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Incidence of Mango fruit Borer *Autocharis albizonalis* on some Mango fruit varieties in relation to their different Physiochemical parameters

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Abstract
A study was conducted in several mango producing areas in the districts of Malda, Murshidabad, Nadia and Midnapur in West Bengal during the month of April to June, 2013 to observe the infestation of fruit borer *Autocharis albizonalis* in eight folk varieties of mango (*Mangifera indica* L). Frequent observations on incidence of fruit borers showed that the larvae of fruit borer completed their larval stage within the fruit and damage to grown up fruits during this period. The borer caused substantial damage when the fruits were medium to full grown size. During the observation the physiochemical analysis of the mango varieties mentioned, were also analyzed in the laboratory. From the study, it is found that the different physiochemical parameter like TSS, total sugar, reducing sugar and acidity of different mango varieties is changed throughout the developmental period of a mango fruit. From the study it was found that the average infestations of fruit borer in the folk varieties are continuously higher after fruit set. It was also analysed that the susceptibility of the fruit borer attack increases with the decreases of acid content of the mango fruit. Therefore, it is revealed that the fruit borer attack is in peak when the acid content of the fruit is at low level.

Keywords: Mango, Folk varieties, Fruit borer, titrable acidity, Phunia

Introduction
India has the natural advantage of growing all kinds of fruit crops. Mango is called the king of fruits in our country. According to statistics of the FAO, more than 92 countries worldwide produce mangoes [1]. India is the largest producer of mango, contributing 54.2% of total world production, but its export hardly crosses 3% of the total international demand [2]. The major mango producing regions in India are Andhra Pradesh, Uttar Pradesh, Bihar, Karnataka, Tamil Nadu, West Bengal and Orissa & Maharashtra. India's mangoes are unique in taste and aroma as they represent more than one thousand varieties, a diversity unmatched by any other national production [3]. Two important causes of low share in export of mango in the world markets are the contamination by insect pests and pesticide residues. Despite the largest production base of mango, productivity in our country is rather low. Coupled with limitations like irregular bearing, low yielding varieties and poor nutrition management, this is high incidence of insects pest and diseases that really reduces productivity [4]. Mango is attacked by more than 400 pests in the world [5]. Usually in a particular mango growing area, three or four major pests occur. Amongst them mango midges and fruit borers (*Autocharis albizonalis*) are of prime importance along with mango hoppers. Sahoo & Jha reported that the fruit borer, *Autocharis albizonalis* recently appeared in serious proportion in the major mango growing areas of the West Bengal, particularly in the districts of Malda, Murshidabad, Nadia & Hooghly causing 10-52% damage of fruits from pin head stage to full maturity [6]. It is revealed that the different physiochemical parameter like TSS, total sugar, reducing sugar and acidity of different mango varieties is changed throughout the developmental period of mango fruit. The infestation and the degree of damage by the borer vary considerably according to the genotypes of the folk varieties of mango plant and their different developmental period [7]. The role of physio-chemical characteristics of mango fruits in governing the incidence of fruit borer infesting in different days after fruit set, has not so far been investigate. Keeping this in view, the present investigation on the physiochemical characteristics including TSS, total sugar, reducing sugar, titrable acidity and sugar acid ratio of different folk varieties of mango in relation to incidence of fruit borer was carried out.

Materials and Method

The survey on the infestation of fruit borers were conducted in different mango growing districts of West Bengal namely Malda, Murshidabad, Nadia and Midnapur. Total eight folk varieties were surveyed. They were Phunia, Rarhi, Kelua, Kohitur, Khirsapoti, Gurjali, Sukhapakhia and Begunphuli. Phunia, Rarhi and Kelua are the local fruit varieties of Maldaha district. Kohitur and Khisrapoti from Murshidabad while Sukhapakhia and Begunphuli are the folk varieties of Midnapur district. Gurjali is the only variety of Nadia district. The survey period was fixed depending upon the local farmers' report in the month of April to June, 2013. Detail observations on seasonal incidence of fruit borers were determined regularly at different mango orchards of the above districts. Minimum two plants of each mango folk variety were selected and the fruit borers at random observed 50 fruits per tree for determining percentage infestation of fruits. Frequent observations on incidence of fruit borers showed that the larva of fruit borer completes their larval stage within the fruit and damage to grown up fruits during this period.

During the field study, the infested fruit were collected according to the different days after fruit set for preparation of juice. The infested fruits were brought to the laboratory and washed in running water, peeled and destined before extracting juice from the help of squeezing with mosh line cloth by hand. At every date of experiment the fresh juice was prepared for the chemical analysis of the juice. The duration of the experiment was 60 to 75 days after fruit set. The juice taking four replication was analyzed at an interval of three days for total soluble solids, acidity, reducing sugar and total sugars.

Total soluble solids were measured by Erma hand refractometer of 0.32 percent range at 200 C. Before using, the refractometer was washed with distilled water, cleaned with a little quantity of alcohol, dried and the observed shadow level was adjusted to "0" mark with a drop of distilled water. Subsequently, the water was blotted out, the refractometer was dried and a drop of strained juice was placed on the plate to record the refractometer reading. The mean value was expressed as percentage of total soluble solids in the juice.

The acidity of the juice samples were estimated by A.O.A.C (1984) method. 10 ml of the juice samples was measured and the volume was made up to 100 ml with distilled water. For determination of acidity 10 ml of dilute juice was taken in a conical flask for each sample. Then two drops of phenolphthalein indicator was added to it and then titrated against N/10 NaOH solution taken in the burette. The end point was determined by the appearance of light pink colour. The results were expressed on percentage in terms of citric acid.

Calculation: % total acid = (Titre x normality of alkali x volume made up x equivalent weight of acid x100)/(volume of sample taken for estimation x weight or volume of sample taken x 1000).

The total and reducing sugar of the juice samples were determined by Lane and Eynon's method (1923) using methylene blue as an indicator. The method of reducing sugar estimation is based upon the reduction of alkaline tartarate solution of the copper using methylene blue as an internal indicator. As alkaline solution of cupric salt is reduced to red cuprous oxide on warming with glucose solution.2CuO + CHO = COOH + Cu2O. Firstly standardization of Fehling's solution was done on the day of observation. Two ml. each of Fehling A and B were taken in a conical flask. The burette as filled with the sample. The conical flask containing Fehling's solution was heated to boil and few drops of sample from burette was added and heated again. Then 1-2 drops of methylene blue indicator as added and titration continued until the indicator was decolourized at the end point, the boiling liquid assumed to be brick recolor of precipitated cuprous oxide and the burette reading was noted. Here, Reducing sugar content (%) = (Xx strength of known glucose solution x dilution x 100) /(Y x W)

X = Burette reading of known glucose solution, Y = Burette reading of unknown glucose solution and W = Weight or volume of sample taken.

For total sugar also, Fehling's solution was standardized. Then 10 ml of juice was taken in a 250 ml beaker with little amount of water and 1-1.5 ml concentrated HCl was added for acid hydrolysis. The solution was allowed to boil and then cooled down and pH was adjusted to neutral or alkaline with NaOH and volume was made up to 100 ml. Titration was followed in the same manner mentioned for reducing sugar estimation. Calculation: C12 H22 O11 + H2O = 2C6H12O6.

Therefore 342 gm of sucrose is equivalent to 360 of invert sugar.1gm of invert sugar = 342/360 gm of sucrose = 0.95 gm of sucrose. Sucrose content = gm of invert sugar x 0.95

Total sugar (%) =(X x strength of known glucose solution x dilution) / (Yx W x 100). Where X = Burette reading of known glucose solution, Y = Burette reading of unknown glucose solution and W = weight /volume of sample taken.

Table 1: Physiochemical characteristics of mango fruit cv. Phunia in relation to incidence of *Autocharis albizonalis*

Sl. No.	Days after fruit set	Average % infestation	TSS (^{0}Brix)	Total sugar (%)	Reducing sugar (%)	Titratable acidity (%)	Sugar/acid ratio
1	60	10.23	17.23	7.62	2.92	0.25	30.48
2	63	10.87	17.57	7.83	3.14	0.22	35.59
3	66	15.78	18.54	7.94	3.28	0.19	41.78
4	69	21.43	18.79	8.12	3.44	0.18	45.11
5	72	27.65	19.28	8.22	3.55	0.15	54.8
6	75	30.77	19.47	8.45	3.78	0.12	70.41

Table 2: The avg. physiochemical values of eight mango folk varieties in relation to incidence of *Autocharis albizonalis*

Mango varites	TSS(^{0}Brix)	Total sugar (%)	Reducing sugar (%)	Titrable acidity (%)	TSS/acid ratio	Average % infestation
Phunia	18.48	8.03	3.35	0.18	46.63	19.45
Rarhi	16.0	7.33	6.11	0.19	38.57	8.17
Kelua	19.24	12.64	6.07	0.22	57.45	16.69
Kohitur	13.65	8.21	5.11	0.16	51.31	10.73
Khirsapoti	15.37	8.47	4.76	0.20	42.35	11.45
Gurjali	14.40	6.11	3.65	0.11	55.55	24.62
Sukhapakhia	15.53	8.32	5.07	0.21	39.90	11.43
Begunphuli	15.26	8.11	5.02	0.18	45.06	15.60

Result and Discussion

The result from the above mentioned chemical analysis of folk variety Phunia was tabulated in the (table 1). From the table, it is evident that total soluble solids, total sugar, reducing sugar, TSS/acid ratio and sugar/acid ratio are 17.23%, 7.62%,2.92%, 0.25%, 68.8%, 30.48% respectively in case of fruit infested by borer at 60 days after fruit set. Likewise at 75 days after fruit set, total soluble solids, total sugar, reducing sugar, TSS/acid ratio and sugar/acid ratio are 19.47%, 8.45%, 3.78%, 0.12%, 161.6% and 70.41% respectively in case of fruit infested by fruit borer (fig1). While in case of titrable acidity, an important physiochemical parameter, it is interesting to mention here that values decreases with the increase in the development of the fruit growth in infested fruits. The highest infestation (30.77 %) was observed at the lower acidity (0.12%) while the lowest infestation at higher acid value (0.25%). It is showed that the infestation of fruit borer is inversely proportional to the acid content of the mango fruit Phunia (fig.2). More or less similar results were obtained from the other seven folk varieties of mango (fig 3). It is observed that among the folk varieties, the average highest infestation was occurred in Gurjali (24.62%) when the average acid content was 0.11% and the average lowest infestation was occurred in rarhi (8.17 %) when the average acid content was 0.19% (table 2). The data indicate that the incidence of fruit borer *Autocharis albizonalis* varies from 10.23% to 30.77% at different days after fruit set, showing a positive correlation of the increase of percent infestation with the increase in the development of fruits (fig 2). This is also indicates that the fruits having increase percentage of physiochemical attributes namely total soluble solids, total sugar, reducing sugar and sugar /acid ratio were found susceptible to the attack of *Autocharis albizonalis*, which is reverse in case of titrable acidity of fruit. In case of titrable acidity, it was observed that the susceptibility of the fruit borer attack increases while decreases of acidity in different days after fruit set.

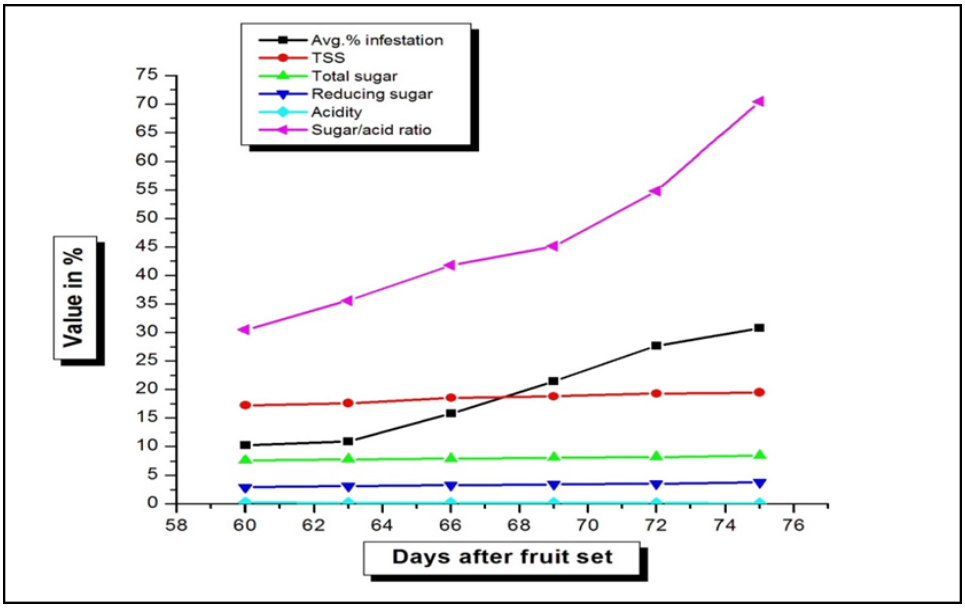

Fig 1: Physiochemical characteristics of mango fruit cv. Phunia infested by Autocharis albizonalis in relation to the average percent infestation.

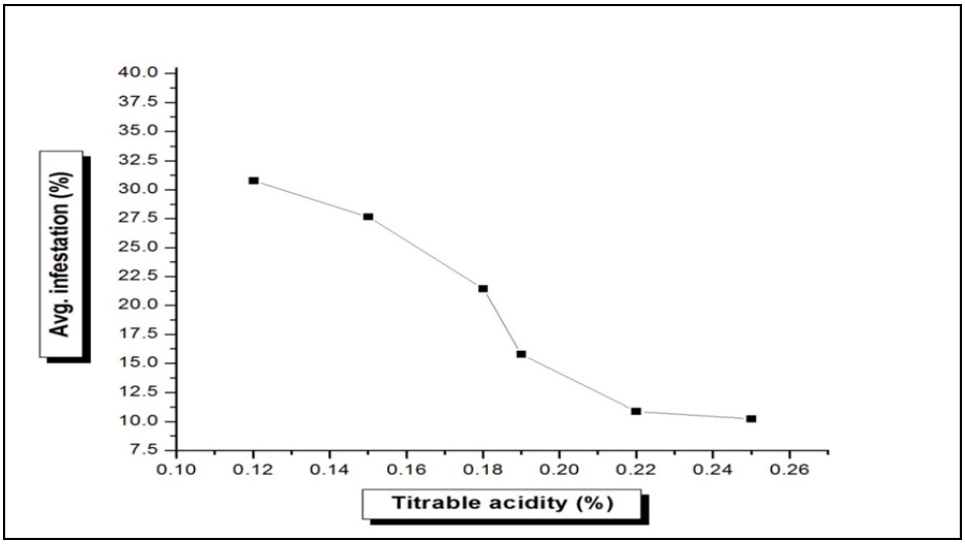

Fig 2: The relation between the average percent infestation and titrable acidity of Phunia, infested by *Autocharis albizonalis.*

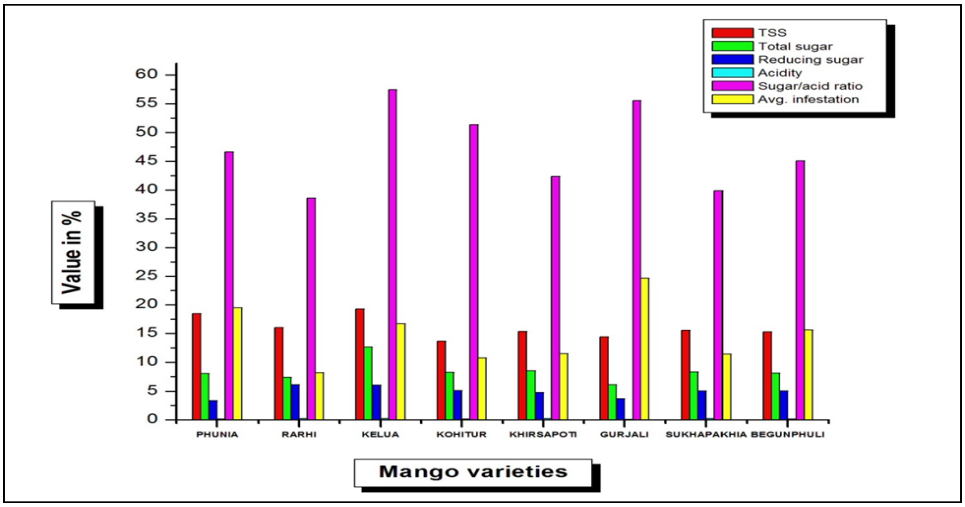

Fig 3: Data of average infestation and different physiochemical values of eight folk varieties of mango during April to June 2013.

Conclusion

From the results as obtained from the investigation carried out under both field and laboratory condition, it is concluded that there is a relationship of the borer infestation to the mango fruits with the contents of different physicochemical parameters. From the overall results as obtained from investigation, we concludes that the fruit borer attack is in peak when the acid content of the fruit is at low level and the infestation is continuously decreased with the increased level of acid content of the fruit.

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