

## Article

# *Crithmum maritimum* L.: First Results on Phenological Development and Biomass Production in Mediterranean Areas

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**Abstract:** In Mediterranean cropping systems, it is important to utilise marginal lands for the cultivation of native food crops. Previous research on *Crithmum maritimum* L., a species native to southern Europe, has focused on its alimentary and chemical parameters. The aim of the present study was to identify the effects of irrigation and fertigation systems on *C. maritimum* in Mediterranean cropping systems. We planted *C. maritimum* seeds in an organic farm in Italy, and we carried out three experiments (fertigation, irrigation, and control) with three replications each. We evaluated plant phenological development and biomass production. We found that these treatments significantly influenced plant phenology and biomass parameters. Even with low irrigation and fertigation, this species showed a significant difference in the Bundesanstalt, Bundessortenamt, Chemische Industrie (BBCH) phase at harvest: in fact, there were 39 and 35 leaves on the main stem in the irrigation and fertigation treatments, respectively, while there were 29 leaves on the main stem in the rainfed unfertilised control. Biomass production also showed the same significant difference: 1.8 and 2.0 t ha<sup>-1</sup> of total dry biomass in the irrigation and fertigation treatments, respectively, and 1.2 t ha<sup>-1</sup> of total dry biomass in the rainfed unfertilised control. In conclusion, we recommend the use of *C. maritimum* for food production in Mediterranean organic cropping systems.

**Keywords:** *Crithmum maritimum* L.; organic cropping systems; halophyte; Mediterranean marginal areas



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## 1. Introduction

The purpose of agriculture is to provide enough food to meet the nutritional demand of the current human population. Until the year 2050, the population is predicted to grow by 2.6 billion people [1]; agriculture will need to meet the increasing demand for food [2] while reducing production costs and pollution. The European Union has committed to complying with the Kyoto Protocol on Climate Change by adopting a series of directives to reduce greenhouse gas emissions by 2020 [3]. These directives aim to establish a common framework to limit greenhouse gas emissions and promote cleaner transport [4].

In Mediterranean areas, to increase food productivity, it is important to utilise some marginal lands for the cultivation of non-food crops, thus reducing competition with food crops for land [5]. It is also important to use surplus and marginal lands to promote regional economic structures, provide alternative sources of employment in rural areas, reduce CO<sub>2</sub> emissions, and decrease vulnerability to short-term weather changes [6]. In the Mediterranean region, soil water content is one of the most limiting factors for plant growth under rainfed conditions. Water availability strongly affects the choice of crops in Mediterranean environments [7] where only few options are suitable for growing. In addition, the choice and introduction of crops should take into account the existing cropping systems and plant needs at the local level [8]. In marginal areas, it is necessary to

identify the most promising species in terms of adaptation capacity, required inputs, and yields [8].

In recent decades, the aim of production-focused agriculture is the preservation of agrobiodiversity [9] by seeking possibilities to use and revalue germplasms of local varieties, including wild ones, which are well adapted to environmental conditions, in order to ensure agroecosystem resilience and adaptability to new global challenges [10].

In Mediterranean coastal cultivation systems, sea fennel (*Crithmum maritimum* L.), also known as samphire, crest marine, marine fennel, and rock samphire, is an example of a native plant. It is a perennial halophyte which inhabits sandy beaches, maritime rocks, breakwaters, and piers of the world's coastlines, being particularly abundant along the coasts of Mediterranean countries [11,12].

Among halophytes, which are plants tolerant to saline environments, sea fennel has been proposed as a potential crop in biosaline agriculture [11–14]; it can be used for the development of sustainable agroecosystems that require fewer inputs than conventional ecosystems, and that provide multiple services that can address climate change problems and tackle problems related to certain poor agricultural practices, such as the preference for cultivation of annuals over multiannuals, use of weak drainage systems, and inefficient water use management [15–17].

Urban Mediterranean environments can be improved using plants such as *C. maritimum*; in fact, implementation of green infrastructures can limit some negative impacts of urban environments on their inhabitants [18], providing the environment as well as the inhabitants with a wide range of services and advantages [18], such as rainwater retention [19], energy saving [20], thermal regulation [21], increased carbon sequestration capacity [22], and increased albedo values [23], which can lead to a significant reduction in the urban heat island effect [24]. Other benefits of these infrastructures include the reduction in atmospheric and sound pollution [25], improvement of biodiversity in urban areas [26], and certain improvements on aesthetic, psychological, and social levels [27]. *C. maritimum* is considered a species potentially suitable for growth in the conditions of extensive green roofs, as it already naturally grows in habitats characterised by shallow soils with low organic matter content, high solar radiation, and high temperatures, as well as its high tolerance to water stress [28].

*C. maritimum* could be used in marginal or degraded areas to promote soil desalination, enable agricultural production, and recycle nutrients from aquaculture effluents [29], as well as to act as a phytoremediator in areas polluted by heavy metals [30]. To date, many methods have been developed to desalinate soils, such as leaching, phytodepuration using halophytic plants, and subsurface drainage [30], to counteract the reduction in soil fertility [31].

Although halophytic species represent only 1% of all plants, they are particularly interesting because they inhabit salty environments, and are adapted to living under extreme conditions [32]. They have a wide range of uses, including as food and feed sources, for the production of oil, and for the pharmaceutical industry [30]. In particular, most food [33–36] and industrial products [29,37–39] obtained by processing *C. maritimum* and available in national and international markets are preserved in oil, and are produced by family-run or artisanal enterprises using wild plants harvested manually from coastal areas.

The current crisis involving the scarcity of water resources and increase in agricultural land salinisation has awoken a particular interest in *C. maritimum* and other halophytes, especially those that can achieve high and economically convenient yield [13].

Indeed, there were some promising initial attempts to grow glycophytic plants in saline regimes using conventional breeding programs, but the results were disappointing [40]. Other attempts [41] involved the implementation of strategies for adapting conventional agricultural crops to improve their salt tolerance through genetic screening, selection, and backcross breeding with salt-tolerant germplasms. However, these studies also revealed poor results [42].

Despite the scientific community's understanding of the importance of selecting and breeding viable halophytes for agricultural purposes, most experiments carried out on wild halophytic plant germplasms have typically focused on the mere detection of salt stress response or types of salt resistance mechanisms, and not on the evaluation of biomass yields and commercial potential of the studied crops [43].

The yield of halophytes can be as high as that of conventional crops, even when irrigated with seawater [43,44]. Their potential yield depends on the species and the salt concentration to which the plant is subjected [45]. Unfortunately, these findings were obtained in short-term (14–60 days), small-scale trials [46] or laboratory trials, and the recorded yields refer to fresh or dry biomass per pot or per plant, without taking into account the actual planting density [47,48].

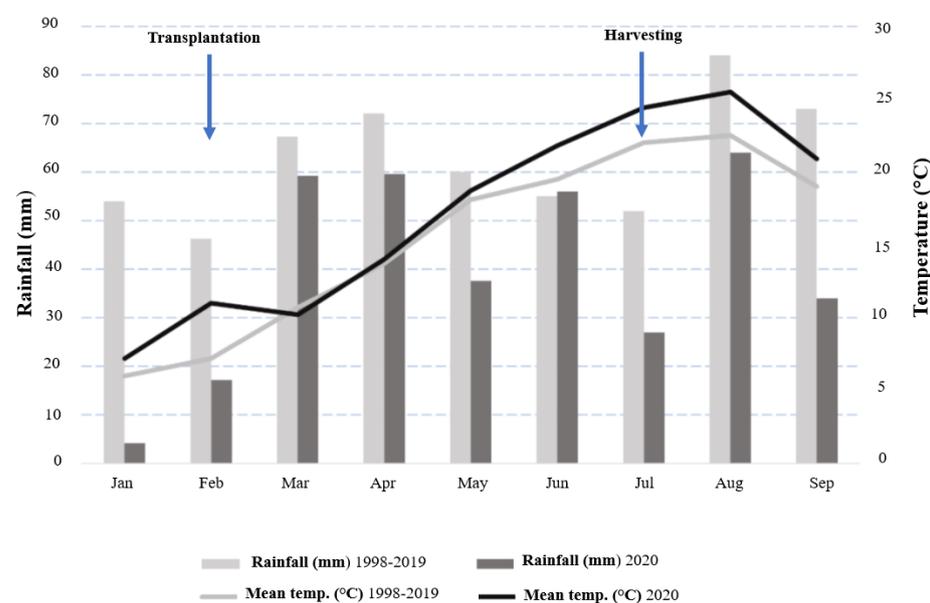
Field trials simulating agronomic growth conditions are rarely reported in scientific literature [44]. Considering the lack of agronomic data in scientific literature and the growing interest in the food, environmental, and industrial sectors, the aim of the present study was to evaluate the productive and phenological response of *C. maritimum* to different levels of agronomic intensification in the context of Mediterranean organic farming.

## 2. Materials and Methods

### 2.1. Experimental Site

The experimental site was located at an organic farm called “Paccasassi del Conero”, located in Camerano, Italy (43°53' N,13°55' E), at an altitude of 100 m above sea level and a slope gradient of 10% on silty-clay soil classified as Calcaric Gleyic Cambisol [49].

The weather data were provided by ASSAM (Agenzia Servizi al Settore Agroalimentare delle Marche, Osimo Stazione, Ancona, Italy). The climate of the site is Mediterranean corresponding to the type Csf with no dry season and hot summer (Koppen-Geiger Map classification (1980–2016), <https://people.eng.unimelb.edu.au/mpeel/koppen.html>, accessed on 4 April 2021) (Figure 1).



**Figure 1.** Temperature and precipitation trends in the 2020 growing season compared with the 1998–2019 thermo-pluviometric series.

Between transplanting and harvesting, we observed that the total rainfall during the 2020 growing season (from March to September; 337.4 mm), which coincided with the period of *C. maritimum* vegetative development and flowering, was approximately 27% lower than the total rainfall during the same period in the historical series of 1998–2019 (463.3 mm) less (Figure 1). In particular, Figure 1 shows that precipitation in 2020 was

particularly low compared with the historical average in the months of May (37.26 mm in 2020 compared with 60 mm in 1998–2019) and July 2020 (27.20 mm in 2020 compared with 52 mm in 1998–2019). The only month in which there were no major differences in rainfall was June. The reduction in precipitation coincides with the trend of increase in average monthly temperature in 2020, starting in May and ending in September, compared with the temperature data from 1998 to 2019. In July, compared with the average temperature in the period of 1998–2019 (22 °C), a 2.2 °C higher average temperature was recorded in 2020, which corresponded with the decrease in monthly rainfall; a higher average temperature was also recorded in August 2020 (3 °C higher temperature and 20 mm less precipitation than those in the period of 1998–2019).

Soil characterisation was performed immediately before transplanting (Table 1) using a total of three soil samples that were taken from the depth of 0–30 cm.

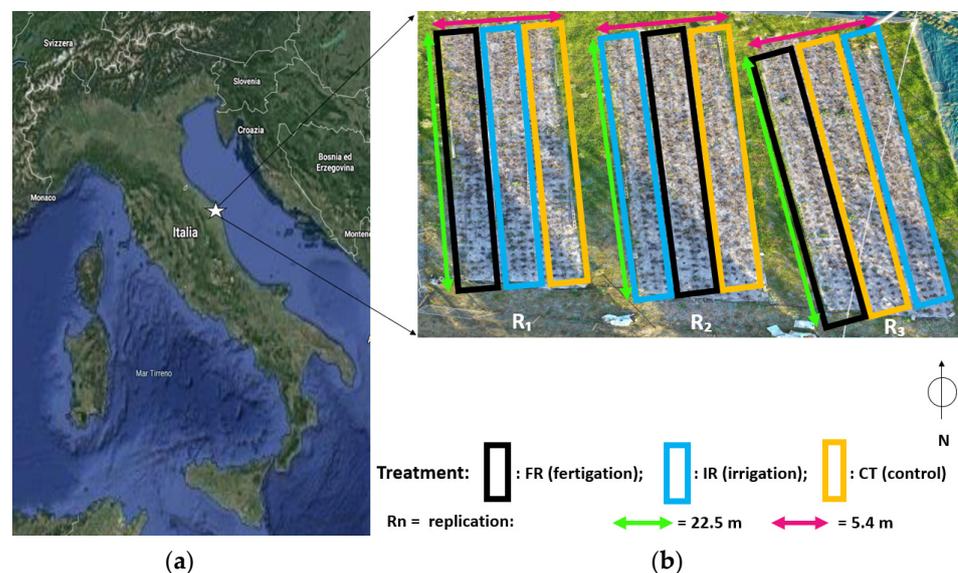
**Table 1.** Soil properties in the 0–30 cm layer in the experimental plots in 2020.

| Soil Properties                                     | Values <sup>1</sup> |
|---|---------------------|
| Sand (g kg <sup>-1</sup> )                          | 129 ± 18            |
| Silt (g kg <sup>-1</sup> )                          | 449 ± 17            |
| Clay (g kg <sup>-1</sup> )                          | 422 ± 20            |
| Soil organic matter (g kg <sup>-1</sup> )           | 11.0 ± 2.1          |
| Total nitrogen (g kg <sup>-1</sup> )                | 0.8 ± 0.1           |
| pH  | 8.1 ± 0.9           |
| Bulk density (Mg m <sup>-3</sup> )                  | 1.40 ± 0.4          |
| Soil electrical conductivity (mS cm <sup>-1</sup> ) | 0.55 ± 0.0          |
| Exchangeable Na (mg kg <sup>-1</sup> )              | 62 ± 4.0            |
| Volumetric soil water content (%):                  |                     |
| Field capacity                                      | 44.0 ± 1.2          |
| Permanent wilting point                             | 18.0 ± 2.4          |
| Total available water                               | 26.0 ± 1.8          |

<sup>1</sup> Values are shown as mean ± standard deviation.

## 2.2. Experimental Design and Crop Management

The experimental site covered about 400 m<sup>2</sup> and was laid out in a randomised block design with three replicates. Three treatments were compared: fertigation with liquid fertiliser and water (FR), irrigation with water (IR), and control rainfed treatment without fertilisation (CT) (Figure 2).



**Figure 2.** Experiment location (a) and planting design (b).

Each of the three treatments was carried out in an area of 120 m<sup>2</sup>, divided into three replication plots of 40 m<sup>2</sup>. In each replication plot, 200 plants were planted in four rows of which the two central rows were sampled in three test areas. *C. maritimum* is a heliophile and therefore requires a planting pattern that ensures adequate inter- and intra-row spacing to maximise the leaf area exposed to the sun [11]. Its tendency to branch and its laterally and deeply expanded root system provide the plants with enough space to develop. Thus, the planting distance we used was 0.45 m × 0.45 m: considering this plant density, on the longitudinal distance of 10 metres, the number of plants on the inter-row was calculated as 44 plants on an area of 4.5 m<sup>2</sup> corresponding to a density of 9.8 plants m<sup>-2</sup> and 98,000 plants ha<sup>-1</sup>. The plants that failed to grow were recovered by transplanting additional seedlings in order for the value of observed density to be equal to that of expected density, so that the recorded yields (Mg ha<sup>-1</sup>) can be compared among different treatments.

The dates of all agronomic practices are shown in Table 2.

**Table 2.** Agronomic management practices used during the experimental period (dd/mm/yyyy).

| Agrotechnique                      | Date  |
|------------------------------------|---|
| Ploughing (40 cm)                  | 13/10/2019  |
| Harrowing and seed bed preparation | 25/10/2019  |
| Mulching with sheeting             | 03/02/2020  |
| Transplantation                    | 17/02/2020  |
| Fertigation and irrigation         | 15/03/2020; 10/04/2020; 05/05/2020;<br>18/05/2020; 26/05/2020 |
| Harvesting                         | 29–31/07/2020   |

### 2.2.1. Seed Bed Preparation and Mulching

In autumn, the soil in the experimental site was ploughed to a depth of 40 cm along the maximum slope using a mouldboard (with two ploughs). After the main tillage, soil refinement was performed with a spike harrow to establish the best conditions for transplanting. It was necessary to include a zinc-plated net fence in the experimental site to protect the crops, especially in the early stages of development, from possible attacks by certain animals, such as hares, which seemed to particularly enjoy the aromatic quality of young *C. maritimum* leaves. A heavy mulch sheet made of coconut jute with a density of 0.8 kg m<sup>-2</sup>, which also protects and limits evaporation from the surface soil layers, was placed along each plot. Natural fibre mulch was chosen because of our intention to create a cultivation system that not only follows biological principles and protects biodiversity, but can also be aesthetically well integrated into the natural landscape.

### 2.2.2. Seedling Collection and Transplantation

*C. maritimum* seeds were collected on the Adriatic coast, in Conero Regional Natural Park located within the Marche region.

The seeds were sown between May and June 2020 in a greenhouse with an average temperature of 20 °C. They were sown in biodegradable pots (Ø 16) in a substratum consisting of a mix of topsoil and peat (50:50 ratio). In the last ten days of July, the cotyledons started to emerge through the surface of the substratum, and by 15–20 January, three or four leaves were already visible. In this phase, field transplantation was performed as soon as the pedo-climatic conditions were favourable. After the rooting phase in March, a check of the actual plant density in the open field was carried out.

### 2.2.3. Irrigation and Fertigation

A drip irrigation system was installed with the tubes positioned on the ground, below the mulching sheet, so that the water is diffused by means of low-pressure sprays directly next to the plants and their root systems, so that it can be easily absorbed, thus avoiding irrigation with large volumes of water and maintaining low pressure use. The system

was connected to a central programming unit, from which watering operations could be automated. The controller was in turn connected to a sensor in the field that detected the humidity at a given depth. The primary line of the tubes reached the connection point, from which the secondary supply lines led off via the valve unit. The system consisted of two lines of tubes, each with a total length of 250 m, distributed in two lines (irrigated and fertigated) in the three blocks. Irrigation planning was carried out considering the rainfall regime and the soil moisture level, which was continuously monitored by a probe: at 65% of total available water (TAW), the water supply started. Along these tubes there were 5 nozzles  $m^{-1}$  (a total of 1250 nozzles), with a flow rate of  $2 L h^{-1}$ . Fertigation was carried out with “Solabiol” liquid fertiliser permitted for use in organic farming systems (N = 1.5%, C = 10%, pH = 6.4) as follows: a dose of 1.20 L was diluted in 20 L of water at each fertigation, and this solution passed from a bucket to the fertigation lines via a “Venturi” pumped system. During the growing season, the water amount provided for both fertigation and irrigation treatments was 25,000 L corresponding to 210 mm. For the fertigation treatment, 25 kg  $ha^{-1}$  units of N were added to the water.

### 2.3. Measurements

#### 2.3.1. Phenological Development

To characterise crop phenological development in the treatments, for the main stem, we adopted the Bundesanstalt, Bundessortenamt, Chemische Industrie (BBCH) scale [50] during the full crop biological cycle: phenological characterisation started between phase BBCH 13 at the time of transplantation (February) and continued until phase BBCH 50 (initial inflorescence emergence) at harvesting date (July).

#### 2.3.2. Biomass Production Evaluation

Biomass production was evaluated at different phenological stages and at single plant level in three test areas for each replication.

In the last week of July, close to the harvesting date (BBCH scale phases between 40 and 50 (initial inflorescence emergence), before the flowering, which corresponded to the total inflorescence emergence 60 BBCH scale phase), the epigeal biomass was cut at 5 cm from the ground level and its fresh weight was determined. Then, the biomass was placed in an oven at  $105^{\circ}C$  for 48 h, after which its dry weight was determined. Within the three replications in each plot, the average biomass production of 30 samples was determined, for a total of 270 plants.

The values obtained from all replications within the same treatment were averaged, and the standard deviation was determined. Production per hectare for each treatment was calculated from the average fresh unit production, taking into account the actual plant density. Yield per hectare was then calculated using the following formula:

$$\text{Total yield (tha}^{-1}\text{)} = (\text{Biomass sampled plant weight (g)} \times \text{plant density (n. plants ha}^{-1}\text{)}) \times 10^{-6}$$

where *Biomass sampled plant weight* is the average production per plant for each treatment type [ $g \text{ plant}^{-1}$ ], *plant density* is the number of plants per ha, and  $10^{-6}$  is the conversion factor from g to t. The means and standard deviations of the total production in the plots within the same treatment were then calculated and compared with the results of other treatments.

### 2.4. Statistical Analysis

All statistical analyses were performed in R statistical software [51,52]. The analysis of the production and phenological variables was performed using a generalised linear model (GLM) procedure. Before ANOVA, we tested if the complete factorial model satisfied the three criteria of ANOVA: normality distribution of the residual model was verified both graphically (QQ-plot) and by performing the Shapiro–Wilk normality test, and homoscedasticity was checked using Levene’s test. The last ANOVA hypothesis was satisfied

by the experimental design and random sampling. As all three criteria were met, we analysed our data using ANOVA.

### 3. Results

#### 3.1. Phenology

Phenological measurements carried out between February and July 2020 (Table 3) showed that in the period between the first measurement (15 February 2020) and three subsequent measurements (10 April, 5 May, and 16 June 2020), vegetative development, in terms of total number of leaves present on the main stem, was reduced compared with that in the time interval between the fifth (14 July 2020) and sixth measurement (29 July 2020), the latter two being performed during pre-harvest when the plants reached their maximum leaf development. This reduced growth in the period between February and June may have been due to the acclimatisation phase of new plants to the new growth conditions in the post-transplant period. In fact, the seedlings had already developed their root systems in the pot cultivation substrates in the months before transplanting.

**Table 3.** Average number of leaves ( $\pm$ standard deviation) in six phenological measurements performed during different phenological phases (Bundesanstalt, Bundessortenamt, CHemischeIndustrie, BBCH) from transplanting to harvesting in the three treatments.

| Treatment | Phenological Stages |                      |                 |                               |              |                                 |
|-----------|---------------------|----------------------|-----------------|-------------------------------|--------------|---------------------------------|
|           | Leaf Development    | Side Shoot Formation | Stem Elongation | Vegetative Plant Parts Growth |              | Initial Inflorescence Emergence |
|           | (BBCH 13)           | (BBCH 25)            | (BBCH 35)       | (BBCH 40–45)                  |              | (BBCH 50)                       |
| CT        | 3 $\pm$ 1 a         | 6 $\pm$ 2 a          | 10 $\pm$ 1 a    | 12 $\pm$ 1 a                  | 16 $\pm$ 3 b | 29 $\pm$ 4 b                    |
| IR        | 3 $\pm$ 1 a         | 7 $\pm$ 1 a          | 9 $\pm$ 1 a     | 12 $\pm$ 2 a                  | 22 $\pm$ 4 a | 35 $\pm$ 2 a                    |
| FR        | 3 $\pm$ 1 a         | 6 $\pm$ 2 a          | 10 $\pm$ 2 a    | 14 $\pm$ 2 a                  | 20 $\pm$ 2 a | 39 $\pm$ 2 a                    |

CT = control treatment, IR = irrigation treatment with 210 mm ha<sup>-1</sup>, FR = fertigation treatment with 25 kg N ha<sup>-1</sup> in 210 mm ha<sup>-1</sup> of water. Among the treatments, means with different letters indicate significant differences (ANOVA,  $p < 0.05$ ).

Regarding the four observations between BBCH 13 and BBCH 40 phases, no significant differences were found among the three treatments, as all the plants were probably in the initial phase of leaf development. Specifically, in the transplant phase, the three treatments had the same number of leaves on the main stem; in the second and third phenological phases, the control and fertigated plants had the same number of leaves, but this number was not significantly different from that of irrigated plants. In the BBCH 40 phase, the control and the irrigated plants had the same number of leaves, but this number not statistically different from the number of leaves in fertigated plants. In the BBCH 45 phase, significantly higher leaf growth was observed in the irrigated and fertigated plants than in the control, and this difference was also observed in the last phase (BBCH50).

#### 3.2. Biomass Production

Biomass of *C. maritimum* L. was analysed per plant and per surface unit. Fertigation and irrigation treatments did not differ in terms of fresh biomass production (g plant<sup>-1</sup>), which varied between 112.1 ( $\pm$ 18.6) g plant<sup>-1</sup> and 120.0 ( $\pm$ 17.5) g plant<sup>-1</sup> (Table 4).

**Table 4.** Quantification of *Crithmum maritimum* L. biomass per plant and per unit area in the three treatments. Values are shown as mean  $\pm$  standard deviation.

| Treatment | UFB<br>(g Plant <sup>-1</sup> ) | TFB<br>(t ha <sup>-1</sup> ) | UDB<br>(g Plant <sup>-1</sup> ) | TDB<br>(t ha <sup>-1</sup> ) |
|-----------|---------------------------------|------------------------------|---------------------------------|------------------------------|
| CT        | 82.9 ( $\pm 26.5$ ) b           | 8.0 ( $\pm 2.6$ ) b          | 12.7 ( $\pm 1.6$ ) b            | 1.2 ( $\pm 0.1$ ) b          |
| IR        | 112.1 ( $\pm 18.6$ ) a          | 11.1 ( $\pm 1.8$ ) a         | 18.2 ( $\pm 2.9$ ) a            | 1.8 ( $\pm 0.3$ ) a          |
| FR        | 120.0 ( $\pm 17.5$ ) a          | 11.8 ( $\pm 1.7$ ) a         | 20.1 ( $\pm 3.1$ ) a            | 2.0 ( $\pm 0.3$ ) a          |

CT = control treatment (without irrigation and fertilisation), IR = irrigation treatment with 210 mm ha<sup>-1</sup>, FR = fertigation treatment with 25 kg N ha<sup>-1</sup> in 210 mm ha<sup>-1</sup> of water, UFB = unit fresh biomass, TFB = total fresh biomass, UDB = unit dry biomass, TDB = total dry biomass. Among the treatments, means with different letters indicate significant differences (ANOVA,  $p < 0.05$ ).

The fresh biomass unit production of the control was significantly lower than that of the two treatments. The total production of fresh biomass was significantly lower in the control treatment than in the irrigation and fertigation treatments. A significant difference between the control and the two treatments was also observed in the amount of dry biomass produced; it was significantly higher in the irrigation and fertigation treatments than in the control.

#### 4. Discussion

In the present study, plant production in the three treatments was evaluated in terms of phenology (determined by the number of expanded leaves per plant) and biomass, as the studies on *C. maritimum* to date referred only to the chemical-organoleptic aspects [14,53,54] or its responses to different salinity concentrations in the soil [55,56].

Regarding plant phenology, the presence of clay soil, which is not a very hospitable substrate compared with the pot cultivation substrate, as well as the temperatures in the first few months after transplanting may have conditioned the exploration by the roots of the portions of the soil close to the part of topsoil with which the plants were transplanted, and consequently also slowed down leaf growth. More differences in phenology were visible in the BBCH 45 phase and especially in the BBCH 50 phase, in which certain morphological differences were observed, as the plants began to take a more expanded and elongated shape, due to the approaching of the flowering phase and the elongation of the flowering shoot. In some cases, a reduction in the size and number of leaves was observed along the stems that had begun to elongate. From the observation of these characteristics, the attainment of the ideal harvesting period was defined, i.e., the period in which the plant reached maximum leaf development in relation to the flowering phase.

The non-significant difference observed between irrigated and fertigated plants was probably related to the fact that the amount of nitrogen fertiliser applied was low (25 kg ha<sup>-1</sup>), in accordance with the aim of the financial project (Project “BioVeg Conserve: Nuove conserve vegetali biologiche da varietà autoctone di finocchio marino coltivato in biologico”, PSR Marche 2014–2020, Misura 16.1 Azione 2 (Project ID 28913)). Another factor that influenced the small difference between the three treatments in terms of phenology, and which consequently influenced the production variables measured, was the plants’ young age. In fact, the data were collected in the phase immediately after their acclimatisation in the field. This meant that the plants did not have sufficient time to fully manifest the influence of the different intensification levels used in the present study, as they used their resources for root system development in the first post-transplant phase. Although there was a significant difference in terms of production between the control and the other two treatments, this may be more evident at the end of the second growing season. Having already adapted to the environmental conditions during the first year, the plants may have used their energy resources for aerial development in a timely manner, thus increasing the overall time interval from vegetative regrowth to full development. Research activities will continue in the coming years with the aim of evaluating the production dynamics of *C. maritimum* in full vegetative development as well.

## 5. Conclusions

The investigated *C. maritimum* plants adapted well to the rainy season 2020, which was markedly dryer in some months than in those months in the historical series 1998–2019. Despite growing in a very clayey soil, the treated plants managed to grow more than the control plants, even with minimal water and nitrogen inputs; furthermore, weeds were controlled in the two months following transplantation and did not prove to be a limiting factor for production. *C. maritimum* is an interesting species whose spread and increasing use may represent a valid strategy for mitigating the effects of climate change and whose production may be useful for the growing caloric demand associated with the population increase. In light of the FAO (Food and Agriculture Organization) 2019 projection [10], which foresees a population increase of +26% within the next 30 years, and in light of the desertification risk induced by climate change and increasing salinisation caused by the excessive use of potable water which has resulted in saline intrusions into groundwater, the use of *C. maritimum* in agricultural practices is an interesting possibility. For these reasons, *C. maritimum* has the potential to be grown in areas where the growth of other species is limited; thus, it could guarantee forage in areas with high desertification risk. In Conero Regional Natural Park in the Marche region (central Italy), the use of *C. maritimum*, better known in this context as “Paccasassi”, in the food and gastronomy sectors is increasing, and the present study is the first to evaluate different agronomic protocols that have previously not been investigated for the cultivation of this species.

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**Conflicts of Interest:** The authors declare no conflict of interest.

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