
2004	0.75	6.7	29
2005	0.5	4.4	16.5



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### Monitoring in our IPM System


**Why monitor systematically?**

- ◆ Universal information tool
- ◆ Know when to treat and how to treat: prevent damage
- ◆ Know what efficiency has been obtained from your treatments
- ◆ Rate your bee stock
- ◆ Rate globally your IPM strategy
- ◆ Learn from what you are doing

**Monitoring is worth the investment!**

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### Monitoring in our IPM System

**Monitoring: which Method to Use?**  
**Let us define our needs:**

- ◆ Extensive use in all kinds of circumstances
- ◆ To be used as a prediction tool => high level of sensitivity required

**NATURAL MITE DROP SAMPLING only meets our requirements**  
**APINOVAR HAS BEEN DESIGNED TO MAKE NATURAL DROP SAMPLING**


- ◆ Easier, faster and cheaper
- ◆ Accessible at any time
- ◆ More accurate



**EYE EVALUATION IS NOT RELIABLE. IT IS LIKE GOING BLIND UNTIL YOUR COLONIES REACH THE DAMAGE THRESHOLD. SAMPLING STOPS BEING A BURDEN AND IS EVEN FUN TO DO WHEN YOU DO IT WITH THE RIGHT TOOL.**

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### Monitoring in our IPM System

**Natural Drop vs Alcool Wash**


**Which is the best prediction tool?**

ruche no	mortalité naturelle 18 au 23 juillet (chute journalière)	lavage alcool 25-juil (200 abeilles)	population totale de varroas en septembre
048	2.4	0	2458
062	1.0	0	887
136	0.2	0	396
146	2.8	0	2820
235	0.2	1	417
240	0.2	0	775
257	0.6	0	228
288	0.0	0	469
359	0.0	0	1325
410	0.8	0	1186
429	0.2	0	413
612	0.2	0	420
617	2.2	0	1337
637	0.0	0	213
654	1.2	0	326
699	0.4	0	453
751	0.0	0	879
857	1.0	0	550
895	1.8	0	1980
moyennes	0.8	0.1	923
corrélation:	r = 0.79	r = -0.16	

tableau 2  
 Comparaison de la sensibilité de l'échantillonnage par mortalité naturelle par lavage à l'alcool

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### Monitoring in our IPM System

**STANDARDS for Natural Mite Drop Monitoring are Essential**

- ◆ What size of sticky board?... **Full size**
- ◆ Which varroa to include in the count?... **All pigmented varroas (even lightly pigmented)**
- ◆ How to express the results?... **24 hour basis**

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### Monitoring in our IPM System


**How many yards should we sample?... All if possible**

**How many colonies in each yard?... 6 or more**



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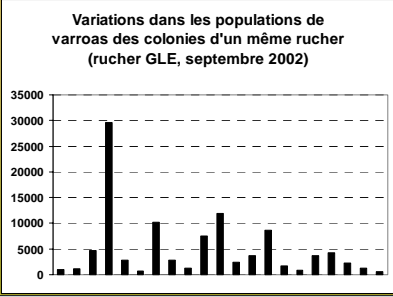
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### Monitoring in our IPM System


**Variations between Hives, same Location**

Variations dans les populations de varroas des colonies d'un même rucher (rucher GLE, septembre 2002)



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**Monitoring in our IPM System**

**Variations among Locations**

**Facteurs de multiplication de la mortalité naturelle journalière de varroas par rucher entre juillet et septembre 2002**

Month	Multiplication Factor
mai	11
dew	41
lem	25
the	82
ath	44
lan	78
joy	35
rle	39
roy	17
aut	20
gle	101
moy	45

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**Monitoring in our IPM System**

**How often and when should we sample?**

- ◆ Enough to keep the control of the situation
- ◆ At times where treatments can be applied if needed
- ◆ At times where you and your colonies are available

⇒ **A SAMPLING SCHEDULE is necessary**



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**Monitoring in our IPM System**

**Proposed Sampling Schedule**

DATE (beginning)	PURPOSE	DURATION
MAI 1st	Know if spring threshold reached and plan treatments if so	
JULY 25-30	Know if mid-season threshold reached and plan emergency treatments if so	
SEPTEMBRE 5-10 <small>(juste before treating)</small>	Plan your end of season treatments	
OCTOBRE 25-30	Measure the efficiency of your treatments and plan an oxalic if needed	

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**Monitoring in our IPM System**

**What is the Ideal Duration for Each Sampling?**

- ◆ The longer the period, the more precision
- ◆ The longer the period the more hive debris on the sticky board!!!
- ◆ Low levels of infestation suggest longer sampling periods

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**Monitoring in our IPM System**

**Proposed Sampling Schedule**

DATE (beginning)	PURPOSE	SUGGESTED DURATION
MAI 1st	Know if spring threshold reached and plan treatments if so	3-4 days
JULY 25-30	Know if mid-season threshold reached and plan emergency treatments if so	1-2 days
SEPTEMBRE 5-10 <small>(juste before treating)</small>	Plan your end of season treatments	1-2 days
OCTOBRE 25-30	Measure the efficiency of your treatments and plan an oxalic if needed	3-4 days

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**Thresholds and Treatments**

**Damage Threshold**

Summer: +-30 mites/day  
What about winter?

**Seasonal Thresholds:**

- ◆ Predictive tool (Spring, mid-season). Can we safely reach the next window where a treatment is possible?
- ◆ Did the mite drop actually reach the damage level?




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Thresholds and Treatments			
Seasonal Thresholds we Use (average natural drop):			
Sampling Date (beginning)	PURPOSE	SUGGESTED DURATION	THRESHOLD (average nd)
MAI 1st	Know if spring threshold reached and plan treatments if so	3-4 days	0.5 - 1
JULY 25-30	Know if mid-season threshold reached and plan emergency treatments if so	1-2 days	10
SEPTEMBRE 5-10 (juste before treating)	Plan your end of season treatments	1-2 days	25
OCTOBRE 25-30	Measure the efficiency of your treatments and plan an oxalic if needed	3-4 days	0.5 - 1

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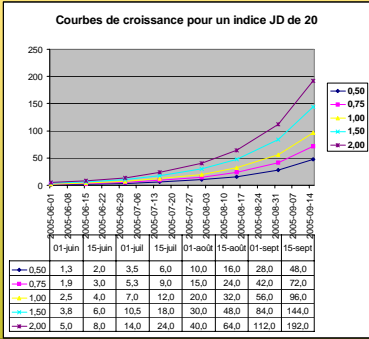


Thresholds and Treatments

**SPRING THRESHOLD**


- Importance of a low natural drop in spring
- No chance of reaching safely the end of season treatment period unless may nd is very low (<1)

Courbes de croissance pour un indice JD de 20



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Thresholds and Treatments

**MID-SEASON THRESHOLD (nd)**

Early August	≥ 10
50 days before end of season treatment	≥ 6

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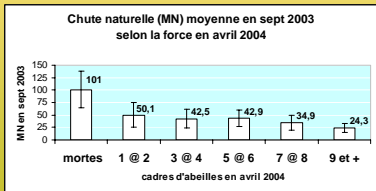


Thresholds and Treatments

**SEPTEMBER THRESHOLD**


- Impact of September level of infestation on successful wintering. Strenght of colonies in spring decreases as september nd increases

Chute naturelle (MN) moyenne en sept 2003 selon la force en avril 2004



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**WINTER THRESHOLD?**

- Swiss recommandation: 0,5 m/day
- With such a threshold, treatment can be avoided the next spring in most cases if improved stock is used.

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Thresholds and Treatments

spring	fall	Treatments: what is the best time?  SEPTEMBER IS THE BEST TIME TO TREAT
Vulnerable colony weakened by long winter parasitism: less resistant to acid treatments	colony of fresh young bees Will be healthy for winter and spring	
Weak colonies and uneven strenght Difficult to apply uniform dosage	All strong colonies Uniform dosage	
Expanding brood Higher % of varroas in brood	Brood in reduction Lower % of varroas in brood	
Repeated exposure to formic may affect the development	Colony less affected by formic	
Low temperatures	Favourable temperatures in september	

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### Thresholds and Treatments

#### Looking for a treatment: REQUIREMENTS

- ◆ Efficiency and reliability
- ◆ Low cost (product and application)
- ◆ Versatility
- ◆ Safety
- ◆ Must treat also T. mite

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### Flash Treatment



VIDEO AVAILABLE AT [REINESCHAPLEAU.WD1.NET](http://REINESCHAPLEAU.WD1.NET)

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### Flash Treatment

#### What is Flash?

- ◆ Method of application of formic
- ◆ Fast volatilisation
- ◆ High concentrations (400 ppm) /very short period
- ◆ Some effect on varroas in the brood
- ◆ Application from the bottom
- ◆ Variable number of applications



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### Flash Treatment

#### Flash:

- ◆ Equipment needed
  - Drench gun
  - Paper towels
  - Water
  - Safety gear



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### Flash Treatment

#### History

- ◆ Largely used in Europe (Centre suisse de recherches apicoles)
- ◆ In Canada: Works of Kerry Clark in early 90's
- ◆ Proposition for exemption of scheduling PMRA (Note C94-5)
- ◆ Authorization of use recently renewed (RDD2005-02)

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### Flash Treatment

#### What is the interest of Flash used with APINOVAR?

- ◆ FAST
- ◆ CHEAP
- ◆ EFFICIENT
- ◆ VERSATILE (short duration, repeatable, dosage can be adapted)
- ◆ Well supported by bees



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### Flash Treatment

#### Efficiency of flash with APINOVAR

- 60% reduction of natural drop per application
- 96% for 4 end of season applications

Réduction de la MN obtenue lors des traitements d'automne: flash (4) vs Coumaphos

Traitement	% Réduction
flash (4)	96,2%
Coumaphos®	98,3%

traitement	n	MN 10-9	MN 30-10	% réduction	écart type
flash (4)	31	42,5	1,6	96,2%	6%
Coumaphos®	21	51,4	0,9	98,3%	4%

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### Flash Treatment

#### Efficiency Comparison of Flash on Apinovar vs on Standard Bottom (mid-season 50 ml)

Twice as much efficient with less variations on APINOVAR

Évolution de la MN (penne) pour les colonies "flashées" en août

Type of bottom	n	NB 26-07	NB 08-09	penne	stan. Dev.
APINOVAR	20	21	57	0,792	0,633
STANDARD	21	28	109	1,804	1,469

P < 0,0086

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### Flash Treatment

#### How does flash compare vs other methods of delivering formic (with APINOVAR)?

#### SINGLES

Efficacy comparison of 3 methods of application of formic (end of season, singles)

Treatment	% reduction of natural mite drop
M Away II	91,8 A
M Wipe	93,6 A
Flash	99,5 A

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### Flash Treatment

#### How does flash compare with other methods of delivering formic (with APINOVAR)?

#### DOUBLES

Efficacy comparison of 3 methods of application of formic (end of season, DOUBLES)

Treatment	% reduction of natural mite drop
M Away II	66,3 A
M Wipe	89,2 AB
Flash	96,3 B

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### Flash Treatment

#### Comparison of Formic Treatments (fall 2005)

- Observations about Mite Away II on singles
  - Burr comb
  - Queen loss danger (25% in 2004)

GROUPE	N	RUCHES SIMPLES			
		Tombée naturelle 9 sept 2005 (n=3)	Tombée naturelle 24 oct 2005 (n=3)	Taux de réduction de la tombee naturelle (n=3)	Traitement contrôlé à l'acide oxalique (n=3)
Mite Away II	11	7,2 ± 7,0 (A)	0,2 ± 0,5 (A)	91,8 ± 22,3 (A)	22,9 ± 80,4 (A)
Mite Wipe	11	7,2 ± 6,9 (A)	0,7 ± 1,1 (A)	93,6 ± 9,6 (A)	79,6 ± 136,1 (A)
Flash	11	1,3 ± 3,1 (A)	0,1 ± 0,4 (A)	99,5 ± 1,6 (A)	11,2 ± 68,2 (A)

GROUPE	N	RUCHES DOUBLES			
		Tombée naturelle 9 sept 2005 (n=3)	Tombée naturelle 24 oct 2005 (n=3)	Taux de réduction de la tombee naturelle (n=3)	Traitement contrôlé à l'acide oxalique (n=3)
Mite Away II	12	6,8 ± 6,3 (A)	2,5 ± 3,5 (A)	66,3 ± 26,1 (A)	17,5 ± 166,7 (A)
Mite Wipe	12	6,7 ± 6,0 (A)	1,3 ± 3,1 (AB)	89,2 ± 15,7 (B)	145,4 ± 194,1 (AB)
Flash	12	1,3 ± 7,8 (A)	0,1 ± 0,3 (B)	99,5 ± 5,1 (B)	15,8 ± 49,2 (B)

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### Flash Treatment

#### Flash Dosage Chart for Bottom Application with APINOVAR

Maximum temperature anticipated in the next 6 hours (Celsius)	doubles		singles	
	20-24	40 ml	20 ml	
16-19	45 ml	22 ml		
10-15	55 ml	27 ml		

- Supers filled with bees
- Not for nucs or weak colonies
- 65% concentration
- NO HONEY SUPERS
- Abundance of open nectar cells reduces efficacy

60% reduction of natural mite drop per application (measured 15 days after application)

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**Flash Treatment**

### When do we use the flash treatment?

- ◆ Fall
  - ideal
- ◆ Mid-season
  - suitable: short duration
- ◆ Spring
  - Not ideal but can be used with caution

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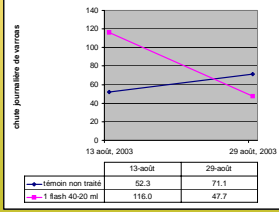
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**Flash Treatment**

### Mid-season flash with Apinovar


- ◆ Emergency situation mostly
- ◆ No honey supers
- ◆ Heat waves may be a problem
- ◆ Higher dosages possible in emergency situations (with risks of brood or queen damage)
- ◆ Colonies with ND up to 30/day brought down to normal

	13 août, 2003	29 août, 2003
— témoin non traité	52,3	71,1
— 1 flash 40-20 ml	116,0	47,7

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**Flash Treatment**


### End of season flash with APINOVAR: number of applications

- ◆ Important to lower the natural drop <1 or even < 0,5
- ◆ Minimum 2 applications

Number of applications according to natural drop before treatment	
ND before treatment	Number of applications
< 2	2
2 @ 7	3
8 @ 30	4
31 +	4 + oxalic

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**Flash Treatment**


### End of Season Flash with APINOVAR: Sequence of Applications

- ◆ Start early with short interval
- ◆ Finish late

End of Season Flash: Sequence of Applications				
Number of applications	Application #1	Application #2	Application #3	Application #4
2	Sept 15-21	oct 1-10		
3	Sept 15	Sept 21 7 days	Oct 1-10	
4	Sept 15	Sept 19 4 days	Sept 26 7 days	Oct 1-10

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**Flash Treatment**

### Flash as a Spring Treatment

- ◆ Avoid spring treatment if possible (nd <=1)
- ◆ Good efficiency
- ◆ Risky if colonies do not fill well their super(s)
- ◆ Experimental dosage (2 - 2.5 ml per frame of bees)... strenght evaluation is touchy
- ◆ Treat in late spring when colonie are stronger
- ◆ Avoid the dandelion period: nectar in open cells reduces efficiency of formic
- ◆ Mite Wipe is a safe alternative

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**Treatments**

### Interventions According to ND Level

Sampling Date (beginning)	THRESHOLD (average nd)	action
MAI 1st	0.5 - 1	Do a spring treatment if exceeded (Mite Wipe, flash??)
JULY 25-30	10	Do 1 flash if exceeded (up to 30 m/day) Complete treatment if largely exceeded
SEPTEMBRE 5-10 (juste before treating)	25	Do the number of flash applications required by the ND level (End of season treatment can never be avoided)
OCTOBRE 25-30	0.5 - 1	Oxalic is desirable if exceeded

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**Flash Treatment**

**Important:**

- ◆ Right dosage, right number of applications
- ◆ Prevent drifting (treat whole yard or wait until the end of the day for treating individual colonies)
- ◆ Tight bee equipment
- ◆ Safety rules

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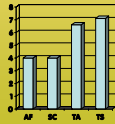
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**Oxalic**


**Oxalic**

- ◆ Seldom needed
- ◆ Labor intensive
- ◆ Should not be used as the main end of season treatment
- ◆ Is sublimation really well tolerated by the bees in Canada?
- ◆ Possibility of applying only to colonies that need it

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**Tips for sampling and Counting**


**Preparation for Sampling**

- ◆ Full size sticky board
- ◆ Type of material
- ◆ Lines on the sticky board
- ◆ Liquefied Crisco

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**Tips for sampling and Counting**


**Distribution and collection of sticky boards**

- ◆ Cleaning of the sampling trays at the same time
- ◆ Do not put supers or frames at the same time
- ◆ Use the right duration
- ◆ Spare set of trays for collection
- ◆ Trays are piled up and tied up together with strong tape



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**Tips for sampling and Counting**


**Counting varroas:**

**Do not be overconfident in your skills. On average 50% of varroas are missed!**

- ◆ Professional training is useful to confirm or improve your skills


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**Tips for Sampling and Counting**

**Which varroas should be included in the count?**



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**Tips for Sampling and Counting**


**Counting: Doing it Right**

- ◆ Counting at home easier
- ◆ Use magnifying glass
- ◆ Use hand counter
- ◆ Count your sticky boards as soon as you can

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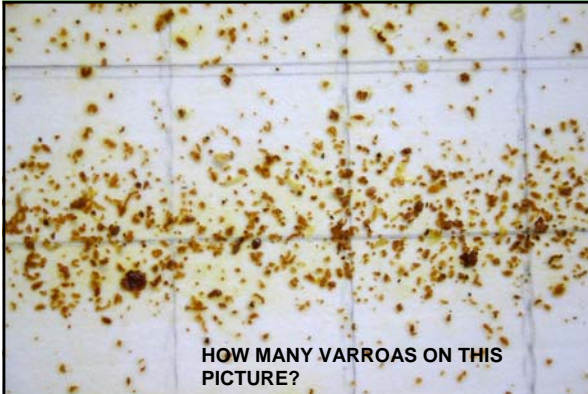
**Tips for Sampling and Counting**

**Monitoring is essential but you can make it suit your needs.**

- ◆ Individualised or grouped results?
- ◆ Use of a computer database?
- ◆ Is the possibility of treating individual hives interesting for you?

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**HOW MANY VARROAS ON THIS PICTURE?**


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**IPM-Apinovar e-mail newsletter project**

- ◆ Send us an e-mail if you want to be on our distribution list:

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For more info: [reineschapeau.wd1.net](http://reineschapeau.wd1.net)

Thank you and...

Let us not loose control



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