

## MORPH forecast for carrot flies

### Purpose:

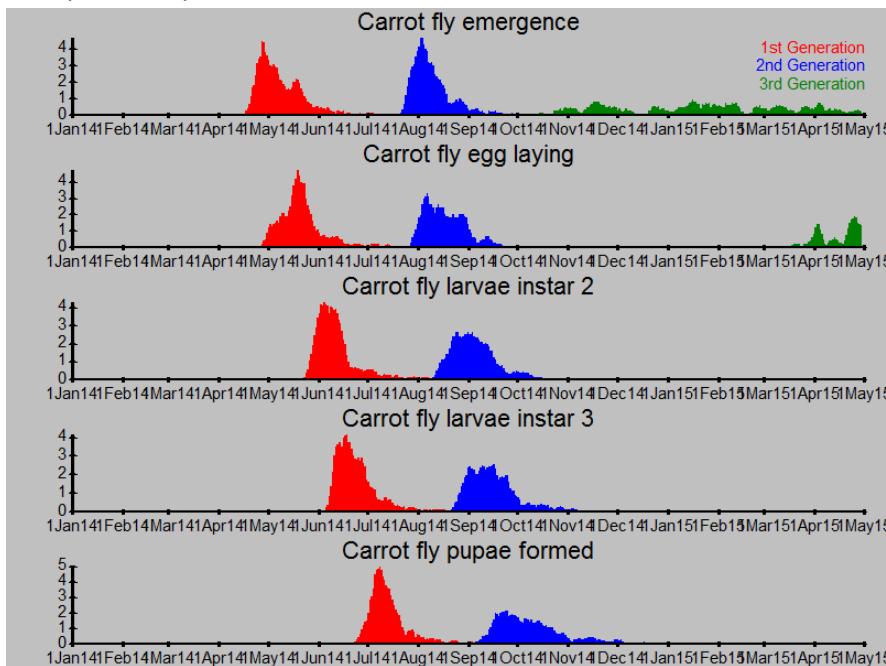
- to measure and collect temperature data for the carrot fly forecast model in MORPH and
- investigate the possibilities to use MORPH in Denmark to forecast optimal timing of carrot fly control. Control in this context may mean spraying or harvesting before visible attack on roots.

### Background:

Carrot flies are perceived as an increasing challenge in carrots in some parts of Denmark. Mainly because the possibilities to control carrot flies with insecticides has been severely limited. There is only one approved product and the application is limited to maximum two seasonal sprays including control of other insects such as cutworms and aphids.

Yellow sticky plates are widely in European carrot production to monitor the activity of carrot flies in the fields and used for timing of spraying. The use of yellow traps is very sensitive to how they are placed in the field, angulation, wind direction, height and type of fence along the field. Traps do only say something about the number of flies caught the week before, and can't forecast the activity of carrots flies. In some European countries models to forecasting the carrot fly activity has been implemented like in UK with the MORPH carrot fly forecast from University of Warwick. Here they have found that yellow traps as a tool for timing of spraying can be optimized, if they are supported by the MORPH forecasting tool based on the air and soil temperature. The MORPH model for carrot flies uses hourly air temperatures and soil temperatures (6 cm) from 1 February. Based on those data MORPH calculates and predicts when the overwintering carrots files will emerge, lay eggs and develop into larvae for the first and subsequent generations of carrot flies.

Example of output from MORPH:



### Description:

Four weather stations from Metos and one from Decagon have been set up on 1 February in carrot fields in different areas in Jutland. In each field or nearby fields carrot fly activity has been monitored on yellow sticky traps with 5 traps per field.

Temperature data from the weather stations has been collected weekly during the season and transformed in Excel spreadsheet into a text format that MORPH can read. This has been a bit of a challenge because MORPH operates with the English dot decimal separation, where the Danish computer operates with a comma separation.

The MORPH model from University of Warwick has kindly been made available for testing in Denmark in 2014.

### Results:

Carrot fly forecast according to MORPH

The tables below show predicted dates by which 10% and 50% of flies will emerge/lay eggs at the five locations with weather stations.

For site 3 some weather data for air temperature are missing in beginning of February and beginning of March. Missing weather data has been substituted by an average of the air temperature from the nearest three weather stations.

#### 12 May forecast 1st generation carrot fly

Location	Forecast 10% emergence	Forecast 10% egg-laying	Forecast 50% egg-laying
Site 1	25 April	15 May	27 May
Site 2	24 April	13 May	28 May
Site 3	29 April	16 May	28 May
Site 4	22 April	9 May	23 May
Site 5	24 April	13 April	27 May

#### 14 July forecast 2nd generation carrot fly

Location	Forecast 10% emergence	Forecast 10% egg-laying	Forecast 50% egg-laying
Site 1	1 Aug	8 Aug	21 Aug
Site 2	25 July	31 July	10 Aug
Site 3	24 July	29 July	10 Aug
Site 4	20 July	26 July	8 Aug
Site 5	27 July	1 Aug	12 Aug

#### 22 August forecast 3rd generation carrot fly

Location	Forecast 10% emergence	Forecast 10% egg-laying <sup>1)</sup>	Forecast 50% egg-laying <sup>1)</sup>
Site 1	23 Dec	<del>2</del> April	<del>23</del> April
Site 2	29 Okt	<del>1</del> April	<del>22</del> April
Site 3	16 Okt	<del>28</del> March	<del>16</del> April
Site 4	12 Okt	<del>1</del> April	<del>23</del> April

Site 5	12 Nov	<del>29 March</del>	<del>22 April</del>
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<sup>1)</sup>: provided that flies and eggs survive the winter

The MORPH forecast for the first generation does not differ much between the different sites. It looks like the forecast for first generation can be used for a larger region than just a local site. At the time of the second generation carrot fly activity there is much more differences between the five locations – with nearly two weeks between the earliest location and the latest location. The differences between locations are even bigger when looking at the emergence of the third generation. So when using the MORPH forecast for the second generation of carrots flies, the soil and air temperature data needs to come from a local weather station.

### Number of carrot flies on yellow traps per trap per day in carrot fields from 10 different location in Jutland 2014

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Average
	number of carrot flies per trap per day										
05-maj	-	'-	'-	'-	0	0	0	0	0	0	<b>0,00</b>
12-maj	'-	'-	'-	'-	0	0	0	0	0	0	<b>0,00</b>
19-maj	0	0	0	0	0	0,17	0,03	0,09	0,43	1,17	<b>0,19</b>
26-maj	0,06	0,03	0,27	0,11	0,23	0,03	0,09	0,06	0,14	0,11	<b>0,11</b>
02-jun	0,03	0,03	0,28	0,06	0,06	0,06	0,11	0,00	0,09	0,03	<b>0,07</b>
09-jun	0	0	0,07	0,02	0	0	0	0	0	0	<b>0,01</b>
14-jul	0	0	0	0	0	0	0	0	0	0	<b>0,00</b>
21-jul	0,11	0,03	0,11	0,14	0	0,06	0	0	0,06	0,29	<b>0,08</b>
28-jul	0,6	0,06	0,66	0,4	0	0,00	0	0	0,03	0,94	<b>0,27</b>
04-aug	0,10	0,00	0,86	0,09	0	0,03	0,11	0,03	0,06	0,11	<b>0,14</b>
11-aug	0,07	0,03	1,31	0,07	0,03	0,11	0,14	0,11	0,06	0,03	<b>0,20</b>
18-aug	0,17	0,05	0,49	0,07	0,03	0,09	0,20	0,06	0,09	0,00	<b>0,12</b>
25-aug	0	0	0	0	0,06	0,09	0,09	0,00	0,40	0,00	<b>0,06</b>
01-sep	'-	'-	'-	'-	0	0	0	0,09	0,14	0,00	<b>0,04</b>
08-sep	'-	'-	'-	'-	0	0	0	0	0	0	<b>0,00</b>

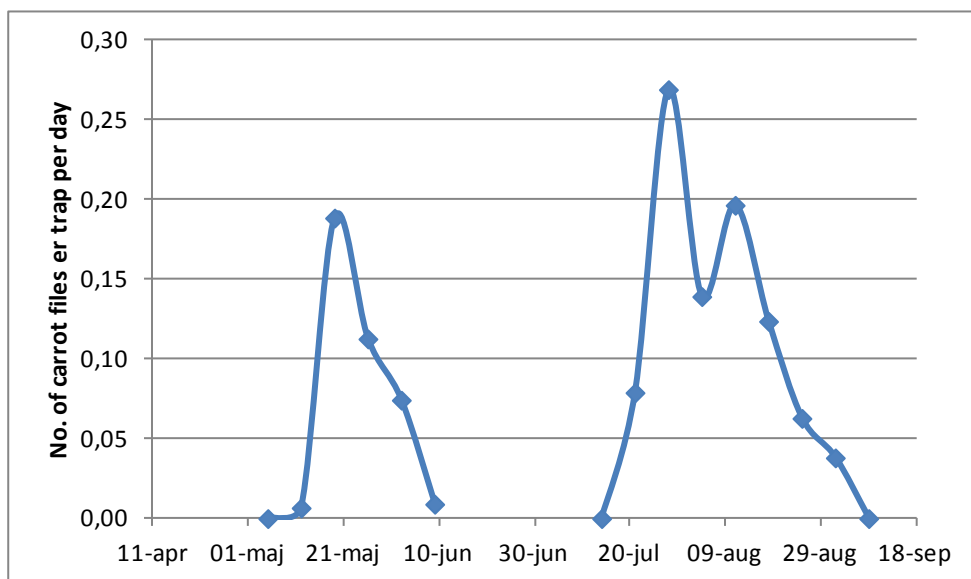
*Five yellow sticky traps per field.*

*Site 6, 7, 8, 9 and 10 are located in the area around site 5 (maximum 30 km's away).*

Comparing the forecasts with the corresponding locations carrot fly catches is a bit difficult because some of the fields have been sprayed according to the forecast. Spraying might have had an influence on the number of flies caught on the traps.

On site 5 there are two fields with two different seeding days for early and late carrots respectively. The first seeded carrots on site 5 were sprayed according to the MORPH forecast on the 22 May and the 30 May, and the second seeded lot of carrots was sprayed on the 5 August and the 15 August. There have been carrots in the neighbor fields during the last five years with critically high levels of carrot flies on the yellow traps each year. So it was expected to find the same high level of flies on the traps again this season.

Wright timing of the spraying might be part of the reason way there is hardly any carrot flies on the traps in August on site 5.



The graph shows the average number of carrot flies per trap per day caught on yellow sticky traps in 2014 at 10 different locations. The counts on the graph represents the day when the traps were changed. The fly activity would have taken place in the days just before.

According to the MORPH forecast most of the activity of the carrots files in the fields should have taken place around the end of July and 1-2 week after. This corresponds very well with the activity showed on the graph for 2014. The carrot fly activity in August 2014 came very early. Normally the fly activity peaks in the second half of August. MORPH did very well predict an early fly activity in 2014.

### Conclusions:

- Converting data from the weather stations into MORPH is a challenge. This needs programming if its going to run automatically in large scale.
- It looks like MORPH can be used to forecast the first generation of carrot activity for a larger region then forecasting the second generation carrot fly activity. To forecast the second generation activity the weather data needs to be more local.
- This test indicates that there is a nice correlation between the model forecast, and the actual activity displayed on the yellow traps in the fields.
- When the decision to spray is based only on yellow traps, spraying will often be too late. When fly activity peaks on the yellow traps, most of the eggs will all ready have been laid. The yellow traps are on the other hand a very good complement to the MORPH forecast, verifying the accuracy of the model.

The investigation needs to be repeated more the one year before making any final conclusions.



Weather station with rain gauge and temperature sensor in air and soil.



Yellow traps for carrot flies 10 meter from fence and 10 meters apart.



Carrot fly on yellow sticky.

**Lars Møller, 2014**