EFECTO DE LA APLICACIÓN DE CAOLÍN EN OLIVO EN EL SUR DE TENERIFE (II)

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EFFECTS OF THE APPLICATION OF KAOLIN IN OLIVE TREES, IN THE SOUTH OF TENERIFE

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1.- SUMMARY

In Tenerife, the area of olive cultivation has increased considerably in recent years, being the main pests affecting this crop the olive fly (Bactrocera oleae) and the olive moth or prays (Prays oleae). In this work the effect of the application of kaolin on the weight and caliber of the fruits, on the damage by the olive fly and on some quality parameters of the olives was evaluated. The kaolin is a clay with registration in Spain as a phytosanitary product, with no term of safety, with low environmental impact and usable in organic agriculture. The trial was carried out on 80 olive trees of the Arbequina variety, 40 olive trees treated with kaolin and another 40 untreated controls, with two applications of kaolin (Surround WP Crop) during the fruiting period. To determine the effectiveness, the percentage of olives chopped by the olive fly was calculated. Likewise, the weight and size of a sample of olives was recorded at the time of each application and during harvesting. The parameters of quality of the olives that were evaluated were index of maturity and content of oil in fruit. The trees treated with kaolin presented 2% of chopped fruits compared to 12% of the fruits of the untreated olive trees. Also, kaolin increased production and size by 21.3% and 9.1% respectively in relation to the production of untreated trees and olives treated with kaolin had an oil content higher than untreated olives . In conclusion it can be affirmed that the application of kaolin produced a decrease in the fruit affected by the olive fly, an increase in production and an improvement in the quality of the olives, economically compensating the application of the two kaolin treatments.

2.- INTRODUCTION, BACKGROUND AND JUSTIFICATION

The area devoted to the cultivation of olive trees in Tenerife has experienced an increase in recent years, currently occupying some 38 hectares located mainly in the south of the island (Medina, G., personal com).

A follow-up carried out by the Island Council of Tenerife through records of catches in traps, as well as observations of field damages during the different phases of the crop, indicated that the main pests that cause significant damage are the olive fly (Bactrocera oleae) and the moth of

the olive tree or prays (Prays oleae) (Medina and Perera, 2014). The main damage of the olive fly is due to the loss of quality (acidity, rarefied taste, etc.) suffered by the affected olive, especially if the humidity and the time elapsed allow the development of fungi and bacteria in the galleries of the larva (Fontaneg, X., 2011).

Kaolin is considered a broad spectrum protector that, in addition to decreasing the damages of pests, can act as a protector against sunburn and water stress (Romero et al., 2006).

The application of kaolin makes the tree less recognizable to the pest and the tiny particles of kaolin invade the body of the insect causing irritation and discomfort that manifest its repelling action. Sometimes, even if the insect does not come into contact with the particles, the appearance of the layer on the plant and the fruits make them unattractive for feeding and oviposition (Puterka, 2000).

Field studies have shown that film based on kaolin particles effectively suppresses damage due to high temperatures, water stress and sunburn (Glenn et al., 1999, 2001, 2002). The technology of particle film can be an effective instrument in the reduction of thermal stress in apple and grapefruit trees that can result in a potential increase in production and quality (Glenn et al., 2001, Jifon and Syvertsen, 2003).

Phillips and de la Roca (2003) observed a lower attack of fly and prays in olives treated with kaolin, compared to olive trees treated with dimethoate and olives not treated in four trials carried out in Malaga and Seville. Saour and Makee (2003 and 2004) found a better protective effect of kaolin, compared to dimethoate, against the olive fly in Syria, an effect that persisted longer than 14 weeks. Caleca and Rizzo (2006), comparing two different formulations of kaolin and copper hydroxide, observed a significant reduction in the percentage of olives affected by fly, during two consecutive years, in olive groves in Sicily. Perri et al. (2005) also obtained lower percentages of olives affected by the fly with the application of kaolin with significant differences with respect to untreated olives.

Regarding the quality of the olives, Saour and Makee (2003 and 2004) verified certain positive effects of kaolin on the characteristics of the olives harvested at the end of the trial and Phillips and de la Roca (2003) obtained an increase in the oleic yield with the application of kaolin.

l year 2014, the Technical Service Agriculture and Rural Development of the Cabildo Insular de Tenerife conducted an essay on the effect of the application of kaolin on olive trees in the south of Tenerife (Perera et al., 2014) on a farm with precedents of attack olive fly In this study it was

concluded that under the conditions of said trial, the application of kaolin produced an increase in the weight and size of the fruit with respect to the fruits of untreated trees and that said increase in production economically compensated the cost of the three treatments with said product. Likewise, it was considered appropriate to repeat this study in areas with greater incidence of the olive fly to determine the effectiveness of this insect, as well as to evaluate the effect on the quality of the oil. Based on this, it was considered to repeat this test on a farm where there was a history of damage caused by the olive fly in previous campaigns.

3.- OBJECTIVE

To determine the effect of the application of kaolin in olive tree on the damages of the olive fly (Bactrocera oleae), the production and on some parameters of quality of the olives.

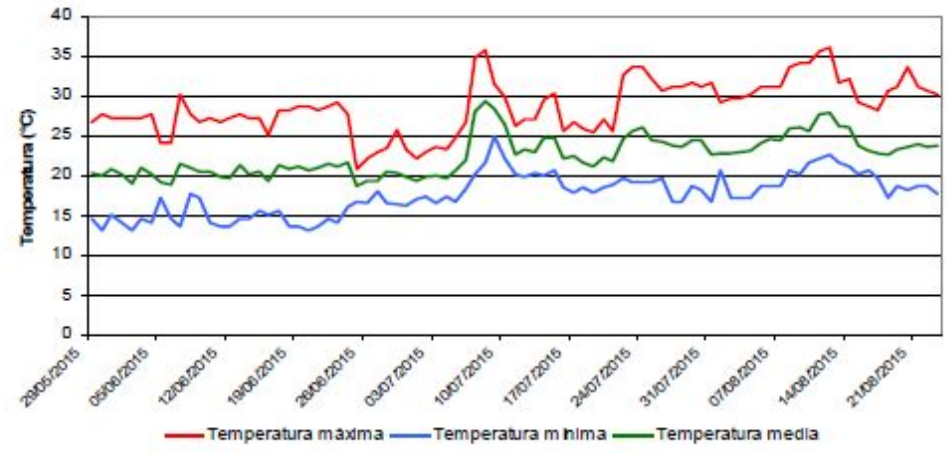
4.- MATERIAL AND METHODS

The trial was conducted in a plot that is located at 315 meters above sea level in the area known as Casparianes in Tijoco Bajo and belonging to the municipality of Adeje. This farm has a total of 5000 olive trees of the variety is Arbequina with 3 years of age, planting frame of 5 X 3 m, drip irrigation and certified in organic farming. In the last campaign, this farm had damage caused by olive fly.

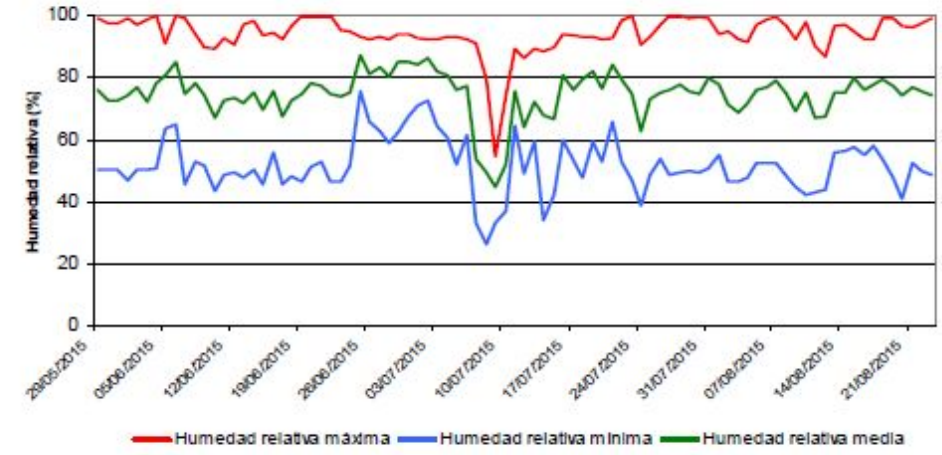
Four cultivation lines were chosen, each one consisting of 20 trees, 2 lines were destined to the treatment with kaolin and another two lines were designated to the control treatment (without application of kaolin). Each treatment was separated from the other by two other cultivation lines that acted as border plants (figure 1).

To determine the degree of homogeneity among the selected trees, 20 trees of the 40 assigned for each treatment were chosen, and they were measured tree height and trunk diameter approximately 20 cm from the ground.

The product used was Surround® WP Crop Protectant with a composition of kaolin 95% wettable powder and with registration number of phytosanitary product 24689. This product is authorized in mandarin, orange, olive and pear trees and for the olive its authorization is for fly and prays at doses of 25-50 kg / ha. In their phytotherapeutical conditionings, **it is indicated that it must be applied preventively before the laying of eggs on fruits is carried out.**



Gráfica 1.- Temperatura máxima, media y media durante el periodo del ensayo.



Gráfica 2.- Humedad relativa máxima, mínima y media durante el periodo del ensayo.

As shown in graph 1 during the fruiting period, two peaks of temperatures occur in which the maximum exceeds 35ºC in the months of July and August coinciding with a decrease in relative humidity.

Two applications of kaolin were made on 05/28/2015 and on 06/25/2015. At the time of applying the treatments, temperature, relative humidity and wind speed were recorded with a

hydrothermal anemometer, PCE-THA 10. The time of beginning of the application and the state of the sky were also taken.

Fecha de aplicación	Hora de inicio de la aplicación	Temperatura (°C)	Humedad relativa (%)	Velocidad del viento (m/s)	Estado del cielo
28/05/2015	10:30 a.m.	26,3	45	0-0,6	Intervalos nubosos
25/06/2015	9:30 a.m.	23,9	60,4	0-0,6	Poco nuboso

Table 1. Meteorological conditions at the time of spray applications

The dose used in the two applications was 50 kg / ha. A hydropneumatic sprayer (atomizer) suspended and coupled to the PTO of the tractor was used. The working pressure was 25 atmospheres and the quantity of liters per ha was 950 l / ha. **The trees to which the control treatment corresponded were not treated with any insecticide product with action on the olive fly.**

For the evaluation of the effect on production, three samples were taken (at the time of the two applications and at harvest). In the sampling at the time of the two applications, 5 random fruits of 20 trees of each treatment were taken and the total weight of the fruit and size was recorded. In the sampling carried out at the time of harvest, 20 random fruits of 20 trees were taken from each treatment. The weight of the 20 fruits was recorded and 10 of the 20 fruits of each tree were calibrated.

To determine the percentage of fruits chopped by the olive fly, the harvested fruits were placed in aerated plastic containers and allowed to evolve for about 14 days, after which the number of fruits affected by the olive fly was recorded.

For the calculation of the effectiveness the formula of Abbott (1925) was used taking the percentage of fruits with damages in the control treatment and in the treaty.

For the evaluation of the quality of the olives (maturity index, humidity (%), oil content in fresh and dry fruit (%), 5 random fruits of 20 trees of each treatment were taken, with these 100 fruits of each treatment and they were sent to the laboratory of the IFAPA-Alameda del Obispo Center of the Ministry of Agriculture, Fisheries and Rural Development of the Junta de Andalucía.

For the ripening index the classification was followed in 5 categories according to the scale of the variation of the external color of the fruit according to the proposal of Barranco et al., 1998. (0: intense green, 1: yellowish green, 2: poisoned, 3: violet , 4: black).

Next, the maturity index of the sample will be established by the sum of the number of fruits of each category by the numerical value assigned to its category, divided by 100,

where A, B, C, D and E are the number of fruits of each category. category 0, 1, 2, 3 and 4, respectively, as expressed in the following formula:

I.M. = (A * 0 + B * 1 + C * 2 + D * 3 + E * 4) / 100

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I.M. = (A * 0 + B * 1 + C * 2 + D * 3 + E * 4) / 100

Once the maturity index is obtained, the sample is homogenized again and two subsamples or repetitions of 25 to 30 grams each are taken, noting the weight of each one of the repetitions (fresh weight of the fruit), as well as the number of fruits which contains each one, which must be the same for each sample.

Each repetition is placed on an uncovered petri dish and placed in an oven at 105 ° C for a minimum of 42 hours. After this time the subsamples of the stove are removed and the fruits are reweighed (dry weight of the fruit) and wrapped in fireproof paper and closed with a rubber to prevent the olives from retaking moisture.

For the difference between fresh weight and dry weight, we can obtain the wt% of moisture contained in the fruits, while the percentage of oil on dry pulp will be determined by nuclear magnetic resonance on a Bruker NMR analyzer. The analyzer has a computer in which the data is processed and stored using the "minispec mq-10" program.

5.- RESULTS and DISCUSSION

5.1.- Height and diameter of trees

Table 2 shows the results of the height and diameter of the trunk of the trees chosen for each of the treatments and where it is observed that there are no significant differences between them, so it is considered that the trees assigned have a similar development .

Table 2.- Statistical result of the height and trunk diameter of the trees by treatment.

	Altura (m) ±SE	Diámetro de tronco (cm) ±SE
Caolín	3,10±0,05a	24,01±0,65a
Testigo	3,22±0,08a	22,58±0,43a
p	0,1941	0,0750

5.2.- Effect of kaolin on the weight and size of the fruits

The results of the weight and size of the fruits in the two dates of application were those shown in table 3.

Table 3.- Weight and caliber result by treatment at the time of the two applications.

Fecha de aplicación	Tratamiento	Peso medio de 10 frutos (g)	Calibre medio (mm/fruto) ±SE
Primera aplicación 28/05/2015	Caolín	3,1	6,98±0,09
	Testigo	2,6	6,48±0,12
Segunda aplicación 25/06/2015	Caolín	5,3	8,41±0,09
	Testigo	5,0	8,51±0,08

Table 4.- Statistical result of the weight and size of the fruits by treatment at the time of harvesting.

	Peso medio de 10 frutos (g) ± SE	Calibre medio (mm/fruto) ± SE
Caolín	18,75±0,96a	10,45±0,08a
Testigo	15,45±0,49b	9,58±0,06b
p	0,0000	0,0040

As shown in table 4, the production of the trees treated with kaolin increased by 21.3% and the caliber by 9.1% with respect to the trees not treated. These data are similar to those obtained by Perera et al. (2015) carried out in the south of Tenerife in which the trees treated with kaolin increased in production and caliber with respect to those not treated. Likewise, Saour and Makee (2003) also found that olives treated with kaolin were more productive and the fruits were of a higher caliber, coinciding with the data obtained in the present work. However, Romero et al. (2006) did not observe any significant effect on the characteristics of olives at the time of harvest of trees treated with kaolin with respect to those not treated.

This difference could be due to the fact that the application of kaolin could diminish the negative effect that the high temperatures exert on the tree, decreasing its transpiration, and in this way the production in the trees treated with kaolin will be improved.

Figure 3 shows the average weights of 10 fruits and the caliber at the time of the two applications of kaolin and in the harvest.

	Peso medio de 10 frutos (g) ± SE	Calibre medio (mm/fruto) ± SE
Caolín	18,75±0,96a	10,45±0,08a
Testigo	15,45±0,49b	9,58±0,06b
p	0,0000	0,0040

5.3.- Effect of kaolin on the olive fly and efficiency percentage

Table 5 shows the percentage of chopped olives per treatment registered after the 14-day fruit evolution period in aerated plastic containers.

Table 5.- Statistical result of the percentage of olives affected by the olive fly by treatment.

	Porcentaje de aceitunas picadas por mosca del olivo ± SE
Caolín	2,0±0,73a
Testigo	12,0±1,43b
p	0,0000

5.4.- Effect of kaolin on the quality of olives

The results of the analysis of the olives by treatment are detailed in table 6.

Table 6.- Percentage of humidity, maturity index and oil content in dry and fresh fruit of the olives at the time of harvest and for the two treatments.

	Humedad (%)	Contenido de aceite en fruto seco (%)	Contenido de aceite en fruto fresco (%)	Indice de madurez
Caolín	55,76 ± 0,44a	40,06 ± 0,56a	17,72 ± 0,26a	2,55
Testigo	57,88 ± 0,62a	39,65 ± 0,25a	16,70 ± 0,35a	2,85
p	0,055	0,55	0,084	

The olives of the kaolin treatment have a lower moisture content and a higher oil content in dry and fresh fruit than the untreated olives without significant differences.These results coincide with Romero et al. 2006b in experiences carried out in the localities of P. Cérvoles and Falset in 2004 and 2005 respectively. Also, those treated with kaolin have a lower maturity index at the time of collection.

5.5.- Comparative economic study

Table 7 shows the comparative income between the treatment with kaolin and the control taking into account the increase in production with kaolin, the waste by fly of the

olive tree in both cases and the cost of the application of kaolin.

Table 7.- Comparison of income between the treatment with kaolin and the control treatment.

INGRESOS EN EL TRATAMIENTO TESTIGO (sin aplicaciones fitosanitarios frente a mosca del olivo) (1)	5.860,8 €/ha
INGRESOS EN EL TRATAMIENTO CAOLÍN (2)	7.945,38 €/ha
DIFERENCIAS DE INGRESOS A FAVOR DEL TRATAMIENTO CAOLÍN	1.354,08 €/ha

(1) The 12% detriment due to olive fly damage has been deducted.

(2) Production has increased by 21.3% and 2% detriment has been deducted for olive fly and the cost of the two treatments. DATA FOR THE CALCULATION = Cost of labor for the treatment = 240 € / ha; Number of plants / ha = 666 trees. Product cost = € 2.49 / kg; No. of treatments applied = 2; Water price = € 0.4 / pipe; Average production of a tree of 3 years = 10 kg / tree; Broth expenditure = 950 l / ha. Price per kilo of olives = € 1 / kg

6.- CONCLUSIONS

Under the conditions of the present test, the application of kaolin produced a significant increase in the weight and size of the fruits with respect to the fruits of untreated trees.

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With respect to the damage caused by the olive fly, the trees treated with kaolin presented 2% of fruits that were picked by this pest, compared to 12% of the untreated olive trees and the effectiveness of the treatment with kaolin was 83.3%.

TECHNICAL INFORMATION

Effect of the application of kaolin on olive trees in the south of Tenerife

The olives treated with kaolin show a lower moisture content and a higher oil content in dry and fresh fruit than the untreated olives without significant differences.

The increase in production and the reduction in olive fly damage due to the application of kaolin economically compensates the cost of the two treatments with this product.

7.- ACKNOWLEDGMENTS

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