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Theme

INVENTORY OF BIOLOGICAL AGRICULTURAL PRACTICES IN GHARDAIA REGION

Presented by

- KACHAOU Sarra

Members of the jury

President:	BAZZINE Meriem	M. C. B	Univ.Ghardaia
Examiner:	KADRI Ahmed	M. A. A	Univ.Ghardaia
Supervisor:	ALIOUA Youcef	M. C. A	Univ.Ghardaia

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List of abbreviations

FAO: Food and Agriculture Organization

IPM: Integrated Pest Management

IOBC: International Organization for Biological Control

EPA: Environmental Protection Agency

PPN: Plant Parasitic Nematodes

SCN: Soybean Cyst Nematode

RKN: Root Knot Nematode

CT: Terminal complex

CI: Intercalary continental

GAP: Good Agricultural Practices

CEC: Cation Exchange Capacity

INTRODUCTION

Throughout its history, traditional oases agriculture has had a significant socioeconomic impact**.** It has made it possible for the locals to settle in a harsh and challenging environment where the main source of income is the marketing of dates **(DOLLÉ, 1990)**. The farming systems in oases have evolved a variety of adaptation techniques to deal with environmental limitations and socioeconomic advancements. The three-stages agriculture system (date palm stage, arboreal stage, and herbaceous stage: vegetables and fodder) is one of these strategies. Its goal is to create microclimate oases that, by reducing the ardor of the desert, provide ideal conditions for the effective development of the species grown in association.

Plants are the source of the air we breathe and most of the food we eat, however we frequently overlook the need to maintain their health. The effects of this could be deadly. According to the Food and Agriculture Organization (FAO), plant pests and diseases cause up to 40% of food crops to be lost each year. **(IYPH, 2020)** Plant health is increasingly under threat ecosystems have been impacted by climate change and human activity, which has decreased biodiversity and created new niches for pests to flourish in. Protecting plants from diseases and pests is the best way to avoid the devastating effects of agriculture and food security. It is more cost-effective and dealing with living conditions of plants, and this is by applying biological agricultural practices which works to prevent and combat pest and diseases in a biological way, such as through integrated pest management. This ecosystem approach combines different management strategies and biological agricultural practices to grow healthy crops while minimizing the use of pesticides. Avoiding poisonous substances when dealing with pests not only protects the environment but also protects natural pest enemies, beneficial organisms and of course the health of people and animals as well. **(IYPH, 2020)**

The plants are attacked by pathogenic microorganisms such as (fungi, bacteria, viruses, etc.). and animals like (nematodes, mites, insects, rodents, etc.) or weeds (bad grass). These pests or plant organisms directly attack the tissues of plants, as they compete with them in terms of resources (air, water, soil nutrients, etc.) that stimulate symmetry disorders and affect their physiology. their shape and growth. The way to control it is by using “Integrated pest management” it’s an increasing well-known term in agriculture resulting from consumers and ecologists' concerns about the problems caused by the repetitive application of pesticides **(FIRLEJ & VANOOSTHUYSE, 2001)** What are the objectives of this management method? what are the fundamental principles? The main goal is to reduce the use of pesticides through the use of alternative control methods. Among the components of integrated pest management is biological control, a method using natural enemies to control pest populations. **(FIRLEJ & VANOOSTHUYSE, 2001)**

The objective of this study is to analyze the type of biological agricultural practices, knowledge and attitudes of farmers in Ghardaia region. In our study we try to answer the following question:

- What are the biological agricultural practices that used in Ghardaia region?

Our study has three chapters:

Chapter one: General on biological agricultural practices

Chapter two: Materials and Methods

Chapter three: Results and Discussion

Finally, a conclusion summarizing the different results.

Chapter one:

Generalities on Good Agricultural Practices

I. Biological agricultural practices

1. Good agricultural practices

The term "good agricultural practices" (GAP) refers to a set of guidelines for the sustainable and safe raising of animals and crops. It attempts to minimize production costs and environmental effects while assisting farm owners in maximizing yields and streamlining business operations. Adhering to good agricultural practices facilitates producers meeting store demands for high-quality products and consumer preferences**. (TARLENGCO, 2024)**

Good Agricultural Practices are crucial because they support ethical farming techniques across the board, from picking a location and preparing the soil to harvesting and processing. In order to address environmental, economic, and social sustainability for on-farm production and post-production processes, (FAO) the Food and Agriculture Organization of the United Nations states that GAP leverages existing knowledge, producing safe and healthful agricultural products. Good agricultural practices can help achieve sustainable development goals or national development objectives by enhancing the standard of living for farmers and the local economy as a whole. **(TARLENGCO, 2024)**

1.1. Basics of GAP's

- Clean soil: properly applied amendments
- Clean water: used in production, harvest and packing
- Clean hands: good personal hygiene in the field and packing house
- Clean surfaces: properly washed and sanitized on a regular basis

The important of GAP is to Produce safety affects every fruit and vegetable grower and every grower can reduce those risks, keeps consumers healthy and better business reputations and performance also prevent crop and financial loss

2. Integrated pest management

(IPM) is a practical and eco-friendly method of controlling pests through a blend of common-sense techniques. IPM programs earn use of up-to-date, thorough data regarding the life cycles of pests and how they interact with the environment. Using this knowledge along with current pest control techniques allows for the most affordable management of pest damage while posing fewer dangers to people, property, and the environment. **(Dittmar & Peter J, 2023)** IPM is a set of pest management evaluations, actions, and controls instead of a single method of pest control. Growers using integrated pest management (IPM) who recognize the possibility of pest infestation employ a four-tiered strategy. The four actions consist of:

a. Set action thresholds

Integrated Pest Management (IPM) develops action levels, which are the points at which pest populations or environmental conditions warrant the use of pest control measures. It's not always necessary to take action when one pest is seen. Future decisions about pest treatment must take into account the degree to which pests will pose an economic risk.

b. Monitor and identify pests

Not all insects, weeds, and other living organisms require control. Many organisms are innocuous, and some are even beneficial. IPM programs work to monitor for pests and identify them accurately, so that appropriate control decisions can be made in conjunction with action thresholds. This monitoring and identification remove the possibility that pesticides will be used when they are not really needed or that the wrong kind of pesticide will be used.

c. Prevention

IPM programs, which aim to manage crops, lawns, and indoor spaces, serve as a first line of defense against pests. This could entail applying cultural techniques to an agricultural crop, like crop rotation, the use of pest-resistant cultivars, and the planting of pest-free rootstock. There is minimal to no harm to the environment or human health associated with these control techniques, which can also be quite successful and economical. **(Dittmar & Peter J, 2023)**

With these steps, IPM is best defined as a continuum with these steps. Before spraying, a large majority of agricultural growers identify their pests. Pheromones are among the less dangerous pesticides used by a smaller percentage of growers. These growers are all situated along the IPM continuum. Moving growers further along the continuum to employing all suitable IPM approaches is the aim.

3. Cultural control

Cultural control is any farm practice that is used with some consideration for insect management. In this context, a farm practice is a multipurpose agricultural operation used for profitable crop production as a fundamental priority, such as choosing seed, planting, cultivating, or harvesting. Farming operations can have positive, negative, or neutral influences on insect populations, and knowledge of all three impacts is useful in making cultural control decisions.

Traditionally, cultural control has referred to the use of farming practices to manage insects. This simple idea is too restrictive and does not include concepts associated with risk management. In the current context, cultural control also includes methods that avoid creating hazardous crop environments for insect infestations. **(John N. ,1999).**

3.1. Soil Treatment

Plants develop more quickly in favorable soil, and robust crops are more resilient to pest attacks. Soil testing is used in integrated pest management to determine whether a field is suited for growing a certain crop and to add nutrients that are lacking to promote healthy plant growth. Mulching and adding organic matter stimulate nutrient release and soil organism activity. By reducing soil erosion, no-till farming methods support sustainable agriculture. If tilling is required, though, it is best done in the fall when they are more vulnerable to predators and bad weather. **(CHERLINKA, 2022)**

3.2. Tillage

The essential role of tillage is to obtain a soil condition favorable to the establishment of crops and their root development. It allows the maintenance of the soil and the reorganization of its structure in order to welcome a new culture in the best agronomic and economic conditions

3.3. Ensure quality sowing

The preparation of the soil should make it possible to obtain a regular distribution of seeds on the ground, a suitable burial to protect them from seed animals and placement in contact with a sufficiently humid soil favoring their germination. In the latter case, unless the humidity is excessive, the preparations of the soil must allow, after sowing, the contact of the seed with a portion of soil that is stale or packed in which the movements of the water will be easily made. **(ANGONIN, 2024)**

3.4. Improving internal circulation in the soil

The tillage helps to conserve and increase the porosity of the soil and improve the permeability of the layer worked. It can indeed lead both to an increase in percolation, that is to say the descent of the water in depth, as well as an improvement in the lateral circulation of the water. **(ANGONIN, 2024)** Plowing before winter at a certain depth can disrupt the life cycle of some pests, not only by its mechanical effects, but also by exposing them to colder temperatures that can be fatal, to predation by birds or small mammals, or by burying them deep in the ground.

3.5. Crops rotation

Planting different crops in succession on the same piece of land is known as crop rotation, and its goals include enhancing soil health, maximizing nutritional content, and reducing insect and weed pressure. Let's take an example where a farmer plants a field of maize. He may plant beans after the corn harvest is done because beans replenish the nitrogen in the soil while maize uses a lot of it. a basic rotation can comprise two or three crops, while a complex rotation can include twelve or more. Different plants have different nutrients and are vulnerable to various diseases and pests. In conventional farming, if a farmer plants the same crop in the same spot every year, she will be taking the same nutrients out of the soil. Since their favorite food source is always present, illnesses and pests gladly establish a permanent home. These kinds of monocultures necessitate higher dosages of chemical pesticides and fertilizers in order to maintain high yields while warding off insects and disease. Crop rotation aids in restoring soil nutrients without the need for artificial inputs.

Additionally, by boosting biomass from the root structures of various crops, the approach helps to enhance soil health, break the cycles of pests and diseases, and boost biodiversity on the farm. Variety is essential for soil life, and it also draws pollinators and beneficial insects to the variety found above soil. **(BAKER & RICHER, 2009)**

3.6. Lime-sulfur

A fungicide made of lime and inorganic sulfur, it is widely used nowadays to manage a range of illnesses, including plum pockets, black knot, black spot-on roses, and several diseases of raspberries.

4. Physical control

Control of horticultural and agronomic insect pests was prioritized through the use of physical and mechanical methods. Urban and stored-product pests can now be controlled using some of the methods used for commodity pests. Modern physical and mechanical procedures range in complexity from basic handpicking to the intricate use of machines, and they entail direct or indirect human input.

4.1. Traps types

a. sticky traps

Sticky traps are colored paper or plastic boards that are dyed the same color on both sides and coated with glue. The insects get stuck to this glue, stopping them from being able to bother your plants, Sticky traps for insects come in several different colors, as different insect species are attracted to different colors. Using sticky traps for insect control. Generally, sticky traps are only used for monitoring pest infestations and not directly as a control method. Only adult insects are drawn to the traps; most damage is usually caused by the larvae that are found in the soil. Additionally, a small percentage of insects always manage to escape the trap and continue to procreate. Nevertheless, using sticky traps for insects makes sense as they can help detect infestations at an early stage and allow you to act quickly to take measures to tackle the problem. As they also allow you to detect infestations more easily and monitor pest numbers, the traps also help to gauge how successful your control method is. Sticky traps work by making use of the fact that insects are instinctively drawn to the respective color of the traps as well as the light reflected by them. Many insects are attracted to the color yellow, for instance, as it is the color of flowers containing nutritious pollen and nectar. This causes the insects to fly towards the traps and get stuck in the glue.

b. Light traps

Light traps use artificial light sources to attract and capture nocturnal flying insects. These traps are effective for monitoring and managing flying insects that are active at night, such as certain types of moths, beetles, and other flying insects.

c. Pheromone traps

Insect hormones that mimic the aroma that female insects release to entice or lure their male counterparts are used in pheromone traps. Males that are drawn into traps are unable to procreate. By counting insects captured over time, these traps help the farmer determine the insect pest's mating behavior. With the use of this knowledge, wise decisions can be made about when to release beneficial insects and when to employ insecticides and organic repellents to control big populations of pests**.** **(Kammara & Meghlatha, 2023)**

d. Trap Plants

Another method for IPM intercropping is to put trap plants in patches. According to this integrated pest management strategy, pests should be drawn to particular plants and then managed via mechanical or chemical means. Soybeans in particular can be grown as Japanese beetle trap crops. Cabbage root maggots are also drawn to radishes. **(CHERLINKA, 2022)**

4.2. Barriers

Barriers deny insects access to feeding and oviposition sites. A variety of mate rials and techniques have been used as barriers, including screens, row covers, mulches, trenches, various particles, bags, shields, and packaging.

a. Palms leaves

In oases system they use palms leaves as a barrier to protect the crops from many things like pests, sand, winds, rodents and animals.

4.3. Temperature

For growth, microbes require a minimum, an optimum, and a maximum temperature. For bacteria, temperatures below the minimum typically have a static effect. By slowing down metabolism, they prevent microbial development but do not always result in the organism's death. Since they denature proteins and microbial enzymes, temperatures over the maximum typically have a tidal effect. One popular and useful method of managing bacteria is temperature.

a. Heat

Steam/Heat Therapy An effective integrated management strategy to combat pests, their eggs and larvae, diseases, and weed seeds at high temperatures is heating or steaming soils. Additionally, heating and steaming can contaminate agronomic instruments, organic debris, and composts. By burning fuels to create water steam, this mechanical integrated pest control method treats the soil. Pasteurization (160–182°F) or sterilization (212°F) for 30 minutes are two methods for heating soil. igniting agricultural land prior to use in order to rid the soil of any living things. **(Kammara & Meghlatha, 2023)**

b. Cold

Low temperature inhibits microbial growth by slowing down microbial metabolism. Examples include, Refrigeration and Freezing: Refrigeration at 5° C slows the growth of microorganisms and keeps food fresh for a few days. Freezing at -10° C stops microbial growth, but generally does not kill microorganisms, and keeps food fresh for several months.

4.4. Controlled atmospheres

An agricultural storage technique known as "controlled atmosphere" involves controlling the temperature, humidity, and concentrations of carbon dioxide, nitrogen, and oxygen in a storage room. It is possible to keep fresh produce as well as dry goods in regulated environments. Because freezing food kills germs and other microbes and inhibits their growth, controlled atmosphere storage is beneficial in minimizing nutrient loss. Foods can also be dried to restrict the growth of germs by removing moisture, which lowers the activity of enzymes in the meal.

5. biological control

Biological control is the intentional manipulation of populations of living beneficial organisms in order to limit populations of pests. Although biological control can be used to control weeds, the microorganisms that cause plant diseases, and even some vertebrates, this study focuses on the biological control of insects and mites. In this study we refer to the beneficial organisms that attack pests as natural enemies of insects are a diverse group of organisms that includes predators, parasitic insects, nematodes, and various microorganisms. The intent of biological control is not to eradicate pests, but to keep them at tolerable levels at which they cause no appreciable harm. In fact, because natural enemies require their prey or hosts for survival, biological control works best when there is always a small population of pests to sustain their natural enemies. This major difference between biological control and the use of pesticides**. (MAHR, 1993)**

6. Recognizing the role of natural enemies of pest insects

When a species successfully preys on resources that humans attempt to protect to the extent that it poses a serious risk to human health or property, it is deemed a pest. Among the many species of insects in our surroundings, they comprise a very tiny percentage. Rarely do many of the animals that we classify as major pests endanger people or our resources**. (STONER, 1998).** The densities of possible pests are significantly reduced by natural enemies. This has been shown time and time again when natural adversaries of potential pests have been decimated by chemicals. Released from the clutches of their natural enemies, once-insignificant insects often grow into dangerous pests. On the other hand, when a non-toxic technique for managing a key

There are four categories of natural enemies of insect pest are:

6.1. Predators

They may be insects or other insectivorous animals, each of which consumes many insects prey during its lifetime. Predators are often large, active, and/or conspicuous in their behavior, and they are therefore more readily recognized than are parasites and pathogens. the important insect predators include lady beetles, ground beetles, rove beetles, flower bugs and other predatory true bugs, lacewings, and hover flies. Spiders and some families of mites are also predators of insects, pest species of mites, and other arthropods **(MAHR, 1993)** (Table 1).

Table 1: Liste of some common predators found in agroecosystems **(Coll, Moshe, and Richard L. Ridgway, 1995)**

Order	Family	Predators	Prey	Reference
Orthoptera	Mantidae	Praying mantids	large and small insect	Bellows,1996
Dermaptera	Labiduridae	Earwigs	Caterpillars, many others	Ruberson, 1996
Thysanoptera	Aleolothripidae	Predaceous thrips	Spider mite eggs	Ruberson, 1996
Heteroptera	Anthocoridae	Minute pirate bugs	Insect eggs, soft-bodied	Naranjo,1996
	Lygaeidae	Big-eyed bugs	Insect eggs, soft-bodied	Ruberson, 1996
	Nabidae	Damsel bugs	Insect eggs, small insects	Ruberson, 1996
	Miridae	Plant bugs	Insect eggs, soft-bodied	Naranjo, 1996
Neuroptera	Chrysopidae	Lacewings	Aphids, soft-bodied insects	Driestadt, 1998
Coleoptera	Coccinellidae	Lady beetles	Aphids, soft-bodied	Driestadt, 1998
	Carabidae	Ground beetles	Insect eggs, soft-bodied	Ruberson, 1996
	Staphylinidae	Rove beetles	small insects	Ruberson, 1996
	Melyridae	Soft-winged flower	Insect Eggs, soft-bodied	Ruberson, 1996
Diptera	Cecidomyiidae	Predaceous	midges Aphids	Driestadt, 1998
Hymenoptera	Formicidae	Ants	Insect eggs, soft-bodied	Ruberson, 1996

6.2. Parasitoids

Parasites of insects (also called parasitoids) are insects that lay their eggs in or on a host insect. When the parasite egg hatches, the young parasite larva feeds on the host (the pest) and kills it (figure1). Usually that one host is sufficient to feed the immature parasite until it becomes an adult. Many parasites are host-specific, meaning they attack only one or at most a few closely related species of host. No insect parasites are harmful to humans or other vertebrates. Although very common, they are not well known because of their small size. **(MAHR, 1993)** There are species with a parasitoid lifestyle in 6 orders: Hymenoptera (67,000 species, about 75% of parasitoids), Diptera (16,000 species), Beetle (4000 species), Neuroptera (50 species), Lepidoptera (11 species) and Trichoptera (one species).

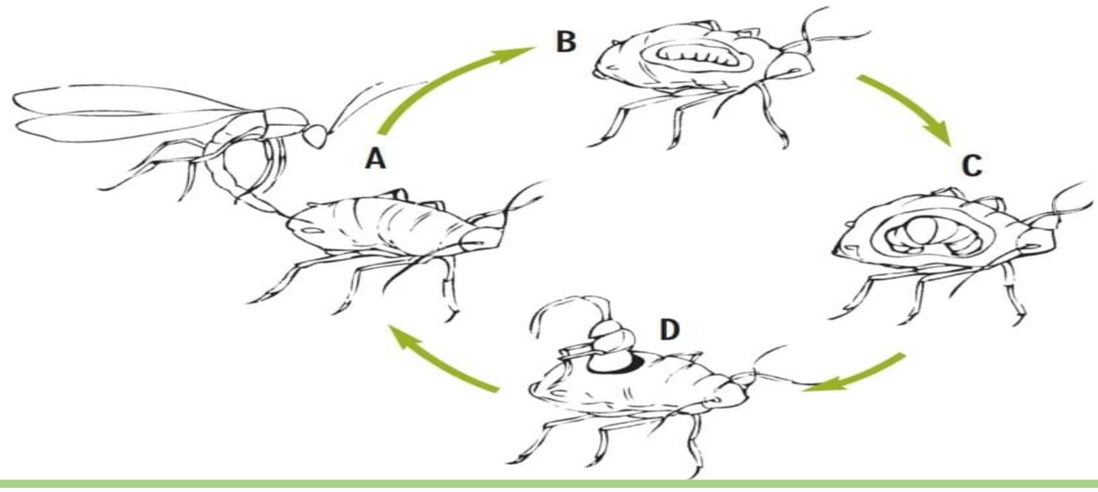

Figure 1: The generalized life cycle of a parasitic wasp, as exemplified by an aphid parasite. (A) Wasp lays egg in a host, in this case a young aphid. (B) As host feeds and grows, parasite larva feeds on host and also grows. (C) When parasite larva is full grown, it pupates within the host, which is now dead. (D) The parasite pupa transforms into an adult wasp, which emerges from the host. After mating, the young wasp seeks new hosts to parasitize.

Table 2: Liste of some common parasitoids found in agroecosystems **(Coll, Moshe, and Richard L. Ridgway, 1995)**

Order	**Family**	**Predators**	**Prey**	**Reference**
Diptera	Tachinidae	Beetles, moths	Internal	Knutson, 1996
	Nemestrinidae	Locusts, beetles	Internal	Dreistadt,1998
	Phoridae	Ants, caterpillars	Internal	Dreistadt,1998
	Cryptochaetidae	Scale insects	Internal	Dreistadt,1998
Hymenoptera	Chalcididae	Flies and butterflies	Internal or External	Dreistadt,1998
	Encyrtidae	Various insect's eggs	Internal	Knutson, 1996
	Aphelinidae	Whiteflies, scales	Internal	Bellows, 1996
	Trichogrammatidae	Moth eggs	Internal	Bellows, 1996
	Scelionidae	Insect egg of true bug	Internal	Dreistadt, 1998
	Ichneumonidae	Larvae or pupae of beetle	Internal or External	Ruberson, 1996

6.3. Microorganisms

These are bio-pesticides developed from pathogens such as viruses, bacteria and fungi. They have some advantages over conventional pesticides. They are more selective, generally non-toxic to predators and parasitoids and have less harmful effect on the environment. Microorganisms include bacteria (about a hundred species), viruses (650-1200 species), fungi (700 species) and protozoa (six phyla) pathogenic to insects.

6.4. Entomophagous nematodes

Entomophagous nematodes exploit insects as a resource to develop and reproduce. There are entomophagy nematodes in 30 families, which represents about 4000 species.

a. Biological control through acclimation

Where exotic auxiliaries are introduced to control exotic pests. This approach has been successfully used in open fields. This tactic has led to the permanent reduction of more than 165 pest species worldwide. Auxiliary species introduced are most often indigenous to the area of origin of the target pest. **(KHASIRIKANI, 2009).** Generally, acclimatization is ecologically successful when the introduced auxiliary is found at least 3 years after its release.

The success of such an operation depends on a number of conditions:

- Plasticity of adaptation and its plasticity to defeat a new environment "Presence of shelters, permanent food, climatic conditions…".
- Biological potential, parasitic specificity, research behavior, high reproductive power compared to the pest.
- the biological characteristics of the target population.
- Dynamics, voltinism and spatial distribution on the plant.
- To the technique used.
- Season, type and quantity of release, choice of species and ecosystem.

b. Augmentative biological control

Exotic or indigenous auxiliaries are periodically released at selected periods, either by flooding a field with a large number of individuals without the establishment and reproduction thereof being targeted (biological flooding), or by inoculating relatively small quantities of auxiliaries which must be established, multiply and colonize a given zone and it is therefore their descendants that will be effective (biological inoculative struggle). However, this establishment is generally not permanent and introductions should be made one or more times per season. This tactic is often used in closed agricultural systems such as greenhouses. Augmentative biological control has been used for 90 years, and more than 150 auxiliary species are commercially available for controlling about 100 species of pests **(KHASIRIKANI MBAKWIRAVYO, 2009).**

c. Biological control by conservation

Conservation biological control tends to manipulate the habitat to increase the impact of auxiliaries already present in the crop, using pesticides to a minimum and providing the main ecological resources (ecological infrastructure). (IOBC) The International Organization for Biological Control, defines ecological infrastructure as “any infrastructure, in a farm or within a radius of about 150 m, which has ecological value, such as hedge, meadow, floral strip, stone heap, etc. and judges that its judicious use increases the functional biodiversity of the farm. This approach (conservation and management of existing auxiliaries), which appears to be both the most logical and the most obvious, is in fact more difficult than it seems to be implemented.

a. The protection of orchard auxiliaries requires:

- The control of the populations of the pest populations.
- The development of a reasoned chemical control, by the decision of an intervention according to the real risk, the choice of the specific active ingredient, the respect of the doses and the conditions of application.

7. Biotechnic control

7.1. Sexual pheromones in insects

In Lepidoptera, twilight or nocturnal mores, the sexual pheromone is produced by the virgin female at a specific moment of the Nychtemere: this is the calling behavior. This emission period corresponds to that where the males are most receptive to the perception of this chemical message, these specialized receptors located on their antennas. This results in a specific attraction at a distance from the male which, following an oriented flight, accurately locates its female. All attractive sex pheromones of Lepidoptera are long-chain aliphatic fatty acids, having one or more conjugated or non-conjugated unsaturations. In the case of beetles, there is more diversity because sexual pheromones can be produced either by females (Dermestidae, Scarabidae), or by the Mâies (Curculionidae, Bruchidae). They also attract the opposite sex partner from a distance, but can also act as a simple short-distance sexual stimulant.

In Diptera, the sexual pheromones emitted by females are hydrocarbons with long chains, of cuticular origin. They serve more aphrodisiacs for males than real attractants. **(KHASIRIKANI, 2009).**

7.2. Agronomic application of insect sexual pheromones

Techniques of agronomic use of pheromones are intended for mass trapping or sexual confusion of insect pests.

a. Monitoring

Attractive sexual pheromones of lepidoptera are widely used to monitor harmful species, especially in fruit arboriculture, by selective male trapping. The method consists of placing, in the center of a sticky trap, an attractive capsule loaded with a synthetic mixture reproducing as faithfully as possible the pheromonal bouquet produced by the female of the species to be supervised. The traps, once placed in the plot, provide information on the periods of appearance of adults, the duration and intensity of the flights and especially on the relative importance of the population. This information, which is the basis of any integrated pest management strategy, makes it possible to determine the thresholds of pests below which it will be useless to intervene, the same method is applicable to beetles, mealybugs, and fruit flies

d. Mass Capture

This method is based on the use of traps containing or not containing a chemical attractant to collect pests to limit their population and their offspring in a crop. Different types of traps exist: pheromy traps, food traps, chromatic traps or light traps.

7.3. Growth regulators

These are synthetic chemicals that inhibit natural hormones and govern the development of insects. These growth regulators are more selective, less harmful to the environment and more compatible with biological control. There are three types of growth regulators: chitin synthesis inhibitors, juvenile hormone analogs, and juvenile anti-hormone agents. **(KHASIRIKANI MBAKWIRAVYO, 2009).**

II. Main enemies of cultures in the world

1. Crops pests

Productivity of crops grown for human consumption is at risk due to the incidence of pests, especially weeds, pathogens and animal pests. Crop losses due to these harmful organisms can be substantial and may be prevented, or reduced, by crop protection measures. **(OERKE, 2006)** Agricultural crops are attacked by a wide variety of pests, the most important being: insects, mites, and nematodes.

2. Insects

An insect is any member of the largest class within the phylum Arthropoda, which is the largest of the animal phyla. This class is known as the Insecta or Hexapoda. Insects have external skeletons, jointed legs, and segmented bodies (exoskeletons). The body of an insect is separated into three main regions that set it apart from other arthropods: The head, housing the eyes, mouthparts, and two antennae. The term "Hexapoda" refers to the three-segmented thorax, which typically consists of one or two pairs of wings and three pairs of legs in adults. The digestive, excretory, and reproductive systems are located in the numerous segments of the abdomen. Insects range widely in size, but most are small, typically measuring less than 6 mm (0.2 inch) in length. Feather-winged beetles and Some **(WIGGLESWORTH, 2024)**

a. Insect damage

There are two main types of damage that insects cause to crops that are growing. The feeding insect, which feeds on leaves or burrows in stems, fruit, or roots, causes direct harm to the plant first. This class of pest includes hundreds of species among the orthopterans, homopterans, heteropterans, coleopterans, lepidopterans, and dipterans, both as adults and as larvae. Indirect damage refers to the situation where an insect causes minimal or no harm to a crop, but instead spreads a bacterial, viral, or fungal infection. Aphids spread the viral diseases, such as those affecting potatoes and sugar beets, from plant to plant. 2024's **(WIGGLESWORTH, 2024**)

3. Mites

Mites are microscopic arthropods that are the second most diverse group after insects. They can be found in many habitats and damage agricultural crops by sucking plant sap. Common phytophagous mites include spider mites, gall mites, rust mites, and false spider mites**. (SINHA, 2021).** Mites are minute (usually less than 1mm) arachnids with eight legs when adults. They are often pests of animals and plants, infest stored food products and in some cases transmit diseases. **(PETERSON & Hannah, 2023).**

a. Mite's damage

Mites damage crops by piercing plant cells with their mouthparts and sucking the plant juices. The first evidence of mite feeding which usually can be seen on the top of the leaf is a yellow or whitish spotting of the leaf tissues in areas where the mites are feeding on the lower leaf surface **(PETERSON & Hannah, 2023)**

4. Nematodes

Nematodes are roundworms that resemble threads and can live in both fresh and salt water as well as soil. Certain nematode species consume bacteria, fungi, protozoa, plants, and other nematodes as food. They are also capable of parasitizing animals, people, and insects. Plant parasitic nematodes (PPN) are nematodes that consume plant parts and are commonly found in soil used for agriculture. Nematodes have three life stages: eggs, juveniles, and adults. Any of these stages can overwinter. The environment, the pathogenicity of the nematode species, the plant's tolerance to nematode feeding, and the initial nematode populations at planting all interact in a complex way to cause crop damage. **(WILLIAMS, Geoffrey M., and Matthew D. Ginzel, 2023)**

a. Nematode's damage

The majority of PPNs feed by using structures called stylets, which resemble needles, to pierce and kill root cells. This kind of feeding is used by lesion, lance, needle, sting, stunt, and sting nematodes, among other nematodes. A permanent feeding site is established by some of the most economically destructive nematodes, such as the soybean cyst nematode (SCN) and the root knot nematode (RKN), where they finish their life cycles without destroying the surrounding cells. Nematode infection symptoms can mimic both biotic factors like stem and root rots and abiotic stressors like nutritional deficiencies and drought because they are similar to symptoms of impaired root growth and function. **(WILLIAMS, Geoffrey M., and Matthew D. Ginzel, 2023)**

5. Crop diseases

In agriculture, several disease-causing agents can infect plants simultaneously. A plant is often more vulnerable to infection by pathogens when it is experiencing nutrient deficiencies or an imbalance between soil moisture and oxygen. Additionally, plants that have already been infected with one disease are frequently more susceptible to secondary pathogen invasion**.** Historically, crop disease has been divided into two categories: biotic (infectious) and abiotic (also referred to as non-infectious). Noncommunicable diseases are often the consequence of unfavorable environmental conditions. Examples include extremes in temperature and moisture content. Infectious disease agents, commonly referred to as biotic disease agents, are pathogens that are living organisms that have the ability to spread from one host to another and cause illness. **(Wright, 2022)**

Pathogens are classified into the following categories:

5.1. Fungi

Pathogenic fungus is the most prevalent issue in agriculture. Studies show that about one-third of all food crops are destroyed annually by this type of plant disease. The issue is serious in this regard from both an economic and humanitarian perspective. Similar to bacterial crop diseases, these infections mostly impact plants through their stomata, water pores, and wounds. Moreover, gusts of wind frequently carry fungal spores.

5.2. Viruses

The smallest and most dangerous plant enemies are viruses (subviral contagious agents). After a plant becomes infected, it is nearly impossible to save it. The majority of the time, contact between healthy and diseased plants is how the infection spreads. Moreover, viruses can proliferate vegetatively by taking the form of insects, pollen, and seeds. But the most common way for viruses to spread is through the soil.

5.3. Bacteria

Among the most prevalent infections in agriculture are bacterial crop diseases, which are typically brought on by bacteria. This makes it challenging to prevent and control this kind of illness. For the culture's tissue to become infected, the causative agent needs to penetrate it. It mostly happens as a result of damaged areas, which can be brought on by agricultural tools, insects like fleas, or just bad weather conditions like wind, dust, and heavy rain. Conversely, plants can become infected with bacteria through built-in gaps or glands (like those that secrete nectar).

5.4. Parasitic plants

Feed on crops and, since they are chlorophyll-deficient, obtain it from the host plant. For example, dwarf mistletoe grows on other plants and feeds on their nutrients. algae They don't really harm anything, in theory, but in some situations, they might be troublesome.

6. Weeds

Unwanted and undesirable plants known as weeds negatively impact human welfare by interfering with the use of water and land resources. Another name for them is out-of-place plants. In crop land, they compete with the desirable and beneficial vegetation. Although they have a significant impact on all land and water resource management, agriculture is most affected by weeds. Weeds are the agricultural pest category that causes more losses than any other. Weeds account for 45% of the annual produce loss in agriculture, insects for 30%, disease for 20%, and other pests for 5% **(TNAU and COMBATORE, 2016)**.

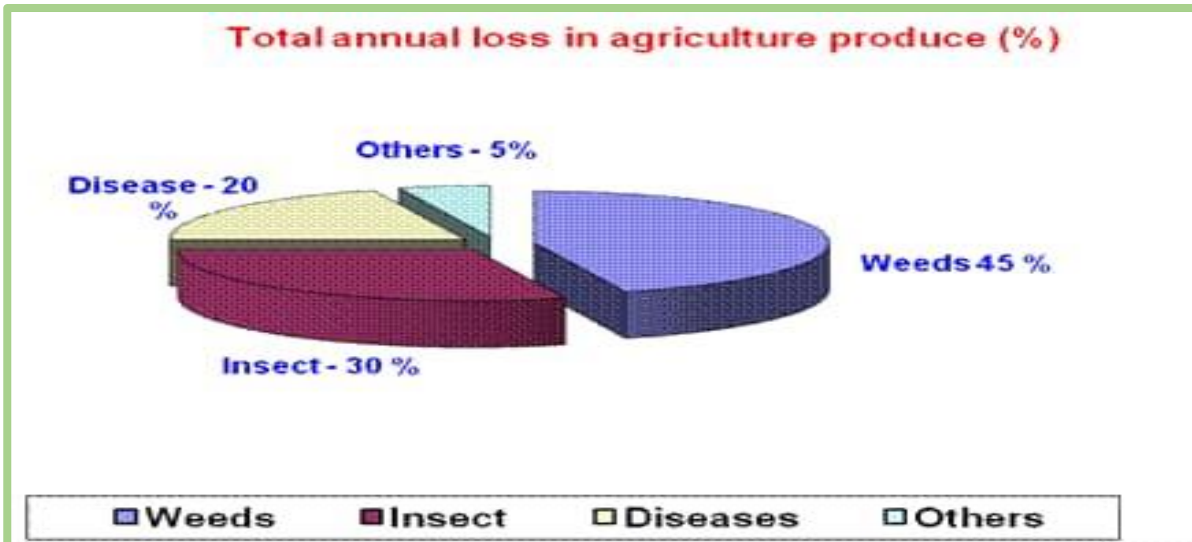

Figure 2: Total annual loss in agriculture produces **(TNAU and COMBATORE, 2016)**

Chapter two:

Material and Methods

I. Presentation of the study area

1. Geographic location

The wilaya of Ghardaïa is located in the northern and central part of the Algerian Sahara (Figure 4), and it extends over 21.352.58 Km² **(DPSB, 2016)**. Administratively, it is limited by the following wilayas:

- To the north by the wilaya of Laghouat
- To the north-east by the wilaya of Djelfa
- To the east by the wilaya of Ouargla
- To the south by the wilaya of El Menia
- To the west by the wilaya of El-Bayadh

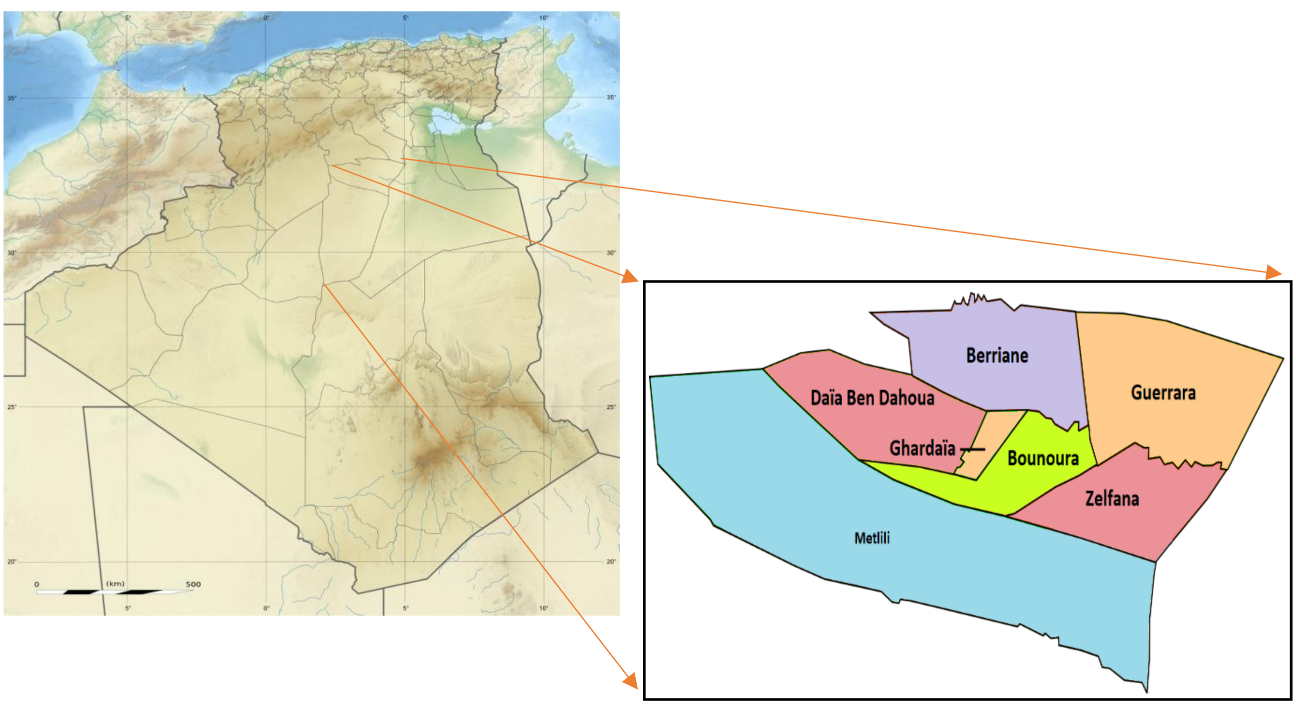

Figure 3: Map showing the location and boundaries of Ghardaia wilaya
(google,2023 modified)

2. Geomorphology of Ghardaïa

The Ghardaïa region is characterized by places where water accumulates and drainage channels, as well as a plateau of rocks known as the "Hamada". Four major sets are presented

a. Chebka du M'zab

Is a rocky Cretaceous plateau and cut by small valleys of overlapped directions generally directed towards the east, which can reach a few kilometers in width. The encasing formations include generally dolomitic limestone above layers of marls. This rocky plateau occupies an area of about 8000 km2 **(COYNE, 1989).**

b. Dhayet bendhahoua region

Its geological mio-pliocene bedrock, the daïa are depressions of very variable dimensions. Only the municipality of Guerrara, located to the northeast, occupies a small part of this plateau **(BENSAHA, 2011).**

c. Region of the regs

They are in the form of expanses of stony solid soils without apparent relief located to the east (Zelfana, Banoura and El Atteuf), and geological substratum of the Pliocene **(Khene, 2013).** Erg region dominated by the western erg, dune massif. It constitutes a source of silting for agricultural perimeters, in the Mansoura – El Menia axis **(Khene, 2013).**

3. Socio-economic context

Of the administrative division of the territory of the year 1984, brings together 13 municipalities and 9 daïra.

3.1. The evolution of population

More than 451,456 inhabitants are divided into nine municipalities. The municipality of Ghardaïa, capital of the wilaya which extends over a small area compared to other municipalities, includes the highest concentration in population (Table 3).

Table 3: Total population of Ghardaia region **(DPSB, 2022)**

Towns	Population	Surface(m²)	Density (%)
Ghardaia	137.123	306.47	447.43
Dhayet bendhahoua	19.192	2234.94	8.59
Berriane	42.000	2609.80	16.09
Metlili	60.860	5010.12	12.15
Guerrara	82.000	3382.27	24.24
El atteuf	21.406	717.01	29.85
Zelfana	10.137	1946.23	5.21
Sebseb	3.049	4366.82	0.7
Bounoura	61.781	778.92	79.32
Total	470.369	84353.65	4.25

3.2. Agricultural activity

Several factors characterize the agricultural activity of the region: the aggression of the climate (low precipitation, excessive evapotranspiration, etc.), the nature of the soil in agricultural production areas, the oasis system, the vast agricultural areas, and the hydrogeological reservoir **(DPSB, 2022).** Environmental Exploitation: There are two main ways to exploit this environment:

- The old oasis: relies entirely on the exploitation of shallow groundwater or wadis floods.
- The development of vast agricultural areas the creation of new irrigated perimeters by deep boreholes in the Albian aquifer, which give a very high flow.

3.3. Agricultural production

Various agricultural divisions are witnessing an expansion of the cultivated area and an increase in production, in particular important crops such as vegetables and fruits. The largest planted area is in the fruit crop, and the largest production is in the vegetable's crops, as for the other crops, they reach significant figures. **(DSA, 2019)**

Table 4: productive potential of Ghardaia **(DSA, 2020)**

Crops	Surfaces(ha)	production
Vegetable crops	4500	870100
Fruit crops	16341	60666
Herbaceous crops	22643	
Industrial/ aromatic .C	785	50343
Fig tree	251	12462
Citrus	1416	75268
Date palms	11564	620000
Olive	1945	59000

3.4. Agricultural areas:

There is a remarkable evolution in the agricultural areas of the wilaya of Ghardaïa, where the areas increased from 44,155ha in 2015 to nearly 72,500 ha in 2022.

Table 5: Agricultural areas of Ghardaia region **(DSA, 2022)**

Total area (ha)	8466021
Total agricultural area	1370911
Useful agricultural area	72491

4. Abiotic factors

Abiotic factors are represented by edaphic and climatic factors

4.1. Edaphic factors

Edaphic factors have an ecological action on living beings, they play an important role, in particular for insects that perform part or even all of their development in the ground **(DREUX, 1980**). According to (Ramade, 1984), soil is the essential element of biotopes. In this part, mainly two factors are developed, first the soils then hydrology and hydrography of the study region.

a. Soil

At the level of the Ghardaïa region, the soils are skeletal following the action of wind erosion and often marked by the presence on the surface of an abundant clayey **(DUBOST, 1991).** In depressions, soils are richer thanks to the accumulation of alluvial deposits. **(DADDI BOUHOUNE, 1997).** indicates soft, deep, low-salted and sandy-loamy soils, little to moderately calcareous, alkaline to strongly alkaline and have a low gypsum content. The cation exchange capacity (CEC), is moderately low as well as organic matter. According to (DJLLI B, 2004), it is possible to identify six cartographic units which made it possible to make a sketch of a soil map.

- stony ground from the surface
- Sandy-gravelous soil
- silty soil in loamy-sandy
- sandy-loamy soil on sand
- sandy limestone soil on sand
- Sandy soil with sandstone gravel

b. Hydrology

Hydrology in the desert not only is precipitation rare and irregular but evaporation is considerable and higher than the level of precipitation **(DSA, 2020).** Even in the heart of the Sahara one can witness unusual phenomena such as floods. During some exceptional years, such as at the beginning of the past century when in 1991, in autumn 1994, and in October 2008 violent floods broke down on the valley causing serious damage **(DSA, 2018).**

c. Hydrical resources

Instable resources depend mainly on the drilling of shallow wells and small dams to direct the floods of valley. For a long time, the valley was the only oasis water resource until the first drilling in the continental intercalary.

d. Groundwater

Groundwater is often stored in a very large "Aquifer" reservoir, for the exploitation of this resource, wells must be drilled to a deep level. The underground water resources are composed of three characteristic waters:

- Superficial groundwater
- Terminal complex groundwater (CT)
- Intercalary continental groundwater (CI)

II. Climatological study

The aim of this study is to provide an overview of the climate characteristics of the region. and to determine the different parameters that condition the surface discharge and underground. The parameters studied are: precipitation, temperature, humidity, and evaporation for a series of observations from 2009 to 2019 taken at the Ghardaia station **(ONM)**

1. Temperature

One of the elements that affects an insect's ability to survive and multiply is temperature. In research, it is the primary factor that must be considered. In entomology, bioecological. **(DSA, 2024).** The characterization of the climate of Ghardaia is made from a climate synthesis, the recorded data was collected for a period of 10 years using (Tutiempo) 2024 (Tableau 6)

Table 6: Temperature data of the Ghardaia region in 2024

Ghardaïa	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
T (°C)	11.55	13.50	16.82	21.61	26.84	31.63	35.07	33.97	30.03	23.30	16.89	12.5
P (mm)	1.60	3.84	3.53	3.66	3.99	0.71	0.20	4.09	4.70	3.27	3.35	1.27

2. Humidity

The water vapor content of the atmosphere is known as relative humidity, or hygrometry, according to Ramade (2003). It is between the most important factors for the survival, dispersal, and procreation of insect life. It is more variable and dependent on wind, precipitation, and temperature.

3. Wind

Is another important climate factor in characterizing the climate. The results of average monthly wind speed recorded at Ghardaïa station during the study period (2014-2024), the average monthly wind speed was the highest high is recorded during the month of March (14.20Km/h). On the other hand, the lowest value is recorded in October (9.86Km/h), and December (10.71Km/h).

III. Methods of study

1. Objective of study

The aim of our study is to survey all the biological agricultural practices that are used by farmers in the region of Ghardaia, in order to protect their crops. The sampling was carried out during the period from January to April 2024, and the samples were randomly chosen across the studied sites.

Our current study is based mainly on one methods of data collection which is a field survey using a **questionnaire**, it includes several questions directed to farmers and focuses on 3 basic parts:

- General information about the farmer.
- Information about the farm.
- Information about plant protection.

The questionnaire was translated into Arabic to facilitate communication and understanding to the farmers (Annexe 1).

2. Development of the questionnaire

A questionnaire is a list of questions or items used to gather data from respondents about their attitudes, experiences, or opinions. Questionnaires can be used to collect quantitative and qualitative information. **(BHANDARI, 2021)**

During our investigations we used a multi-part questionnaire of which the most important are:

- The age of the farmer
- Level of education
- Agricultural area and geographical location
- Cultivated crops
- Types of pest’s present
- A table that includes the types of controls (cultural; physical; chemical; biological and integrated)
- Type of biological agricultural practices
- Effectivity level of biological agricultural practices

3. Sampling

Our questionnaires covered 30 agricultural farms across the region of ghardaïa which includes: Dhayet Bendhahoua, Matlili, El Atteuf, Bounoura, Zelfana, Sebseb, Berriane, El Guerrara. (table 7) and (figure 6)

Table 7: Presentation of the investigation sites in the Ghardaia region.

Region	Sites	Number of samples	Type of cultivated crops
Ghardaia	Dhayet Bendhahoua	5	Palm / citrus / vegetables
	Matlili	5	Palm / olive / citrus / feed / vegetables / beans
	El-Atteuf	2	Palm /beans / feed / vegetables / citrus
	Bounoura	4	Palm / olive / vegetables / citrus / saffron
	Zelfana	2	Palm / beans / vegetables
	Sebseb	5	Palm / beans / vegetables / feed / citrus
	Berriane	1	Palm / vegetables
	El Guerrara	2	Palm / vegetables

4. Questionnaire procedure

The investigations were conducted in the selected farms, through direct interviews with the farmers. This is done in order to avoid obtaining incomplete data as well as misunderstandings. For each interview we took from 10 -15 minutes depending on the response and reaction of the farmer. Some answers were verified through direct observation in the field during the survey.

In some cases, Some farmers at the level of the Agriculture Office (DSA) in charge of the Ghardaia town.

5. Data collection and processing

The collected data during the survey were introduced and categorized into computer to create a database using Microsoft Excel 2021 software. The statistical parameters (averages and percentages) were calculated and used for the creation of distribution graphs for each of the analysed parts of the questionnaire.

A: Matlili

B : Sebseb

C : Dhayet Bendhahoua

D : Berriane

E : Bounoura

F : El-Atteuf

Figure 4: Photos from different spot in Ghardaia region

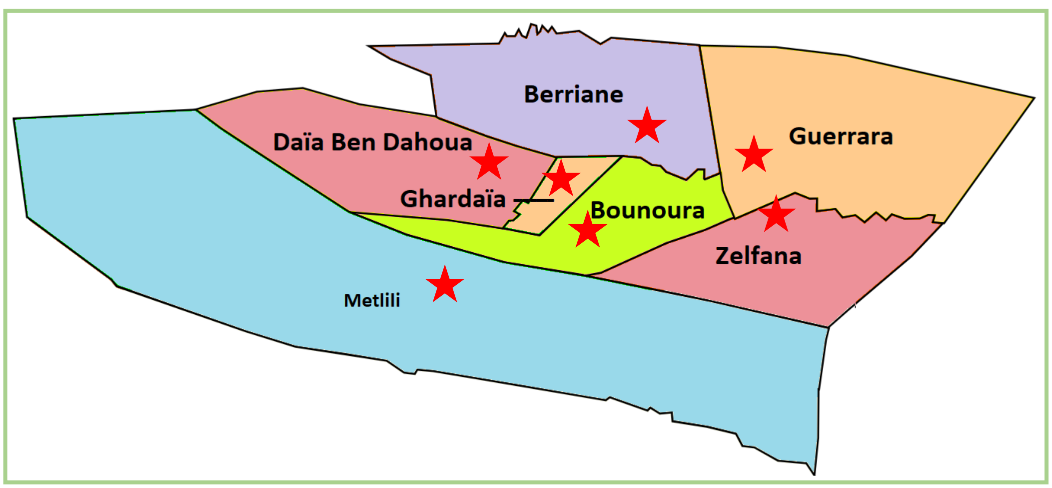

Figure 5: Sites location that we have studied in the region of Ghardaia

Chapter three:

Results and discussion

I. Presentation of results

In this section we present results of our survey that we have conducted in the study region.

1. General information about the farmer

1.1. The age of farmers

The farmers ages distribution in the studied region can be divided into 5 categories according to the results of Table 8 and figure 8.

The first category of ages is comprised between 50 and 60 years old, it represents the highest value with 43%, followed by the second category of ages comprised between 60 and 70 years, it represents 23% of the total result. The category of old farmers over 70 years old, was indicated by 17% rate. For the rest categories of (40-50) and (30-40) years old, the values are, respectively, 10 and 7%.

We notice that 43% of the farmers are between 50 and 60 years old, this is the highest recorded rate among the studied farms, the same result was confirmed by BEN HAMMOUDA & al., 2021 in their study in El Guerrara region, they have found that 50% of the farmers are more than 60 years and 33% are between 30 and 40 years.

Also, from comparing with ZITARI et al., 2022 result we found that 11% of farmers are in category (30-40) and 32% for the category of age from 40 to 50, 18% are for the category (50 -60) and for the last category with 39% for farmers who are more than 60 years.

From all the obtained results, we conclude that the farmers belonging to age section of 40 and 60 years old are the main agricultural practices in the studied region.

Table 8: age of farmers in Ghardaia

Age	Number of farmers	Relative frequency
30 – 40	2	7%
40 – 50	3	10%
50 – 60	13	43%
60 – 70	7	23%
Over 70	5	17%
Total	**30**	**100%**

1.2. Level of education

In our questionnaire we requested to knew the level of education and the farmers, the results are presented in the following (table 9) and (figure 9)

Table 9: Distribution of farms by level of education.

Level	Number	Percentage (%)
None	7	23%
Elementary	3	10%
Secondary	14	47%
University	6	20%
total	**30**	**100%**

The education levels of farmers in ghardaïa region are, nearly half of the farmers have a secondary education with a value of 47% then the farmers with none education there is 23% of them and 20% for postsecondary level, 10% of them are elementary level.

Comparing to BITOUR, Rehaiem.2022 results we can notice that there is no significant difference in the level of farmers education in Ghardaia, the following result will show that:

In the study of BITOUR , 2022, they found a similar result as ours, first we have none education level they find 30% of farmers without any education level , in our result there is 23% and that’s because most of farmers are elderly men’s, in the elementary level they found 25% and its more than the percentage of my result that have only 10% its less than the last years, then we have secondary level in their study they find 35% its less than my result that have 47% and it’s the highs percentage in the education level in ghardaïa that’s mean most farmers of our region have the secondary education level, lastly the postsecondary there is only 10% of farmers who have this level of education but I found 20% it’s more higher than the last year with 10% different. The education level in BITOUR, 2022 result is mostly similar with our study with only a few differences.

We conclude that the low educational level is an important reason why farmers are unable to improve the agricultural yield.

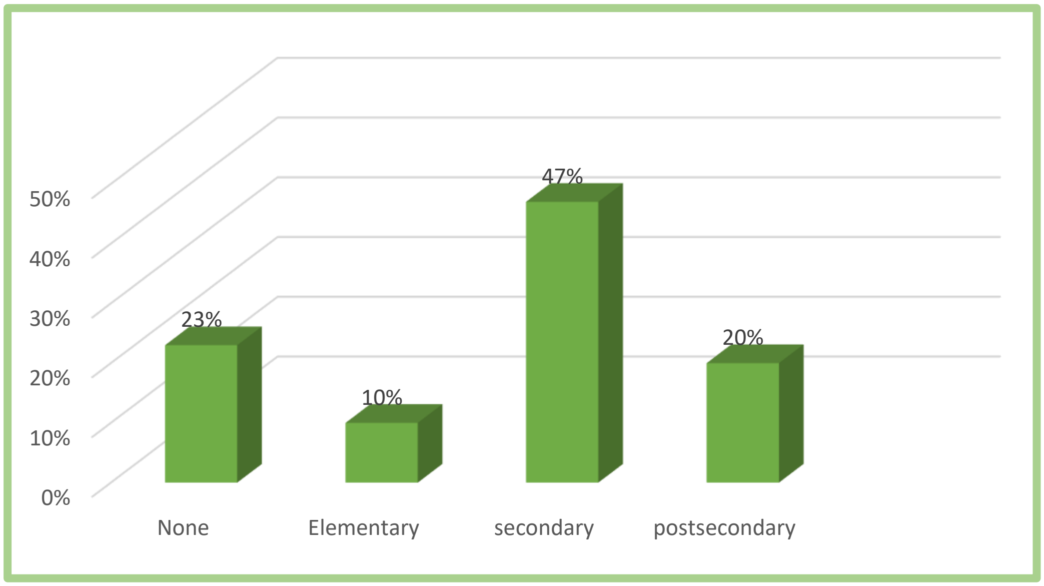

Figure 6: Distribution of farms by level of education in Ghardaia.

2. Information about the farm

2.1. Farm size

According to data relating to farm size are shown in (table 10) and (figure 10), we see that the surface area of farms is sometimes limited. We conclude:

- 7 farms use less than 2 ha, with a rate of 23% and these are oases farms.
- 21 farms own between 2 - 4ha, and percentage 70% these are average farms.
- 2 farms bigger than 4ha, and percentage 7% these are a large farm.

Table 10: Size of farms in Ghardaia region

Surface (ha)	Number of farms	Percentage (%)
< 2ha	7	23%
2ha-4ha	21	70%
> 4ha	2	7%

Comparing to BITOUR, 2022 study we can notice:

- 3 farms are less than 2ha, with percentage of 5% and its lees than my result
- 7 farms are between 2ha-4ha, 52% its less than our result
- 10 farms are more than 4ha whit 24% and its beiger than our result

Comparing to ZITARI, 2022 studies she founds:

- 9 farms are less than 2ha with percentage of 24% and beiger than our result
- 20 farms are between 2ha-4ha with percentage 52% its less than our result but it's the same result with BITOUR, 2022
- 9 farms are more than 4ha with percentage 24% this result is beiger than my result but it's the same with BITOUR, 2022

The differences between compared results may be explained by the fact that both studies subjects are not the same.

2.2. Irrigation water

According to (Table 11) and the results obtained in the questionnaire; we acknowledge that the percentages are close and the number of farms as well. Most of farms contain individual and collective water sources it's also contains water basins and tanks. Most farmers in the Ghardaia region depend on the use of irrigation methods specific applications such as spraying and dripping methods.

Table 11: Distribution of water sources on the farms surveyed.

Water source	Number	Percentage (%)
Individual	13	43%
Collective	11	37%
Tanks	6	20%
Total	**30**	**100%**

Category one: farmers who use the individual water sources are 43% and it's the highest level in ghardaïa region.

Category tow: farmers who use the collective 37% and it's the second highest level in ghardaïa region

Category three: farmers who use tanks with 20% they don't use it at much like the others

In ZITARI, 2022 results we found that there are only two water sources; collective water source with 47% and individual water source with 53%

2.3. Existing cultures

Depending on the crops grown, we were able to distinguish categories of farms depending on the surface area of each farm. The categories are presented in (table 12)

Table 12: Existing crops on the farms

Town	Sites	Number of sites	Type of cultivated crops
Ghardaia	Dhaia	5	Palm / citrus / vegetables / Fruit tree
	Matlili	5	Palm / olive / citrus / feed / vegetables / beans
	Al-Atef	2	Palm /beans / feed / vegetables / citrus/ Fruit tree
	Banoura	4	Palm / olive / vegetables / citrus / saffron/ Fruit tree
	Zelfana	2	Palm / beans / vegetables / Fruit tree
	Sebseb	5	Palm / beans / vegetables / feed / citrus / Fruit tree
	Brian	1	Palm / vegetables/ Fruit tree
	Grara	1	Palm / vegetables/ Fruit tree

Table 13: productive crops of Ghardaia **(DSA, 2023)**

Crops	Surfaces(ha)	Production
Vegetable crops	4500	870100
Fruit crops	16341	60666
Herbaceous crops	22643	50012
Industrial/aromatic .C	785	50343
Fig tree	251	12462
Citrus	1416	75268
Date palms	11564	620000
Olive	1945	59000

According to table 12 and 13 we notice that the dominant culture is the date palm and vegetables they have the largest surface area in Ghardaia. Through the interviews with farmers, we found that the majority of farmers depend on agriculture using greenhouses, especially seasonal vegetables, there is also the olive tree and Fodder crops represented mainly by the cultivation of fodder are intended for feeding livestock.

2.4. Crops enemies

We notice that most of the farmers in ghardaïa region suffer from many crop enemies like mites, weeds and insects. Fungal diseases and animal’s attacks are classified in second place as follow:

Table 14: Crop enemy species in ghardaïa

Pests	Host plant	Number of farms
Mites: Boufaroua *(Oligonychus afrasiaticus)* Red mites *(Tétranyque tisserand)*	Date palm	30 Farms
Insectes: Pussrons Tomato Leafminer *(Tuta absoluta)* Mediterranean fruit fly *(Ciratitis capitata)* Date moth White cochineal Olive fly *(Bactrocera Oleae)*	Mint / beans tomatoes /olive Date palm /feed Vegetables / citrus/Fruit's	20 Farms
Weeds	All cultures crops/Date palm	30 Farms
Disease: Mildew Gummose Tomato fungal disease	Vegetable crops /Fruit tree	13 Farms
Animals: Birds Mouse Dogs Donkey Peg Rabbit	All cultures crops/Date palm	09 Farms

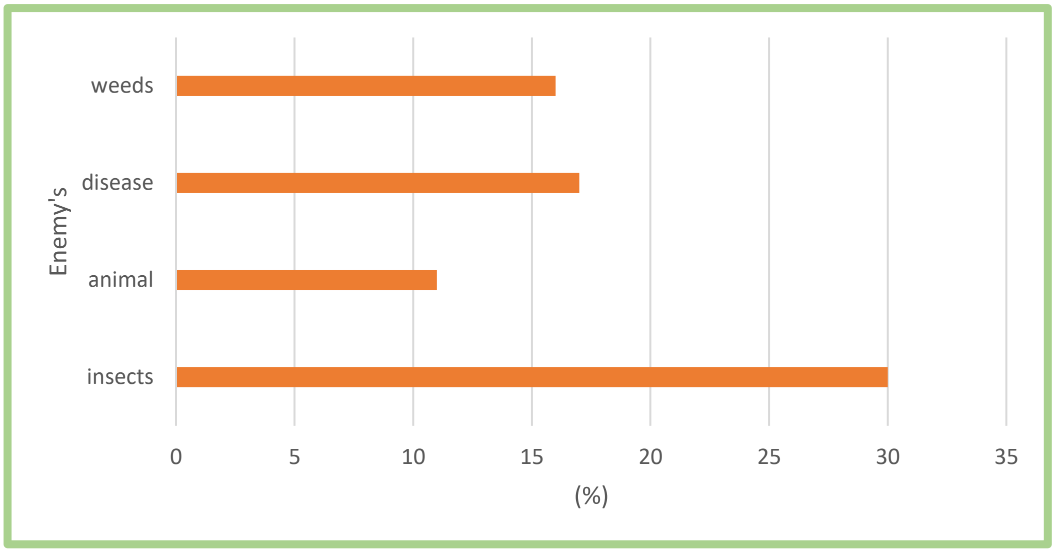

Figure 7: Crop enemy species in Ghardaia

In El Guerrara, Ben Hammouda, 2021 found that the highest percentage of damages are caused by weeds with 30% , followed by insects then animals, and for the disease in El Guerrara they found only small percentage.

3. Agricultural practices in the region of Ghardaia

3.1. Crop protection methods

Farmers in the region use different methods to control enemies. We can notice that the majority of farmers use all four methods together (cultivation control, chemical control, biological control, physical control, integrated) (figure13):

- 36% of farmers use chemical treatments such as pesticides (insecticides, herbicides, fungicide, acaricides) which are widely used on insects and weeds also mites.
- 26% use biological control such as resistant seeds, pheromone trap, rodent trap, lime, smoke, sulfur, salt water, plastic bags. These techniques are applied in order to protect the crop, particularly against insects. For ashes and smoke, sulfur and salt water, lime they are used against mites and some insects.
- 22% use the cultural control. Like crop rotation; plowing the land and by cutting weed roots before planting.
- 6% use integrated pest management. We found that some farmers apply three different controls and sometimes more, chemical, biological and cultivated at different times of the year depending on the type of pest and its life cycle as well as the crop grown. To avoid problems.

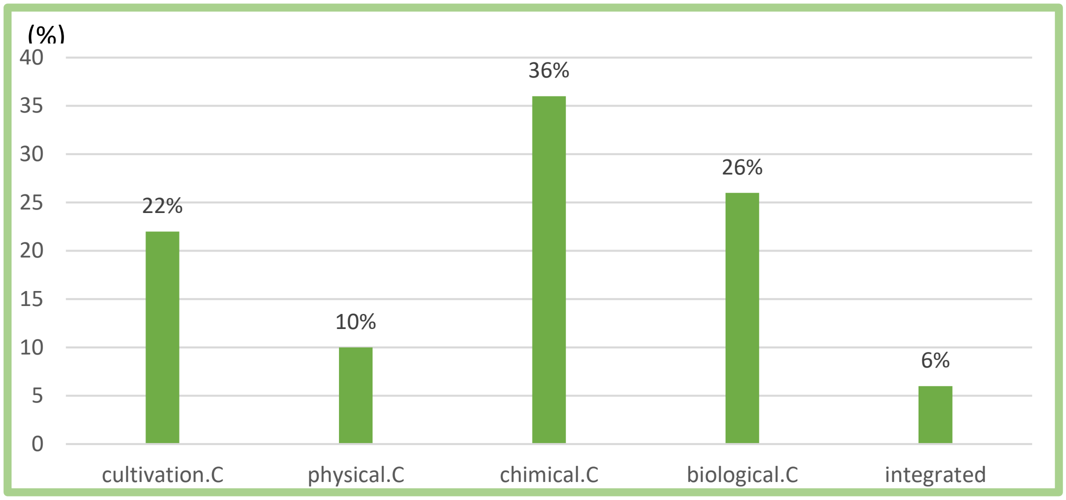

Figure 8: percentage of using different control types in Ghardaia region

In the other side we can see that the percentage of the different control types in Guerrara Ben Hammouda, 2021 was a little different from Ghardaia, they use the same methods but with different level**,** they found 32% biological.C and we find 26%; and 39% chemical.C, we found 36%; 29% cultural.C and for ghardaïa we found 22%.

3.2. Good agricultural practices

As a subject for this study, and from comparison with results from previous studies, can conclude the biological agricultural practices that are used in Ghardaia region can be divide in two groups:

- **Traditional practices group**

Traditional control using natural product like sulfur, lime, smoke, salt water they all help to limit insects and mites from date palm and crops tree (citrus / vegetables / Fruit) and traditional traps for rodent, mulch like covering the soil with fabric or plastic to control evaporation and decrease the number of insects and weeds.

- **Modern practices group**

Modern control such as resistant seeds, pheromone trap, plastic bags, bio-pesticides, using plants as traps, Parasites of insects (also called parasitoids), acoustic camouflage it makes a sound that make birds stay away from the crops.

When we visited the farms, we were able to see some biological practices methods and they were a mix between the traditional and modern control (figure14)

A : Cover crops with plastic B : Pheromone trap C : Plow the soil

D : Removing weeds E : Acoustic camouflage F : Using of lime

Figure 9: some of good agricultural practices in Ghardaia region

3.3. Farmers opinion on GAP

As last step in our questionnaire we asked farmers to give a rating for using biological agricultural practices and it’s showed on the following figure.

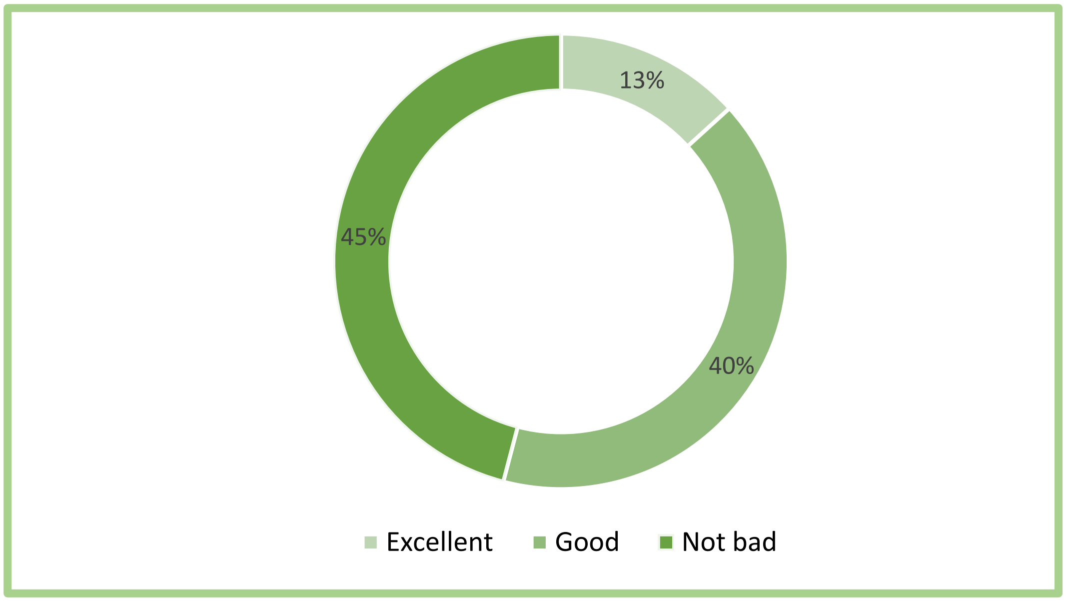

Figure 10: Level of effectivity from the perspective of farmers

The result in the (figure15) was conclused by the interviw with farmers showed a different opinions about the effects, the only 13% of farmers get an excellent results after using biological agricultural practices from this point we noticed that this 13% of farmers all have a Postsecondary education level that's the reason why they get excellent effect on their crops. The 40% of farmers said that the biological agricultural practices was only good becouse they cant see a good effect on their crops, and foe the rest 45% they are the farmers who didn't see any good effect after usin biological agricultural practeces and we can see the reasen it revolves around being them withe low edication level .

As a last comment I want to make after we study the biological agricultural practeces in ghardaia. I would like to suggest to creat a dictionary centered around biological agricultural practeces that we can use in ouisec airea

Conclusion

In this study, we give a review on Good Agricultural practices related to crop protection in the region of Ghardaia, we have found that, 43% of the studied farmers are between 50 and 60 years old, and 23 % of the farmers are of secondary scholar level,

From our result we find:

- The age of Ghardaia farmers is mostly between 50-60 years with percentage of 43% this is the highest recorded rate among the studied farms. From all the obtained results, we conclude that the farmers belonging to age section of 40 and 60 years old are the main agricultural practices in the studied region.
- Level of education in ghardaïa have 47% of farmers with a secondary education level, we conclude that the low educational level is an important reason why farmers are unable to improve the agricultural yield.
- Farms size in Ghardaia are mostly between 2ha-4ha with percentage 70%
- Most farmers in ghardaïa region use different Irrigation source (**c**ollective, tanks, individual)
- Existing cultures the dominant culture is the date palm and vegetables they have the largest surface area in ghardaïa.
- Crops enemy in ghardaïa region. we notice that most of the farmers in Ghardaia region suffer from many crop enemies like mites, weeds and insects, Fungal diseases and animal's attacks are classified in second place as follow:
- Farmers in the region of Ghardaia use different methods to control enemies. We can notice that the majority of farmers use all five methods together (cultivation control, chemical control, biological control, physical control, integrated) but the most user one is the chemical control with percentage 36%
- The opinion of farmers on GAP shows that 45% of them say "it's not bad" result and that's because they don't have enough about how to use GAP provably to get excellent result

In conclusion, the results of this survey showed that farmers in the region of Ghardaia generally uses good agricultural practices, but in the traditional way, only 2% of them use GAP. This is due to the low level of education and lack of agricultural culture of the farmers in Ghardaia region. Therefore, we suggest in the future to let the specialist's people in this field to organize awareness courses for farmers, also we suggest to focus and study deeply traditional practices that have resisted over the centuries which stipulate avoiding the use of chemicals products and replacing them with the use of good agricultural practices to make sure about farmers and food safety.

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استبيان حول الممارسات الزراعية السليمة في منطقة غرداية

1. اسم المزرعة:
2. العمر:
3. مكان الإقامة (في المزرعة أو خارجها):
4. المستوى التعليمي

غير متعلم	يقراء و يكتب	ابتدائي	ثانوي	تخصص جامعي

5. المهنة :

متقاعد	موظف حكومي	قطاع خاص	مزارع	لايعمل

6. تاريخ تاسيس المزرعة:
7. مساحة المزرعة:
8. الموقع الحغرافي:
9. عدد العاملين فيها:
10. هل هناك مهندس او تقني زراعي مشرف على المزرعة ؟:
11. الحيازة الزراعية:

مالك	مستاجر	ضمانة	مشتركة

1. المحاصيل المزروعة:

اسم المحصول	المساحة	كمية الانتاج على مدار السنة

2. هل تقوم بتحليل التربة كل فترة؟
3. هل تقوم بتحليل المياه كل فترة؟
4. ماهي مصادر المياه المستخدمة في الري؟

بئر جماعي	بئر فردي	خزانات

5. ماهي طرق الري المستخدمة ؟

الري المحوري	الري بالتنقيط	الري السطحي (تغريق النيتة)	الري بالرش (مطر صناعي)

6. أذكر أهم أعداء المحاصيل في مزرعتك؟ (يجب تصنيفها كما يلي : عوامل ممرضة من فطريات وفيروسات وبكتيريا، أعداء حيوانية، أعشاب ضارة)

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- -
- -

7. ماهي انواع المكافحة المطبقة في المزرعة ؟

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-
-
-

8. هل المبيدات المستعلمة مرخصة؟
9. هل تتم عملية رش المبيدات المستعلمة بآلات معتمدة وبأشخاص مؤهلين؟
10. هل يتوفر بالمزرعة مخزن للمبيدات؟
11. كيف تتخلص من بقايا علب المبيدات؟
12. ماهو نوع الأسمدة المستعملة؟ :

نوع	التركيبة

13. هل تعرف مصدرها؟
14. هل توجد وثائق مصاحبة للبذور و الشتلات عند تزودك بها؟

1. هل تستعمل الطريقة البيولوجية في المكافحة ؟

2. ماهي الطرق البيولوجية (الطبيعية أو التقليدية) التي تستعملها أو تعرفها ؟ (أمثلة: بذور وشتلات مقاومة، فيرومونات، مصيدات (فئران، حشرات...الخ)، دخان، جير .....)

المكافحة البيولوجية	شرح طريقة المكافحة

3. هل تملك بعض الأعداء الحيوية في مزرعتك؟ أذكرها؟ كيف تتعامل معها بالطريقة البيولوجية؟

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4. ماهو ترتيب طرق المكافحة التي تستعملها في المزرعة ؟

- مثال(1-المكافحة الكيميائية 2-المكافحة الفيزيائية 3- المكافحة البيولوجية 4- سيطرة جينية)

م.كيميائية	م.فيزيائية	م.بيولوجية	س.الجينية

5. كيف تقيم نسبة نجاح المكافحة البيولوجية في المزرعة (ان وجدت) ؟

ممتاز	جيد	متوسط	سيء	غير نافع

6. هل تاثير استعمال المكافحة البيولوجية عائد بالنفع على المزرعة ؟

نعم	لا

7. هل تعتبر منتوجاتك بيولوجية؟ ....

تاريخ المكان التوقيت

الملخص

تمارس العديد من الزراعات في منطقة غرداية وهذا ما ادى الى توسع التنوع الزراعي ، الهدف من هذه الدراسة هو معرفة الطرق البيولوجية للمكافحة و فعالية استخدامها ضد آفات المحاصيل الموجودة في منطقة غرداية . بعد دراسة و تحليل الاستبيانات أظهرت النتائج عدد من الطرق البيولوجية لمكافحة التي تستعمل في منطقة غرداية و التي توفر نتائج مرغوبة، مع ذالك يستحسن تخصيص دورات تعليمة من قبل المختصين في هذا المجال لمساعدة الفلاحين على حماية مزارعهم بطرق اكثر فعالية ضد الآفات و الأمراض

الكلمة المفتاحية

المحصول , الفلاحة , الافات , طرق المكافحة , غرداية

Abstract

Many agricultural in the Ghardaia region practice crops. The aim of this study is to know the good agricultural practices and the effective of their use against crop pests present in the Ghardaia region. After studying and analyzing from the questionnaires, the results showed a number of good agricultural practices that are used in the Ghardaia region and that provide desirable results. However, it is advisable to allocate educational courses by specialists in this field to help farmers protect their crops in more effective ways against pests and diseases.

Key word: farm, good agricultural practices, farmers, crops, pest, ghardaïa

Résumé

De nombreuses cultures sont cultivées dans la région de Ghardaia, ce qui a conduit à l'expansion de la diversité agricole. L'objectif de cette étude est de connaître les bonnes pratiques biologiques de contrôle et l'efficacité de leur utilisation contre les parasites des cultures présentes dans la région de Ghardaia. Après avoir étudié et analysé les questionnaires, les résultats ont montré un certain nombre de méthodes des pratiques biologique qui sont utilisées dans la région de Ghardaia et qui donnent des bons résultats. Toutefois, il est conseillé d'attribuer des cours d'éducation par des spécialistes dans ce domaine pour aider les agriculteurs à protéger leurs exploitations d'une manière plus efficace contre les ravageurs et les maladies.

Mot clé : culture maraichère, ravageur, ghardaïa, les bonnes pratiques agricoles