



Research Article

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Vegetable Diseases Control by Using Essential Oils to Access Organic Production in Sudan



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Abstract

The current study will investigate Sudan potentiality to use essential oil in disease control so as to save the organic agriculture production in Sudan free from chemicals. The study is a connectional works depends on the literatures methodology and descriptive analysis to access the hypothesis claimed that Sudan is an essential oil lake for different uses. Depending on the assumption that good utilization of essential oils to be used in disease control access organic production continuity. Different aspects which included; the major vegetables diseases, Sudan potential of essential oil for diseases control, chemical treatment of vegetable crops and their hazards, biological control of diseases disasters and epidemiologic, proposed techniques of essential oil control. The results indicated that using of essential oil in vegetable disease control have many beneficial such as; save lands, healthy products, efficient control, cheapest techniques, easiness of use, increased incomes, and green environment. It concluded that Sudanese essential oils can positively guide the roles of disease infection control to access organic farming.

Keywords: Disease control; Essential oils; Vegetable diseases; Infections; Pesticides; Green environment; Epidemiologic

Background

Vegetables constitute a major portion in our diet. They play a vital role in human nutrition [1]. They are very essential to provide all essential nutrients for good health. Nowadays due to the introduction of new hybrid varieties in vegetables, which are susceptible to pest and diseases, there is demand for more plant protection, usually with toxic chemicals. Moreover, even post harvest treatment requires Agro Chemicals before it reaches consumers, to increase the shelf life. As a result of all these practices, we are ultimately consuming high dosages of toxic chemicals, which are causing undiagnosable diseases for us [1]. Availability of organically grown, good quality vegetables is very low. The best solution for this could be developing a Kitchen Garden with all varieties of vegetables available round the year, and cultivating it by utilizing all Organic and Bio-dynamic agricultural principles and methods. Flat dwellers can practice it using pots, provided they have an open terrace. For those who have backyards, it provides a better chance to keep their surroundings clean and productive [1].

Sudan is a virgin area of pesticides and chemicals contaminants; therefore, it is a promising land for international

organic production. Saving these lands virgins off pollution must be a compulsory target. Organic fertilizers and natural pesticides are the main focal issues that can be considered. There are many alternatives of natural pesticides, but essential oils are the best choice due to its huge abundance, easiness of extraction, application, volatility, economical, healthy, environment friend and etc..

Introduction

Agriculture in Sudan is the main powering force for its economy. The agricultural sector is the mean driving of income for 60-80 percent of households and participate by about 80 percent of the country's export etc. [2,3]. The most fertile agricultural lands is the promising investment by international companies that belong to China, India, Egypt, Saudi Arabia, Gulf and other countries that have an interest to establish agricultural investments in Sudan [2]. The available areas for agric investment ranged between 84 million hectares (ha) to 105 million ha [3], of rich and fertile soils [4]. Sudan potential includes forest yields, fruits, ornamentals, fodders, agronomic yields, vegetables, aromatic and medicinal plants. Vegetables are

one of the most important products for Sudan food security and exports.

Vegetable suffered from many problems; the most important ones are their susceptibility to diseases that can lead to 50% to complete loss [5]. The major disease in Sudan which can be caused by fungal, bacteria, viruses, viroids, mycoplasma, smut diseases and physiological diseases. The most important diseases are powdery mildew, leaf curl diseases, late blight, early blight, downy mildew, mosaic virus, rotting diseases, yellowing, leaf spots, rust disease, root rotting, virus stunting disease, wilting disease, potatoes Y disease etc. [6].

Collective efforts of farmers must be seriously practiced to establish pest and disease control units for integrated pest management to render the limit of pest and diseases especially during cold winter season in Khartoum state [7].

Chandrashekara et al. [8] reported that good control of plant diseases are need to have good quality and abundance of food and feed by farmers around the world. There are many approaches were done to control plant diseases. The most important ones are Good agronomic and horticultural practices; beside application of chemicals. However, the environmental pollution caused by excessive use of agrochemicals, mankind attention looks conspicuous to application of pesticides in agriculture. In these days prevalence of disease in ecosystem attract attention to words alternatives. To that end, an advanced survey of the natural and practicable biological control applied to the control plant diseases.

A postharvest disease control depends on the activation of natural plant defense in commercial products, since the decline of the asking to look after intensive use of chemical worldwide [9] looking for substituent's [10], therefore alternative methods of using essential oils or crude plant extracts as pesticide and induce fruit resistance through proper elicitor compounds [9,11]. For example garlic extracts showed inhibitory effect against *Pythium ultimum*, *Colletotrichum lindemuthianum* and *Rhizoctonia solani*; *Azadirachta indica* (neem) oil and extract had vital control to tomato oidium (*Oidium lycopersici*); *Thymus vulgaris*, *Lavandula sp.* and *Mentha piperita* essential oils can control *C. lindemuthianum* and *P. ultimum*; *Cinnamomum zeylanicum L.* leaves volatile oils and fruit of *Syzygium aromaticum L.*, sin. *Eugenia caryophyllata*, Thunb had effective effect against anthracnose (*C. musae*) on banana fruit [12-16].

Colletotrichum musae rot on banana is a serious post-harvest disease for immature and mature fruit [17], and their control by chemicals reduces their market values and they can be cured by dipping the berries into the emulsion of *A. sativum* volatile oil incorporated with *C. langsdorfii*, *E. caryophyllata* and *C. zeylanicum* [17].

Sudan contains more than 360 aromatic plants; they can be efficiently used in many purposes [18]. The aromatic plants are widely distributed in the Sudan, they can be forest byproduct

(ex. *Eucalyptus spp.*), pastoral plants (Wild Basil, camel's hay etc.), Cultivated plants (Mints) and cultivated trees and shrubs (Citruses). There are millions of Feddans throughout the countries [18]. On the way, there are many antifungal, antibacterial anti locust, antiviral researches were studied and showed that essential oil inhibitory, curing, preventive or controlling effects. It can be used for biological control [19].

Problem justification: Vegetables in Sudan subjected to many diseases, which can cause a complete loss of yield. Cost of chemicals control in Sudan increasing the cost of production, beside the presence of some side effects for human, animals and environment in limited areas of Sudan; which uses these chemicals in diseases control considering the bad knowledge of using high doses. Cultivating vegetables in the farm or in a Kitchen Garden, pest and disease incidence in it will force people to go for any plant protection measures. Pest and disease occurs mainly due to wrong cultivation practices. Hence, to avoid pest and disease occurrence, the following agricultural practices should be taken into consideration under "Prevention is better than cure" ideology [1]. Therefore, best alternatives are recommended.

Objectives

The objectives of this study is to evaluate the major vegetables diseases, Sudan potential of essential oil for diseases control, chemical treatment of vegetable crops and their hazards, biological control of diseases disasters and epidemiologic, proposed techniques of essential oil control to access biological control of Sudanese vegetables using Sudanese essential oils.

Hypothesis

Hypothesis 1: The research depends on the hypothesis proposed that Sudan possesses a large essential oil lake which can be exploited for different valuable uses.

Hypothesis 2: Green biological farming in Sudan can be achieved by using organic fertilizers and biological disease control with special emphasis on essential oils.

Assumption

The assumptions proposed that:

- Good utilization of essential oils against disease control promotes organic production continuity in Sudan.
- Green environment and healthy food increased by using natural fertilizer and pesticides.
- Green control increase Sudan general income.
- Using green control of disease raised the knowledge of people towards green environment.

Methodology

The study depends on scientific literatures and historical methodology and descriptive analysis of information to access the hypothesis and assumptions.

- A. Historical and scientific literature
- B. Some Sudanese vegetables and their susceptibility

Sudan produces many vegetables for local and export (Table 1). Sudan is infected by many diseases that affected vegetable production. Onion susceptible to smut, mosaic, red neck and

rottening diseases. Potatoes in Sudan infected by Soft rotting, Common scab, Black head disease, early and late blight disease, Mosian virus disease []. Okra susceptible to powdery mildew, leaf cures disease, mosaic virus disease. Snake cucumber, melons, cucumber, water melon and pumpkins are susceptible to powdery mildew (Table 2-4).

Table 1: Some exported Sudanese vegetables and medicinal plants (January 2003-December 2005).

Vegetable and medicinal crops	Jan. to December 2003		Jan. to December 2004		Jan. to December 2005	
	Quantity (Tons)	Price (1000\$)	Quantity (Tons)	Price (1000\$)	Quantity (Tons)	Price (1000\$)
Spices	610.7	753.7	458	568.1	209.2	216.2
Argel	9.7	8.1	12.4	8.3	6.169	1.9
Beans	138.5	47.4	*	*	*	*
Melon	471.5	141	429	134	18	24
Dry Okra	24	14	1	0.5	*	*
Allium cepa	672.5	124	*	*	124	22
Cucurbita pepo	0.5	0.01	*	*	0.4	0.2
Capsicum annum	40	2	*	*	*	*
Water melon seeds	48160	11685.8	40474	10485.6	30157.6	7857.7
Cassia senna	2099.9	972.6	2226.1	2104.2	1515.8	1412.5

Source: (CGA, 2003; CGA, 2004; CGA, 2005).

Table 2: Other use bio-control agents.

r. No.	Biological Agents	Pest	Crop
1	Trichogramma brassiliensis 1.0 c/ac. once in 10 days	Heliothis sp	Tomato
2	Trichogramma chilonis 2cc/ac once in 15 days	Fruit Borer	Vegetables
3	Nuclear Polyhedrosis Virus (NPV) 100-200 LE/ac	Spodoptera sp & Heliothis sp	Vegetables
4	Chrysoperla Sp 500/ha	Prudenia, Caterpillars, White flies, thrips, aphids	Vegetables

Table 3: Commonly available plants that can be used for making herbal extracts are as follows.

Sr. No.	Common Name	Botanical Name	Useful Plant Parts
1	Neem	<i>Azadirachta indica</i>	Neem Cake
2	Pungam	<i>Pongamia glabra</i> <i>Pongamia pinnata</i>	Leaf & flower
3	Notchi	<i>Vitex nugunda</i>	Leaf & flower
4	Nithia Kalyani	<i>Catharanus rosea</i>	Whole plant
5	Unni	<i>Lantana camera</i>	Leaf & flower
6	Devils Trumpet	<i>Datura Metal</i>	Leaf, fruit, flower
7	Yellow Nelliam	<i>Nerium thevetifolia</i>	Flower, fruit, root
8	Aruku	<i>Calatropis gigantea</i>	Leaf, tender stem, flower
9	Siria Nangai	<i>Andrographis paniculata</i>	Whole plant
10	Parthenium	<i>Parthenium sp</i>	Plant before flowering
11	Adathoda	<i>Adathoda vasica</i>	Leaf
12	Tobacco	<i>Nicotiana tobaccum</i>	Dried leaf, plant waste, stem waste

13	Chevanthi	<i>Crysanthemum cinerrifolia</i>	Flower
14	Thumbai	<i>Lucus aspera</i>	Flower, leaf, tender stem
15	Tobacco Plant (weed)	<i>Lobilia sp</i>	Whole plant
16	Ginger	<i>Zingiber officinale</i>	Rhizome
17	Etti	<i>Strychnos nuvomica</i>	Seeds
18	Turmeric	<i>Curcuma longa</i>	Rhizome
19	Artemesia	<i>Artemesia vulgaris</i>	Tender shoots & leaves
20	Papaya		

Table 4:

Sr. No.	Herbal Combinations	Pest
a.	Vitex nugundo (2%)+Neem Kernel Cake (1%)	Thrips
b.	Vitex nugundo (2%)+Calatropips gigantia (2%)	Aphids
c.	Neem Kernel Cake (3%)	Leaf eating caterpillar
d.	Nerium thevitifolia (2%) + Vitex nugundo (2%)	Fruit borers
e.	Andrographis panaculata (Siria nangai) (1%) + Neem cake (1%)	Fruit borers & Stem borers
f.	Parthenium sp (3%) + Vinca rosea (1%)	Thrips
g.	Lantana camera (2.5%) + Nerium thevitifolia (1%)	Aphids
h.	Calatropis gigantia (2%) + Lucas aspera (1%)	Leaf eating caterpillar
i.	Nicotiana tobaccum (1%) + Vitex nugundo (1%)	Leaf roller
j.	Calatropis gigantia (1%) + Nerium thevitifolia (1%)	Leaf roller
k.	Gingiber officianale (3%)	Thrips & Aphids
l.	Papaya (3%)	Leaf eating caterpillar
m.	Occimum sp (Thulasi) (3%)	Caterpillars & Spotted leaf beetles
n.	Soak Turmeric 1kg in 10 lt of Cow urine for two days & then dilute it to 100 lt for an acre of crop	Caterpillars and Aphids

Sudan potential of essential oils

EOs also called volatiles are aromatic oily liquids extracted from various aromatic plants materials such as flowers, buds, seeds, leaves, twigs, bark, herbs, wood, fruits and roots [17]. An estimated 3000 EOs are known, of which about 300 are commercially important destined chiefly for the flavors and fragrances market [20]. For combating infectious or parasitic agents, plants synthesize secondary metabolites which may be present constitutively or generated from inactive precursors in response to stress. Preformed substances pro- or inhibitions in plant tissue include phenolic compounds, flavonols, flavonoids, glycosides, alkaloids, and even poly'acetylenes [21,22]. EOs have been largely employed for their properties already observed in nature, i.e. for their antibacterial, antifungal and insecticidal activities [23]. Sudan have a great potential of essential oils. It can be obtained from wild, cultivated and forest sources. Basil, *cymopogon spp.*, cyprus are largely present in millions of feddans in specially in the central Sudans. *Lavandula coronopifolia Poir.*, was found in Erkowit (Eastern Sudan), Gebeit (Eastern Sudan), Jebel Marra (Darfur), Jebel Meidob (Darfur) [24]. Seedy essential oil crops such as anise (*Pimpinella anisum L.*) (family: Umbelliferae) origin is mediterranean region [25], but their

major production area in Sudan is Northern Sudan, while there is a very limit production in Khartoum state [26]. The essential oils such as Coriandrum, Anise and Spearmint showed antibacterial activity [27-29], therefore it can be acts as a good materials for bacterial diseases treatments on Sudanese vegetables.

Pest and disease control

There are many methods for controlling pests and disease throughout the world. Under Sudan conditions there are many procedures were adopted.

Furthermore, some spices are reported to have bactericidal or bacteriostatic activities. The inhibitory effects of spices are mostly due to the volatile oils present in their composition [30].

Types of disease controls

Chemical control and harzards: Chemical control is the vast effective control of disease. There are thousands of chemicals around the world. In Sudan any chemical pesticide subjected to investigation against the target diseases under Sudan conditions and the residual effects of its application.

Bacterial, virus and fungal chemicals in sudan: Environmental contaminants can be man-made or naturally

occurring substances present in air, water or soil. They can enter the food chain and even bioaccumulate. Examples of environmental contaminants that enter the food chain include heavy metals, polychlorinated biphenyls (PCBs), "dioxins" (polychlorinated dibenzodioxins and dibenzofurans), persistent chlorinated pesticides (e.g., DDT, aldrin, dieldrin, heptachlor, mirex, chlordane), brominated flame retardants (mainly polybrominated diphenyl ethers), polyfluorinated compounds, polycyclic aromatic hydrocarbons (PAHs), perchlorate, pharmaceutical and personal care products or haloacetic acids and other water disinfection byproducts [31]. However, the chemical method concerns due to intensively manpower demands in vegetable crops from planting to harvesting. Thus, the product contact with potential operators and seeds of users is higher, especially in family farming.

Excessive and indiscriminate use of pesticides not only increases the cost of production but also results in many human health problems and environmental pollution. According to WHO estimates, one million cases of pesticide poisoning occur every year and consequently there are 20,000 deaths globally. Organic vegetable growers also need disease control alternatives, since chemical fungicides cannot be used in this cropping system [32].

Biological control

Due to the appearance of chemical pesticides disasters the worldwide looked for other solutions. The prospects of biological control are to use natural types namely predators or plant extracts.

Natural enemies: The natural predators to control diseases can be bacteria against bacteria, virus against bacterial, animals against bacteria and fungus. The main benefit of this method is environment ecosystem balance. The disaster of this method of control outbreak of the predators can brings out another hazard.

Natural extracts: There are many types of natural extracts that used throughout the world to control disease. One of the famous one is Neem plant extracts. The disadvantage of Neem extracts it left soure taste on the vegetable or stored products. Other natural extracts are essential oil, it was found to be effective against many pest such as *Eucalyptus camaldulesis* against different locust life stages.

Plant extracts and essential oils appeared to be efficient to control seed-associated pathogens. They reduce initial inoculum availability and impair resistant strains selection [33]. They also show promising results in the control of several fungi species, due to their antimicrobial activity, which is attributed to the phenolic compounds and to the terpenoids. Kumar et al. [34] emphasized that the cytotoxic property of plant essential oils comes from their lipophilic nature. These oils interact with the lipid layer on the plasma membrane and cross the cell wall.

Herbal extracts

Herbal extracts should be used only as a final remedy only after utilizing & practicing all the above said methods. One should

try to use only the locally available weeds or those that are grown as life fence for making herbal extracts. If enough materials are not available in and around the garden, then materials can be collected from other areas.

Basic important procedures to be followed while preparing the herbal extracts are:

- a. Macerate and grind the plant material to a pulp state.
- b. Soak the pulped material in at least 60-70% of the final volume of spray solution.
- c. Soak it for 3-5 days, filter, make up the spray volume with water and spray.
- d. To avoid soaking it for 3-4 days, soak it at least for overnight and then heat it to a bearable warmth (60-70°C) for an hour by stirring. After this dilute it to the required final volume of spray solution, filter, allow to cool & spray.
- e. Use at least 2-3 different materials at a time to prepare the herbal extract.
- f. Change the combination of the materials every time.
- g. Use 2-3% of herbal extract (combination of 2-3 different materials) while the pest attack is at early stage. Increase the dosage to 5-6% if the attack is very severe.

Another method is soaking the pulped material in cow urine (10% of the final volume of spray solution) for 15-20 days by burying the mud pot containing the materials in a compost heap. Then dilute it as 1:9 with water, filter & spray.

Physical control

Physical control can be adopted by using natural physical methods such as using light, noise, echoes, temperature, air etc. The weakness of this method is less effective than other methods never the less when using traditional methods nor it required high technical professions when using modern tools.

Husbandry practices: This method of control is by using optimum different cultural practices such as sowing date, water intervals, fertilizers, in and/or intra spacing, bed-type, insensitive growth, crop rotation, exposture of soil to sun and air, ploughing depth etc. Its weakness is that it required good information about the optimum practice and useless for off season production.

Integrated pest management control: It is a modern method contains all requirements of protection using more than one method at the same time. The weakness is that one method can have easy adaption techniques and the other difficult, also it can be high cost of protection and it needs more training, high techniques and information.

Consideration of integrated pest management (ipm)

Field hygiene:

- a. The heavily infected plant parts should be burnt.

- b. Insects and their egg clusters and larval stages can be physically collected & destroyed.
- c. Dropped and decaying fruit should be removed & put in the center of the compost heap.
- d. Over-grown weeds should be slashed and used in compost making.

Trap crops should be raised: Light traps should be used to monitor and control insects [1].

Integrated disease management (IDM)

Field sanitation: The diseased plants should be collected and burnt at the early stages of any disease spreading. 2. Control the vectors by IPM. 3. Spray BD 501 on Moon opposite to Saturn days every month. 4. Dress the seeds with CPP manure slurry – will help to overcome seed borne & soil borne pathogen attack. 5. Dip the roots of the seedlings in with CPP manure slurry to reduce root rot & collar rot diseases. 6. Spray CPP manure as foliar (1.5kg/ac/50 lt water) once in a month for annuals and once in two months for perennials against leaf rot, leaf blight, fruit rot, sheath blight & sheath rot (as prophylactic and also as a foliar nutrition). 7. Spray 2% well fermented buttermilk- Mix 2 lt of well fermented curd (6-7 days) in 98 lt of water and after thorough mixing & potentising by 10-15 minutes of clockwise & anti-clockwise stirring. 8. Mixture of Garlic (2%) & Turmeric (1%) can also be sprayed. 9. Use BD 508-Take 1kg of Casuarina equisetifolia or Equisetum arvense or Equisetum ramassisimum and boil it for 2hrs in 10 lts of water. Leave it for two days, dilute it to 100 lts, filter and spray. 10. Bordeaux spray 1.0% can also be sprayed.

5.8.2. Use bio-control agents against wilt and rot diseases: Trichoderma viride-10g/kg seeds or Trichoderma harzianum - 10g/lt for spray 5 kg/ac for basal dressing. Pseudomonas fluorescens-5g/kg seeds -3g/lt for spray 2-3 kg/ac for basal dressing. Noted that it is preferably all the above-mentioned sprays should be done on Full Moon Day & on Perigee, or 1 or 2 days prior to these days.

General precautionary measures: (against pest & disease control)

- a. Avoid irrigation 1 or 2 days prior to Full Moon and Perigee,
- b. Avoid close planting.
- c. Avoid excess application of Nitrogenous manures.
- d. Avoid wrong season to raise any crop.
- e. Avoid cross hybrid seeds, but use selection hybrids.

We can conclude that pest and disease management should be carried out in a holistic way by properly planned farming practice. Hence, rather than searching for remedies let us try to identify the cause and rectify it by correct farming methods.

Essential oil as a disease control

Biological control has been advanced as an alternative to synthetic fungicides and considerable success in laboratory and pilot scale tests has been realized utilizing antagonistic microorganisms to control crops diseases. Several antagonistic yeasts and bacteria have been isolated and shown to have a broad spectrum of activity against a number of pathogens on a variety of fruit recently; interest has been shown in combining microbial biocontrol agents with other chemical components to increase their activity against crops pathogens [35]. Essential oils are also considered a promising alternative with many having antifungal properties [36,37]. Application of essential oil is a very attractive method for controlling diseases.

Essential oils and their components are gaining increasing interest because of their relatively safe status, their wide acceptance by consumers, and their exploitation for potential multi-purpose functional use [38]. Essential oils have been used successfully in combination with a variety of treatments, such as antibacterial agents, mild heat and salt compounds [39].

Application of essential oil is a very attractive method for controlling diseases. Production of essential oils by plants is believed to be predominantly a defense mechanism against pathogens and pests and indeed, essential oils have been shown to possess antimicrobial and antifungal properties. Essential oils and their components are gaining increasing interest because of their relatively safe status, their wide acceptance by consumers and their exploitation for potential multi-purpose functional use [40]. Essential oils are made up of many different volatile compounds and the composition of the oil quite often varies between species [41]. It is difficult to associate the antifungal activity to single compounds or classes of compounds. It seems that the antifungal and antimicrobial effects are the result of many compounds acting synergistically [42]. Thus, there would be negligible chance of development of resistant races of fungi after application of essential oils to fruit and vegetables. Consequently, essential oils are one of the most promising candidate groups of natural compounds for the development of safer antifungal agents. Despite the intensive work and good management practices, one of the greatest challenges to organic tomato growers in humid climates is disease management [43]. The management of necrotrophic fungi in conventionally grown tomatoes is by the use of protectant fungicides like mancozeb and chlorothalonil or systemic fungicides in the strobilurin class [44].

Essential oils were found to be effective against fungal disease. Spearmint essential oil is associated with a number of antifungal properties. Spearmint has been studied for antifungal activity; its essential oil was found to have some antifungal activity, although less than oregano. More over essential oil were found to be more effective against many gram positive and gram negative bacterial. Salim found that spearmint had inhibitory

effect against *staphylococcus aureus*, *Klebsella sp.*, *E. coli* and *Pseudomonas aeruginosa*.

Spearmint has been studied for antifungal activity; its essential oil was found to have some antifungal activity, although less than oregano.

Souza Júnior et al. [45] found that essential oils from "alecrim-pimenta" (*Lippia sidoides Cham.*), wild basil (*Ocimum gratissimum L.*), lemongrass (*Cymbopogon citratus Stapf*) and "cidrão" (*Lippia citriodora Kunth*) inhibited the germination and mycelial growth *Colletotrichum gloeosporioides* conidia. Rozwalka et al. [46] concluded that the partial or total inhibition of *Glomerella cingulate* and *C. gloeosporioides* mycelial growth *in vitro* showed that most of the studied essential oils and medicinal plants present biologically active compounds with antifungal effect. Thyme, eucalyptus citriodora, citronella and neem oils showed direct effect on *Phakopsora pachyrhizi*, because they reduce Asian soybean rust severity. The major compounds found in garlic, coriander and pepper extracts also had their fungitoxic properties proven to be positive on plants. Plant essential oils are also useful to treat seeds and prevent the presence of microorganisms on them. The effects of these oils are proven by commercial products from orange essential oils on wheat seeds [47] and neem essential oils as well as on rice seeds. However, studies specifically targeting on the use of natural products to treatment vegetable seeds are still scarce. Therefore, the current study aims to investigate the effectiveness of garlic (*Allium sativum L.*), red pepper (*Capsicum baccatum L.*) and coriander plant extracts (*Coriandrum sativum L.*), and neem (*Azadirachta indica A. Juss.*) and orange essential oils (*Citrus sinensis L.* (Osbeck)) to control *A. alternata* and *A. dauci* as well as their efficiency on carrot seeds germination and emergence.

The garlic extract and the orange essential oil showed the potential to control *A. alternata* and *A. dauci*, since their lower concentrations were able to satisfactorily reduce the incidence of these fungi. They were harmless to carrot seed germination and emergence table (-).

Formulation of Pesticides

The formulation of pesticides is found in pallets, powder, liquids or capsules. They can be used directly as homogenous solutions, thinned with water, emulsified by gasoline, as suspension, powder with filling materials or with irrigation water.

Pesticide active ingredients in their "raw" or unformulated state are not usually suitable for pest control. Manufacturers of pesticides mix in other ingredients to "formulate" the pesticide into a usable final product. This Chapter discusses different pesticide formulations and handling information that will help applicators work safely with each type [48]. Pesticide active ingredients by themselves may not mix well with water, may be chemically unstable, may be difficult to handle or store,

and may be difficult to apply for good pest control. To make an active ingredient useful, manufacturers add other ingredients (sometimes called inert ingredients) to "formulate" the pesticide into the final product offered for sale. This Section explains why pesticides are manufactured in different formulations and describes the benefits and disadvantages of different formulations [49]. It is important to learning Objectives:

- Explain the difference between a pesticide formulation and an active ingredient.
- Identify strengths and weaknesses of common types of pesticide formulations.
- Know how to interpret common abbreviations used to describe formulations (For example, WP, DF, EC, RTU, S, G, ULV) [49].

Pesticide can be in terms as; Active ingredient (a.i.), Emulsion, Fumigant, Impregnates, Pheromones, Phytotoxicity, Solution and Suspension. And the pesticide formulation may consist of:

- The pesticide active ingredient (a.i.) that controls the target pest.
- The carrier, such as an organic solvent or mineral clay.
- Surface-active ingredients, such as stickers and spreaders.
- Other ingredients, such as stabilizers, dyes, and chemicals that improve or enhance pesticidal activity .

Natural pesticides can be used as an extracts, solvent extract or powder (spray dry powder with filling material). Sudanese essential oil can be used directly, water emulsifiers, solvent solution or spray dried powder for fumigations, but it require some technical trials to optimization. Investigate garlic, pepper and coriander plant extract as well as neem and orange peel essential oil effective ness to control *Alternaria alternata* and *Alternaria dauci* and their efficiency during carrot seeds germination and emergence. The garlic extract and the orange essential oil showed the potential to control *A. dauci* and *A. alternata*, because their lower concentrations were able to sufficiently reduce the incidence of these fungi and because they do not affect carrot seeds germination and emergence. *A. alternata* conidia were found on the embryo (8%), pericarp (17%) and endosperm (31%) [32].

Application techniques and the future prospects in Sudan

Application of pesticides for disease control cab is achieved by many methods. The most used methods for large scale production is aircraft spraying or large machines sprayers. For medium scale production small machines are suitable either trailed or portable ones. But for small areas snap sac or hand sprayers are preferable. All the above methods can be used for

natural extracts taking into consideration coarse particles must be removed from the tools [50-57].

Results and Discussions Summary

Future prospects of essential oils

From the above items discussed showed that there is an important roles must be done in vegetable disease control. Considering the different types of diseases control they can cause environmental hazards specially chemicals ones. Biological control by predators can out breaks and cause side effect on the yield and the environment. Integrated pest management may be suffering from out season recommendations for production and then we cannot achieve their goal.

In general the results indicated that using of natural extract is the best choice for organic agric. production. In specific emphasis essential oil as a pesticide in vegetable disease is future conceptual preferable method of control; this because essential oils are:

- a. Non residual effect component.
- b. Quickly evaporate naturally.
- c. Non toxic materials for human and animals whatever it used immediately.
- d. Can acts as a healthy natural component for human disease treatment.
- e. It is a preferable one for vegetables because it is an edible and appreciable crop.
- f. Easiness of preparation.
- g. It can be locally adapted technology even in rural areas.
- h. Easiness of application.
- i. Cheapest method.
- j. Effective naturally method.
- k. Environment friend components (green environment).

The hypothesis and assumption

Hypothesis 1: This hypothesis proposed that Sudan possesses a large essential oil lake which can be exploited for different valuable uses; gives a positive good conceptionl idea which can lead to flexibility of application.

Hypothesi 2: This hypothesis of green biological farming in Sudan can be achieved by using organic fertilizers and biological disease control with special emphasis on essential oils; gives a positive good conceptionl idea which can lead to save Sudan green supporting organic agric. vegetable products, healthy environment and increase economic by organic products.

Recommendations

- a. Biological experiments using different Sudanese essential oils must be performed on different Sudanese

vegetable diseases, so as to determine the actives doses for treatments.

- b. Formulation of different essential oil pesticides formula for efficient and economic application.
- c. Community orientation must be achieved to provide a large spectra flour for this technology.
- d. Encouragement of farmers and different sectors to lead and direct their efforts towards exploitation of this technology.

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