



**Ministry of Environment  
and Food of Denmark**  
Environmental  
Protection Agency

# Experience with an upper limit for total pesticide use on Danish golf courses

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# Content of presentation



## 1. Background:

- Agreement between DGU and the Minister of Environment
- Calculation of pesticide load – used for national indicator and pesticide tax

## 2. National regulation on pesticide load on golf courses

## 3. Development of a limit of max pesticide load on Danish golf courses

## 4. Effect of this regulation

## 5. Experience from this process

## 6. Further IPM initiatives



## Background – political proces



- **2005: Agreement between Danish Golf Association and the Minister of Environment. Goal: to reduce the pesticide use on golf courses to 0,1 kg ai/ha**
- **Data on yearly pesticide use was submitted by golf courses to the DGA**
- **2008: the target was not reached (0,23 kg ai/ha)**
- **2011: political agreement between the government and several political parties in Parliament**
  - **Requirement of a national law and regulation setting a maximum level of pesticide use on golf courses**
  - **All data on pesticide use on golf courses to be submitted to the Danish EPA each year by 1 March**

## 2010: Pesticide load – pesticide tax



### Calculation of pesticide load on environment and human health – based on three main items:

#### 1. Human health

Measure of the load that people who use pesticides (operators, workers etc.) are exposed to when handling and applying and pesticides

#### 2. Environmental fate

Measure of the environmental load in terms of degradability, potential for bioaccumulation and leaching to groundwater

#### 3. Environmental toxicity

Measure of the environmental toxicity to non-target organisms such as birds, fish, bees, earthworms, mammals etc.

**Pesticide load is a complex calculation based on data from 1 + 2 + 3**

**A national legislation on pesticide tax came into force in 2013. From then on we could calculate pesticide load**



# How can we establish a maximum load on pesticides on golf courses?

The table shows:

Pesticide products authorised for use on golf courses

Pesticide load/kg

Pesticide load/ha

Type pesticide	Active substance	Pesticide product	Pesticide load per kg or liter product	Pesticide load per ha at max dose
Herbicides	Clopyralid	Matrignon 72SG	3,47	0,57255
	Florasulam	Primus	0,5717	0,085755
		Saracen	0,5717	0,085755
	Fluroxypyr, clopyralid, MCPA	Ariane FGS	0,487	1,7045
	Fluoxypyr	Tomahawk 200 EC	0,8387	1,50966
	Iodosulfuron-methyl-natrium	Hussar OD	0,3837	0,023022
	Tribenuron-methyl	Express ST	1,515	0,022725
		Express SX	1,515	0,022725
		Nuance WG	2,1735	0,021735
Fungicide	Cyprodinil og fludioxonil	Switch 62,5 WG	0,70338	0,70338
	Prothioconazol	Proline EC 250	0,463	0,3704
	<i>Streptomyces K61</i>	Mycostop WP	0	0
		Turf S+	0	0
	<i>Gliocladium catenulatum</i>	Prestop WP	0	0
		Turf G+	0	0
	<i>Trichoderma harzianum T22</i>	Trianum-G	0	0
Trianum-P		0	0	
Insecticide	<i>Bacillus thuringiensis subsp. israelensis</i>	Gnatrol SC	0	0
	Indoxicarb	Avaunt	3,4323	1,544535
Growth regulators	Trinexapac-ethyl	Clipless NT	0,0693	0,02772
		Primo Maxx II	0,19379	0,077516



## We had to describe an average golf course and average pesticide needs



### Average need for pesticide use on individual part of the golf course (% area that is anticipated to need treatment)

	Herbicide %	Fungicide %	Insecticide %	Growth regulation %
<b>Greens</b>	5	100 x 2 yearly	20	100 x 15 yearly
<b>Tee</b>	10	10 x 2 yearly	10	0
<b>Fairway</b>	25	0	25	0
<b>Semirough</b>	5	0	3	0
<b>Rough</b>	2	0	0	0
<b>Nature</b>	0	0	0	0



## Average need for pesticide products on the golf course

Herbicide		Fungicide		Insecticide		Growth regulator	
Product	%	Product	%	Product	%	Product	%
Ariane	50	Proline	50	Merit turf	98	Clippless	100
Hussar	50	Switch	50	Avaunt	2		





## Calculation of the maximum pesticide load per ha

	Green	Tee	Fair-way	Semi-rough	Rough	Nature	Max pesticide load
<b>Herbicide</b>	0,04	0,09	0,22	0,04	0,02	0	<b>0,41</b>
<b>Fungicide</b>	1,14	0,11	0	0	0	0	<b>1,25</b>
<b>Insecticide</b>	16,40	8,20	20,50	2,46	0	0	<b>47,55</b>
<b>Growth regulation</b>	0,31	0	0	0	0	0	<b>0,31</b>



## How did the new regulation work?



### Do all 190 golf courses submit pesticide data?

- Data on total area and pesticides used on the golf course to be submitted to the Danish EPA each year since 2013
- Deadline 1 March each year
- Danish EPA need to send out reminders to golf courses – if so most golf courses do submit data within the deadline (also give information if no pesticide use).

### Did golf courses keep below the maximum pesticide load?

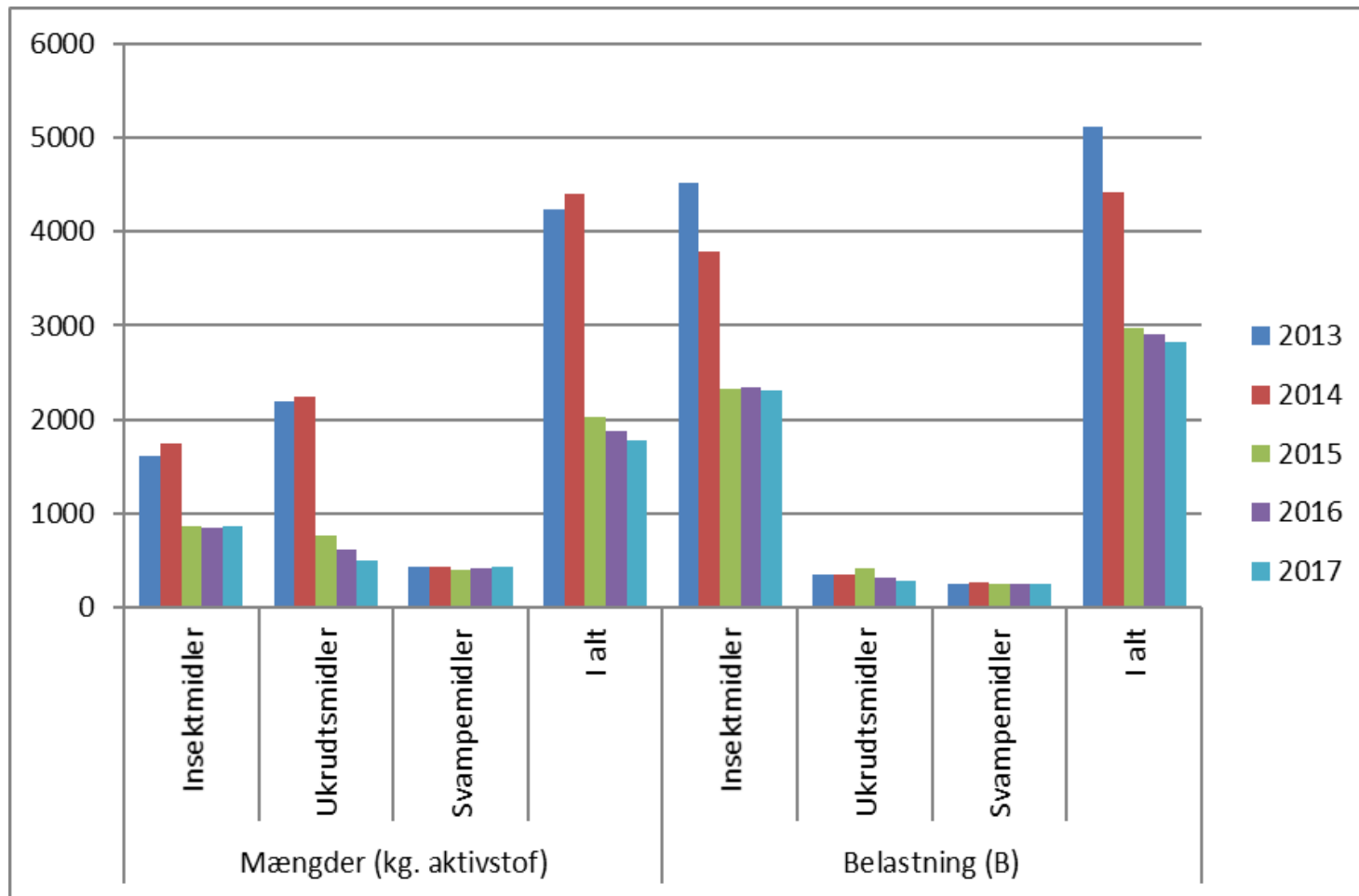
- During the first few years some golf courses did not – they needed guidance
- Now, only very few golf courses do not

### Diversity in golf courses

- Age of golf course
- Soil types
- Pests - some golf courses have garden chafer – others do not
- Number of players
- Economic possibilities
- Number of greenkeepers



# Development in the use of pesticides and the Pesticide Load: 2013-2017



**Amount of pesticide (kg ai)**

**Pesticide Load**



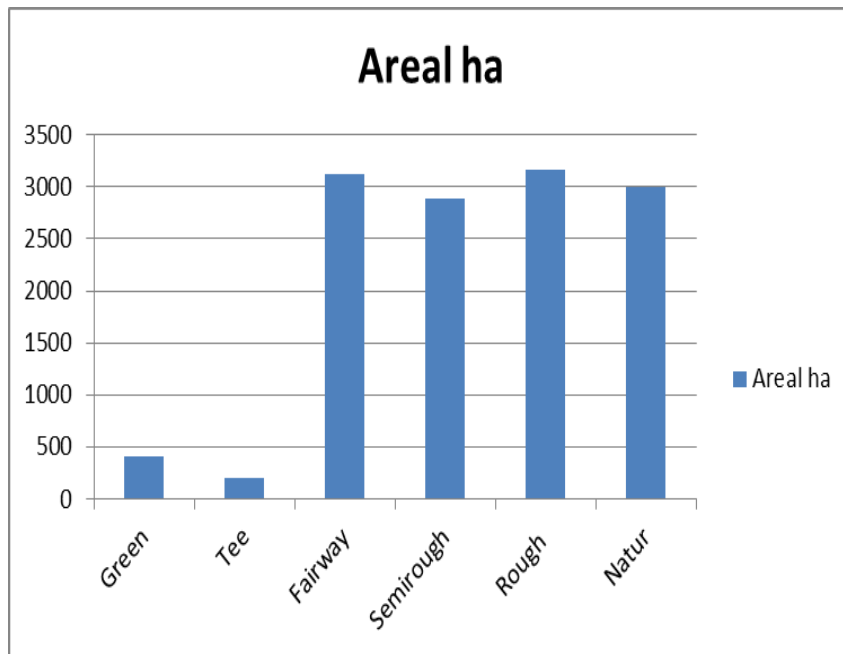


		2013	2014	2015	2016	2017	Reduction 2013-2017 %
<b>Amount (kg. ai)</b>	Insecticide	1617,89	1737,92	863,94	839,6	863,15	<b>46,6</b>
	Herbicide	2190,37	2234,39	765,14	609,55	493,08	<b>77,5</b>
	Fungicide	426,7	432,09	394,35	424,05	428,8	<b>0,6</b>
	total	4234,96	4404,4	2023,43	1873,23	1785,03	<b>57,9</b>
<b>Load</b>	Insecticide	4510,74	3793,49	2318,07	2335,2	2307,86	<b>48,8</b>
	Herbicide	350,12	356,22	416,13	319,56	276,64	<b>21,0</b>
	Fungicide	253,43	268,86	243,61	256,76	245,88	<b>3,0</b>
	total	5114,28	4418,57	2977,82	2911,56	2830,38	<b>44,7</b>

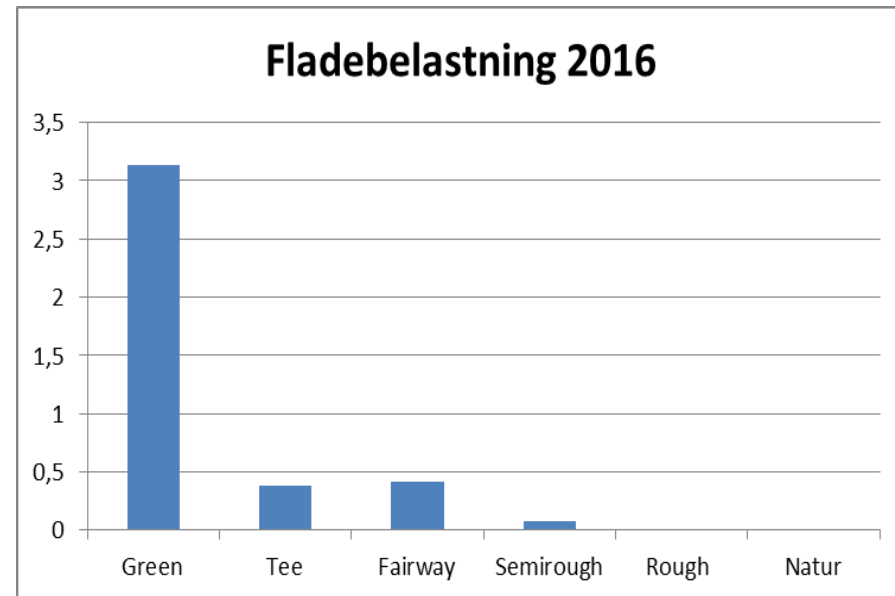




## Area - ha



## Average Load pr ha



## In addition to the regulation of max pesticide load – what have the Danish EPA done to increase IPM implementation?



### Focus on education of greenkeepers

- We have given financial support to several types of activities to increase education of greenkeepers

### Close cooperation with all relevant parties – we established a group that have had 1-2 meetings yearly

- Danish Golf Association
- Danish Greenkeeper Association
- Educational bodies/schools
- Researchers

### Control of pesticide use on golf courses

- Control of app. 15 golf courses each year regarding all requirements in pesticide regulation (which pesticides used, filling and cleaning of spaying equipment, spraying journal, spaying certificate etc.)

### Further IPM initiatives

- 2018: Financed a study on precision spraying of herbicides on golf courses – showed potential of 40% reduction in pesticide use



## Conclusion



- 1. It is possible to set a max pesticide load on golf courses and gain a reduction in pesticide load on environment and human health**
- 2. It has to be differentiated on the different types of pesticides e.g. herbicides and insecticides**
- 3. The maximum load has to be re-calculated when changes happen in authorised pesticides**
- 4. Setting a maximum load is a driver for the golf organisation to apply for minor use of pesticides with lower load on the environment and human health and for the golf courses to use these**
- 5. And it is a driver to get greenkeepers to think more about preventive measures**
- 6. The regulation do cause quite some work for the Danish Golf Association to advise greenkeepers/golf courses**
- 7. The regulation do cause administrative work for the Danish EPA – but also gives a lot of interesting knowledge**



# Thank you for your attention!

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