Order number :
Serial number :

الجمهورية الجزائرية الديمقراطية الشعبية

People's Democratic Republic of Algeria

وزارة التعـليـم العالي والـبحـث الـعلـمي

Ministry of Higher Education and Scientific Research

جامـعة الشهيد حمه لخضر- الوادي

Echahid Hamma Lakhdar University - El OUED

كلية علوم الطبيعة والحياة

Faculty of Natural and Life Sciences

قسم الفلاحة

Department of Agromy

END OF STUDY DISSERTATION

With a view to obtaining an Academic Master's degree in Agricultural Sciences.

Speciality : Plant Production

THEME

Contribution to the study of garlic pests and diseases in El Oued region

Presented by:

LASSOUED Chaima

Jury members	Grade	University
President : D[r] BAKOUCHE. A	M.C.B	Echahid HammaLakhda- El Oued
Examiner: D[r] KASMI.Y	M.A.A.	Echahid Hamma Lakhdar-El Oued
Promoter:D[r] HADEF.L	M.C.A.	Echahid Hamma Lakhdar-El Oued

- College year 2023/2024-

Aknowledgement

First of all, I would like to thank Allah, the Almighty, for giving me given the health, will and patience to complete my training of master's degree.

I would like to express my gratitude to my promoter, Dr. HADEFL., Lecturer at Echahid Hamma Lakhdar University. El Oued,for having supervised me, helped me and put me allow time to carry out this work.

My sincere thanks also go to Dr. Bakouche A., Lecturer at Echahid Hamma Lakhdar University. El Oued, for agreeing to chair my dissertation jury.

My sincere thanks also go to Dr. Kasmi Y., Assistant Professor at Echahid Hamma Lakhdar University. El Oued, for agreeing to examine and participate in our dissertation jury.

Without forgetting to thank all the agronomy department teachers who contributed to our training during our journey university.

Dedications

I dedicate this humble work:

- ✓ *To my dear parents for their trust and encouragement, their sacrifice, we hope that this work will be fruitful for their efforts...*
- ✓ *To my dear brothers and sisters*
- ✓ *To all friends promotion of the Master 2 plant production of the year 2023/2024.*

Summary

Chapiter II : Pests of garlic

Chapiter III : Diseases of garlic

List of tables

List of figures

List of abbreviations

ASD	Agricultural Services Directorate
°C	Degré Celsius
Ca	Calcium
cm	centimeter
Fe	Iron
K	Potassium
Kg/ he	Kilogram per hectare
l/ he	liter per hectare
MARD	Ministry of Agriculture and Rural Development
Mg	Magnesium
mg/Kg	milligram per kilogram
mm	millimeter
m/s	meter / second
Na	Sodium
P	Phosphorus
Pr	Precipetation
qx	quintals
qx/hectare	quintals per hectare
Tm	Temperature
Zn	Zinc
%	Percent

Introduction

Introduction

Garlic (Allium sativum) is classified under Alliaceae family (Takhtajan, 1997) and is widely consumed for its culinary and medical benefits. Garlic is planted by hand in the fall and harvested in the following summer (Samavatean et *al*., 2011). Garlic is a relatively good source of calcium, phosphorus, and potassium. Its leaves are sources of protein and of vitamins A and C. Garlic is said to contain antibiotic substances that inhibit the growth of certain bacteria and fungi(Samavatean et *al*., 2011).

The garlic as a global food crop, ranking fourth among other crops with an overall annual production of nearly 327 million tonnes and about 19 million hectares planted. China, India, Republic of Korea and United States are the main Garlic producer countries. Based on FAO statistics, Algeria is the eleventh producer in world (FAO, 2018). Current annual production is estimated at 202,201 tonnes from 12,945 he of land with a productivity of 15.6 t/he (FAO, 2018). However, the productivity and quality of garlic produced in the country is acceptable compared to the global average as mentioned above. El Oued region is one of the potential areas in Algeria for garlic production. El Oued produced about 306,000 qt/ he of garlic in 2023, from 1,460 he of land (DAS, 2024).

Garlic plant can be affected by various diseases caused by viruses, fungi and bacteria. The viruses that tend to cause it severe damages are potyviruses, such as Leek Yellow Stripe Virus (LYSV), Garlic Yellow Streak Virus (GYSV) and Onion Yellow Dwarf Virus (OYDV). Some carlaviruses, like Common Latent Virus (GCLV) and Shallot Latent Virus (SLV) can also infect the garlic plant (Messiaen et al., 2004). One of the most widely spread diseases in garlic producing countries is white rot, caused by the fungus Sclerotiumcepivorum, which provokes wilting of the plant and rotting of the bulb. Its sclerotiacan survive in soil for up to 20 years, therefore limiting garlic production. Various bacteria (*Bacillus spp*., *Erwinia spp*., *Pseudomonas spp*.) can also cause damages on bulbs upon storage. Garlic can also be affected by pests like thrips that infest plants from early developmental stages and cause severe foliage damages. Mites (Rhizoglyphus spp.) are another garlic pest that invade the bulbs and limit their sprouting ability. On the other hand, bulb nematode (Ditylenchusdipsaci) causes the root knot disease, characterized by yellowing and rolling of leaves, as well as rotting of the bulb's base(Bujanos-Muñiz&Marín-Jarillo, 2000).

The study is an attempt to document the actual field pests and diseases situation of garlic with the aim that results obtained can be depended on to develop appropriate control measures.

This dissertation is divided into two main parts:

 A bibliographical chapter structured in 3 parts. The first part gives a general overview of garlic and its cultivation and the second concerns the different pests and diseases that affect garlic

The second part, experimental, divided into two chapters,

 A chapter reserved for the experimental part includes the characteristics of the study region, the methodology adopted in carrying out this study.

 A chapter reserved for the presentation and discussion of the different results recorded during the study.

Bibliographic part

Chapiter I
General information on garlic

CHAPITER I

General information on garlic

I.1. Botanical description

Garlic is a perennial plant of the Alliaceae related to onions, chives, shallots, and leeks. It is an indigenous herb of Western Asia and Mediterranean where it has been cultivated for centuries. The major garlic growing countries includes Korea, China, India, USA, Spain, Argentina, and Egypt, among which China is by far the largest producer (Ourouadi et *al*., 2016) . Garlic is a bulbous, annual plant that reproduces only vegetatively, from lateral buds commonly called cloves. In the vegetative state, garlic, like all Alliums, has a stem reduced to a conical "plateau" which produces at its base roots and at its apical part a succession of linear and alternate leaves whose cylindrical sheaths fit into each other, thus forming a pseudo-stem or "stem". The free part of the blade is ribboned, folded into a gutter, of a glaucous green or gray. The leaves become scarious at their base during the tuberization of the buds and constitute the tunics of the bulb (Farnsworth et *al*., 1992). The bulb extends to the surface in a stem surrounded by sheathing, linear, flat and smooth leaves, measuring 1 to 2.5 cm wide and 30 to 60 cm long. The inflorescences are umbels. The flowers vary in number and are sometimes absent. Rarely opened, they can wither in the bud. The fruit is a small capsule with loculicidal dehiscence. Seeds are rarely if ever produced (Farnsworth et *al*., 1992; Girre,1980).

I.2. Classification

The garlic (Allium sativum L.) belongs to the genus Allium. The taxonomic position of Allium and related genera had been a matter of controversy for long (Fritsch, Friesen 2002). The following hierarchy (table 01) was adopted by (Takhtajan, 1997)

Table 01.Botanical classification of garlic (Takhtajan, 1997).

Kingdom	Plantae
Order	Asparagales
Family	Amaryllidaceae
Genus	Allium
Species	A.sativum

I.3. Morphological Description

I.3.1. Vegetative system

I.3.1.1. Stem

The pseudostem is very short and forms a plateau at the base where adventitious roots develop. It is made up of a series of leaves connected by an integument(figure 01) (Choudhary et *al*., 2022).

Figure 01. Garlic Stem (Bernard, 2018).

I.3.1.2. Roots

The root system of garlic is indeterminate, quite thick and poorly branched(figure 02), with an epidermis, a multicellular cortex and an endothelium surrounding a central stele. Plant root development is sensitive to soil humidity and temperature. A poorly developed root system is one of the factors limiting its ability to absorb nutrients. They measure up to 40 cm long and 2 cm wide (Kouassi et *al*., 2021).

Figure 02. Garlic roots (Larose, 2021).

I.3.1.3. Bulbs

Bulbs are formed at the base of the stem, they are composed of 3 to 20 arched bulbils (more commonly known as pods) called cloves(figure 03). The latter have a diameter of 5 to 10 mm and are composed of an external envelope, an epidermis containing a non-chlorophyll mesophyll; parenchyma and a layer of lower epidermal cells (WHO, 1999).

Figure 03. Garlic Bulbs (Sinkovič et *al*., 2022).

I.3.1.4. Leaves

The leaves are linear and alternate with a tubular sheath and their number varies from 9 to 12 in the species(figure 04) (Aslam et *al*., 2016). They can measure up to 40 cm long and 2 cm wide (Sultan et *al*., 2020). The limbs are broad and streamlined and the bases of all the leaves are located at the bulb (Man, 1952).

Figure 04. Garlic leaves (Anonym 01, 2024).

I.3.2. Reproductive system

I.3.2.1. inflorescences

The inflorescences are umbels composed of perfect flowers with 6 petals, 6 anthers and 3 locules composed of 2 ovules each (Simon et *al*., 2003). they can can be large or small containing important number of sterile flowers and bulbils. However, the ability to produce inflorescences is not observed in all varieties. This ability is most common in central Asian and Spanish varieties (Etoh et *al*., 2002).

I.3.2.2. Flowers

Garlic produces hermaphroditic flowers. They are greenish white(figure 05)or pink with 6 tepals (sepals and petals) approximately 3 mm long. Small carnations are often interspersed between the flowers (Alam et *al*. , 2016).

Figure 05. Garlic flowers (Beauchemin, 2017).

I.3.2.3.Fruits

Fuits (figure 06) have a pungent odor and are pale or slightly yellowish. . Fertilization can occur before the fruit reaches a stage where it can reproduce (Alam et *al*., 2016).

Figure 06. Garlic fruits (Alaoui, 2005).

I.4.Life cycle

During its life cycle, the garlic plant goes through several successive phases of growth and development. Dormancy of mature cloves, induced by temperatures of 25–30°C, is eliminated most quickly at 6–7°C. Vegetative growth is most rapid at 18–20°C. When 12–14 leaves have been produced (the first ones have already disappeared when the last ones are emitted), swelling of the bulb is induced at temperatures above 20°C, provided that the photoperiod exceeds a threshold of 12–15 hours, depending on the cultivar, and that a "need for cold" after the elimination of dormancy has been previously satisfied. Because of all these conditions, bulb production in the tropics is more difficult for garlic than for onions.

Fortunately, there is considerable physiological variability among garlic cultivars. Those that can be grown in tropical conditions are not strongly dormant, their "need for cold" is not very pronounced, and their photoperiod threshold is barely 12 hours. The complete cycle varies from 4 months (in the tropics, or for heavily dormant cultivars planted in spring in a temperate climate) to 9 months (for less dormant cultivars planted in fall in a north-Mediterranean climate). In optimal altitude and latitude conditions, certain cultivars regularly produce inflorescences. Only certain cultivars from Central Asia and the Caucasus produce well-developed flowers and seeds, provided that the bulbils present among the flower buds have been removed early. Other cultivars that normally produce inflorescences have flowers that remain sterile. Other cultivars do not produce inflorescences under normal conditions, but only at higher altitudes or latitudes (Messiaen, et *al*., 1993).

I.5.Cultivation conditions

Garlic is grown in different types of soils, but preferably light soils, rich in organic matter, well drained, and which have a good capacity to retain nutrients and humidity. Heavy soils are not recommended since they tend to harden during dry periods and limit the expansion of the bulbs which take on an irregular shape (Omafra, 2002). White garlic and purple garlic must be planted before December (for winter varieties), pink garlic and red garlic are preferably planted in spring (spring varieties) (Arvy and Gallouim, 2003). Sandy soils require more rigorous cultivation management to ensure soil fertility and humidity are maintained. The size of the bulbs is directly linked to the vegetative growth of the plant. The most favorable pH is around 6.5 (Arvy and Gallouin, 2003).

I.6.Garlic variety

There are 2 main families of garlic: autumn garlic (ophioxorodon) and spring garlic (sativum). The first is planted from October to November, in the coastal zone and the other is planted between December and the beginning of January, in the interior zones. In both cases, the harvest takes place in April – May (ITCM, 2010). White garlic: autumn garlic of the Messidoreouthermidrome variety which flowers in early spring. Pink garlic: is a spring garlic, of the Fructidor or Printanor variety. The plant is quite small and forms light pink flowers. Purple garlic: this is an autumn garlic of the Germidour variety (ITCMI, 2022).

I.6.1. Most cultivated varieties in Algeria

Local red, Rose of Kabylie, Rose of China, Red of Spain, Thermidrome, Messidrome, Fructidor, Red of Iran, Germidour, Mocta Bulgarian, Simple Californie (ITCMI, 2022).

I.6.2. Different types of marketed garlic

Commercial garlic products come in various forms:

I.6.2.1. Fresh Garlic

Fresh garlic only contains alliin with a quantity of 4 to 12mg, however allicin is formed once garlic is crushed (Gambogou et *al*., 2019).

I.6.2.2. Macerate

The oil macerate is made from mixtures of completely crushed garlic cloves encapsulated in vegetable oil. During the manufacturing process, alliin can be converted into allicin and allicin derivatives mainly ajoenes (Gambogou et *al*., 2019).

I.6.2.3. Garlic Powder

Garlic cloves must be pulverized, crushed and dried to make them extract the powder which contains the same compounds as raw Garlic, the main compound of which is alliin. It is generally used as a condiment in foods (Costeplane, 2018).

I.6.2.4. Garlic essential oil

A clove of garlic contains 0.2 to 0.5% essential oil. Garlic capsules are available containing vegetable oil with a small amount of essential oil, since the smell is very overpowering (Gambogou et *al*., 2019).

I.7.Garlic compositions

Garlic contains more than 200 chemical compounds with multiple properties. It is 65% water, 28% carbohydrates, 2.3% organosulfur compounds, 2% proteins, 1.2% free amino-acids, and 1.5% fiber. It also contains fat-soluble vitamins (vitamin A, vitamin K, and vitamin E), water-soluble vitamins (vitamin C, B-complex vitamins: B1, B2, B3, B6, and B8), and minerals (Ca, Fe, Mg, P, K, Na, and Zn). Organosulfur compounds give garlic its characteristic taste and odor as well as its pharmacological properties (Moutia, 2018). The energy value of garlic is 138.7kcal/100g (Saleh et *al*., 2015). Nutritional value of fresh garlic is illustrated in table 02.

Table 02. Nutritional value of fresh garlic (Sulerai et *al*., 2015)

Nutrients	Quantity per 100g/m.h
Energy	134 calories
Water	65%
Proteins	6 - 7g
Carbohydrates	24 - 27g
Fibers	1g
Lipids	0.1 mg
Sodium	19mg
Phosphorus	134 mg
Calcium	38 mg
Vit C	14 mg
Vit E	0.01mg
Vit B1	0.2 mg
Iron	1.4 mg

I.8.Therapeutic uses

Garlic is first used in cooking to enhance the taste of foods, but its many therapeutic properties make it a popular food supplement. Indeed, antimicrobial, antioxidant, anti-inflammatory, anti-tumor and Cancer prevention have been recognized. In addition, it would have the power to inhibit coagulation, reduce hypercholesterolemia and blood lipid levels, or even facilitate digestion. Garlic also prevents the risk of thrombosis and atherosclerosis. Finally, it reduces hyperglycemia and blood pressure (Bruneton, 1999).

I.9.Production of garlic

I.9.1. Global production

According to the Food and Agriculture Organization of the United Nations (FAO), the production of garlic cultivation worldwide is estimated at just over 28 million tonnes, in the genus Allium, the consumption of Garlic is in second position after onion. Garlic production is very high in Asia. This continent comes in first place with 26 million tonnes of garlic produced in 2018. Followed by Europe, America, Africa and finally by Oceania. The leading producing country is China (81%), although Algeria occupies 11th place in terms of garlic production and productivity.

Table 03. Garlic producing countries in the world (FAO,2018).

No.	Country	Quantity in tonnes
1	China, mainland	22273802
2	India	1721000
3	Bangladesh	461970
4	Republic of Korea	331741
5	Egypt	286213
6	Spain	273476
7	United States of America	260340
8	uzbekistan	254857
9	Rrussian federation	211981
10	Myanmar	207094
11	Algeria	202201
12	Ukraine	

I.9.2. National production

National garlic production has seen a marked increase in planted areas in recent years. It is 12,945 ha for a production of 202,201 tonnes during the 2017/2018 campaign, a very significant value compared to the forecast previously made for this year (128,753 tonnes). Algeria achieved more than 27% of African garlic production for the same year (2018) (FAO, 2018), the largest production areas of which are: Mila, Médéa, Skikda, Boumerdès, Batna and El Oued. It should be noted that the Wilaya of Mila tops the list in the production of garlic and participates with 27 to 30% of national production (ITCMI, 2018). The area reserved for garlic cultivation is 520 hectares with an average yield of 70 tonnes. Figure 3 shows the evolution of garlic production in Algeria between 1994 and 2014 (FAO, 2017). The yield increased from 35,470 to 100,256 (hg/ha) for the same area. The Garlic production in Algeria 1994-2014 was presented in figure 07.

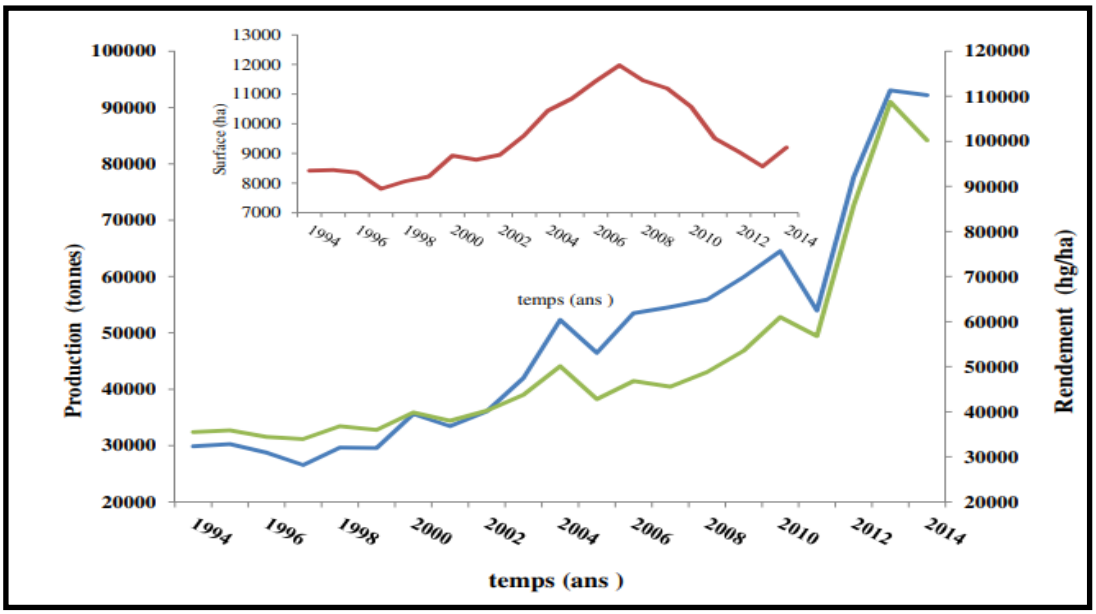

Figure 07. Garlic production in Algeria 1994-2014 (FAO, 2017)

I.9.2. Regional production

Statistics provided by the ASD of Oued Souf (Table 01) indicate that the largest area reserved for garlic cultivation was recorded during the year 2019 (267,320 ha). The best yields are obtained in 2022 (410,000 qx/ha) and the lowest yields are recorded in 2014 (27,270 qx/ha).

Table 04. Area and production of garlic cultivation for the period 2014-2023 in El Oued region.

Year	Area (ha)	Production (qx/ha)
2014	303	27,270
2015	344	34,400
2016	434	43,400
2017	498	50,670
2018	1,683	168,300
2019	1,686	267,320
2020	1,106	277,380
2021	1,281	320,603
2022	1,500	410,000
2023	1,460	306,000

Chapiter II
Pests of garlic

CHAPTER II

Pests of garlic

II.1. Pests

II.1.1. Stem and bulb nematode

II.1.1.1. Biology

The Stem and Bulb Nematode, Ditylenchus dipsaci, Kühn (Filipjev), belongs to majorpests of several vegetable crops. Considerable loses are repeatedly reported from the culturesof garlic, onion (Aftalion and Cohn, 1990), Ditylenchus dipsaci is a sedentary nematode, which penetrates through the stomatal openings of plants (Palomares-Rius et *al*., 2019). Life cycle of D. dipsaci average in 19−23 days. Mature females deposit eggs during 20−50 days and about 10 eggs/day. Under favorable conditions, the second stage juveniles hatch from the eggs and undergo two molts become the fourth juveniles and infective stage. These juveniles can penetrate and feed on young tissues of leaves, stems, bulbs, and other plant parts, but generally not roots. The fourthstage juveniles go through the fourth molt and differentiate into mature males and females and may complete several generations in the succulent cells of the cortex layer of leaf or bulb tissues of garlic and onions. The fourth-stage juveniles of Ditylenchus sp. are known to withstand desiccation conditions, their condition make they survive for several years in the dry state in infected plant tissues or free in soil. Stem and bulb nematodes can spread mainly by infected seeds and planting materials, contaminated equipment, and other means of transporting infested soil. Economic thresholds of D. dipsaci are very low, each 10 nematodes per 0.5 kg of soil may caused to significant crop losses (Subbotin et *al*., 2005).

II.1.1.2. Symptoms

- **Seedling:** swelling of the base of the seedlings, rolling and deformation of the leaves. Young roots and the bulb may rot.
- **Leaf:** in garlic, yellowing begins at the tips of the basal leaves and progresses from the basal leaves toward the top of the plant.
- **Bulb:** Garlic's tunics appear damp and discolored. The inside of affected bulbs have areas that appear watery and spongy. Small scattered brownish spots are sometimes observed on the cloves (figure 08). Affected bulbs split and are misshapen. At a later stage, the root plate turns brown, rots and separates from the bulb(Richard and Boivin, 1994). Garlic cloves heavily infected with Ditylenchus dipsaci may not store well, and nematode reproduction and damage to bulbs will continue and may increase during storage (Johnson and Fuller, 2021).

.

Figure 08. Symptoms of Stem and bulb nematode (leaves and bulb) (Richard and Boivin, 1994; Johnson and Fuller, 2021)

II.1.1.3. Control

- Alliaceous crop rotations every 4 to 5 years
- Integration of a green manure of brown mustard (oriental)
- Propagation by bulbils. Nematodes are generally absent.
- Curative treatment of cloves with hot water before planting (Legault, 2023).

II.1.2. Bulb Mites

II.1.2.1. Biology

Bulb mites have a short life cycle and high reproductive potential. Their life cycle consists of an egg, larva, nymph and adult (figure 09) . Bulb mites tend to occur in groups or colonies. There is also a non-feeding stage known as a “hypopi”, which can occur when there is overcrowding. This form can attach itself to other insects for dispersal. Bulb mites are 1/50 to 1/25 inch long with eight legs. They are shiny white to translucent with two brown spots on their body, with short reddish-orange legs. These extremely small, slow-moving mites are usually found in clusters underneath bulb scales or at the base of the bulb (Pundt, 2019).Each female bulb mite lays up to 100 eggs during her lifespan. The life cycle takes approximately 40 days to complete depending upon relative humidity, temperature and host plant. For example, at 77ºF, the life cycle takes approximately 12 days. They do not undergo a resting stage or diapauses (Pundt, 2019).

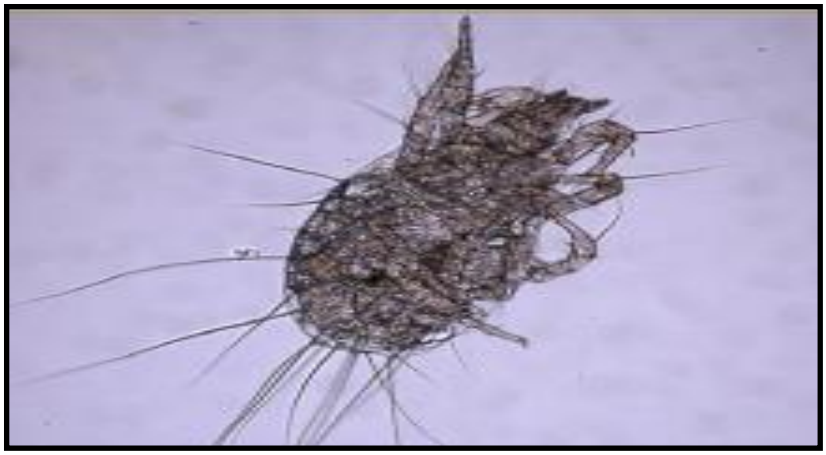

Figure 09. Adult Rhizoglyphus mite Magnification 10x(Madeiras, 2014).

II.1.2.2. Symptoms

Symptoms of bulb mite infestations include stunting with low mite populations to failure of bulbs to produce new growth with heavy infestations. Leaves will be stunted, distorted and turn yellow. Flowers will not develop. Infested bulbs show reddish-brown discoloration (figure 10) and may rot after planting. Feeding sites provide entry points for Rhizoctonia, Pythium, and Fusarium. Populations may increase faster on bulbs infested with Fusarium and other fungi. Signs of damage may not be evident until large populations develop (Pundt, 2019).

Figure 10. Mite damage on (garlic brown spots) (Madeiras, 2014).

II.1.2.3. Management

- Plant clean seed. Hot water treatment of seed garlic is effective, but can decrease germination. Put seed in water heated to 130°F 10-20 minutes, or 140°F for 10-15 minutes. Soak seed for 24 hours in 2% soap (not detergent) and 2% mineral oil prior to planting.

- Dust bulbs with sulfur.
- Mild mite infestations are often mitigated by the process of drying bulbs before storage.
- Rotate out of Alliums for at least four years.
- Control wild Allium species in the vicinity mites can survive on the residues of a number of crops.
- Plant only in fields where crop residue is thoroughly decomposed.
- Avoid planting Alliums directly after Brassicas, corn, grain, or grass cover crops (Madeiras, 2014).

II.1.3. Onion fly

II.1.3.1. Biology

The Onion Fly looks a lot like the House Fly. Yellowish-grey in color, its thorax has five darker bands; the wings are yellowish; black legs and antennae. The pupae overwinter in the soil. The imagos fly at the end of April, the males preceding the females. Their flight is not sustained; to feed themselves, they gather flowers from various plants. At the end of April, beginning of May, the imagos appear, the males before the females, then mate and laying begins 10 to 20 days later, the eggs are laid in small groups of 10 to 15 at the base of the plants. After a week the young larvae(figure 10) penetrate between the leaves or at the base of the bulb at the roots. Shortly afterwards, we notice the wilting and rotting of the plants due to the action of bacteria: Bacillus carotovorus. The larvae feed on decaying tissue. The growth of the larvae is rapid: 15 to 25 days. Pupation takes place in the soil and 2 to 3 weeks later we can observe the new imagos (figure 10) in July; This is followed by new eggs and summer damage. The larvae can be parasitized by nematodes Mermitids or devoured by the Staphylinid beetle Aphaereta minuta (Coutin,2004).

Figure 11. Rotting plant with maggot(Acheampong and Richardson, 2016).

II.1.3.2. Symptoms

The maggots feed on seedlings, transplants and bulbs. Infested plants wilt and turn pale green to yellow (figure 12). First generation maggots in the spring cause the most damage. Young plants are more susceptible to attack and can be killed, established plants are damaged but not usually killed. Feeding damage causes misshapen bulbs and allows the entry other species of maggots and decay organisms (Acheampong and Richardson, 2016).

Figure 12. Onion fly larvae and adults (Acheampong and Richardson, 2016).

II.1.3.3. Management

- Regularly practice strict hygiene and good farm sanitation.
- Practice crop rotation with non-host crop (not from garlic family).
- Infested plants should be carefully uprooted and burnt or buried deeply (60 cm).
- Destroy crop debris after harvesting. n Remove and dispose of volunteer onions.
- Grow resistant or tolerant varieties.
- Coverseedlingsin nursery with finemesh or net to prevent onion flies from layingeggs on host crop (Okwae, 2021).

II.1.4. Thrips

II.1.4.1. Biology

The thrips possesses several biological characteristics that enable it to become a dominant thrip species in many of the areas it has invaded. Its short generation time and high reproductive potential, often with a predisposition to parthenogenesis, enhances the likelihood of establishment (Zhang et *al.*, 2010); There are three or more generations per year. Adults and nymphs overwinter on plants, debris, legume forage crops, and weeds. Eggs laid into the leaves hatch in 5 - 10 days. Nymphs develop through four stages in 2 - 4 weeks (figure 13). The first two stages feed on the plant and the later two non-feeding stages complete

development in the soil. Hot dry weather favours thrips outbreaks(Acheampong and Richardson, 2016). Its cryptic behavior and high level of vagility enable it to disperse to a wide variety of crops (Reitz, 2009); its polyphagous nature likely supplements its predisposition to evolve resistance to many classes of insecticides through metabolic detoxification pathways (Demirozer et *al*., 2012); its widespread resistance to most major insecticides, in turn, makes it difficult to control (Gao et *al*., 2012); its highly efficient exploitation of food sources provides it with a competitive advantage over indigenous species and enables it to become successfully established in new regions (Demirozer et *al*., 2012). However, its propensity to transmit viruses often results in serious losses in a wide range of crops (Ogada & Poehling, 2015).

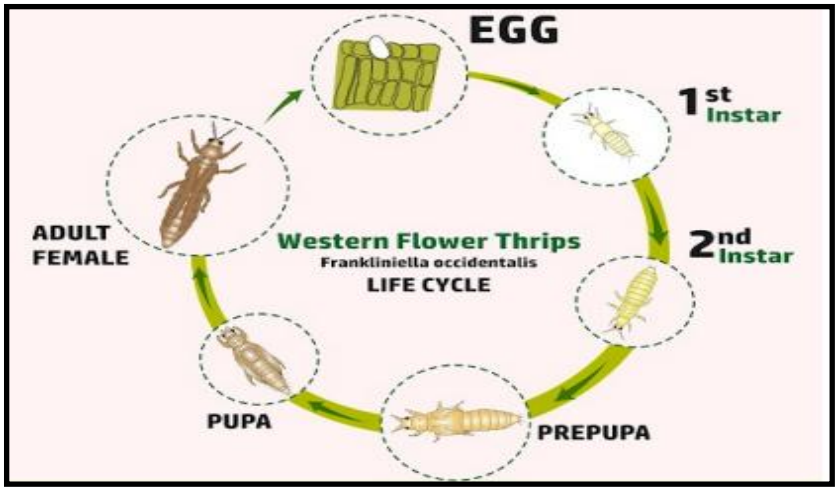

Figure 13. Life cycle of thrips (Marchiori, 2024).

II.1.4.2. Symptoms

The larvae and adults bite the leaves and suck the cellular contents thus destroying the chlorophyll. The leaves then take on a silvery appearance or light gray. These symptoms are associated with the presence of black spots which are the droppings of thrips. If the attack is strong, the tips of the outer leaves turns yellow and dries up, the plant becomes deformed and becomes sensitive to lodging. The plant grows poorly and produces small bulbs and high populations can lead to damage in storage (figure 14) (Kimba et *al*., 2015).

Figure 14. Thrips damage to stored garlic (Acheampong and Richardson, 2016).

II.1.4.2. Management

Control Cultural control

- Remove cull piles, plant debris and volunteer plants from the field.
- Delay controlling weedy areas until they begin to dry out.
- Controlling weedy areas after plant emergence may increase thrips problems.
- Sprinkler irrigation can help suppress thrips.
- Avoid planting near crops that harbor thrips such as alfalfa, wheat or clover (Acheampong and Richardson, 2016).

II.1.5. Leek moth

II.1.5.1. Biology

The leek moth, *Acrolepiopsis assectella*, also commonly called “leek worm”, are a pest of Allium vegetables, including leeks, garlic (Hutchins, 2022). The adult butterfly measures 16 to 18 mm in wingspan. It is essentially characterized by the presence of 2 white spots on the wings, which come together when resting, the rest of the body being brownish in color. The larva (10 to 12 mm) is light green in color, with 8 black spots on each segment. The cocoon is spindle-shaped, with a wide mesh, and is most often observed on the leaves of the plant.This lepidopteran can develop at the expense of all the alliaceae grown in our regions.Overwintering takes place as an adult, more rarely as a nymph, within plant debris or under the bark of trees and shrubs (figure 14) . Males and females resume their activity as soon as the night temperature exceeds 12°C. Laying can begin 2 to 3 days after mating and last 2 weeks on average, with around a hundred eggs per female. The eggs are laid under the leaves andhatching occurs 4 to 12 days later, depending on temperature conditions and the current generation. The caterpillars begin by digging galleries, then leave the leaves 2 to 5 days later (stageplayer) to sink into the bole where they will be protected until pupation.

Larval life lasts approximately 2 weeks at 25°C and goes through 5 stages. At the same temperature conditions, lifenymph lasts 10 days, giving a total lifespan from egg to adult stage of 1 to 2 months depending on temperature (Legrand, 2023).

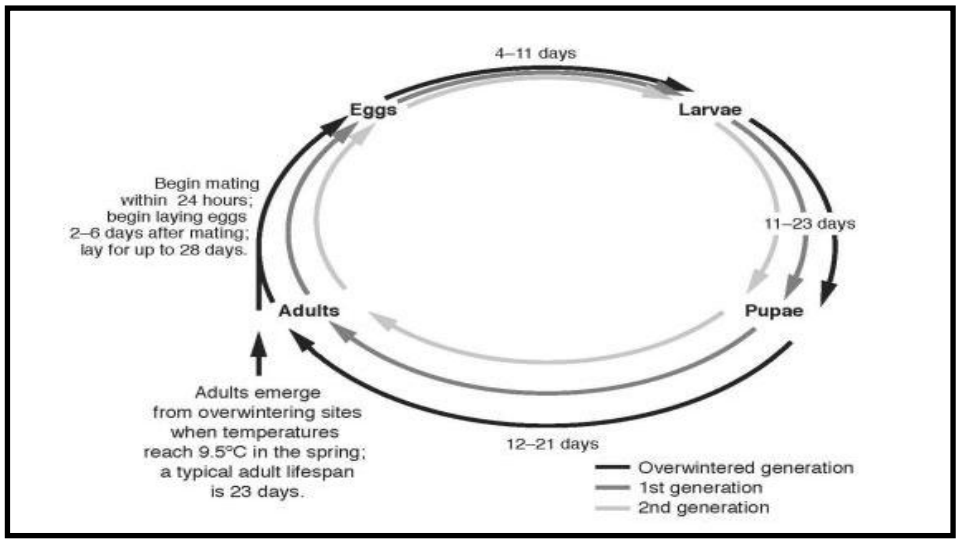

Figure 15. Life cycle of the leek moth (Anonym 01, 2024).

II.1.5.2. Symptoms

Leek moth larvae can cause significant damage by tunneling and feeding on leaf tissue and sometimes even bulbs.The larvae attack the surface of the leaves and inside them. They mine the rolled leaves, towards the center of the plant (Figures 16), creating numerous small holes on the inner leaves. On the adult plant, the larval galleries take the form of longitudinal grooves in the central leaves. Affected plants may appear deformed and are more vulnerable to different pathogens. Damage is generally more significant at the edges of fields (Anonym 01, 2024)

Figure 16. Damage to a garlic plant (Anonym 01, 2024).

II.1.5.3. Management

Several cultural controls have been recommended for control of leek moth.

- Covering allium crops with row cover is the best way to control leek moths. Since the moths fly only at night, growers can weed and remove garlic scapes during the day and then replace covers (Fuller,2018).
- Crop rotation
- Delayed planting
- Emoval of old and infested leaves
- Destroying pupae or larvae
- Early harvesting (to avoid damage by last generation larvae and population build-up)
- Positioning susceptible crops away from infested areas
- Destruction of plant debris following harvest (Allen et *al*,2022).

Chapiter III
Diseases of garlic

CHAPTER III

Diseases of garlic

III.1. Fungal Diseases

III.1.1. White Rot

III.1.1.1. Etiology

Garlic and onion white rot are caused by the fungus, *Stromatina cepivorum Berk*. White rot is the most important and destructive of the fungal diseases of onion and garlic. While all Allium-family plants can be infected with white rot, onion and garlic are the most susceptible(Johnson and Fuller, 2020).

III.1.1.2. Life cycle

The sclerotia present in the soil originate from the roots of diseased plants, crop residues, runoff water, contaminated soil carried by the wind, equipment, transplants and seeds (garlic bulbs and onions). The sclerotia are preserved in the soil for between 10 and 15 years. Only one to five sclerotia/kg of soil are enough to cause significant damage. Primary infections begin as soon as the germination of sclerotia is triggered by organic sulfur compounds exuded by Allium roots. Root infections occur at temperatures varying between 10 and 24°C (optimum 18°C). Once inside the roots, optimal temperatures for disease development are between 10 and 20°C. Moist, but not waterlogged, and cool soil favors infections. In Quebec, the disease can appear as early as June when the climate is favorable. However, the first symptoms are usually visible in August. Secondary infections occur through the mycelium from one plant to another in the row when planting density is high (Richard and Boivin, 1994). Garlic and onion white rot development is favored by cool and moist soil conditions. The soil temperature optimum for infection 60° to 65°F and infection can occur from 50° to 75°F. At soil temperatures above 78°F, the disease is inhibited. Soil moisture conditions that are favorable for garlic and onion growth are also favorable for white rot development (Johnson and Fuller, 2020).

III.1.1.3. Symptoms

The culture often withers in outbreaks. Very early attacks are possible but the symptoms are not very visible.Young attacked plants die before emergence or shortly after. On older plants:

- Older leaves turn yellow and wither.
- The base of the bulb is covered with white mycelium(Figures 17), on which small Black sclerotia can be seen in large numbers.
- A felting thick white is visible at the base of the bulbs.Ultimately, this disease causes:

- Destruction of the roots ("plates") of the base of theleaf sheaths and bulb rot. The fungus causesa watery rot of the bulb which results in its complete destruction (Anne-Laure et *al*., 2003).

Figure 17. Symptoms of white rot (Anne-Laure et *al*., 2019).

III.1.1.4.Management

To reduce the bank of sclerotia in the soil and the disease, the use of certified seeds and a long crop rotation (4 to 5 years) with non-host plants must be prioritized. Prophylactic measures are required such as cleaning machinery and tools, removing infested crop debris left in the field and using clean irrigation water (Richard and Boivin, 1994).

Once white rot is present in a field, little can be done other than to cease planting Allium crops in the field. The Allium crops from an infested field should not be used as seed. Infected plants should not be tilled under or composted, but rather disposed of off-farm. All equipment and tools that have been used in an infested field should be sanitized with an approved quaternary ammonia product (Johnson and Fuller, 2020).

III.1.2. Fusarium wilt of garlic

III.1.2.1. Etiology

Fusarium wilt of garlic is a soil-borne disease. It is associated with a complex of fungi of the Fusarium genus, including Fusarium oxysporum, Fusarium culmorum and Fusarium proliferatum.It is important to emphasize that there is a great diversity of fungi of the Fusarium type, with very diverse and complex characteristics (host plants, modes of contamination, development, etc.) (Fuscien, 2016).

III.1.2.2. Disease Cycle

Fusarium is a soil borne fungus and can persist for long periods in the soil. Transmission may occur via infested soil on tools or equipment, infected debris, infected seed, or run-off water. The pathogen enters the plant through stem plate or wounded tissue. The disease

develops from the base of the bulb and progresses towards the tips of the cloves(figure 18). Infection may occur at any time in the field, or in storage. The disease is favored by higher temperatures, 68º – 86º F (20-30 C), and high humidity. Late season rains may favor the pathogen (Jepson, 2008).

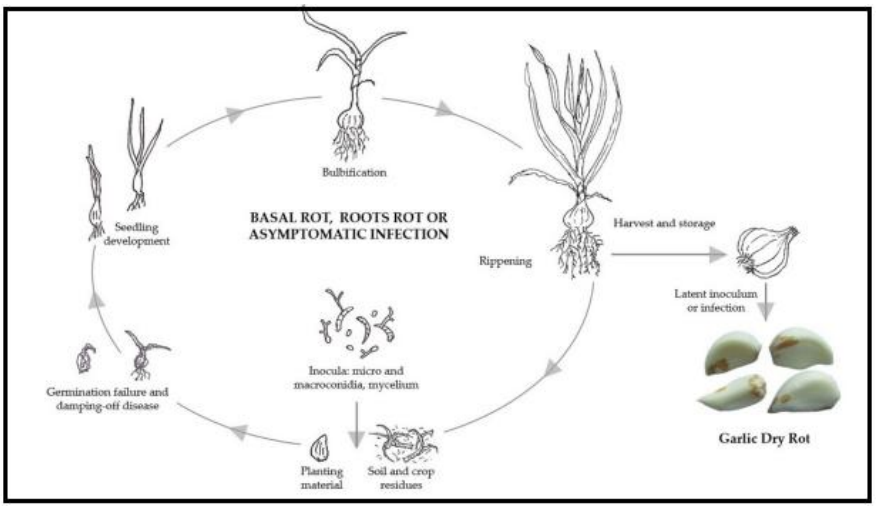

Figure 18. Disease cycle of garlic dry rot caused by *Fusarium proliferatum*(Gálvez and Palmero, 2022)

III.1.2.3. Symptoms

Plants may or may not show symptoms in the field or at harvest, but bulbs may subsequently rot in storage(Jepson,2008).

The appearance of the disease caused by *Fusarium spp.* on postharvest garlic bulbs differs depending upon time and environmental conditions. At the initial phase, brown lesions with a dehydrated appearance may emerge in different zones of the garlic cloves (Figure 19). These lesions are superficial or penetrate several millimeters and can progress (Figure 19) to cover the entire clove during the storage period. Sometimes, infected garlic cloves appear with softened water-soaked lesions that progress to tan-colored lesions and are covered with white/pink mycelia. Finally, infected cloves dry out and crinkle (Tonti et *al*., 2012; Leyronas et *al*., 2018).

Figure 19. Different symptoms of rot in garlic cloves caused by *Fusarium spp.*

III.1.2.3. Management

There are no established methods to eradicate Fusarium pathogens from garlic seed cloves. Managing seed clove infection is critical for mitigating Fusarium basal rot losses in both fresh market and processing garlic production since seedborne infections can be a significant driver of pathogen spread and primary infection into other fields. Even asymptomatic seed can be infected.Use garlic seed that was tested for Fusarium basal rot pathogens. Avoid planting seed fields or production fields with seed lots that are heavily rotten, as Fusarium pathogens are likely present(Swett,2024).

III.1.3.Downy Mildew

III.1.3.1. Etiology

Downy mildew, caused by the fungus *Peronospora destructor*, is a destructive disease of onions, garlic and other alliums (leeks, shallots, etc.). This disease reduces yield and bulb quality in humid, temperate regions.The severity of the disease varies widely with locality and Season and depends upon how often and how long alliums foliage is wetted by dew fogs irrigation or rain (Delhaut and Stevenson, 2009).

III.1.3.2. Disease Cycle

Downy mildew overwinters as mycelium on bulbs leftb in the field after harvest and in cull piles.Thick-walled resting spores,oospores, can withstand adverse condition in the soil for 4-5 years and can germinate to infect seedling garlics. Once established, the pathogen can complete its life cycle in as few as 11-15 days under ideal(cool and wet)environmental conditions.Multiple cycle can occur throught the growing season often resulting in severe epidimics (Delhaut and Stevenson, 2009).

III.1.3.2. Symptoms

Downy mildew of garlic is caused by the fungus *Peronospora destructor*. Symptoms appear as elongated patches up to 3mm longthat are somewhat paler than the rest of the foliage or have turned alight tan to brown in colour(figure 20). A furry growth, greyish violet in colour,may be visible on the surface of infected leaves during moist periods,especially early morning. Downy mildew lesions may be violet topurple and can be confused with initial lesions of purple blotch. Infected leaves gradually turn pale green to yellow and diseasedparts such as leaf tips fold over and collapse (Napier,2012).

Figure 20.Downy mildew symptoms(Napier,2012)

III.1.3.3. Management

To reduce the incidence and severity of downy mildew:

- Minimize canopy leaf wetness:
- Avoid sprinkler irrigation, especially when the canopy begins to fill.
- If avoiding sprinkler irrigation is not feasible, adjust the irrigation schedule to maximize leaf drying and prevent extended leaf wetness between irrigation events.
- Plant in fields where there is good air movement.
- Select fields that are well drained.
- Align rows with the prevailing winds.
- Use a 3-year rotation away from Allium crops in fields where the disease has occurred.
- Use disease-free bulbs, sets, and seed.

- Remove and destroy material of any Allium plants, including residue from the previous crop, volunteer plants, and culls from storage(Swett et *al*., 2019)
- Any cultural practices that facilitate air movement and drying of leaves will reduce disease severity(Napier,2012).

III.1.4.Garlic Rust (Puccinia alli)

III.1.4.1. Etiology

Garlic Rust is a fungal disease caused by the fungus *Puccinia allii*, which causes limited damage to crops. It can affect the allium family of plants the worst affected being leeks, onions and chives but onions are also sometimes affected (Marks,2010).

III.1.4.2. Disease Cycle

Rust is an obligate parasite; that is, it can only survive on living plant tissue. It's also autoecious, which means it completes its entire lifecycle on a single host. So while it feeds on its host, it does not kill it (the infected crop). It merely reduces plant vigor.Rust completes several cycles of spore production in one growing season, and can either overwinter on volunteer crops or produce dormant spores that survive the winter and wait for new hosts to infect (Anonym 02., 2024). When temperatures begin to rise in mid spring to early summer rust spores are released from infected living plants which land on other plants and infect them. The ideal temperature range for spore release and germination is 10°C to 20°C / 50°F to 68°C although it will still occur outside of these ranges. Spores are transferred by wind and rain drops.In early summer to late autumn,when the spores land on a suitable plant they germinate. Rust fungus then infects the new plant and begins to feed on it. The time between the spores infecting a plant and the visible signs of the infection appearing can be as short as a week but as long as a month. It all depends on the temperature and humidity levels. The infection easily spreads form one part of the plant to another (and to nearby plants) over the summer and autumn.In winter, as the temperature falls, the infection rate slows down, the fungus effectively overwinters on infected living plants, leeks especially because they are quite capable of living through winter and well into the next year (Marks,2010).

III.1.4.3.Symptoms

Symptoms *Puccinia alli* infects Garlic at bulb formation stage (Koike et *al*., 2001). Garlic rust is readily identified by the earliest symptom of small, circular to elongate white flecks that occur on both sides of leaves, as the disease progresses, these small spots expand, and the leaf tissue covering the lesions ruptures and masses of orange(Figure 20), powdery spores (uredospores) become visible as pustules (Worku, 2017). The pustules become full of

uredospores that spread the disease to plants by rain splash and wind currents. Severely infected leaves are almost entirely covered with pustules, resulting in extensive yellowing, wilting and premature drying of leaves. Teliospores, a second type of spores formed by Garlic rust fungus, later develop on the same leaves, resulting in black pustules (Koike et *al*., 2001). The earliest severe rust on Garlic and other Alliums can cause extensive loss of foliage and subsequent reduction in bulb size and quality. On infected Onion and chives, symptoms consist of small (less than 3.2 mm in diameter), white to tan spots. The orange pustules often form concentric groups on the spot periphery. Disease severity on Onion and chives is significantly less severe than on Garlic. Generally, this Garlic rust can cover entire leaves, causing them to die (Tahir et *al*., 2006).

Figure 21. Garlic rust symptoms(Anonym 02, 2024).

III.1.4.4. Management

- Plant seeds in well drained soils.
- Use of resistant/tolerant garlic varieties with supplementation of appropriate and compatible fungicides (Malik et *al*., 2017).
- Avoid excess nitrogen fertilizers
- Decreasing plant population
- Crop rotation,
- Removal and burning of crop debris and eradication of weed hosts help in reducing the inoculum potential for subsequent plantings of susceptible crops (Agrios, 2005).

III.2. Bacterial disease

III.2.1. Café au lait disease

III.2.1.1.Etiology

The causal agent of this disease was initially assigned to biovar I of *Pseudomonas fluorescens* (Calzolari and Bazzi 1985) and more recently Gardan et *al*. (2002) showed that it belongs to a new species, *P. salomonii*. This bacteria attacks the foliage mainly in humid weather up to the base of the bulb. This disease is favored by mild and humid springs, storms and strong day/night temperature variations. Rainy climatic conditions and waterlogged soils are also favorable to its development(Carretier, 2018).

III.2.1.2.Symptoms

Diseased plants develop lesions at the base of leaf blades followed by yellowing and wilting of the leaf (figure 22), These characteristic symptoms most frequently appear on internal leaves(Samson, 1982). In addition to aerial leaf symptoms, papery leaves of bulbs become torn and dark brown(figure 22). Brown soft rot of the pseudostem and total decay of plants are rare (Jacques et *al*., 2000).

Figure 22. Café au lait disease (Carretier, 2016).

III.2.1.3. Management

- Favor long rotations,
- Use healthy semen free of symptoms,
- Avoid early planting,
- Carry out subsoiling before cultivation,
- Favor plots that are drained and dry well,
- Avoid planting in too humid soil,
- Rationalize fertilization and irrigation (Carretier, 2018).

III.3. Viral disease

More than eight viruses were detected in garlic, including Potyviruses, Carlaviruses and Allexiviruses, which are often found in viral complex that causes diseases known as garlic mosaic (Van Dijk, 1993; Dovas and Volvas, 2003). Among them, the economically most significant ones is Onion yellow dwarf virus (OYDV).

III.3.1. Onion yellow dwarf virus (Onion Yellow Dwarf) of garlic

III.3.1.1. Etiology

Reduced seed production in onion and galric is associated with Onion yellow dwarf Virus (OYDV), a filamentous Potyvirus (Kumare et *al*., 2006) Onion yellow dwarf virus (OYDV) is a plant virus in the genus Potyvirus that has been identified worldwide and mainly infects species of Allium such as onion, garlic, and leek (Abraham et *al*., 2019)

III.3.1.2. Symptoms

On garlic, the virus causes the appearance of a dashed mosaic on the leaves (figure 23), as soon as the bulbs begin to grow, which gets worse with the growth of the plant. Symptoms are more or less severe depending on the variety, incubation conditions, physiological state of the plant and virus strain. In general, the diseased plant has weaker growth. In extreme cases, leaf deformations can be observed: flattened and twisted foliage.

Figure 23.Onion yellow dwarf virus symptoms in garlic leaves (yellowing mosaic) (Araújo et *al*., 2023)

III.3.1.3.Management

There is no method of curative control against viruses, once the plants are infected. Control mainly involves the use of seeds certified. The regulation of certified plants guarantees seeds free from viral diseases of the order of 99% at least. However, this concerns viruses primary, and not secondary viruses which can occur during cultivation (Carretier, 2018).

PRACTICAL PART

Chapiter I
Materiel and Methods

Chapiter I

Materiel and Methods

I.1. Geographical location of the study region

The wilaya of El Oued (figure 24) is located in the southeast of Algeria, to an area of 44586.8 Km^2 by 10.87 ٪ of the original surface area at a distance of 650 km from the capital, northeast of the northern Sahara and 350 km west of Gabes (Tunisia) (NIDA, 2014).

According to Voisin (2004), it is limited by the following neighboring Wilayas (Figure 04):

• To the North-East via Tébessa

• To the North by Khenchla and Biskra

• To the North-West by Biskra

• To the west by Djelfa

• To the southwest and south by Ouargla

• To the East by the Tunisian Republic

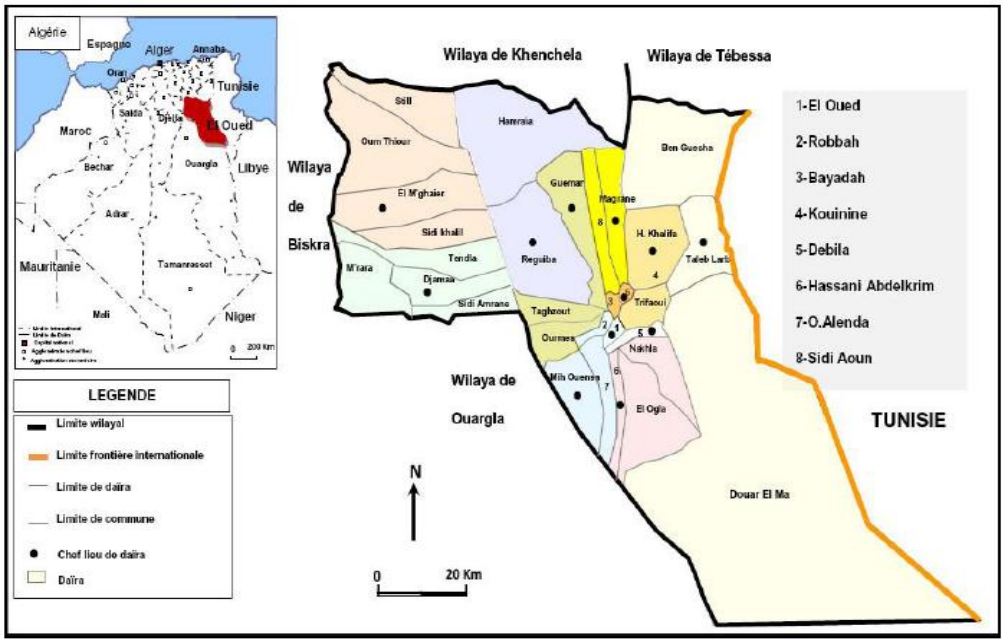

Figure 24. Geographical location of the study region (Medarag et *al*., 2009).

I.2.Climatic factors

The region's climate is Saharan, characterized by a hot and dry summer where the temperature can reach 35°C and a mild winter. The main climatic constraints remain the regular frequency of winds and their violence known as Sirocco as well as sandstorms during spring (Arami, 2008).

I I.2.1.Temperature

The table below shows the average annual, maximum and minimum temperature temperatures of the El-Oued region during the period (2012-2023)

Table 05. Average temperatures in the El-Oued region during the period (2012-2023) (ASD of El Oued, 2024)

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Tm(°C)	22,9	22,7	23,3	22,5	23,3	22,5	23,0	23,0	23,1	23,7	23,5	23,3
TM(°C)	29.9	29,6	30,3	29,4	30,1	28,8	29,5	29,5	29,4	29,8	30,1	29,7
Tm(°C)	15,6	15,8	16,5	15,6	16,4	15,9	16,5	16,2	16,2	17,1	16,9	16,7

T Average annual temperature

TM Average annual maximum temperature

Tm Average annual minimum temperature

El Oued region is characterized by an average annual temperature which oscillates between 22,5 – 23,7°C. the Average annual maximum temperature (30,1C°) is registered during the years 2016 and 2022. The Average annual minimum temperature (15,6C°) is registered during the years 2012 and 2015.

I.2.2.Precipitation

The annual distribution of average annual rainfall during the period (2012-2023) is shown in table 06.

Table 06. Average precipitation in the El-Oued region during during the period (2012-2022)(ASD of El Oued, 2024)

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
P(mm)	23,62	32,27	26,67	50,04	-	-	-	-	28,95	27,43	20,08	29,71

Precipitation is between 20.08 and 50.04mm. 2015 is the rainiest year with an average of 50.04mm mm. While the driest year is 2022 with an average value of 20.08 mm.

I.2.4.Wind

The average annual wind speeds during the period (2012-2023) are recorded in table 07

Table 07. Average wind annual speed in the El-Oued region during the period (2012-2023 (ASD of El Oued, 2024)

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
W(m/s)	0	8.2	0	3.6	9.2	11.06	12.4	12.2	11.4	12.2	11.5	11.4

Table 06 shows that winds are frequent throughout the period (2012-2023). The highest speeds are recorded during 2018 with an average of 12.2m/s.

I.3. Objectif

Garlic is susceptible to many pests and diseases which contribute to hight losses in yields. Given the scarcity of documentation devoted to phytopathology in the region, we are interested in this work in the inventory of the main pests and diseases affecting garlic crops.

The study is an attempt to document the actual field pests and diseases situation of garlics with the aim that results obtained can be depended on to develop appropriate control measures. The objectives of the study were to determine the major pests and diseases of garlics and document farmers' knowledge of these diseases and their control measures in six municipalities: El Oued, Guemar, Trifaoui, Hassani Abdelkerim, Magrane,Tagzout of El Oued region. The survey was carried out during the period from february to may 2024.

I.4.Materiel

The information was collected through a questionnaire

I.5.Method

I.5.1. Study period

This survey was carried out during the period from february to may 2024covering the following municipalities: El Oued, Guemar, Trifaoui, Hassani Abdelkerim, Magrane,Tagzout

I.5.2. Type of study

This is a descriptive, cross-sectional study.

I.5.3. Study population

The study population is made up of garlic farmers from the municipalities concerned by this study.

I.5.4. Data collection methods

The survey was carried out through direct meetings with farmers. We fill out the questionnaire ourselves.

I.5.5. Organization of the questionnaire

The questionnaires are prepared in an easy way in order to collect as much information as possible on pests and diseases that affect garlic cultivation in our region; The questionnaire included several questions divided into 5 sections:

- Information on the study population.
- Identify the characteristics of culture of garlic.
- Determine technical field works
- Identifying garlic pests, their effects and factors that contribute to its emergence
- Identifying garlic diseases, their symptoms and factors that contribute to its spread

- Evaluate farmer knowledge of the risks associated with use of pesticides

I.6. Statistical analyzes

All data collected was entered into a Microsoft Excel file. Data processing was restricted to descriptive statistical analysis.

Chapiter II
Results and Discussion

Chapitre II : Reults and discussion

II.1. Results

Our survey, carried out in a way to cover a few subdivisions, allowed us to have a lot of information on fungal diseases in farms in the wilaya of Oued Souf and the use of fongicides. We were able to recover 36 copies from the farmers, or 100%. The responses obtained for each of the targeted parameters are reported and/or presented in the form of graphs or tables.

II.1.1. Population characteristics

II.1.1.1. Gender

The distribution of participating individuals in this study according to their age is illustrated in Figure 25.

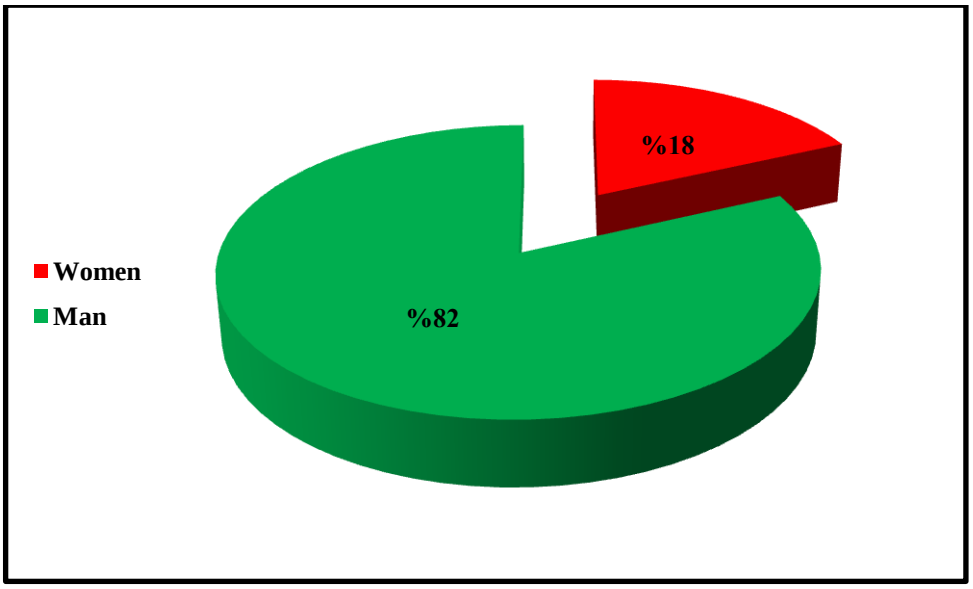

Figure 25. Distribution of the study population by gender

Among the 33 respondents, there were 82% men and 18% women.

II.1.1.2. Age

The distribution of farmers in this study by age is illustrated in Figure 24.

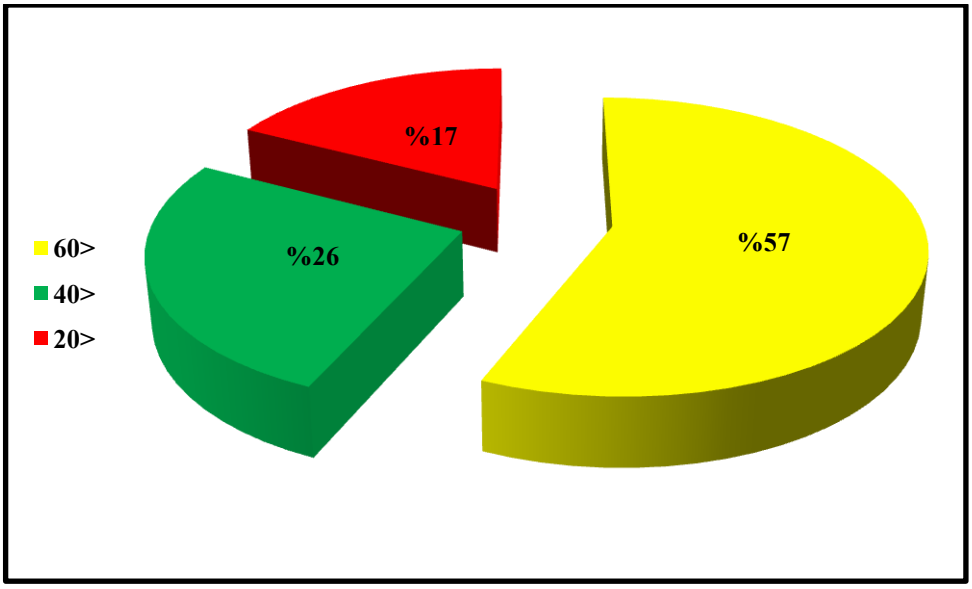

Figure 26. Distribution of farmers according to their age

48% of farmers in this study were ≤40 years old. Nearly 42 % of people were ≤60 years old. Whereas, 10% of participating individuals were ≤20 years old.

II.1.1.3. Educational level

The educational level of farmers is illustrated in Figure 27.

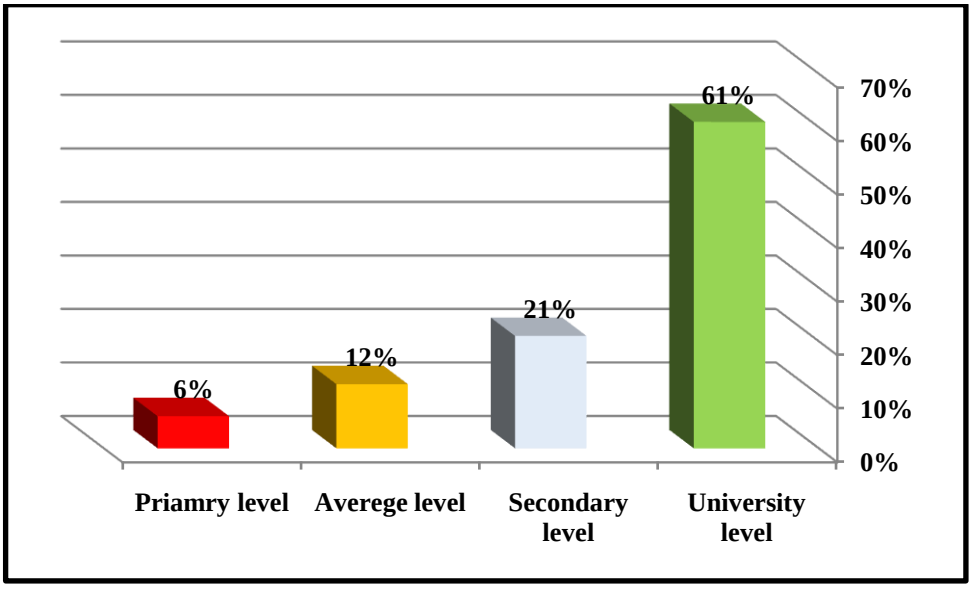

Figure 27. Distribution of farmers according to their educational level

39% of the farmers surveyed had a University level followed by people with average level level and a secondary level with respective rates of 21 % and 12 %.

II.1.1.4. Municipality

Figure 28 represents the distribution of questionnaires according to municipality.

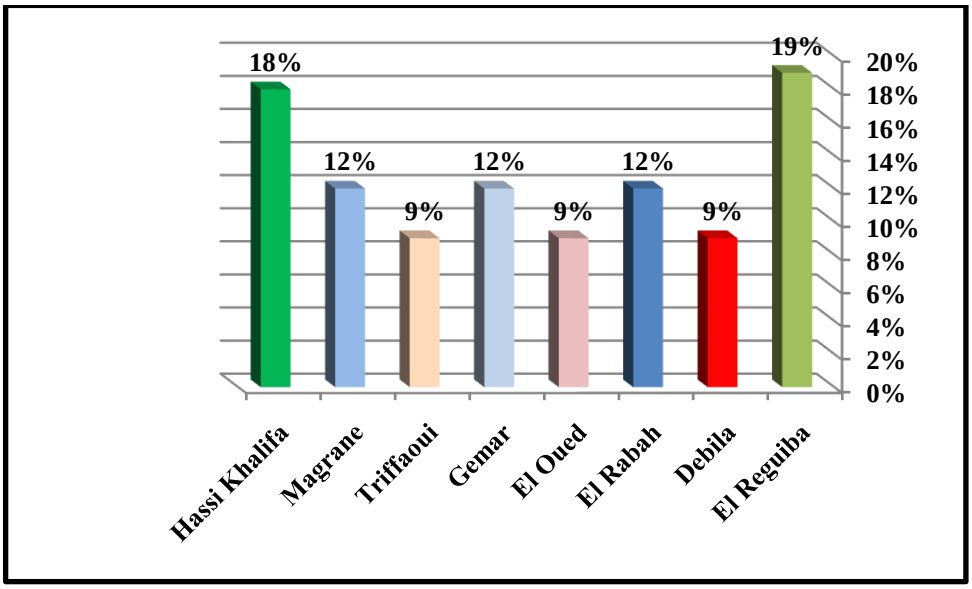

Figure 28. Distribution of questionnaires according to municipality

The study population was distributed among the municipalities as follows: 6 in Hassi Khalifa, 4 in Magrane, 3 in Triffaoui, 4 in Gemar, 3 in El Oued, 4 in El Rabah, 3 in Debila and 6 in El Reguiba. By giving respective percentages of: 18%, 12%,9%, 12%, 9%, 12%, 9% and 19%.

II.1.2.Characteristics of culture

II.1.2.1. Total area

The total areas of the interviewed farmers are shown in Figure 29.

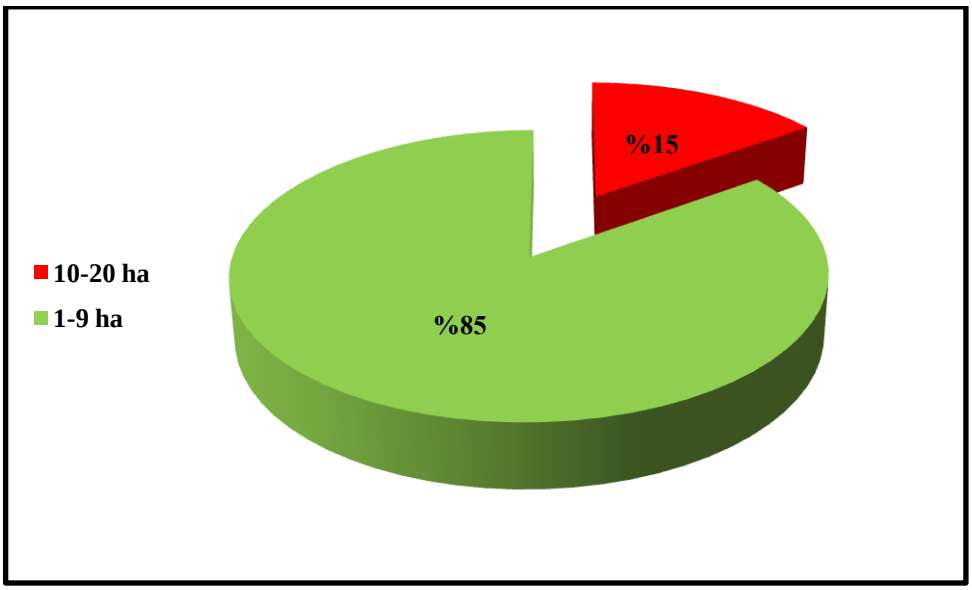

Figure 29. Total land surface of the farmers

According to Figure 11, the majority of individuals questioned (85%) having a surface area between 1-9He while 15% of them have less than 5He between10-20He.

II.1.2.2. Cultivated area of garlic

Figure 30 represents the cultivated area of the farmers interviewed

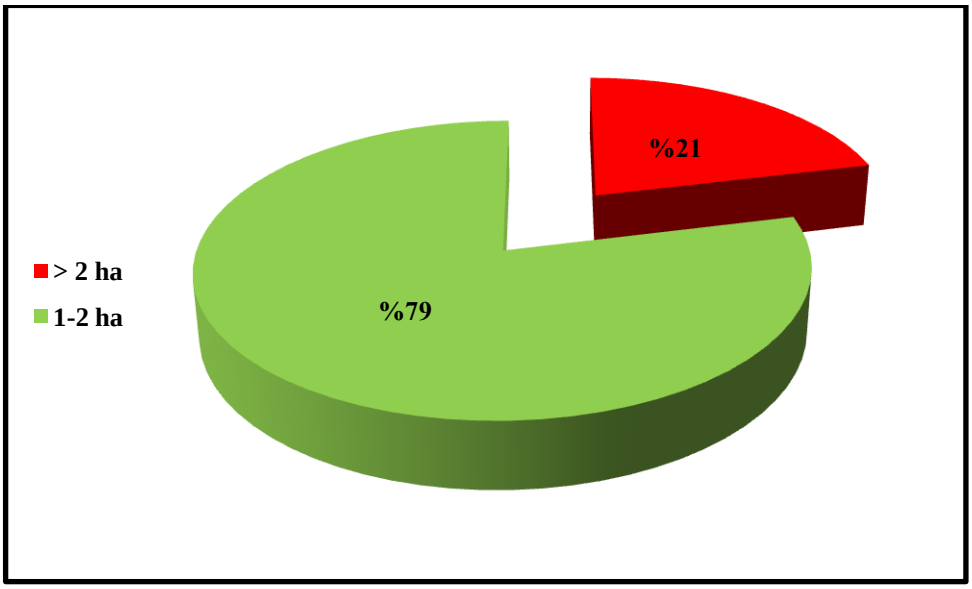

Figure 30. Cultivated Area surface of garlic

79% of farmers surveyed have cultivated an area between 1-2 He of garlic while 21% of them have cultivated more than 2 He of garlic.

II.1.2.3. Purposes of growing garlic

Figure 31, represents the distribution of purpose of growing garlic among the interviewed farmers

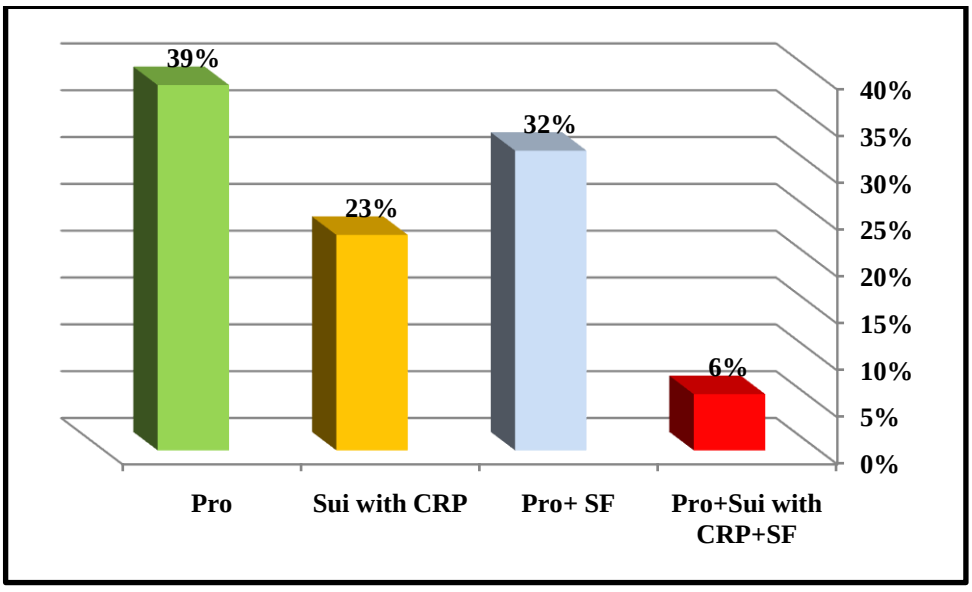

Figure 31. Purposes of growing garlic

39% of the farmers confirmed that they grow garlic because it the cultivation of garlic is profitable. Whereas, 32% of them suggest they grow garlic because it is profitable and the soil is favorable for their cultivation. 23% reported that the cultivation of garlic is suitable with the agricultural rotation of potatoe; while 6% of them confirmed that the cultivation of garlic

is profitable + suitable with the agricultural rotation of potatoe+ soil is favorable for their cultivation**.**

II.1.2.4. Irrigation source

Figure 32 illustrate the irrigation source used by farmers in this study

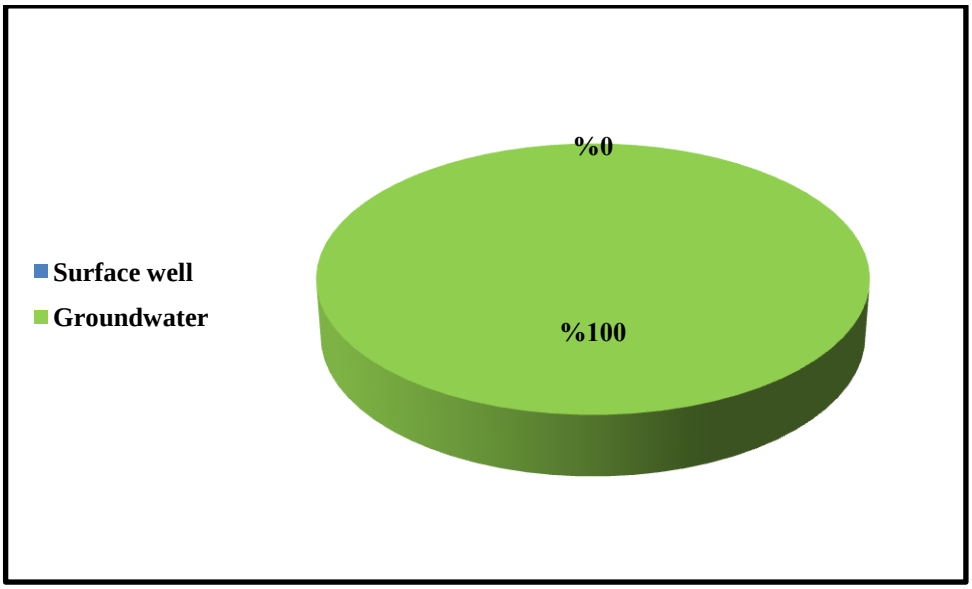

Figure 32. Irrigation source

All farmers interviewed use groundwater for irrigation

II.1.2.5. Irrigation method

Irrigation method used by farmers is represented in the following figure:

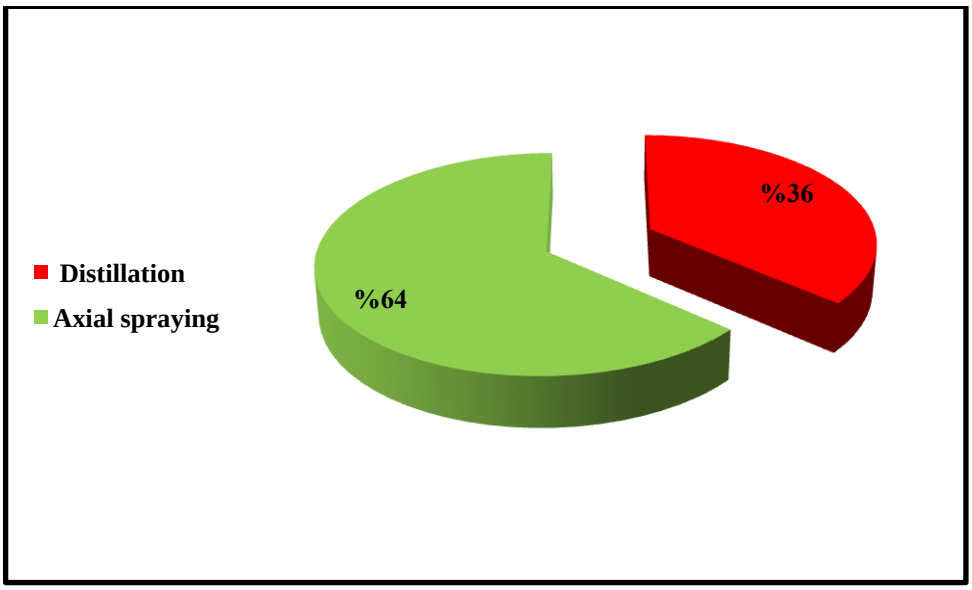

Figure 33. Irrigation method

The results show that more than half (64%) of farmers practice axial spraying while 36% of them practice distillation.

II.1.2.6. Agricultural cycle

Farmers' responses regarding the agricultural cycle are demonstrated in Figure 34.

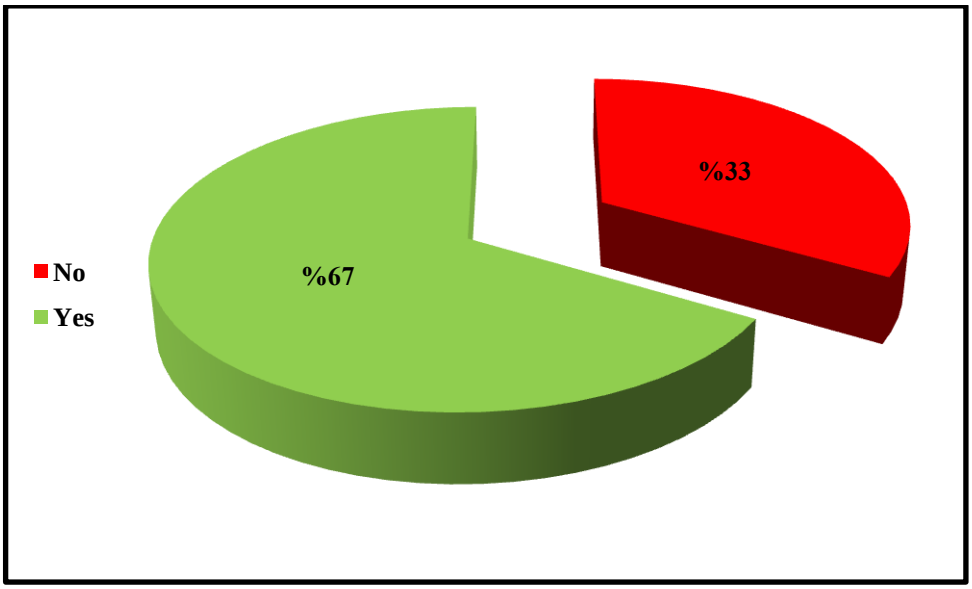

Figure 34. Follow of agricultural cycle

87% of farmers survived, practicing the agricultural cycle where 33% of them do not practice an agricultural cycle.

II.1.3. Technical field works

II.1.3.1. Tilling of the soil

The responses obtained regarding the tilling of the soil are shown in figure 35.

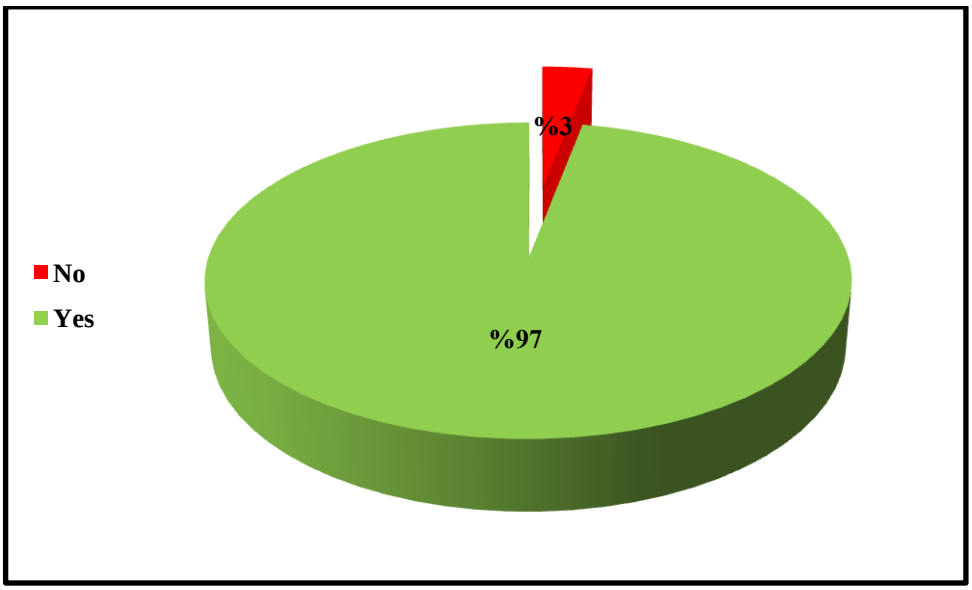

Figure 35. Tilling of the soil

The results show that 97% of farmers declare that they plow their soil. On the other hand, 3% of them declare that they do not plow their land.

II.1.3.2. Type of tillage

The answers regarding the time of tillage are shown in figure 36.

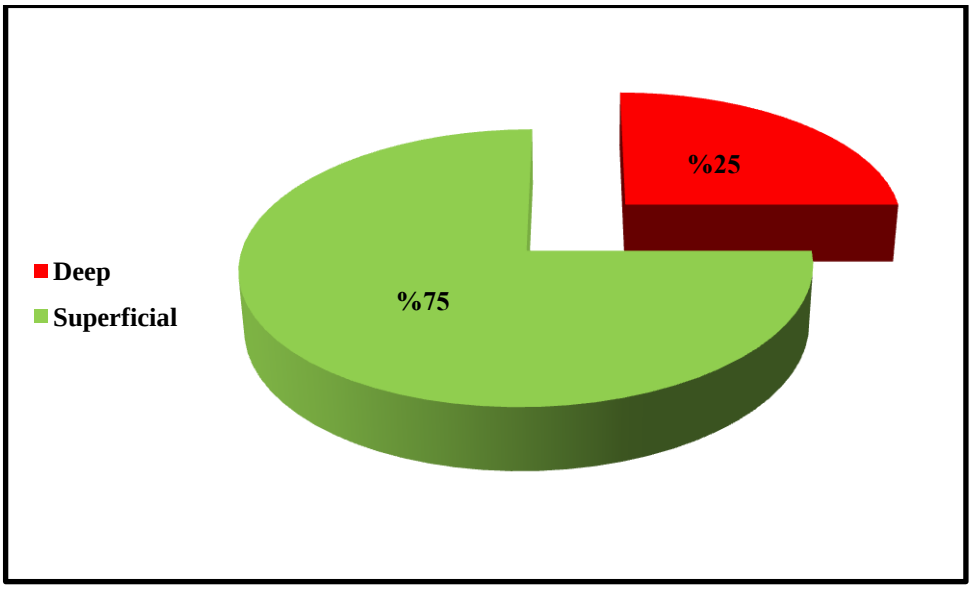

Figure 36. Type of tillage

The results show that more than 75% of farmers practice superficial tilling but 25% of them practice deep tilling.

II.1.3.3. Time of tillage

Figure 37 shows the type of tillage practiced by farmers participating in this study

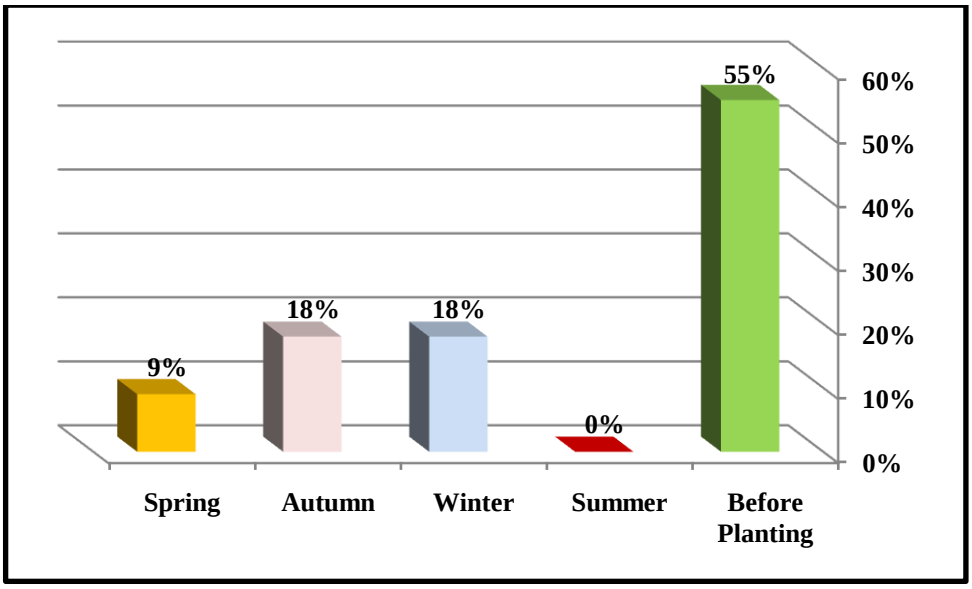

Figure 37. Time of tillage

The results show that, farmers plow at the following times; before Planting, Winter, Autumn and Spring at the respective rates of 58%, 18%, 18% and 9%.

II.1.3.4. Fertilization

Farmers' responses regarding the fertilization of their area are shown in the figure below:

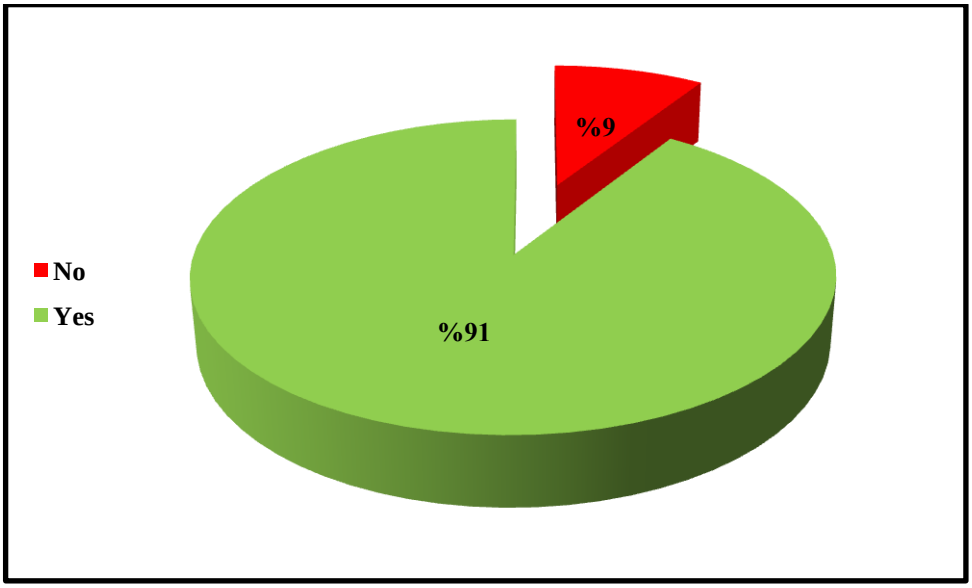

Figure 38. Fertilization

Most of farmers (91%), are fertilizing their land.But, only 9% of them do not fertilise their land.

II.1.3.5. Fertilization type

Fertilization type is illustrated in the following figure.

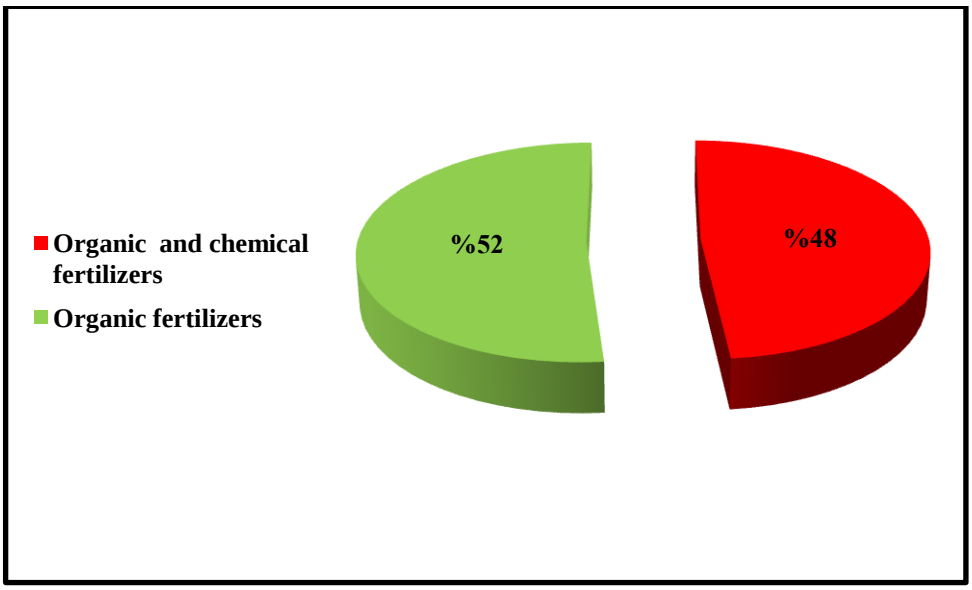

Figure 39. Fertilization type

According to the results obtained, 52% of farmers use in the fertilization process organic fertilizers. While 48% of them use organic and chemical fertilizers in addition to chemical fertilizers.

II.1.3.6. Fertilization time

Figure 40 shows the time of fertilization according to the farmers.

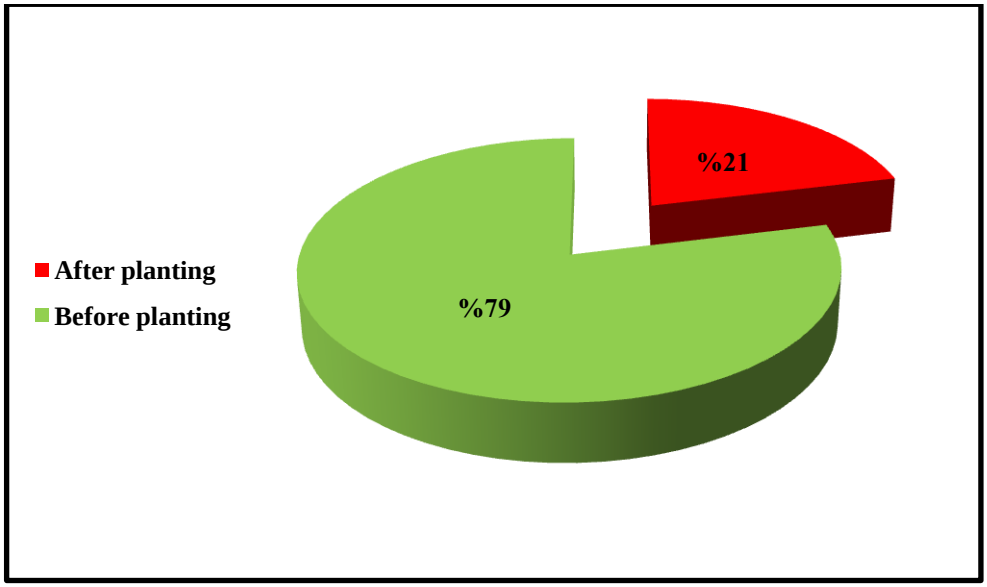

Figure 40. Fertilization time

79% of farmers fertilize their lands before planting. While, 21% of them fertilize their lands after planting.

II.1.3.7. Type of sowing

Type of sowing used in our study is illustrated in the following figure.

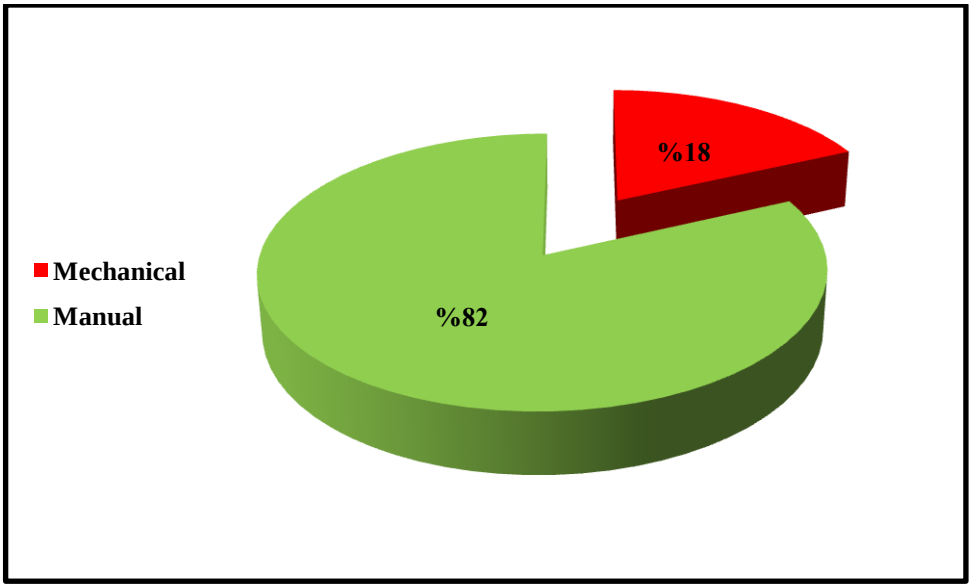

Figure 41. Sowing type used

The most of farmers (82%) sowing their lands manually.

II.1.3.8. Harvest type

Figure 42 shows the harvest type used by farmers in this study

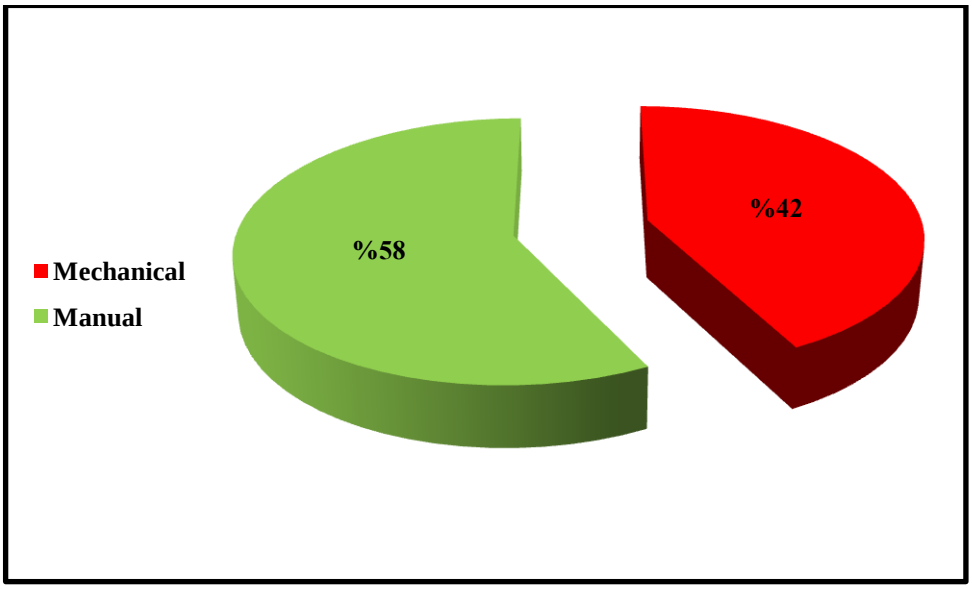

Figure 42. Harvest type used

More than half of farmers interviewed (58%) practice manual harvest. Wheras 42% of them use the mechanical harvest.

II.1.3.9.Use of herbicides

Figure 43 shows the herbicide use according to the farmers' responses

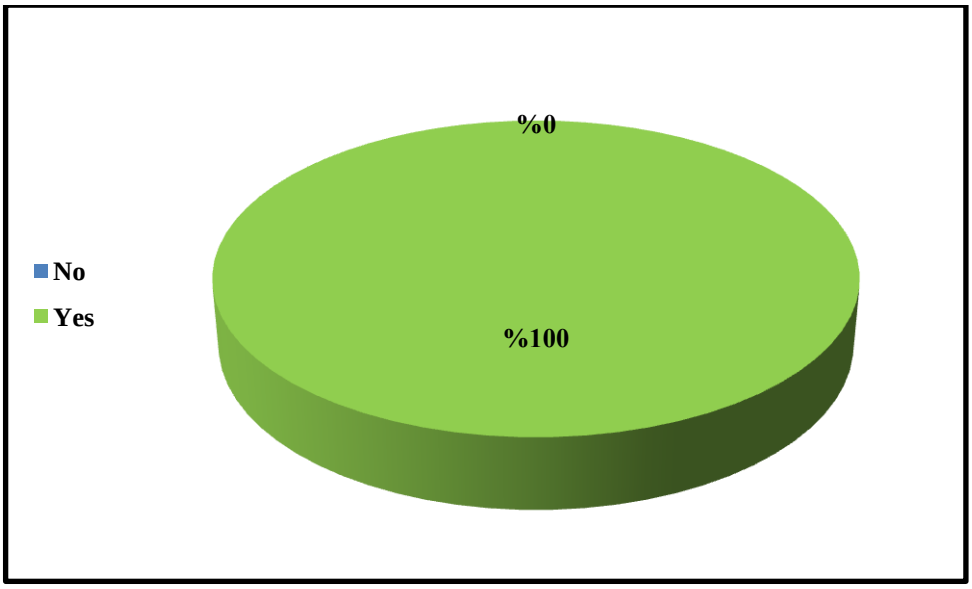

Figure 43. Herbicides use

The results show that all (100%) of farmers use herbicide.

II.1.4. Pests of garlic

II.1.4.1. Main Pests affecting garlic cultivation

Pests affecting garlic cultivation in our study are represented in the following figure:

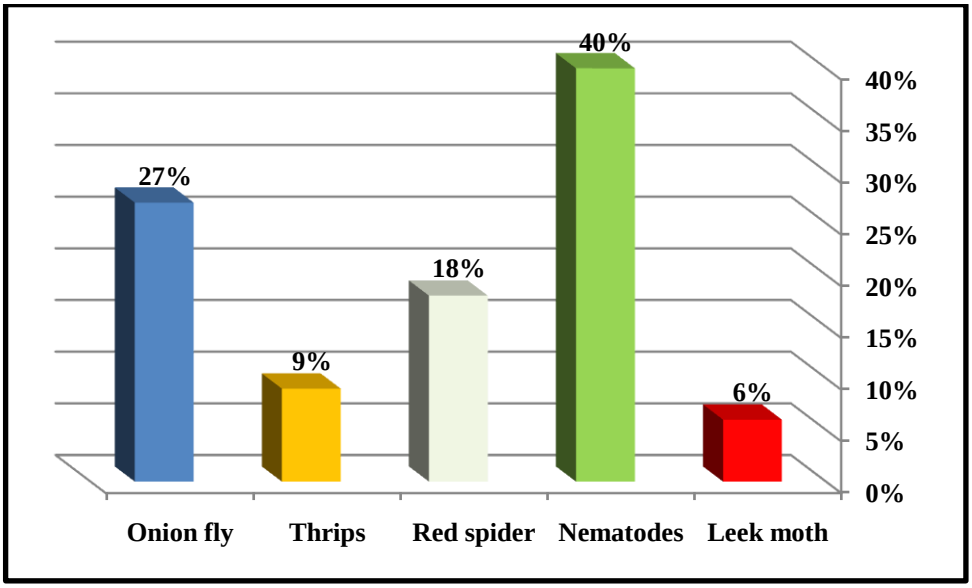

Figure 44. Pests affecting garlic cultivation.

According to figure 44 the most frequently observed pests by farmers in our study are: nematodes, onion fly, red spider, thrips and leek moth with respective percentages of the order of 40%, 27%, 18% , 9% and 6%.

II.1.4.2. Favorable conditions

Figure 45 shows the most important factors that contribute to the emergence of pests.

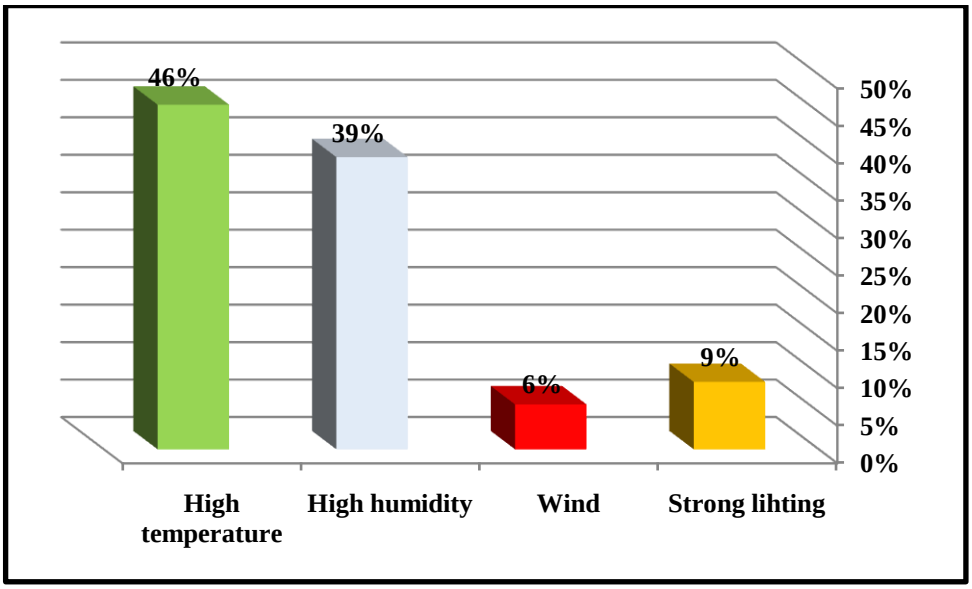

Figure 45. Favorable conditions for the emergence of pests of garlic

The results show that, 46% of farmers report that high temperature is the most cause of the emergence of pests in garlic crops followed by high humidity, wind and strong lihting with respective percentages of the order of 39%, 9% and 6%.

II.1.4.3. Type of insecticide used

Table 08 summarizes insecticide used by farmers, their commercial name and their dose per hectare

Table 08.Insecticide used by farmers.

Active substance	Trade Name	The ratio	Quantity per hectare	stage
Thiamethoxame + de Lambda-cyhalothrine	ANGEO	33%	h /50ml- 400ml 500ml/600ml	Suitable at all times of cultivation
Lambda-cyhalothrine pyrimicarbe +acetamipride	LAZAR, RUSTILAN	27%	500ml/600ml/he	Suitable at all times of cultivation
Amidachlorprid +Lambda-Cyhalothrine	MATADOR, COMMANDO, KARTEKA	20%	0,5 l/he/0.75 l/he	Not recommended during flowering period
Thiamethoxam + Abamectin	ABAMECTIN, VERLAN, VERTIMEC Actara, EL-TORO	13%	0,5 l/he/0.75 l/he	Suitable at all times of cultivation
Midacloprid + Deltaméthrine	MIDACLOPRID + DECIS	7%	1 l /he	Suitable at all times of cultivation

According to the table, Thiamethoxame + de Lambda-cyhalothrine is the insecticide most used by the farmers surveyed with a percentage of 33% followed by Lambda-cyhalothrine pyrimicarbe +acetamipride with a percentage of 27% and to a lesser extent other insecticide such as Amidachlorprid + Thiamethoxam + Abamectin, Midacloprid + Deltaméthrine , with percentages of 20%,13% and 7%.

II.1.5. Main diseases of garlic

The main diseases that affected garlic crops according to the farmer are illastrated in the figure 46.

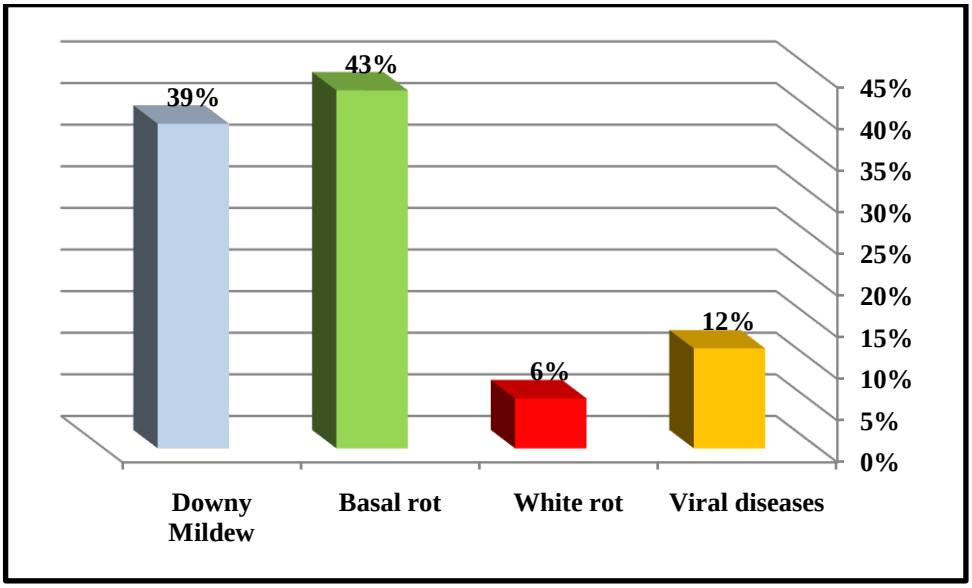

Figure 46. Main diseases that affected garlic crops

The results show that the main diseases of garlic most frequently observed in our study are: Basal Rot, Downy Mildew, Viral diseases and White rot with respective percentages of the order of 43%, 39% ,12% and 6%.

II.1.5.2. Symptoms

The distribution of disease symptoms according to the farmers interviewed is illustrated in the figure below.

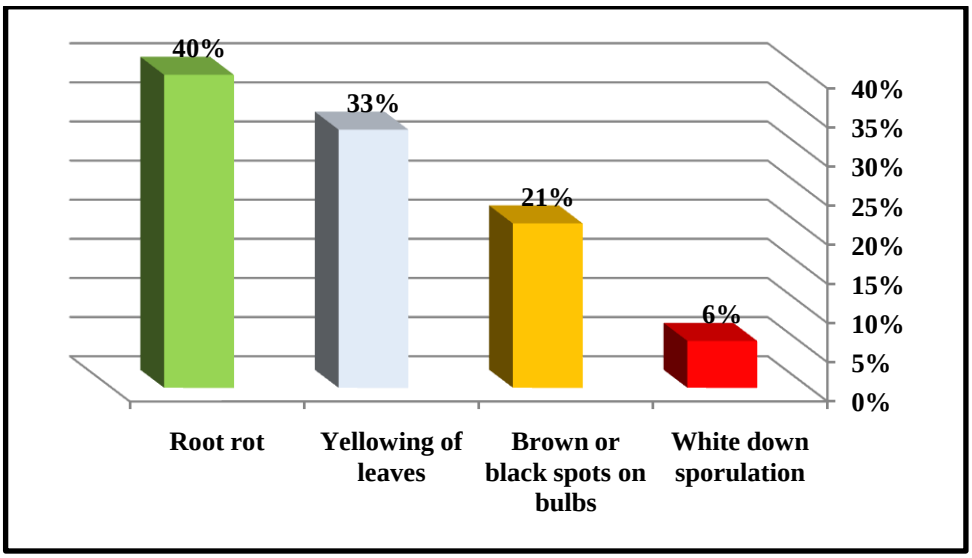

Figure 47. Distribution of farmers' responses according to the nature of the symptoms

The most common symptoms are : root rot, yellowing of leaves, brown or black spot on bulbs and white white down sporulation with respective percentages of 40%, 33%, 21% and 6%.

II.1.5.3. Favorable conditions

Figure 48 shows the most important factors that contribute to spread of disease of gralic

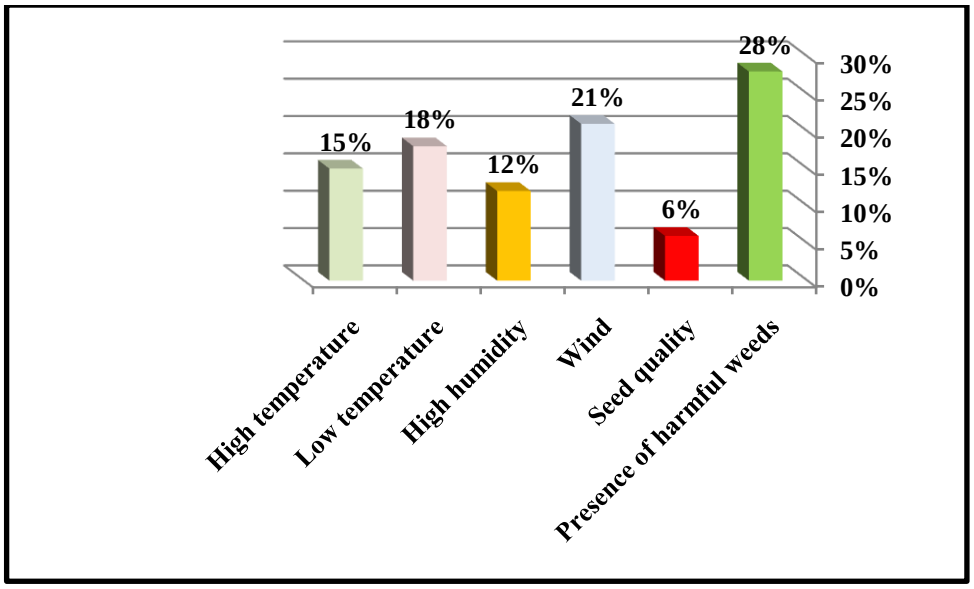

Figure 48. Favorable conditions for spread of disease of garlic.

According to figure 48 , 46% of farmers report that presence of harmful weeds is the most cause of the spread of disease in garlic crops followed by wind, low temperature, high temperature, high humidity and seed quality with respective percentages of the order of 28%, 21%, 18%, 15%, 12% and 6%.

II.1.5.4. Types of pesticides used

Table 09 summarizes pesticide used by farmers, their commercial name and their dose per hectare.

Table 09. Pesticides used by farmers.

Active substance	Trade Name	The ratio	Quantity per hectare	Efficiency
Difenoconazole.	SCOR®	40%	200ml/he	+++
Azoxystrobin and Difenoconazole	AMISTAR TOP®	30%	200ml/he	+++
Boscalid + Pyraclostrobine	BELLIS®	20%	200ml/He	+++
Thiophanate –Methyl	PELTHIO ®	10%	1kg/he	++

According to table 09, Difenoconazole, Azoxystrobin and Difenoconazole and Boscalid + Pyraclostrobine are the most used pesticides with respective rates of: 40%, 30% and 20% .

II.1.6. Storage and preservation

II.1.6.1. Drying place

Figure 49 shows the drying place of garlic according to the farmers

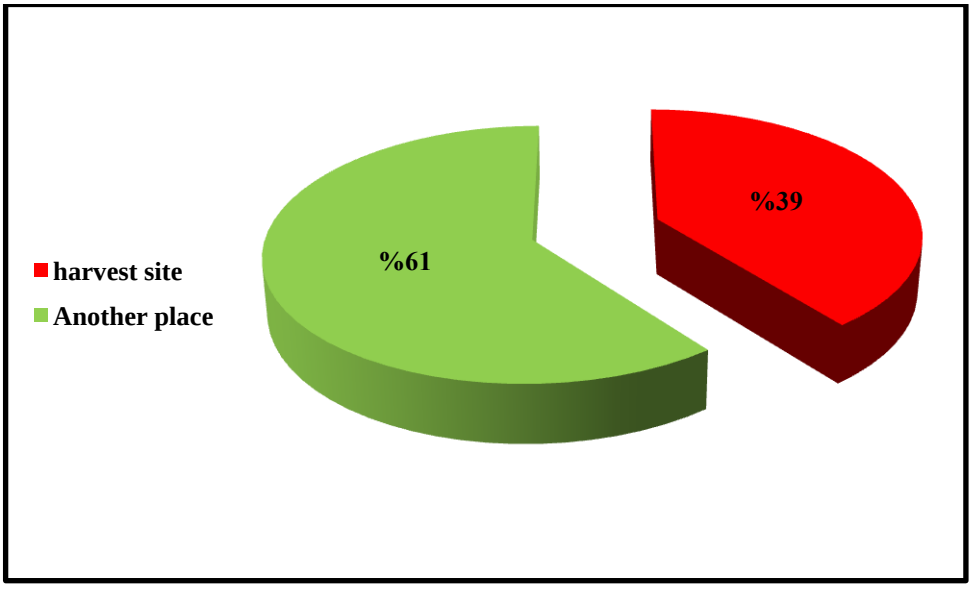

Figure 49. Drying place of garlic

According to the results obtained, 61% of farmers dry garlic in locations other than the harvest site. While 39% of them drying it at the harvest site.

II.1.6.2. Storage equipment

Farmers' responses regarding the storage equipment are illustrated in figure 50.

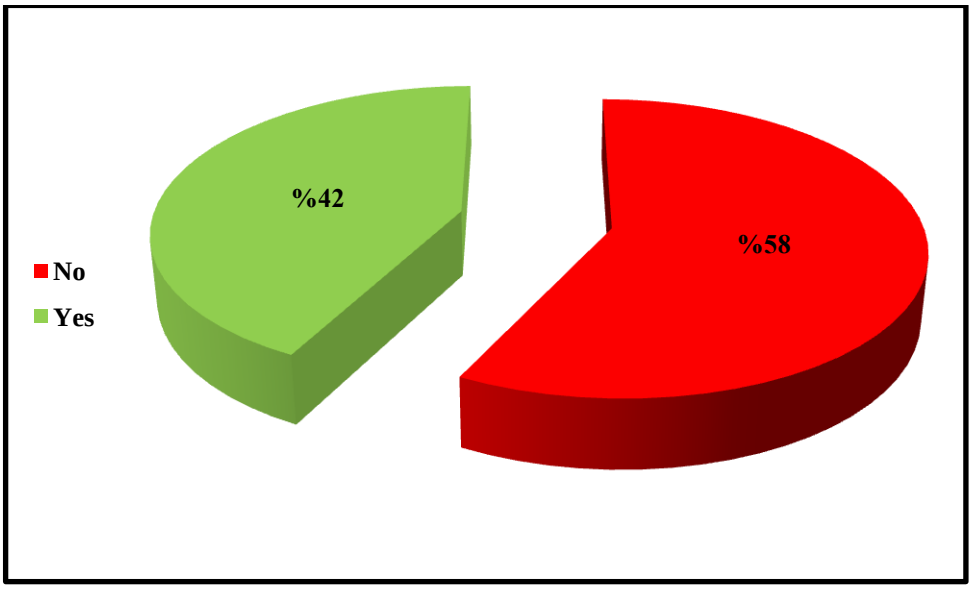

Figure 50. Storage equipment of garlic

The results show that more than half (58%) of farmers do not have equipment to store garlic.While 42% of them have storage equipment.

II.1.7. Use of pesticides

II.1.7.1. Methods of using pesticides

A. Use protective clothing while spraying

Figure 51 shows the use protective clothing while spraying .

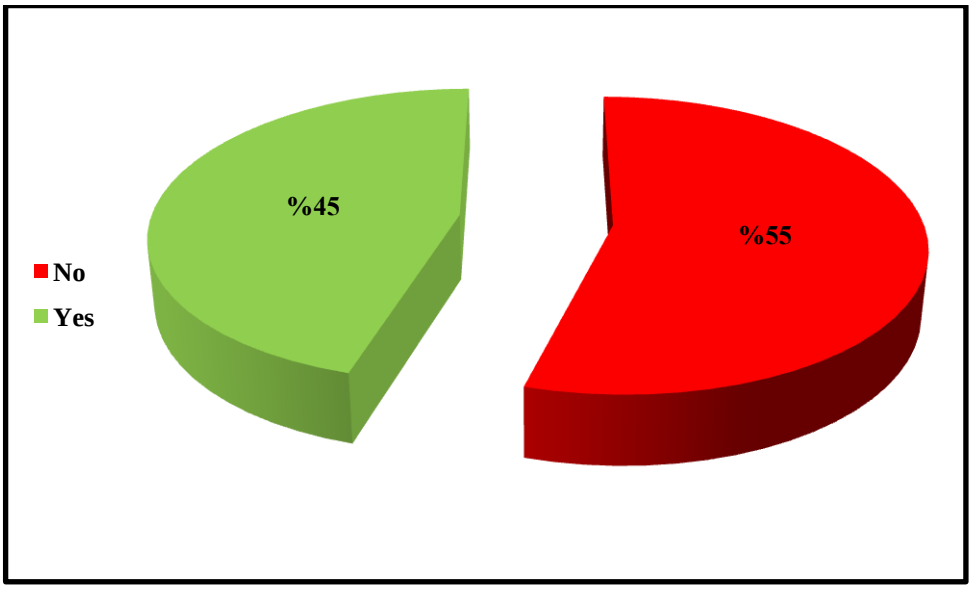

Figure 51. Use protective clothing

55% of farmers use protective clothing. While 45% of them do not use protective clothing.

B. Compliance with the recommended amount of pesticide

The compliance with the recommended amount of pesticide is shown in Figure 52.

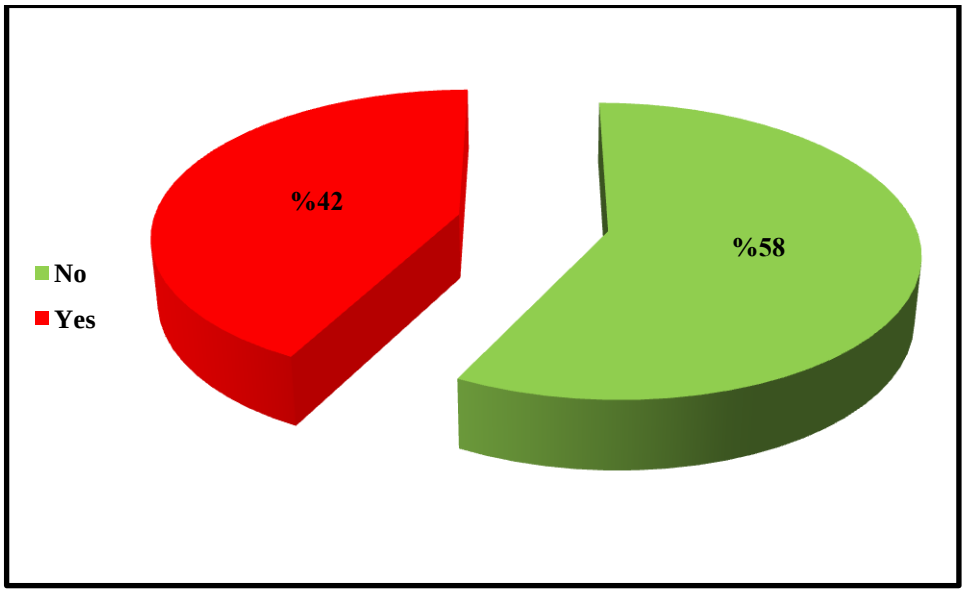

Figure 52. Compliance with the recommended amount of pesticide

58% of farmers report that they do not exceed the recommended amount of pesticide. While, , 42% of them report that they exceed the recommended amount of pesticide.

C. Management of packaging of pesticide used

The management of packaging of pesticide used is illustrated in figure below

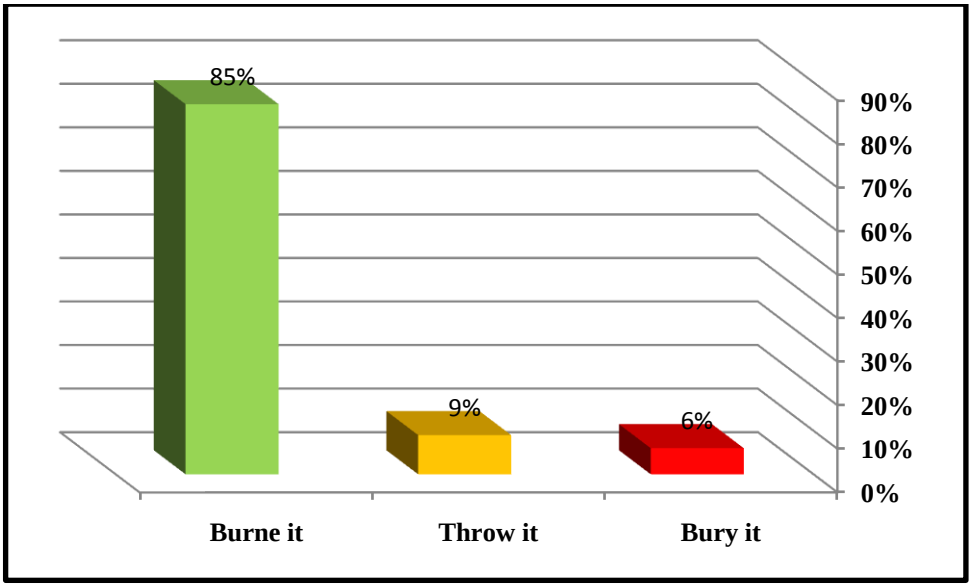

Figure 53. Management of packaging of pesticide used

The results show that 85% of farmer burne the packaging and 9 % of them throw it in the trash. But, 6% of farmer bury empty packaging.

D. Safety period

figure 54 shows the safety period of pesticide.

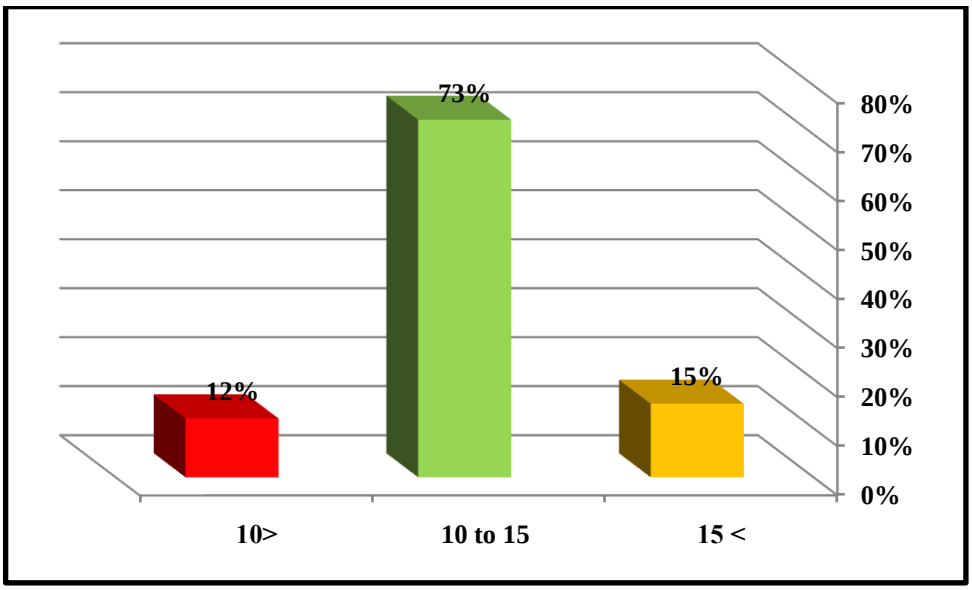

Figure 54. Safety period

73% of farmers applied a safety period of 10 to 15 days between the last application of pesticides and the harvest; 15% of farmers harvest garlic after 15 days and 12% of them applied a safety period of 10 days.

E. Training on the use of pesticides

Rates of training on the use of pesticides tillage is shown in figure 55.

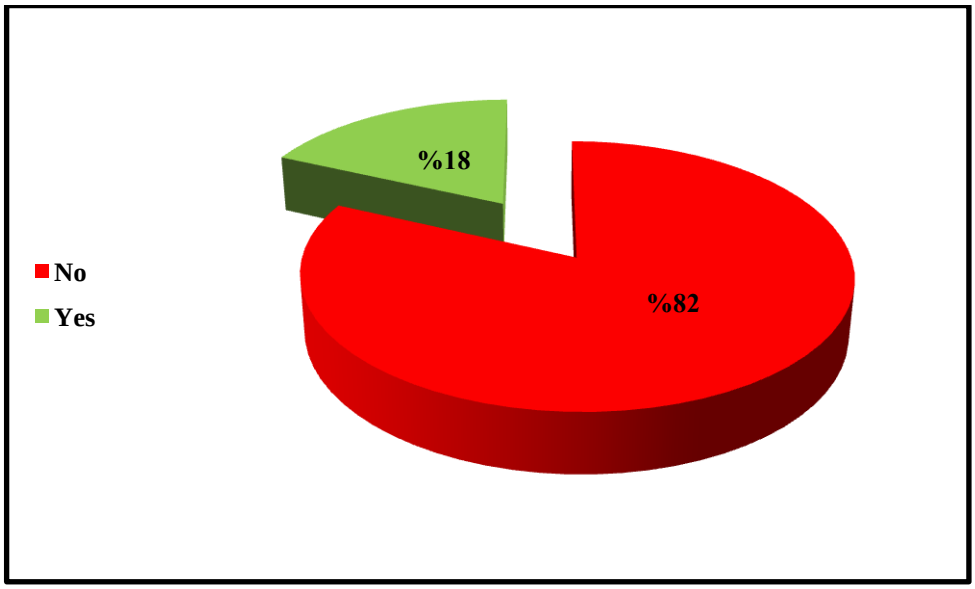

Figure 55. Training on the use of pesticides

According of farmers interviewed only 19% of them have received training on good pesticide practices. However, 87% have not received any type of training on good practice of pesticide.

II.2. Discussion

garlic (*Allium sativum* L.) is one of the most important commercial vegetable crops grown in algeria and being used as vegetables, spices or as medicines. . However, garlic crops is vulnerable to many insect pests and diseases, the most important of which are thrips, nematodes,downy mildew and basal rot. Theses insect pests and diseases can reduce yields of the crop significantly. the objectives of our study is to determine the major pests and diseases of garlics and document farmers' knowledge of these diseases and their control measures in El Oued region.

II.2.1. Population characteristics

Our results show that 82% of the study population are men. While, 18% of them are women. These results are in agreement with the results of Aouine and Mahmoudi (2022) who reported a predominance of the male sex with 100% in a descriptive study on the factors linked to the infestation of tomatoes by *Tuta absoluta* (Meyrick, 1917) in the region of El Oued. In fact, men are more inclined towards the agricultural profession, and agriculture in the valley is a source of livelihood for many young men. On the other hand, 48 % of the farmer participating in our study were $\leq$ 40 years old followed by the age group $\leq$60 years old with 42%.These results are comparable to the results of Gheraissa and Askri(2020) who reported that the age of farmers is between 20 and 65 years and over, when producers aged over 30 represent the majority of producers by a proportion of (80%) in an investigation into the tomato situation in the El-Oued region. This could be explained by the fact that the subjects in this age group are the most active and the agriculture requires muscular effort and great efficiency. Farmer in this study have different educational levels ranging from average to university with the predominance of the university and secondary level. Since agriculture has developed in the region and become a profitable field, we find many educated people investing in the agricultural field.

II.1.2.Characteristics of culture

The total areas of the farms surveyed are different sizes, thus the areas of garlic cultivated are moderately low. Whereas, 79% of farmers surveyed have cultivated an area between 1-2 He of garlic. in fact, garlic crops are less profitable than potato crops and most farmers grow it as a secondary crop with potato.

The reasons for growing garlic in our study varied, including that it is profitable and that the soil is suitable for its cultivation. These results are in agreement with the results of Mahdi (2020) who reported that the practice of garlic cultivation by farmers in the region of M'sila is for a subsistence purpose associated with profit (40%) and some for a profit purpose only

27%. A rate of 23% of the farmers surveyed are mainly motivated by the quality of their soil which is favorable for growing garlic. All farmers interviewed use groundwater for irrigation. This is due to the nature of the region, which is characterized by an abundance of groundwater. On the other hand, the most of farmers survived, practicing the agricultural cycle. The objective of the rotations is to avoid the accumulation in the soil of spores of phytopathogenic agents and secondarily of pest larvae (Schröder et *al*., 2015).

II.1.3. Technical field works

The results show that almost all farmers declare that they plow their soil. These results are comparable to the results recorded by of Mahdi (2020) who reported that 70% of farms practice plowing before planting the crops. The process of preparing the ground before planting it is essential, to provide a suitable medium for plant roots, as it facilitates their passage in the soil, and provides properties that help the seeds absorb water and nutrients from the soil, and grow. Any pre-grown plants are removed, so that they do not deplete the nutrients. Preparation processes differ. The land depends on the region and crops, as it gives the plants better results when prepared in the correct ways (MARD,2020). The most of farmers in this study practice superficial tilling before planting. The aim of this technique is in fact to eliminate the weeds and most of all the residues of the previous crop. In this way it's possible to soften the soil and gradually prepare it for the next crop. On the other hand, our results showmore than half of farmers use in the fertilization process organic fertilizers and 48% of them use organic and chemical fertilizers in addition to chemical fertilizers. The use of organic fertilization has a great influence on improving garlic crop yields. While, using of chemical fertilizer increases soil fertility and compensates for the deficiency in the basic elements that contribute to the natural growth of plants. It also contributes to reducing the incidence of diseases in plants due to a lack of important soil elements. As for the method of harvesting, more than half of farmers interviewed practice manual harvest Wheras 42% of them use the mechanical harvest. However, Mahdi (2020) in his study reported that the harvesting technique is completely manual. In fact, manual harvesting is less expensive for farmers, while mechanical harvesting saves time and effort

II.1.4. Pests of garlic

Our results show that the most frequently observed pests by farmers in our study are: nematodes, onion fly, red spider, thrips and leek moth . The results of this survey are comparable to the results of Mahdi (2020) who reported that nematodes, onion fly, are the main pests recorded in the Msila region. Similarly, Trépanier et *al*.(2016) report that the onion thrips and the onion maggot are pests that can cause damage important to the crops of onions,

leeks, garlic and cabbages in Ontario. However, Boinahadji and Kebe (2020) in an investigation report on the recognition and management of insect pests of market garden crops by producers from the Niayes area found that Aphids and thrips are the two groups of insects cited by growers as onion pests. . These insects take refuge in senescing weeds found around fields and mowing is necessary to destroy their habitat (Dufresne, 2009). Indeed, several factors can be at the origin of pests , humidity, temperature, poor soil quality, vulnerability of certain varieties, etc. In general, all important life-cycle stages of pests (growth, maturation, and reproduction for insect pests, survival, reproduction, and dispersal for plant pathogens) are more or less directly influenced by humidity, temperature, light quantity or quality, wind, or combinations of these factors (Juroszek et al., 2020). Additionally, Brown and Gange (1990) report that several soil factors influence the development and survival of root pests: texture, compaction, pH, temperature, humidity and nutrients.

According to our results, Thiamethoxame + de Lambda-cyhalothrine is the insecticide most used followed by Lambda-cyhalothrine pyrimicarbe +acetamipride, however, Rahatlfoul and Cherif (2019) recorded that Deltamethrine is the insecticide most used for pests of vegetable crops in the regions of Adrar, , also Boinahadji and Kebe (2020) reported that organophosphates (29%) and pyrethroids (21%) are the main chemical families most used for the fight against pests of vegetable crops in the Niayes area. Indeed, there are multiple names on the market for products whose active ingredient or mode of action is the same. The choice of a insecticide is made according to their purchase price and their effectiveness.

II.1.5. Diseases of garlic

The results show that the main diseases of garlic most frequently observed in our study are: Basal Rot, Downy Mildew. The results of this survey are comparable to the results of Mahdi (2020) who reported that mildew and rust,white rot (sclerotinia) and fusarium wilt.are the main diseases recorded in the El Msila region for garlic crops, similarly, From different parts of the world, others studies suggested that downy mildew, rust, purple blotch; Stemphylium blight, basal rot, have been observed leading to substantial losses (Evarts and Lacy, 1990; Schwartz and Mohan, 1995; Apaza and Matos, 2000). On the other hand, According to our results presence of harmful weeds is the most cause of the spread of disease in garlic crops followed by wind, low temperature, high temperature and high humidity. Indeed, Pathogens that attack crops can often survive on suitable alternative weed hosts when the crop is absent, providing a reservoir from which infection of the crop can occur (Wisler and Norris, 2005). The role of environmental conditions cannot be denied in case of creation of epiphytotic situations in plant diseases. Each parameter of environmental factor plays its

role in reducing or enhancing of pathogenic activity. Different environment variables (max. temperature, min. temperature and avg. temperature) significantly influenced the disease incident Factors such as weather air temperature 18.50C, relative humidity 82% and precipitation 1670mm favoured the disease development of white rot were discussed (Sharma, 1985) . Drier season heavy dew favours the purple blotch (*Alternaria porri*) (Miller, 1995).

. The most common symptoms are : root rot, yellowing of leaves and brown or black spot. These symptoms are characteristic symptoms of the diseases found. On the other hand, our results show that, Difenoconazole and Azoxystrobin + Difenoconazole Boscalid + Pyraclostrobine are the most used pesticides. However, Rahatlfoul and Cherif (2019) recorded that Spiroxamine + Tebuconazole + Triadimenol and Pyroxsulam + Cloquintocet-mexyl are the pesticides most used either in the regions of Adrar.

II.1.6. Use of pestcides

Our results show that 55% of farmers use protective clothing. Likewise, Marot et *al*. (2003), report that more than 50% of farmers admit to never wearing protective accessories in a study on Farmers and pesticides: Knowledge, attitudes and practices in Belgium. On the other hand, the results indicated that 85% of farmer burn pesticides, which causes great damage to the environment and humanity, and 9 % of them throw it in the trash., exposing the animal and the environment to the dangers of pollution and of poisoning. While a 6% of farmer bury empty packaging in designated places and this is the behavior that must be taken to care for the protection of the environment and people. On the other hand, most of farmers in this study applied a safety period of 10 to 15 days between the last application of pesticides and the harvest. Our results are comparable to those obtained by Cisse et *al*. (2006) show that the average waiting period adopted by producers is between 10 and 14 days. the duration before harvest. Indeed, the duration before harvest depends on the phytosanitary product, it is mentioned on the packaging of each product. It must be respected to avoid possible accumulation of pesticide residues in agricultural products. Unfortunately, many of them never meet this deadline because they are always exposed to unstable vegetable prices at the wholesale market level; since the higher the market price, the more the farmer rushes to sell his harvest, even if he has processed the day before or a few days before.

The most of farmers survived did not have training on the method of applying pesticides. Similary , Kanda et *al*. (2013) reported that the rate of market gardeners trained in the application of pesticides is generally low. Indeed, Handling pesticides not only requires taking protective clothing measures but it also requires good knowledge of the product as well as the methods of its application to successfully carry out the mission of phytosanitary treatment.

The farmer must be trained to control the pesticide on its chemical level in order to determine its persistent constituents. Also, he must respect good practices of spray.

Conclusion

Conclusion

Garlic crop is attacked by many diseases and insect pests at different crop growth stages which causes considerable losses in yield.Thus, this survey aims to take stock of the recognition and management of insect pests and diseases of garlic cultivation by producers in the El Oued region. The results of our survey show that:

- The most of farmers participating in this study were men aged <40 years old
- The most of farmers surveyed have cultivated an area between 1-2 He of garlic.
- The majority of farmers practicing the agricultural cycle and practice superficial tilling specialy before planting;
- the most frequently observed pests in our study are: nematodes, onion fly, red spider, thrips and leek moth. With the use of Thiamethoxame + de Lambda-cyhalothrine and Lambda-cyhalothrine pyrimicarbe +acetamipride us insecticides.
- The main diseases of garlic most frequently observed in our study are: Basal Rot, Downy Mildew, Viral diseases and White rot with the following symptoms : root rot, yellowing of leaves and brown or black spot on bulbs,
- Difenoconazole, Azoxystrobin and Difenoconazole and Boscalid + Pyraclostrobine are the most used pesticides
- More than half of farmers dry garlic in locations other than the harvest site.
- More than half of farmers do not exceed the recommended amount of pesticide and most of them applied a safety period of 10 to 15 days between the last application of pesticides and the harvest;

Indeed,To deal with these enemies of the garlic, it is recommended to support the farmer, and this by establishing popularization and awareness days on the methods of prevention and control of these diseases and pests.

In Perspective, this study must be supplemented by the bio-ecological study of species of pests and diseases (fungal, bacterial, viral, viroid, etc.), in particular the cycle, reproduction, modes of transmission, assessment of physiological disorders that can touch the plant...etc. at the same time, the fight must be considered, in particular by means biological and physical so as not to create disturbances in the Saharan agro-ecosystem.

Bibliographic References

Bibliographic references

A

Abraham AD, Kidanemariam DB, Holton TA., 2019. "Molecular identification, incidence and phylogenetic analysis of seven viruses infecting garlic in Ethiopia". European Journal of Plant Pathology, 155: 181–191.

Agrios GN., 2005. Plant pathology,5 Th ED. Academic press, San Diego, 922p

Alam D, Hoq D, Uddin D, 2016. Medicinal plant Allium sativum = A Review. Journal of Medicinal Plants Studies, 4: 72-79.

Alaoui SB., 2005. Référentiel pour la Conduite Technique de l'ail (*Allium sativum*)

Allen J, Fraser H, Margaret A., 2022. Leek moth: a pest of allium crops https://www.ontario.ca/page/leek-moth-pest-allium-crops

ANDI., 2014. Agence Nationale de Développement de L'investissement wilaya d'El oued 11P.

Aouine H , Mahmoudi FZ., 2023. Contribution à l'étude des facteurs liées à l'infestation du Tomate par *Tuta absoluta* (Meyrick,1917), Mémoire Master Production Végétale Université d'El Oued,52p.

Apaza WE, Matos L., 2000. Reaction of onion cultivars to basal plate rot caused by Fusarium oxysporum f.sp. cepae. Fitopathologia. 35:231-236

Aslam T, Mohapatra PP, Karthik CS, Das SP, Dudi BS., 2016. Characterization of Garlic (Allium Sativum L.) Genotypes Based On Morphological Characters Inter J of Agri Sci. 1901-1903.

Araújo ER, Higashikawa FS , Lima M., 2018. First report of Onion yellow dwarf virus and Allexivirus associated with noble garlic in Itajai Valley, Santa Catarina State, Santa Catarina State, Brazil. Summa Phytopathol., Botucatu,44: 195-196,

Arvy MP, Gallouin, F.,200. Epices aromates et condiments. Paris : Belin. P : 24-30.

B

Beauchemin M., 2017. La fleur d'ail, l'aliment a connaitre.

Bernard C., 2018. L'ail (*Allium Sativum*).

https://www.altheaprovence.com/ail-allium-sativum/

Bertoni G, Morard P, Soubieille C, Llorens JM., 1992. Growth and nitrogen nutrition of garlic (*Allium sativum L.*) during bulb development. Sci Horti, 50:187- 195.

Blondlot A.,1992. Recherche des strategies de lutte contre le zucchini *Yellow Mosaic Virus* (ZYMV) et l'Onion Yellow Dwarf Virus (Oydv) sur cultures maraicheres a la reunion. Mémoire pour l'obtention d'un Diplôme d'Agronomie Approfondie en Protection des Cultures**,** 47p

Boinahadji AK, Kebe B ., 2020. Rapport d'enquête sur la reconnaissance et la gestion des insectes ravageurs des cultures maraîchères par les producteurs de la zone des Niayes.Technical Report, 19p.

Brown VK. et AC. Gange., 1990. Insect herbivory below ground. Adv. Ecol. Res. 20 : 1-57.

Bruneton J., 1999. Pharmacognosie, phytochimie, plantes médicinales. Techniques et Documentations Lavoisier.

C

Calzolari A, Bazzi C.,1985. Un marciume fogliare dell'aglio causato da *Pseudomonas fluorescens*. Informatore Fitopatologico, 7, 35–38.

Carretier D., 2018. Bulletin de sante du vegetal, ÉDITION MIDI-PYRÉNÉES N°7 , 4p

Choudhary S, Ubed Noor M, Hussain M, Mishra M, Tyagi S, 2022. Pharmacological properties and phytoconstituents of garlic (*Allium*). Biological Sciences, 02: 338-346.

Cisse I., Fall S. T., Badiane M., Diop Y, Diouf A., 2006. Horticulture et usage des pesticides dans la zone des Niayes au Sénégal, ISRA/LNERV, EISMV, LACT / Faculté de Médecine Pharmacie / UCAD, 14 p.

Costeplane C.,2018. L'ail : un véritable super-aliment .

D

Delhaut K and Stevenson W., 2009. Onion diseases: downy mildew, University of Wisconsin-Extinsion, 2p.
https://barron.extension.wisc.edu/files/2023/02/Onion-Disease-Downy-Mildew.pdf

Demirozer O., TylerJulian K., Funderburk J., Norm L, Stuart, R., 2012. *Frankliniella occidentalis* (Pergande) integrated pest management programs for fruiting vegetables in Florida. Pest Management Science, 68: 1537–1545.

Dovas CI, Vovlas C.,2003. Viruses infecting Allium spp. in southernItaly. J. Plant Pathol., pp. 85-135.

Dufresne C.2009.,L'AIL Allium sativum.Guide de production sous régie biologique Édition 2009, p 28.

E

Etoh T, Simon PW. 2002. Diversity, fertility, and seed production of garlic. In: H. Rabinowitch L, Currah (eds.), Allium crop science: Recent advances. CABI Publ., New York.

Everts KL, Lacy ML., 1990. The influence of dew duration, relative humidity and leaf senescence on conidial formation and infection of onion by Alternaria porri. Phytopathology, 80:1203-1207.

F

Fritsch RM, Friesen N., 2002. Evolution, domestication and taxonomy. In: Rabinowitch D., Currah L. (eds), Allium Crop Science: Recent Advances. Wallingford, CAB International: 5–30.

Fuller D., 2018. Pest Control » Leek Moth
https://www.mofga.org/resources/pest-control/leek-moth/

Fuscien AL., 2016. Bulletin info ail
https://ecophytopic.fr/sites/default/files/202004/Synth%C3%A8se_biblio_fusa_2016.pd

G

Gálvez L, Palmero D., 2022. Fusarium Dry Rot of Garlic Bulbs Caused by Fusarium proliferatum: A Review Horticulturae, 8: 628.

Gardan L, Bella P, Meyer JM., Christen R., Rott P, Achouak W, Samson R., 2002. *Pseudomonas salomonii sp. nov*., pathogenic on garlic, and *Pseudomonas palleroniana sp.* nov., isolated from rice. International Journal of Systematic and Evolutionary Microbiology, 52, 2065– 2074.

Gheraissa D, Askri A., 2019. Enquête sur la situation da la tomate dans la région d'El-Oued, mémoire Master Production Végétale Université d'El Oued,53p.

Guelph AJ, Fraser H, Appleby M., 2024. Leek moth: a pest of allium crops. Research Entomologist, Agriculture and Agri-Food Canada. Leek moth: a pest of allium crops
https://www.ontario.ca/page/leek-moth-pest-allium-crops

Guellier N., 2020. La mouche de l'oignon : comment s'en débarrasser ?
https://jardinage.lemonde.fr/dossier-3340-mouche-oignon-debarrasser.html

H

Hwang JM, Lee BY.,1990. Effect of temperature and humidity conditions on rooting and sprouting of garlic. J Kor Soc Hort Sci, 31:15-21.

Hutchins L., 2022. Leek Moth Identification and Management Sustainable; Agriculture Research and Education Program, Research and Education Grant LNE 2:19-379.

J

Jacques MA, Luçon N, Josi K.,2000. La maladie café au lait de l'ail. PHM-Revue Horticole, 414, 36–38.

Jepson SB., 2008. Fusarium rot of garlic bulbs. OSU Plant Clinic, Oregon State University, p3.

Johnson SB, Fuller D., 2020. White Rot of Garlic and Onions Bulletin #2062, 3p https://extension.umaine.edu/publications/wp-content/uploads/sites/52/2020/03/2062.pdf

Johnson SB, Fuller D.,2021. Bloat nematode in maine garlic. University of Maine Cooperative Extension. https://extension.umaine.edu/publications/wp-content/uploads/sites/52/2021/06/1205.pdf

Juroszek P, Racca P,Link S, Farhumand J, Kleinhenz, B., 2020. Overview on the review articles published during the past 30 years relating to the potential climate change effects on plant pathogens and crop disease risks. *Plant Pathol. 69*, 179–193.

K

Kanda M., Gbandi D.B., WALA K., Gnandi K, Batawila K., Sanni A., Akpagana K., 2013. Application des pesticides en agriculture maraîchère au Togo.VertigO,13: 65- 87p.

Kimba A, Delmas P (RECA), Kabirou M.,2023. Les thrips sur l'oignon et les méthodes de lutte (Chambre Régionale Agricole de Tahoua). Réseau National des Chambres d'Agriculture du Niger, 7p.

Koike ST, Smith RF, Davis RM, Nunez JJ, Voss RE., 2001. Characterization and control of garlic rust in California. Plant Dis, 85:585-591.

Kouassi Agbo So T., Abdou R., Saidou Sani I., Toudou A., Bakasso Y., 2021. Garlic (*Allium sativum L.*): Overview on its Biology. Asian Journal of Biochemistry, Genetics and Molecular, 7: 1-10.

L

Larose C., 2021. Présentation du plant d'Ail.

https://www.lesproductionsgourmet.com/blogs/infos/presentation-du-plant-dail

Legault G.,2023. Maladies et conditionnement de l'ail. https://www.agrireseau.net/documents/Document_110306.pdf

Leyronas C, Chrétien PL, Troulet C, Duffaud M, Villeneuve F, Morris, C, Hunyadi H., 2018. First report of Fusarium proliferatum causing garlic clove rot in France. Plant Dis, 102: 2658.

M

Mahdi M., 2020. Enquête sur la conduite de la culture d'ail (Allium sativum) dans la région de M'sila, Mémoire Master en sciences agronomique, Université de M'Sila,52p.

Malik G, Mahajan V, Singh A.S, Sharma A, Mir JI, Sajad H, Wani SY., 2017. Present status and future prospects of garlic (Allium sativum L .) improvement in India with special reference to long day type. Journal of Pharmacognosy and Phytochemistry, 6: 929-933.

Man LK., 1952. Anatomy of the garlic bulb and factors affecting bulb development. Hilgardia, 21:195–251.

Marchiori CH., 2024. Thrips (Insecta: Thysanoptera: Thripidae).. Qeios.

Marks D.,2010. identify and treat allium rust

https://gardenfocused.co.uk/fruitarticles/pest-disease/rust.php

Marot J, Godfriaux J, Maraite H, Calaeys S, Steurbaut W, Vanbol V, Debongnie P, Pussemier L., 2003. Agriculteurs et pesticides : Connaissances, attitudes et pratiques, 69 p.

Madeiras A., 2014. Bulb Mites in Garlic. UMass Extension Vegetable IPM Fact Sheet, 2p.

Medarag H, Boubir N, Farhi A., 2009. Le rôle des services et des investissements dans l'hypertrophie de la ville d'El Oued au bas Sahara algérien. Environnement Urbain / Urban EnvironmentUrbanisme et développement durable, 3 :1-23.

Messiaen CM, Cohat J, Leroux JP, Pichon M, Beyries A., 1993. Variétés d'ail et modes de culture. ln: « Les allium alimentaires reproduits par voie végétative », Éditions INRA: 165-192.

Miller ME., 1995. Stemphylium leaf blight and stalk rot in Compendium of Onion and Garlic Diseases APS Press, St. Paul, Mnnisota, USA, 25-26.

N

Napier T.,2012. Downy Mildew, Australian Garlic Industry Association Information Sheet.

www.garlicaustralia.asn.au – info@garlicaustralia.asn.au AUSTRALIAN GARLIC INDUSTRY ASSOCIATION – www.garlicaus

ANDI., 2014. National Investment Development Agency wilaya of El oued 11P.

O

Ogada PA, Poehling HM., 2015. specific influences of Frankliniella occidentalis (western flower thrips) in the transmission of Tomato spotted wilt virus (Tospovirus). Journal of Plant Disease Protection, 122: 264–274.

Okwae K., 2021. Pest Management Guide for Onion. The HortiFresh Programme

OMAFRA., 2002. Fiche technique : La culture de l'ail.

P

Palomares-Rius JE, Escobar C, Cabrera J, Vovlas A, Castillo P.,2017. Anatomical Alterations in Plant Tissues Induced by Plant-Parasitic Nematodes. Front Plant Sci, 8:1987.

Pundt L.,2019. Bulb Mites. Integrated Pest Management Program https://ipm.cahnr.uconn.edu/wpcontent/uploads/sites/3216/2022/12/2019bulbmitefactsheetfinal.pdf

R

Rahatlfoul M, Cherif I., 2019. Utilisation et risques des pesticides dans les périmètres de mise en valeur de la wilaya d'Adrar : cas de la région d'Aougrout, Mémoire Master en sciences agronomique, Université Ahmed DRAIA- Adrar,48p.

Reitz SR.,2009. Biology and ecology of the western flower thrips (*Thysanoptera: Thripidae*): the making of a pest. Florida Entomology, 92: 7–13.

Richard C, Boivin G.,1994. Nématode des tiges et des bulbes. Dans Maladies et Ravageurs des Cultures Légumières au Canada. La Société Canadienne de Phytopathologie et la Société d'Entomologie du Canada, 213-214 p.

S

Samson R.,1982. A biovar of Pseudomonas fluorescens pathogenic to Allium sativum. In CIAT (Ed.),Plant pathogenic bacteria (pp. 60–64). Colombia: Proceedings of the Vth international conference on plant pathogenic bacteria Cali.

Schwartz HF, Mohan SK., 1995. Compendium of onion and garlic diseases. American Phytopathological Society St. Paul Minnesota USA, 54.

Seto M, Ivy A, Shelton A ., 2013. Leek Moth *Acrolepiopsis assectella* (Zeller) Identification and Management Guide https://rvpadmin.cce.cornell.edu/uploads/doc_756.pdf

Sharma V, Sharma A, Kansal L., 1985. The effect of oral administration of Allium sativum extracts on lead nitrate induced toxicity in male mice. Food and Chemical Toxicology, 48:928-936.

Schröder ML, Glinwood R, Webster B, Ignell R, Krüger K., 2015. Olfactory responses of Rhopalosiphum padi to three maize, potato, and wheat cultivars and the selection of prospective crop border plants Entomologia Experimentalis et Applicata 157: 241-253

Swett CL., Aegerter BJ., Turini TA, Putman AI., 2019. Downy Mildew, Agriculture: Onion and Garlic Pest Management Guidelines

Swett CL, Aegerter BJ, Turini TA, A.I. Putman.,2024. Thrips (Insecta: Thysanoptera: Thripidae Instituto Federal Goiano.

Simon PW, Jenderek M., 2004. Flowering seed production and the genesis of garlic breeding. In: Janick J (ed.) Plant Breeding Reviews, Wiley, New York,211-243.

Subbotin SA, Madani M, Krall E, Sturhan D, Moens M., 2005. Molecular Diagnostics, Taxonomy, and Phylogeny of the Stem Nematode Ditylenchus dipsaci Species Complex Based on the Sequences of the Internal Transcribed Spacer-rDNA. Phytopathology 95: 1308−1315.

Suleria HAR, Butt MS, Khalid N, Sultan S, Raza A, Aleem M, Abbas M., 2015. Garlic (Allium sativum): Diet based therapy of 21st century-a review Asian Pacific Journal of Tropical Disease, 5: 271-278

Sultan SM, Raina SK,2020. Agromorphological characterization of local garlic (Allium sativum L.) germplasm accessions collected from different regions of Jammu and Kashmir. J Appli Nat Sci,12:124-127.

T

Tahir M, Ahmad M, Shah M, Alam S, Khattak M.,2006. Field efficacy of different spray fungicides on the severity of garlic rust (Puccinia porrii Wint). Sarhad Journal of Agriculture, 22: 237 - 241.

Takhtajan A., 1997. Diversity and Classification of Flowering Plants. New York, Columbia University Press: 643.

Tonti S, Prà MD, Nipoti P, Prodi, A, Alberti I., 2012. First report of Fusarium proliferatum causing rot of stored garlic bulbs (Allium sativum L.) in Italy. J. Phytopatho. , 160: 761–763.

Trepanier R, Ferland P,Maurice M., 2016. insectes secondaires de l'ail https://www.agrireseau.net/agriculturebiologique/documents/autresinsectes_thrips.pdf

V

Van Dijk P.,1993. Carlavirus isolates from cultivated Allium species represent three viruses. Neth. J. Plant Pathol, 99: 233-257.

Voisin P., 2004. Le Souf; Ed. El-Walide; El-Oued, 319p.

W

Wisler GC, Norris RF.,2005. Interactions between Weeds and Cultivated Plants as Related to Management of Plant Pathogens. Weed Sci.,53:914–917.

Worku Y., 2017. Determination of Optimum Nativo SC 300 (Trifloxystrobin 100g/l + Tebuconazole 200g/l) Spray Frequency for Control of Rust (Puccinia allii Rudolphi) on Garlic in Bale Highlands, South Eastern Ethiopia American Journal of Agriculture and Forestry, 5:16-19.

WHO., 1999.WHO Monographs on selected medicinal plants. Vol. 1. WHO: Genève.

Z

Zhang ZJ., Wu QJ., Li XF. , Zhang YJ. , Xu BY, Zhu GR., 2010. Life history of western flower thrips, *Frankliniella occidentalis* (*Thysan., Thripae*), on five different vegetable leaves. Journal of Applied Entomology, 131: 347–354.

Websites

Anonym 01., 2024. La teigne du poireau, ravageur des cultures alliacées

Consulted:23/04/2024

https://www.ontario.ca/fr/page/la-teigne-du-poireau-ravageur-des-cultures-alliacees

Anonym 02., 2024. Stop Garlic Rust Before It Starts (and What to Do If It's Too Late) Consulted:02/05/2024
https://gardenbetty.com/grrr-garlic-rust-and-how-to-deal/#:~:text=Rust%20completes%20several%20cycles%20of,for%20new%20hosts%20to%20infect.

Annexes

للفلاحين

ضمن مشروع انجاز مذكرة ماستر في الإنتاج النباتي

حدد (X) الإجابة المناسبة

الجنس: ذكر ☐ انثى ☐

العمر: 60 ≤ ☐ 40≤ ☐ 20≤ ☐

المستوى التعليمي: لاشيء ☐ ابتدائي ☐ متوسط ☐ ثانوي ☐ جامعي ☐

المنطقة:.....

المساحة الصالحة للزراعة:.....

المساحة التي تشغلها زراعة الثوم:.....

لماذا تزرعون الثوم؟

أ) مربحة ☐ ب) مناسبة للدورة الزراعية مع البطاطا ☐ ج) التربة مواتية ☐ د)اخرى ☐

متى تقوم بالسقي:صباحا ☐ مساءا ☐ ليلا ☐

مصدر ما السقي:.....

طريقة السقي :.....

هل عندك تكوين في الفلاحة: نعم ☐ لا ☐

ما هي أصناف بذورالثوم المزروعة : .....

....

لماذا اخترت هذه الأصناف: نوعية جيدة ☐ انتاجها وفير ☐ مقاومتها للامراض ☐ تتناسب مع طبيعة المنطقة ☐ اخرى ☐ .....

هل تطبق الدورة الزراعية: نعم ☐ لا ☐

كيف تطبقها: كل سنة ☐ كل سنتين ☐

<u>الأعمال التقنية على الارض</u>

هل تقوم بحرث الارض: نعم ☐ لا ☐

طبيعة الحرث : عميق ☐ سطحي ☐

التوقيت:الربيع الخريف ☐ الصيف ☐ الشتاء ☐ قبل الزراعة مباشرة ☐ اخرى ☐

.....

عمق الحرث:25< ☐ 15-25 ☐ 15> ☐

هل قمت بعملية التسميد: نعم ☐ لا ☐

طبيعة السماد: عضوي ☐ معدني ☐

وقت التسميد: قبل الزراعة ☐ بعد الزراعة ☐ اخرى ☐ .....

ما نوع البذر الذي تمارسه؟

أ) يدوي ☐ **ب) ميكانيكي** ☐

ما نوع الحصاد:

أ) يدوي ☐ **ب) ميكانيكي** ☐

ما هي معايير نضج الثوم؟

.....

مكافحة الأعشاب الضارة: نعم ☐ لا ☐

طريقة المكافحة: يدوي ☐ كيميائي ☐

<u>الافات الزراعية للثوم</u>

<u>ماهي اهم الافات التي اصابت محصول الثوم خلال السنتين الاخيرتين</u>

اسم المرض	
الذباب	
التربس	
حشرة المن	
العنكبوت الاحمر	
النيماتودا	
اخرى	

ما هي اهم الاثار التي تتركها الافات على نبات الثوم؟

حسب ما لاحظته ما هي اهم العوامل المساعدة على ظهور الآفات الحشرية؟

الحرارة المرتفعة	
الحرارة المنخفضة	
الرطوبة العالية	
الرطوبة المنخفضة	
الرياح	
الاضاءة القوية	
نوعية البذورمع تحديد النوع الاكثر حساسية	
وجود الاعشاب الضارة	
استعمال السماد العضوي	

اخرى	

ماهي اهم المبيدات الحشرية التي تم استعمالها خلال هذه السنة وحدد اكثرها فعالية؟

الاسم العلمي للمبيد	الكمية في الهكتار	الفعالية

الفعالية:- :غيرفعال +: فعالية حسنة ++: فعالية جيدة +++: فعالية ممتازة

<u>امراض للثوم</u>

مإهي اهم الامراض التي اصابت محصولك خلال السنتين الاخيرتين؟

اسم المرض	
البياض الزغبي	
العفن القاعدي	
العفن الابيض	
تورد الجذور	
امراض فيروسية	
شق الشتلات	
اخرى	

ما هي اهم الاعراض التي لاحظتها؟

الاعراض	
اصفرار للأوراق	
عفن الجذور	
بقع بنية أو سوداء على الثمار	
بقع بصورة حلقات دائرية عل الاوراق	
بقع بنية خضراء زيتية على الثمار	
بقع مسحوقية بيضاء تغطي اعلى الاوراق	

زغب أبيض	
تشقق في الشتلات	
اخرى	

حسب ما لاحظته ما هي اهم العوامل المساعدة على ظهور الامراض؟

الحرارة المرتفعة	
الحرارة المنخفضة	
الرطوبة العالية	
الرطوبة المنخفضة	
الرياح	
الاضاءة القوية	
نوعية البذورمع تحديد النوع الاكثر حساسية	
وجود الاعشاب الضارة	
اخرى	

ماهي اهم المبيدات العلاجية التي تم استعمالها خلال هذه السنة وحدد اكثرها فعالية؟

الاسم التجاري للمبيد	**الكمية في الهكتار**	**الفعالية**

الفعالية:- :غيرفعال +: فعالية حسنة ++: فعالية جيدة +++: فعالية ممتازة

ثالثا. التخزين والحفظ:

1) ما هي تقنية التجفيف المستخدمة:

أ) في موقع الحصاد ☐ **ب) تغيير الموقع** ☐ **اخرى** ☐

2) هل لديك معدات تخزين وحفظ مناسبة؟

أ) نعم ☐ **ب) لا** ☐

طريقة استعمال المبيدات:

هل تستعمل ملابس واقية اثناء الرش؟ نعم ☐ لا ☐

هل تتجاوز الكمية الموصى بها؟ نعم ☐ لا ☐

كيف تتخلص من بقايا المبيدات؟ رميها في الزبالة ☐ حرقها ☐ جمعها ودفنها ☐ اخرى ☐

.....

متى تقطف الثمار بعد الرش؟

>15 j ☐ 10-15 j ☐ < 10j ☐

هل حضرت في تكوينا عن كيفية استخدام المبيدات؟ نعم ☐ لا ☐

شكرًا لكم على الوقت الذي استغرقتموه لإكمال هذا الاستبيان.

- شكرا لتعاونكم

Abstrat

Abstract

Garlic (*Allium sativum L*.) is the most important commercial crops grown allover the world and consumed in various forms. It is generally used as vegetables, spices or as medicines. This study was carried out in El Oued region with aim of determining the main pests and diseases of garlic crops and to document the knowledge of farmers on these pests and diseases and their control measures in some communes of the wilaya of Oued Souf. The investigation was carried out took place in the period from Febrary to May 2024. In total, 33 questionnaires were distributed to garlic farmers in 6 different municipalities. Our survey results show that: 82% of farmers are men 48% of them aged $\leq$40 . 39% of them having a University level. 79% of farmers surveyed have cultivated an area between 1-2 He of garlic,39% of the farmers confirmed that they grow garlic because it the cultivation of garlic is profitable, the most of farmers(87%) survived, practicing the agricultural cycle.The most frequently observed pests of garlic are: nematodes, onion fly, red spider, thrips and leek moth. With the use of the following insecticide Thiamethoxame + de Lambda-cyhalothrine. On the other hand the main diseases of garlic most frequently observed in our study are: Basal Rot, Downy Mildew, Viral diseases and White rot With the use of Difenoconazole, Azoxystrobin and Difenoconazole and Boscalid + Pyraclostrobine us fungicide. Most farmers surveys respect the dose of pesticide and the time before harvest. and more than half of farmers dry garlic in locations other than the harvest site and do not have equipment to store garlic. 55% of farmers do not use protective clothing while spraying the pesticide the most of them applied a safety period of 10 to 15 days and did not receive any training on good pesticide practices.

Key words: Garlic, pests, diseases, pesticides, El Oued, survey, farmers.

Résumé

L'ail *(Allium sativum L.*) est la culture commerciale la plus importante cultivée partout dans le monde et consommée sous diverses formes. Il est généralement utilisé comme légume, comme épice ou comme médicament. Cette étude a été réalisée dans la région d'El Oued dans le but de déterminer les principaux ravageurs et maladies des cultures d'ail et de documenter les connaissances des agriculteurs sur ces ravageurs et maladies et leurs mesures de lutte dans certaines communes de la wilaya d'Oued Souf. L'enquête a été menée entre Fevrier et May 2024. Au total, 33 questionnaires ont été distribués aux producteurs d'ail dans 6 communes différentes. Les résultats de notre enquête montrent que : 82 % des agriculteurs sont des hommes, dont 48 % sont âgés de <40 ans. 39% d'entre eux ont un niveau universitaire. 79 % des agriculteurs interrogés ont cultivé une superficie comprise entre 1 et 2 hectares d'ail. 39% des agriculteurs ont confirmé qu'ils cultivent de l'ail parce que la culture de l'ail est rentable, la plupart des agriculteurs (87%) questionnés en pratiquant le cycle agricole. Les ravageurs de l'ail les plus fréquemment observés sont : les nématodes, la mouche de l'oignon, l'araignée rouge, les thrips et la teigne du poireau. Avec l'utilisation de l'insecticide suivant Thiamethoxame + de Lambda-cyhalothrine. Par ailleurs, les principales maladies du garlic les plus fréquemment observées dans notre étude sont : Pourriture basale, Mildiou, Maladies virales et Pourriture blanche Avec l'utilisation du Difénoconazole, de l'Azoxystrobine et du Difénoconazole et du fongicide Boscalid + Pyraclostrobine us. La majorité des agriculteurs respectent la dose de pesticide et le délai avant récolte et plus de la moitié des agriculteurs sèchent l'ail dans des endroits autres que le site de récolte et ne disposent pas d'équipement pour stocker l'ail. 55% des agriculteurs utilisent de vêtements de protection lors de la pulvérisation du pesticide, la plupart d'entre eux ont appliqué une période de sécurité de 10 à 15 jours et n'ont reçu aucune formation sur les bonnes pratiques en matière de pesticides.

Mots clés : Ail, ravageurs, maladies, pesticides, El Oued, enquête, agriculteurs.

الملخص

يعد الثوم (*Allium sativum L.*) من أهم المحاصيل التجارية التي يتم زراعتها في جميع أنحاء العالم ويتم استهلاكها بأشكال مختلفة. يتم استخدامه بشكل عام كخضروات أو توابل أو كأدوية. أجريت هذه الدراسة بمنطقة الوادي بهدف تحديد أهم الآفات والأمراض التي تصيب محاصيل الثوم وتوثيق معارف الفلاحين حول هذه الآفات والأمراض وإجراءات مكافحتها ببعض بلديات ولاية واد سوف. تم إجراء التحقيق في الفترة من فبراير إلى ماي 2024. وفي المجمل، تم توزيع 33 استبيانًا على مزارعي الثوم في 6 بلديات مختلفة. تظهر نتائج المسح الذي أجريناه أن: 82% من المزارعين هم من الرجال، و48% منهم تقل أعمارهم عن 40 عامًا. 39% منهم حاصلين على مستوى جامعي. 79% من المزارعين الذين شملهم الاستطلاع قاموا بزراعة مساحة تتراوح بين 1-2 هكتار من الثوم. أكد 39% من المزارعين أنهم يزرعون الثوم لأن زراعة الثوم مربحة، أكثر المزارعين (87%) من المزارعين يقومون بالدورة الزراعية. وأكثر آفات الثوم شيوعاً هي: الديدان الخيطية، ذبابة البصل، العنكبوت الأحمر، التربس وفراشة الكراث. مع استخدام المبيد الحشري التالي ثياميثوكسام + دي لامبدا- سيهالوثرين. من ناحية أخرى فإن أمراض الثوم الرئيسية الأكثر ملاحظة في دراستنا هي: العفن القاعدي، البياض الزغبي، الأمراض الفيروسية والعفن الأبيض مع استخدام مبيد الفطريات ديفينوكونازول، أزوكسيستروبين و ديفينوكونازول وبوسكاليد + بيراكلوستروبين. تحترم اغلب المزارعين جرعة المبيد والوقت الذي يسبق الحصاد. كماأن أكثر من نصف المزارعين يقومون بتجفيف الثوم في أماكن أخرى غير موقع الحصاد وليس لديهم معدات لتخزين الثوم. 55% من المزارعين لا يستخدمون الملابس الواقية أثناء رش المبيدات، وأغلبهم طبقوا فترة أمان تتراوح بين 10 إلى 15 يومًا ولم يتلقوا أي تدريب على الاستعمال الجيد للمبيدات.

الكلمات المفتاحية: الثوم، الآفات، الأمراض، المبيدات، الوادي، مسح، المزارعين.

Abstract

Garlic (*Allium sativum L.*) is the most important commercial crops grown allover the world and consumed in various forms. It is generally used as vegetables, spices or as medicines. This study was carried out in El Oued region with aim of determining the main pests and diseases of garlic crops and to document the knowledge of farmers on these pests and diseases and their control measures in some communes of the wilaya of Oued Souf. The investigation was carried out took place in the period from Febrary to May 2024. In total, 33 questionnaires were distributed to garlic farmers in 6 different municipalities. Our survey results show that: 82% of farmers are men 48% of them aged ≤40 . 39% of them having a University level. 79% of farmers surveyed have cultivated an area between 1-2 He of garlic,39% of the farmers confirmed that they grow garlic because it the cultivation of garlic is profitable, the most of farmers(87%) survived, practicing the agricultural cycle.The most frequently observed pests of garlic are: nematodes, onion fly, red spider, thrips and leek moth. With the use of the following insecticide Thiamethoxame + de Lambda-cyhalothrine. On the other hand the main diseases of garlic most frequently observed in our study are: Basal Rot, Downy Mildew, Viral diseases and White rot With the use of Difenoconazole, Azoxystrobin and Difenoconazole and Boscalid + Pyraclostrobine us fungicide. Most farmers surveys respect the dose of pesticide and the time before harvest. and more than half of farmers dry garlic in locations other than the harvest site and do not have equipment to store garlic. 55% of farmers use protective clothing while spraying the pesticide the most of them applied a safety period of 10 to 15 days and did not receive any training on good pesticide practices.
Key words: Garlic, pests, diseases, pesticides, El Oued, survey, farmers.

Résumé

L'ail *(Allium sativum L.*) est la culture commerciale la plus importante cultivée partout dans le monde et consommée sous diverses formes. Il est généralement utilisé comme légume, comme épice ou comme médicament. Cette étude a été réalisée dans la région d'El Oued dans le but de déterminer les principaux ravageurs et maladies des cultures d'ail et de documenter les connaissances des agriculteurs sur ces ravageurs et maladies et leurs mesures de lutte dans certaines communes de la wilaya d'Oued Souf. L'enquête a été menée entre Fevrier et May 2024. Au total, 33 questionnaires ont été distribués aux producteurs d'ail dans 6 communes différentes. Les résultats de notre enquête montrent que : 82 % des agriculteurs sont des hommes, dont 48 % sont âgés de <40 ans. 39% d'entre eux ont un niveau universitaire. 79 % des agriculteurs interrogés ont cultivé une superficie comprise entre 1 et 2 hectares d'ail. 39% des agriculteurs ont confirmé qu'ils cultivent de l'ail parce que la culture de l'ail est rentable, la plupart des agriculteurs (87%) questionnés en pratiquant le cycle agricole. Les ravageurs de l'ail les plus fréquemment observés sont : les nématodes, la mouche de l'oignon, l'araignée rouge, les thrips et la teigne du poireau. Avec l'utilisation de l'insecticide suivant Thiamethoxame + de Lambda-cyhalothrine. Par ailleurs, les principales maladies du galic les plus fréquemment observées dans notre étude sont : Pourriture basale, Mildiou, Maladies virales et Pourriture blanche Avec l'utilisation du Difénoconazole, de l'Azoxystrobine et du Difénoconazole et du fongicide Boscalid + Pyraclostrobine us. La majorité des agriculteurs respectent la dose de pesticide et le délai avant récolte et plus de la moitié des agriculteurs sèchent l'ail dans des endroits autres que le site de récolte et ne disposent pas d'équipement pour stocker l'ail. 55% des agriculteurs utilisent de vêtements de protection lors de la pulvérisation du pesticide, la plupart d'entre eux ont appliqué une période de sécurité de 10 à 15 jours et n'ont reçu aucune formation sur les bonnes pratiques en matière de pesticides.
Mots clés : Ail, ravageurs, maladies, pesticides, El Oued, enquête, agriculteurs.

الملخص

يعد الثوم (*Allium sativum L.*) من أهم المحاصيل التجارية التي يتم زراعتها في جميع أنحاء العالم ويتم استهلاكها بأشكال مختلفة. يتم استخدامه بشكل عام كخضروات أو توابل أو كأدوية. أجريت هذه الدراسة بمنطقة الوادي بهدف تحديد أهم الآفات والأمراض التي تصيب محاصيل الثوم وتوثيق معارف الفلاحين حول هذه الآفات والأمراض وإجراءات مكافحتها ببعض بلديات ولاية واد سوف. تم إجراء التحقيق في الفترة فبراير إلى ماي 2024. وفي المجمل، تم توزيع 33 استبيانًا على مزارعي الثوم في 6 بلديات مختلفة. تظهر نتائج المسح الذي أجريناه أن: 82% من المزارعين هم من الرجال، و 48% منهم تقل أعمارهم عن 40 عامًا. 39% منهم حاصلين على مستوى جامعي. 79% من المزارعين الذين شملهم الاستطلاع قاموا بزراعة مساحة تتراوح بين 1-2 هكتار من الثوم. أكد 39% من المزارعين أنهم يزرعون الثوم لأن زراعة الثوم مربحة، أكثر المزارعين (87%) من المزارعين يقومون بالدورة الزراعية. وأكثر آفات الثوم شيوعاً هي: الديدان الخيطية، ذبابة البصل، العنكبوت الأحمر، التربس وفراشة الكراث. مع استخدام المبيد الحشري التالي ثياميثوكسام + دي لامبدا- سيهالوثرين. من ناحية أخرى فإن أمراض الثوم الرئيسية الأكثر ملاحظة في دراستنا هي: العفن القاعدي، البياض الزغبي، الأمراض الفيروسية والعفن الأبيض مع استخدام مبيد الفطريات ديفينوكونازول، أزوكسيستروبين و ديفينوكونازول وبوسكاليد + بيراكلوستروبين. تحترم اغلب المزارعين جرعة المبيد والوقت الذي يسبق الحصاد. كماأن أكثر من نصف المزارعين يقومون بتجفيف الثوم في أماكن أخرى غير موقع الحصاد وليس لديهم معدات لتخزين الثوم. 55% من المزارعين لا يستخدمون الملابس الواقية أثناء رش المبيدات، وأغلبهم طبقوا فترة أمان تتراوح بين 10 إلى 15 يومًا ولم يتلقوا أي تدريب على الاستعمال الجيد للمبيدات.
الكلمات المفتاحية: الثوم، الآفات، الأمراض، المبيدات، الوادي، مسح، المزارعين.