Research Articles

Current status of the Solanum fruit fly *Bactrocera latifrons* (Hendel) in the eastern part of Democratic Republic of Congo

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Abstract

Fruit flies (Diptera: Tephritidae) are well-known for their invasiveness and propagation through the movement of infested products. Also, they constitute the limiting factor for fruit and vegetable exploitation. *Bactrocera latifrons* Hendel is present throughout the Kabare area in the South Kivu province of eastern Democratic Republic of Congo in *Solanum aethiopicum* and *Capsicum frutescens.* It is a species of Asian origin. It is a major destructive pest of fruits and vegetables of the family of Solanaceae and, to a lesser extent, Cucurbitaceae. It displays a rapid progression given that it invaded other territories even entire eastern part of Democratic Republic of Congo.

Keywords: *Solanum aethiopicum*, *Capsicum frutescens*, incubation, invasive species, Solanum fruit fly, tephritid

Introduction

The Solanum fruit fly *Bactrocera latifrons* (Hendel) is among the economically most important insect pest, belonging to the Dacinae subfamily of tephritid fruit flies (Vargas *et al.,* 2015). *Bactrocera latifrons* is of Asian origin (Carroll *et al.,* 2002). Its range has however expanded through introductions into Hawaii (Vargas and Nishida, 1985), Japan (Ishida *et al.,* 2005), Tanzania (Mwatawala *et al.,* 2010), Kenya (De Meyer *et al.,* 2011), Burundi (Ndayizeye *et al.,* 2019) and Congo (Ndayizeye and Kataraka, 2021). McQuate and Liquido (2013), based on reported field infestation data, show that a total of 59 plant species from 14 plant families are identified as hosts of *B. latifrons*. However, Yong *et al.* (2013) and Vargas *et al.* (2015) attested

in their study, *B. latifrons* infests mainly solanaceous fruits. It has caused serious damage to solanaceous crops such as chili pepper, tomato, and eggplant (Vijaysegran and Osman 1991, Liquido *et al.*, 1994).

The study of Ndayizeye and Kataraka (2021) focused on African eggplant in the farms in low land Uvira territory of South Kivu province at Kavimvira. However, they were chosen this region because it borders Burundi to the west and there is a lot of movement of people and goods across the border. In addition, the agriculture sector is quite well developed in this low land area. Moreover, because it might be that retail trader people traveled to purchase solanaceous crops such as chili pepper, tomato, and eggplant to Rwanda and Burundi.

There is further expansion of the species throughout the province South Kivu province, eastern part of Democratic Republic of Congo, and the whole area of Kabare territory by bringing in host fruits and /or by the movement of adult flies.

This paper outlines the current status of the Solanum fruit fly in the area of Kabare territory at the South Kivu province in the eastern part of Democratic Republic of Congo.

Materials and Methods

The frequency of sampling is invariable, but depends on the time of year. An incubation study was carried out over a two-months period from 10 February to 10 March 2020 and 2021 on *Solanum aethiopicum, Lycopersicon esculentum, Capsicum* spp. collected in the field at Lwiro, Ciranga, Kamakombe, Kashenyi, Bishibiru, Kamakombe, Cegera and Buhandahanda localities, Kabare territory. For each fruit species, 12 fruits were sampled and incubated at periods of up to four or five weeks, depending on the stage of infestation of the fruits. Convenience sampling was used to select the fruits collected. It is a non-probability sampling plan where the sampling units are selected on purpose. The basis of selection was the presence of visual fruit fly puncture marks on the surface of the fruit. The infested fruits collected are placed in incubation units and provided with labels, following the method described by Ekesi and Billah (2007). The incubation units consist of two plastic tubs of different diameters, depending on the size of the fruits. All fruits collected were washed, weighed, placed and incubated (four fruits per box individually). The bins are respectively 30 cm and 20 cm in diameter. The trays are superimposed, a layer of

fine sand 2 to 3 cm thick at the bottom of the large tray, on which is placed the second small tray containing the infested fruit (s) to be incubated. The trays are then covered with a fine cloth or muslin cloth, to ensure good ventilation of the medium and prevent secondary infestations during incubation. Then, the boxes with the fruits are placed in the laboratory to allow the flies to form pupae. The pupae are removed from the sand by sieving from the first 10 days of incubation. The sand is sieved at intervals of 3 to 4 days. The pupae are counted and placed in Petri dishes and / or in a transparent box with a perforated lid, lined with toilet paper and kept in cages until adults emerge. The sieving is continued until the fruit has completely rotten. They are then dissected to collect any residual pupae or larvae. The methods of breeding fruit flies are described by Ekesi *et al.* (2007) were used. The pupae are separated and then counted. After emergence of adult flies, Tephritidae are placed in tubes filled with ≥ 90% ethanol for storage. Several types of determination keys are used: the recent systematic review of tephritidae including that of White and Elson-Harris (1994), CABI (2005), White (2006), De Meyer *et al.* (2008).

The DTMs are derived by using different interpolation methods. Indeed, the applied interpolation methods can be changed depending on the structure of the surface and the number of control points (Yilmaz, 2007). In this study, a different interpolation method is interpreted to define a surface. Measured points are transferred to Surfer 17.1 software and the volume of the object is calculated by using the previously mentioned interpolation methods. So, the better the surface is described, the closer the amount of volume is to the real value. Accordingly the results closest to the real value of the volume are obtained from the following methods: kriging (90.00%) and inverse distance to a power (95.00%). The most suitable contour map of the object is obtained from the triangulation with linear interpolation and inverse distance to a power method. The most suitable 3D model of the object is obtained from triangulation with inverse distance to a power method.

Software R was used to analyze paired t-Test, one-way ANOVA and linear model regression of flies and making boxplot of fruit flies observed during incubation of Solanaceous. T-test was done for examining the difference in means of solanaceous fruits weight bags from Rwanda and eastern of DRC, South Kivu province. The parametric methods (t-Test) appropriate for examining the difference in means that is paired or dependent on one another. Tukey

multiple comparisons of means at 95% family-wise confidence level was done and mean ± standard deviation was calculated too.

Results

The results from the current study indicated that Solanum fruit fly *Bactrocera latifrons* (Hendel) observed after incubation in those fruits *Solanum aethiopicum* and *Capsicum frutescens* but not in *Lycopersicon esculentum* and *Capsicum annuum* in the area of Kabare territory at the South Kivu province in the eastern part of Democratic Republic of Congo. The figure shows the visually maps of irregularly spaced *B. latifrons* in surface of this area. Additionally, *B. latifrons* set has a stationary variance but also a non-stationary mean value within the search radius (Figure 1). Calculated value of ‘‘t’’ comes to -3.185 at df 3 on 0.01 level, p-value is 0.050. Thus, the calculated value is less. Therefore, the difference between solanaceous fruit weight bags from Rwanda and DR Congo is significant. Thus, small traders and peoples often bring a greater quantity of solanaceous from Rwanda country to DR. Congo. Table 1 shows the difference in mean of whole origin of the solanaceous fruits. In the table 2 of one-way anova, it shows the significant difference of fruits weight bag in different sites of South Kivu province i.e. Walungu_Kamanyola has a greater solanaceous fruits weight bag than Kabare and Kalehe, so Kabare has a greater fruits weight bag than Kalehe too (table 3). The boxplot and the linear model regression show tendency of fruit flies observed during incubation of Solanaceous fruits (Figure 2 and 3). The average at eggplant was of 69 ± 41.78 for *Bactrocera dorsalis,* of *2* ± 0.97 for *Zeugodacus cucurbitae*, of 2 ± 0.89 for *Dacus bivittatus* and of 1 ± 1.13 for *Bactrocera latifrons.* According chili pepper, the average was of 44 ± 33.70 for *Bactrocera dorsalis* and of 1 ± 0.58 for *Bactrocera latifrons*. Additionally, the average of *Bactrocera dorsalis* on tomato was of 57 ± 39.59 and of 3 ± 1.53 *Ceratitis capitata* on pepper.

Discussion

In view of the results, Solanum fruit fly *Bactrocera latifrons* (Hendel) is detected for the first time at the South Kivu province in the eastern part of Democratic Republic of Congo. Near border and trade can explain this presence of Solanum fruit fly. This is the reason of *Bactrocera latrifons* migration and other fruit flies.

This result confirms the observations of Mziray *et al.* (2010 a, b) indicating that *B. latifrons* attacks mature ripe eggplant. Ndayizeye (2019) shows that it displays a rapid progression given that it invaded the entire country within one year of first detection, with potential to invade neighboring countries in the region of Great Lake of central Africa. The results of the study of Ndayizeye and Kataraka (2021) showed that *Bactrocera latifrons* on African eggplant (*Solanum aethiopicum*) in Kavimvira, Uvira territoty of South Kivu province.

Conclusion

Bactrocera latifrons is present throughout Kabare area at the South Kivu province in *Solanum aethiopicum* and *Capsicum frutescens.* It displays a rapid progression given that it invaded other territories even entire eastern and western part of Democratic Republic of Congo.

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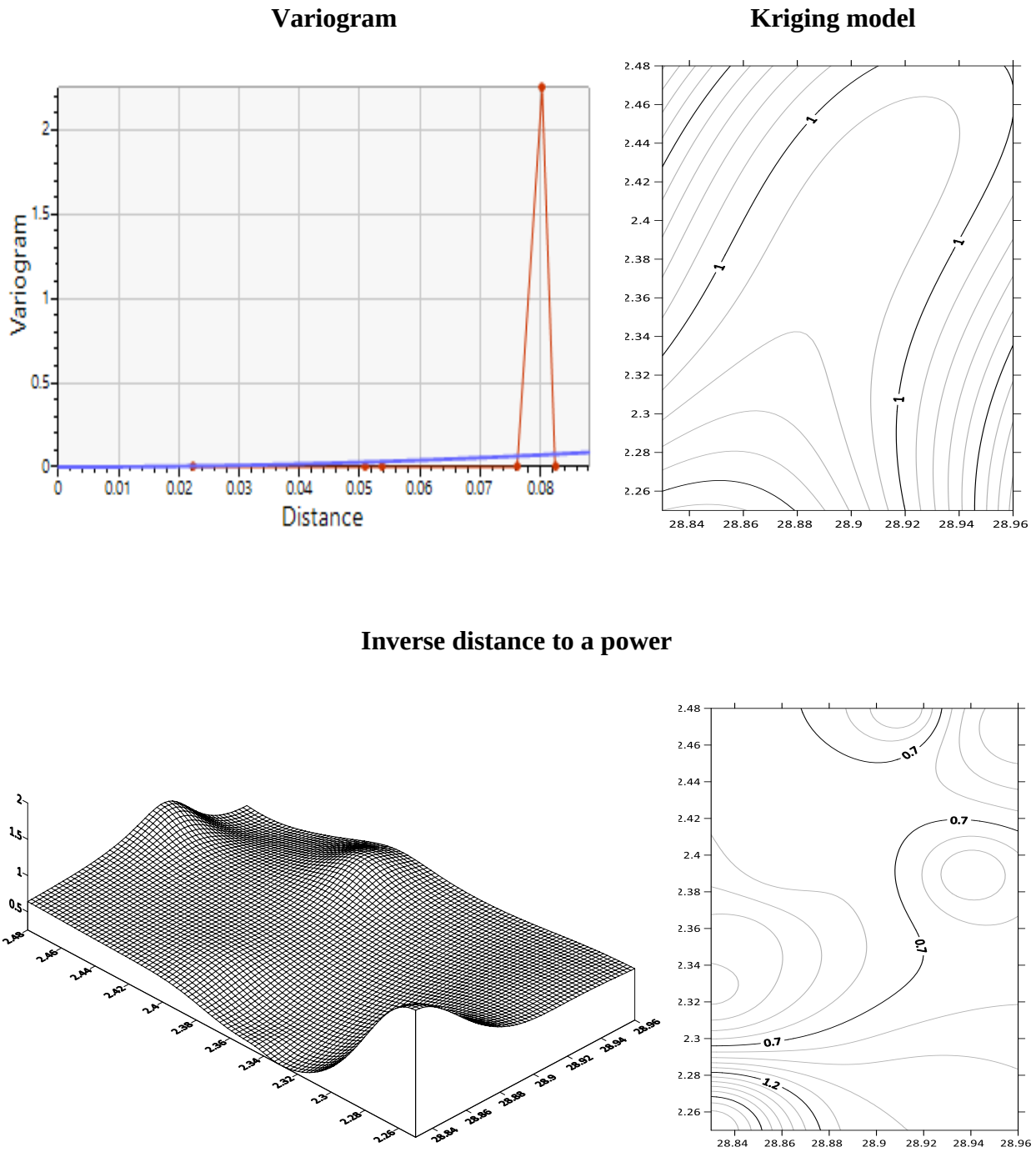


Figure 1. Solanum fruit fly *Bactrocera latifrons* (Hendel) in study area

Table 1. Solanaceous crops (Tomato, eggplant, pepper, chili pepper) weight bag of South Kivu province

Area	Tomato	Eggplant	Pepper	Chilli pepper
Kabare	1440	5550	2250	2000
Walungu_Kamanyola	7000	6500	3050	3000
Kalehe	4080	0	0	0
Mean ± Standard deviation	4173.33 ± 2781.17	6025 ± 671.75	2650 ± 565.68	2500 ± 707.1

Table 2. One-way ANOVA of solanaceous fruits weight bag of South Kivu province

Source of variance	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Area	2	29970217	14985108	3.661	0.0687
Residuals	9	36840875	4093431		

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Table 3. Tukey multiple comparisons of means

Area	Diff	lower	upper	p adj
Kalehe-Kabare	-1790.0	-5784.3398	2204.34	0.4551230
Walungu_Kamanyola-Kabare	2077.5	-1916.8398	6071.84	0.3569167
Walungu_Kamanyola-Kalehe	3867.5	-126.8398	7861.84	0.0574106

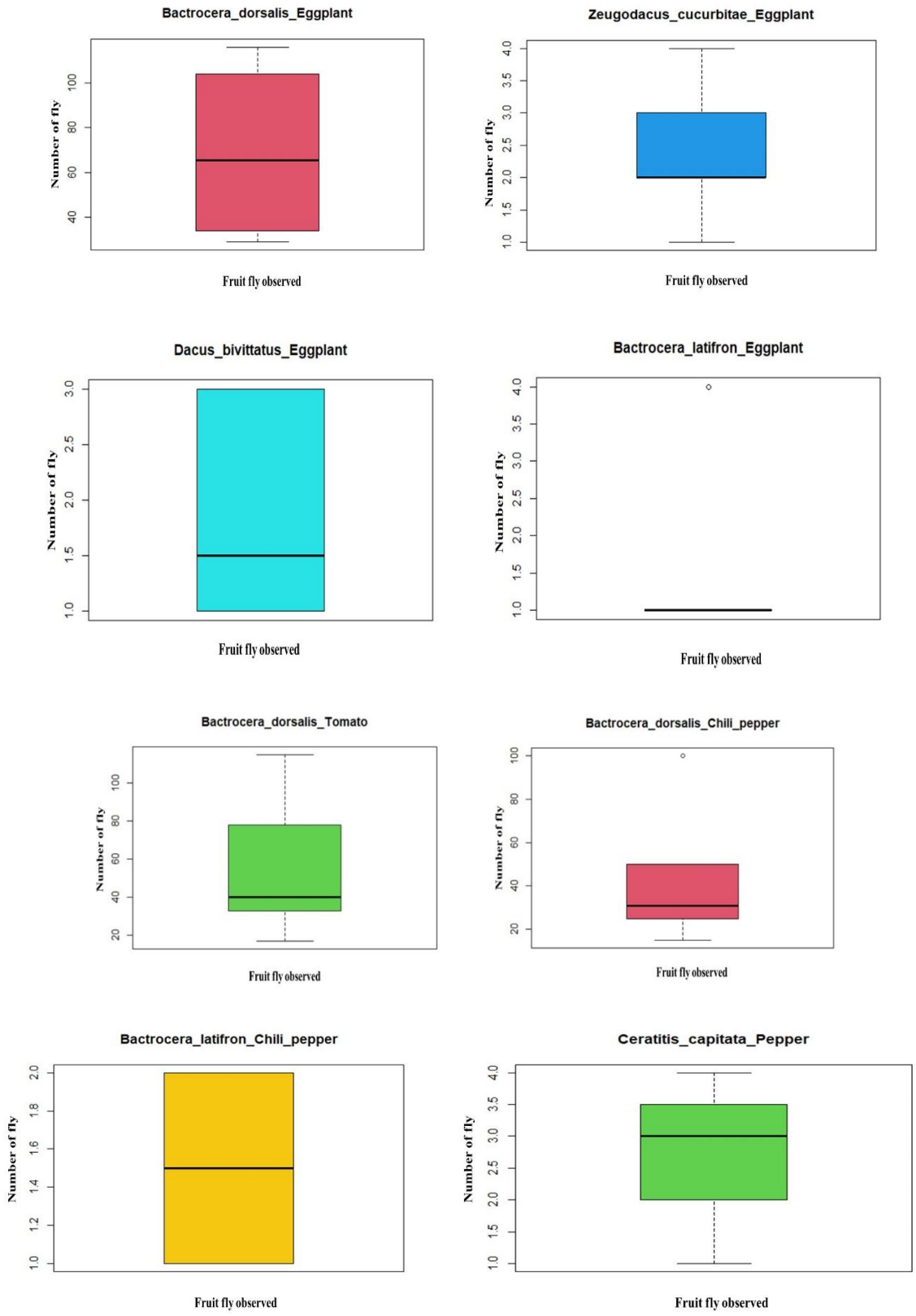
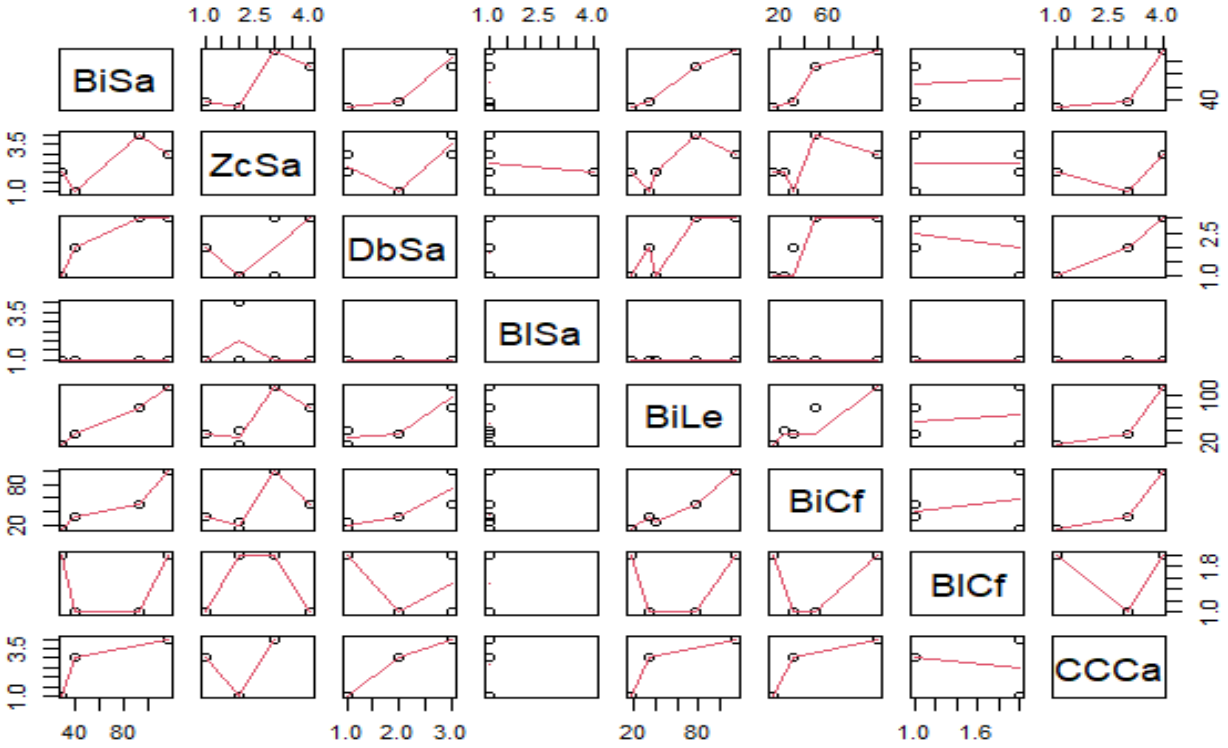


Figure 2. Boxplot of fruit flies observed during incubation of Solanaceous



Legend

Bi:Bactrocera dorsalis, Bl: Bactrocera latifrons , Db: Dacus bivittatus , CC: Ceratitis capitata, Zc: Zeugodacus cucurbitae , Sa: Solanum aethiopicum, Le: Lycopersicon esculentum, Cf: Capsicum frutescens, Ca : Capsicum annuum

Figure 3. Linear model regression of flies observed