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THEME

Experiment of two aqueous extracts as a growth stimulant ''*Urtica dioica* and *Ulva lactuca*'' on industrial tomatoes

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In front of the jury:

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Thanks

First, we praise God almighty with praise befitting his majesty and greatness of his power, for he has guided the steps, opened the chest, and facilitated the matter, and prayers and peace be upon the most honorable of messengers, our master Muhammad, may God bless him and grant him peace, the faithful prophet who sent among the illiterate a messenger to guide them to the path of guidance and light.

We can - after God Almighty has enabled us to complete this modest research - only to extend our thanks and gratitude to

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Dedication 1

To my first love and inspiration that made me fall in love with the land, soil, plants and agriculture , to my father Kamal, who put a small dream in me and stayed by my side until I achieved it , with pride, Idedicate to you the result of the years of your life, your first graduate .

To the one and only, my soul mate and my life partner Salah, who supported me in my training, and wrote this note with me word by word, to my precious husband who promised me many beautiful dreams, i hope that this note is the first step to achieve them together .

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To my dear grandmother, thank you for being the good smell and warm hug, thank you for your stories about our ancient land that motivated me to bring it back .

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To my friend and soul mate Juhaina, the refuge to which i escape whenever life narrows down on me .

To the shoulder that supports me in life my wonderful brother and sister Wasim and Randa Malak i wish you a long life and peace of mind .

May Allh`s peace , mercy and blessings be upon you

Dedication 2

To whom God has crowned him prestige and dignity , to whom i carry his name with all pride my dear father may Allah protect him

To the one who kneeled in front of her feet and she gave me from her blood and soul and age love and determination to push to a more beautiful tomorrow my mother may God save her as a support for me

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To my son, the joy of my eyes: Ibrahim

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God willing , we will meet, , in the coming appointments until than , i entrust you to God, whose deposits are not lost, may God help you and me in professional life

ملخص

الهدف من دراستنا هو رصد فعالية الري و الرش بإستخدام معالجة عضوية مستخلصة من نبتة القراص *Urtica dioica*) و طحلب خس البحر (*Ulva lactuca*) في ما يخص تطور و نمو الطماطم الصناعية (*Lycopersicon escumentum*)لتقييم هذا التأثير قمنا بتقسيم أربعة مجموعات و كل مجموعة مسقية بمستخلص مختلف ((S1 Witness , S2 Compost , S3 *Urtica dioica* , S4 *Ulva lactuca*لإجمالي 120 شتلة ،كما قمنا برش المجموعتين S3 و S4 بالمستخلص المثبت بالتوين 20 و هذا من خلال قياس عدد و قطر و معدل نمو السيقان و عدد الاوراق و مساحتها و وزن الثمرة و كمية الثمار المحصودة لكل مجموعة امتدت الدراسة من 08\02\2023 الى 08\06\2023 . بين التحليل الكمي الذي تم الحصول عليه أنه بعد استخدام كل من سماد نبات القراص و سماد طحلب خس البحر شهدت النباتات المعالجة زيادة إيجابية في جميع المعايير التي تم اختبارها خاصة سماد طحلب خس البحر و مع ذلك ، يبدو أن المستخلصات قد أظهرت تأثيرًا في حماية النباتات من الأمراض والحشرات عن طريق تقليل وتحديد تأثيرها. يعني ذلك أن استخدام المستخلصات قد يساعد في تقليل الإصابات الناجمة عن الأمراض والحشرات في النباتات . من خلال النتائج يمكننا ان نستنتج ان سماد طحلب خس البحر و سماد نبات القراص يمثلان عامل محفزا للنمو و تطور و إنتاج و حماية نبات الطماطم .

الكلمات المفتاحية : *Lycopersicon esculentum* ، منشطات النمو ، *Urtica dioica*، *Ulva lactuca*، السماد.

Abstact

The objective of our study is to monitor the effectiveness of irrigation and spraying using organic treatment extracted from the nettle plant (*Urtica dioica*) and sea lettuce (*Ulva lactuca*) in terms of the development and growth of industrial tomato plants (*Lycopersicon esculentum).*To evaluate this impact, we divided the plants into four groups, with each group treated with a different extract (S1 Witness, S2 Compost, S3 *Urtica dioica*, S4 *Ulva lactuca*) , a total of 120 seedlings were used, and we sprayed groups S3 and S4 with the fixed extract with Tween 20, measuring parameters such as the number, diameter, and growth rate of stems, leaf count and area, fruit weight, and harvested quantity for each group , the study took place from 08/02/2023 to 08/06/2023. The quantitative analysis obtained indicated that after using both nettle and sea lettuce fertilizers, the treated plants showed a positive increase in all tested parameters, especially with the sea lettuce fertilizer, However, it seems that the extracts have shown an effect in protecting plants from diseases and insects by reducing and limiting their impact. This means that the use of extracts may help reduce the infections caused by diseases and insects in plants. Based on the results, we can conclude that sea lettuce and nettle fertilizers act as growth stimulants and contribute to the development and production of tomato plants.

Keywords: *Lycopersicon esculentum*, growth stimulants, *Urtica dioica*, *Ulva lactuca*, compost.

Résumé

L'objectif de notre étude est de tester l'efficacité de l'irrigation et de la pulvérisation d’un traitement organique à base d’extrait de feuilles d’ortie (*Urtica dioica*) et de la laitue de mer (*Ulva lactuca*) en ce qui concerne le développement et la croissance des plants de tomates industrielles (*Lycopersicon esculentum*). Pour évaluer cet effet, nous avons divisé les plantes en quatre groupes, chaque groupe étant traité avec un extrait différent (S1 Témoin, S2 Compost, S3 *Urtica dioica*, S4 *Ulva lactuca*). Au total, 120 plants ont été utilisés, et nous avons pulvérisé les groupes S3 et S4 avec l'extrait fixateur avec du Tween 20, et mesuré des paramètres tels que le nombre, le diamètre et le taux de croissance des tiges, le nombre et la surface des feuilles, le poids des fruits, et la quantité récoltée pour chaque groupe. L'étude s'est déroulée du 02/08/2023 au 06/08/2023. L'analyse quantitative obtenue a montré qu'après avoir utilisé à la fois l'engrais ortie et l'engrais laitue de mer, les plantes traitées ont connu une augmentation positive de tous les paramètres testés, en particulier l'engrais laitue de mer, Cependant, il semble que les extraits aient montré un effet dans la protection des plantes contre les maladies et les insectes en réduisant et en limitant leur impact. Cela signifie que l'utilisation des extraits peut aider à réduire les infections causées par les maladies et les insectes chez les plantes. D'après les résultats, nous pouvons conclure que la laitue de mer et l'engrais d'ortie représentent un catalyseur pour la croissance, le développement et la production des plants de tomates.

Mot clé : *Lycopersicon esculentum,* stimulants de croissance*, Urtica dioica*, *Ulva lactuca,* compost.

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Introduction

Introduction:

Modern agricultural technologies and global population growth pose important challenges to ensure food security and meet growing global food needs, increasing crop production should be a priority to achieve these goals, however, the problem of using more agrochemicals appears in the news regularly due to their negative effects on public health and the environment.

The agricultural industry faces an urgent need to search for natural and environmentally friendly alternatives to fertilizers and traditional agrochemicals.

In this note, we will focus on two natural plants that are likely to be used as alternative fertilizers, nettle and sea lettuce, which are known in the scientific field as *Urtica dioica* and *Ulva lactuca*. The aim of our study is establish if the agrochemicals can be replaced with alternative organic fertilizers and does it give results that compete with chemicals fertilizers, and if we will considerer it as an alternative cheaper mean for farmers in order to answer this problem, we study the effect of nettle fertilizer and sea lettuce fertilizer on tomato plants according to the following plan:

- **The theoretical part** consists of three chapters :
  - Chapter 1 : Information about the tomato plant *(Esculentum lycopersicon).*
  - Chapter 2 : Information about nettle *(Urtica dioica)* .
  - Chapter 3 : Information about sea lettuce *(Ulva lactuca)* .
- **The experimental part** consists of two chapters :
  - Chapter 1 : The material and methods used .
  - Chapter 2 : Analysis and discussion of the results .
- Finally, a general **conclusion** showing the main results obtained.

The theoretical part

Chapter 01 : Tomato plants

I. Tomato plants

I.1. The origin and history of tomatoes :

The first habitat of the tomato plant (var. *Esculentum lycopersicon;* Grierson and Hobson, 1993) is the highlands of western South America, in what is now Peru and Ecuador as well as the Galapagos Islands in the pacific ocean belonging to Ecuador where traces of the tomato plant were found (Rick, 1978 ; Thomann *et al.*, 1987).

Spanish explorer Hernán Cortés is the first to transport yellow small tomatoes to Europe after the capture of the city of Aztecs from Tenochtitalen (Esquinas, 1981), also moved from Mexico to Europe in the sixteenth century, first mentioned in Italy in 1554 (Nuez, 1995). They used it as food (Miller, 1731) and it is believed that the cultivated tomatoes originated in the breed very small-fruited tomatoes of the plant variety cerasiforme, which grows wild in South America, and the demand for cultivation of the consumption of tomatoes is limited because of the spread of a misconception that their fruits are toxic to humans and may be the reason its fruits are similar to other nightshade species with poisonous fruits (Doré and Varoquaux, 2006) .

This remained the case until the mid-nineteenth century, when the expansion of tomato cultivation in the United States and then the rest of the world (Matthiolus, 1544), the beganning of the cultivation in Algeria was in the region of Oran in 1905 and then extended to the coast of Algeria (Latigui, 1984) .

Tomatoes have many names, as the Italians called them pomodoro (Naika *et al.*, 2005), which it means golden apple, from this name, the levant derived a new name "al banadora" (Warnock, 1988), and named it the Chinese (e'ke faan), West Africa (tomati) and the Spanish (jitomate) (Naika *et al.*, 2005).

The origin of the name of the tomato came mainly from the Nautilian word called tomatl, which means in Mexican the swollen fruit (Berry, 2001) and then came the english name tomato which the Arabs took the name of " a tamatim " from them (Arahim, 2008) .

I . 2 Tomato production

I.2.1. Growing the tomato crop in the world :

In light of the rapid demographic growth in recent times, and the great interest in the type of food product and its safety Food has increased the demand for healthy and attractive foods (Laterrot, 1996), which has led many researchers to be interested in improving the productivity of a small number of existing crops, rather than increasing crop diversity (Shelef *et al.*, 2017) .

Tomatoes are one of the most common vegetable crops, as they are widely grown in many countries of the world and are considered as one of the basic vegetables because of their great benefits in nutrition for most peoples (Abd El Aal *et al.*,, 1977) , this is what made many countries of the world more interested in tomato production , where in recent times, it has witnessed a large global production estimated in 2019 at 182 million tons in a cultivated area estimated of 8.4 hectares as indicated by the world food organization estimates shown in table 01 .

Table 01:Total world production, cultivated area of tomato crop and yield per hectare (FAO, 2019).

Production	Unit	Element
4,848,384	Hectare	cultivated area
37,600	tons/ha	productivity rate
182,301,395	Tons	total world production

China leads the tomato producing countries in 2019 with a production of about 900,626.59 tons in an area it is estimated at 276,033.1 hectares, followed by India, Turkey, Mexico and Brazil are in ninth and the tenth place, the table 02 shows the ranking of the top ten tomato producing countries according to the statistics of the organization international foods .

Table 02 : Ranking of the most tomato producing countries other statistics of the world food organization (FAO, 2019) .

Ton production	Country	arrangement
59,626,900	China	1
20,708,000	India	2
12,750,000	Türkiye	3
10,910,990	America	4
7,297,108	Egypt	5
6,177,290	Iran	6
6,015,868	Italy	7
5,163,466	Spain	8
4,243,058	Mexico	9
4,230,150	Brazil	10

I.2.2. Cultivation of tomatoes in Algeria and Mostaganem

Tomatoes are considered one of the most important agricultural products in Algeria in terms of production and consumption (El Rudy, 2009), according to the statistics of the world food organization (FAO). Algeria ranks 18th in the world for the year 2017, with a production of 286,286.1 tons in an area estimated at 977.23 hectares, where most of its states are famous for growing tomatoes, for example Mostaganem produced more than 289,000 quintals of protected tomatoes (greenhouse tomatoes) in 2019 , according to the provincial directorate of agricultural interests, which reported that 153,000 quintals of this crop were harvested on an area of 180 hectares, representing about 50% of the total area (340 hectares), where the cultivation of protected tomatoes, whose yield that season reached 850 quintals per hectare, is based in the area of Achacha in the east of Mostaganem with an area of 200 hectares 58% and in the area of Estidia in the west, the target area that year was 1435 hectares, of which 305 hectares have been planted in various regions (FAO, 2019) . The table 03 shows the development of production and yields of the tomato crop in Algeria from 2008 to 2017.

Table 03: Development of tomato production in Algeria (2008 – 2017)

cultivated are (Hectare)	Yield (htg/ha)	production (tons)	the year
19,655	284,533	559, 249	**2008**
20,789	308, 352	641,034	**2009**
21,358	336,284	718,235	**2010**
20,575	375,021	771,606	**2011**
21,542	369,958	796,963	**2012**
22,497	433,424	975,075	**2013**
22,646	470,551	1,065,609	**2014**
24,065	483,593	1,163,766	**2015**
22,556	567,729	1,280,570	**2016**
23,977	536,467	1,286,286	**2017**

I.3. Tomato plant classification :

Tomato is an annual herbaceous plant (Lannoy, 2001) dendritic develops in a creepy, semi-erect or erect (Nuez, 1995) belongs to the solanaceae family (Gooseberry or night shade), and the genus *Solanum*, which includes seven other wild species scientifically called *Solanum lycopersicum* (Mill, 1990) and according to Toundou (2016) tomatoes are scientifically classified as in the table 04.

Table 04: Botanical classification of tomatoes (Toundou, 2016)

The kingdom	**Plantae**	**The plants**	
Division	Magnoliophyta	flowering plants	**sect**
Class	Magnoliopsida	Dicotyledonous	**the line**
Subclass	Asteridae	asterisks	**below grade**
Order	Solanales	nightshade	**Rank**
Family	Solanaceae	Solanaceae	**the family**
Genus	*Solanum*	nightshade	**sex**
Species	*Solanum lycopersicum*	Tomatoes	**Type**

I.4. The importance of tomato :

The tomato crop is one of the most important vegetable crops (Foolad, 2012) because it is one of the important crops on the food list that achieves food security for the turbulent population increase (Mersi *et al.*, 2013) in addition to being one of the main vegetable crops consumed in fresh, cooked or processed for the majority of the population (Obikwe and Obaseki, 1987) topping the crop tomatoes canned vegetables list (Kader *et al.*, 1987).

Tomatoes play a very important role in human nutrition (Arab and Steck, 2000) because of their content sugars, acids, vitamins, minerals, and fiber (Bradley, 2003) in which water represents about 94% and has a relatively low caloric value of 20 calories per 100 grams is cholesterol-free, and has low amount of fat (Aagarwa and Rao, 2000) also contains a significant group of dietary carotenoids, which include the more active and antioxidant leukopene , (Dimascio *et al.*, 1989) responsible for the red coloration of its fruits (Shi and Le Maguer, 2000) , many compounds also contribute tomatoes contain the prevention of serious diseases such as cancer, cardiovascular diseases (Juroszek, 2009). The nutritional composition per 100 g of raw tomatoes is shown in the table 05.

Table 05: Nutritional value in 100 g of raw tomatoes (Grasselly *et al.*, 2000)

Amounts	Food
93.52 - 95.2 g	Water
0.88 - 1.1 g	Protein
0.2 g	Fats
2.8 - 4.79g	Carbohydrate
0.5 - 1.2 g	Fibres
097.00 - 015.0 g	Calcium
0002.0 - 0006.0g	Iron
03.00 - 011.0g	Magnesium
20 0.0- 027.0 g	Phosphorous
0202. - 0300. G	Potassium
03.00 - 011.0 g	Sodium
00017.0 g	Zinc

833 international units	Vitamin A
00004.0 - 00006.0 g	Vitamin B1
00002.0 - 00005.0 g	Vitamin B2
000594.0 g	Vitamin B3
00008.0 - 0001.0 g	Vitamin B6
00004.0-012.00 g	Vitamin E
015.0- 023.0 g	Vitamin C
7.9 µg	Vitamin k
15 mcg	Folic acid

I.5 Morphological description of tomato plant

The tomato plant is a seasonal dicotyledonous shrubby plant , self-pollinated (Naika *et al.*, 2005), it has different shapes, its stems branch from the sphenoid stem fixed in the soil renewed cultivation annually belongs to short day plants and cold-season crops from aerobic germination carbon tertiary plants (Cutter, 1978).

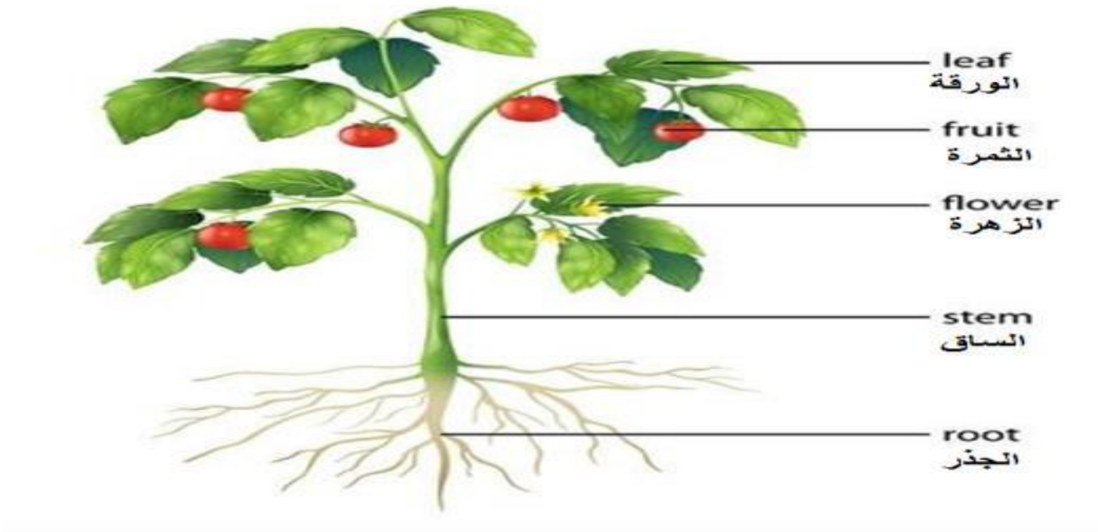


Figure 01 : Fully grown tomatoes (Diyat and Masbahi, 2019).

I.5.1. Roots :

The tomato plant is characterized by peg roots if the seeds are shown directly in the permanent land, but when planting seedlings the peg root dies and new roots are formed that extend horizontally and do not go deep into the soil, their horizontal spread reaches more than 60 cm, and adventitious roots are formed on the stem nodes buried under the soil (Najdat, 2008).

Figure 02 : Tomato root system (Original, 2023)

I.5.2. Stem :

The stem of the tomato plant is round and covered with bristles, and contains glands that secrete a greenish-yellow substance, with a distinctive smell, ranging in diameter from 2 to 4 cm and extending until it reaches a length of 30 cm and may reach 60 cm it grows laterally before the main bud turns into flowers and growth occurs from the axillary buds of the last leaf, which develops into a secondary stem, which grows as an extension of the main stem (Franco, 1999). The stem according to the nature of growth is either limited growth (ending with a floral inflorescence at the top) or unlimited growth (which does not end with a floral inflorescence at its top) and wooded with age (Fig. 03) (Hassan, 2005).

Figure 03 : Tomato stem (Original, 2023)

I.5.3. Leaves :

The tomato plant has feathery compound leaves carried on the stem with a long neck, consisting of 7-9 alternating leaflets sitting, between which small leaflets grow, and the edge of the leaflets is lobed and covered with dense hairs and the leaf has a distinctive smell that appears when pressed between the fingers, and distinguishes it from the potato leaf (Fig. 04) (Arahim, 2008) .

Figure 04 : Tomato leaves (Original, 2023)

I.5.4. Inflorescences of tomato plant :

The tomato inflorescence is called chuster flouer or truss and is botanically a limited monochasial inflorescence, although it appears as a simple cluster unlimited inflorescence , simple racem the tomato inflorescence always arises from the plant top, after it forms several leaf principles, and when the inflorescence is formed, the shape of the merci summit changes, so it tends to elongate and increase in diameter, and thus it turns from the vegetative state to the floral state and produces a cluster of flower buds that later gives the first floral cluster (Hassan, 2017) .

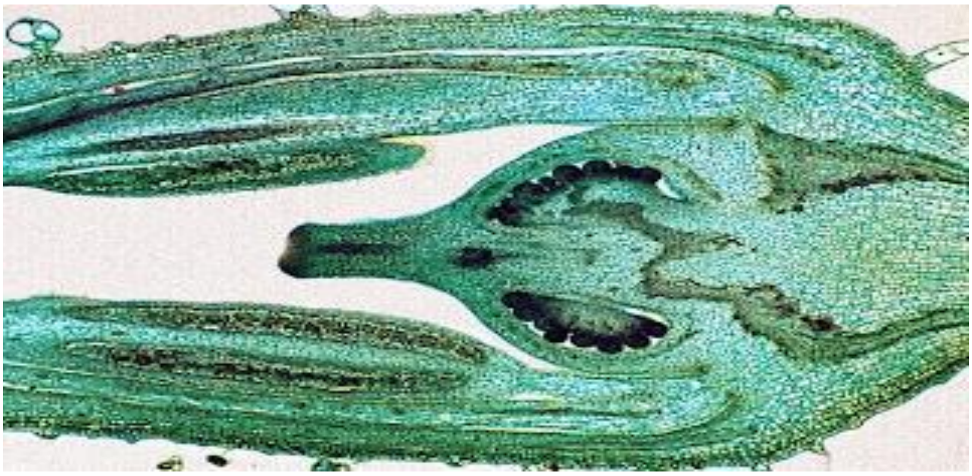


Figure 05: Inflorescences of tomato plant (Wiki, Netsite, 2023)

I.5.5. Floral :

The flowers are found in clustered apical inflorescences with limited growth, and the number of flowers per inflorescence ranges from 4 to 8 flowers (Najdat, 2008) (can reach 30 flowers in some varieties) (Atherton and Rudish , 1986) is a hermaphrodite, consisting of (5-10) green spilanes, and a corolla with 5 or more petals conjunctive at first and forms a short tube around the pollen and pistil , then the third petal opens and the pollen consists of five or more suprapetal stamens that have short and long filaments that fuse and form the cone of the stamens.The belongings are surrounded and the belongings consist of a multi-dwelling ovary (Hassan, 2017) (Nuez, 1995). carpel 2 + Stamens 5 + Petals 5 + Spallet 5 (Rey and Costis, 1965) .

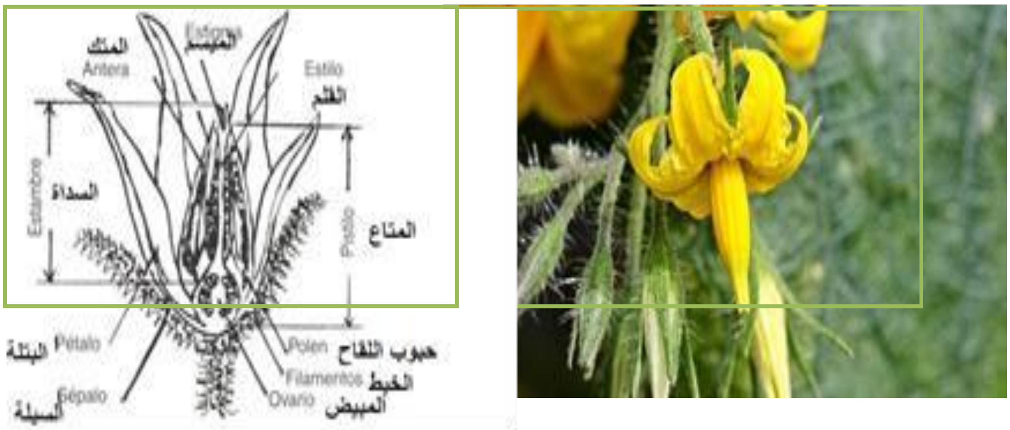


Figure 06 : Detailed representational photograph and drawing of flowering tomato plant (Rick, 1978)

I.5.6. fruits :

The fruit of tomatoes is fleshy, containing (2-10) dwellings depending on the variety, but the large fruits contain on average 5 or 10 dwellings, there are several colors in the fruits, including: Pink, red, crimson, orange, yellow ، and in shape, including: cherry, spherical, pear, round square, oval and elongated (Fig. 06) (Arhim, 2008) .

Figure 07 : The fruit of the tomato plant (Original, 2023)

I. 5. 7. Seed :

Tomato seeds have a lenticular shape with approximate dimensions 5 x 4 x 2 mm and consist of the embryo surrounded by albumin and covered with bristles (Melo, 1989) it has many renal shapes, the fetus is surrounded by a gelatinous membrane, it weighs up to 2500 seeds to 6.5 g) (Naika *et al*., 2005) (Fig. 07).

Figure 08 : Tomato seeds with a longitudinal section (Melo, 1989)

I.6. The life cycle of the tomato plant :

The tomato cycle varies from one variety to another as it is controlled by the cultivation conditions, but in general its cycle extends from 3.5 to 4 months from germination to harvest (7 to 8 weeks from seed to flowering and 7 to 9 weeks from flower to fruit) (Gallais and Bannerot, 1991).

I.6.1. Growth stages of a tomato plant :

The tomato plant goes through five stages of growth (Garnham, 2017) :

I.6.1.1. The stage of germination :

It begins with the growth of the embryo inside the seed thanks to the presence of warmth and moisture, as the root that develops into the root emerges and extends downward in search of moisture and nutrients, oval seedling leaves (called cotyledons) appear on the surface of the soil.

I. 6. 1. 2. The stage of vegetative growth :

The main stem extends upwards, and soon the first true leaves appear and develop, the main stem continues to grow, then begins to branch as lateral shoots develop.

I. 6. 1. 3. The flowering stage :

Small buds appear near the apical meristem of the plant and develop into a flower stem or cluster, then the flower petals open, and the plant moves to the pollination stage (Garnham, 2017).

I.6.1. 4. The stage of pollination and fertilization :

The self pollination in tomato is between 95 and 99% in nature, and this is helped by the presence of the stigma inside the stigma tube, which works to ensure that the pollen grains reach the stigma of the flower itself after the anthers open, and cross-pollination occurs at a rate of no more than 1% sometimes, although it reaches sometimes to 5% in a few cases, and cases of cross-pollination by insects occur (Melo, 1989 ; Chamarro, 1994) .

I.6.1.5. Fruiting stage :

The fruiting stage is one of the most important stages that tomato seedlings go through, as it needs an ample amount of strong lighting, suitable humidity for the fertilization process, in addition to the ideal temperature ranging from 25-29 °C (Spooner *et al.*, 1993) the pollinated flower develops into a green fruit that changes it changes color during the ripening stages and the evenly pollinated flowers give well rounded fruits (Garnham, 2017). The summarizing growth stages of a tomato plant is reported in figure 08.

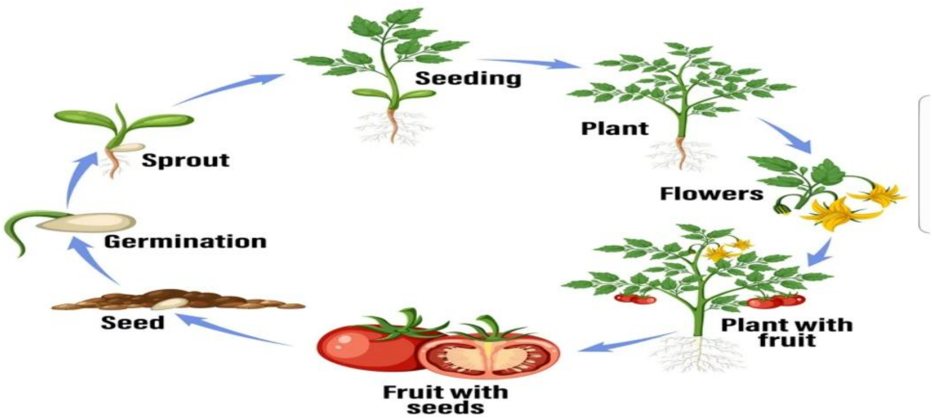


Figure 09 : Growth stages of a tomato plant (Vectorstockweb.site, 2023)

I.6. 2. Harvest :

Tomatoes are harvested after120-150 days from planting a tomato seed. The fruits are collected twice a week, and the collection season lasts from 2.5 to 4 months, depending on the variety and weather conditions. it is recommended to harvest at the beginning of maturity during the rainy season to avoid cracks (Wiragi, 2016) the fruits are collected in the cup and part of the neck, taking into account care during picking so that the fruits do not get injured and rot. Tomatoes are perishable vegetables a few days after harvest (Okhuoya, 1996) .

I.6.3. Storage :

Fully-grown green fruits can be stored at 10 - 15 °C for a duration 30 days, but if we want to market it, then it should be stored at a temperature (15-20) °C and a relative humidity of 95 to 90% , so that they color well in a short time (Haber, 1933).

It is advised not to store green tomatoes at a temperature 5 °C due to the lack of complete coloration under these conditions, and the completeness of the coloration of green fruits when stored at zero degrees Celsius (Tomkins, 1963). Fully-grown green fruits become colored within a period of time 4-5 days if stored at a temperature of (18-20) ºC. Temperature and storage period are two important factors influencing the chemical properties of tomato fruits and thus their quality (Craft and Heinze, 1954).

I.7. Types of tomato plant varieties:

Tomatoes are divided into two types of varieties:

- **Natural varieties :**

There are more than 500 cultivars whose genetic and phenotypic characteristics are transmitted from one generation to the next (Chaux and Fourry, 1994). They are susceptible to disease , but give excellent quality fruits (Polese, 2007).

- **Hybrid varieties :**

They are numerous and have the ability to combine several traits of agricultural importance, such as good early maturity (Gomez, 2003) (Polese, 2007) diseases resistance (Chaux and Fourry, 1994) and high productivity.

Figure 10: Varieties of tomatoes in terms of shape, size and color (website.Healthline, 2023)

II. Environmental requirements for tomato plant growth

II.1. Suitable soil :

Tomatoes can grow in a variety of soils, from sandy soils to limited supplies (Hokam et al, 2011) even heavy clay, provided that it is free from nematodes and wilting diseases and that it has good draina , where the soil pH ranges from 6.0 to 6.5, and the higher the soil pH, the lower the production (C.T.S.A.E, 2006) .

II.2. Lighting :

Tomatoes need a long lighting period to get the best production, and the vegetative growth and the chemical content of the fruits are reduced if the plants are exposed to a lighting period of less than 8 hours daily (Fryer *et al.*, 1954) or more than16 hours a day. Studies have shown that blue light is the most effective in enhancing the biosynthesis of carotenoids in tomato fruits during ripening, red light also activates the phytochrome photoreceptor, thus stimulating the ripening process (Khudairi, 1972).

II.3. Heat :

Tomato production increases when grown in temperatures ranging from13 and 20°C during the night and between 20 and 27°C during the day, and the difference between 6 and 7°C between day and night temperatures is necessary for flowering (Nyabyenda, 2007).

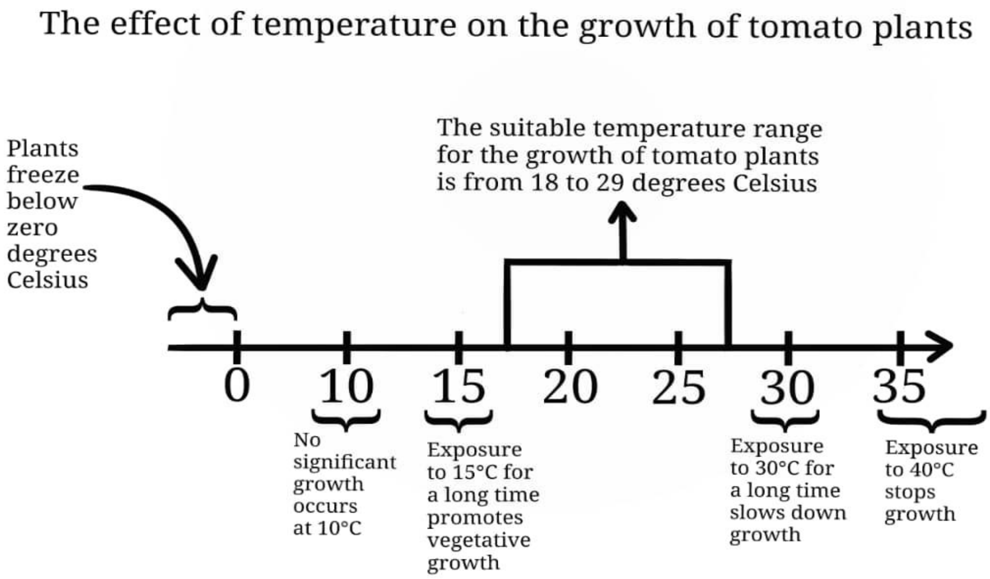


Figure 11: Effect of temperature on tomato plant growth

II.4. Moisture :

Humidity plays an important role in the growth of tomato plants 50 to 60% (Naika *et al*., 2005) while high humidity causes the spread of fungi and bacteria that cause diseases, while low humidity is a source of stress for the plant (Baptista *et al*., 2012) .

II. 5. Ventilation :

Although tomato flowers are self-pollinating hermaphrodites and do not need auxiliary factors for pollination, such as wind and insects, they need ventilation, to prevent the formation of high humidity and increase the viscosity of pollen, which causes difficulty in its transfer to the stigmas of flowers and thus the failure of pollination (Saud, 2017).

II. 6. Fertilizing :

Fertilization is one of the very important factors for raising the yield and quality of tomato production, as it is subject to important rules that the farmer must follow in order to rationalize the used quantities of fertilizers to avoid any shortage or increase that would harm production (Chapagain et Wiesman, 2004), the table 06 explain the process of fertilization.

Table 06 : The main elements required for tomato cultivation in units (kg/ha) (C.T.S.A.E, 2006)

inside greenhouses	open field	
270	150	Cultivation period (number of days)
580	250	Nitrogen (kg/ha)
210	110	Phosphorus (kg/ha)
1150	370	Potassium (kg/ha)
290	150	Magnesium (kg/ha)
600	280	Calcium (kg/ha)

In addition to the major elements, tomato cultivation needs microelements such as iron, magnesium, zinc, boron, copper, and molybdenum in very small quantities, but tomato cultivation is very sensitive to a deficiency of any one (Brun et Montarone, 1987).

II.7. Irrigation :

Regular irrigation is taken into account and its time is determined according to the nature of the land, temperature, and the stage of growth, (the age of the plant) , at the beginning of growth, irrigation is non-existent, in order to help the root system to spread and be regular when flowering and knot formation , in the summer months, irrigation is done in the morning or evening period, while in Early varieties and hybrids, so the irrigation periods are reduced at the beginning of maturity, after which irrigation is carried out continuously , 30% in varieties and hybrids with a short collection period, and reducing irrigation during the period of fruit formation leads to cracking and the appearance of apical flower tip rot (Howedy *et al.*, 1998) .

IV. Diseases and pests of tomatoes :

Tomato plants are affected by many biotic and abiotic stresses (Al Issa, 2017) where the tomato plant is affected by several physiological, bacterial, fungal and viral factors, the factors are often caused by the nature of the soil and weather conditions, where the change in temperature by increase or decrease and acidity in the soil lead to the multiplication of some insects, fungi, parasites and others (Doolttle, 1970).

Table 07: The most important diseases affecting tomato plants (Young *et al.*, 1986 ; Al Howedy *et al.*, 1998)

Symptoms	**Causative**	**the disease**
Fungal diseases		
Yellowing and wilting of the leaves. **The vascular system of the plant is colored brown.** 	*Fusarium oxysporum* *F.sp.lyeopersici*	**Wilting**
The appearance of small blackish-brown spots, rapidly enlarging, the leaf becomes yellow. 	*Alternaria solani*	**early blight**

bacterial diseases		
scab-shaped spots form,The spot is raised or prominent from the surface of the fruit . 	*Xanthomonas capestris pv . vesicatoria*	**Scabies or bacterial spotting**
Dark brown spots on the leaves. **Small yellowish-white areas on the stem.** **The crust peels off easily from the wood.** **White spots with a black center on the fruits.** 	*Clavibacter michiganensis subsp. Michiganensis*	**Bacterial** **-ulcer disease**
Viral diseases		
Spots appear on the leaves. 	*Tobacco Mosaic Virus*	**Tobacco Mosaic Virus (TMV)**

Plant growth stops, abnormalities in Leaves, this leads to the small size of the leaf and its yellowing. 	*Bemisia tabaci*	**Yellow Leaf Curl Virus (TYLCV)**
Physiological diseases		
The occurrence of cracking in the fruits, and with the increase in irregular irrigation, the cracking increases, and the fruits become infected with rot. 	Excessive watering over fertilizing	**Fruit cracking**
White spots on green fruits, then turn pale yellow when ripe. 	Expose the fruits to the sun	**sun blight**

At the tip of the fruit pink appears a small watery spot that may enlarge to cover about half of the affected fruit. 	Physiological, due to an imbalance of water between leaves and fruits.	**Top rot**

Table 08 :The most important pests affecting tomato plants (Foolad, 2007 ; Nzi *et al.*, 2010 ; A.P.C, 2017)

Symptoms	The insect that causes it	Pest
• The appearance of nodes on the roots. • Yellowing and wilting of the plant. • Reducing plant growth.	*Meloïdogyne incognita et Meloïdogyne arenaria*	**Nematodes Meloidogyne spp**
Wilting plant the infection is more frequent in the summer and Nile loop than in the winter loop. **Use of the pesticide chlorfanec 48% .**	*Tuta absoluta* 	**Tomato digger**
There are scattered yellow spots on it . **The upper surface of the leaf Turns a glossy color on the leaves.** **Lack of plant nutrition as a result of the absorption of plant sap.** **Infection increases in June,**	*Tetranychus urticae* 	**red spider**

July and August. **Among the pesticides used is micronized sorrel7 WP% at the rate of 250 g / 100 liters of water.**		
Leaves wrinkling, yellowing, wilting, and general weakness when the infection is severe. **Leaf curling and yellowing.** **Plants are stunted and deformed.** **Lack of flowering, nodes, and small size of its fruits.** **They appear from May to November.** **The pesticide Agre Flex is used against her6 5.81% SC.**	*Bemisia tabaci et Trialeurodes vaporariorum* 	**Whitefly**

Chapter 2 : ***Urtica dioica***

II. Urtica dioica

II.1. History and origin

We find the nettle regularly mentioned in the pharmacopoeia, since the first century of our era until the first half of the twentieth century, in the first century, galen insisted rather on its nutritional qualities , and in the twelfth century, we find the nettle in the coat of arms Schleswig Holstein, a German state (Mostade, 2015) .

It is appreciated since ancient Greece and ancient India in traditional medicine, its therapeutic use is widely practiced in Europe, but has recently fallen into oblivion, and has only been cultivated by Russia and Scandinavia, at the same time, saint Hildegaard distinguishes between large and small nettles, and is attributed to both the medical virtues in angina headaches and stomach pain (Mostade, 2015) .

In Scandinavia, it was dedicated to Thor (Idem Donar), in the tomb of the Viking they found nettle seeds next to the remains, in Roman times, Pliny the elder said that it was a "religious observation for many ", it is now established that she was also cultivated according to the same methods in ancient Egypt by the peoples Northern (Mostade, 2015) .

Dioecious nettle is an edible herbaceous plant with stinging hairs, native to Eurasia, its flavour is more or less pungent, depending on the variety (QA International, 2008), the nettle has become widespread in all temperate regions of the world, it is found more in Northern Europe than in Southern Europe, North Africa, Asia and widely distributed in North America and the South (Brisse *et al.,* 2003) .

II. Language of flowers

In antiquity, the nettle plant of Venus, symbolizes and promotes lust, in the language of flowers, nettle means betrayal, in Walloon Prussia, a bouquet of nettles placed on May 1 at a woman's window indicates that she is of light morals, in the Bouches-du-Rhône, offering a bouquet of nettles means breaking up (Bertrand Bernard, 2002) .

III. Geographical distribution

Urtica dioica is the largest and most widespread of all nettles in the whole world , especially in temperate zones, it is very common in Europe , it can grow on all types of land, provided it is rich in nitrogen, it is a so-called nitrophilous plant, it is also described as "ruderal" because it is particularly appreciates the "dirty" land in the vicinity of men, this is why it`s found well in hedges, gardens, around houses that in rubble, paths and ditches (Bertrand, 2010) .

IV. Taxonomy

Kingdom : Plantae – Plants

Subkingdom : Tracheobionta - Vascular plants

Superdivision : Spermatophyta - Seed plants

Division : Magnoliophyta - Flowering plants

Class : Magnoliopsida - Dicotyledons

Subclass : Hamamelidae

Order : Urticales

Family : Urticaceae - Nettle family

Genus : *Urtica*

Species : *Urtica dioica* , stinging nettle (Truffa-Bachi , 1988).

- **The main species of *Urtica* are:**
  1. *Urtica dioica* L.;
  2. *Urtica urens* L. (Burning nettle or "little nettle");
  3. *Urtica pilulifera* L. (Roman nettle or 'pill nettle');
  4. *Urtica cannabina* L.;
  5. *Urtica atrovirens* Req;
  6. *Urtica membranea* Poiret;

But since the subject of our study is *Urtica dioica*, we will talk about it :

V. Description of dioecious nettle

It was first described in 1753 by Swedis naturalist Carl Von Linnaeus, the dioecious nettle plant is covered with stinging hairs, it is a perennial herbaceous thanks to a creeping yellow rhizome, it can reach 1.5 meters high , it is a plant with male and female flowers borne by two different plants (Chavoutier *et al.*, 2000).

- **Scientific name: *Urtica dioica* L .**

According to Fleurentin (2008) the French and English vernacular names of *Urtica dioica* are the following:

- **French name:** Grande ortie, ortie piquante, ortie commune, ortie vivace
- **English name:** Stinging Nettle.

According to Beloued (1998) the Arabic and Kabyle vernacular names of *Urtica dioica* are as follows:

- **Arabic name:** El Hurrayq, Bent ennar, Bou zegdouf**.**
- **Kabyle name:** Azagtouf

Figure12 : The different parts of the dioecious nettle (Wikipedia, 2023) .

V.1. The leaves :

The leaves of *Urtica dioïca* are dark green (rich in chlorophyll), carried by a stem, erect, quadrangular, unbranched, covered with stinging hairs, the arrangement of the leaves is opposite and elliptical, lined with triangular teeth, the lower leaves are somewhat oval and the upper leaves are more lanceolate, veins protruding on the underside of the leaf, the leaves, like the stem, are covered with safe fine hairs and stinging hairs, especially at the peduncle, or there are also two stipuls (Boyrie, 2016) .

V.2. The flowers :

The flowers are dioecious, sometimes monoecious, united in unisexual clusters, they develop rapidly to form very compact colonies, it stands out from far by its special smell, (Mostade, 2015), they appear from June to september, the female flower is green and has four sepals free between them, and from a single carpel with a upper ovary surmounted by a style and a brush stigma , the male flower is yello and has four long fillet stamens containing pollen, elastic, folded into the flower bud (Ait Haj Said *et al*., 2016)

V.3. Stinging hair :

Nettle has stinging hairs located on its stem and leaves to allow it to protect itself from animals that may eat or trample it, at the level of the mature epidermis of the plant we can observe its hair. They are hard conical and made of silica, it consists of two parts :

- At the base, the bulbous bulb, which looks like a pimple, contains pungent substances such as formic acid, acetylcholine, histamine and serotonin.

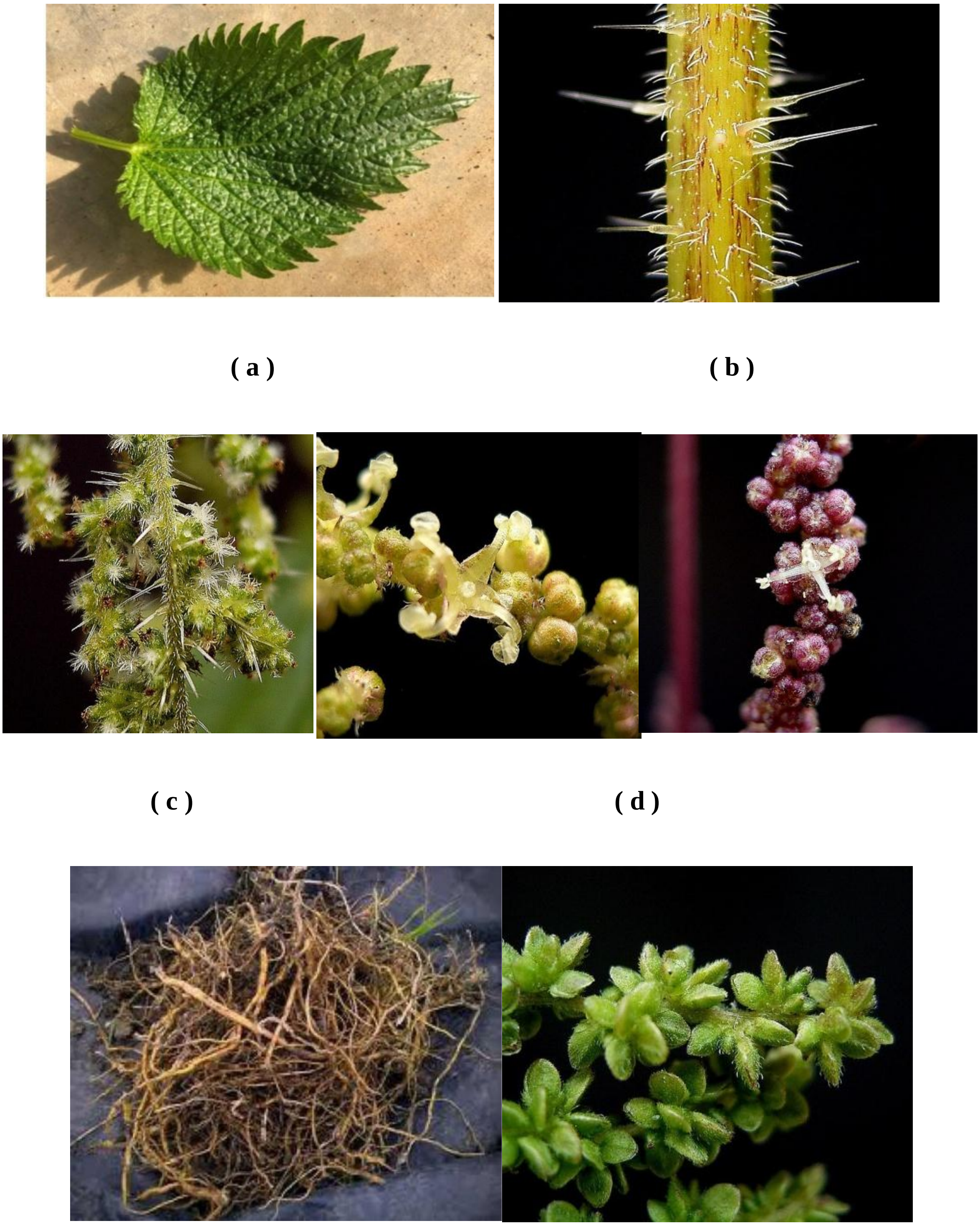
- At the top, the pointed tip has the appearance of a needle, covered with a small ball that breaks at the slightest contact and thus releases pungent substances that enter the skin creating local irritation (Delahaye, 2015).

V.4. The roots :

The roots of the nettle are underground yellowish, traceable and abundantly branched rhizomesstems that develop new shoots every year, they fix nitrogen air through the action of rhizobium frankia microorganisms that live in symbiosis with nettles (Moutsie, 2002).

V.5. The fruits :

The fruit of the nettle consists of an oval, sandy, yellow-brown achene, flattened shape, it is enclosed in a persistent chalice containing a seed, generally the fruits are surrounded by two narrow outer leaves, and two inner leaves more large and wider, they open at maturity to drop the akene (Boyrie, 2016).



(a) (b)

(c) (d)

(e) (f)

Figure 13 : The different parts in the dioecious nettle, **(a)**the leaf, **(b)** stinging hair,**(c)** female flower **, (d)** male flower , **(e)** the roots , **(f)** the fruits (Wikipedia, 2023) .

VI. The harvest

The nettle is harvested from April for consumption (young shoots), then from June to September for the harvest of whole plants , the aerial parts of the nettle are harvested just before or shortly after flowering , the leaves contain a high concentration of active ingredients, unlike other parts of the plant (Wicki, 2004).

VII. Nettle chemical composition

The composition of the nettle varies according to the nature of the soil, variety and origin, plant exposure and climatic conditions, it obviously varies according to the organ of the plant and the period of harvest , for this, the values provided by the literature are different.

The young nettle leaves have high nutritional value, they are rich in proteins, fats, carbohydrates, vitamins, minerals and trace elements, proteins represent 30% of dry mass, in addition, the protein composition of nettle leaves largely covers the needs of amino acids, especially essential amino acids for humans, regarding the mineral fraction, nettle leaves can contain up to 20% of the dry mass, so nettle is rich in minerals including iron, zinc, magnesium, calcium, phosphorus and potassium, the content of cobalt, nickel, molybdenum and selenium of the leaves has also been determined .

Table 09 : Nutritional composition of fresh leaves of Urtica dioica (Ait Haj Said *et al.*, 2016).

Composition nutritionnelle en%	Min	Max
Eau	65	90
Protides	4.3	8.9
Cendres	3.4	18.9
Glucides	7.1	16.5
Lipides	0.7	2
Fibres	3.6	5.3

Calories (Kcal/100g)	57	99.7

Table 10 : Content of mineral elements and trace elements in mg/100g dry matter (Ait Haj Said *et al*., 2016).

Teneur en minćraux en mg/100g		**Min**	**Max**
	Calcium	113.2	5090
	Magnćsium	0.22	3560
Macroćléments	**Phosphore**	29	75
	Potassium	532	917.2
	Sodium	5.5	16
	Cobalt	0.0084	0.018
	Cuivre	0.52	1.747
	Fer	3.4	30.30
	Mangančse	0.768	5.784
Oligo-ćléments	**Molybdčne**	0.4265	
	Nickel	0.0732	
	Sćlćnium	0.0027	0.0074
	Zinc	0.9	3.033

The composition of the nettle in vitamins is very varied, it is made up of both fat-soluble vitamins A, D, E, K but also significant amounts of water-soluble vitamins, such as vitamin C and group B vitamins (B1, B2, B3, B9), according to the work of Wetherilt (1992) it was found that 100g of fresh leaves contained 0.01 mg of vitamin B1 (thiamine), 0.23 mg of vitamin B2 (riboflavin), 0.62 g of vitamin B3 (niacin), 0.068 mg of vitamin B6, 238 mg of vitamin C, 5 mg of pro-vitamin a (β carotene) and 14.4 mg of vitamine (a-tocopherol) (Ait Haj Said et al, 2016) , these nutrients give nettle interesting pharmacological properties, trace elements and vitamins strengthen the immune system and allow the body to better resist bacterial and viral infections.

Chapter 3 : *Ulva lactuca*

I. Morphology

The common name of *Ulva lactuca* is sea lettuce, because of its morphological resemblance to lettuce, *Ulva lactuca* consists of a large leaf like thallus and a holdfast, which anchors the seaweed to shells, rocks and other materials figure14, the thallus can reach lengths of 1m, but large thalli are more likely to be torn into pieces by the current, as a result, *Ulva lactuca* usually grows to a length of 30 cm in nature (Wald, 2010), especially under eutrophic conditions, mainly free floating thalli of *Ulva lactuca* can be found in natural waters (Malta *et al.*, 1999), although *Ulva lactuca* has a strong plastic like structure, the thallus is only two cell layers thick (Wald, 2010), normally, thallus colour ranges between light green and dark green, but transparent and olive green spots or edges are observed as well (Robertson-Andersson *et al.*, 2009) have mapped the colour range of *Ulva lactuca* in relation to the nitrogen content: the more intensely green coloured, the higher the nitrogen content.

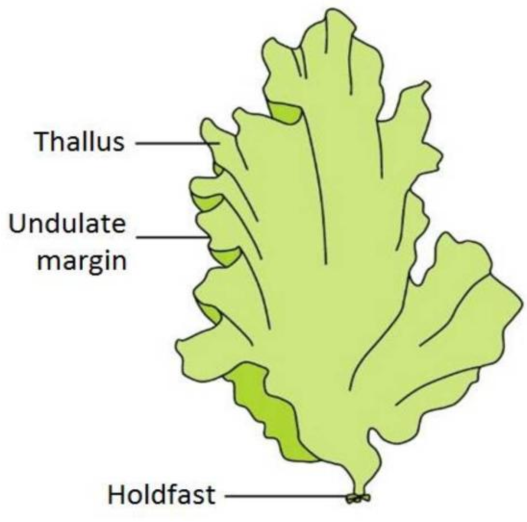


Figure 14 : Schematic morphology of *Ulva lactuca* (Cronodon, 2013).

Figure 15 : Sea lettuce algae (*Ulva lactuca*) (Original, 2023).

II. Taxonomic hierarchy

Kingdom	Plantae – plantes, Planta, Vegetal, plants
Subkingdom	Viridiplantae – green plants
Infrakingdom	Chlorophyta – green algae
Division	Chlorophyta – green algae, algues vertes
Subdivision	Chlorophytina
Class	Ulvophyceae
Order	Ulvales
Family	Ulvaceae
Genus	*Ulva* Linnaeus, 1753
Species	*Ulva lactuca Linnaeus, 1753*
Variety	*Ulva lactuca* Var. *lacinulata* (Itis , Web.Site)

III. Reproduction

The reproduction cycle of *Ulva lactuca* is given in figure 14, under natural conditions, the diploid sporophyte sporulates in winter or early spring, this can be observed by a change of colour and breakdown of the edges of the thallus, the spores grow into haploid gametophytes, which are morphologically similar to the sporophyte, a male and female gamete produced by gametophytes together form a 2n zygote which grows into a sporophyte after germination , germination is stimulated under low temperature combined with high light intensities (Wald, 2010).

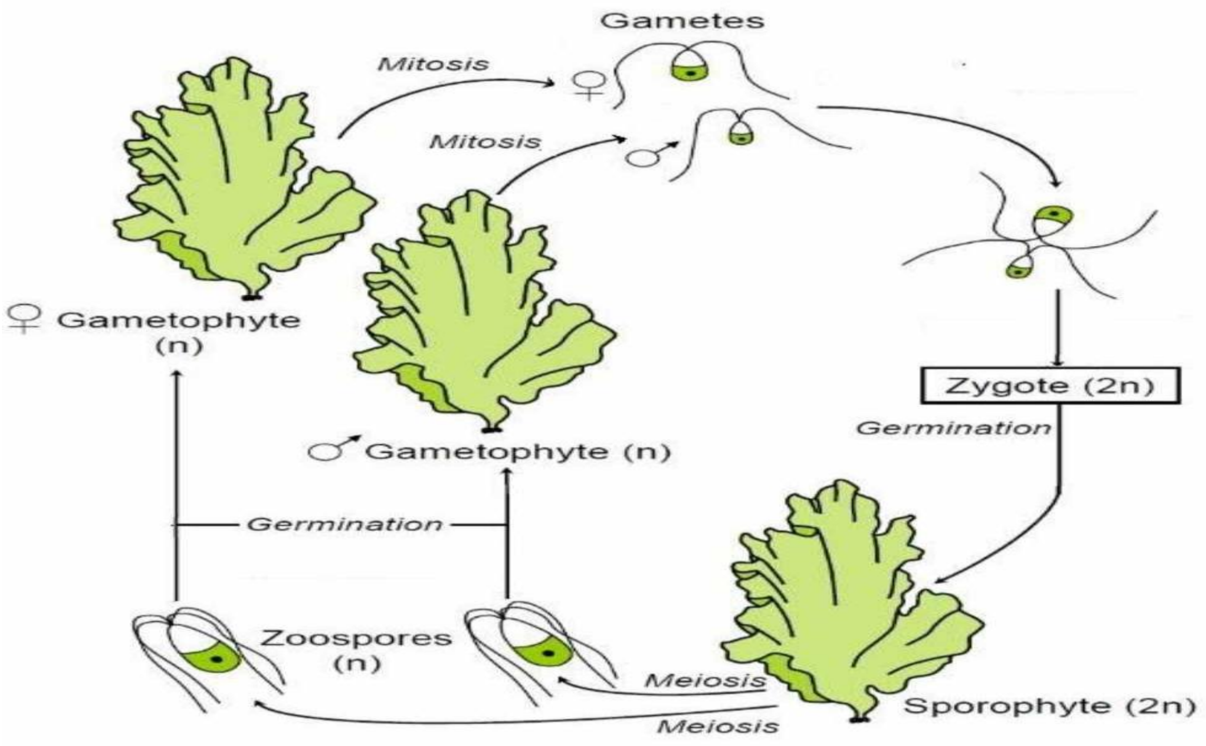


Figure 16: Schematic life cycle of *Ulva lactuca* (Cronodon, 2013)

IV. Chemical characteristics

Terrestrial plants are known for their high cellulose (45% DW), hemicellulose (18% DW) and lignin (20% DW) content in cell walls (Brady and Weil, 2002). Cellulose, hemicellulose and lignin are indispensable for the construction of vessels, fortify the entire plant structure and prevent collapse of the plant in air (Martone *et al.*, 2009 ; Raven *et al.*, 2005), in contrast to land plants, seaweeds do not need support, because they are growing in an aquatic environment. Although compounds comparable to lignin have been found in primitive algae, most seaweeds lack or contain very low levels of lignin (Martone *et al.*, 2009 ; Yanagisawa *et al.*, 2011).

Cellulose is the most abundant organic compound on earth and is present in both sea and land plants (Raven *et al.*, 2005) .

However, cellulose from algae species form a more porous network, which differs significantly from higher plant cellulose (Siddhanta *et al.*, 2009), cellulose contents show a wide variation among different kinds of seaweed crude cellulose contents of 11%, but also as little as 0.85% of the dry weight were found (Siddhanta *et al.*, 2010).

Also, cellulose concentrations vary in different parts of the seaweed (i.e. frond or stipe; Yanagisawa *et al.*, 2011).

Table 08 shows the chemical composition of *Ulva lactuca* collected in tunisia and the typical composition of green land plants, the insoluble fibres, (hemicellulose, cellulose and lignin) constitute about a third of the seaweed dry matter content, which is much lower than in land plants. Lignin content of *Ulva lactuca* is only 1.6%, which is extremely low compared to the 17-24% found in grasses and leguminous plant families (Vahdat *et al.*, 2011), cellulose content of *Ulva lactuca* is alsomuch lower than in terrestrial plants, hemicellulose contents of *Ulva lactuca* and green plants are found to be similar.

Table 11 : Chemical composition of *U. lactuca* (Yaich *et al.*, 2011) and representative green plants (Brady and Weil, 2002) based on % of DW.

Component	Ulva lactuca (% DW)	Green plants (% DW)
Ash	**20**	**8**
Protein	**8.5**	**8**
Lipid	**8**	**2**
Soluble sugars	**0.6**	**5**
Uronic acid	**10**	**ND**
Soluble fibres	**20.5**	**ND**
Insoluble fibres	**31**	**83**
Hemicellulose	**21**	**18**
Cellulose	**9**	**45**
Lignin	**1.6**	**20**

ND : no data available

The ash content of *Ulva lactuca* is about 20% of the dry weight (Bruhn *et al.*, 2011) reported ash contents between 14-35% DW) and contains many different minerals, in a variety of articles, the mineral content of *Ulva. lactuca* is described, the mineral contents of *Ulva lactuca* vary when grown under different mineral concentrations and depend on other growth aspects , therefore, the different collection sites influence the mineral content of *Ulva lactuca*, for some waters are more eutrophicated than others, in comparison to green manure species, *Ulva lactuca* contains similar amounts of N and K, has higher amounts of Ca, Mg and Fe, but contains very low amounts of P table 09, in addition to the elements described in table 09, many micronutrients like Cu, Mn, Zn, B, Al, Ni, Cr, Cd and Pb are found in *Ulva lactuca* (Villares *et al.*, 2007).

Yaich *et al*., (2011) found the protein content of *Ulva lactuca* to be 8.5% DW, but Bruhn *et al*. (2011) states that protein content can be as high as 40% DW under high external N concentrations, About 30% of *Ulva lactuca* DW consists of soluble sugars, uronic acid and soluble fibres (e.g. starches), These are sugars or sugar polymers and are decomposed relatively fast figure 14.

Table 12 : Mineral contents of *Ulva lactuca* and green manure species , *Ulva lactuca* is collected at Hong Kong (Ho, 1981), Norway (Pedersen *et al., 2010*), Mexico (Hernández-Herrera *et al.,* 2013 ; Pérez-Mayorga *et al.*, 2011), Spain (Villares *et al.*, 2007) and Tunisia (Yaich *et al.,* 2011). Data on alfalfa and clover: Morón and Cozzolino (2002), vetch: Caballero *et al.* (1996).

Element	Amount (mg/lOOg DW)	Paper	Green manure species and amount (mg/lOOg DW)
Nitrogen (N)	2700	Ho (1981)	Alfalfa: 4380
	4950	Pedersen *et al.* (2010)	White clover: 3790
	5800	Pedersen & Borum (1996)	Vetch: 2800
	2000	Pérez-Mayorga *et al.* (2011)	
	2000	Villares *et al.* (2007)	
Phosphorus (P)	100	Hernåndez-Herrera *et al.* (2013)	Alfalfa: 3660
	145	Ho (1981)	White clover: 2970
	140	Pedersen *et al.* (2010)	Vetch: 310
	150	Villares *et al.* (2007)	
	93	Yaich *et al.* (2011)	
Calcium (Ca)	1700	Ho (1981)	Alfalfa: 1920
	2600	Villares *et al.* (2007)	White clover: 1210
	2700	Yaich *et al.* (2011)	Vetch: 680
Magnesium (Mg)	940	Villares *et al.* (2007)	Alfalfa: 290

	3900	**Yaich *et al.* (2011)**	**White clover: 280**
Potassium (K)	**1900**	**Ho (1981)**	**Vetch: 290** **Alfalfa: 2450**
	1970	**Villares *et al.* (2007)**	**White clover: 2100**
	630	**Yaich *et al.* (2011)**	**Vetch: 1100**
Sodium (Na)	**4570**	**Villares *et al.* (2007)**	
	552	**Yaich *et al.* (2011)**	
Iron (Fe)	**820**	**Ho (1981)**	**Vetch : 21**
	250	**Villares *et al.* (2007)**	

Pedersen *et al.* (2010) found *Ulva lactuca* C:N and C:P ratios of 6.7 and 238 respectively, but these values depend on nutrient availability and factors such as irradiance (Bruhn *et al.*, 2011), *Ulva lactuca* dry matter content (DMC) varies throughout the season (Brandenburg *et al.*, 2012; Bruhn *et al.*, 2011; Mann, 1972). (Bruhn *et al.*, 2011) reported *Ulva lactuca* DMC varying between 9.6 and 20.4%; during pilot studies of this research, *Ulva lactuca* dry matter contents of 16% were found.

V. Applications

Seaweeds are a multipurpose food commodity, Seaweeds can have a high nutritional value: they are low in fat (compared to animal foods) and calories, but high in vitamins and minerals (Smith *et al.*, 2010), also, *Ulva lactuca* has a high protein content and contains 17 different (including all the essential) amino acids, making seaweeds an excellent source of high quality proteins for human consumption (Yaich *et al.*, 2011), asecond important application of seaweeds, is the conversion into biofuels, *Ulva lactuca* is seen as one of the best sources of biomass for producing biofuels, because of its high potential biomass yield of 24 tonnes DW ha–1y–1, which is similar to the potential production of sugar beets and which is three times higher than brown algae (Bruhn *et al.*, 2011; Smit *et al.*, 2011) , the polysaccharides in *Ulva lactuca* are easy hydrolysable due to the low lignin content , this results in high bioethanol concentrations per unit weight (Yanagisawa *et al.*, 2011) .

Also, in nature, seaweeds are a food source for many aquatic invertebrates (Williams and Smith, 2007), not only aquatic animals can feed on macroalgae, but terrestrial animals as well, due to the high polysaccharide and protein content, seaweeds are suitable as fodder, in coastal regions in Iceland, Norway, Great Britain, Ireland and France, animals are regularly fed with seaweeds, either as fresh material or processed seaweed meals (Verkleij, 1992). furthermore, extracts of seaweeds can be used for their medicinal effects or food supplements (Craigie, 2011; Wald, 2010). european immigrants in New Zealand made puddings with carrageen originating from red seaweeds found on the beaches of New Zealand, also, during the second world war, dried seaweeds were sent from New Zealand to troops located in the Middle East, probably for their laxative effects, on desert marches, troops chewed on seaweeds, because they quenched thirst more than chewing gum (Smith *et al.*, 2010), also, the worldwide used culture medium agar, is a product from a red seaweed (Li *et al.*, 2008), finally, seaweeds have been described as a means to decrease eutrophication, to control red tides and to control biological diseases (Yu and Yang, 2008). Also, seaweed production has been suggested to be integrated with fish and shrimp farming, to diminish the release of dissolved nutrients and convert this into a useful product (Troell *et al.*, 1999).

The experimental part

Chapter 01 : Material and methods

I. Objective of study:

The aim of our work is to study the behavior of the tomato plant, which belongs to the Solanaceae family, by treating it with extracts of natural plants (nettle and sea lettuce fertilizer) to determine its efficiency as biostimulant.

II. Study area :

II.1. The wilaya of Mostaganem :

The wilaya of Mostaganem is located in the northwest of Algeria and covers an area of 2269 km² bordered by:

East: Chlef and Relizane

Provinces South: Relizane and Mascara

West : Mascara and Oran

II.2. The climate :

The state's climate is characterized by a semi-continental climate with mild winters, with a depth ranging from 350 mm to 400 mm in the heights of the Dahra Mountains.

II.3. Landforms :

The landform of the state is divided into 4 regions for two main directions:

- Plateaus the low plains of the western region and the plateaus of Mostaganem
- Dahra Mountains and the plains of the eastern region.

II.4. Experiment and plant material collection site :

We did the experiment in greenhouse N°12 in the experimental farm of the university of Mostaganem (Mezghran).

- The nettle collection site is Mazghran experimental farm;
- The sea lettuce moss collection site is Salamander.

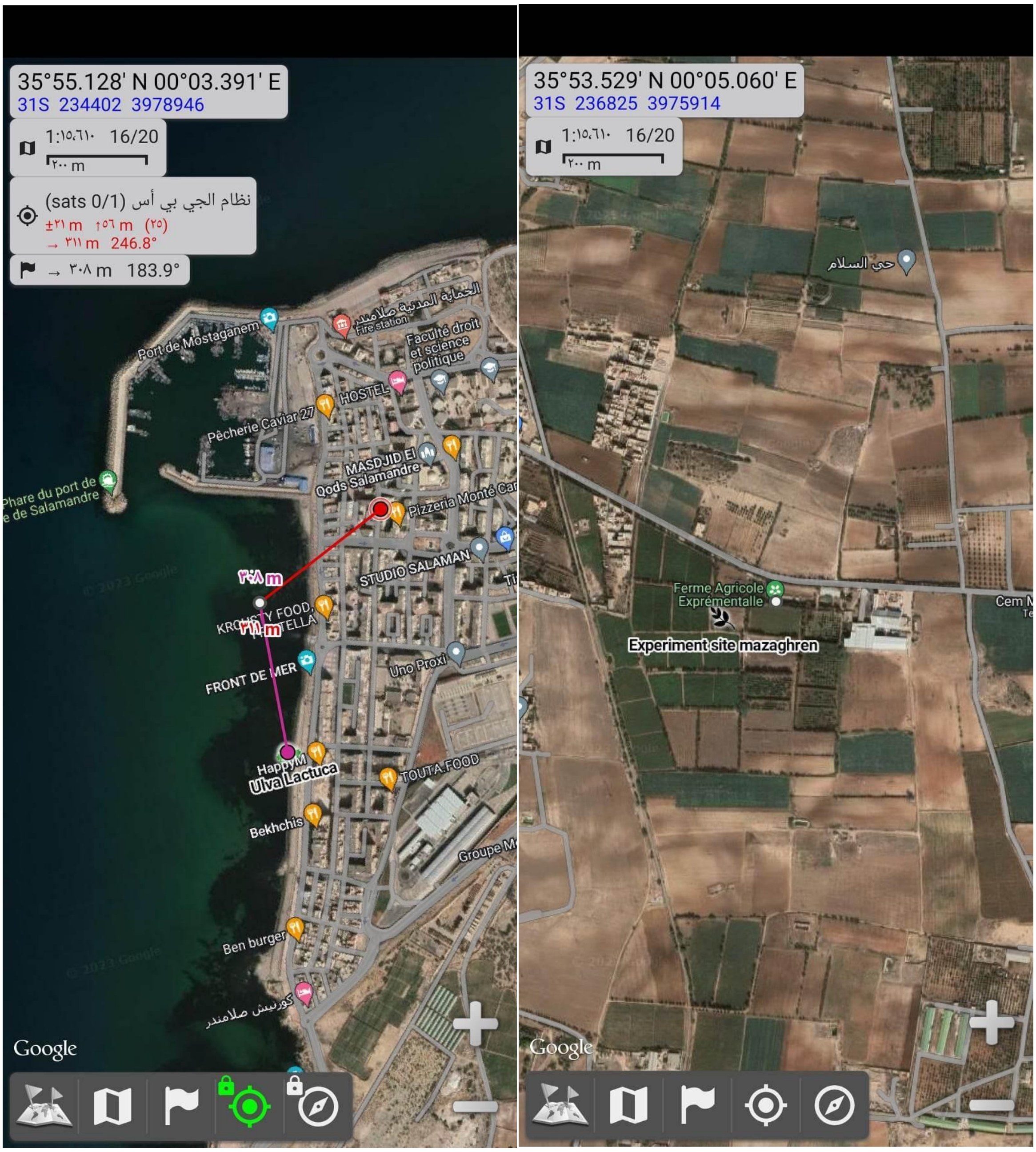


Figure 17 : Collection site of *Olva lactuca* and *Urtica dioica* Salamander and Mazghran experimental farm by satellite.

III. Material and methods

III.1. Product used in the preparation of our solution :

The solutions used in our research are summarized in distilled water and tween 20 and instant baker's yeast.

III.2. Plant material :

120 seedlings of industrial tomatoes were brought from one of the nurseries (Oued El Kheir 2).

III.3. The plant used in the preparation of liquid fertilizer :

III.3.1. *Urtica dioica* :

We used leaves and stems that we cut immediately after harvest , On 20/02/ 2023, in the experimental farm Mezghran .

III.3.2. *Ulva Lactuca* :

We used sea lettuce moss after collecting it from Salamander port, Mostaganem in 20/02/2023 .

Figure 18 : Nettle collection process (Original, 2023)

Figure 19 : Sea lettuce algae collection process (Original, 2023)

IV. Liquid fertilizer preparation

After collecting plant materials (***Urtica dioica*** and ***Ulva lactuca***) we follow the following steps:

IV.1. *Urtica dioica* :

IV.1.1. Preparation of the mixture :

- Sorting and washing nettle;
- We weigh 1.1 kg of fresh plant;
- Cut the leaves and stems to facilitate the fermentation and filtration process;
- We spread the plant on the newspaper and leave it to dry in the shade;
- The next day we put the plant in a plastic container of 15 liters;
- pour 11 liters of tap water;
- Add 11 g of instant yeast to the mixture, help speed up the fermentation process;
- Close it tightly and keep it away from light;
- Mix the mixture every day once for ten minutes, to enhance the oxygenation of the environment and notice the presence of bubbles rising to the surface during fermentation.

IV.1.2. Mixture filtration :

After 15 days from the beginning of fermentation , from 21/02/2023 until 07/03/2023, the filtration process begins using a strainer and then we store the liquid in plastic containers covered with black plastic bags to prevent air, light and fermentation .

- 10 liters for watering plants .
- 1 liter for spraying them .

Knowing that the process of watering with liquid fertilizer is repeated once a month and the fermentation process lasts 15 days before watering, and the following figures show the steps involved .

Figure 20 : Steps liquid fertilizer preparation (*Urtica dioica*) (Original, 2023)

IV.2. *Ulva lactuca* :

IV.2.1. Preparation of the mixture :

- After collecting sea lettuce algae from Salamander, we clean them from sand, seaweed and shells, then wash them with distilled water several times until the salt disappears completely.
- Weigh 1, 1 kg of algae;
- Place the algae in a 15 liter plastic container;
- Pour 11 liters of tap water;
- Add 11 g of instant yeast to speed up fermentation;
- We mix the mixture every day for 10 minutes to enhance the oxygenation of the environment, we note the presence of bubbles Proof of fermentation.

IV.2.2. Filtering the mixture :

we do the same steps as nettle , and the following figures explain the steps in detail :

Figure 21 : Steps liquid fertilizer preparation (*Ulva lactuca*) (Original, 2023)

V. Experimental plan adopted :

- The adopted plan is to divide **120** industrial tomato seedlings into **4** groups consisting of **30** seedlings .
- **4** treatments : **S1** (Water) .
  S2 (Compost) .
  S3 (Liquid nettle fertilizer) .
  S4 (Liquid sea lettuce fertilizer).

V.1. The different stages of the experiment :

V.1.1. Planting :

After stirring and drying the soil completely and removing gravel from the greenhouse, we planted the seedlings inside the greenhouse because the temperature was low and this might cause damage to the seedlings , were they was 25 days old on 08/02/2023 at a depth of 7 cm .

Figure 22 : Tomato seedling in a greenhouse (Original 2023) .

V.1.2. Irrigation :

The first irrigation process with fertilizers that we prepared was a month after planting on 08/03/2023, and the irrigation continued every month for 4 months .

- 08 March 2023
- 08 April 2023
- 08 May 2023
- 08 June 2023

Where we watered :

- 30 plants ⟹ tap water .
- 30 plants ⟹ 2.5 kg compost .
- 30 plants ⟹ 10 liters of liquid nettle fertilizer + 1 liter mixed with 5 ml of tween 20 to spray Plants .
- 30 plants ⟹ 10 liters of sea lettuce fertilizer + 1 liter mixed With 5 ml of tween 20 to spray the plants .

Knowing that the plants are irrigated twice a week with water (on Tuesday and Thursday)

Figure 23 : Irrigation process (Original, 2023) .

VI. Crop care :

We removed weeds on 22-23/05/2023, the goal of removing them is to avoid weeds competing for water and nutrition and their impact on plant growth .

VII. Harvest :

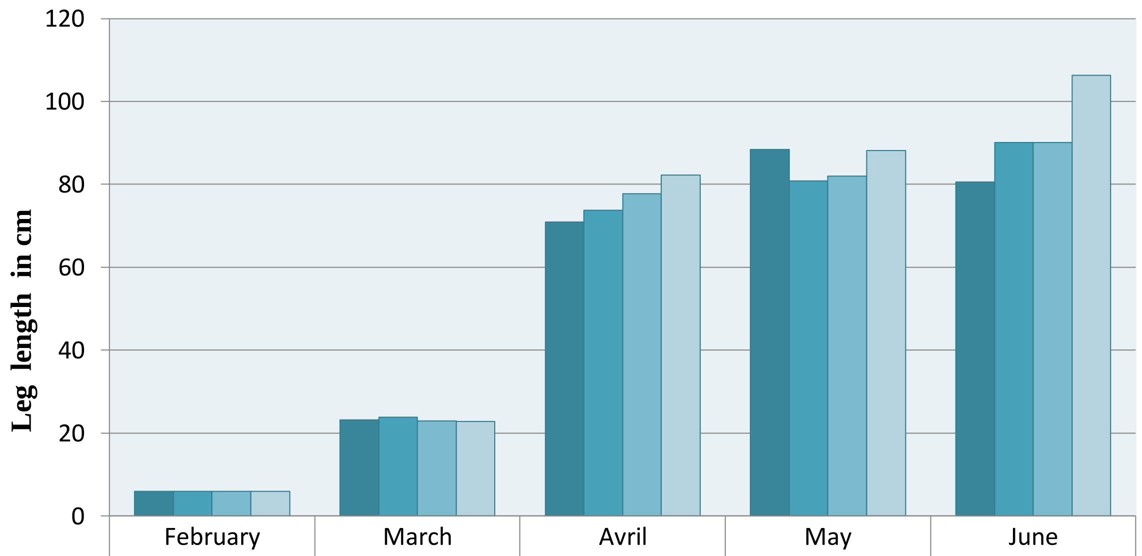
The process of harvesting the fruits began on 12 /04/2023, which means after 63 days after planting the seedlings , we also noticed that the fruits of group S4 ripened first .

Chapter 02 : Results and discussion

I. The results of the effect of fertilizer types on tomato plants

I.1 . Length of stems :

The length of the stems was measured over a period of 5 months (the beginning of planting seedlings until after the growth stops) and the following results were observed.



	February	March	Avril	May	June
S1	6	23.2	70.875	88.437	80.6
S2	6	23.8	73.812	80.875	90.133
S3	6	23	77.687	82	90.133
S4	6	22.86	82.187	88.187	106.333

Figure 24 : Length of stems over 5 months

From these results, we can observe the difference between groups S1, S2, S3 and S4 in the effect of different fertilizers on plants we can say that the S4 group has an average leg length of 106.333 cm , which is higher than the other groups studied .

On the other hand, the average stem length of the S3 group that was treated with nettle fertilizer is equal to the average stem length of the S2 group at a rate of 90.133, meaning that liquid nettle fertilizer has the same effect as compost .

We also noticed that the S1 group treated with water only showed the shortest stem length, due to the lack of essential nutrients for plant growth and development

We conclude from these observations that nettle fertilizer and algae fertilizer constitute a huge reservoir of nutrients that work positively on the development and growth of cultivated plants such as tomatoes .

I.2. Number of stems :

The number of stems was calculated at planting and after maturity and the results are shown in the figure below:

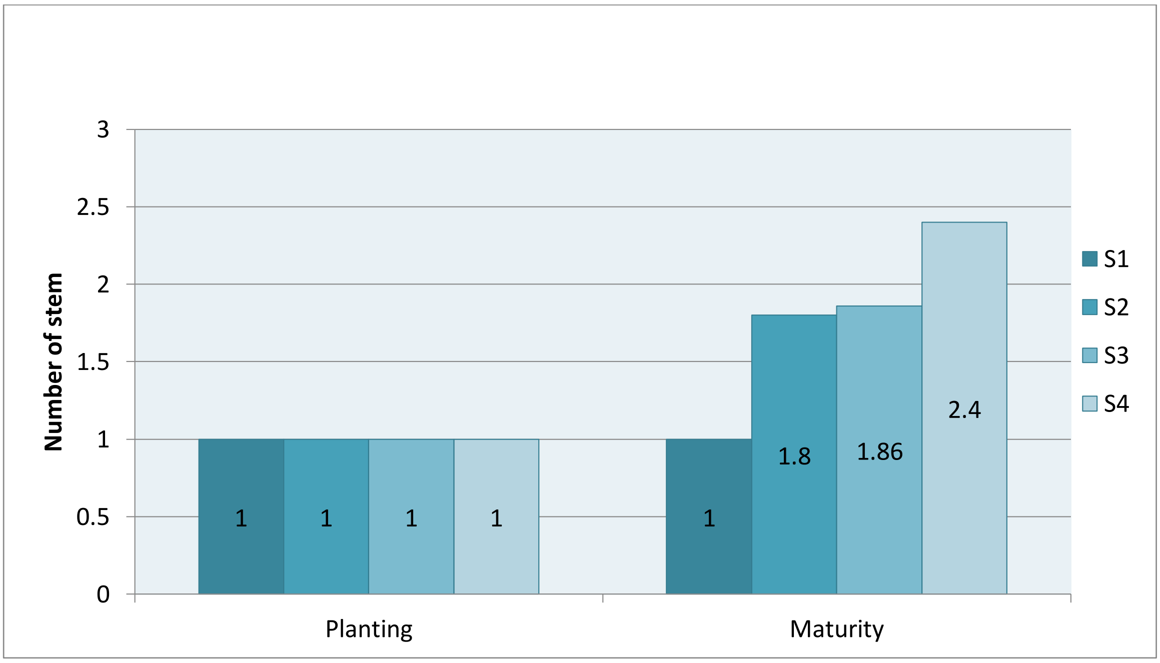


Figure 25 : Average number of stems per group

Based on the available data, we note that the average number of stems of the group treated with sea lettuce extract is much greater than the rest of the groups 2,4 , and we also noticed a convergence in the average number of stems of the S2 and S3 groups with a score of 1.8, and in the end we see that the S1 group has the lowest average.

Based on this, we conclude that the extracts play an important role in completing the growth of Plants.

I.3. Stem diameter :

Stem diameter was measured for all plants in March and June (after plant growth stops), the data are shown in the following figure :

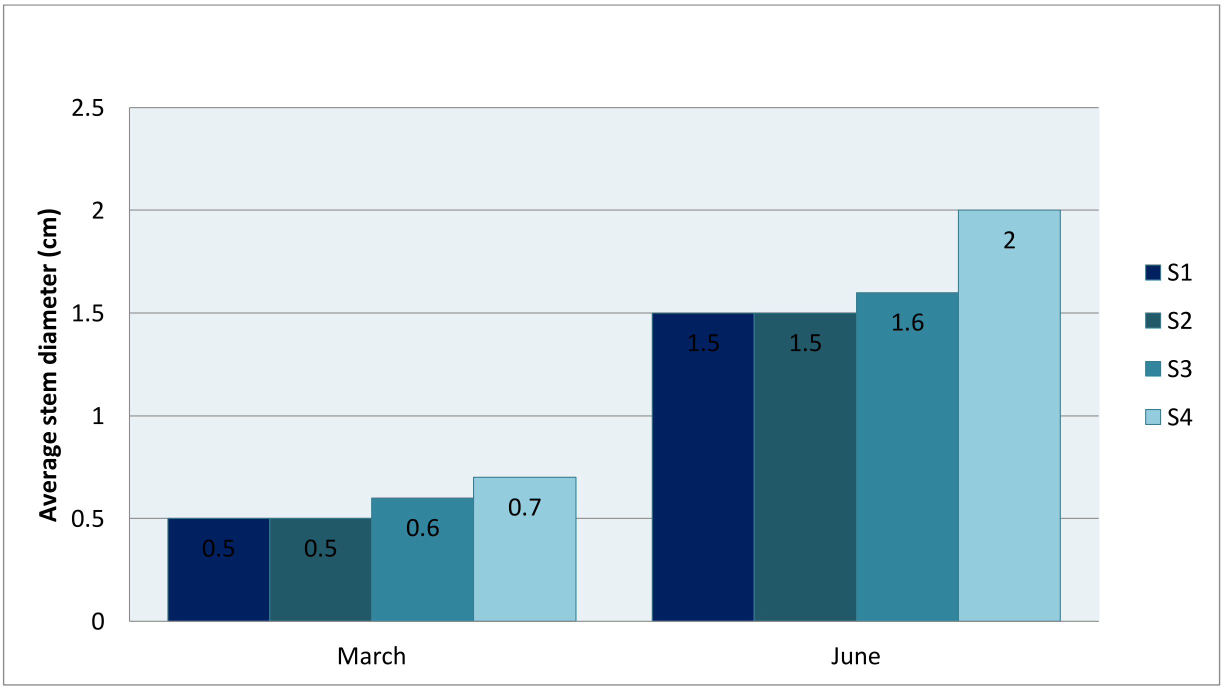


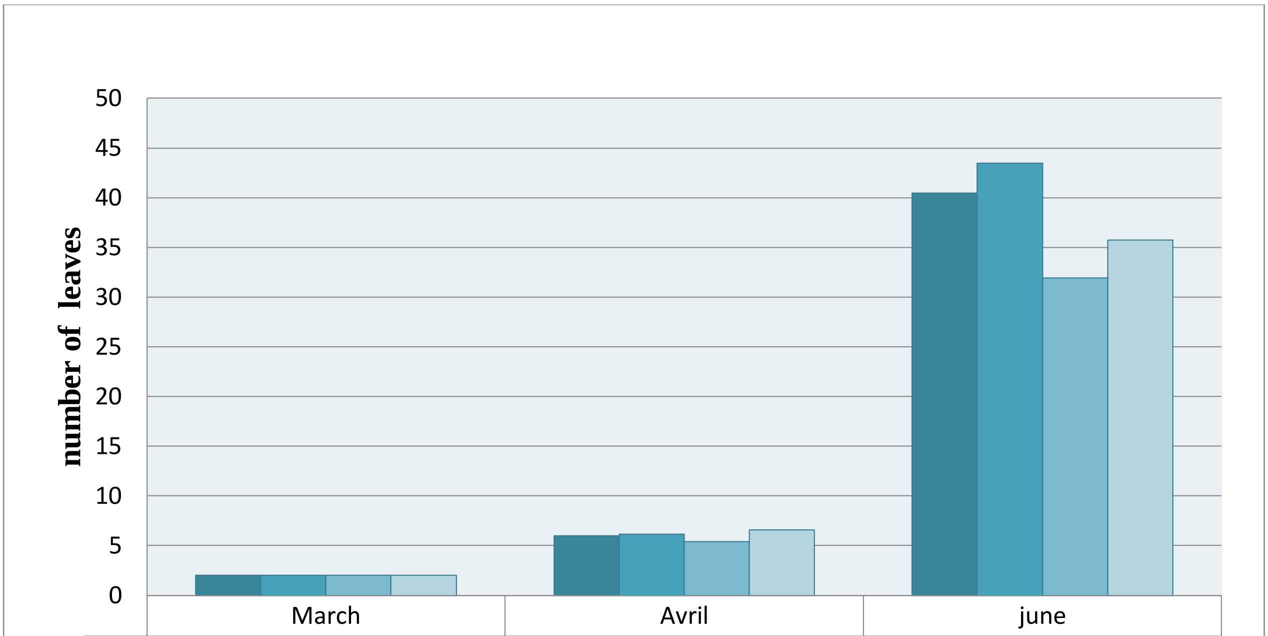
Figure 26: Average stem diameter per group

Based on the results provided, it can be concluded that both *Ulva lactuca* (sea lettuce) fertilizer and *Urtica dioica* (nettle) fertilizer have a noticeable effect on the diameter of the stems in comparison to the control groups (S1 and S2) treated with water only and compost, respectively.

The S4 group, treated with *Ulva lactuca* fertilizer, had the highest average stem diameter of 2 cm, while the S3 group, treated with *Urtica dioica* fertilizer, had an average stem diameter of 1.6 cm. In contrast, the S2 group, treated with compost, and the S1 group, treated with water only, both had an average stem diameter of 1.5 cm .

These results suggest that the application of both sea lettuce and nettle fertilizers positively influenced the diameter of the stems compared to the control groups, it indicates that the fertilizers had a significant impact on the growth and development of the plant stems, leading to larger average stem diameters in the treated groups .

I.4. Number of leaves :



	March	Avril	june
S1	2	6	40.46
S2	2	6.13	43.46
S3	2	5.4	31.93
S4	2	6.6	35.73

Figure 27: Average number of leaves in each group

Based on the results shown in Figure 29, we observe that the number of leaves in groups S1 and S2 is greater than the groups treated with extracts, with a difference of 40.46 and 43.46, respectively. Furthermore, in figure 30, which represents leaf area, a significant difference is observed, as the leaf sizes in the extract-treated groups are much larger than in S1 and S2. From this, we can infer that the quantity of nutrients used subjected to the principle of quantity over quality.

I.5. Leaf area :

The leaflet area was measured after the plants stopped growing and the results are shown in the figure below :

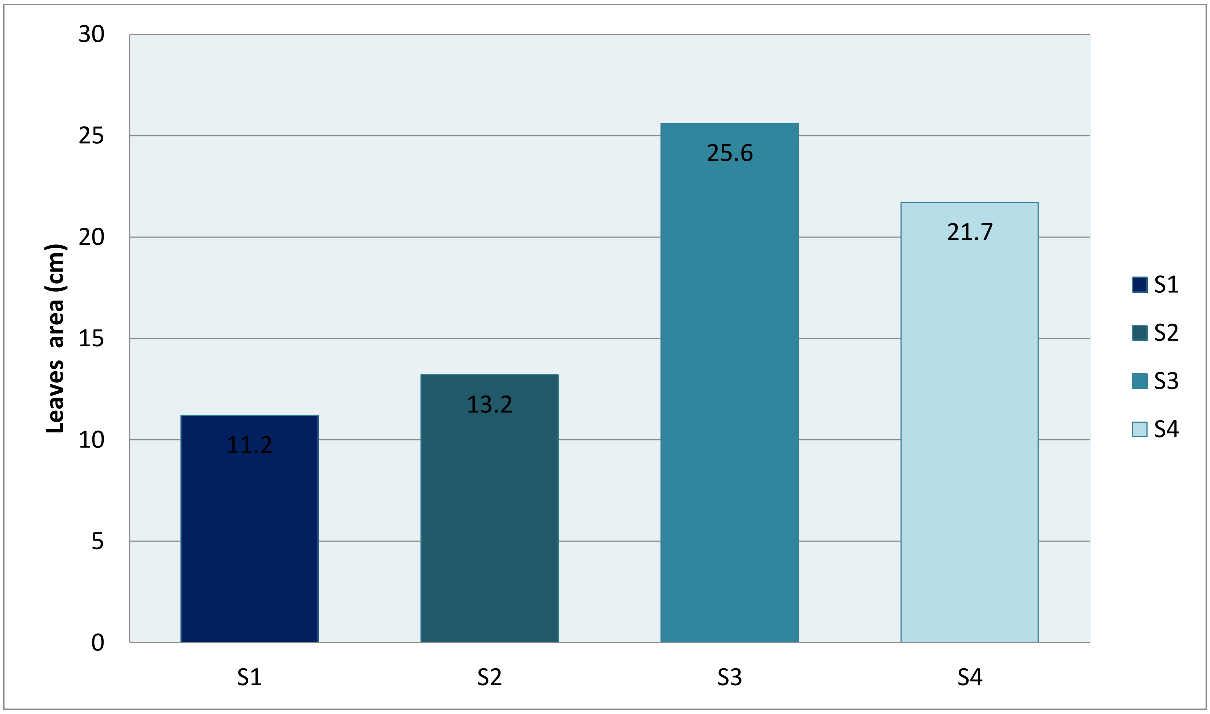


Figure 28 : Average leaves area for each group

Based on the given information, it can be concluded that the groups treated with *Urtica dioica* fertilizer (group S3) and *Ulva lactuca* fertilizer (group S4) showed the highest leaflet areas, with group S3 ranking first and group S4 ranking second .

The group treated with compost (group S2) ranked third in terms of leaflet area, while the group treated with water only (group S1) had the smallest leaflet area .

From these results, it can be inferred that both nettle fertilizer (*Urtica dioica*) and sea lettuce fertilizer (*Ulva lactuca*) have a significant positive effect on the growth and development of leaflets compared to the control group (water-treated plants) .

This suggests that these organic fertilizers contribute to the overall growth and productivity of plants, specifically in terms of leaflet size .

I.6. Fresh weight of harvested fruits :

Based on the provided information that shown in the next figure, it can be concluded that the sea lettuce moss fertilizer and nettle fertilizer had a significant effect on the fresh weight of the fruits .

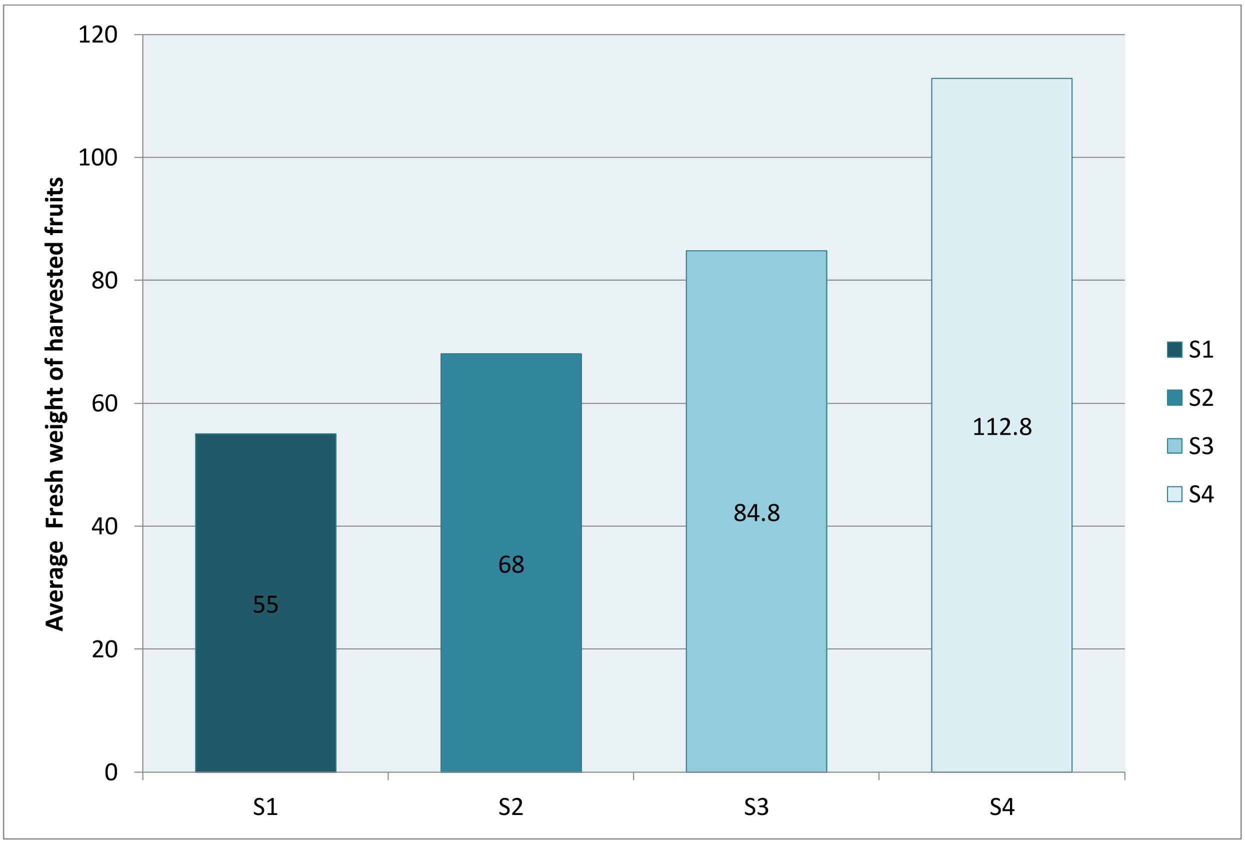


Figure 29 : Average fresh weight of harvested fruits in each group

Tomato plants irrigated with sea lettuce fertilizer yielded fruits with the highest average weight of 112.8 grams.

Additionally, group S3 (treated with nettle fertilizer) had an average fruit weight of 84.8 grams which was notably higher compared to group S2 (treated with compost)

Also the plants in group S1 (treated with water only) has the lowest average wiegth of 55g .

Therefore, it can be inferred that the application of sea lettuce moss fertilizer resulted in the highest average fruit weight, while both nettle fertilizer and compost treatments also had a significant effect on increasing the average fruit weight compared to the group treated with water alone.

I.7. The harvest:

Based on the analysis of the fruit harvest results , that shown in the figure below :

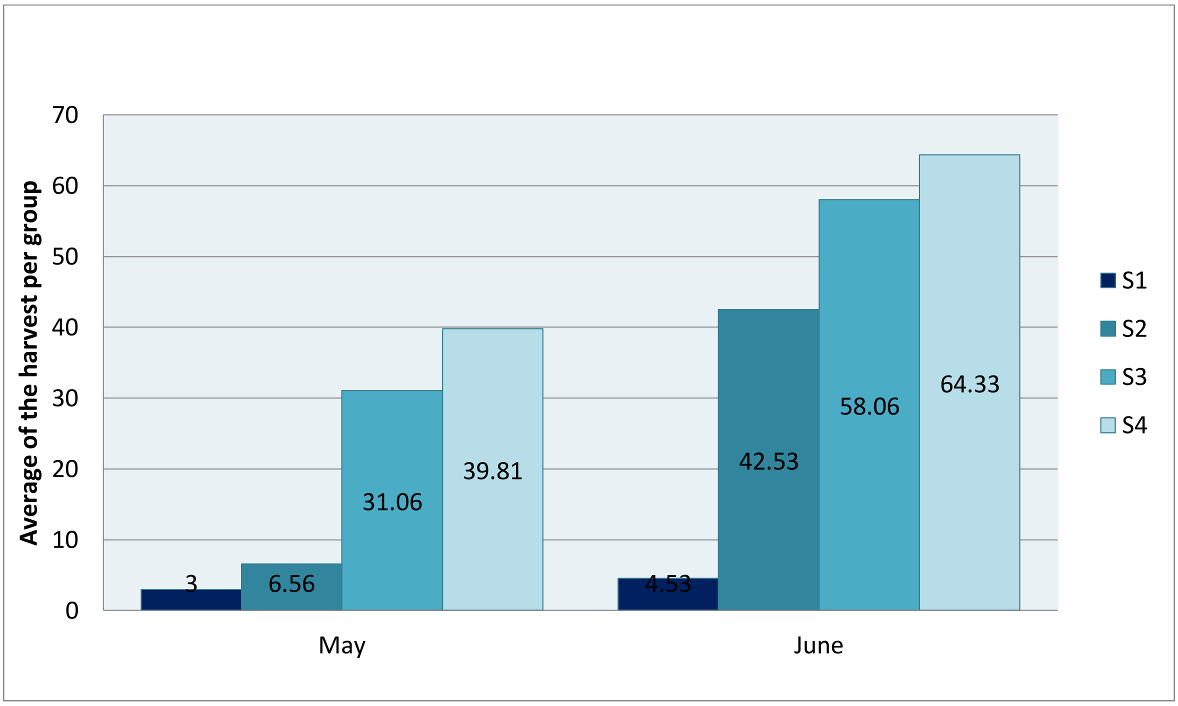


Figure 32 : Average of the harvest per group

It can be concluded that the doses of liquid fertilizer, specifically nettle and sea lettuce moss fertilizers , had a significant impact on the average number of fruits produced by the tomato plants.

The S4 group, which was treated with sea lettuce moss fertilizer had the highest average number of fruits, with 39.81 fruits in the first batch and 64.33 fruits in the second batch.

The S3 group, which was treated with nettle fertilizer, had the second-highest average number of fruits, with 31.06 fruits in the first batch and 58.06 fruits in the second batch.

In contrast, the S1 group, which was treated with water only, had very low average fruit yields in both the first and second batches, with only 3 fruits in the first batch and 4.53 fruits in the second batch.

Therefore, it can be concluded that the application of liquid fertilizers, particularly sea lettuce moss and nettle fertilizers, positively influenced the productivity of the tomato plants, resulting in significantly higher average fruit yields compared to the group treated with water alone.The following figures show the difference between the yield of each group :

Figure 30 : Group **S1** crop (treated with water only) (Original, 2023).

Figure 31 : Group **S2** crop (treated with compost) (original 2023).

Figure 32 : Group **S3** crop (treated with *Urtica dioica* fertilizer) (Original, 2023) .

Figure 33 : Group **S4** crop (treated with *Ulva lactuca* fertilizer) (Original, 2023)

I.8. Diseases and pests

During the treatment process, we did not neglect the importance of spraying both groups S3 and S4 with the liquid fertilizer (nettle, sea lettuce moss) stabilized with Twen 20.

This was done to monitor the effectiveness of protecting the manufactured fertilizers and evaluate the development of each group in terms of pests and insects that may affect them

Based on the information provided, it appears that liquid fertilizer has a positive effect on plants by reducing and preventing the spread of diseases and pests. The use of liquid fertilizer can enhance the plants' resistance to diseases and pests, resulting in healthier growth and increased productivity of crops.

Based on the following figures, a clear difference is observed between group S1 and the groups treated with liquid fertilizer, it is evident that Group S1 has been affected by *Tuta absoluta*, while the treated groups were not affected to the same extent. Only four fruits affected by the insect were found in the treated groups. This indicates the effectiveness of liquid fertilizer in suppressing the spread of pests and reducing their impact on plants.

It can be concluded that regular use of liquid fertilizer can be an effective method to help protect plants from diseases and pests and enhance their healthy growth, the following figures illustrate the results obtained :

Figure 34: *Tuta absoluta* damage on tomato plant irrigated with water (Original, 2023).

Conclusion

Conclusion

The experiment was conducted on the extracts of the nettle plant *(Urtica dioica)* and sea lettuce *(Ulva lactuca)* on tomato plants *(Solanum lycopersicum),* the main results obtained indicated that the prepared solutions contained important sources of nutrients and were capable of significantly enhancing the growth and development of the cultivated plants, such as tomatoes in our study, it was observed that the extract of *Ulva lactuca* had the greatest impact on the group it was applied to, while the *Urtica dioica* plant also exhibited noticeable effects, Various biometric parameters were measured throughout the months, from the planting stage until the plants reached maturity, these parameters included stem length, stem diameter, number of stems, number of leaflets, leaflets area, fresh fruit weight, and number of fruits produced, it is intriguing to consider the application of these extracts to other plant varieties due to their effectiveness and numerous benefits, they are cost-effective, non-harmful to humans, and environmentally friendly .

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