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Effect of plant extracts on egg deposition of fruit fly (*Bactrocera Cucurbitae*) on bitter gourd

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Abstract
In the present study repellency of four plant extracts were studied against the egg deposition of fruit fly, *Bactrocera cucurbate* in field conditions. For preparation of extracts leaves of *Azadirachta indica* (Neem), seeds of *Datura stramonium* (Datura), fruits of *Zingiber officinale* (Ginger) and *Allium sativum* (Garlic) were use. Three concentrations (5%, 10% and 15%) of plant extracts were sprayed directly on the fruits of bitter gourd by hand sprayer on weekly basis. After three days of Spraying the plant extracts three infested fruits from each unit plot were picked and then placed in cages under laboratory conditions. Emerged pupae against each extract with each concentration were counted after ten days. Datura Extract (DE) was the most effective with 15% concentration as only (7.33± 0.95) pupae were emerged and the Ginger Extract (GE) was least effective as (10.58± 1.70) pupae were emerged at 15% concentration. Similarly, minimum pupal emergence was obtained by DE at 4th week of application and GE gave the least results. Keeping in all the view it is concluded that among all four extracts, Datura Extract (DE) gave the most promising results as compared to Garlic Extract (GAE) and Ginger extract (GE).

Keywords: Bactrocera cucurbate, datura extract, bitter gourd, plant extracts

Introduction
Vegetables are considered the important part of human being due to nutritive values. But they are exposed to insect pest's attack due to attractive colors and softness, so 40% of vegetables are damaged due to insect pest's infestation (Srinivasan, 1993) [15]. Cucurbitaceae is a large vegetable group which are very rich in minerals and nutrients. There are 130 genres and more than 800 species in this group (Dhiman *et al.* 2012) [4]. Bitter gourd is very important cucurbit vegetable which is grown in many countries of the world. In Pakistan it is cultivated on 6107 hectares and give 57190-ton annual production (GOP, 2014) [6]. *Bactrocera cucurbitae* is very destructive pest of cucurbits crop, particularly its preferred host is bitter gourd. This pest has ability to destroy the crop from 30% to 100% depending upon the environmental conditions (Dhillon *et al*. 2005) [3]. From the very early times, diverse control measures have been taken to manage insect pests, some of those were eco-friendly while others were not. As, all of the eco-friendly management practices have not proved to be effective or affordable. Now days, farmers rely almost exclusively by using the chemical insecticides to control pests but don't achieve satisfactory results. As, sole dependence on chemical insecticides and their unselective use have led to the development of resistance in most of the insect pests (Singh & Singh, 1998) [14]. The other important problem caused by indiscriminate use of chemical pesticides concerns the accumulations of pesticide residue in food (Fraisse *et al*. 2006) [5]. *B. cucurbitae* has also been reported to resist against many chemical insecticides including organophosphates, carbamates, pyrethroids and spinosad (Hsu & Feng, 2006) [8]. In current scenario, best eco-friendly alternatives to synthetic chemical insecticides are bio-pesticides. These are present as God given materials from living organisms (natural enemies) or their harvests (microbial products, phytochemicals) or their by-derivative (semio-chemicals) that can control pest without producing toxic mechanisms (Mazid *et al*. 2011) [11]. Due to high requirement and the governments' struggle to stop climate change, bio-pesticides are going play an important role in future pest management programs (Gupta *et al*. 2013) [7]. Bio-pesticides may be considered of different types for example plant based (i.e. botanicals), insects' natural enemies (i.e. parasitoids) and microbial (i.e. *Bacillus thuringiensis*). Plant based pesticides are also known as biochemical pesticides as are naturally present materials used against pests without producing toxic mechanism and because it is hardly sometimes to evaluated whether a natural pesticide can control the pest by a non-toxic method of effect (Pal & Kumar, 2013) [12]. Use of plant based bio-pesticides for insect control is non-toxic, and safe biodegradable another to the conventional chemical control (Chandler, 2011) [2]. Plant extracts have been used to manage different insects including fruit flies worldwide. For example, Isman (2006) [10] reported that more than 400 insect pest's species have been found susceptible to neem, which is easily achieved and less expensive as compared to synthesis of some complex chemical formulations. Such as, other important bioactive plants are datura, garlic, ginger, catnip, basil, artemisia, borage, dahlia, hyssop, chrysanthemum, lime, black pepper.

Materials and Methods

Plant Materials

Seeds of *Datura stramonium* (Datura), fruits of *Zingiber officinale* (Ginger) and *Allium sativum* (Garlic) were collected to obtain their extracts.

Preparation of Plant Extracts

Collected plant materials were washed with water and kept under shade at bio-control laboratory of Entomology Department, PMAS Arid Agriculture University Rawalpindi for drying. After drying plant materials were ground to obtain the fine powder by using simple grinder in the laboratory of Institute of Soil Sciences & SWC, PMAS Arid Agriculture University Rawalpindi. After obtaining the fine powder from each plant material plant, extracts were obtained by using Soxhlet's apparatus at 55-60 ºC at Animal nutrition laboratory of Faculty of Veterinary and Animal Sciences, PMAS Arid Agriculture University Rawalpindi. In Soxhlet's apparatus, a proportion of 50 grams (botanical powder) and 250 ml (acetone) was used for several times to get the required amount of each plant extract. To get the stock solution, excessive amount of acetone was evaporated from the solution. Pure plant extracts were stored under 4 ºC in refrigerator.

Field Experiments

Field experiment was conducted at University Research Farm Knoot, Chakwal. Bitter gourd crop was sown by maintaining the row to row distance at 1.5 metre and plant to plant distance at 0.6 metre. Proper agronomic practices (i.e. hoeing, weeding, nutrients and irrigation) were adopted to grow the crop. Sixteen plots were maintained and from each plot three plants were randomly selected. Each of the selected plant served as an experimental unit. Three concentrations (i.e. 5%, 10% and 15%) of each plant extract were prepared and applied to separate experimental units along with control. Three replications for treatment were maintained. First treatment was applied at fruit setting while remaining three treatments were applied with a time interval of one week after each application. Infested fruits were collected three days after each treatment application and brought to bio-control laboratory of Entomology Department, PMAS Arid Agriculture University Rawalpindi. Collected samples were placed inside transparent plastic cages under optimum conditions. The mixture of soil and sand was placed in the cages for the pupation of fruit fly. After ten days of sample collection, the soil was sieved out to collect the pupae. The collected pupae were counted down to record the pupal emergence data concerning each treatment and control.

Results

Efficacy of the Plant Extracts with Different Concentrations on Egg Deposition of *Bactrocera Cucurbitae*

During the application of Datura Extract (DE) against number of emerged pupae at four time intervals. Result revealed that averaged minimum pupal emergence (7.33± 0.95) against Datura extract was obtained at 15% concentration at four weekly intervals followed by 10.25± 0.63 and 13.17± 1.09 at 10% and 5% concentrations, respectively Fig.01. Data pattern demonstrated the inverse relationship between pupal emergence and extract concentrations i.e. pupal emergence was decreased with the increase in concentration and same relationship was found between pupal emergence and time interval. In case of Garlic extract (GAE) at 1-4 weeks' intervals averaged minimum pupal emergence (9.58± 0.91) was obtained at 15% concentration, followed by 12.33± 0.91 and 16.25±1.14 at 10% and 5% concentrations, respectively. Moreover, minimum pupal emergence was recorded at fourth weekly application interval, while that of maximum pupal emergence was observed at first weekly application interval with 5% concentration Fig 02**.** During the application of Ginger Extract (GE) averaged minimum pupal emergence (10.58± 1.70) was calculated at 15% concentration, followed by 13.41± 0.69 and 17.25±0.12 at 10% and 5% concentrations Fig 03.

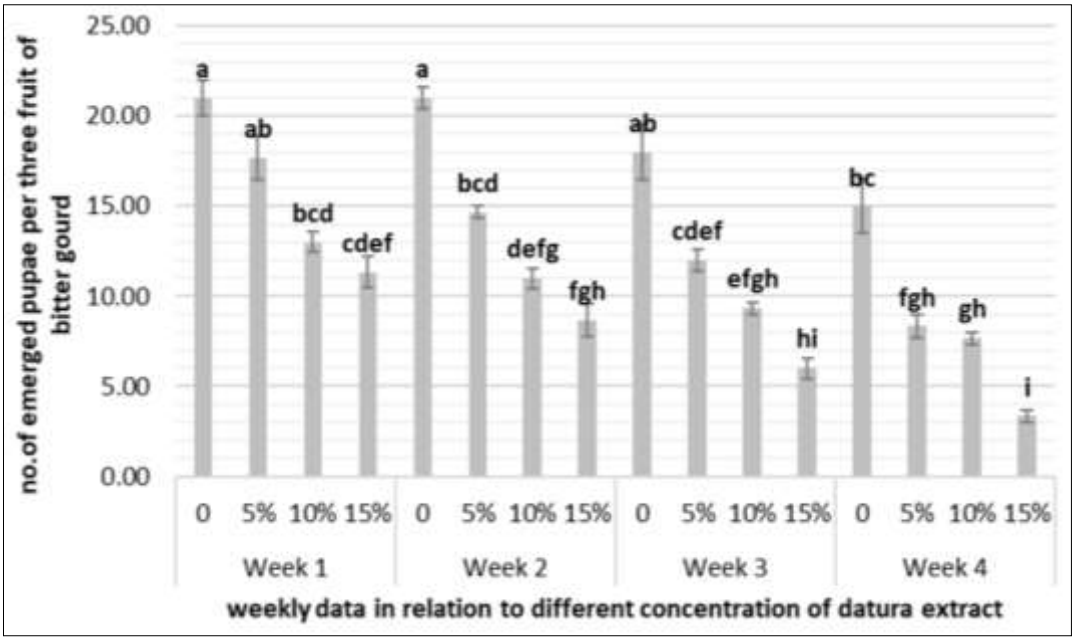

Fig 1: Efficacy of Datura Extract (DE) with three concentrations at four time intervals against pupal emergence of fruit fly

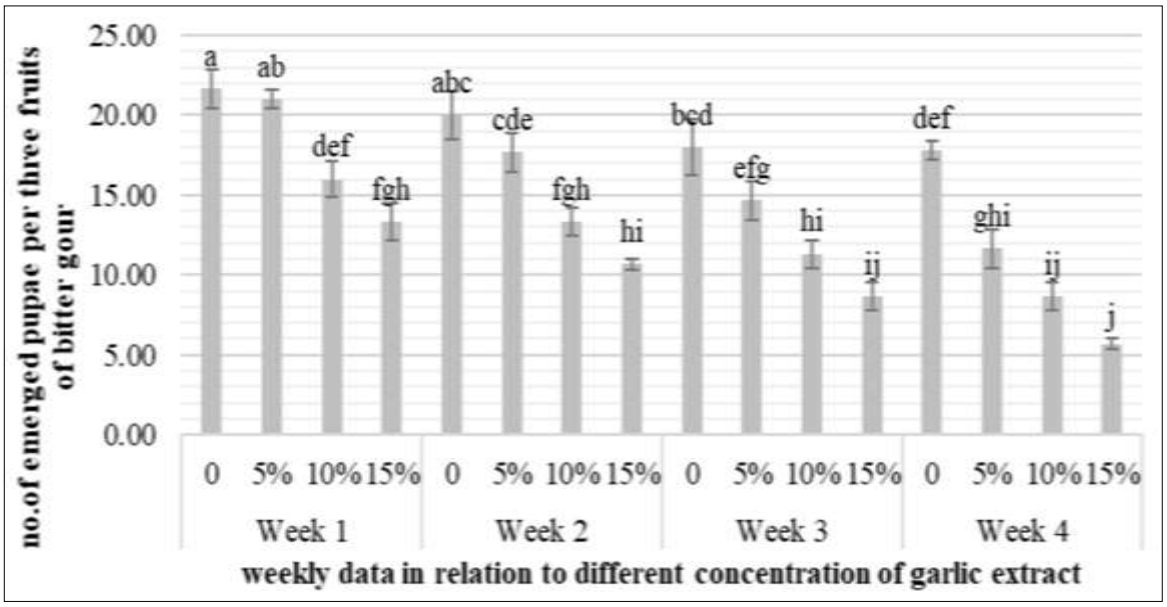

Fig 2: Efficacy of Garlic Extract (GAE) with three concentrations at four time intervals against pupal emergence of fruit fly

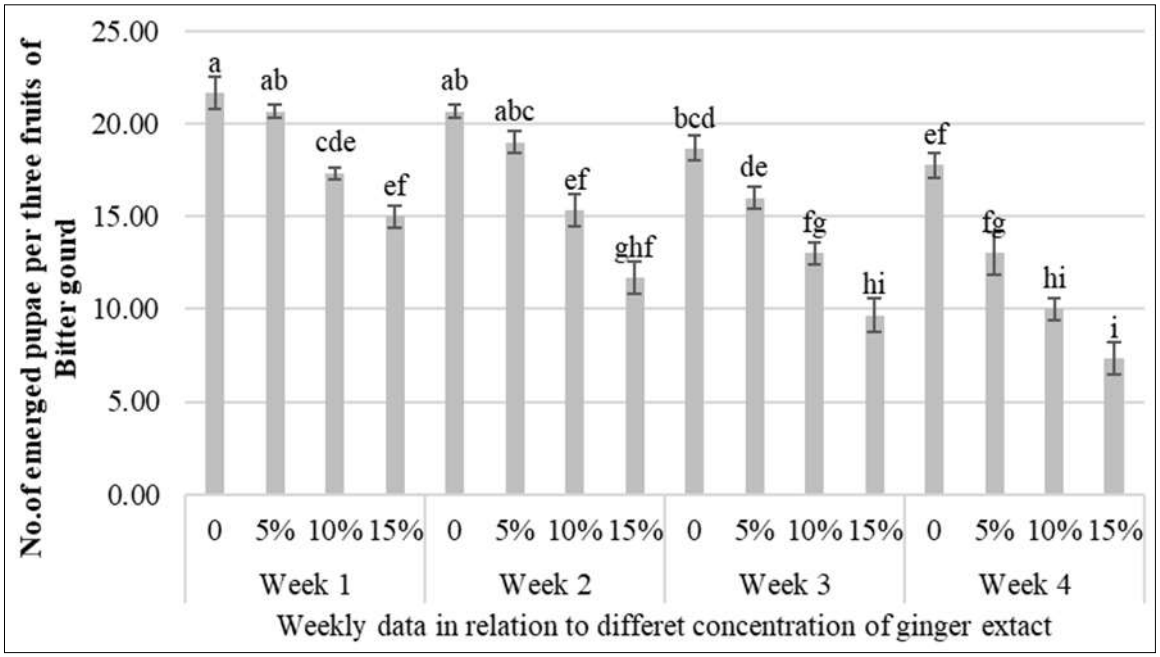

Fig 3: Efficacy of Ginger Extract (GE) with three concentrations at four time intervals against pupal emergence of fruit fly

Discussion

Outcomes of the current studies were reviewed in the literature to compare the findings of the different investigators of the world regarding the effect of the plant extracts on egg deposition of the fruit fly on different vegetable crops. It was found that most of the observed results were associated and relevant to the past work. Current results showed that number of emerged pupae changed with plant extracts, concentrations and applied intervals. Moreover, pupal emergence was decreased with increase in concentration and applied interval while minimum pupal emergence was observed at applied interval of fourth week along with 15% concentration and maximum pupal emergence was recorded at applied interval of first week along with 5% concentration. Concerning the concentrations, it was recorded that 15% concentration produced the best results as it caused the minimum pupal emergence of *B. cucurbitae* on bitter gourd. Similar findings regarding the efficacy of concentrations were observed by Siddique *et al*. (2018) [13]. Current findings concerning the efficacy of plant extracts at different applied intervals on pupal emergence of *B. cucurbitae* reported that pupal emergence was decreased with increase in number of applied intervals. Furthermore, minimum pupal emergence was recorded at last applied interval (i.e. fourth week) while that of maximum pupal emergence was recorded at first week of plant extracts application. As far as plant extracts were concerned, outcomes revealed that datura extract had highest efficacy with lowest rate of mean pupal emergence with 15% concentration at fourth applied interval. It was concluded that datura extract had maximum repellent effects followed by garlic and ginger. Relevant findings about efficacy of the plant extracts on the setting and oviposition response of *B. zonata* were reported by Ilyas *et al*. (2017) [9]. It was concluded that datura extract can be applied at higher concentrations to control *B. cucurbitae* on bitter gourd.

Findings concerning the pupal emergence while focusing the interaction between applied intervals and plant extracts indicated that efficiency of all plant extracts changed with applied intervals. And inverse proportion was explored between mean pupal emergence of *B. cucurbitae* and applied intervals of all plant extracts. Similar results regarding the plant extracts and applied intervals have been reported by Ashraf *et al*. (2018) [1]. They had reported the enhanced impacts of plant extracts on brassica pest (i.e. aphid) with increase in applied intervals. Outcomes concerning the pupal emergence while studying the interaction between concentrations and treatments (i.e. plant extracts) indicated that efficiency of all plant extracts changed with applied concentrations. In this scenario, an inverse proportion was again documented between mean pupal emergence of *B. cucurbitae* and applied concentrations of all plant extracts. Siddique *et al*. (2018) [13] have also documented the relevant findings regarding the efficacy of concentrations.

Conclusions

From overall outcomes of the current research studies, it may be concluded that among all treatments (i.e. Datura, Garlic and Ginger extracts) Datura extract had most efficient effects against egg deposition of *B. cucurbitae* on bitter gourd. It can be used to manage *B. cucurbitae* populations on bitter gourd with 15% concentration in four consecutive week intervals.

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