

Investigation of vegetal bio-insecticides for the stored seeds

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Abstract

To preserve traditional agricultural knowledge and seek alternative methods to chemical insecticides, we carried out an ethnobotanical study among the rural population of two Moroccan regions, Casablanca-Settat and Fez-Meknès.

The survey covered 800 people, 79% of them were male. The 40-60 year olds are the most representative age groups (54%), and farmers are the most represented group in the sample surveyed (78%) with a higher illiteracy rate (43%).

Pesticide use has changed farmers' habits over time; ethnobotanical data show that only 39% are aware of the use of plants for harvests protection. In the field, we identified 24 species from 14 families that were traditionally used to protect crops. The aerial part of plants is the most used with a rate of 42% and the use of plants without transformation remains the most practiced mode by farmers for the majority of plants.

Keywords: Ethnobotany, chemical pesticides, plants

1. Introduction

Chemical control is an effective strategy widely used in everyday life ^[1]. In particular, the widespread use of synthetic insecticides has had many negative consequences on health and the environment ^[2].

In conventional research, plants can provide alternative solutions for insect control because they are a very rich source of bioactive molecules ^[3-5]. Essential oils are among the most well-known substances tested against insects ^[6-8]. These compounds act as fumigants ^[9-11], contact insecticides ^[12], repellents ^[13] and anti-medication ^[14] and can also affect some biological parameters such as fecundity ^[15-16], life duration and reproduction ^[16-17].

The risks and problems associated with the use of chemicals are leading to increasingly stringent environmental regulations for pesticides ^[18]. There is therefore an urgent need to develop effective, environmentally friendly and sustainable alternatives to synthetic pesticides ^[19]. In this context, the screening of natural products has attracted the attention of researchers around the world ^[20]. Many secondary plant metabolites are known for their insecticidal properties ^[21] and in many cases, plants have already been used as a remedy to destroy or repel insects ^[22].

Currently, one of the simplest approaches to identify plants, which may be potential phytochemical sources, is to conduct an ethnobotanical survey on traditional plant use practices against plant insects and phytopathogens. In this project we were interested in an "Investigation of vegetal bio-insecticides for the stored seeds" this contribution is based on surveys carried out to collect all the information and protective applications of plants with insecticidal effect used by the rural population in Morocco In order to

establish an effective and environmentally friendly control strategy.

2. Materials and methods

2.1 Study site

This study was carried out in two major regions of Morocco. Questionnaire surveys and interviews were conducted in forty villages in eight provinces as follows: Fez, Boulmane, Sefrou, and Taounate belonging to the Fés-Meknes and Casablanca region, El jadida, Sidi Bennour and Settat belonging to the Casablanca-Settat region. The choice of these two different regions was based on the variation of bioclimatic and floristic criteria on the one hand and the diversity of ethnic groups and their cultural practices on the other hand. The following paragraphs present the general characteristics of the regions in which we work.

Fez-Meknès Region

According to the Monograph of the Fez-Meknes region, it covers an area of 4,427,004 ha, representing 10% of the surface area of the Kingdom. Geographically, it is made up of disparate natural areas, which can be grouped into five geographical units belonging in particular to the natural domains of the Rif, Pré Rif, the Middle Atlas: the Saïss plateau, the mountain areas, the hills at the foot of the Rif, the high hills of the Missouri and the Mesétien domain of the Highlands (Fig 1).

The region is characterized by a continental climate in the north, cold and humid in the mountainous areas, and a semi-arid climate in the Missouri High Shelves. This climate variability leads to wild plant diversity and crops that are better adapted to the specificities of this region.



Fig 1: Geographical location of the Fez-Meknès study region

Casablanca-Settat Region

The Casablanca-Settat region, located in central-western Morocco, covers an area of nearly 20,394 km². The proximity to the Atlantic Ocean has given this region a moderate and humid climate with a mild winter and a summer that is cooled by ocean breezes. Overall, the climate of the region is characterized by an arid to arid semi-arid climate with a decreasing rainfall gradient from north to south (Fig 2).

The Casablanca-Settat region is part of the Atlantic domain, characterised by a very varied geographical framework composed of 3 natural zones: the sea with the coast which extends over approximately 235 km, the relief consists of plains and plateaus with small hills scattered throughout the territory bordering the cities of Casablanca and El Jadidia and the Sahel is a region consisting of an alternating pattern of depression and consolidated dunes.



Fig 2: Geographical location of the Casablanca-Settat study region

2.2 Methodology

The surveys were conducted among 800 people from the local population in different study areas. Interviewees were randomly selected in the markets (weekly souk) and in the surrounding villages of each province. The surveys were conducted over a one-year period (June 2018 to June 2019). In each province, the survey questionnaires were administered either individually or to groups of people.

These forms were completed at different locations in the village (market, family, fields, street, etc.). The questions related to the enumeration of wild and cultivated plants used by Moroccan farmers in the protection of cereal and legume foodstuffs, the parts of these plants (leaves, roots, tubers, fruits, etc.), the state of the plant (fresh or dried), the mode of use (whole part, powder, maceration, others) and the quantity used.

3. Results & Discussion

3.1 The survey population

Of the 800 people surveyed in this work, 79% of men and 21% of women completed the question form and are between 20 and 100 years old. The age group of 40-60 years is the most representative followed by 60-80 in all the regions surveyed.

The population included the following main socio-economic groups: farmers, herbalists, traders, and unemployed people. Farmers were the most represented group in the survey sample with a percentage of 78% of the total population. The level of education is very low because the vast majority of people are illiterate (43.375%) followed by people with a primary level (35.5%), the percentage of people with a secondary level and university are respectively (17%) and

(4.125%).

3.2 Plants with biocide-effect

The use of chemical pesticides has changed farmers' habits over time, ethnobotanical data shows that only 39% of the spreaders know information on the use of plants in crop protection. This value differs from one station to another depending on several socio-ethnobotanical factors.

A total of 24 plants were identified in the study areas (Table 1, Fig 3); they are divided into 14 families (Fig 4). The families represented are: Urticaceae, Solanaceae, Apocynaceae, Apocynaceae, Apiaceae, Cucurbitaceae, Zingiberaceae, Geraniaceae, Myrtaceae, Thymelaeaceae and Cupressaceae (only one species), Liliaceae and Rutaceae (2 species), Asteraceae (3 species) and Lamiaceae (7 species).

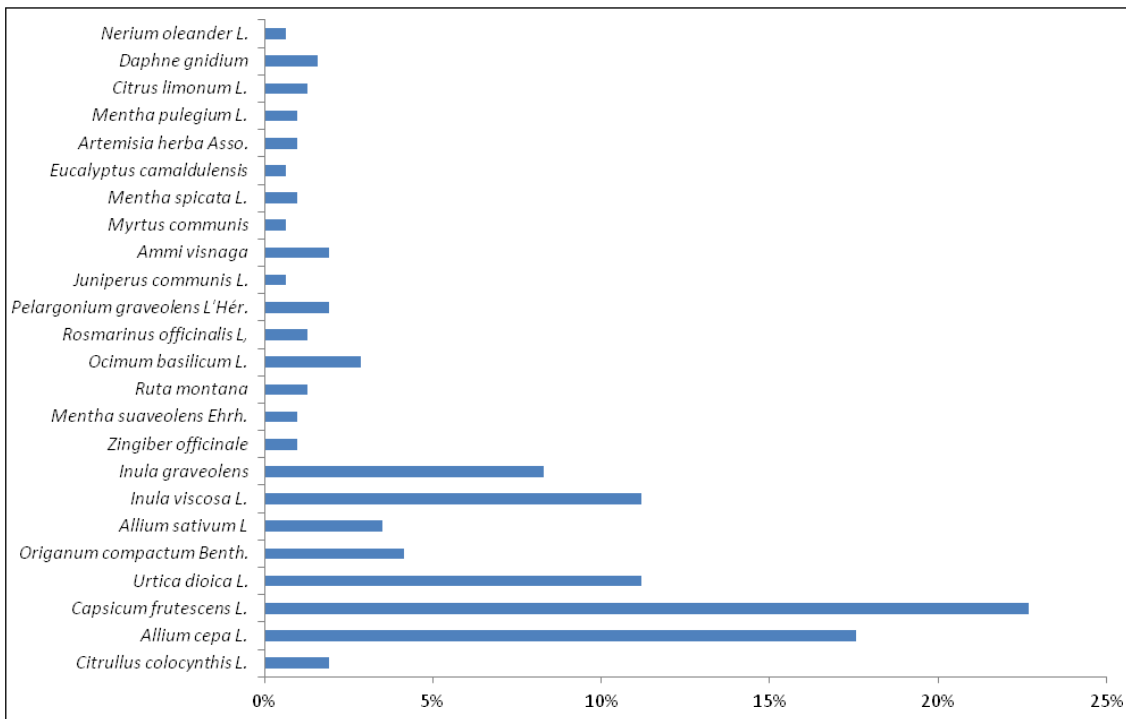


Fig 3: Citation percentage of species used in the protection of stored seeds

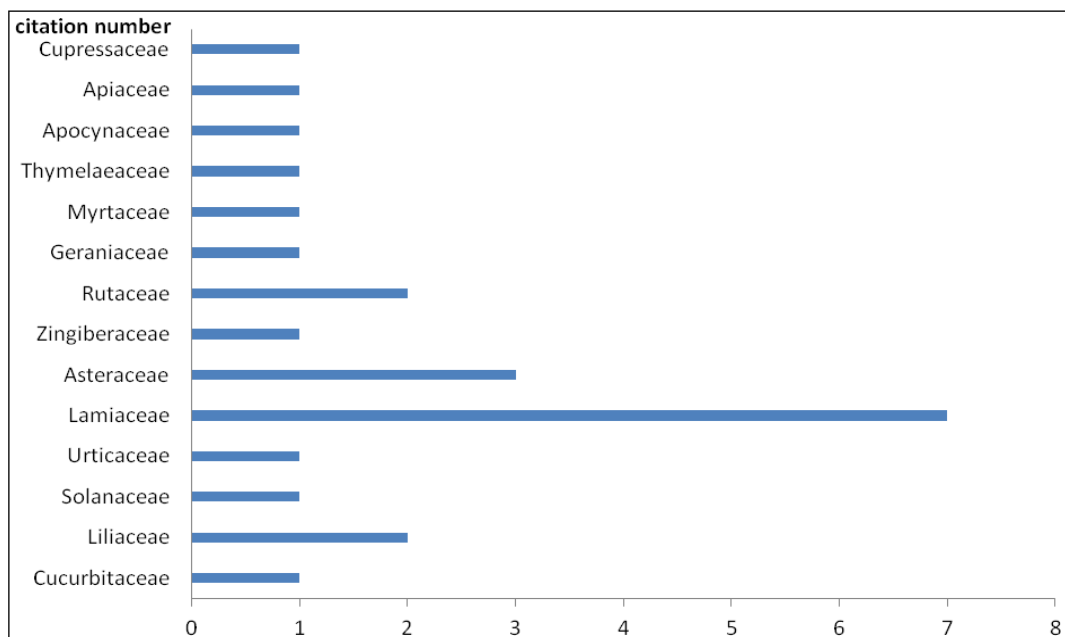


Fig 4: Distribution of plants cited by family

3.3 Part used

The active compounds (secondary metabolites) can be found in different parts of medicinal plants (leaves, flowers, roots,

bark, fruits, seeds, rhizomes). In this study the results show that the aerial part remains the most used part of the plants with a rate of 42% (Fig 5).

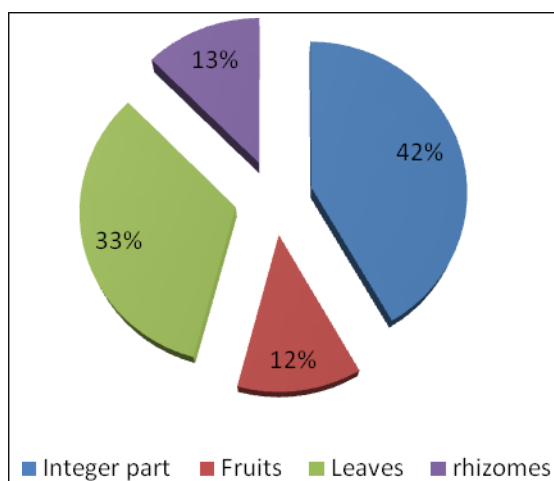


Fig 5: Percentage of citation of parts used

Table 1: List of plants selected by their ethno-agricultural uses

Scientific name of plants	Family	Local name	Plant type	State of the plant	Part used	Method of application	Type of toxicity
<i>Citrullus colocynthis L.</i>	Cucurbitaceae	al handal	spontaneous	Dry	Fruit	Integer part	Repellent
<i>Allium cepa L.</i>	Liliaceae	al bassal	Cultivated	Fresh	Rhizome	coupé	Repellent / Lethal
<i>Capsicum frutescens L.</i>	Solanaceae	soudania / al harra /	Cultivated	Dry	Fruit	Integer part and / or powder	Lethal
<i>Urtica dioica L.</i>	Urticaceae	Al hariga	spontaneous	Dry	Leaves	Integer part	Lethal
<i>Origanum compactum Benth.</i>	Lamiaceae	zaatar	spontaneous	Fresh/Dry	Aerial part	Integer part	Repellent
<i>Allium sativum L.</i>	Liliaceae	touma	Cultivated	Fresh	Rhizome	powder	Repellent / Lethal
<i>Inula viscosa (Ait.) L.</i>	Asteraceae	magramane / tirihla	spontaneous	Fresh	Aerial part	Integer part	Repellent / Lethal
<i>Inula graveolens</i>	Asteraceae	al attassa	spontaneous	Fresh	Aerial part	Integer part	Repellent / Lethal
<i>Zingiber officinale</i>	Zingiberaceae	azanjabile	spontaneous	Dry	Rhizome	powder	Repellent
<i>Mentha suaveolens Ehrh.</i>	Lamiaceae	timija	spontaneous	Dry	Leaves	Integer part	Repellent
<i>Ruta montana</i>	Rutaceae	fijl	spontaneous	Fresh	Aerial part/ Fruit	Integer part	Repellent / Lethal
<i>Ocimum basilicum L.</i>	Lamiaceae	lhbakh	Cultivated	Fresh/Dry	Leaves	Liquid/ Integer part	Lethal / Repellent
<i>Rosmarinus officinalis L.</i>	Lamiaceae	azir	spontaneous	Fresh	Aerial part	Integer part	Repellent
<i>Pelargonium graveolens L'Hér.</i>	Geraniaceae	laatrcha	Cultivated	Fresh	Leaves	Integer part	Repellent
<i>Juniperus communis L.</i>	Cupressaceae	Araar	spontaneous	Fresh	Aerial part	Integer part	Repellent
<i>Ammi visnaga (L.) Lam.</i>	Apiaceae	bachnikha	spontaneous	Dry	Aerial part	Integer part	Repellent
<i>Myrtus communis</i>	Lamiaceae	Ariihan	spontaneous	Dry / Fresh	Aerial part	Integer part	Repellent
<i>Mentha officinalis L.</i>	Lamiaceae	Marseta	spontaneous	Fresh	Aerial part	Integer part	Repellent
<i>Eucalyptus camaldulensis</i>	Myrtaceae	calytous	Cultivated	Fresh	Leaves	Integer part	Repellent
<i>Artemisia herba Asso.</i>	Asteraceae	chih	spontaneous	Fresh	Aerial part	Integer part	Repellent
<i>Mentha pulegium L.</i>	Lamiaceae	fliyou	spontaneous	Fresh	Aerial part	Integer part	Repellent
<i>Citrus limonum L.</i>	Rutaceae	lhamd	Cultivated	Fresh	Zest	cut off	Repellent
<i>Daphne gnidium L.</i>	Thymelaeaceae	alzaz	spontaneous	Fresh/Dry	Leaves	Integer part	Repellent
<i>Nerium oleander L.</i>	Apocynaceae	defla	Cultivated	Fresh	Leaves	Integer part	Repellent

3.4 Mode of using plants

In the results, the plants are used by several preparations (whole plant, cut, powder, maceration/liquid, etc.) depending on the chemical nature of the active ingredients

and the degree of toxicity. In this study, the use of plants in their untransformed state remains the most common mode practiced by farmers for the majority of plants (Fig 6).

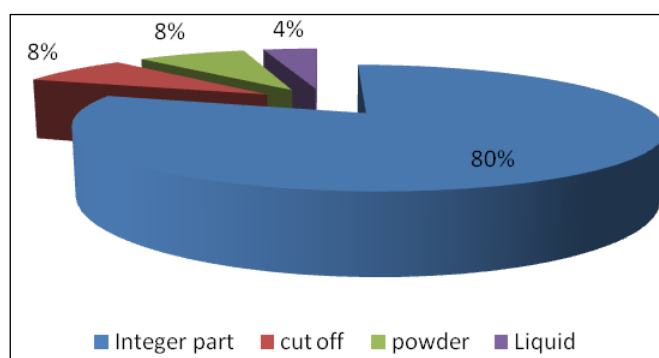


Fig 6: Percentage of use mode

3.5 Type of toxicity

With regard to the type of toxicity, according to the responses of individuals, plants can have several types of toxicity, namely: Lethal effect, repellent effect or lethal and repellent effect at the same time. The results show that the repellent effect is most often presented by the plants cited (Fig 7).

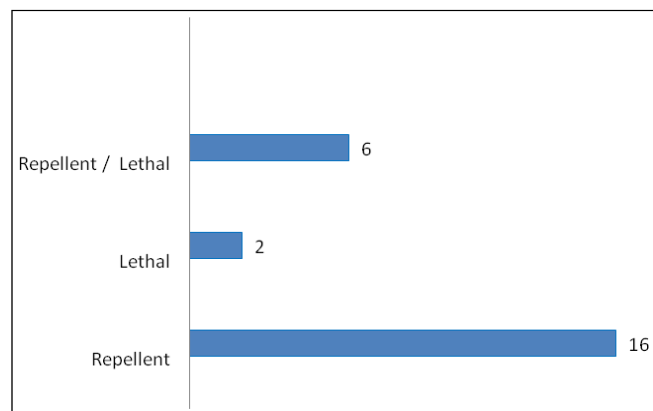


Fig 7: Type of plant toxicity

4. Conclusions

Our study showed that plants play an important role in phytosanitary activities as well, as an alternative to chemicals and the control of insects that damage agricultural products in Morocco. A range of plants has traditionally been used by farmers to protect and conserve crops. An ethnobotanical catalogue composed of 24 plant species belonging to 14 families has been prepared for laboratory testing.

This study represents a research tool that can contribute to improving the quality of information and documentation for the preservation of knowledge and traditional know-how of the use of plants with biocidal effect in Morocco. This will ensure effective protection of agricultural products against insect pests, reduce the harmful effects of chemical substances on health and the environment, and ultimately enhance biodiversity and contribute to the development of the local population.

Subsequently, *in vitro* studies can confirm the results of insecticidal activities of plants traditionally used by farmers.

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