

# Impact of *Jacobiascalybica*'s attacks on the physiology of the vine leaf.

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## ABSTRACT

During the inventory undertaken in Algeria on the vine, the green leafhopper proved to be a new bio aggressor on this crop. Indeed, the first observations on vines date back to July 2002 and renewed in 2003 and 2004 [4], in the vineyards of the Western Mitija where the insect has spread rapidly throughout the country ([6]; [7]; First data *Jacobiascalybica* ( Bergevin&Zanon ) (Homoptera , Jassidae ) on Vine in Algeria; [8]).

*Jacobiascalybica* responsible of the grillure on the vine leaves, generates considerable damages on the leaf after each attack. Given the climate change, These studies were made during the wine-making campaigns on 2013, 2014 and 2015 and having for objectives of:

- Consolidate the searches undertaken during the wine-making campaign in 2007, on the fluctuation in the populations of the green leafhopper, responsible of the grillure but this time on the grape varieties of local product not imported one and observe the effect of the climate change on this harmful.
- Determine the influence of the vigour of stocks and their sensibilities to this insect.
- Demonstrate the effect of the attacks of this devastator on the limb physiology.

These studies were conducted through the seasonal evolution of the green leafhopper on the vine variety: cinsaut, grenache and carignan by accounting larvae on the young and old leaves of the same vine variety studied by using the similar attractive traps to the sexual traps type INRA. They are established by a plastic shelter in the shape of tent, at the bottom there is a sticky sheet. The shelter is of bright yellow color. This technic permits to trap the green adults of leafhopper by chromatic attraction. The samplings were made once a week during three wine-producing campaigns, on 2013, 2014 and 2015 by making a periodic enumeration of larvae and adults. They were realized in Hadjout, the Metidja and Mascara (west of Algeria). This study showed the succession of four peaks from May to September in Hadjout on the carignan wine which pilosity on the lower face of the limb has compared with cinsault and Grenache. Indeed the numbers of the green leafhopper on carignan especially in second generation exceed widely the recommended threshold. Moreover, it would seem that the most vigorous vine to this leafhopper: Carignan accuse a strong depigmentation of the limb 50% followed with 40% and 10% respectively by Grenache and cinsault. However, no presence was revealed on the same vines of Mascara with 0% for all vignard.

These studies allowed us to conclude that the populations evolution of the green leafhoppers depends of several factors such as the temperature, vigor of the vine and hairiness of its limb.

**KEYWORDS:** *Jacobiascalybica*, Hadjout, depigmentation, hairiness, vigor, carignan, Grenache, cinsault.

## INTRODUCTION

Since more than hundred years, the viticulture, besides the devastating and native diseases, is subject to pressure of invasive insects come from distant parts of the country. The expanding trade since the middle of the XXth century increases the risk of seeing appearing which an Aphids, which a leafhopper, which a beetle which

is going to proliferate [33]. The inventories undertaken in Algeria on the vine show that the green leafhopper is a new bio-aggressor to this culture. Indeed, the first observations on vine go back to July, 2002 and seen out renewed in 2003 and 2004[4] in the wine-growing region of the Metidja west, where from the insect propagated quickly in all the country([6]; [7]; First data *JacobiascaLybica* ( Bergevin&Zanon ) (Homoptera , Jassidae ) on Vine in Algeria; [8]) when he describe the extent of damage, leaves which wind, then turn yellow to the white grapes variety or red to the red grape one, which finish by a total drying of the limb and consequently a decrease in the vigour of the vine which have an impact on the quality of the grape and its by-product.

These studies were made during the wine-making campaigns on 2013, 2014 and 2015 and having for objectives of:

- Consolidate the searches undertaken during the wine-making campaign in 2007, on the fluctuation in the populations of the green leafhopper, responsible of the grillure but this time on the grape variety of local product not imported one and observe the effect of the climate change on this harmful.
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#### *Description And Bio-Ecology:*

For over a hundred years, viticulture is subject, in addition to native pests and diseases, invasive insect pressure from distant lands. The increase in trade since the mid-twentieth century increases the risk of seeing that an aphid that a leafhopper that exogenous ladybug that will begin to proliferate [33]. During the inventory undertaken in Algeria on the vine, the green leafhopper proved to be a new bio aggressor on culture. For over a hundred years, viticulture is subject, in addition to native pests and diseases, invasive insect pressure from distant lands.

*Jacobiascalybica*( Bergevin&Zanon 1922) also noun by the common name Cotton Jassid, in profile it look like an orthoptera, is an odonopterygota, also known as holometabola, class insecta, on order of Hemiptera, family of Cicadellidae and subfamily of Typhlocybinae[29], [30], which includes according to [27]small sized insects. On the top of the front body appears spots yellowish white, the adult has a very elongated form, its wings longer than its body are of a translucent white with green vein. The female adult is 2,9 mm long, the male of 2,6 mm. Most of the leafhopper are of green color firing at the yellow, The distinction is bases on the very clear white points on the head, the pronotum and the metathorax, as well as a vein particularity (one of the 3 apical vein of the elytron come from an apical cell and the other two veins come from median cell). This insect is a little darkness than the *Empoascavitis*. Eggs are fusiform, long of 0,5 mm and larva is 0,8 feet long at the time of the hatching and reaches 2mm at the time of its complete development.

This insect has a big vivacity and jumb to the lesser perturbation in its environment, or flies easily when it's disturbed. It can fly longue distant supported by the wind. The egg stage lasts 6 to 10 days and the larva's stage (resemble to the adult) lasts 8 to 16 day. The moving of the larvas on the leaves, when we disturb it, is special, it's a lateral moving (like a crab) [3]. During the day, the larvas are on the inferior side of the leaves sheltred from the sun, and at night it pass to the superior side.

Like the vine, this polyphagous insect attacks others cultures such as the Malvaceae (Mallows), Cucurbitaceae (cucurbits), tomatos, pepper and aubergine.

#### *Description Of Symptoms / Damages:*

This green leafhopper was been point out primary as a devastator of cotton in Egypt an Soudan. It has been describe for the first time in Libya by Bergevin and Zanon in 1922, then, it has been describe causing damages in some wine-growing regions; south-east of Spain : province of Murcia and Almeria [31]; Sardinia.

The African leafhopper of the vine was pointed out for the first time in Italy (Sicily, Sardinia) on the vine in 1962[37]. It crosses its way to find its self in Spain and Portugal. It was not captured in France yet. Larvas move laterally and begin to be observed at the beginning of June, a larvas's population pick reach the end of September (4,1 individual/leaf) [25]. The wintry low temperatures in Sicily killed strong autumnal populations of the insect; that is why only some individuals are found in January on wild botanical species off particle (*Angelica* sp., *Rubusfruticosus* L.) [25]. This could explain temporarily the absence of the leafhopper in the vineyards of the South of France. The adults and the larvas infest the foliage of the vine and suck the skin of leaves. They feed on the xylem, the phloem or the cellular contents of mesophile tissues of the plant, provoking so damages close to those of *Empoascavitis* but more pronounced.

The symptoms appear a few weeks after the stings of larvas causing a blushing of the limbs edges. The discoloration appears in interveinal zones of the leaves, forming afterward grillures then they win; This leads a possibility of the decrease of the functional foliar surface and pulls entails the lesser one photosynthesis, so a delay of the maturation and the cold hardening and a reduction of the growth of plants ([10]; [1]; [8]).



**Fig. 1:** Damages on vine leaf

After rolling-up of sheets leaves, these dry out completely, with transmission of viruses due to the injection by the green leafhopper of toxic salivas during the suction. This insect, considering its nuisibilité, made the object of ecological and biological studies led by Vidano ([37]; [38]; [39]). The threshold of nuisibilité is reached to leave 0,5-1 larva by leaf in the beginning of summer. Tries of chemical treatments with flufenoxuron allowed to reduce considerably the populations, and in fact the foliar symptoms [25]. For the green leafhopper, The rate of parasitism with the parasitoid *Anagrusatomus* in first generation is important. But afterwards, Due to the lack of synchronization, The populations of the parasitoid fall with for result a not effectivness of the control in July-August. To complicate the whole, the populations hibernate and multiply especially outside of the plots of land of vines and the waves of infestations are especially important in July. In a certain situations. The populations of green leafhopper remain below thresholds of intervention, A regulation is thus compulsory. All the difficulty lives in the census and the characterization of the feature of the auxiliaries towards the devastator of the vine: indeed, if certain specialized parasitoids are really present, they seem incapable allow, to control the peaks of population. It appears that a certain number non-specialized natural enemies adapt themselves to eat or live as a parasite the devastators when they are present, and use other resources in case of low action [17].

The parasitic procession was studied in Italy revealing the presence of more than about ten parasitoid hymenopterans.

#### *Biological Cycle:*

The hibernation at the adult stage takes place on different plants belonging to different botanical families: Labiatae, Malvaceae (Mallow), Alder (*Alnusglutinuso*), fig-tree, apple tree, oaks (*Quercusspp*).

The adults return on the vine at the beginning of May when the first eggs take place in mid-May, engendering the 1st generation. Every female lays up to 50 eggs, the duration of the embryonic development is about 10 days; the larval development, between 3 and 4 weeks, passing by 05 stages. Most of the time, 5 generations follow one another in the year, partially overlapping. The populations stay on the vine to October [15].

Described by Libya, it is distributed since North Africa to Egypt. It is also in the oriental and the Ethiopian region where it causes damages in the vines of South Africa [40].

#### *The Favorable Conditions Of Infestation:*

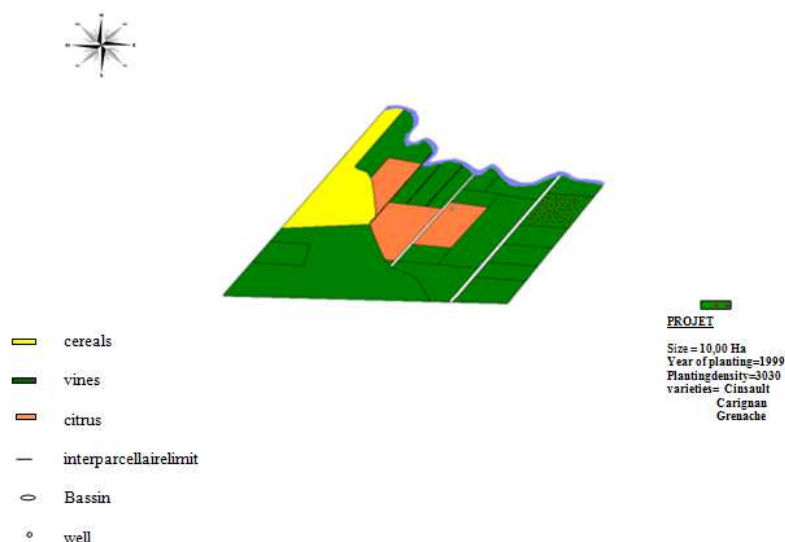
The presence of wild, hosts or cultivated plants around the vine, The hot and wet periods of the year, An excess of nitrogen fertilization, are so many conditions favorable to the appearance of the infestations of the jassid.

The adults and the larvas infest the foliage of the vine and suck the skin of leaves. They feed on the xylem, the phloem or the cellular contents of mesophile tissues of the plant, provoking so damages close to those of *Empoascavitis* but more pronounced.

## MATERIALS AND METHODS

### *5.1. Study site:*

The study was realized in a vineyard of a surface of 10 ha, affiliated to the national office of marketing of the wine-making products of Bourkika. This vineyard is situated in the extreme West of Mitidja (36 ° 36 N 02 ° 24E), on the national road number 42 between the municipalities of Hadjout and Bourkika in 80 km on the West of Algiers.



**Fig. 2:** Plot exploitation plan of Si Semiani-Hadjout

### 5.2. Vineyard:

The observations were realized in a vineyard of tank of a surface of 10 ha crashed in 2001 graft-welded, carry Clerk's Office 99 R, in density of 3300 plants by hectare directed north-south. The studied vines are native; it is about the cinsaut, grenache and carignan. These vineyards are led on trellis on three wires there, cut in simple guyot pear.

### 5.3. The trapping technique of the green leafhopper:

The samplings were made once a week during three wine-producing campaigns, on 2013, 2014 and 2015 by making a periodic enumeration of larvas and adults.

#### 5.3.1. The follow-up plan of adult populations:

The follow-up of the dynamics of the adults was realized by the use of similar attractive traps to the sexual traps type INRA. They are established by a plastic shelter in the shape of tent, at the bottom there is a sticky sheet. The shelter is of bright yellow color. what permit to trap the green adults of leafhopper by chromatic attraction. The latter are fixed by means of a hook to the thread of trellis as high as the lowest leaves at the rate of 05 traps by plot of land distributed on 5 rows and according to the diagonal of the plot of land [2].

For a better observation, the triangular chromoactifs traps were every week changed for the period of study going from mars to november.

#### 5.3.2. The follow-up plan of larvas populations:

The dynamics of the embryonic populations was followed every week by an enumeration and a in-situ counting of larvas on 200 vine leaves by plot of land, At the rate of 4 sheets leaves by vine tree and 50 feet by plot of land, taken in a random way according to the plan of Bastide([2]) ; These vine trees are distributed on 5 rows while avoiding borders [14]. The observations were realized between Mars and in November from 8 am in the morning. The phytosanitary treatments with a regulator of growth Cascade (100g / l of Flufenoxuron) were realized from the first ten days of May and July against the green leafhoppers. Other antifungal treatments were applied against the Mildew and the Powdery mildew with Bordeaux mixture and with wetttable sulfur in alternancy.



**Fig. 3:** Device of capture of the adult leafhoppers, the Triangulated trap set up on vines of tanks in Hadjout in 2015.

#### 5.3.3. Estimation of the vigour of plants:

The vigour was estimated by the weighing of the pruning wood of during the vegetative rest of the year of study and those from December, a total of 10 vine trees is taken at random according to the diagonal of the plot of land ([2]; [20]). The vigour was estimated according to the middleweight of pruning wood by stump ([19]; [28]).

#### 5.3.4. Varietal sensibility:

The estimation of the damages on sheets (leaves) was realized by a visual control, on hundred plants for every vine studied before the harvest of the grape. We used the ladder described by [9], quoted by [26], who concerns a leafhopper of the same family on potato.

The ladder describes the damages as follows:

- 1 = No foliar attack.
- 2 = < 10 % at the beginning of Blushing or yellowing of sheets leaves.
- 3=11-50 % blushing or yellowing of leaves.
- 5 = < 50 % blushing and yellowing of leaves with grillures.
- 6 = 51-90 % blushing and yellowing leaves with sanded grillures.
- 7 = < 90 % blushing and yellowing of leaves with very sanded grillures.

#### 5.3.5. Statistical analysis:

It was realized by with the software «PAST », The seasonal fluctuations were handled by the analysis of the variance " Anova one way ". The vigour and the varietal sensibility were analyzed by a comparison method of the averages.

#### Discussion:

The study made on the dynamics of the populations of the green leafhoppers *Jacobiascalybica* is relatively difficult to estimate, seen that from one year to another one the flights of this insect are not similar what consolidates the works undertaken previously in Bordeaux and at the level of the Mitidja of Algiers respectively byJehanno, [22] andBounaceur, [5], which can make difficult to confirm the preference of this insect on a precise vine.

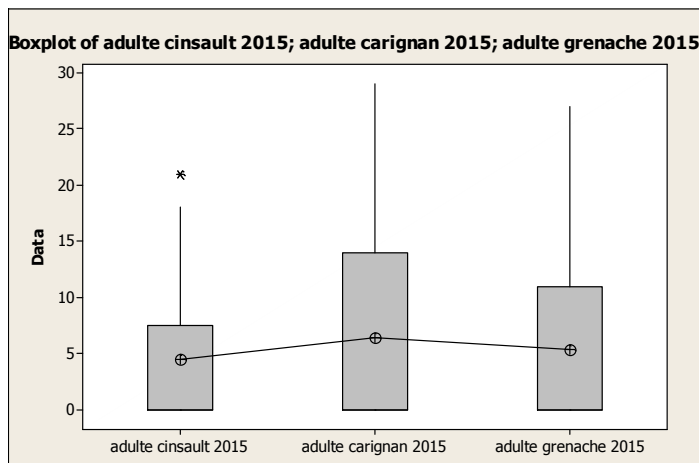
However observations made throughout the winegrowing year 2015, were able to reveal conclusions which can be perpetuated for the other studies on this devastating insect.

The distribution of the larval and grown-up stages in 2015 was characterized by four very significant peaks on three varieties of vine (cinsaut, grenache and carignan) what corresponds certainly to four generations of green leafhopper.

#### 6.1. Evolution of the adults during year 2015:

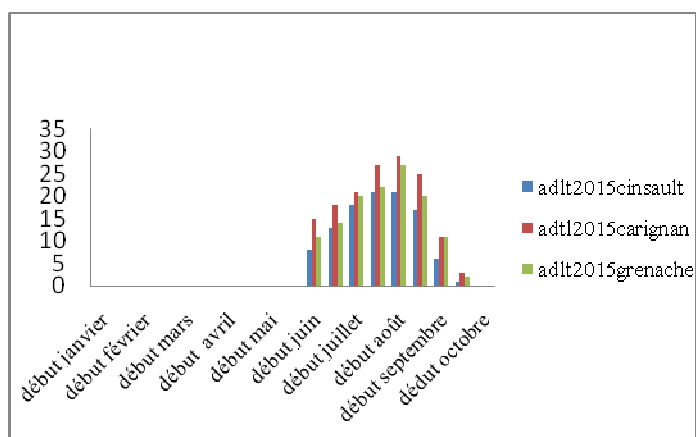
The presence of the first relatively low generation detected between the end of May and the beginning of June, coincides with the growth of the vegetative organs of the vine, in particular the exit of the young leaves which will be the home of the clutch of eggs by the adults emigrants of the neighbouring plots of land on which they had cultures considered as home of hibernation for the leafhoppers adults.

The dominance was observed on the carignan with a significant variation,  $p=0,001$  followed by the Grenache and finally the cinsaut with an average of individuals respectively of 20, more than 10 and more than 5.



**Fig. 4:** Boxplot of adult on vine varieties

The second peak is observed from July with a number of 24, 21 and 19 respectively on carignan, grenache and cinsaut. This second peak corresponds certainly to the second generation of the leafhoppers. The third peak is registered during the first ten days of August with an upper number compared with that of July. The fourth peak is indicated from the middle of September with a fluctuation which gets closer in that of the first generation what corresponds to the migration of the adults of leafhoppers towards shelters besides that vine to hibernate there.

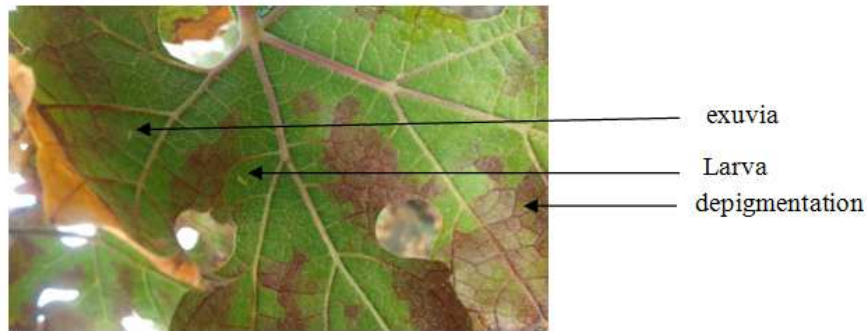


**Fig. 5:** Distribution of adult by type of grape and by time

#### 6.2. The larvas population evolution of the *Jacobiascalybica*:

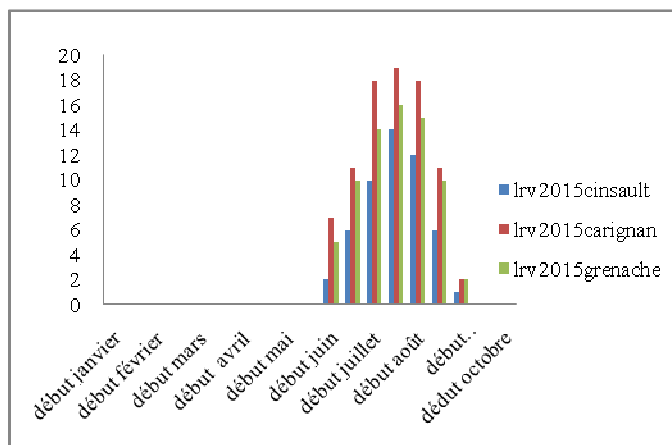
The seasonal evolution of the populations of *Jacobiascalybica* on native vines of tank is characterized by a distribution similar to that of the adults on three autochthonous vines in question, with a preference for the carignan followed by the grenache then by the cinsaut. In spite of the use, from April to July, divers phytosanitary products on vines answering to the local needs, to protect itself from diseases and insect and acarid attacks and master so in the vigour of the vine. The embryonic populations of the green leafhoppers did not know a paralysis in their evolution; they developed an habituation to these products.

The distribution of the embryonic and grown-up populations shows their dominance on the carignan vine.



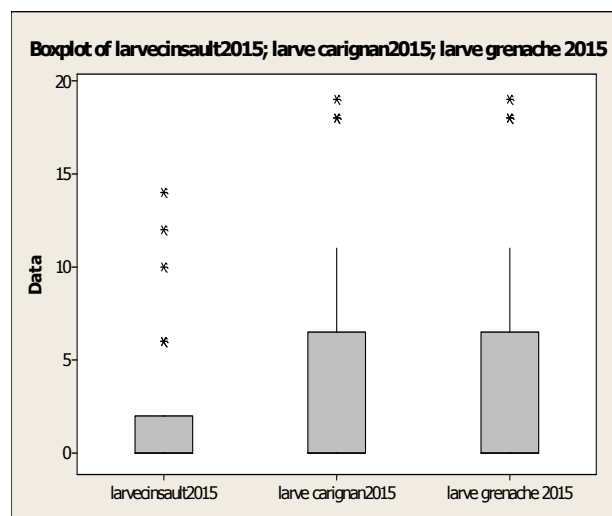
**Fig. 6:** Green leafhopper’s attacks

Our results assert those previously obtained by [4] and [6] which show the existence of the first generation from June but contradict the existence of a third one in the north of Algeria. Because we noted appearance of four generations. These can be explained by the climate change because from 2007 till 2015 the earth(ground) knew a rise of the temperature which seems to have a role in the development of the green leafhoppers.



**Fig. 7:** Distribution of larva by type of grape and by time

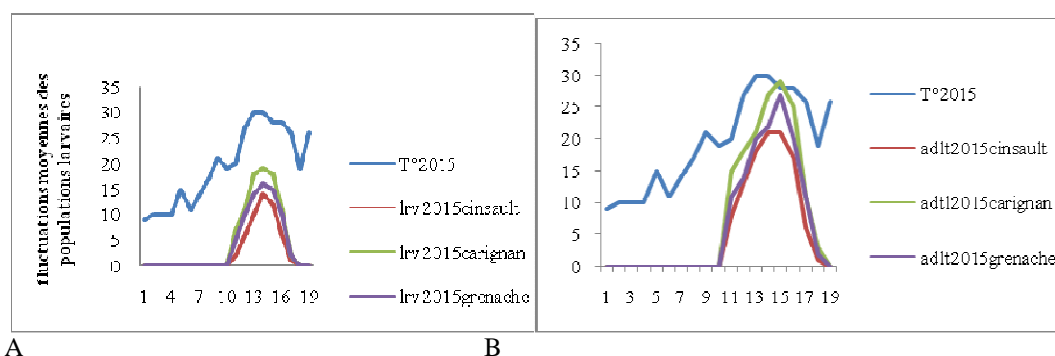
Indeed according to the statistical test student, we noted a significant correlation of the presence of the adult compared with the temperature which is 64 with one  $p = 0,001$ . The same result was obtained for larvae for a positive correlation of 58 and one  $p = 0,001$ .



**Fig. 8:** Boxplot of larva on grapevine varieties

Our results coincide with those of [13] who indicated on *Auchenorrhyncha* of the same family, that this variability of these intra-fragmented distributions and the differences of the levels of the populations enter years

confirm the importance of the weather conditions during the colonization of the plot of land. Migrations like this were observed already in North America for *Empoasca fabae* (Harris) a Typhlocibinae of the same kind. Polyphage, polycyclic and migrant, winter in the southeast of the United States, then migrate gradually northward ([23]; [34];[35];[18]) then go southward to winter[32].



**Fig. 9:** Distribution of larval (a) and adults (b) stages depending on the temperature and grapes

These migrations are made possible by weather conditions favorable to the flight, which are going to allow the rise of the adults until heights of 200 meters and their passive transport by the hanging wind 24 to 36 hours. This succession of such migrations allows the insect to travel several hundred kilometers ([11]; [32]).

The humidity and the precipitation seem to have no effect on the presence of the populations of this insect with a negative correlation. We can confirm it by the absence of humidity in Mascara on a planted vineyard in the same year and the same vine. The vineyard of Mascara is in AinFekkan known for its heat and absence of humidity. Our results are also comparable with those of [1] who note differences between wine-producing regions.

In Algeria, it is only in 2007 observations were made on this insect by Bounaceur, because before, it were never quoted as devastating of the vine, neither by the departments of the protection of vegetables, nor in the oldest literature which testifies of it [16]. The cultural practices of the South, as well as the global changes can be the cause of these massive invasions on vine during these last years.

### 6.3. Varietal sensibility of the vineyard (vine) towards *Jacobiascalybica*:

The comparison of the populations of green leafhoppers on the vines of autochthonous tanks allows highlighting differences of important infestations from a vine to another one. The Carignan vine is the most sensitive and most attacked variety (pic.3). The observed damages were in touch with the present populations (pic.3, 3b) and (pic.5a) with rates of foliar attack relatively mattering going to 50% followed by the Grenache 40% and finally the Cinsaut with 10%. This sensibility is due to the ampelographic characteristics of these vines. Touzeau (1968; 1971 In [19]) indicates that vines with tomentous leaves accommodate much fewer larvae than those in hairless leaves. Now, it is clearly visible that the plot of land of Carignan is the most affected, nevertheless, its limb is hairy on its lower face and that its surface is clearly smaller than that of the Grenache and the Cinsaut. What brings us to confirm that the factor villosity plays a role in the presence of the adults and the larvae of the green leafhopper. This further to the average density of hairs slept between the veins which can be a natural factor for the presence of the population of the leafhopper, because they can allow the adult to lay between the veins and insure the implant and the protection of eggs on the face inferior of the Carignan, contrary to Grenache and Cinsaut in which, the slept hairs are low.

- The first variety has restless limb and very embossed with a lower face with an average density of the hairs slept between the veins and a weak density concerning hairs slept on the main veins;
- The second has a very restless and hairless limb (smooth) with a lower face weakly or by no means covered with raised and slept hairs;
- The last variety is characterized by a limb slightly involved with a lower face weakly covered with slept hairs and averagely covered with hairs raised on the main vein [21].

### 6.4. Effect of vigour of the native vines of tank on the populations distribution of the *Jacobiascalybica*:

The study of the distribution of *Jacobiascalybica* on vines in question seems to demonstrate a preference of it devastating on certain vine compared with others. However we want to demonstrate the influence of this parameter on this distribution, then that this hypothesis was confirmed by [5] on the noble vines among others the Merlot which is the strongest follow-up by the vine Cabernet-sauvignon.

The adults seem to be clearly integrated into the zones of strong vigour, so corresponding with the observations of [24] and [12]. Indeed, [36] as well as [13] mention that the strong plants are the most attractive for leafhoppers. Effectively, according to our observations made during the samplings, we noticed that the adult



population dominated in its presence compared with larvae. What is in compliance with results reported by [5] who demonstrated that from the digital point of view the strong vines stood out the highest number of populations as adults that embryonic.

However, the confused stages (larvae and adults) of leafhoppers occupied the leaves of the vines of carignan first of all which were affected by the green leafhoppers. As for the grenache, it was little affected by *Jacobiascalybica* compared with the carignan and finally the cinsaut which was the least attacked with regard to previous both varieties.

This gives some explanation by the fact that the vigour of three varieties in question is respectively of :

- Low
- Medium
- Acceptable

These results can be interpreted only by a single way, it is that the attacks of *Jacobiascalybica* are due to two major factors:

- a- Vigour of the vine.
- b- Presence of hairs slept between the vein and the absence or the low density of hairs raised on the lower face of the limb.



**Fig. 10:** Attacked vineyard

#### Conclusion:

The study of fluctuation in the populations of *Jacobiascalybica* during the winegrowing year 2015 has allowed highlighting four peaks corresponding to a cycle of four generations. The very strong infestations by the embryonic populations were especially observed during the strong hot season which coincide in July and August which suits to the appearance of 2<sup>nd</sup> and 3<sup>rd</sup> generations so much on vines of tanks or tables. The attacks realized by the 1<sup>st</sup> and 4<sup>th</sup> generation are relatively low. The percentage of the native vine tank attacked was 50 % followed by the grenache 40 % and finally the cinsaut with 10 %.

The populations evolution of the green leafhoppers depends of factors:

- Increase of temperature
- The Wind which contributes to the move of this devastating and very light insect because it just has to be a whoever disturbance there, the insect flies away.
- Vigor of the vine, the most sensitive are the most affected by the population of leafhoppers.
- Pilosity of the limb.

The obtained results can urge to think about the control of the attacks of it devastating without eradicate it not to end in a biological imbalance. So, it should be noted that for the next days, a breeding of the predators or parasitoid of this insect is to be realized, to be able to realize either exclusively biological treatments for the cultures led under the biological mode or the integrated treatments, including biodegradable insecticides to protect the environment,

Besides, this insect shows a certain potentiality or a quiet overpower during its presence comparing to the other devastating which can affect the vine apart from the mildew, the powdery mildew, phylloxera, red mite and the Esca.

At last, these studies allowed knowing the extent of damage caused by leafhoppers on different varieties vines, whatever their vigor. Nevertheless, the limb's hairiness could be one of the factors that permit to this insect to be in the favorable condition for its reproduction.

Moreover it is necessary to choose the surrounding crops which could be repulsive and consequently, avoid the hibernation of this insect in off season, in order to avoid ravages caused by leafhoppers on vineyard readily invaded by this insect and can suffer seriously.

As well as, a study is in progress on the type of toxin injected by this devastating which cause the discoloration and the withering of the foliage of the vine. Which enzymes or proteins or antioxidants are released as soon as the first attacks start? Why even the most vigor vine is also damaged?

In addition, it is important not to neglect the biological aspect that must be considered and carry parasites or predators breeding of this insect to minimize its presence in the culture of vine

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