Research Article

The Study of Correlation Between Ecological Margins and Inhabitants of *Bactrocera dorsalis* (Handle) in Different Mango Fields of District Naushahro Feroze Sindh, Pakistan

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Abstract | The *Bactrocera* species which belong family Tephritidae commonly called as fruit flies, according to inhabitants they live in tropical and subtropical areas of the world. The fruit flies are the pest of several economical important fruits of world. The *Bactrocera dorsalis* (handle) complex fruit fly according to morphology, physiology and genetically. It is very serious pest of many fruits in the overall world; such as guava, apricots, Sapodillas etc. this species is voracious for the mango in whole world mostly; means the favorable host of delicious mango. During current study observe the ecological margins and its habitats, host effects on the occurrence of this decisive pest. This study was steered in district Naushahro feroze of Sindh Pakistan during mango season of 2014-2015. Actually, this district is well known according to citreous fruity land Pakistan where lot of citreous fruits cultivated. The selected 2 hectors orchards per of mango field in per-taluka (five talukas) with different varieties of mango; 10 traps and lures were hanged in (2 hector) trees. Volatile chemical (Methyl eugenol) in plastic traps by cotton water-logged. Weekly traps were checked and changed almost we find out 10-12 replications of flies. According to statically examination we have got results 98.6% *Bactrocera dorsalis* flies caches in lures and traps, maximum number of flies cached during July (8285, 11693, respectively) at the peak mango season while minimum number of flies caches during month of September (959, 1100, respectively) during successive season of mango in 2014-2015. The mean value of *Bactrocera* species were found with figure of 207.1. Total fruit flies significant values ($f = 41.36$, $p<0.05$) with total mean population of fruit flies (15.62±137.4) in different talukas during two seasons of mango. The climatic parameter shows the relationship with occurrence of *Bactrocera dorsalis* species with mostly positive impact, temperature ($r=0.66$, $r= 0.77$ respectively), rainfall ($r = -0.45$, $r= 0.82$ respectively), Humidity ($r=- 0.37$, $r = - 0.024$, respectively) and wind velocity ($r=-0.62$, $r= -0.419$, respectively). Current status of fruit flies shows that all the factors of ecology, directly are indirectly impact on the progress physically and reproductively enhance the growth of *Bactrocera dorsalis*. These ecological correlations play key role in development of pest.

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Introduction

Insects have different territories and behaviors for survival, hot habitat fruit flies are always durable circulators, having significant volume for covering long-distance movement (Christenson and Foote, 1960). The occurrence of fruit flies frequency was diverse with cultivars and age of orchards (Kannan and Rao, 2006). The incidence of this multifaceted pest obligatory strong restraint on growth and variation of cultivation in all over the tropical and subtropical areas. It has provided a huge basin of annoying and progressively regular *overview* of oriental fruit fly into sub-continental area. According to territories and environmental adjustment, these *Bactrocera* species remain to impend the huge denomination fruit and vegetable fields in tropical and sub-tropical areas of world. Sex eradication with diseased volatile chemical (methyl eugenol) is the repetition implemented by the management authority for locality wide control of this irritant, although there is lot of techniques already used for controlling this fly population such (fruit bagging, net house cultivation and mass liberated insecticides spray), all these are major arrangements, that growers were used for defense of their cultivations against oriental fruit fly, although the fruit bagging and net house cultivation strategies exhausted against employment, second strategy volatile chemical have impact on environment (Chen *et al*., 2006a). The presence of this pest complex has imposed strong constraints on the development and diversification Mango (*Mangifera indica* L) is most delicious fruit, it is harshly spoiled by fruit fly pest. The *Bactrocera dorsalis* (Diptera: Tephritidae) is one of Asian and African nastiest; this fly is injurious pest for fruits, this pest have more than hundred host, major hosting in fruits and vegetables it attacks as major host mango and guava (Ye and Liu, 2005). The incidence of fruit fly was observed in mango fields in different cultivar, the fruit flies status not continue all over the year, although it changes consequently based on ecological components. The *Bactrocera dorsalis* research have specified that displacement covered by this species about sixty five k/m (Steiner *et al*., 1962). Mostly specie have specific host, according to their environmental and feeding territories, although some are generally attacked on fruits and vegetables (Kapoor *et al*., 1981). For the survival of *Bactrocera* species, most effective three factors such temperature, humidity and suitability of host fruit for progeny (May, 1963). Fecundity results of fruit flies are strongly positive relationship during rainfall as compare to dry years (Bateman, 1968). Ecological factors, such as temperature and rainfall are major factors that inducing the dissemination of oriental fruit fly, locality vise infestation factor imitate the native temperature (Yongsheng *et al*., 1996; Jiang *et al*., 2001) Oriental fruit fly broad more than five progenies per-year in hot regions, but in particular areas above 10 cyclic, while in sub-tropical areas minimum 4 generations per year were shedding (Fletcher, 1989; Li, 2000). Although major critical philosophy have concentrated on identical hypothetically physiology or environmental matters, such as abundance (density, dependence/ independence debate), sexual behaviors and diversity is a quarantining appliances. When the insects move from one environment to another; there is speedy functional variations occurs, as the fruit flies mostly feed on bacteria and male pheromones. There are some noticeable concerns according to research work which indicating the inadequate techniques for postharvest disinfestation managements there is lot of work in world concerned with *SIT* (sterile insect techniques), there is lot of information according to insects natural sciences (Biology and Ecology) related to emerging justifiable for management but mostly inadequate the risks is decreased by insufficient countrywide and native Self-protective plans, such as confinement services, pest reconnaissance system and parameters of product measures, particularly in the situation of small-limited Trans edge trade. In additional local come back system instant and operative suppression or annihilation of the appropriate noticed innovative pests are not well-organized adequate, non-operational or do not occur. Under such situations, the familiarized pests may continue hidden for extended time, distributed and found definitely. Although the flourishing horticulture industry remnants very susceptible (Lux *et al*., 2003). Their fore this study was arranged to observe the current status of *Bactrocera dorsalis* in this local region, beside this also worked out on the ecological factors of this area. There is lot of research work has been don on the development and influencing factors, but The current research studies was aimed to study area vise influence and abundance of pest where the huge area were covered with orchards.

Materials and Methods

Locality for study

Naushahro feroze district is located in south-western

in Pakistan situated at Sindh province, Plain land areas with full of agro-ecosystem, and also popular with citreous fruits. It located at [Longitude 68°7'0E, Latitude 26°50'0N] with an altitude [38 meters (127 feet)], its boundaries connected north-east side with Khairpur district of Sindh Pakistan, and the west Indus River is natural connection boundary between two district (Dadu and Naushahro feroze), district Larkana in the north-west, and its south east border is surrounded by district Nawab Shah. Plainly areas covered with full pasture of citreous gardens and vegetation. The weather conditions tropical, semitropical with significant winter and summer seasons. Many agriculture harvests and citrus fruits grows, such as lemon, oranges, grape fruit, limes, pommels, mandarins etc., and other gardens such as berries, Banana, guava and mangoes orchards covered huge area of this citreous fruity district of Sindh. Outstanding favorable conditions of this locality (district) give the space for survival to oriental fruit fly whole the year (Liu and Ye, 2005; Jianhong and Hui, 2005).

Traps and lures

During the field work, two types of homemade traps were used (Lyn field trap-Jackson trap). The first homemade trap just like Lyn field was made from decomposable plastic bottle with tubular shape with (size of 10cm width and 10cm in length) cut with scissor or knife, divided bottle in two parts top part (1/4th), bottom part (2/3rd), the top part (lid) inserted in the bottom part of clear bottle sealed it. Two holes with 0.5cm size bored in the bottom for hanged it with tree by rope and 4 holes with size of 1.7 cm in size, uniformly-spaced everywhere the higher half of the trap. Second type lure is just like Jackson trap confined a sticky enclosure sited at bottom, took a clear Jar and drilled two holes with size of 0.8inch in diameter, then fixed the pipe on the both sided for entrance of fruit flies. The two types of baits were used such as methyl eugenole and cure baits were embedded in above traps. A quarter of a Dichlorvos (DDVP) and 1ml of methyl eugenole block was sited at the bottommost of the Lynnfield trap was messy on the field wire to avert entry of ants. The traps were dangled in the mango orchards. The traps were checked weakly (Lux *et al.*, 2003).

Transects

After Traps were suspended in the different orchards (mango), started the visits during 2014-2015 during peak mango season (June-October 1st weak). Every weak checked the traps and data were collected. The 10 traps were placed in each garden of each location about (150 traps) were suspended whole district's orchards in different tallukas; with area selected of (2 hectors of mango gardens) per tallukas, although there is wast area covered with citreous orchards present in district Naushahro feroze. The five tallukas in District Naushahro feroze such as (Naushahro feroze, Moro, Bhiria city, Kandiaro and Mehrabpur), all these tallukas mostly full with the orchards of citrus fruits, there is mostly mango orchards in Bhiria, Kandiaro and Mehrabpur where the both types of (methyl eugenol and Cue Lure) were randomly placed in different localities of above tallukas. The Global positioning system was also find in each trap and site area and locality of district with mobile GPS soft wear. To find out the initial awareness about the fruit flies abundance in various localities, the traps are accessible as according to average "weakly trap cache" formula: "The No. of fruit flies collected in location/ No of traps set in that location/ No. of days of traps in involvement" (Shah *et al.*, 2012).

Laboratory experiments (Rearing from fruits)

During survey sites collected rotten and fallen infested mangoes from ground for check out the incidences of fruit flies regarding to different *Bactrocera* species ratio findings in mango orchards. All the collected infested fruits were packed in wooden boxes from orchards and transferred to insectary at university of Sindh Jamshoro and rear the flies according to standard method of *ICIPE* isolation capability. The infested mangoes were kept in transparent plastic rearing cages with size of 60 × 60 × 40cm and maintained (temperature 25-27°C and Humidity 50-70% and under natural light system), the thick layer of moistened sterilized sand lined in floor of rearing cages, this sand provide the medium for buried the excited larvae for pupation. After three-five days, pupae were collected with handpicked and camel brush from the sand and kept in petri dishes (moist filter paper used) with size 1.5-9cm. These petri dishes were kept in small size 15 × 15 × 20 cm of ventilated rearing cages (two side walls with net and two wall sides with plastic) up to emergence of flies. The artificial diet (water+ hydro lysate yeast powder + sugar= quantity 3:4 ratio) provided till the full adult growth and mature in coloration. The collected specimen from traps were preserved in 70% ethanol for taxonomic identification; the identification of

Bactrocera flies based on external appearance and according to the standardized taxonomic keys of literature, later it was sent for conformation to Ian white (Natural History Museum, U.K) for further taxonomic identifications.

Metrological observations

The influence of climatic factors on abundance of host and pest (population dynamics of fruit flies) were observed and provide correlation between metrological data and pest (fruit flies) population. The mean values of different climatic parameters such as temperature (maximum and minimum), rainfall (mm), Humidity (%) and wind velocity (Km^2) were found in different standard weeks were recorded from the metrological data (www.time.anddate.come) 2014 and 2015.

Statistical analysis

The data were analyzed by following the statically methodology by for the above experiments, the means were compared by using the LSD method, calculation of correlation of population and weather parameters by SPSS software package 21.0.

Results and Discussion

The *Bactrocera dorsalis* is gluttonous pest of fruits in Sindh such as guava and mango. During this research work; it was observed that in district Naushahro feroze due to temperate weather there is lot of abundance were found to the population of *Bactrocera dorsalis*. These findings were recorded during the peak mango season of 2014 and 2015 (June-September). Figure 1 with curve data chart shows that slowly gradually fruit flies emerge to start with mango ripen stage, after peak of emergence flies suddenly decrease the population at end of season in the study area during two successive seasons of mango, although in lures and traps 98.6% *Bactrocera dorsalis* flies caches, while 2% other *Bactrocera* species cached.

The maximum number flies were cached during 2014-2015 in month of July (8285, 11693, respectively) at two successive seasons with mean value 207.1. While the minimum in number of flies were cached during 2014-2015 month of September (959, 1100, respectively) with mean values 51.47. Figures 2-3 were describe the reason beyond the highest and lowest mean value is due to influence of A-biotic factors. When we compare the abiotic factors with population of *Bactrocera dorsalis*, it was observed that during both years the weather parameters have different mode of effectiveness on population such as during 2014 (Figure 4A, B, C, D) shows the occurrence of flies with +ve sign with temperature (r=0.66), while with other parameter it clearly indicates –ve correlation such as Rainfall (r = -0. 45), Humidity (r=- 0.37) and with wind velocity (r=-0.62).

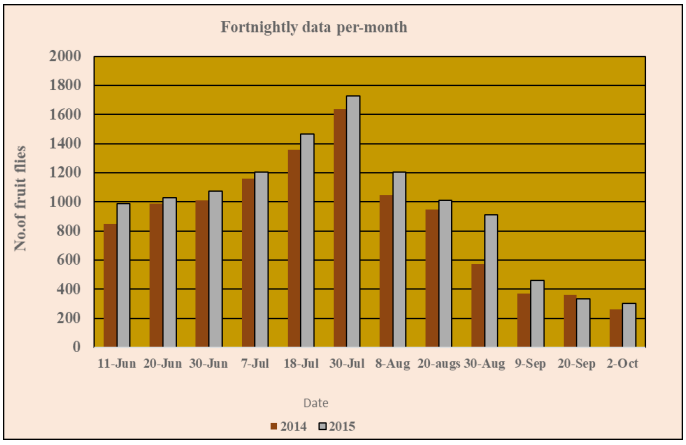

Figure 1: *Described month-wise population of Bactrocera dorsalis in Naushahro feroze during 2014-2015.*

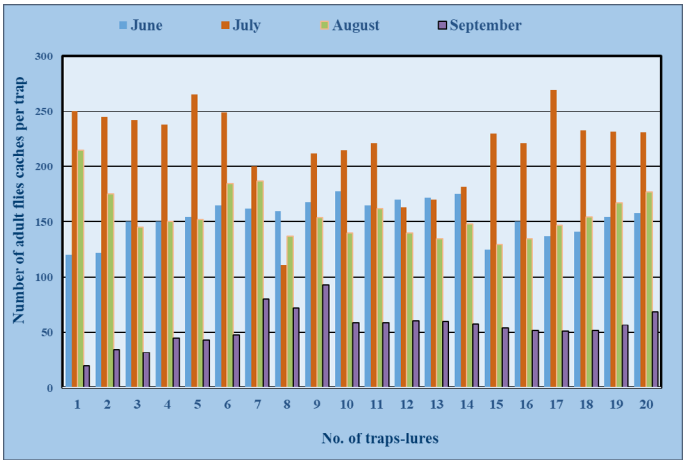

Figure 2: *Described the per-trap population of fruit flies Bactrocera species during 2014 in of Naushahro feroze.*

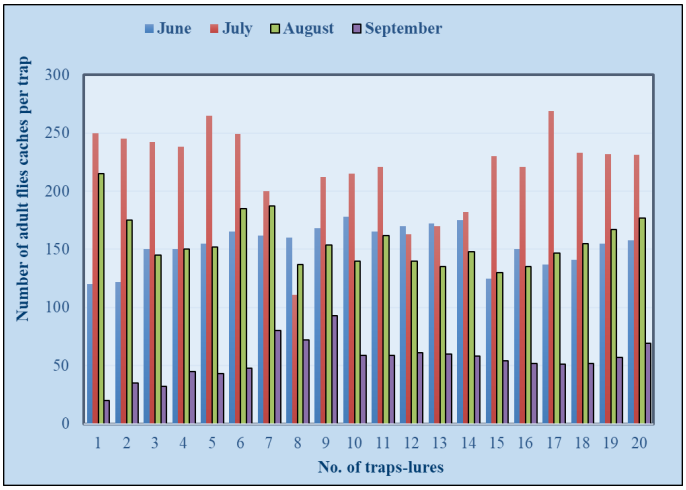

Figure 3: *Described the per-trap population of fruit flies Bactrocera species during 2015 in of Naushahro feroze.*

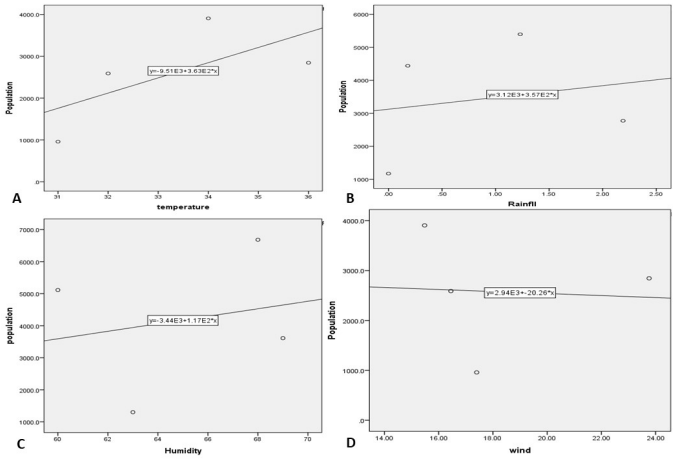

Figure 4: *(A) showing the moderate positively co-relation between average temperature; (B) showing the weak negative co-relation between averages Rainfall; (C) showing the weak negative co-relation between average humidity; (D) showing the moderate negative co-relation between average wind velocity and Population of Bactrocera species in Naushahro feroze during Jun-Sept 2014.*

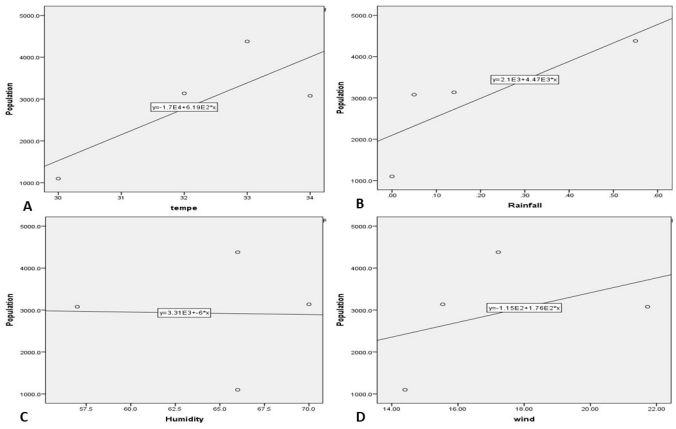

Figure 5: *(A) showing the strong positively co-relation between average temperature; (B) showing the strong positive co-relation between average rainfall; (C) showing the weak negative co-relation between average humidity; (D) showing the moderate positive co-relation between wind velocity and population of Bactrocera species in Naushahro feroze during Jun-Sept 2015.*

Figure 5A, B, C, D shows the Pearson's correlation between the abundance of fruit flies population and four major a-biotic factors during 2015. Figure 5A shows the correlation +ve temperature (r= 0.77), +ve rainfall (r= 0.82), -ve humidity (r= - 0.024), +ve wind velocity (-0.419). The Figure 1 described the significantly deference's with statically values (f= 41.36, p<0.05) during experimental observation in district Naushahro feroze, it was recorded that during both years (2014-2015) population at peak incidence in July with maximum number of flies were recorded, while in September the less (minimum) number of flies population were collected. This district of citrus fruits of Sindh shows the total mean population of fruit flies (15.62±137.4) during both successive seasons.

This research work specifies that eruption of *Bactrocera dorsalis* pest in Sindh varies according to weather influences and with peak of ripen host season. Findings of this study professed that *Bactrocera dorsalis* is major pest of mango because these results clearly find out that during the June and July the mango season in its peak of ripen and harvesting time; at this time, it was noted that abundance of *Bactrocera dorsalis* population is also with its peak position, the population of this pest increase gradually from mid of May month; and it slowly decline at the end of August. There are two reasons beyond the increasing and decreasing population of *Bactrocera dorsalis*. First one the host (mango fruit) is major host of this species of *Bactrocera dorsalis* which started harvesting or ripened from mid of May up to end of August with gradually end up to first week of October; means this pest population attractive to its host (Biotic factor). Second one reason the influence of A-biotic factors which mention in above results. These findings were very similar to findings (Mwatawala *et al*., 2006) who find that *Bactrocera* species abundance have often influenced by weather factors means there is influence of temperature, rainfall and humidity, this quote resemble to above results such as in 2014 there is less number of flies were collected as compare to 2015, because due to weather parameters, such as rainfall is very rare fall during 2014 as compare to 2015 which shows the negative effect on population. Another researcher (Kumar *et al*., 2022) described that environmental factor such as biotic and abiotic play a key role of pest population survival. Similar results were described by (Raghu *et al*., 2004), which is very similar to this research work, according to their research finding the *Dacus tryoni* and *Dacus neohumeralis hardy* collected in big numbers during the peak of fruiting season which is major host of these fruit flies, and the abiotic factors such as temperature and rainfall very helpful to increase their population in summer season, while the population of fruit flies decrease with decline in temperature, these species were resourcefully exploit their host fruit when environmental conditions fully favorable regarding to their survival, they rapidly grow their abundance increase. Other similar findings of states (Ye and Liu, 2005) that fruit flies abundance decrease due to low temperature in November–February. According (Vayssières *et al*., 2009) maximum loss of fruits (Approximately, 10-50%) due

to *Bactrocera* species during the beginning of April till to end of June. Danjuma *et al.* (2013) described that due to temperature is less growth *Bactrocera dorsalis* species in Thailand country. According to (Amur et at., 2022) described the influence of abiotic factors such as wind velocity, temperature, rainfall, and humidity district Mirpur Khas during 2014-2015, which are very similar results to this research study. Currant research work contradict with (Danjuma *et al.*, 2013) because if we look at the (Figure 4A and 5A) we will find out that during both successive seasons of mango (2014-2015) temperature remain an important parameter; its positive influence on population growth of *Bactrocera dorsalis* in District Naushahro feroze of Sindh Pakistan. This research work is also contradict with (Saleh and El-Hamalawii, 2004) regarding to their concept of findings *C. capitata* population increase during the September-December and population of this species started declined up to March due to not suitable limit range of temperature. Regarding to our critical thinking about this observation is that there is one major reason beyond this *C. capitata* is availability of major host during these months September-December up to March, which provide the suitable survival conditions as compare to weather parameters. Another researcher (Chen *et al.*, 2006b) and (Shahzad *et al.*, 2017) share same results regarding to fruit flies population is high during month of October while it was decrease during November-January, heir same above thinking arise availability of favorable host is very important for population of fruit flies, same there is temperature also very important tool for enhance of population growth of fruit flies. Same findings regarding to current study discus another researcher (Nboyine *et al.*, 2013); it reported that fruit flies abundance increases from May-November, some critical views regarding to this statement there is favorable temperature as well as there is alternative host such as Mango, Guava, Eugene jambolana (Jamoo), Sapodilla (Chiku), Apricot (Aaroo) all these host are very major host of many fruit flies and grow with alternative time duration during these months. (Kannan and Rao, 2006) recorded the high activity of fruit flies, and slowly gradually increase till the 4th week of June, during field observation, it was noted the ecological factors directly or indirectly correlated with occurrence of fruit flies. The Optimal range of temperature 21.2^{o}C-9.9^{o}C, respectively, it was observed that as the temperature raise during summer season, the flies population also increase at certain threshold level, these experiments point out that temperature is positively correlated with temperature. Vayssières *et al.* (2009) reported that *Bactrocera dorsalis* reproduce and developed certain maximum limit of temperature, its suitable range of temperature for survival is 15^{o}C-34^{o}C, although best temperature ranges between 18^{o}C-30^{o}C. Khan (2002) states that population decrease in month of August-October on apple fruit in Maree. Although in August and September fruit flies highly attack on guava fields in Sindh and Punjab provinces. At this adding our experimental scenario that in overall Sindh Province mango and Sapodilla (Chikhu) in full mode of ripen stage so the alternatively host fruits consequentially attacked by *Bactrocera* species during August and September months up to mid of November because of host availability and suitable eco-factors for their survival. Shahzad *et al.* (2017) worked on influence of A-biotic factors on population of *Bactrocera dorsalis* due positive correlation with temperature, recorded that average temperature sufficient for survival of *Bactrocera dorsalis* 21.2˚C and minimum temperature required 9.9˚C is sufficient. Dhillon *et al.* (2005) discussed that humidity and temperature; two important trappings tools which effect the population of fruit flies cucurbit species. Current study relate to (Zhang and Hou, 2005) who described the seasonally occurrence of *B. dorsalis*, in which temperature is increase which is positive clue for the emergence of flies; seasonally emergence time of *Bactrocera dorsalis* started from end of Spring season up to start of autumn. Drew and Hooper (1983) were discussed same results in their research work described that fruit flies population rises during summer season and rainy days while it declined as temperature decrease with rainfall in autumn. Susanto *et al.* (2022) described that wind velocity had significant –ve correlation with *Bactrocera dorsalis* which is same result was found from this locality, while other parameters also influce same (+ve) which strongly supported the current results, they discussed the abiotic conditions about development and reproduction of *Bactrocera dorsalis* their maximum temperature 15˚C-34˚C, although the required temperature for hatching of *Bactrocera dorsalis* is 18˚C-30˚C. When we observed the developmental stages such as eggs, larvae and adults, these developmental stages could not survive above than 34˚C, but as the temperature decreased from optimal ranges such as 18˚C; the survival duration of larvae and pupae is prolonged, although the emergence ratio of young once is decrease. Mustafa *et al.* (2011)

discussed vice versa study regarding to biological factors that humidity factor is very important it is (+ve) correlated with population of fruit flies, while when the humidity and temperature was reached to its optimal range it sometime give (-ve) correlation with population of *Bactrocera dorsalis* because when temperature increase humidity decreased while the temperature declined its optimal range than the humidity increase and its vice versa. At this point if we discussed the optimal range of the humidity is discussed by (Duyck *et al*., 2004) according to him humidity is 30%-50% should be range limit of fruit flies survival. According to (Noman *et al*., 2021) described that temperature, major and minor host positive co-relation to fruit flies population in citreous fruits to in southern Multan, although the Multan and Naushahro feroze weather almost relate, this study also support current results (Chen and Ye, 2007) discussed the environmental factors, such as temperature is the basic factor for survival of fruit fly population, while lowest humidity play important role in occurrence and emergence of fruit flies population. Their studied clearly described that seasonal temperature play important role in development and reproduction of fruit flies, while during autumn or winter months such as November-January it was observed that population of fruit flies decreased although their host fruits also available in orchards, so because of temperature declined the population rate is decreased and inactive. Khan and Naveed (2017) also discussed about the monthly average temperature and humidity (26°C to 35°C, 60%) positively (+) correlate with population of *Bactrocera dorsalis* species; and After the temperature discussed the humidity factor in this research work different scientist discussed different theories regarding to humidity, (Broufas *et al*., 2009) discussed that developmental stages of fruit flies such as egg population and other progressive forms were quickly survive at highly humidity 5%-75% while its survival were decreased at 49% humidity. At this point (Imura and Nakakita, 1984) contradict with scientist reported results it described that humidity factor is not suitable and significant in hatchability time but this factor is very important in progressive stages of larvae and pupal, maximum ranges was between 0.85% for progress. Chen *et al*. (2006b) reported that the monthly mean temperature fell within the ranges of the temperatures suitable for development and reproduction of the fly. But the monthly mean minimum temperatures from November to January seemed to be lower and were suggested to be responsible for the low populations in this period. In the comparison of three ecological factors (Vayssières *et al*., 2009) discussed critical and contradict thinking regarding to *Bactrocera invaders* species, its observation is that *Invaders* population occurs in wet season while it's declined during dry season, as the rainy season start, the flies population occurs high in ratio because humidity increase during the rainy season and humidity % increase till the end of rainy season, these results declared that all the progressive stages (egg, Larvae, Pupae) declined their growth progress with increased optimal temperature factor 18°C-33°C. Liu and Ye (2009) described that pre-oviposition in flies is physiological condition which have needed maximum 36°c temperature, while for the growth and development temperature 24°C-33°C and it decreased from higher to lower temperature. During current study the correlation between the rainfall and fruit flies were positively curved, while temperature is significantly correlated with number of flies, it suggested that during high rainfall and high temperature in mango season during July, the formers should give extra attention toward the orchards (Mahmood *et al*., 2002) According to biological studies it was observed that temperature should be effective on egg hatching up to optimal range 18°C-33°C although its range is increased from 26.5-66.75h. This range of temperature is also favorable for larvae. The developmental time days decrease and increases according to range of temperature such as at 33°C the developmental time days are17.56 days while at 36°C developmental time decreased to at 7.96 days (Liu and Ye, 2009; Wang *et al*., 2009) the temperature range affect egg maturation and reduction. At 18.3°C-35°C the development decreased. This study is little bit contradict with above scientist (Danjuma *et al*., 2013) because locality vise the weather effect is little bit different Naushahro feroze is with hot weather although host availability is whole the time of summer season so fruit flies occurrence lot of chances.

Conclusions and Recommendations

Current experimental research findings with the compatibility of other research findings it was prove that host and ecological parameters play important role in the survival of pest; if we observe that in all over world, major host of mango *Bactrocera dorsalis*, but due to availability of other fruits, there

is present *Bactrocera* species in little bit numbers. Host availability is important aspect for survival of the pest and ecological factors are very significant for development and reproductive physiology of *Bactrocera dorsalis*. Above research work clearly shows that the mango season and all the ecological factors such as temperature, rainfall, wind, and humidity are best for inhabitants of *Bactrocera dorsalis* means district Naushahro feroze (Sindh, Pakistan) is best place for survival of the *Bactrocera* species because alternative host available with alternative time space and eco-seasons. This study is very significant for research area and very beneficial for former to pay attention towards the control measures when the moon soon started and when the host season is in ripen stage, because in this research all the timings and seasons of mango pest attack and threshold of *Bactrocera dorsalis* described.

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Novelty Statement

The study has a major impact of ecological factors on the population of pest and host occurrence because it uses a novel approach to investigate population occurrence of *Bactrocera dorsalis* with influence of the ecological factors on Sindh's mango land (Mirpur Khas).

Author's Contribution

All authors contributed in this manuscript.
Aiman Amur: Conducted the research work.
Nasreen Kousar: Provide guidance.
Khalida Unar: Helped in literature review and helped in writing.
Roshan Jamali: Helped in field survey and laboratory examinations.
All authors read and approved the final manuscript.

Conflict of interest

The authors have declared no conflict of interests.

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