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Impact of Four Plant Extracts on *Bactrocera dorsalis* a Pest on Fruits

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Menthol extracts of four local plants (*Ocimum tenuiflorum, Hibiscus, Mentha longifolia* and *Bougainvillea glabra*) were analysed to check their toxicity on third instar larvae of *B. dorsalis* by estimating the larval mortality for four plant extracts and different times exposure (1-5 hr) and measured LT_{50} value for each plant extract. Larval mortality varies for extract of each studied plant as *Ocimum tenuiflorum* showed its highest value of 56.68% at 4.57hr, for hibiscus it was 72% at 3.5 hr., for *Mentha longifolia* it was 95.23% at 4 hr., while for *Bougainvillea glabra* it was 100% at 2 hr. exposure. The LT_{50} values for *B. dorsalis* varying from 1.011 for *Bougainvillea glabra* to 2.946 for *Ocimum tenuiflorum* whereas LT_{50} values were 1.402 and 1.123, forHibiscus and *Mentha longifolia* respectively. Present study results showed that *Bougainvillea glabra* was highly toxic whereas *Ocimum tenuiflorum* shows least toxicity.

Keywords: Local plants; Bougainvillea glabra; Ocimum tenuiflorum; toxicity; Bactrocera dorsalis.

1. INTRODUCTION

Synthetic pesticides have benefitted tremendously not only agriculture sector but also by its use in forestry and control of vector-borne diseases. The use of pesticides not only prevent crops from the damage from the pests by thereby improving productivity, also prevent reduction in

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crop yield, vector borne disease control such as malaria, quality of food etc. The estimated use of insecticide in India is 76% and globally is 44% [1]. For human health and environment, pesticides cause serious damages over time. Synthetic pesticides pose a potential risk to humans and other life forms and non-target organisms [2]. Through Fig. 1, we showed the bibliographic map analysis of the selected keyword, i.e., 'plant extracts and fruit flies' in the web of science database. A total of 191 studies reported in the previous 22 years, and all of them have been selected for bibliographic analysis. Among the total reported 1788 terms, the most relevant 102 terms have met the threshold with minimum occurrences of 5. Also, proximately 100% most relevant terms (i.e., 102) terms have been selected for analysis.

It has been found most of the studies are in relation to extract, petroleum ether, ethanol, ethyl, in laboratory on mango over time, lifespan, identification in either melon fly or peach fruit fly and *Drosophila melanogaster*. But a gap of studies has been observed for different compounds for investigations of insecticidal activity, resistance, mortality, fruit infestation in laboratory etc. (Fig. 2).

For pest control,the development of insecticides can be done from plants due to richness of bioactive compounds [3], [4]. Alkaloids, terpenoids, phenolics, and flavonoids are secondry compound of plants and can affect pest in various ways likewise act an attractant, repellent, antifeedants or effect life history of insect pest (increase or decrease development) [5], [6]. Plant extract and their bioactive compound have shown antifeadent, repellent, and ovicidal effect on pest [7]. *Bactrocera dorsalis* being an invasive pest has invaded in ~ 65 countries. 400 different species of genus Bactrocera are spread in Asia, China, Japan, Micronesia, Australia, and Hawaii, part of America, Oceania and continental Africa [8,9,10]. This fruit fly cause serious losses by direct feeding on guava and mango. It has emerged as a major threat to global agriculture and food security. According to distribution pattern [10], host range [11], rapid establishment of population [12,13] and economic loss, among 400 different Bactrocera species, *B. dorsalis* and *B. cucurbitae* are serious damaging pests. The losses incurred by *B. dorsalis* species are extremely large. In Japan, eradication from the Ryukyu Islands has cost more than 200 million euros [14]. Every year these species cause

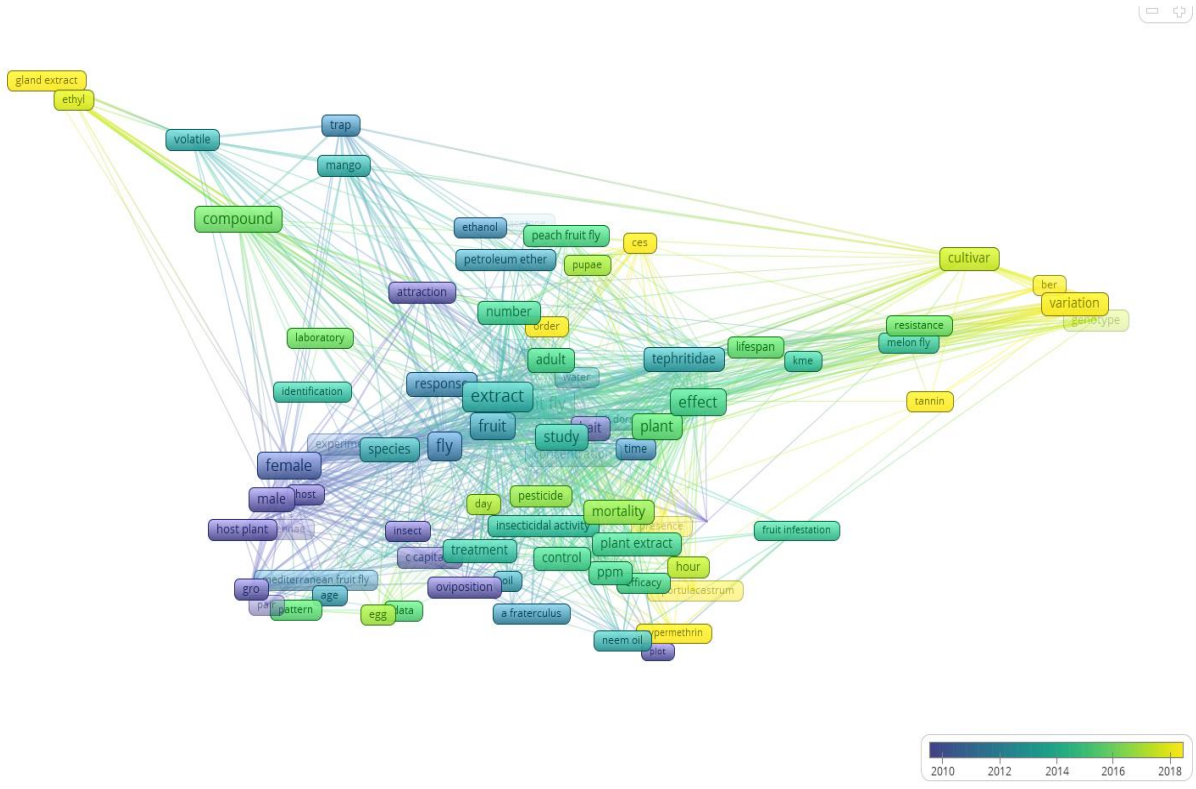

Fig. 1. Detailed VOS-Viewer bibliographic analysis for the keyword 'plant extracts and fruit flies' (Database source: www.webofknowledge.com) (colors of nodes represent the clusters)

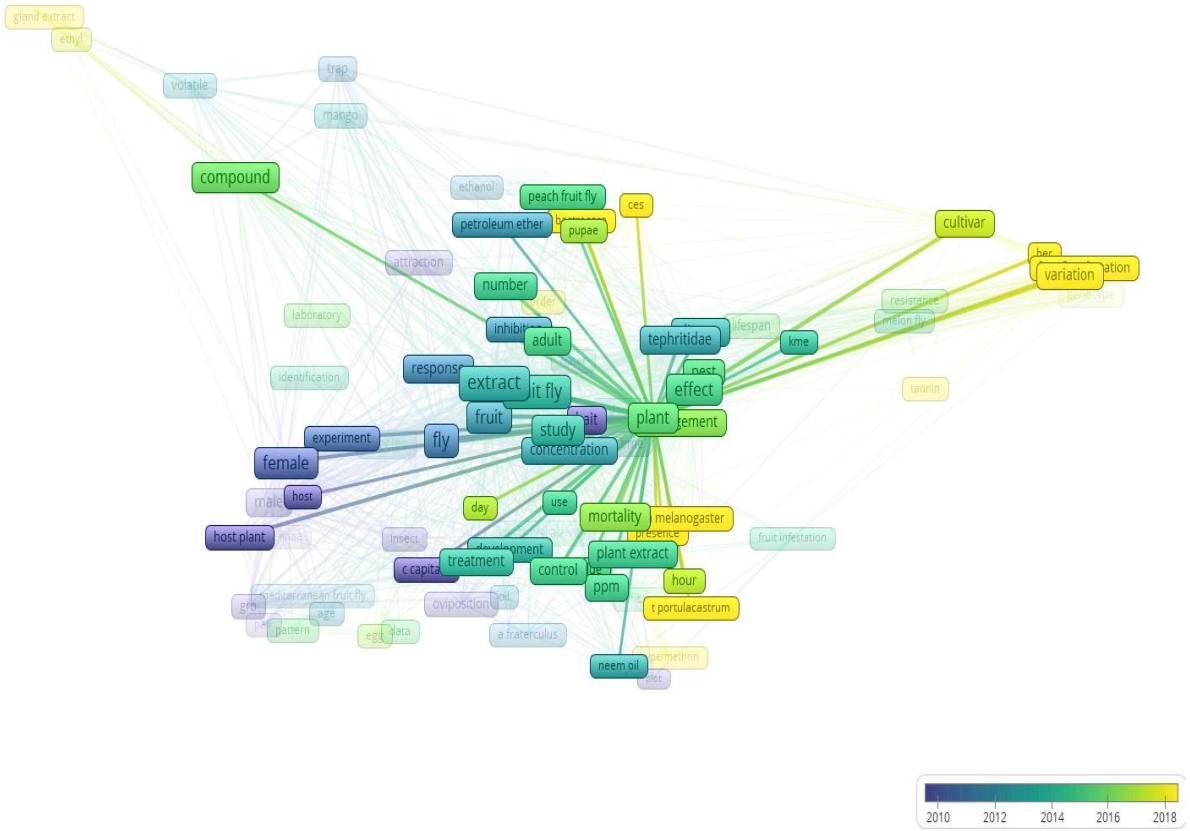

Fig. 2. Bibliographic gap analysis for plant extracts and fruit fliesfrom year 2010 to 2018. (Database source: www.webofknowledge.com) (colors of nodes represent the clusters)

damage to various fruit and vegetables in India worth over 3000 million rupees, and in particular to major fruits, like mango, guava and citrus. Fruit flies caused direct loss of fruit production and indirectly losses of export market. Huge expenditure for maintaining fruit productivity and on eradication of this pest also causes great economic loss. These fruit flies cause direct loss in yield of crop as well as loss of export market. Costs of pest control and expenditures on fruit treatment maintenance also affect economy.In this paper we report toxic effect of four plant extract on the mortality and fecundity of *Bactrocera dorsalis.*

2. MATERIALS AND METHODS

2.1 Plant Materials

Leaves *of Ocimum tenuiflorum, Hibiscus, Mentha longifolia* and *Bougainvillea glabra* plants were collected from Chandigarh University. Leaves of plants were cleaned with H_2O and dried in shade and grind to powder with pestle morter. 10 gm powdered material of each plant soaked separately in the dark, in a solution of 10 ml water and 50 ml ethanol solvent. Solutions filtered after 24hr and kept in the refrigerator. Effect of plant extracts waschecked on the third larval stage of *B. dorsalis* to determine percentage mortality and effect on fecundity.

2.2 Mortality Test

Mortality rate of *B. dorsalis* third instar larvae tested with four plant extracts. With the help of a pipette 1 mL solution of each plant extract was mixed with inside a petri-plate (size = 6 cm). Twenty third instar larvae (1-2 days old) were put into each petri dish, and the same number was also confined to media treated with water and ethanol as an untreated check in replicates. The mortality of *B.dorsalis* was recorded at 1.0, 1.5,2.0, 2.5, 3.0, 3.5, 4.0, 4.5, and 5.0 hr after treatment. The mortality was checked and flies were considered dead when no leg or antennal movements were observed.

2.3 Statistical Analysis

The mortality (%) was corrected by Abbott's formula (Abbott 1925) and then subjected to probit analysis (Finny 1971) with time as the explanatory variable to derive the estimated hr for (LT_{50}) 50% mortality. We used VOSviewer for bibliographic analysis.

3. RESULTS AND DISCUSSION

In this paper we report the insecticidal activity of the four plant extracts used on *B. dorsalis*. Significant differences in larval mortality were shown for different plant extracts. Table 1 shows performance of plant extracts on mortality of *B. dorsalis*. Percentage of mortality differs for each plant for different time periods. *Ocimum tenuiflorum* attained its highest value of 56 .68% at 4.57 hrs, for hibiscus it was 72% at 3 hr, for *Mentha longifolia* it was 95.23% at 4 hr, while for *Bougainvillea glabra* it was 100% at 2 hr exposure.

Mortality of *B. dorslais* was tested with four plant extract with different exposure times. *Ocimum tenuiflorum* attained its highest value of 56 .68% and at 4.57 hr able to prompt 50% mortality at 3.5 hr, whiles Hibiscus induced greater than 50% mortality after 1hr, and reached 72.88 % at 5 hr after treatment and *Mentha longifolia* cause more than 50% mortality after 1hr and 95.24 % at 5hr after treatment. *Bougainvillea glabra* bring out more than 50% mortality at 0.5 hr., and attained its maximum value of 100% at 2 hrs. These results are in accordance of Schleinet al. 2001 which show *Bougainvillea glabra* plant leaves have insecticidal activity in sand fly. Therefore, in this study we report the efficiency of the extracts of *Bougainvillea glabra* plant leaves on mortality of *B. dorsalis*. We found that the leaves of *Bougainvillea glabra* have the maximum toxic effect. It causes more than 50% mortality within half an hour and 100 % mortality within 2 hours. Results of this study clearly indicate that botanical extract have the potential to kill the pest.

The selected four plants have shown toxicity against larvae of *B. dorslis* and toxicity of these crude plant extract depends on chemical composition and susceptibility of *B. dorsalis.* Increase in dose rate of ethanolic extract from *Verbascum cheiranthifolium Boiss* and exposer time increase the mortality of insects (Khoshould and Khayamy 2008). It is clear from their results that plant extracts are effective on insects. Various studies have examined the lethal concentration (LC) and lethal dose (LD) of these plant extracts for insect like rice weevil [15]; *Spodoptera litura* [16]; mosquito [17]; termites [18]; *Callosobruchus maculatus* [19] or other insects in mortality. But, there is paucity of data for mortality of *B. dorsalis*. *B. dorsalis* is a highly destructive pest and hence there is necessity to control this pest. LT_{50} values for four plant extracts of *B. dorsalis* have been shown in Table 2 for using these extracts in integrated pest management. LT_{50} values of *B.dorsalis* ranged from 1.011 for *Bougainvillea glabra*, and 2.946 for *Ocimumtenui florum* whereas the LT_{50} values for Hibiscus and *Mentha longifolia* were 1.402 and 1.123 respectively. *Bougainvillea glabra* have shown highest toxicity whereas *Ocimumtenui florum* was least toxic. Insecticidal activity varied with different plant and exposer time.

Table 1. Cumulative percent mortality of *B. dorsalis* with *Ocimum tenuiflorum*, Hibiscus, *Mentha longifolia* and *Bougainvillea glabra* plant extracts at exposed periods

Exposed periods (hour)	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
Plant Extract	**(Mortality %)**								
Ocimum tenuiflorum	24.33	31.20	35.22	37.52	46.23	50.00	51.75	58 .67	58 .67
Hibiscus	47.30	52.11	56.12	60.12	70.00	72.05	72.13	72.05	72.88
Menthalongifolia	29.19	61.12	82.15	89.12	90.10	90.12	95.23	95.13	95.23
Bougainvillea glabra	78.78	89.13	100	100	100	100	100	100	100

Table 2. LT_{50} values for *Ocimum tenuiflorum*, Hibiscus, *Mentha longifolia* and *Bougainvillea glabra* plants extracts on *B. dorsalis*

Plant extract	LT_{50}	Linear regression
Ocimum tenuiflorum	2.946	y=4.070 - 1.457 x
Hibiscus	1.402	y= 4.070 - 1.457 x
Mentha longifolia	1.123	y= 3.921 - 2.429 x
Bougainvillea glabra	1.011	y= 3.323 - 2.431 x

4. CONCLUSION

The results of the current study show that plants derivatives can be useful as pest control agents. The four plant extract used in this were moderately effective in reducing the number of *B. dorsalis.* Of the four test plant extract against larvae of *B. dorsalis* extract of *Bougainvillea glabra*was found to be most effective followed by *Mentha longifolia*, Hibiscus and *Ocimum tenuiflorum*. Use of plant derivatives as an insecticide will prove beneficial for agricultural sector in poor countries as these plant derivatives are of low cost and eco-friendly.

CONSENT AND ETHICAL APPROVAL

It is not applicable.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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