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Diversity of Host Preference of Peach Fruit Fly *Bactrocera zonata* (Saunders, 1842) (Diptera: Tephritidae)

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ABSTRACT

Bactrocera zonata (Saunders) is a major pest that affects a variety of fruits and vegetables globally, including in Pakistan. This pest causes significant economic damage to the fruit and vegetable industry, mainly due to strict quarantine regulations imposed by importing countries to prevent its spread. The present study examined the host preferences of *B. zonata* for various fruits (*Prunus armeniaca*, *Prunus domestica*, *Prunus persica*, *Cucumis melo*, *Citrullus lanatus*, *Prunus avium*, *Ziziphus jujube*) and vegetables (*Momordica caranthia, Beta vulgaris*, *Daucus carota*, *Solanum lycopersicum*, *Cucumis sativus*, *Solanum melongena*, *Cucurbita pepo*) under field and laboratory conditions. The study found that apricot (*Prunus armeniaca*) was the most preferred fruit, while jujube (*Ziziphus jujuba*) was the least preferred. For vegetables, bitter melon (*Momordica charantia*) was favored by *B. zonata*, while pumpkin (*Cucurbita pepo*) was the least selected. The research indicated that fruit flies can adapt their host preferences based on availability host plants. This behavior may significantly impact the yields of fruit-bearing plants.

Keywords: Peach fruit fly, Host plants, Host choice, Diversity, Pest management

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INTRODUCTION

Fruit flies (Diptera: Tephritidae) are one of the most interesting pest species that affect agricultural products globally, lowering fruit and vegetable yields and market values. Tephritid flies are the primary worldwide fruit and vegetable-insisting insect species that consistently cause financial mutilation (Aluja & Mangan, 2008; Sarwar, Hamed, Rasool, Yousaf, & Hussain, 2013; Bradshaw et al., 2016; Rasool, Sarwar, Masoom, & Ahmad, 2023). The Tephritidae family contains 500 genera and nearly 5,000 species that are recognized worldwide (He, Xu, & Chen, 2023; Papadopoulos, Meyer, John, & Kriticos, 2024).

Bactrocera is a large genus of Tephritid fruit flies, and the species of *Bactrocera* genus are the potentially destructive pests of horticulture causing huge losses at local and global levels (Zhao, Carey, & Li 2024). It is a major threat to horticultural crops due to its invasive potential with a wide range of hosts and has attained international attention due to its cosmopolitan nature (Vargas, Piñero, & Leblanc, 2015; Rasool et al 2024). *Bactrocera* species are native to Asia and pose a significant threat to fruit and vegetable production in Pakistan, causing substantial yield losses for farmers and increasing financial losses for vendors and exporters (White & Elson, 1992; Stonehouse, Mumford, & Mustafa, 1998; Allwood, Chinajariyawoong, Drew, Hamacecek, & Hancock, 1999; Sarwar et al., 2013; Zubair, Shehzad, Mastoi, & Mahmood, 2019). The small agricultural growers grieved unambiguously and were incapable of arranging adequate protection actions. The non-operative control methods have prophesied the loss of >20% of fruits and >25% of vegetables in Pakistan (Stonehouse et al., 1998). Due to their polyphagous nature, the majority of species mutilate a variety of plant hosts, including horticultural crops and inclusive vegetable varieties (Rauf, Ahmad, Rashdi, Ismail, & Khan, 2013).

It has already been reported that ten species from Pakistan‘s Punjab province can harm fruits and vegetables both directly and indirectly (Zubair et al., 2019). One of the most prevalent and well-established in various parts of Pakistan is *B. zonata* (Saunders). It is prevalent throughout Punjab province, Pakistan, particularly in the southern areas (Marwat, Hussain, & Khan, 1992; Sarwar et al., 2013; Rasool et al., 2024). *Bactrocera zonata* fruitflies are likely to feed on more than 60 fruit and vegetable species (Sarwar et al., 2013; Rasolofoarivao, Raveloson-Ravaomanarivo, & Delatte, 2021).

Female fruit flies select their hosts based on several important characteristics of fruit plants, including color, size, shape, and fragrance (Mahfuza, Tahira, & Howlader, 2011). Numerous studies have documented herbivorous insects‘ host preferences, and because of their great obligations to jump hosts, this phenomenon may vary and diversify. It is estimated that between 20 and 40 percent of all animal species are host-specific insects. While some fruit flies exhibit a narrow focus on one or two plant species, others exhibit a more generalized behavior, infiltrating as many host plants as possible (White & Elson-Harris, 1992; Bush & Butlin, 2004; Rasolofoarivao et al., 2021).

Host quality has a significant impact on the reproductive parameters of adults as well as the evolutionary time and endurance of pre- and post-larval stages. For insect species, obtaining adequate resources and excellent ovipositional host sites is a relatively complex situation (Kostal, 1993; Stonehouse, 2002; Chang, Tzeng, Tsai, Kao, & Tseng, 2003; Darshanee et al., 2017; Saeed et al., 2022).

Fruit and vegetables comprise important nutritional assets like protein, lipids, Phenylpropanoids, proponoids, tyrosine and phenylalanine. These compounds play a detrimental role in locomotion, sexual maturity, flight, tissue assembly of plants, and plant defense against ultraviolet light, predators, pathogens, or odors and colors that regulate the pollinators (Nasution & Kuswadi, 2004; Rizk, Abdel-galil, Temerak, & Darwish, 2014; Darshanee et al., 2017; Rasolofoarivao et al., 2021).

Informational acquaintance with the host range is important to understand insect population compassion concerning host plant choices during diverse growing periods. The survey aimed to collect data on host plant choice diversity of *B. zonata* and understand host selection and plant dispersal. The research explored how host diversity influences pest biology and the importance of identifying alternative plant hosts for better insect population management. The main objective was to examine insect-plant interactions concerning host preference and diversity of *B. zonata*. The findings will improve our understanding of food preferences and help standardize rearing practices for fruit flies, which are essential for studying their biology and control methods.

MATERIALS AND METHODS

Host and adult egg-laying selection

Host preference research studies were conducted particularly for *B. zonata* fruit flies using different selected fruits and vegetables. There were eight diverse treatments containing untreated control and were recorded in four replicates. The food sources included seven fruits *i.e.,* apricot, (*Prunus armeniaca*), plum (*Prunus domestica*), peach (*Prunus persica*), yellow muskmelon (*Cucumis melo*), watermelon (*Citrullus lanatus*), cherry (*Prunus avium*), beer (*Ziziphus jujube*) and seven vegetables *i.e.,* bitter melon *(Momordica caranthia*), sugar beet (*Beta vulgaris*), carrot (*Daucus carota*), tomato (*Solanum lycopersicum*), cucumber (*Cucumis sativus*), eggplant (*Solanum melongena*) and pumpkin (*Cucurbita pepo*).

These hosts provided food-stuffs, breeding places and ovipositional plugs for adults and nourishment for the developing larvae of *B. zonata*. Good quality, ripened fruitage was picked from the fruit shops, deposited in bags and tagged as identification numbers. Fruits and vegetables, each weighing 250 grams from every sample, were used for field and laboratory analyses. Food choices were observed with four replications. The smaller fruits and vegetables were kept in plastic chambers concealed by a fine mesh (10 cm x 7 cm, diameter x depth) and larger fruits and vegetables were kept in individual containers (31 cm x 13 cm, diameter x depth). These structures were attached to a tree with a string and the bottom layer is filled with sand for the pupal stage. The field experiments were conducted in the orchard and vegetable farms with the studied host plants. The host samples attached with trees and branches of the vegetables remained visible to the flies for oviposition for a duration of 48 h (Sarwar et al., 2013) and later the fruit samples were shifted to the laboratory where they were tagged with identification numbers, and individually transported to plastic rearing chambers (L x W x H: 50 x 44 x 42 cm).

Performance of the progeny

The oviposited fruits and vegetables were taken out from the plastic buckets in the field. The samples of fruits and vegetables were retained individually in distinct plastic containers (L x W x H: 42 x 40 x 38 cm) and shifted to the laboratory. The plastic vessels were enclosed with small fine mesh and firmly protected with a sticky material to monitor the outflow or entrance of insects. The impact of fruit flies on the nominated fruticulture was evaluated by nurturing these flies over wet sand in the vessels for 16- 24 days under a standardized maintained laboratory (25 ± 2 °C, 70 ± 5% RH, 16: 08 h LD period).

The appearance of flies was consistently noted in the samples taken from the host. The process of larval feeding was monitored for 10 to 12 days. The samples were observed to confirm that the larvae had left the food plants and the sand was filtered to separate pupae from the substrate. The datasets regarding the puparia from each food plant were observed. The puparia were retained in a plastic Petri dish at 10-15% moisture level with tissue paper and covered with sand (Amaral et al., 2021). Plastic Petri dishes were retained in small plastic vessels with a fine-sized mesh cloth by keeping enough aeration.

The established larvae escaped from the oviposited fruit culture and transformed into a pupa in the sand. The datasets on the development of flies were calculated conjointly evolving from the pupa. The adult fruit flies were presented with a sugar solution and wet cotton in the rearing chambers.

The datasets of host and nutritional observations were calculated and the % occurrences of flies were counted from the number of developed adults for each host in all studied fruticulture. The control host samples were reared on the finely filtered wet sand in distinct chambers for a minimum of 14 days to perceive the observation of the invasive insects or the emergence of flies from the samples.

Developmental times and means survivor rates

The colony of *B. zonata* was established from samples collected from various hosts and locations in Pakistan. The procedures adopted in the present research were identical to the previous work carried out (Carey, 1984; Sarwar et al., 2013). The duration of the egg stage and hatching rate were constructed by retaining 100 fresh eggs on filter paper in Petri dishes at standardized laboratory conditions of 25 ± 2, 70% ± 5 RH, and 12:12 LD. After one day, the hatching possibilities of eggs were monitored on an hourly basis and the mean values were recorded. The freshly emerged larvae were employed in different dishes with small amounts of fruit and vegetable, covered and placed in a rearing chamber at earlier mentioned standard conditions for determining the larval and pupal trials. Fresh fruits and vegetables were added as food to each dish as required. While the larvae in each replicate started to reach maturity, they were shifted to sand in other vessels to allow for pupation. The pupae convalesced were placed in containers for adult emergence under the same laboratory conditions as the larval trials. Ten pairs of fresh adults were retained in a small vessel for the study of other life-history traits. Fecundity data were also recorded by employing small pieces of host fruits and vegetables on the filter paper. Adults frequently oviposit underlayer of hosts. Eggs were counted. The methodology regarding the observations of egg to pupal stages, maturation of female progeny, developmental times and means survivorship calculation was performed by following the protocols of the studies of other tephritids (Brévault & Quilici, 2000). All life stage was calculated by an RCBD analysis supposing replicates as multiple annotations at each host. The detailed methodology adopted for each life stage has been explained in earlier literature (Duyck & Quilici, 2002).

Statistical analysis

The intensities of fruit fly infestations in all possessions were interpreted statistically and calculations of datasets were through analysis of variance (ANOVA) by the Statistics software package. The Least Significant Differences (LSD) test was carried out to find the substantial differences among treatment means at $P= 0.05$ (R Core Team, 2020). All developmental investigations of life stages of *B. zonata* were observed in four replicates and ovarian maturation was calculated from three replicates of twenty females. Means developmental times and percent survivorship, calculations were performed through ANOVA by applying the Student Newman-Keuls multiple range test, $P < 0.05$) and the number of eggs used (n=100). The percent insect survival (S) and the mean developmental periods (T) were assessed and Howe's index (Howe 1971; Rasool, Qayyum, Iqbal, & Rasool, 2024) a measure of the suitability of a diet, was calculated as follows by dividing the log of the percentage adult emergence by the mean development period. The Pearson correlation coefficient and coefficient of determination were also calculated.

RESULTS

The peach fruit fly, *B. zonata* was reared from eatable host fruitage (fruits and vegetables) collected from the investigational location. The results regarding the feeding choices of *B. zonata* for fruits and vegetables are presented in Table 1.

Preference of fruit host

Field studies

Prunus armeniaca host to presented *B. zonata* displayed the highest archives of pupae (197.37) and adult emergence (177.67) from the progeny of *B. zonata*. The least records of pupae (27.41) and adult emergence (11.78) were observed in *Z. jujube*. The number of pupae (164.57, 132.27, 112.84, 110.74 and 31.94) and adult (137.87, 104.53, 86.7, 78.5 and 20.6) were observed in *P. domestica*, *P. persica*, *C. melo*, *C. lanatus*, *P. avium* hosts, respectively. The percentage emergence of *B. zonata* adults was highest (90.01%) on *P. armeniaca* than other hosts showed 83.78,79.03,76.83, 70.89, 64.53 and 42.97 percent emergence in *P. domestica, P. persica, C. melo*, *C. lanatus*, *P. avium*, and *Z. jujube* respectively. The emergence of *B. zonata* adults was significant among different fruit host samples. The pupal weight of *B. zonata* was high (7.35 mg) from the *P. armeniaca* host than those captured from other host fruits (*P. domestica*, *P. persica*, *C. melo*, *C. lantus*, *P. avium*) with values 6.17, 5.07, 4.31, 4.27, 1.90 and 1.78 mg, respectively. All pupal weight was significantly different among different fruit hosts (Table 1).

Developmental times and percent survival from eggs to adults

These results presented an oviposition choice rankings of *B. zonata* among the different observed fruits as hosts. These studies determine evidence for the importance of the potential role of adult favoritism for host selection in the oviposition process as an objective assessment.

The developmental time of *B. zonata* for each life stage was significantly different for each host fruit species (Fig. 1). The developmental time for life stages (total days, maturation of overy, pupal and larval) was observed respectively ($F = 57.4$, $df = 3$, $P <$ 0001). The increased developmental for each least preferred fruit host was observed. *Prunus armeniaca* is the most preferred among the studied fruit hosts whereas *Ziziphus jujube* is the least preferred.

Survivorship for all immature stages varied significantly relative to host species of fruits ($F = 724.8$, $df = 3$, $P < 0.0039$). The adults emergence (%) from a unit of 100 eggs was remained (87.17, 83.78, 78.57, 76.12, 70.31, 65, 43.39), pupal (98.73, 100, 97.22, 98.52, 100, 97.77, 96.36), larval (96.34, 92.5, 86.74, 83.95, 82.05, 75.6. 74.32), eggs (82, 80, 83, 81, 78, 82, 74) for fruit species *P. armeniaca, P. domestica, P. persica, C. melo, C. lanatus, P. avium* and *Z. jujube* respectively (Fig. 3). The impact of different hosts on the pest also analyzed through the Howe's index decreased significantly in the less preferred hosts as shown by the high negative correlation coefficient ($r =- 0.9269$; $P = 0.002$) and represented a highly significant interaction (Table 2). This indicates that developmental times increased in less preferred hosts and Howe's index decreased significantly where whereas in preferred hosts developmental times in not affected.

Preference of vegetable hosts

Field studies

The maximum numbers of 158.41 pupae of *B. zonata* were found from *M. caranthia* followed by *B. vulgaris*, *D. carota*, *S. lycopersicum*, *C. sativus*, *S. melongena* and *C. pepo* with values 138.94, 127.20, 95.37, 67.35, 29.26 and 21.89, respectively. The pupal weight of *B. zonata* exposed to *M. caranthia* was significantly high (6.12 mg) as compared with those from *B. vulgaris*, *D. carota*, *S. lycopersicum*, *C. sativus*, *S. melongena* and *C. pepo* with values 5.12, 5.01, 4.07, 2.39, 1.81 and 1.24 mg, respectively. A total of 132.27 adults emerged from the pupae of *B. zonata* nourished on *M. caranthia* which was significantly greater than *B. vulgaris*, *D. carota*, *S. lycopersicum*, *C. sativus*, *S. melongena* and *C. pepo* with values 107.42, 94.38, 67.17, 81.29, 13.08 and 7.96, respectively. The occurrence of the maximum inhibition of 36.37 percent was perceived in the *B. zonata* offspring nourished on *C. pepo* trailed by *S. melongena*, *C. sativus*, *S. lycopersicum*, *D. carota*, *B. vulgaris* and *M. caranthia* with values 44.70, 61.31, 70.43, 74.20, 77.31 and 83.50, discretely. The effects of the diets nourished by flies discovered the evidence from progenies as the significantly different values from each other of each tested factor (Table 1). The laboratory placed containers having samples of fruit and vegetables as cross-examination revealed the emergence of *B. zonata* confirming no prior pest invasions in the studied hosts.

Developmental times and percent survival from eggs to adults

These results exhibited the choice rankings of *B. zonata* among the different studied vegetables as hosts. The developmental time of *B. zonata* for each life stage was significantly different for each host vegetable species (Fig. 2). The developmental time for life stages (total days, maturation of overy, pupal and larval) was observed ($F = 66.7$, $df = 3$, $p < 0001$). The increased developmental time for each least preferred vegetable host as compared to the most preferred was observed. *Momordica caranthia* was the most preferred vegetable among the studied hosts while *Cucurbita pepo* with less preference (Fig. 2).

Survival percentages for life stages varied diversely concerning the vegetable host species ($F = 957.2$, $df = 3$, $p < 0.0042$). The adult's emergence (%) from the cohort of 100 eggs remained (83.75, 76.31, 75.36, 70.15, 61.67, 44.83, 37.03), pupal (100, 98.7, 98.57, 98.52, 96.77, 96.66, 94.74), larval (97.56, 96.25, 89.74, 88.31, 83.78, 83.33. 81.42), eggs (82, 80, 78, 77, 74, 72, 70) for vegetable species *M. caranthia, B. vulgaris, D. carota, S. lycopersicum, C. sativus, S. melongena, C. pepo* respectively (Fig. 4). The impact of different vegetable hosts on the pest was analyzed through the Howe's index. The results showed that in the less preferred hosts, the developmental times increased, and Howe's index decreased significantly, as shown by the high negative correlation coefficient ($r = -0.933$; $p = 0.002$). This interaction was highly significant (Table 3). On the other hand, in preferred hosts, the developmental times were not affected. The impact of different vegetable hosts on the pest was analyzed through Howe's index. The results showed that in the less preferred hosts, the developmental times increased, and Howe's index decreased significantly, as shown by the high negative correlation coefficient ($r = -0.933$; $p = 0.002$). This interaction was highly significant (Table 3). On the other hand, in preferred hosts, the developmental times were not affected.

Table 1. Effects of various fruit and vegetable hosts on the preference and growth of fruit fly *Bactrocera zonata*.

Category	Sr. No.	Fruit host	Pupae	Pupal weight (mg)	Adults emerged	Percent emergence
Fruits	1	*Prunus armeniaca* (apricot)	197.37 a	7.35 a	177.67 a	90.01 a
	2	*Prunus domestica* (plum)	164.57 b	6.17 ab	137.87 b	83.78 b
	3	*Prunus persica* (peach)	132.27 c	5.07 b	104.53 c	79.03 bc
	4	*Cucumis melo* (yellow muskmelon)	112.84 e	4.31 c	86.7 d	76.83 c
	5	*Citrullus lanatus* (watermelon)	110.74 e	4.27 c	78.5 e	70.89 d
	6	*Prunus avium* (cherry)	31.94 h	1.90 e	20.61 f	64.53 e
	7	*Ziziphus jujube* (beer)	27.41 i	1.78 e	11.78 h	42.97 f
	SE		3.74	0.012	3.495	0.689
	LSD		16.395	0.078	13.726	3.100
Vegetables	1	*Momordica caranthia* (bitter melon)	158.41 b	6.12 ab	132.27 b	83.50 b
	2	*Beta vulgaris* (sugar beet)	138.94 c	5.12 b	107.42 c	77.31 bc
	3	*Daucus carota* (carrot)	127.20 d	5.01 b	94.38 d	74.20 c
	4	*Solanum lycopersicum* (tomato)	95.37 f	4.07 c	67.17 f	70.43 d
	5	*Cucumis sativus* (cucumber)	67.35 g	2.39 d	41.29 g	61.31 e
	6	*Solanum melongena* (eggplant)	29.26 i	1.81 e	13.08 h	44.70 f
	7	*Cucurbita pepo* (pumpkin)	21.89 j	1.24 ef	7.96 i	36.37 g
	SE		3.425	0.011	3.674	1.382
	LSD		16.575	0.067	9.570	4.057

Values followed by the same letter within a column are not significantly different at the 5% probability level

Table 2. Mean (± SE) development time (days) and survival (%) of *Bactrocera zonata* fed with different different fruits

Fruit hosts	Days from egg to adult	Survival	Howe's index Log S/T
Par	42.2 ± 1.5 a	87.17 ± 1.00 a	0.1058
Pd	46.0 ± 2.4 b	83.78 ± 0.3 b	0.0962
Pp	46.5 ± 2.5 bc	78.57 ± 0.5 c	0.0938
Cm	48.0 ± 2.0 c	76.12 ± 0.3 d	0.0902
Cl	49.0 ± 1.2 d	70.31 ± 0.5 e	0.0868
Pav	50.5 ± 2.4 e	65.00 ± 1.0 f	0.0827
Zj	53.0 ± 2.5 f	43.39 ± 0.3 g	0.0711

Values followed by the same letter in a column are not significantly different (post-hoc Tukey's HSD multiple comparison range test, $P \leq 0.05$).
Highly significant correlation r =-0.9269 and R2, the coefficient of determination, is 0.8591. p = 0.002); S expressed as %.

Table 3. Mean (± SE) development time (days) and survival (%) of *Bactrocera zonata* fed with different different vegetables.

Vegetable hosts	Days from egg to adult	Survival	Howe's index Log S/T
Mc	44.0 ± 2.0 a	83.75 ± 0.5 a	0.1006
Bv	46.0 ± 2.5 b	76.31 ± 0.5 b	0.0942
Dc	48.2 ± 1.9 c	75.36 ± 0.3 c	0.0896
Sl	49.8 ± 2.5 d	70.15 ± 1.00 d	0.0853
Cs	53.0 ± 3.2 e	61.67 ± 0.7 e	0.0777
Sm	53.8 ± 3.0 ef	44.83 ± 0.5 f	0.0706
Cp	55.0 ± 2.0 f	37.03 ± 1.00 g	0.0656

Values followed by the same letter in a column are not significantly different (post-hoc Tukey's HSD multiple comparison range test, $P \leq 0.05$).
Highly significant correlation r =--0.933; R^2, the coefficient of determination, is 0.8705; p = 0.002); S expressed as %

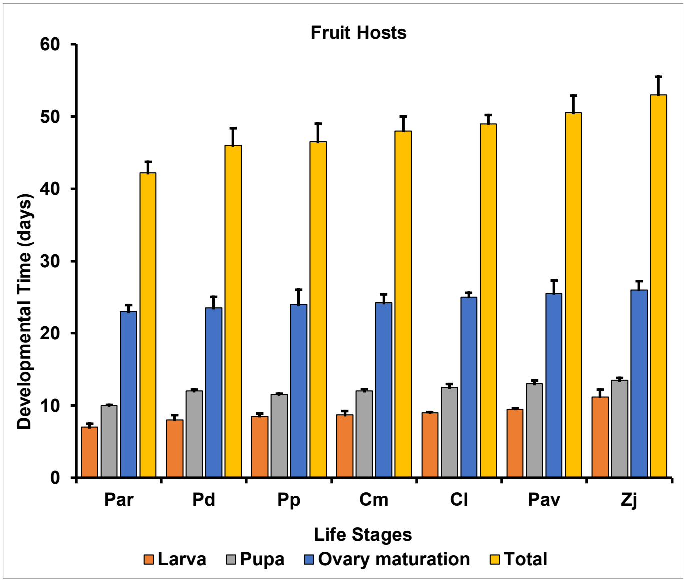

Figure 1. Mean developmental time of different life stages of *Bactrocera zonata* in seven different fruit hosts (Par, *Prunus armeniaca;* Pd, *Prunus domestica;* Pp, *Prunus persica;* Cm, *Cucumis melo;* Cl, *Citrullus lanatus;* Pav, *Prunus avium;* Zj, *Ziziphus jujube*), (Number of replicates, N= 4).

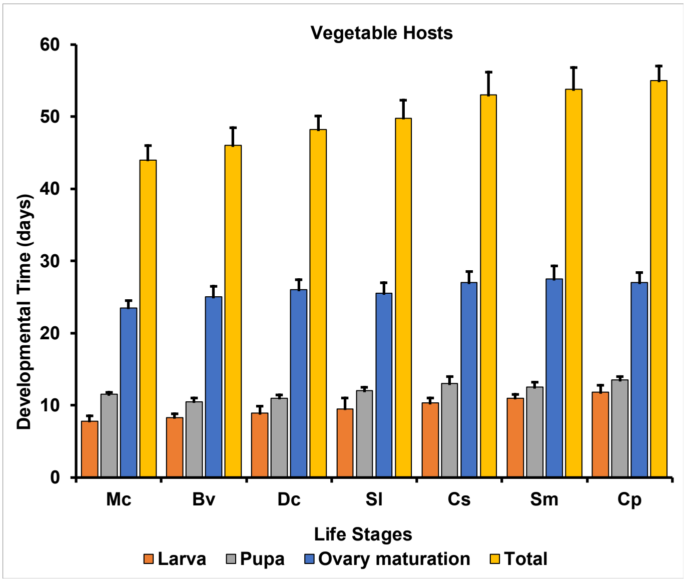

Figure 2. Mean developmental time of different life stages of *Bactrocera zonata* in seven different vegetable hosts (Mc, *Momordica caranthia;* Bv, *Beta vulgaris;* Dc, *Daucus carota;* Sl, *Solanum lycopersicum;* Cs, *Cucumis sativus;* Sm, *Solanum melongena;* Cp, *Cucurbita pepo*), (Number of replicates, N= 4).

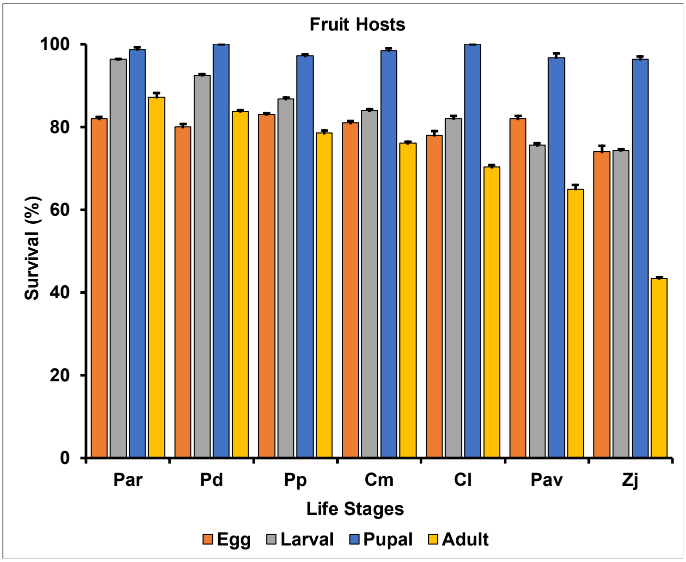

Figure 3. Mean survivorship (%) of life stages of *Bactrocera zonata* in seven different fruit hosts (Par, *Prunus armeniaca;* Pd, *Prunus domestica;* Pp, *Prunus persica;* Cm, *Cucumis melo;* Cl, *Citrullus lanatus;*Pav, *Prunus avium;* Zj, *Ziziphus jujube*), (N = 4 replicates), (n= 100 eggs).

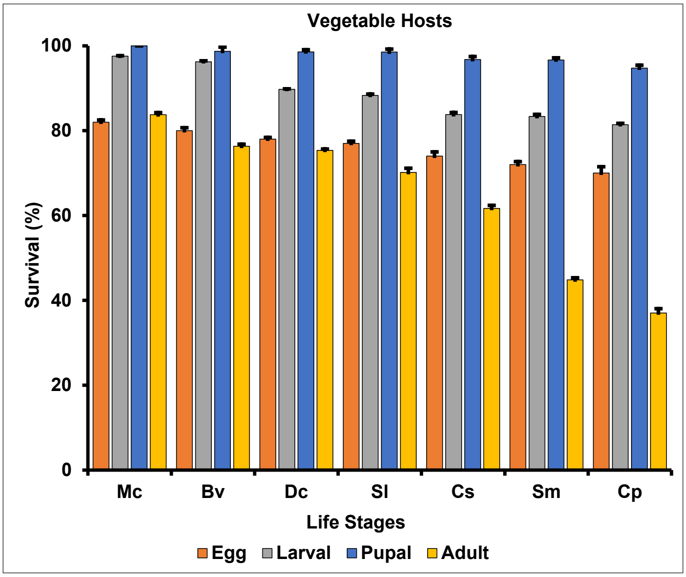

Figure 4. Mean survivorship (%) of life stages of *Bactrocera zonata* in seven different vegetable hosts (Mc, *Momordica caranthia;* Bv, *Beta vulgaris;* Dc, *Daucus carota;* Sl, *Solanum lycopersicum;* Cs, *Cucumis sativus;* Sm, *Solanum melongena;* Cp, *Cucurbita pepo*), (N = 4 replicates), (n= 100 eggs).

DISCUSSION

Experimental designs showed that fruit flies behave differently from their dominant hosts and may be more suited to advantageous ones. The host preference diversity study of *B. zonata*, fruit fly, effectively identifies their food preferences by categorizing attractive choices. To reduce the risks associated with pre- and post-harvest activities, this study explored various marketable fruit and vegetable varieties that are less attractive to fruit flies. Seven different fruits and vegetables were tested as potential hosts for the fruit fly species *B. zonata*. Among these, certain tested plants supported more to fruit fly development than others. Research on the fruit fly *B. zonata* showed that it significantly affects its plant hosts. Apricot and bitter melon are the top choices for oviposition and feeding. The scents of the tested hosts attracted adult *B. zonata* flies. Fruits, including *Prunus armeniaca* (apricot), *P. domestica* (plum), *P. persica* (peach), *Cucumis melo* (melon), *Citrullus lanatus* (watermelon), *P. avium* (sweet cherry), and *Ziziphus jujube* (jujube), along with vegetables such as *Momordica charantia* (bitter melon), *Beta vulgaris* (beet), *Daucus carota* (carrot), *Solanum lycopersicum* (tomato), *Cucumis sativus* (cucumber), *Solanum melongena* (eggplant), and *Cucurbita pepo* (squash), were ranked in order of preference by *B. zonata*. The preference for *P. armeniaca* was notably significant compared to the other six fruit hosts tested, followed closely by *M. charantia* among the other six vegetable hosts.

The current findings indicate that all the tested natural fruits and vegetable hosts are considered suitable for the pest *B. zonata*. The host selection by *B. zonata* may be influenced by factors such as the availability of the hosts, their species, nutritional value, chemical properties, and the overall quality of the host for the development of their offspring (Alies-van, 2005; Sarwar et al., 2013; Akol, Masembe, Isabirye, Kukiriza, & Rwomushana, 2013; Ahmed et al., 2018; Rasool, Sarwar, Masoom, & Ahmad, 2023). Present findings are necessary to explain the outcome acquired as delay or earlier premature growth may be the reason for different compositions of the nutrients present in plant host species causing different choices of fruit flies (Fernandes-Da-Silva & Zucoloto, 1993). These aspects could affect the adult behavior and development of immature instars of *B. zonata*. Rajpoot, Ali, & Rizvi (2002) experienced cucurbits for the comparative population and host discrimination of another *Bactrocera* species i.e., *B. dorsalis*, and categorized the practiced cucurbits into three preference categories from higher to low.

Previously, the richness of species on various hosts was connected with the preference adopted by female fruit flies over larval capacity (Fitt, 1986). The host's suitability and quality play an important part in the insect-rearing methods (Fletcher, 1989). The larval development and survival patterns affected by the host quality have been reported in earlier Tephritidae studies. The larval development process of the fruit fly *C. capitata* increased from seven days in favorable hosts (mango and tomato) to more than twenty days in least favorite quinces (Carey, 1984). The developmental time of different life stages of both *Anastrepha ludens* and *B. cucurbitae* may fluctuate based on host fruit species (Leyva, Browning, & Gilstrap, 1991; Carey, Harris, & McInnis, 1985). The developmental time of larval stages and survival are precisely connected with the quality of the host as food. The potato tuber as food for larval development (Etienne, 1973), was more appropriate than tomato in mass rearing. Numerous host plants can tolerate the full progress of various fruit flies however qualitative hosts can accomplish the significant changes in survival rate and larval focus. The fruit fly, *B. dorsalis* unveiled a documented link between adult oviposition choice and offspring presentation. This is likely that there may be capability transformations of feral flies to permeate a host for oviposition, larval survival, developmental durations and pupation capacity (Rattanapun, Weerawan, & Clarke 2009; Khan, Rashid, & Howlader, 2011). Parental fruit flies are the best thinkers to mark verdicts about oviposition based on the host's suitability (Muthuthantri & Clarke, 2012; Rasolofoarivao et al., 2021). The connection between host choice and the progeny presentation processes exhibited resilient support for the choice-presentation hypothesis, which identified that female flies marked ovipositor on hosts that pretend best for their progeny (Akol et al., 2013). This is also a routine matter for some insects to utilize their taste structures to collect obligatory pieces of evidence about the qualitative nutritional data regarding foodstuffs. The flies use sensory organs, odor receptors and taste structures to mockup the food for appropriateness in rapports to nourishment and lethal effects (Wisotsky, Medina, Freeman & Dahanukar, 2011). Flies discover and consider the hosts by utilizing different strategies and quantifying their characters based on their qualities. These qualities may be in the shape of color scheme, structure, profiles and aroma of host fruitage which further inspire fruit flies' reaction towards hosts (Allwood et al., 1999; Mahfuza et al., 2011; Draz, Tabikha, El-aw, El-gendy, & Darwish, 2016).

Fruit flies have adapted to the phonological interactions of their host plants, according to trials that were surprising when compared to earlier fruit-culture studies (Feder et al., 1997; Sarwar et al., 2013). Plant hosts that exhibit variations in basic metabolites (Roitberg & Isman, 1992) and nutritional value may affect larval survival and growth patterns (Haggstrom & Larsson, 1995).

The differences observed in pupal formation, pupal weight (in mg), adult emergence, and percentage of emergence in the studied *B. zonata* indicated that the nutritional content of food can significantly affect larval development and growth rates, which in turn impacts the survival rates of fruit flies (Sarwar et al., 2013). Additionally, the hard outer layer of certain plant hosts may make them less suitable for oviposition. This could explain why some hosts attract larger flies than others, as noted in the present findings (Feng-ming, 1997; Sarwar et al., 2013).

The relationship between host species is significant due to its nutritional importance (Fernandes-Da-Silva & Zucoloto, 1993). The developmental time for *B. zonata* was assessed in conjunction with previous findings regarding other fruit fly species (Brévault & Quilici, 2000; Duyck & Quilici, 2002). The varied developmental times and survival rates of the immature stages observed in this study demonstrated considerable diversity among different food hosts, highlighting the adaptability of this fruit fly to a range of fruit and vegetable hosts.

Ovarian maturation was calculated in the present study as a significantly diversified range of food hosts (Duyck & Quilici, 2002). However, the impact of laboratory studies on the maturation of ovaries (Tzanakakis & Koveos, 1986) may be different with the diversified field condition. This phenomenon may be calculated with more intention about the available field conditions in the future. The results obtained in this study show that the studied host species are appropriate for the larval development of *B. zonata*. Nevertheless, before considering mass rearing it is worth comparing the quality and the chemical constituents of each fruit and vegetable host for *B. zonata* as compared to the artificial diet (Qureshi, Ashraf, Bughio, & Hussain, 1974).

The feeding on apricot (*P. armeniaca*) and bitter melon (*M. charantia*) may provide essential nutritional values necessary for the offspring growth. It is likely that the other host plants did not meet the nutritional requirements of the fruit flies, which could explain why they were not attracted to them. The research area includes a diverse range of host plant species that can sustain various fruit fly species. Furthermore, a broader selection of samples should be considered for comprehensive studies of Tephritidae hosts, especially concerning the less common species.

CONCLUSION

Host plant preferences enable an analysis of fruit fly ovipositional behavior regarding different fruits and vegetables, highlighting their food preferences. *Bactrocera zonata* favors hosts like *M. caranthia*, (bitter melon) and *P. armeniaca* (apricot), while other tested foods also align with its dietary preferences. This insight suggests that some commercial fruit varieties, though considered poor hosts for fruit flies, might reduce pre and post harvest risks by applying these findings.

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