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Evaluation Damage Caused By Rastrococcus Invadens (Willams. 1986) (Homoptera. Pseudococcidae) on Mango in Casamance (Senegal)

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Abstract: Rastrococcus invadens Williams [1] (Homoptera, Pseudococcidae) is an insect pest mango and many other fruit trees including citrus. Originated in Southeast Asia, this cochineal was identified at first in Senegal precisely Dakar in 1995. Since then it has spread throughout the country and particularly in one most productive area of fruit (Casamance). To evaluate damage of Rastrococcus invadens on mango tree, a study was carried out on farm in Diatock located in natural Casamance. This study took place between may and september 2016. In arm, we chose after study the four varieties mango most attacked namely "Kent", "Keitt", "Sewe" and "Bouko diekhal". For each variety, we harvested 10 non-infested and 10 infested fruits. These fruits are then weighed to determine weight average of infested fruits and non-infested fruits in order to evaluate the losses and yields obtained. The results showed that a loss of 37% for mangoes weight of sewe variety, 36% of keitt variety, 24% of kent variety and 16% of bouko diekhal variety. However, this damage is more pronounced on some varieties (sewe and keitt) than others. Attacks are more common in June, July and August. Local variety (sewe) and improved variety (keitt) are more sensitive than others.

Keywords: Rastrococcus invadens; Damage; Mangifera indica.

1. Introduction

Fruits have generally a higher nutritional and commercial value [2]. They contribute to the improvement of social well-being and health status of populations [3].

In Senegal, the annual production of fruit represents about 1.3 million tons or nearly 4% of world production with post-harvest losses of between 40% and 50% [4]. This production comes mainly from Casamance, Thiès and rural Dakar [5]. Apart from importance of fruit production in general and mango in particular, one can also mention its market and financial value which provides an important currency for producers [2].

In Senegal, as in most West African countries, fruit production is threatened by phytosanitary problems. The most important of which are fruit flies (Tephritidae family) [6] and mealybug Mango tree *Rastrococcus invadens* Williams (Homoptera: Pseudococcidae) [7]. Damage losses from these insects are estimated to be multi-billion-dollar worldwide according to [6]. In contrast to conventional methods, control of these pests is more complex than conventional chemical control [8] and has harmful effects for the environment, producers and consumers. The mango mealybug *Rastrococcus invadens* infests mango trees in various West African countries and poses a threat to orchards [9].

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Various studies have been undertaken to develop an integrated pest management program. Despite the methods of control used against the cochineal, the problems related to its infestation remain. It is therefore necessary to evaluate damage caused by cochineal on mango tree for better control.

2. Materials and Methods

Rastrococcus invadens is an insect originating from Southeast Asia. It belongs to the branch of Arthropods, class of Insects, order of Orthoptera, super family Coccoidea and family Pseudococcidae.

Surveys were carried out in natural Casamance region, which is one of main areas of fruit production in Senegal. Geographical coordinates, humidity and temperature are obtained using GPS, hygrometer and thermometer respectively. Casamance is in Senegal and covers a total area of 52 000 km^2. It is bounded on east by Mali, west by Atlantic Ocean, north by Gambia and south by Guinea-Bissau and Guinea Conakry. In this region we sampled at departments of Bignona, which constitute one of the most fruitful areas in the region. Our sampling is done in Diatock locality: latitude 14 ° 45 '43 North, longitude 17 ° 17' 57 West and altitude of 17 m from the sea. Climate of region is Sudano-Guinean type characterized by a corresponding wet period from June to October (summer) but here called rainy season or winter. Rainfalls vary between 800 to 2000 mm from east to west. In this zone, temperature is substantially equal to 29.8 °C.

In Senegal, mango has been identified as one of value chains in horticultural sector with an interesting potential in the USA, European and sub-regional markets [4]. Indeed there are several varieties among which one can quote: "Kent", "Keitt", "Sewe" and "Bouko diekhal".

Flowering and fruiting plant (spermaphyte) the mango tree (*Mangifera indica*) belongs to dicotyledonous class, order of Spindales and Anacardiaceae family. It is native to northern India at foot of Himalayan range [10]. It is a tree with large crown spread rounded and dense which can reach 30 m of height [11] with a trunk monopode well individualized. It has a rotating root system with some ramifications for a good ground anchorage well suited to the search for water table under conditions of water stress [3]. The foliage of dark green mango on upper part of tree is pale in its basal part and usually reddish in young stage [12]. The simple and persistent leaves are whole with an alternate disposition and an elliptic limb with a long stalk up to 5 cm long [11]. The inflorescence is a terminal panicle that carries about 1000 flowers with a pedicel between 2 to 3 millimeters long. The mango tree has flowers either hermaphroditic, or males yellowish to their bloom and which become orange later. These flowers have 5 sepals and 5 petals with a perfect perennial stamper and a superior ovary containing a single egg [13]. A tropical climate plant, mango trees grow in rainfall areas between 600 and 1200 mm per year and develop well in temperature range 2.2 ° C to 43.5 ° C and his optimum growth temperature between 23 and 27 ° C [14].

Study took place between may and september 2016 on farm in Diatock located in natural Casamance. Our study focuses on damage caused by *Rastrococcus* on mango tree which is the most attacked species. In this farm, we chose four varieties of mango most attacked namely "Kent", "Keitt", "Sewe" and "Bouko diekhal". For each variety of mango, we harvested 10 uninfested and 10 infested fruits. A total of 20 fruits are harvested from each variety of mango trees. These fruits are then weighed one by one to determine the average weight of infested fruits and uninfested fruits in order to evaluate losses and yields obtained. This work is repeated every month from may to september for each sampling campaign. We are used Microsoft Excel to draw these graphs. The loss mango weight is evaluated by this formula:

$$\mathbf{LW} = \frac{\mathbf{WMNI} - \mathbf{WMI}}{\mathbf{WMNI}}$$

LW: Loss Weight (%); **WMNI:** Weight Mango None Infested; **WMI:** Weight Mango Infested

3. Results

Figures 1, 2, 3 and 4 showed attacks were most frequent in june, july and august. For Sewe variety (Figure 4), since the error bars do not overlap, we can say damage caused by *Rastrococcus invadens* is very significant and that from beginning the end of mango production. Local variety (Sewe) and improved variety (keitt) are more attacked than others. In all varieties, infestation is proportional to fruit maturation. For kent, keitt and sewe varieties, infestation affects weight mango from june to september but infestation is not significant for bouko diekhal variety in september.

Figure-1. Influence of the infestation on mangoes weight of kent variety

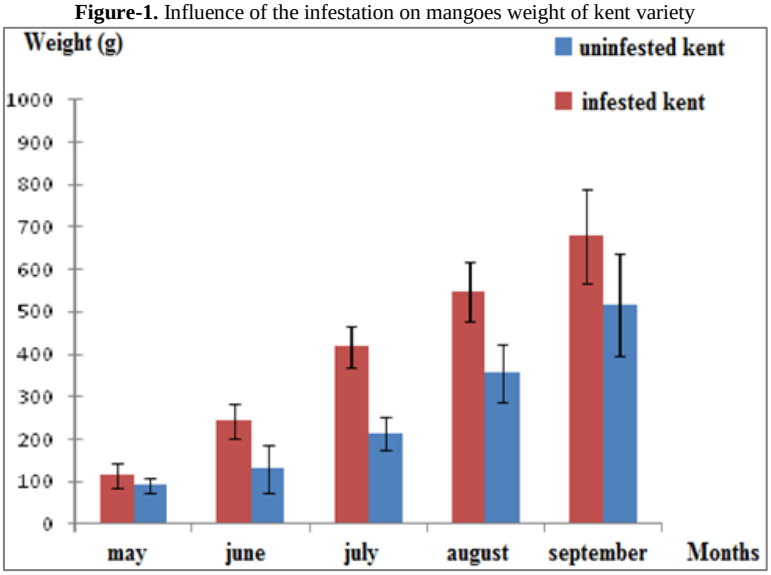


Figure-2. Influence of the infestation on mangoes weight of keitt variety

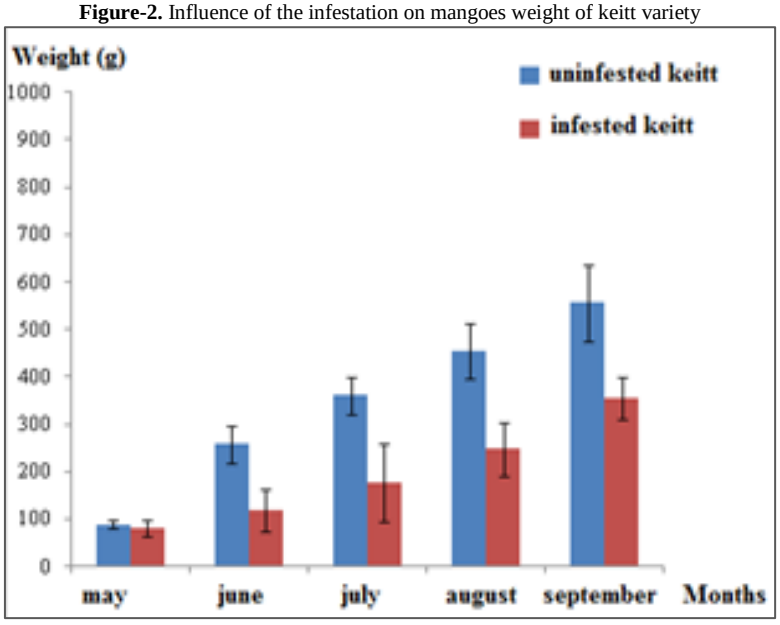


Figure-3. Influence of the infestation on mangeos weight of bouko diekhal variety

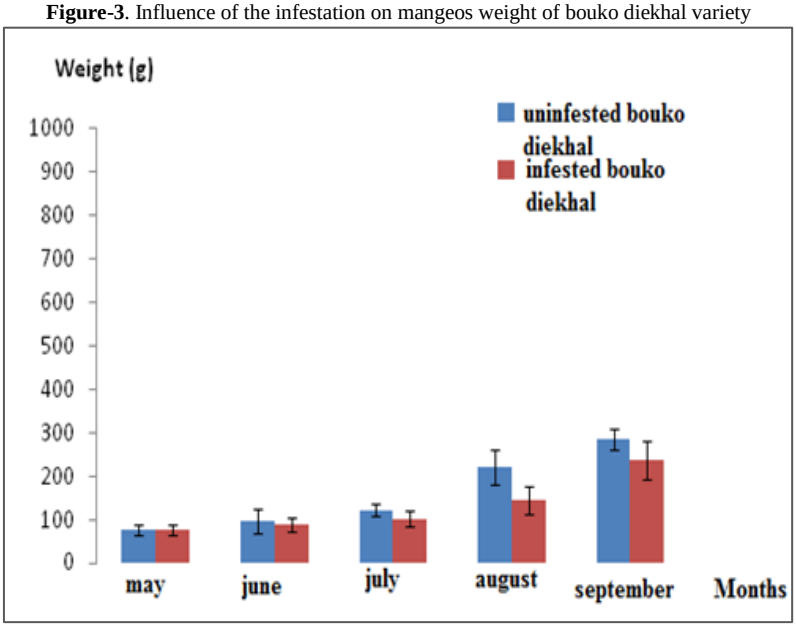
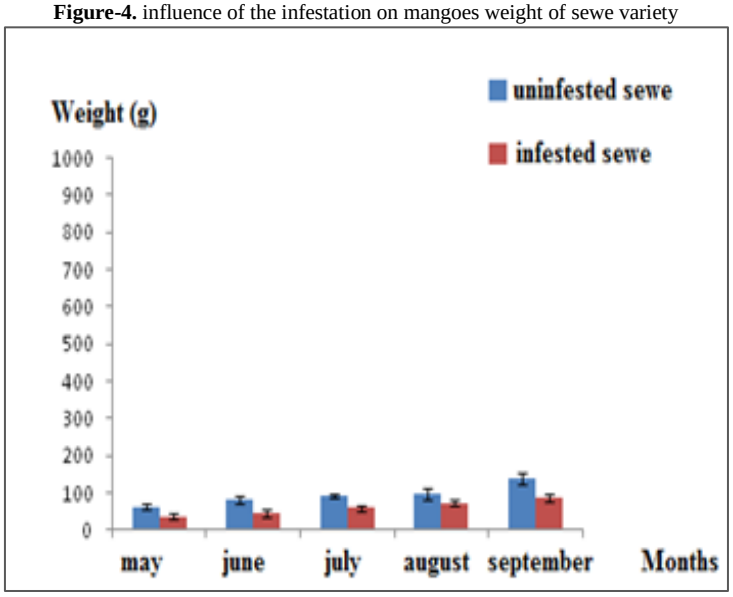


Figure-4. influence of the infestation on mangoes weight of sewe variety



Tables give information on different varieties of mangoes studied: average yield per variety, average fruit weight (infested and not infested), period of production, estimated loss and condition status. Results showed damage was observed for all varieties studied. However, lost weight of fruit (table 2) is more pronounced for sewe (37%) and keitt (36%) than bouko diekhal (16%) and kent (24%).

Table-1. Comparison of different varieties mangoes weights according the months

	Varieties							
Months	**Kent**		**Keitt**		**Bouko diékhal**		**Séwé**	
	I	**NI**	**I**	**NI**	**I**	**NI**	**I**	**NI**
May	91.9 ±128	114.5 ± 28.2	81.9 ±16.28	88.7 ± 9.3	71.2 ± 11	75.5 ± 11.5	36.2 ± 8.08	62.5 ± 7.8
June	130.5 ±564	243.7 ± 41.1	119.5 ± 43.7	257.6 ± 39.92	89.3 ± 15.76	96.6 ± 27.84	45.8 ± 8.6	81.4 ± 8.4
July	213.3 ±37.16	418.9 ±49.8	177.7 ± 81.64	361.4 ± 39.2	102.7 ± 16.5	122.1 ± 14.68	60.0 ± 7.2	91.0 ± 6.8
August	356.2 ±68.24	547.1 ± 71.1	247.5 ± 57.6	454.0 ± 57.8	146.3 ± 31.56	221.5 ± 40.5	73.5 ± 6.6	98.8 ±15.96
September	516.1 ±119.8	679 ± 110.4	355.5 ± 45.5	556.2 ± 80.8	236.9 ± 44.3	285.1 ± 22.3	86.1 ± 8.9	136.7 ± 14.64

Table-2. Evaluation of loss mango weight

	Kent	**Keitt**	**Bouko diékhal**	**Séwé**
Weight Mango Non Infested (g)	679	556.2	285.1	136.7
Weight Mango Infested (g)	516.1	355.5	236.9	86.1
Loss Weight (%)	24	36	16	37

4. Discussion

In our study, results reveled that kent, keitt and sewe varieties are more attacked (as a very significant weight reduction). This means that *R. invadens* is more susceptible to attacks these varieties than bouko diekhal. In September, the low infestation on bouko diekhal could be explained by reduction production [15]. Indeed, during this period, kent and bouko diékhal are at the end of the fruit production cycle and insects are attracted by the other varieties that are in full production. Generally, fruit or vegetable growth is related to fluctuations in abundance of mealybug populations [16]. Kent and sewe varieties are more susceptible to be attacked, we consider they present best development conditions for *Rastrococcus invadens*. Among these conditions, we can emphasize tender aspect of pericarp, which facilitates bite by the insect, and probably its richness in nutrients. This may also justify the fact for same variety, damage is more pronounced on ripe fruit than on unripe [17]. Results confirm these showed by Ndimanya and Strebelle [18].

Damage on tree by this insect has affected several organs: young twigs, inflorescences, peduncles, fruits and leaves. The insect causes direct damage by bites on inflorescences (abortion of flowers), leaves and indirect damage by production of honeydew and fumagine that forms on the surface [19]. On most attacked trees, loss leaves and drying branches were noted. Moreover, soot affects quality of mangoes: even after washing and brushing, most of

fruits showed discolored areas on epidermis, thus becoming non-exportable. Populations of mealybug are weak from october to february and especially during harmattan. From march to august, numbers are higher between june and august. [20].

A delay in flowering was noted on untreated plots [19]. Emission of new branches has been slowed down. Losses ranged from 19% to 60% respectively, for panicles and tree height. Yield dropped by 53%, the most attacked trees (entirely covered with sooty mold) having not flowered. Losses of production in peasant environments have sometimes reached 100% and planters are forced to destroy their orchards or non-productive trees. On most attacked trees (Kent and sewe), loss of leaves and drying of branches were generally noted. Moreover, soot affected the quality of mangoes and also causes a slowing down of the growth resulting in decrease of mass. The presence of mealybug colonies and black fungus on fruit causes discolorations and loss of quality of them. It is for this reason that these fruits attacked or soiled, even after washing and brushing, have for the most part discolored areas on the epidermis, thus becoming non-exportable; which is a real shortfall for the farmer.

On same farm, these fluctuations in abundance of cochineal populations are different between varieties of mango trees (more accentuated on sewe and keitt). When plant is attacked, more its fruit production advances, greater loss of mass (Table 1). These weight losses on fruits are due to a slowing down of growth, which consequence of deposition of soils on fruits and leaves by compromising photosynthesis [21].

According to the surveys carried out in this zone, mechanical or physical methods (slaughter and burning of the trees or branches attacked) are generally practiced by producers, in view of the seriousness of damage. Compared to other agro-ecological zones of the insect in Asia first identified in India, surveys have shown that *Rastrococcus* scale insects cause problems only locally and occasionally [22]. In Senegal we are close to 30% in this present study. Damage varies not only according to mango tree varieties but also according to the agro-ecological zones.

Similarly, ornamental and shade plants, strongly attacked (leaves and stems covered with sooty, droplets of honeydew falling to the ground), and no longer able to perform their primary functions (ornamentation, shelter) were destroyed. In Ghana, losses have been estimated at 80% in peasant environments [23]. Fluctuations in mealybug populations appear to be a function of both climatic factors and biotic factors, including natural enemies [20].

5. Conclusion

This study evaluated losses caused by *Rastrococcus invadens* on four varieties mangoes "Kent", "Keitt", "Sewe" and "Bouko diekhal". Study is valuable because of importance that sector brings to country. It has allowed us to have in-depth knowledge of mango sector, constraints it faces in order to identify measures to better control and increase productivity.

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