International Journal of Agriculture Innovations and Research
Volume 5, Issue 3, ISSN (Online) 2319-1473
Manuscript Processing Details (dd/mm/yyyy) :
Received : 03/12/2016 | Accepted on : 05/12/2016 | Published : 12/12/2016

Sticky Elecampane, *Inula viscosa* (L.) Aiton (Asteraceae)

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***Abstract* – *Inula viscosa* (L.) Aiton, a member of the Asteraceae family, is a widespread, evergreen and naturally grown plant in the Mediterranean basin. Medically, it has been used as medicine because of its calmative, antipyretic, inflammation reductive and antiseptic properties since the ancient times. Due to its long inflorescence period and its potent odour, the plant attracts pollinators and protects itself from natural enemies. There have also been some studies about potential use of *Inula viscosa* regarding the area of plant protection. Detailed studies about the use of this plant as an alternative against harmful organisms may present significant contribution to integrated pest management in plant production in the Mediterranean basin.**

***Keywords* – Component, Cntrol, Inula Viscosa, Pest, Plant Protection.**

I. Introduction

Inula viscosa (L.) Aiton (Asteraceae) (synonym *Dittrichia viscosa*) is a member species of the Asteraceae family. Yet species of this family spread almost everywhere throughout the world, they are widely extended particularly in Southwest America, Mexico, South Brazil, Andes, Mediterranean Region, Southwest Asia, Central Asia, South Africa and Australia [1]. As a cosmopolitan family, it contains nearly 1100 genus and 2500 species. Of these, 133 genus and 1156 species naturally exist in Turkey [2,3].

Inula genus belonging to Inuleae tribe of Asteraceae family is represented by 26 species in Turkish flora. The plant species of this genus are generally in the form of perennial herbaceus or semi-bush. The stem is mostly vertical or ascendant type but it is rarely stemless. Sides and tip of leaves may be flat or crenated; and leaves are linked to the bottom or mostly to the whole stem with petioles [4]. With the current studies, five species of the *Dittrichia* genus can be characterized. These species are *Dittrichia graveolens*, *Dittrichia viscosa*, *Dittrichia revoluta*, *Dittrichia orientalis*, and *Dittrichia maritima*. While naturally growing in Asia, Europa, Africa and especially in the Mediterranean region, the genus is known to be used as traditional medicine worldwide [5,6].

The aim of this study is to present short summaries at present researches about description of *Inula viscosa*, its chemical composition and its function in plant protection, particularly in the field of entomology.

II. Description

As it is known to be a source of nectar and polen, *Inula viscosa* is a flowery plant employing beneficial arthropod populations during biological control [7]. It is basically a species extended throughout the West Mediterranean countries. The primary habitats of *Inula viscosa* are gravel riverbeds, mountain screes and volcanic scorias sometimes on sandy soils and rocky coasts; its secondary habitats, however, are road sides, abandoned fields and walls. The plant is perennial, woody at base, vertical stemmed, densely glandular and hairy, and 40-130 cm high [5]. *Inula viscosa* is named as "yapışkan andız (elecampane)" in Turkish language and its green leaves are used for healing wounds [8]. (Figure 1,2,3).

II. Chemical Composition

Plants have become part of daily life of mankind as food, medicine, and so forth. A great number of plants with vivid odour and medicinal properties were known and used by ancient Egyptians, Romans and Greeks [9]. In recent years, Inula species have drawn attention because of their biological activities; hence, their chemical compositions have commenced to be carried out. Inula species are ascertained to contain chemical terpenic compaunds (*monoterpenes, sesquiterpenes, diterpenes, and triterpenes*), flavonoids, glucolipids and antranilic acid derivatives [10,11].

Inula viscosa species, which belongs to *Inula* genus and represented with 26 different species in Turkish flora, is an herbal plant that is widely used to heal different diseases among Mediterranean communities. This species has a multipurpose use characteristic; hence, it is widely used as an anti – inflammatory, antiseptic, expectorant, neuromascular blocker, diuretical, rheumatic – pain – releaser, and also used for curing anemia, tuberculosis, bronchitis, cancer, and gastroduedonal diseases [12,13].

Recent studies have revealed that the main components of the essential oil isolated from the *Inula viscosa* (L.) leaves and flowers are Sesquiterpenes, Phenols, Hydrocarbons, Monoterpenes, Aldehydes, Ketones, Diterpenes, Alcohols and Tetraterpenes; however, the major component of this oil is highly comprised of Sesquiterpenes [9,14].

Fig. 1. *Inula viscosa*

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Fig. 2. *Inula viscosa*

III. INULA VISCOSA IN PLANT PROTECTION

Müller – Riebau et al [15] reported that based on the gas cromotography profile, essential oil of *Inula viscosa* barely contained terpenic compoundsand; similarly, very low levels of phenolic elements, thymol and carvacrol were also detected. Furthermore, the extract isolated from raw and dried shoots of *Inula viscosa* showed low level of antifungal effect on tomato fusarium wilt (*Fusarium oxysporum* f sp. *lycopersici*).

Wang et al [16] stated that *Inula viscosa* might be used as a defense source against leaf diseases on plants caused by Oomycetes, Ascomycetes and Basidiomycetes family pathogens. *Inula viscosa*, *Inula graveolens* and *Inula crithmoides* (Asteraceae) organic extracts (*hexane, chloroform and methanol*) obtained from leaves and flowers were also assessed to their antifungal activity against two Trichoderma species (*Trichoderma harzianum* and *Trichoderma viride*) and three formae speciales of *Fusarium oxysporum.* Organic extract of *Inula viscosa* showed inhibitory effect against all these fungal isolates, and the above – mentioned Inula species were determined to be used for generation of an environmentally safe and important antifungal product source containing biologically active compounds [17]. Katerinopoulos et al [18] also isolated the sesquiterpene acid from *Dittrichia viscosa* as it had allelopathic activity against phytopathogeneic fungi and acari.

Fig. 3. *Inula viscosa*

Dittrichia viscosa has also been subject of investigation against insects [19, 20] and mites [21]. In a particular research, 29 different plant nectars were assessed as the source of biologically active compound for acaricidal pathogens and mortal effects of raw extracts of these plants were tested against *Tetranychus cinnabarinus* under controlled conditions. Then, mortality and repellency rates, and number of eggs laid were measured. As a result, the extracts isolated from *Inula viscosa* showed 25% more mortality rate effect on *Tetranychus cinnabarinus* [21]. Topakci et al [20] studied repellency and fecundity effect of water extracts obtained from *Inula viscosa* leaves against one of the most important pests for cultivars; *Tetranychus cinnabarinus*, the cotton red spider mite. The study revealed that all concentrations of *Inula viscosa* water extract resulted in strong repellency effect against *Tetranychus cinnabarinus* even after 48 hours of its application. However, there was no evidence regarding the effect of water extract on fecundity of mites. Mamoci et al [22] found that *Dettricihia viscosa* had biological activates against *Spodoptera lituralis* and *M. persicae*, and aphid antifeedant action was the most important biological activity. Salima et al [23] tested sensitivity of *Bactrocera oleae* Gmel (Diptera–Tephritidae) adults against *Inula viscosa* L. essential oils and its compounds. They reported that different concentration of *Inula viscosa* oil extracts subjected to *Bactrocera oleae* adults showed significant insecticide effect. Hence, they stated that essential oils of *Inula viscosa* could effectively be used as an insecticide against certain insect species.

Dittrichia viscosa is well-known as a common overwintering host plant for various mirid species in the Mediterranean region. It has been thought that *Dittrichia viscosa* has an important role on both protecting and increasing numbers of *Macrolophus melanotoma* (Costa) (= *M. caliginosus* Wagner), which is an effective predator for several insects, and development of natural control strategies for vegetable production. It has been also stated that *Dittrichia viscosa* is not a satisfactorily enough dietary substrate alone; considering *Nesidiocoris tenuis* case, however, there may be a link about presence of both *Dittrichia viscosa* and the harmful pest together as an ecological role for protecting mirid populations. Invasion of *Dittrichia viscosa* with particular aphids (example; *Capitophorus inulae* (Passerini) (Hemiptera: Aphididae)) is a common case and it has been proven that *Dittrichia viscosa* plant is a suitable substrate for oviposition and development of *Macrolophus melanotoma* whether the harmful pest is present or not [24]. *Macrolophus melanotoma* hosts on *Dittrichia viscosa* L. (W. Greuter) (Asteraceae) plant during the year and its population increases during summer period [25, 26]. The major and natural dietary supply for *Macrolophus melanotoma* is *Dittrichia viscosa* and they abundantly cluster on this plant [27]. In a study performed in open field in Greece; however, *Dittrichia viscosa* was not proven to be particularly efficient as banker plant for *Macrolophus* pygmaeus [28].

In another study performed in laboratory conditions, effect of two alternative plants, *Dittrichia viscosa* L.

(Asteraceae) and *Sesamum indicum* (Pedaliaceae), on giving damage to *N. tenuis* and *Tuta absoluta* (Lepidoptera: Gelechiidae) eggs were investigated. Firstly, both *Dittrichia viscosa* and *Sesamum indicum* significantly reduced the mirid damage on tomato plants. Secondly, *Sesamum indicum* was much more attractive for laying eggs as compared to *Dittrichia viscosa*, and finally its presence did not interfere with the predation on *Tuta absoluta* eggs. In addition, when two plants were studied in terms of using as mirid substrate without being pest, only *Sesamum indicum* were identified as a suitable host plant for laying *N. tenuis* eggs [29].

Kavallieratos et al. [30] investigated *Dittrichia viscosa* (L.) W. Greuter and *Rubus ulmifolius Schott* as reservoirs of aphid parasitoids; and showed that the aphid parasitoids of *Capitophorus inulae* (Passerini) could be used on *D.viscosa, Rhopalosiphum padi* (Linnaeus) on durum wheat and barley, *Aphis ruborum* (Borner) on *R. ulmifolius*, and Aphis gossypii Glover on cotton.

In another study to identify active compounds of *Dittrichia viscosa*, fractions of n-hexan extracts as insecticide activity against *Sitophilus granarius* (L.) and inhibition effect of these on asetylcholinesterase (AChE) were evaluated. *Sitophilus granarius* has shown a preventive effect on AChE. This study has proven that *Dittrichia viscosa* represents a natural defense supply for pest control and the most effective compound of this supply is costic acid. Polatoglu et al. [31] identified that the main compounds of *Inula viscosa* essential oil were as follows; 26.6% (E)-Nerolidol, 8.5% Selina-6-en-4-ol, 6.8% focienol and 5.1% caryophyllene oxide. They also evaluated the different essential oil concentrations against *Sitophilus granarius* as fumigant insecticide activity. When 0.01 mL/mL (in n – hexane) oil concentration were diluted with 5%, 2.5% and 1% acetone, the mortality rates of *Sitophilus granarius* were recorded as 100.00±0.00%, 95.47±3.41 and 4.53±3.41, respectively. Pure oil and 10 mg/mL oil solution also resulted in 24.42 ± 6.81% and 17.50 ± 0.39% AChE inhibitions, respectively [32]. In a study to determine active compounds of *Inula viscosa*, in cases when n – hekxane extracts were partly purified and obtained fractions against insecticide activity of *Sitophilus granarius* (L.) and their inhibition effects on acetylcholinesterase (AChE) were evaluated. The mortality rate of the above – mentioned pest was identified between 70% and 80% and its preventive effects on AChE (pure enzyme, Sigma – Aldrich) were also observed. In addition, costic acid was suggested as the most effective compound [33].

Another study assessed 121 ornamental plant extracts against *Oncopeltus fasciatus* Dallas (Heteroptera: Lygaeidae) as insecticide and growth regulator. The extracts obtained from *Inula helenium* L., *Rumex crispus* L., *R. acetosa* L., *Asarum europaeum* L. and *Calendula officinalis* L. were found to be the most effective compounds. All these extracts also showed growth inhibitor effect and middle and/or low level of acute toxicity in common. The dried root extract of *Inula helenium*, which is the most promising component, showed a strong antifeedant effect when topically treated, and a strong repellent effect (on shelled sunflower seed) when diet was treated. It was also indicated that the extract contains a few active compounds and such a cocktail could reduce the threat of fast – resistance – development [19].

A laboratory study was also performed to assess toxicity of some plant extracts against *Myzus persicae*. The plants used in the study were *Ricnus communis* L, *Solanum nigrum* L, *Nerium oleander* Mill, *Robinia pseudoacacia* (Fabaceae), *Lantana camara* L and *Inula viscosa* L.; cypermethrine was used as positive control while extract solvent was used as negative control. After 24 and 72 hours, *Inula viscosa* extract resulted in mortality rates of 37.22% and 60.32% on *Myzus persicae*, respectively [34].

CONCLUSION

In the last three decades, over use of chemical insecticides for more plant production resulted in deleterious and adverse affects on environment and living organisms including human beings. Hence, alternative pest control methods have became an important issue in scientific discussions. Plant driven extracts such as essential oils have increasingly been used as alternatives to these chemicals. However, very few studies have been performed on the use of *Inula viscosa* in the field of plant protection, particularly in entomology. This species is naturally extended to our region and extracts obtained from *Inula viscosa* can be used against pests of many cultivated plants including crops and vegetables. Therefore, studies regarding the use of *Inula viscosa* plant extract against pest threat for cultivars and greenhouse production and studies that will support biological control, which is the most important part of integrated pest management, are vitally important.

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