# MONITORING REPORT FOR GMO USES OTHER THAN CULTIVATION

## *CNL1302*
## *FLO-40685-2*
## *Florigene®Moonvista™*



## 1. General information

### 1.1 Crop/traits

Carnation (*Dianthus caryophyllus*) with modified flower colour, variety Florigene®Moonvista™.

### 1.2 Decision authorisation number pursuant to Directive 2001/18/EC and number and date of consent pursuant to Directive 2001/18/EC

Florigene®Moonvista™
Decision authorisation number; C/NL/13/02
Number of consent; C/NL/13/02/00 bes.1
Date of consent; September 5, 2019

### 1.3 Decision authorisation number and date of authorisation pursuant to Regulation (EC) No. 1829/2003

Not applicable.

### 1.4 Unique identifier

FLO-40685-2

### 1.5 Report period from

July 1, 2022 to June 30, 2023

### 1.6 Other monitoring reports have been submitted in respect of cultivation.

YES □ NO ■

## 2. Executive summary

Approximately 17 tonnes (0.94 million flowers) of Florigene® Moonvista™ were imported into the EU from July 1, 2022 to June 30, 2023, through a single importer in the Netherlands. Flowers were imported from Colombia (41%) and Ecuador (59%).
Results of general monitoring for the occurrence of genetically modified carnation in the EU were;

- The importer reported that they were not aware of any illegal growing and that neither they nor consumers have reported any adverse effects of handling the flowers.
- No reports of carnation in nature were provided via the Florigene website.
- Information on survey work was provided by two botanical experts, covering sites in four European countries. There was no evidence of the establishment of any carnation populations in the wild, or of hybridization between carnation and wild *Dianthus* species.
- A review of literature related to *Dianthus* was carried out. None of the literature identified escape populations of cultivated carnation or hybrids with other *Dianthus* species in wild populations.
- Botanical and floral databases were searched for records of carnation and *Dianthus caryophyllus* made since the last monitoring report. Seventy nine percent of the websites examined returned no new information. Eighteen databases provided records of *Dianthus caryophyllus* (or synonyms) in Europe made since July 2022. There was no evidence of escape of cultivated carnation.
- 23 responses were received from 40 emails sent to major Europe-based herbaria. In the six responses where there were records of *Dianthus caryophyllus*, the collections pre-dated the first imports of transgenic carnation into Europe.

The overall results are consistent with previous monitoring reports, indicating cultivated carnation is not present in nature in Europe.

## 3. Uses of GMOs other than cultivation

### 3.1 Commodity imports into the community

#### 3.1.1 Commodity crop (GM and non-GM) imports into the community by country of origin

GM product

GM product was imported from Colombia and Ecuador. Table 1 provides information on the imports of all transgenic carnation varieties imported into the EU in this reporting period. Information on the specific variety covered by this report is highlighted in red font.

***Table 1. Tonnes of GM carnation imported into the EU from July 2022 to June 2023***

| GM carnation variety | Quantity (tonnes) | |
|---|---|---|
| | Imported from Ecuador | Imported from Colombia |
| Florigene®Moonaqua™ | 35 | 9 |
| Florigene®Moonlite™ | 28 | 4 |
| Florigene®Moontea™ | 0 | 9 |
| Florigene®Moonberry™ | 0 | 3 |
| Florigene®Moonvelvet™ | 0 | 3 |
| **Florigene®Moonvista™** | **10** | **7** |
| All GM carnation varieties | 73 | 35 |

GM and non-GM product

Table 2 shows the combined total of GM and non-GM carnation flower imports[1] in this reporting period.

***Table 2. Import of carnation (total of GM plus non-GMO) into the EU, July 2022 to June 2023***

| Country of origin | Quantity (tonnes)* | |
|---|---|---|
| | NL imports | EU27 total imports |
| Ecuador | 322 | 362 |
| Colombia | 10,998 | 13,860 |
| Other countries | 20,876 | 25,932 |
| Total[2] | 32,196 | 40,154 |

** From EUROSTAT (code 06031200; fresh cut carnations, DS-016890 trade since 1988 by CN8).*

Percentage of import which is GM

Table 3 shows the percentage of carnation flower import into the EU which is GM.

[1] http://epp.eurostat.ec.europa.eu/newxtweb/setupdimselection.do
[2] Reporter; EU27_2020_EXTRA

***Table 3. Percentage of carnation flower import into the EU which were GM flowers. Data is calculated from tables 1 and 2.***

| GM carnation variety | Percentage of carnation imports | | |
|---|---|---|---|
| | From Ecuador# | From Colombia## | From all extra-EU countries* |
| Florigene®Moonaqua™ | 9.82% | 0.06% | 0.11% |
| Florigene®Moonlite™ | 7.59% | 0.03% | 0.08% |
| Florigene®Moontea™ | 0.00% | 0.07% | 0.02% |
| Florigene®Moonberry™ | 0.00% | 0.02% | 0.01% |
| Florigene®Moonvelvet™ | 0.00% | 0.02% | 0.01% |
| **Florigene®Moonvista™** | **2.67%** | **0.05%** | **0.04%** |
| All varieties | 17.41% | 0.20% | 0.23% |

*# GM imports into the E27 from Ecuador as a percentage of total GM plus non-GM product imported from Ecuador*

*## GM imports into the EU27 from Colombia as a percentage of total GM plus non-GM product imported from Colombia*

**GM imports into the EU27 from all extra-EU countries (including Ecuador and Colombia) as a percentage of total GM plus non-GM product.*

### 3.1.2 Commodity crop (GM and non-GM) imports into the community by country of destination

All imports of the GM product were into the Netherlands. Table 4 shows the percentage of carnation flower imports into the Netherlands which were GM.

***Table 4. Percentage of carnation flower import into the Netherlands which were GM flowers. Data calculated from tables 1 and 2.***

| GM carnation variety | Percentage of carnation imports | | |
|---|---|---|---|
| | From Ecuador# | From Colombia## | From all extra-EU countries* |
| Florigene®Moonaqua™ | 11.04% | 0.08% | 0.03% |
| Florigene®Moonlite™ | 8.53% | 0.04% | 0.01% |
| Florigene®Moontea™ | 0.00% | 0.08% | 0.03% |
| Florigene®Moonberry™ | 0.00% | 0.02% | 0.01% |
| Florigene®Moonvelvet™ | 0.00% | 0.03% | 0.01% |
| **Florigene®Moonvista™** | **3.00%** | **0.06%** | **0.02%** |
| All varieties | 19.57% | 0.25% | 0.09% |

*# GM imports into NL from Ecuador as a percentage of total GM plus non-GM product imported from Ecuador*

*## GM imports into NL from Colombia as a percentage of total GM plus non-GM product imported from Colombia*

**GM imports into NL from all extra-EU countries (including Ecuador and Colombia) as a percentage of total GM plus non-GM product.*

### 3.1.3 Analysis of data provided in 3.1.1 and 3.1.2

Approximately 17 tonnes of the GM event Florigene®Moonvista™ were imported in the monitoring period (July 2022 to June 2023). Imports were predominantly (59%) from Ecuador (table 1). The transgenic carnation event represents approximately 0.05% of total imports of carnation into the EU from Colombia and 2.7% of total imports of carnation into the EU from Ecuador (table 3). As the Netherlands dominates the import of extra-EU27 imports of carnation, similar percentages were recorded for import into the Netherlands

alone; the transgenic carnation event represents approximately 0.06% of total imports of carnation into the Netherlands from Colombia and 3.0% of total imports of carnation into the Netherlands from Ecuador (table 4).

## 3.2 General surveillance

### 3.2.1 Description of general surveillance

The general surveillance plan consisted of;

1. Importer questionnaire.
2. Survey reports. Florigene contacted a breeder and engaged the services of botanists to alert us to any wild carnation populations or unusual *Dianthus* hybrids. This year we have received information from two experts and the breeder.
3. Literature review (attachment 4) and database review (attachment 5).
4. Herbarium contact (attachment 6).

The same general monitoring plan was applied to all the transgenic carnation varieties which are imported into the EU. Accordingly, the information provided in attachments 1 to 6 is the same in the monitoring reports for each transgenic carnation event imported into the EU.

### 3.2.2 Details of industry, environmental, food and/or feed related surveillance networks used during general surveillance.

Attachment 1. Breeders and experts contacted in 2023.
Attachment 5. Databases reviewed in 2023.
Attachment 6, Herbaria contacted in 2003.

### 3.2.3 Details of information and/or training provided to importers, handlers, processors etc.

No training was provided.

### 3.2.4 Results of general surveillance

Importer questionnaire

See attachment 2. The importer reported that they were not aware of any illegal growing and that neither they nor their consumers have reported any adverse effects of handling the flowers.

Website feedback

One query was made to the Florigene website during the year.

Survey reports

Florigene received survey reports from two expert botanists. The results, summarised in attachment 3, reported no evidence of escape populations of transgenic carnation and no evidence of putative hybrids. Wild *Dianthus caryophyllus* populations were not found.

Literature review

Attachment 4 shows the output from the literature review. A summation is provided in section 3.2.6.

Database review

Attachment 5 lists the details of the 85 websites examined. 12 websites have been added since the last monitoring report. No websites or associated databases identified any cultivated cut-flower carnation, or hybrids between carnation and wild *Dianthus* populations.
Seventy nine percent of the websites examined returned no new information. These were primarily on-line flora and herbaria collections, which are only updated when new taxa are added, or new herbaria specimens digitised and added to on-line databases. As wild type *D.*

*caryophyllus* is rare and carnation is not found in nature, it is to be expected that the majority of websites will typically not yield new information.
Eighteen databases (listed in table 1 of attachment 5 and referenced by number here according to that table) provided records of *Dianthus caryophyllus* (or synonyms) made since July 2022. Where photographs were available, or collectors were able to be contacted, it was established the records were predominantly of wild type *D. caryophyllus* or other five petal "pinks" (refer table 1, attachment 5). Non-transgenic carnation flowers were identified in;

- One of 415 records in *i*-naturalist [2].
- One specimen from a herbarium housed in Croatia [7]

The websites with the most relevant information were the large global/pan-Europe databases [1,11] and the "citizen scientist" supported websites [2,6,9,18]. As mentioned in previous monitoring reports such websites are valuable monitoring tools as they have a large number of records and good details of observations, often including photographs. Data is also uploaded by observers rather than an administrator and is therefore generally more up-to-date.
Herbarium contact
Though the mail out part of the monitoring plan was discontinued in 2022, we undertook to contact European herbaria that had not yet been contacted using the *Index Herbariorum* database.[3] This was done in July 2023. Attachment 6 summarises the output from the herbarium contacts.
The majority of responses indicated that they had no *Dianthus caryophyllus* collections or that they were unable to assist. In the six responses where there were records of *Dianthus caryophyllus*, the dates of collection were from 2000 or earlier – pre dating the first imports of transgenic carnation into Europe.

### 3.2.5 Additional information

No adverse or unanticipated effects associated with production or sale of flowers of the transgenic event have been observed or reported. Additional information relevant to the transgenic event is summarised below.
Production sites
In Oct 2022 the transgenic carnation production areas in Colombia and Ecuador were surveyed for the possible presence of escaped populations of cultivated transgenic carnation. A further survey was carried out in Colombia in May 2023. No carnation plants were found outside of cultivation in any of the three surveys.
Phenotypic stability
Off-type percentage in the event was measured in Colombia in Apr 2023. The flower colour modification phenotype remains stable with an observed off-type (to pink flowers) of 0.07%. Off-type flowers are not exported to the EU from either Ecuador or Colombia.

### 3.2.6 Review of peer-reviewed publications – Attachment 4

Attachment 4 provides details of the methodology of the literature review. Citations are noted numerically in this section and may be cross referenced to the same numbered citation in the reference list in attachment 4. The outcomes from the literature review are summarised below.

Evidence for escape of carnation from cultivation
None of the literature identified cultivated carnation, escape populations of cultivated carnation or hybrids with other *Dianthus* species in wild populations. No naturalised populations of cultivated carnation were identified in any of the papers.

[3] http://sweetgum.nybg.org/science/ih/

Records of *Dianthus* species

Of the 246 papers read, 156 were vegetation surveys, habitat definitions including plant lists, local floras or geographical flora reviews including species lists or plant checklists. No *Dianthus* species were identified in 65 of those papers. In the other 91 papers [1 – 91] one or more *Dianthus* species were described. A total of 174 records of 64 different *Dianthus* species were noted. *Dianthus carthusianorum, D. deltoides*, and *D.superbus* were the three most widely reported species (table 5). The most commonly cited species found in the literature this year were the same as those found in the literature review carried out last year.

***Table 5. The number of citations noted in references 1 – 91 (attachment 4) in which specific Dianthus species were noted.***

| ***Dianthus* species** | **Number of citations** |
|---|---|
| *Dianthus carthusianorum L.* | 19 |
| *Dianthus deltoides L.* | 16 |
| *Dianthus superbus L.* | 15 |
| *Dianthus armeria L.* | 10 |
| *Dianthus barbatus L.* | 9 |
| *Dianthus giganteus d'Urv.* | 6 |
| *Dianthus petraeus Waldst. & Kit.* | 5 |
| *Dianthus sylvestris Wulfen* | 4 |
| *Dianthus serotinus Waldst. & Kit.* | 4 |

*Dianthus caryophyllus* was recorded in a study of La Pèque and La Cabre Sénas, France [41]. *Dianthus caryophyllus* was also mentioned in a study of alien plant species in Romania [54]. *D. caryophyllus* is listed as a casual alien plant in the Czech Republic [61].

There were three records of *Dianthus* species whose synonym names are subspecies of *D. caryophyllus.* These were;

- *D. longicaulis* in Monti Sibillini National Park, Italy [2].
- *D. longicaulis* in Catanzaro, Italy [14].
- *D. siculus* in Sicily, Italy [39].

Many *Dianthus* species were included in a vegetation database allocating environmental adaptation factors (Ellenberg type indicators) to vascular plants in Europe [116]. Unfortunately, *D. caryophyllus* was not included in the assessment.

A database review of neophytes in Europe included *D. caryophyllus* as the only representative of the genus [46]. Defined as a hemicryptophyte of European origin, the species was present in 14 of 24,220 vegetation plots, reflecting the relative scarcity of the species in nature.

Background information on *Dianthus caryophyllus* biology in Europe

- *D. caryophyllus* is included in a recently published flora of San Marino [1] though inclusion is based on a record from the 1800s.
- *D. caryophyllus* was included in a database of seed dispersal distances [106]. Data indicates a short dispersal distance (99% completed dispersal within 5 meters).

*Dianthus* taxonomy

As indicated in last year's literature review, the taxonomy of the *Dianthus* genus is complex and is under assessment by several research groups. Results gathered in recent reviews of genetic and morphological variation in the *D. pungens* sub-species group [15] and the *D.*

*sylvestris* sub-species group [107, 115] suggest that the sub-species groupings may reflect geographical variation within a single species.

Genetic modification of flower colour

Reports on methodologies for carnation transformation [92] and for flower colour modification have been published in the past year. Efforts at genetic modification were;

- Agroinfiltration using flavonoid 3'5' hydroxylase (F35H, the "blue gene" in the transgenic carnation events) in lily [98]. No modified varieties were reported.
- A transformation protocol for the transfer of the *Platycodon* F35H gene to gypsophilia [102].
- Expression of the *Aquilegia buergeriana* F35H gene in petunia, resulting in delphinidin accumulation in flower parts [104].
- Over-expression of the endogenous F35H gene in Chinese aconite resulting in a two-fold increase in flavonoids [109].
- A paper was published which showed examples of blue flowers in five cut flowers achieved through genetic modification [110 ].
- Expression of a petunia F35H gene (the same source as some of the transgenic carnation events) in rose resulted in colour change in leaves and petals due to delphinidin accumulation [118].

Health and safety related reports

Over the years of monitoring the literature on carnation there have consistently been reports on the use of the species as a medicinal or herbal plant [99] and on the health benefits of extracts from this species [121]. Recent papers have demonstrated anti-fungal potential [103]. In a review on allergenicity of ornamental plants, carnation and the ornamental *Dianthus barbatus* were placed in a low allergenicity group [108]. Carnation flowers continue to be defined as safe to use as edible flowers [114].

It has been well established now that flavonoids in general and delphinidin-based anthocyanins specifically have health benefits when consumed. Papers emphasising these themes continue to be published [93, 97, 117, 120, 122]. Of particular relevance to this report are studies on the genetically modified purple tomato [101]. These tomatoes contain higher levels of delphinidin than transgenic carnation petals and have now been approved for human consumption in the USA[4].

Carnation molecular biology

Carnation genome data is included in a new database [96].

Characterisation of the carnation chloroplast genome has been carried out [105]. The genotype analysed has 124 genes, 84 of which are protein coding.

Reports directly relevant to the transgenic carnation events

The transgenic products were mentioned in the context of review of European transgenic plant regulation [113]. An independent protocol for PCR-based identification of the variety Florigene®Moonlite™ was published in China [119].

Other information

[4] https://www.foodingredientsfirst.com/news/us-regulators-give-gm-purple-tomato-approval-after-14-years.html

Other relevant papers were;

- Experiments in which *Dianthus chinensis* seed germination was tested in comparison to a competing plant, *Muhlenbergia capillaris* [94]. Though carnation does not disperse by seed, the data showed that *Dianthus chinensis* was out competed in pot trials.
- Germination experiments with seed of *D.serotinus* [95]. These results showed germinability was a function of location source.
- Re-seeding experiments with *Dianthus deltoides* [100]. Though this species has the potential to spread by rhizomes, survivability in competition with other plant species was relatively poor.
- An experiment demonstrating that seed of *D. morisianus* can be stored for more than 10 years at 5 degree C with no loss in viability [111].
- Though a USA and not European study, an analysis of honey did demonstrate that *Dianthus* pollen can be spread through bees [112].

### 3.3 Case-specific monitoring

#### 3.3.1 Description and results of case-specific monitoring (if applicable)

Not applicable.

**Processing (if applicable)**

| EU member state | Point of entry/point of cultivation | Point of processing | Distance from point of entry/site of cultivation | Transport used |
|---|---|---|---|---|
| Not applicable | | | | |

#### 3.3.2 Monitoring and reporting of adverse effects resulting from accidental spillage (if applicable)

Not applicable.

### 3.4 Concluding remarks

There was no evidence of the establishment of the transgenic carnation event, or of any transgenic carnation event in the wild, or of introgression with wild *Dianthus* species. There has been no evidence of unexpected adverse effects on human health or the environment.

## 4. Summary of results and conclusions

Results

1. The importer reported that they were not aware of any illegal growing and that neither their staff nor consumers have reported any adverse effects of handling the flowers.
2. Reports from surveys carried out by two experts failed to identify Florigene® Moonvista™ in the wild and no evidence of hybridisation to this variety.
3. A herbarium mail out was carried out. None of the responses received identified any plants which could have been Florigene® Moonvista™.
4. A review of recent peer-reviewed literature failed to identify any variety of cultivated carnation outside of cultivation in Europe.

5. Eighteen databases (listed in table 1 of attachment 6) provided records of *Dianthus caryophyllus* (or synonyms) in Europe that were made since the last monitoring report. Where photographs were available, or collectors were able to be contacted it was established the records were of wild type *D. caryophyllus* or non-transgenic carnation in cultivation.

Conclusions

There was no evidence of the establishment of carnation of any variety in the wild, or of introgression.

## 5. Adaptation of the monitoring plan and associated methodology for future years

No changes to the monitoring plan are proposed at this point;

- The literature and database review will be continued. Publicly available flora databases and research vegetation databases remain the most relevant source of observation information and efforts will continue to be made to ensure all relevant European databases have been identified, expanding the current list of databases.
- We will continue to carry out the literature and database reviews with sufficient time to contact authors and collectors if necessary.
- We will continue to work with experts in the Balkans and continue to try and find botanical experts based in Italy and France.

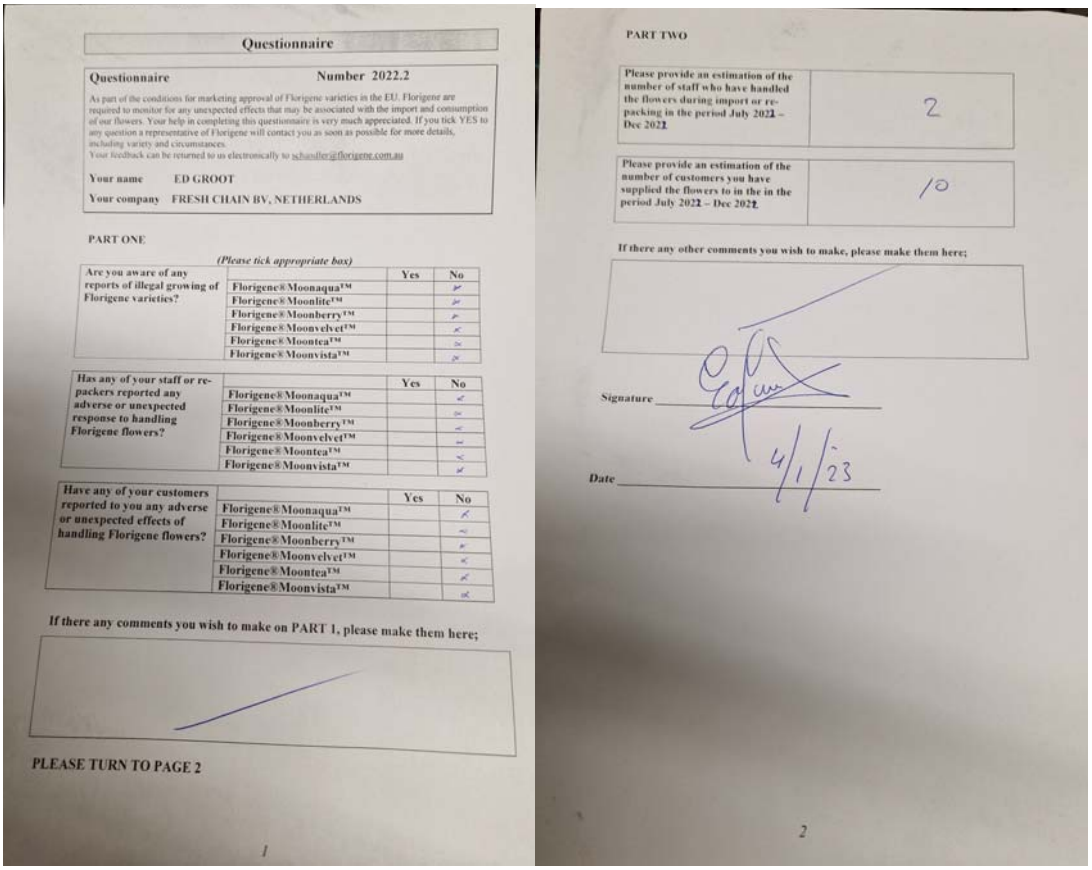
Dated…….. October 6, 2023

## Attachment 1. Breeders and experts contacted.

| **Breeders** | |
|---|---|
| Selecta Klemm GmbH and Co. | Hanfäcker 10<br>70378 Stuttgart, Germany |
| **Botanists** | |
| Ss. Cyril and Methodius University in Skopje | Department of Botany and Dendrology<br>Faculty of Forestry in Skopje<br>MK-1000 Skopje<br>Republic of North Macedonia |
| Slovak University of Agriculture in Nitra | Department of Botany<br>Tr. A. Hlinku 2, 949 76 Nitra<br>Slovakia |

## Attachment 2. Importer questionnaire response

### *January 2023*



Questionnaire

Questionnaire Number 2022.2

As part of the conditions for marketing approval of Florigene varieties in the EU, Florigene are required to monitor for any unexpected effects that may be associated with the import and consumption of our flowers. Your help in completing this questionnaire is very much appreciated. If you tick YES to any question a representative of Florigene will contact you as soon as possible for more details, including variety and circumstances.
Your feedback can be returned to us electronically to schaoller@florigene.com.au

Your name ED GROOT
Your company FRESH CHAIN BV, NETHERLANDS

PART ONE

*(Please tick appropriate box)*

| | | Yes | No |
|---|---|---|---|
| Are you aware of any reports of illegal growing of Florigene varieties? | Florigene®Moonaqua™ | | ✓ |
| | Florigene®Moonlite™ | | ✓ |
| | Florigene®Moonberry™ | | ✓ |
| | Florigene®Moonvelvet™ | | ✓ |
| | Florigene®Moontea™ | | ✓ |
| | Florigene®Moonvista™ | | ✓ |
| Has any of your staff or re-packers reported any adverse or unexpected response to handling Florigene flowers? | Florigene®Moonaqua™ | | ✓ |
| | Florigene®Moonlite™ | | ✓ |
| | Florigene®Moonberry™ | | ✓ |
| | Florigene®Moonvelvet™ | | ✓ |
| | Florigene®Moontea™ | | ✓ |
| | Florigene®Moonvista™ | | ✓ |
| Have any of your customers reported to you any adverse or unexpected effects of handling Florigene flowers? | Florigene®Moonaqua™ | | ✓ |
| | Florigene®Moonlite™ | | ✓ |
| | Florigene®Moonberry™ | | ✓ |
| | Florigene®Moonvelvet™ | | ✓ |
| | Florigene®Moontea™ | | ✓ |
| | Florigene®Moonvista™ | | ✓ |

If there any comments you wish to make on PART 1, please make them here;

PLEASE TURN TO PAGE 2

1

PART TWO

| | |
|---|---|
| Please provide an estimation of the number of staff who have handled the flowers during import or re-packing in the period July 2022 – Dec 2022 | 2 |
| Please provide an estimation of the number of customers you have supplied the flowers to in the in the period July 2022 – Dec 2022 | 10 |

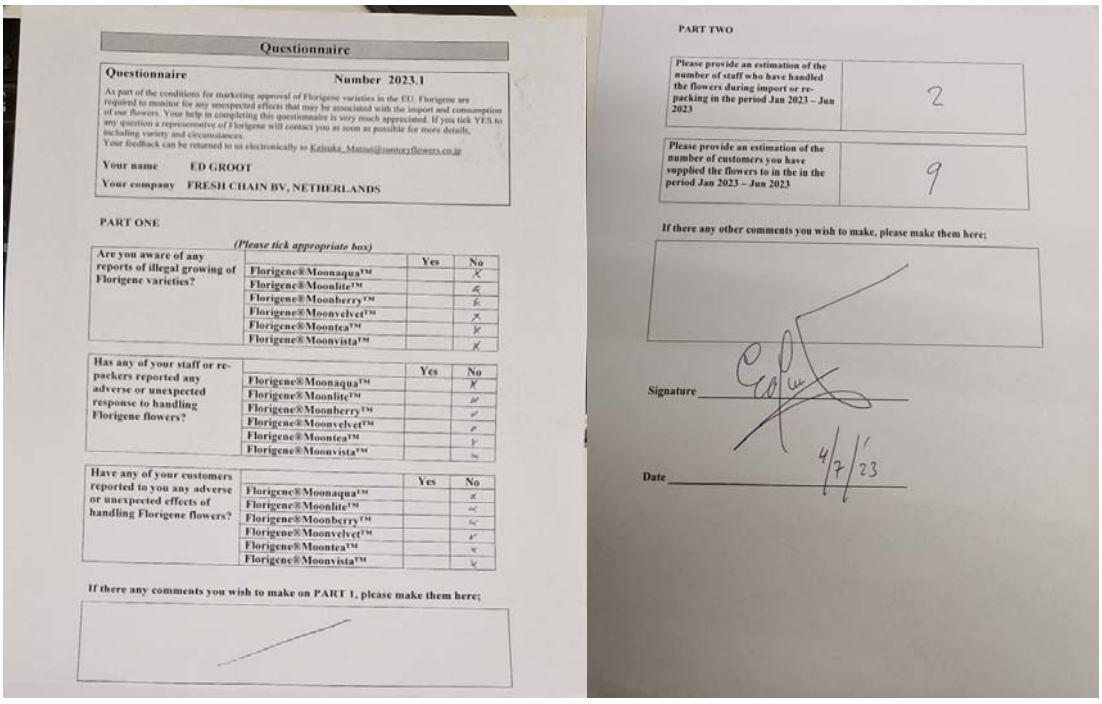
If there any other comments you wish to make, please make them here;

Signature

Date 4/1/23

2

### *July 2023*



Questionnaire

Questionnaire Number 2023.1

As part of the conditions for marketing approval of Florigene varieties in the EU, Florigene are required to monitor for any unexpected effects that may be associated with the import and consumption of our flowers. Your help in completing this questionnaire is very much appreciated. If you tick YES to any question a representative of Florigene will contact you as soon as possible for more details, including variety and circumstances.
Your feedback can be returned to us electronically to Keisuke_Matsui@suntoryflowers.co.jp

Your name ED GROOT
Your company FRESH CHAIN BV, NETHERLANDS

PART ONE

*(Please tick appropriate box)*

| | | Yes | No |
|---|---|---|---|
| Are you aware of any reports of illegal growing of Florigene varieties? | Florigene®Moonaqua™ | | ✓ |
| | Florigene®Moonlite™ | | ✓ |
| | Florigene®Moonberry™ | | ✓ |
| | Florigene®Moonvelvet™ | | ✓ |
| | Florigene®Moontea™ | | ✓ |
| | Florigene®Moonvista™ | | ✓ |
| Has any of your staff or re-packers reported any adverse or unexpected response to handling Florigene flowers? | Florigene®Moonaqua™ | | ✓ |
| | Florigene®Moonlite™ | | ✓ |
| | Florigene®Moonberry™ | | ✓ |
| | Florigene®Moonvelvet™ | | ✓ |
| | Florigene®Moontea™ | | ✓ |
| | Florigene®Moonvista™ | | ✓ |
| Have any of your customers reported to you any adverse or unexpected effects of handling Florigene flowers? | Florigene®Moonaqua™ | | ✓ |
| | Florigene®Moonlite™ | | ✓ |
| | Florigene®Moonberry™ | | ✓ |
| | Florigene®Moonvelvet™ | | ✓ |
| | Florigene®Moontea™ | | ✓ |
| | Florigene®Moonvista™ | | ✓ |

If there any comments you wish to make on PART 1, please make them here;

PART TWO

| | |
|---|---|
| Please provide an estimation of the number of staff who have handled the flowers during import or re-packing in the period Jan 2023 – Jun 2023 | 2 |
| Please provide an estimation of the number of customers you have supplied the flowers to in the in the period Jan 2023 – Jun 2023 | 9 |

If there any other comments you wish to make, please make them here;

Signature

Date 4/7/23

## Attachment 3. Summary of survey data provided by experts.

Florigene received reports from two experts, covering work in Germany, Slovakia, Croatia, and North Macedonia. Neither of the experts found any indication of hybrids with transgenic carnations, populations of carnation or populations of wild *Dianthus caryophyllus*.

Slovakia

One expert provided data for Slovakia and Croatia. Dates and locations of sampling are listed in table 1, with *Dianthus* species identified. Six *Dianthus* species were recorded, but not *Dianthus caryophyllus*.

***Table 1 Details of field work in Slovakia and Croatia***

| Month | Location | Species |
|---|---|---|
| August 2022 | Slovakia, Štiavnické vrchy Mts., Ladzany village, pastures westwards from the village, 48°15'55.3"N 18°54'06.8"E | *Dianthus armeria* and *Dianthus carthusianorum* |
| August 2022 | Slovakia, Štiavnické vrchy Mts., Lišov village, meadows in "Nad Vepercom" site, 48°14'53.0"N 18°50'37.5"E | *Dianthus carthusianorum* |
| August 2022 | Slovakia, Podunajská nížina lowland, Pohranice village, Kolíňnský vrch hill, dry meadows, 48°20'56.2"N 18°11'37.8"E | *Dianthus carthusianorum* |
| August 2022 | Slovakia, Pohronský Inovec Mts., Kňažice village, meadows east from the village, 48°23'19.3"N 18°26'08.8"E | *Dianthus armeria* |
| May 2023 | Slovakia, Štiavnické vrchy Mts., Vyhne settlement, meadows southwest from the village, 48°29'57.4"N 18°48'01.8"E | *Dianthus carthusianorum* |
| June 2023 | Slovakia, Východoslovenská nížina lowland, Zemplínske Kopčany village, Kopčianske slanisko Nature Reserve, salt meadow, 48°35'30.0"N 21°53'21.5"E | *Dianthus armeria* |
| June 2023 | Slovakia, Východoslovenská nížina lowland, Svätuše village, dry grasslands on western slopes of stone pit, 48°25'36.3"N 21°55'37.3"E | *Dianthus carthusianorum* |
| July 2023 | Slovakia, Podunajská nížina Lowland, Mužla village, clearings in forest near the Čenkov farmstead, sandy dunes, 47°46'53.6"N 18°31'05.4"E | *Dianthus serotinus* |
| July 2023 | Slovakia, Tribeč Mts., Radobica village, dry grasslands, 48°35'00.9"N 18°30'01.0"E | *Dianthus carthusianorum* |
| July 2023 | Slovakia, Tribeč Mts., Klátová Nová Ves village, Kostrín hill, dry grasslands, 48°33'15.7"N 18°17'54.7"E | *Dianthus carthusianorum* |
| July 2023 | Croatia, Vir Island, Vir village, coastal meadows near the Virski most bridge, 44°16'52.5"N 15°07'26.3"E | *Dianthus ciliatus* |
| July 2023 | Croatia, Vir Island, Vir village, meadows near the Virski most bridge, 44°16'57.9"N 15°07'34.7"E | *Dianthus integer* |

| Month | Location | Species |
|---|---|---|
| August 2023 | Slovakia, Pohronský Inovec Mts., Veľká Lehota village, grasslands near the Ski Center Drozdovo, 48°25'36.3"N 18°32'52.3"E | *Dianthus deltoides* |
| August 2023 | Slovakia, Malé Karpaty Mts., Vinosady village, dry meadows at "Holubyho pustáky" site, 48°19'06.0"N 17°16'53.4"E | *Dianthus carthusianorum* |
| August 2023 | Slovakia, Kremnické vrchy Mts., Budča, dry grasslands in the Boky Nature Preserve, 48°33'49.8"N 19°01'27.4"E | *Dianthus carthusianorum* |

Republic of North Macedonia and Germany

One expert provided data for North Macedonia and Germany. Dates and locations of surveys are listed in table 2.

***Table 2. Details of field work in Republic of North Macedonia and Germany***

| Month | Location | Species |
|---|---|---|
| Oct 2022 | Mavrovo National Park, NM | No *Dianthus* species identified |
| Mar 2023 | J Belchishko Blato (Belchishta Wetland), Ohrid region, NM | No *Dianthus* species identified |
| Apr 2023 | Moklishte, Tikvesh region, NM | No *Dianthus* species identified |
| Jun 2023 | Bogomila, Jakupica Mountain range, NM | No *Dianthus* species identified |
| Jun 2023 | Skopje, Jakupica Mountain range, NM | *Dianthus kapinaensis* and *Dianthus deltoides* subsp. *degenii* |
| Jun 2023 | Dresden, Saxony, Germany | *D. armeria* |

## Attachment 4. Literature review methodology

### Search terms

Search terms used were carnation, carnation biology, Dianthus, Dianthus biology, Dianthus fertilization, Dianthus gene, Dianthus genome, Dianthus medicinal, Europe flora, Europe plant survey, Europe plant checklist, Europe botany survey, Dianthus caryophyllus, vegetation survey, Europe vegetation, urban plant.
Search terms were each used exactly as listed in normal font, with use of suitable filters to remove papers published before the beginning of 2022 and where filters allowed, confinement to European geography only. The primary focus of the literature review was seeking information on carnation and *Dianthus* populations outside of cultivation.

### Source databases and journals

Literature searches with all search terms were carried out using these databases.

- Proquest -biological sciences
- Science Direct (Elsevier)
- Google Scholar

All papers published since January 2022 in these five journals were reviewed for relevance to the search terms;

- Preslia
- Journal of vegetation science
- Vegetation classification and survey
- PhytoKeys
- *Hladnikia*

Literature searches using only the search term “Dianthus” were carried out using these databases.

- Oxford Academic
- PMC PubMed Central
- Scopus
- SpringerLink
- Wiley Online Library
- Proquest – ecological abstracts

53 key citations from literature reviews from previous monitoring reports (5 papers were included from the 2022 literature review) were searched in Google Scholar for citing literature published since January 2022.

### Literature review short list

The outcome from the initial screen of the literature identified hundreds of abstracts. Papers not considered for further review covered the chemistry of flavonoids and anthocyanins, essential oil preparation and analysis, non-European studies, horticultural studies relating to carnation production and breeding, physiological and biochemical studies relating to post-harvest care in carnation, herbicide resistance and plant pathology studies related to carnation. Abstracts concerning the coral species *Dianthus* or clove oil use were also not considered.

Papers added to the short list were those where there was possible relevance to carnation or *Dianthus caryophyllus* distribution, identification of other *Dianthus* species, possible biosafety implications, *Dianthus* taxonomy and/or genetic modification. These papers are cited in the reference list below.
246 papers were short listed and read, including any supplementary information files provided with the papers.

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## Attachment 5. Database information 2023

Databases previously identified were re-examined for any new entries listing *Dianthus caryophyllus* since the last monitoring report. Newly identified databases were reviewed for content and any records of *Dianthus caryophyllus.*
Results of the database survey are summarized in tables 1 and 2 of this attachment. Each table has the following information:

| | |
|---|---|
| Site no. | Internal number allocated to each website for cross reference. |
| URL | Address of the website |
| Site name | Title of the website, database, flora or checklist according to the website |
| Site geographical coverage | Area and/or country covered by website |
| Site description | Brief description of the information provided at the website |
| Access date | Date the website was reviewed for this report |
| Search outcome | Table 1 - Websites in which observations of carnation or *Dianthus caryophyllus* are described. For existing websites, the observations described have been made since the 2022 monitoring report was compiled. Websites reviewed for the first time are noted. |
| | Table 2 - Websites in which no observations of carnation or *Dianthus caryophyllus* are described. For websites we have previously reviewed and no observations of carnation or *Dianthus caryophyllus* have been made since the last monitoring report, we have noted the search outcome as *No new information.* For websites we have reviewed for the first time, this fact is noted, and a brief description is provided of the coverage of the *Dianthus* genus provided at the website. |

**Table 1. Websites in which observations of carnation or *Dianthus caryophyllus* were described.**

| Site no. | URL | Site name | Site geographical coverage | Site description | Access date | Search outcome |
|---|---|---|---|---|---|---|
| 1 | www.gbif.org | Global biodiversity information Network | Worldwide | Searchable collation of multiple datasets. | 7 August 2023 | Four Europe observations of *Dianthus caryophyllus* since last report[5] |
| 2 | https://www.inaturalist.org/observations | i-naturalist | Worldwide | Searchable dataset with access to record photos and IDs. | 7 August 2023 | 415 records for *Dianthus caryophyllus*, including synonyms. since July 2022. Only four records listed as clove pink. All wild type apart from 1 cultivated, non-transgenic, carnation. |
| 3 | https://search.senckenberg.de/aquila-public-search | Database collection of Senckenberg Society for Nature Research | Worldwide | Collated database of herbarium and natural history collection searchable by species and date, | 8 August 2023 | Newly identified website. Eight *D. caryophyllus* records one of which from post 2008 (2020). |
| 4 | http://herbarium.emg.umu.se/ | Sweden's virtual herbarium | Europe, primarily Nordic countries. | Consolidated database of Swedish herbarium searchable by species and date with some images,. | 8 August 2023 | Newly identified website. Most recent *D.caryophyllus* record from 2011. |
| 5 | https://europlusmed.org | Euro Med plant database | Europe and the Mediterranean region | Plant description and distribution map with links to datasets | 7 August 2023 | Newly identified website. *Dianthus caryophyllus* is included in description. |
| 6 | http://waarnemingen.be | Belgian branch of the observation.org portal | Belgium | Searchable dataset with access to record photos and IDs. | 7 August 2023 | Three records since last report. All wild type. |
| 7 | https://hirc.botanic.hr/fcd/ | Flora Croatica database | Croatia | Searchable dataset of herbaria, bibliographies and images. | 7 August 2023 | Two new herbaria records entered that display double flowered carnation. One record from 2018 is of a red flower. |
| 8 | https://inpn.mnhn.fr/accueil/a-propos-inpn | National inventory of natural heritage (INPN) | France and French territories | Dataset compilation providing atlas searchable by species. | 8 August 2023 | Two new records of *D.caryophyllus*, validated Dec 2022. |

[5] Extracted from i-naturalist, waarmeningen.be and artportlen.se.

| Site no. | URL | Site name | Site geographical coverage | Site description | Access date | Search outcome |
|---|---|---|---|---|---|---|
| 9 | http://www.tela-botanica.org with links to http://siflore.fcbn.fr | Tela botanica | France and Corsica | Searchable datasets and bibliography with access to record photos and IDs. | 7 August 2023 | Two observations of *D.caryophyllus* made in Évosges and Saint-Maurice-de-Cazevieille. |
| 10 | https://nature.silene.eu | Silene nature | Provence-Alpes-Côte d'Azur, France | Searchable datasets and bibliography with access photos and distribution. There are no means to access the record IDs. | 7 August 2023 | 2022-2023 records are of *Dianthus* sub-species synonymous to *D. caryophyllus*, Photos are of five petal wild type. |
| 11 | https://www.flora-germanica.de | Flora of Germany | Germany | Searchable flora with photographs and distribution. | 8 August 2023 | 17 *Dianthus* species are now described including *D. caryophyllus*. Described as an occasionally wild ornamental plant. |
| 12 | http://parlatore.msn.unifi.it/types/search.php | Natural History Museum/ Univ. Of Florence | Italy | Searchable on-line herbarium | 8 August 2023 | Newly identified website. 15 *Dianthus* species are available to view, including *D. longicaulis.* |
| 13 | https://www.actaplantarum.org/flora/flora | Flora of Italy | Italy | Searchable collation of datasets of herbaria specimens, photographs, maps and botanical information. Collector ID accessible. Citizen science options. | 7 August 2023 | *D. caryophyllus* is represented by multiple synonyms and all flowers shown in the gallery are five petal wild type. |
| 14 | http://dass.sav.sk/en/select-species/ | Database of non-native species | Slovakia | Database searchable to species level, with plant descriptions | 8 August 2023 | Newly identified website. *D.caryophyllus* is listed as a neophyte present at 1 – 4 localities |
| 15 | https://dataflos.sav.sk/ | Flora of Slovakia (DataFlos) | Slovakia, Slovenia, Czech Republic. | Observation database searchable to species level | 8 August 2023 | Newly identified website Several thousand *Dianthus* records, but no *D.caryophyllus*. |
| 16 | http://www.floracatalana.net. | Flora of Catalonia | Spain | Searchable dataset with photographs | 7 August 2023 | Newly identified website. Photographs include *D.caryophyllus* and two sub-species. All wild type. |
| 17 | https://www.bimon.se/sida4/sida4_2_2_en.php | Herbarium of Biological Museum, Oskarshamm, Seden | Sweden | Herbarium database searchable by species and date | 8 August 2023 | Newly identified website. !2 *D.caryophyllus* records. All are from Sweden and the most recent in 1994. |

| Site no. | URL | Site name | Site geographical coverage | Site description | Access date | Search outcome |
|---|---|---|---|---|---|---|
| 18 | https://www.artportalen.se | Species observation system | Sweden | Searchable dataset with access to record IDs. | 7 August 2023 | Single observation from July 2023. |

**Table 2. Websites in which no observations of carnation or *Dianthus caryophyllus* were described.**

| Site no. | URL | Site name | Site geographical coverage | Site description | Access date | Search outcome |
|---|---|---|---|---|---|---|
| 19 | https://herbiers.uca.fr/version-francaise/collections-dherbiers/acces-base-de-donnees | UniVegE, Herbarium of University Clermont Auvergne | Worldwide | Searchable on-line herbarium | 8 August 2023 | Newly identified website. More than 1,000 *Dianthus* specimens but no *D.caryophyllus* |
| 20 | http://plants.jstor.org | JSTOR global plants | Worldwide | Herbarium specimens sortable by date and species. | 8 August 2023 | No new information. |
| 21 | https://www.synbiosys.alterra.nl/evc | European vegetation survey | Europe | Searchable link of diagnostic species in EuroVeg database. | 8 August 2023 | No new information. |
| 22 | http://www.nobanis.org | European network on invasive alien species | Europe | Searchable database of invasive species definitions by country.. | 8 August 2023 | No new information. |
| 23 | https://www-mittelmeerflora.de | Mediterranean and Alpine flora | Europe | Checklist with superb photographs. | 7 August 2023 | No new information. |
| 24 | https://easin.jrc.ec.europa.eu | European alien species information network | Europe | Checklist with descriptions and maps. Linked to GBIF and *i*-naturalist. | 8 August 2023 | No new information. |
| 25 | http://herbariumcollection.uliege.be/ | Herbarium of University of Liege | Europe | Searchable database of herbarium specimens | 8 August 2023 | Newly identified website. No *D.caryophyllus*. |
| 26 | http://herbarium.univie.ac.at/database/search.php | Herbarium WU | Austria | Database of herbarium specimens. | 8 August 2023 | No new information. |
| 27 | http://flora.nhm-wien.ac.at/Seiten-Allgemein/Pflanzengattungen.html | Botanik im Bild | Austria | A collection of photographs of the wild plants of Austria. | 8 August 2023 | No new information. |
| 28 | http://www.plantcol.be/search-plants.php | Belgian living plants collection | Belgium | Searchable dataset of living plant collections in nine botanical institutions in Belgium. | 8 August 2023 | No new information. |

| Site no. | URL | Site name | Site geographical coverage | Site description | Access date | Search outcome |
|---|---|---|---|---|---|---|
| 29 | https://alienplantsbelgium.myspecies.info/ | Manual of the alien plants of Belgium | Belgium | Searchable dataset with maps and record IDs. | 8 August 2023 | No new information. |
| 30 | http://www.prirodoslovni.com/inventarna/en/search.php# | Natural history museum Rijeka | Croatia | Searchable dataset of herbarium images. | 8 August 2023 | No new information. |
| 31 | http://www.flora-of-cyprus.eu | Flora of Cyprus | Cyprus | Checklist with photographs. | 8 August 2023 | No new information. |
| 32 | http://www.biolib.cz/en/main | BioLib biological library | Czech Republic | Checklist and linked datasets with photographs. | 8 August 2023 | No new information. |
| 33 | http://www.florius.cz | Catalogue Florius | Czech Republic | Checklist and linked Europe-wide collection with collector ID. | 8 August 2023 | No new information. |
| 34 | https://pladias.cz/en/ | Database of the Czech flora and vegetation | Czech Republic | Searchable database of plant species with distribution. record IDs and some photographs. Links to Flora of Czech Republic. | 8 August 2023 | No new information. |
| 35 | https://ottluuk.github.io/atlas/ | Estonian atlas of vascular plants | Estonia | Searchable database of plant species and their distribution with record IDs and some photographs. | 8 August 2023 | No new information. |
| 36 | https://elurikkus.ee | Estonia biodiversity database | Estonia | Searchable database with photographs. | 8 August 2023 | No new information. |
| 37 | https://kasviatlas.fi/ | Database of the Finnish museum of natural history | Finland | Searchable database of plant species and their distribution. | 8 August 2023 | No new information. |
| 38 | http://www.sivim.info/sivi/ | On-line database of Iberian and Micronesian vegetation | France, Portugal and Spain | Searchable database of plant species and their distribution with record IDs and some photographs. | 8 August 2023 | No new information. |
| 39 | http://cbnmc.fr/cartoweb3/Chloris/atlas_auv/menu_auv.php | Atlas of flora d'Auvergne | Allier, Puy-de-Dôme, Cantal and Haute-Loire, France | On line atlas with distribution maps. Searchable for species only. | 8 August 2023 | No new information. |
| 40 | http://azunpeche.free.fr/flore.htm | Flora of the Pyrenees | Val d' Azun, France | Checklist with photographs. | 8 August 2023 | No new information. |

| Site no. | URL | Site name | Site geographical coverage | Site description | Access date | Search outcome |
|---|---|---|---|---|---|---|
| 41 | http://www.florealpes.com | FloreAlpes | Hautes-Alpes, Corsica, Pyrenees, Provence, France | Searchable flora with photos and distribution maps. | 8 August 2023 | No new information. |
| 42 | http://www.cbn-alpin-icono.fr/Phototheque/categories | National Alpine botanical conservatory | Alps and foothills, France | Searchable datasets of herbaria sheets and photographic images, with collector ID. | 7 August 2023 | No new information. |
| 43 | http://www.naturedugard.org | Observatoire du patrimoine naturel du Gard | Languedoc-Roussillon, France | Searchable dataset with access to record photo gallery and record IDs. | 7 August 2023 | No new information. |
| 44 | https://www.cbnbrest.fr/observatoire-plantes/cartes-de-repartition/ecalluna | Conservatoire botanique national de Brest (CBN). | Nouvelle-Aquitaine Basse-Normandie, Bretagne and Pays, France | Searchable distribution dataset with access to record locations. | 8 August 2023 | No new information. |
| 45 | http://biodiversity-georgia.net/ | Georgian biodiversity database | Georgia | Searchable database with observations linked to GBIF[6]. | 8 August 2023 | No new information. |
| 46 | http://daten.bayernflora.de | Botanical information node Bavaria | Bavaria, Germany | Checklist with distribution maps. | 8 August 2023 | No new information. |
| 47 | http://www.floraweb.de | Floraweb – German wild plants | Germany | Floral descriptions and distribution maps. | 8 August 2023 | No new information. |
| 48 | https://nabu-naturgucker.de | Naturgucker citizen science project (“Enjoy nature”) | Germany | Searchable dataset with access to photo gallery and record IDs. | 8 August 2023 | No new information. |
| 49 | http://filotis.itia.ntua.gr/home | FILOTIS - database for the natural environment of Greece | Greece | Searchable dataset with access to distribution maps and record IDs. | 8 August 2023 | No new information. |
| 50 | https://www.greekflora.gr/. | GreekFlora | Greece | Flora searchable by species name. Photographic illustration. | 8 August 2023 | No new information. |
| 51 | http://portal.cybertaxonomy.org/flora-greece/intro | Flora of Greece | Greece | Checklist with images of some species. | 8 August 2023 | No new information. |

[6] Site no. 1. Refer row 1.

| Site no. | URL | Site name | Site geographical coverage | Site description | Access date | Search outcome |
|---|---|---|---|---|---|---|
| 52 | https://maps.biodiversityireland.ie | National biodiversity data centre of Ireland | Republic of Ireland | Searchable collation of datasets with maps and botanical information. Collector ID accessible. | 8 August 2023 | No new information. |
| 53 | http://www.wildflowersofireland.net/ | Wild flowers of Ireland | Republic of Ireland | Photographic flora. | 8 August 2023 | No new information. |
| 54 | http://dryades.units.it/trieste | Flora of city of Trieste | Trieste, Italy | Species list with links to further information. | 8 August 2023 | No new information. |
| 55 | http://dryades.units.it/casentinesi/ | Flora of National Parks Casentinesi forests, Monte Falterona and Campagna | Casentinesi forests, Monte Falterona and Campagna, Italy | Species list with links to further information. | 8 August 2023 | No new information. |
| 56 | http://dryades.units.it/prealpigiulie | Flora of Julian pre-Alps natural park | Julian Pre-Alps Natural Park, Italy | Species list with links to further information. | 8 August 2023 | No new information. |
| 57 | http://dryades.units.it/dolomitifriulane | Flora of Friulian Dolomites natural park | Friulian Dolomites Natural Park, Italy | Species list with links to further information. | 8 August 2023 | No new information. |
| 58 | http://dryades.units.it/udine | Flora of city of Udine | Udine, Italy | Species list with links to further information. | 8 August 2023 | No new information. |
| 59 | http://dryades.units.it/euganei | Flora of Euganean Hills | Euganean Hills, Italy | Species list with links to further information. | 8 August 2023 | No new information. |
| 60 | http://dryades.units.it/valerio | Flora of Monte Valerio | Monte Valerio, Trieste, Italy | Species list with links to further information. | 8 August 2023 | No new information. |
| 61 | http://www.anarchive.it | Flora of Italy | Italy | Searchable botanical data archive, with maps and sample dates. | 8 August 2023 | No new information. |
| 62 | http://dryades.units.it/Roma | Flora of city of Rome | Udine, Italy | Species list with links to further information. | 8 August 2023 | No new information. |
| 63 | http://urdis.unicam.it/crfa/ | Centro Ricerche Floristiche dellÂ'Appennino (CRFA) | Central Apennines, Italy | List of plant species with distribution details. | 8 August 2023 | No new information. |
| 64 | http://www.floramarittime.it | Floral catalogue of maritime Alps | Italy and France | Searchable photographs catalogue. | 8 August 2023 | No new information. |

| Site no. | URL | Site name | Site geographical coverage | Site description | Access date | Search outcome |
|---|---|---|---|---|---|---|
| 65 | https://cambriasalvatore.wixsite.com/flora-della-sicilia | Flora of Sicily | Sicily, Italy | On line plant species list. | 8 August 2023 | No new information. |
| 66 | http://www.maltawildplants.com/wildplants | Malta wild plants | Malta | Plant list with linked distribution information. | 8 August 2023 | No new information. |
| 67 | http://waarneming.nl | Dutch citizen science-based nature observations | The Netherlands | Searchable dataset with access to photo gallery and record IDs. | 8 August 2023 | *D.caryophyllus* is not listed but there were 24 new observations of "unknown pinks" in the past year. All are single form flowers, not carnation. |
| 68 | http://www.verspreidingsatlas.nl/planten | FLORON – wild flora of the Netherlands | The Netherlands | Searchable dataset with access to distribution and photo gallery. | 8 August 2023 | No new information. |
| 69 | www.artsdatabanken.no | Norwegian biodiversity information centre | Norway | Searchable datasets with access to record photos and IDs. | 8 August 2023 | No new information. |
| 70 | http://www.iop.krakow.pl/ias/en | Alien species in Poland | Poland | Searchable dataset with species description. | 8 August 2023 | No new information. |
| 71 | http://www.florasilvestre.es/mediterranea | Mediterranean and Micronesian wild flora | Portugal, Spain, France, Balearic Islands | Checklist with photographs. | 8 August 2023 | No new information. |
| 72 | http://www.flora-on.pt/ | Flora of Portugal | Portugal | Checklist with photographs. | 8 August 2023 | No new information. |
| 73 | http://azoresbioportal.uac.pt/azores-species | Azorean biodiversity portal | Azores, Portugal | Species list with links to records and distribution maps. | 8 August 2023 | No new information. |
| 74 | http://dryades.units.it/triglav_ita | Flora of Triglav National Park | Triglav National Park, Slovenia | Species list with links to further information. | 8 August 2023 | No new information. |
| 75 | http://www.floraiberica.es | Flora Iberica | Spain | Species list with links to further information. | 8 August 2023 | No new information. |
| 76 | http://biodiver.bio.ub.es/biocat/ | Biodiversity databank of Catalonia | Catalonia, Spain | Searchable dataset with species description, maps and underlying citations. | 7 August 2023 | No new information. |
| 77 | http://www.anthos.es, Anthos | Spanish plants information system | Spain | Species list with links to further information. | 8 August 2023 | No new information. |
| 78 | http://flora-aragon.blogspot.fr/ | Flora of Aragon | Spain | Check list with photographs. | 8 August 2023 | No new information. |

| Site no. | URL | Site name | Site geographical coverage | Site description | Access date | Search outcome |
|---|---|---|---|---|---|---|
| 79 | http://www.almerinatura.com/joyas/ | Flora of Almeria | Spain | Check list with photographs. | 8 August 2023 | No new information. |
| 80 | https://www.floravascular.com | Flora of Western Andalucía | Spain | Check list with photographs and maps (some species). | 8 August 2023 | No new information. |
| 81 | RJB colecciones www.csic.es | Herbarium of royal botanic garden Madrid | Spain | Species list and images searchable by date. | 8 August 2023 | No new information. |
| 82 | www.infoflora.ch | National database of the flora of Switzerland | Switzerland | Searchable atlas with access to record dates. | 8 August 2023 | No new information. |
| 83 | https://www.wsl.ch/land/products/webflora/floramodul1-en.html | Swiss web flora | Switzerland | Checklist with distribution maps. | 8 August 2023 | No new information. |
| 84 | www.biodiversitymonitoring.ch; | Biodiversity Monitoring Program of Switzerland | Switzerland | Checklist | 7 August 2023 | Newly identified website. Ten *Dianthus* species identified in extract from database[7] but not *Dianthus caryophyllus*. |
| 85 | https://database.bsbi.org/ | Botanical society of British Isles – flora of British Isles | United Kingdom | Checklist with distribution maps searchable by species. | 7 August 2023 | No new information. |

[7] Abrahamczyk, S., Kessler, M., Roth, T., & Heer, N. (2022). Temporal changes in the Swiss flora: implications for flower-visiting insects. *BMC Ecology and Evolution*, *22*, 109. https://doi.org/10.1186/s12862-022-02061-2

## Attachment 6. Herbarium contact

Methodology

The source herbarium database, maintained at the New York botanical garden[8] was searched for all herbaria in the countries of the EU. Details of 668 herbaria were extracted and compiled into a single list, from which further selection was made. As we had established from previous monitoring mail outs that email was the most effective means of communication only herbaria with email contact details were considered further. There were 399 such herbaria. From this list we eliminated institutions that we had already contacted in previous years, leaving 210 institutions. We eliminated non-active herbaria and herbaria which did not specialise in vascular plants from that list, leaving 159 institutions on the short list.

Finally, we chose to contact only those institutions with collections of more than 70,000 accessions. Those 40 institutions, which are listed in table 1, had a total of 19.0 million records, representing 91.2% of the total number of records held in the 159 institutions we had short listed.

The 40 institutions were contacted by email on July 30. No emails were returned due to a wrong address.

Outcome

Responses were received from 23 institutions, a 57.5% response rate. The majority of responses indicated that there were no *Dianthus caryophyllus* collections or they were unable to assist. In the six responses where there were records of *Dianthus caryophyllus*, the dates of collection were from 2000 or earlier – pre dating the first imports of transgenic carnation into Europe.

[8] http://sweetgum.nybg.org/science/ih/

**Table 1. List of herbariums contacted.**

| Organisation | Herbarium code | City | Country |
|---|---|---|---|
| Universalmuseum Joanneum | GJO | Graz | Austria |
| Université de Liège | LG | Liège | Belgium |
| Institute of Botany, Academy of Sciences | PRA | Pruhonice | Czech Republic |
| Jihoceské muzeum v Ceských Budejovicích | CB | Ceské Budejovice | Czech Republic |
| Východoceské muzeum Pardubice | MP | Pardubice | Czech Republic |
| Oblastni muzeum v Litomericich | LIT | Litomerice | Czech Republic |
| Kuopio Natural History Museum | KUO | Kuopio | Finland |
| UNIVEGE Université Clermont Auvergne | CLF | Clermont-Ferrand | France |
| Office de l\'Environnement de la Corse | CORS | Corte | France |
| Societe des Lettres, Sciences et Arts de l'Aveyron | SLA | Rodez Cedez | France |
| Museum d'Histoire Naturelle de Chambéry | CHBY | Chambery | France |
| Leibniz Institute of Plant Genetics and Crop Plant Research (IPK) | GAT | Gatersleben | Germany |
| Museum für Naturkunde | MSTR | Münster | Germany |
| Senckenberg Gesellschaft für Naturforschung: Senckenberg Museum für Naturkunde Görlitz | GLM | Görlitz | Germany |
| Pfalzmuseum für Naturkunde | POLL | Bad Dürkheim | Germany |
| Regensburgische Botanische Gesellschaft | REG | Regensburg | Germany |
| Museum Wiesbaden | WIES | Wiesbaden | Germany |
| INRES - Institute for Crop Science and Resource Conservation | NHV | Bonn | Germany |
| University of Patras | UPA | Patras | Greece |
| Aristotle University of Thessaloniki, | TAU | Thessaloniki | Greece |
| Savaria County Municipal Museum | SAMU | Szombathely | Hungary |
| Natural History Museum | FI | Firenze | Italy |
| Università degli Studi di Padova | PAD | Padua | Italy |
| Jagiellonian University | KRA | Kraków | Poland |
| Maria Curie-Sklodowska University | LBL | Lublin | Poland |

| Organisation | Herbarium code | City | Country |
|---|---|---|---|
| Uniwersytet Łódzki | LOD | Lódz | Poland |
| Nicolaus Copernicus University | TRN | Torun | Poland |
| University of Silesia in Katowice | KTU | Chorzów | Poland |
| Gdansk University | UGDA | Gdansk | Poland |
| Gradina Botanica D. Brandza | BUC | Bucuresti | Romania |
| Institute of Biology, Romanian Academy | BUCA | Bucuresti | Romania |
| "Alexandru Ioan Cuza" University | I | Iasi | Romania |
| Natural History Museum | SIB | Sibiu | Romania |
| Slovak National Museum | BRA | Bratislava | Slovakia |
| Slovak Academy of Sciences | SAV | Bratislava | Slovakia |
| Research Centre of "La Orden-Valdesequera" | HSS | Mérida | Spain |
| Lund University | LD | Lund | Sweden |
| Umeå University | UME | Umeå | Sweden |
| Biological Museum, Oskarshamn | OHN | Oskarshamn | Sweden |
| Universität Basel | BASBG | Bottmingen | Switzerland |