ESTACION EXPERIMENTAL TROPICAL PICHILINGUE
COCOA RESEARCH AND TECHNOLOGY TRANSFER TEAM

SPECIFIC COOPERATIVE AGREEMENT INIAP-USDA (ARS): 58-6631-1-143F

PROJECT: EVALUATION OF GERMPLASM, MAPPING POPULATION AND ADVANCED FAMILIES OF THEOBROMA CACAO FOR DISEASE RESISTANCE AND PRODUCTIVITY TRAITS.

TECHNICAL PROGRESS REPORT

YEAR 8 (April 1/2011-April 30/ 2012)

Authors: Freddy Amores, Carmen Suárez, Juan Jiménez, Alfonso Vasco, Omar Tarqui, Wilden Sarabia, Ignacio Sotomayor C., Diego Saquicela, Stalin Revelo, Teresa Casanova and Carmen Campi

A two-year old cocoa clone, a project output

QUEVEDO – ECUADOR
2012

INTRODUCTION

A host of factors are associated with the low average cocoa yield in Ecuador. Witche's broom and moniliasis incidence, combined with the low yielding potential of the planting material in traditional cocoa fields, are by far the main causes limiting productivity and production. Both diseases represent an acute yield depressing factor since their outbreak in the early 1920s. This justifies the urgency to develop new high yielding fine or flavour cocoa varieties. This is the frame of reference for the project we are reporting on and which aims to provide relevant solutions for the situation we just described. These should take the form of high yielding cocoa varieties with disease resistance, flavour quality and adaptation to different environments. We are trying to accomplish this by characterizing, developing and using the cocoa genetic resources currently available at the Estación Experimental Tropical Pichilingue of INIAP.

The achievement of the proposed objective will certainly make a significant contribution to overcome the main factors responsible for the low cocoa productivity in Ecuador: poor yielding cocoa varieties and high vulnerability to diseases. The present Report covers the project's results over the period April 2011-April 2012. Description and explanation of the results are supported by corresponding Tables and Figures containing relevant information. For ease of text organization these are sequentially arranged in the Annex and sequentially referred to as the report develops. When necessary, statements on previous results and perspectives for future activities are inserted. This is to provide context and improve reader's comprehension.

Germplasm Evaluation

CGN Collection

This Collection is currently undergoing routine maintenance. As stated in the last project Progress Report, four Nacional type cocoa varieties (EET 544, EET 558, EET 575 and EET 576) from this collection were released for commercial planting in 2009. Under intensive technological management, including irrigation, these varieties yield as much as CCN 51, a high yielding commercial clone used as control. This was concluded from comparative clone trials carried out in two zones.

Two new clones, EET 559 y EET 577 selected from this Collection are currently being tested intermixed with EET 103 and EET 576, two long time commercial clones. A demonstration plot of 0.65 hectare is used for this purpose in a farmer's field, in the zone of Milagro. Both, EET 559 and EET 577, are planned to be released as new Nacional type varieties in the near future. A clonal garden was set up at the Estación Experimental Litoral Sur near Guayaquil with this purpose in mind. However, flooding events seriously affected its development in the past months. Now we are in the process of developing a new clonal garden. A mixed clonal variety, including these two clones together with 103 and EET 576, will benefit farmers of an important cocoa growing zone (center and south eastern of the Guayas river basin).

Recorded yields for these clones growing intermixed are promising. Calculated yield figures in 2008, 2009, 2010 and 2011 in the same order are: 1.72; 2.15; 1.95 and 1.54 tons of dry beans per hectare. The demonstration plot was set up in March 2004. Though trees benefit from irrigation events (furrow irrigation) during the dry season (June to November) every year, these are intermittent and plants are subjected to short drought periods from time to time. Across

years the average yield shows a clear monthly distribution with 44.6 % of the harvest concentrated in the first quarter, 39.8% in the last quarter while the middle quarter is responsible for 15.6%.

Yield decline from a peak in 2009 was an expected response due to soil fertility depletion as confirmed by soil analysis data. The levels of P and K in this plot were just one third of those from another nearby field (150 m away) of the same soil series but less depleted. Since the farmer runs an organic cacao production system mineral fertilizer is not applied in this plot. From the evolution of yield data, it´s clear that organic manuring application (less than 1 kg per plant per year) is not enough to sustain high productivity. Better provision of plants water needs during the dry season, combined with a generous fertilization, is expected to take yields higher than the 2.15 tons harvested in 2009. However, an average of 1.8 tons obtained across the last 4 years is not a bad outcome so far. Table 1 in the Annex provides more relevant information on this matter.

On the other hand, the CGN Collection variability has been enriched in the past few years with new genotypes from superior trees identified in farmer´s fields, including a few non-Nacional types; they cover the so called "super-trees" selected in the northern Amazonian region. Some local breeding selections have also been added to the collection pursuing the same purpose. All of them are currently being monitored as observation plots. A student was recruited to carry out a phenotypic evaluation of those introductions planted in 2006 and 2007. This work is ongoing since February 2011. Excepting for one irrigation event (or two in the best case) every year, no water is provided during the long dry season to this collection. Consequently, plants are subjected to severe water stress which cuts yield and plant vigor.

Results showed the clones coded Arbol 9, Arbol 5 and B. Eskes were the top yielders with 1.7, 1.62 and 1.57 kg of dry beans accumulated in 15 months (February 2011-April 2012) of evaluation, in the same order. These were followed by ESS 6 with 1.34 kg and a pod index of 40.3. The EES 1 ranked fifth with 1.23 kg, a pod index of 20 and a seed index equal to 1.4. ESS 6 and ESS 1 are two of the members of the so called "Super trees". Table 2 in the Annex provides additional information about this study which will continue until December 2012.

Allen Collection

Evaluation of a first group of Upper Amazon cocoa genotypes available in the so called Allen Collection # 1 started in late 2009. Accumulated number of healthy pods and other variables registered during October 2009 - April 2012 are shown as averages per tree in Table 3 (see the Annex). Variability in the number of plants, vigor and age, even within the same genotype´s row, limits the possibility of making a conclusive remark regarding any trait, at least for the time being. However, the clone EBC 126 seems to stand out as a high yielder. It produced 149 healthy pods in 2.5 years while exhibiting only 3.9 % of diseased pods. Pod index and seed index of 23 and 1.5 are also promising figures for the same clone.

A second group of Upper Amazon genotypes present in the Allen collection # 2, which holds younger plants, was also evaluated during the same period. With 1.82 kg of dry bean weight the genotype LCT EEN 130 was the top yielder clone as shown in Table 4 in the Annex. However, this also exhibited a high percentage of diseased pods (40.4 %) and a relatively high number of witche´s brooms per tree. The clones LCT EEN 169 and LCT EEN 6S/7 ranked 5th and 7th with

0.89 kg and 0.85 kg of accumulated dry bean yield during the last 30 months. These are not as high as that of the top yielder but showed no diseased pods or vegetative witche´s brooms.

The lack of diseases represents an outstanding feature for LCT EEN 169 and LCT EEN 6S/7, so these will be subjected to a close monitoring in order to estimate their value for breeding. If selected they could be used as parents for a new breeding scheme with a group of Nacional type clones. The objective will be to screen for diseased resistance and flavour quality in segregating populations. Both Allen Collection # 1 and Allen Collection # 2 do not receive irrigation and have to withstand a long dry season. This subjects them to a severe water stress every year which undoubtedly diminishes yields.

A third group of Upper Amazon genotypes known as Allen Collection # 3 (planted two years ago and replicated from an old germplasm bank located in the E.E. Central Amazónica) undergoes routine maintenance. Data gathering will begin shortly to develop the capacity of use for this group of 157 different clones that makes up a total of 785 plants. Fig. 1 in the Annex shows the field distribution for this last group of clones.

Chalmers Collection

Accessions in this Collection have been fully characterized in the past, both morphologically and genetically. The question about the presence of fine or flavor genotypes among these has been frequently raised. Some clones exhibit pale or even white beans as has been observed. These traits might be associated with aromatic type cocoas as suggested by earlier scientific evidence.

To clear up suspicions about mislabeling and mixing of different genotypes within each accession´s row in this collection, an earlier study was conducted to generate the genetic identity for each individual tree. Results revealed this suspicion was true and that actually more genotypes were available than those reported according to the available field map as shown in Fig. 2 (Original accessions number: 44; after DNA identification: 73) (See the Annex). This finding eroded the value of previous results on characterization and evaluation of the members of this collection. On the other hand, results had been reported earlier as averages per genotype so it became difficult to trace yield and other data back to the individual trees.

On April 2010 a student was hired to carry out a short study on the physical, chemical and sensorial qualities of the beans following the results of DNA identification. Not all genotypes were covered in this study and the reliability of the data was severely affected by several factors. Despite this constraint the clone coded CUR 3 showed interesting values for seed and pod index though its shell percentage is high, as was for most other genotypes analyzed. Most of them exhibited values of the T/C (Thebromine/Caffeine) ratio ranging from 3.52 to 5.96; only two of them reached a ratio higher than 6.5. This is an interesting result because low T/C ratios are said to be associated with fine or flavor cocoas. This justified the need to continue this evaluation effort.

Following this justification another student was recruited in 2011 to complete a physical and sensorial characterization of the members of the Charmer's collection. This work is currently ongoing. Of course, the genotype´s identity of each tree based on the DNA results is being taking closely into account for this evaluation work. Some results are shown in Table 5 (see the

Annex). The genotype TAP 3 clearly stands out from the others with 3.32 kg of dry bean yield though the diseased pod's incidence got close to 30 %. AMAZ 11 (unfortunately no DNA analysis was available for this particular genotype) ranked second with 2.25 kg of dry bean yield but showed a high level of diseased affected pods (55.1%). BOB 3 with 1.96 kg and 25.5 % of diseased pods is also a good performing genotype.

Most important is that reported yield and other data reflect what happened in the Chalmers 'collection just in the past six months (December 2011-May 2012). Figures of 3.3; 2.5 and 1.96 kg of dry bean yields per tree certainly call our attention. We have to wait and see what the evolution of the data is in the coming months. Only in 30 genotypes we have so far been able to harvest ripe pods. Apparently, most genotypes are low yielding or non productive clones, though some of them show flowers but do not set fruits. Squirrels feed on the ripe pods of a few trees possibly because of their sweet pulp. Some associate this squirrels' behavior with the presence fine or flavour beans. Sensorial analysis will certainly shed light on this issue but we still have to wait for this data.

Evaluation of old hybrid cocoa progenies

Evaluation of old coca hybrid populations

Diseases and low yielding planting material are by far main factors limiting production of "fine or flavour" cocoa in Ecuador. This makes it necessary to develop modern varieties capable of overcoming these limitations. During the 1960s and 1970s INIAP tested several progenies from selected crosses between Nacional type selections and Upper Amazon genotypes. The main objective of these crosses was the recombination of genes to develop hybrid varieties with high productivity and disease resistance. It is in this context that five segregating populations from a similar number of crosses were planted at 4 x 4 m in 1969 at the E.E. Pichilingue (Lote 7A) of INIAP in the zone of Quevedo.

Altitude at the experimental site is 75 m above sea level. Annual temperature and rainfall averages for the last 25 years are 24.9°C and 2166 mm. Rainfall is marked by a seasonal pattern with a dry season prevailing in the second half of the year. The soil classified as a Eutrandept is fertile and deep. For several reasons data collecting was sparse and discontinued for long periods of time making it difficult to draw valid conclusions. After a drastic pruning in mid-2002 to regain growth control by reducing tree's height the management improved, making it possible to re initiate data collection on a monthly basis from 2003 to 2008.

Earlier observations had shown that the cross EET 95 (Nacional-type genotype) x Silecia 1 (Upper Forastero genotype) yielded substantially more than the other populations, this progeny deserved a close monitoring to search for superior trees that combine at the same time high yield and disease resistance traits. With this aim in mind a set of variables were measured to assess individual tree performance.

Results were as follows: dry bean yield (mean 1.1 kg, range 0 to 7.1 kg); number of healthy pods (mean 18.2, range 0.8 to 102.2); number of diseased pods (mean 21.9, range 0.8 to 87.5); number of moniliasis-diseased pods (mean 11.3, range 0.2 to 65); percentage of moniliasis-diseased pods (mean 27.9 %, range 1.5 to 58.3 %;); number of witches' broom-diseased pods

(mean 10.6, range 0 to 36.7); percentage of witches´ broom-diseased pods (mean 27.4%, range 7.8 to 52.4 %); and number of vegetative witches´ brooms (measured once a year: mean 34.9, range 2 to 176).

All reported figures are annual averages for the six year period. Trees coded A 179 and A 196 combined high yield potential and pod disease resistance in a consistent manner during the period of evaluation. They were selected for further development as clones to fix the exhibited favorable traits. The genotype with the most extreme value (7.1 kg) shown in the dry bean yield range was not selected because the tree was growing at the edge of the plot, which may have caused an artificially high yield.

Annual dry bean averages were 5.8 kg for A 179 and 4.1 kg for A 196. Moniliasis diseased pods reached 8.7 % and 6.9 % incidence while for witche´s broom diseased pods the incidence was 15.7 % and 11.8 %. These percentages are substantially lower than respective population means. When both trees are compared to A 745, with a high susceptibility to diseases (45.5 % and 29.2 % of the 65.2 pods it produced were destroyed by Moniliasis and Witches´ broom), the disease resistance capacity of the selections is clearly appreciated.

Pod index values of 15.2 and 17.4 and seed index values of 1.63 g and 1.43 g were found for the selected superior trees. Pollination tests showed that A 179 and A 196 are not self compatible but they are inter-compatible. Further studies in large plots (100 plants plots) are ongoing because potential seems to be high to develop and release in the medium term a biclonal variety for the benefit of farmers. See Figs. 3, 4 and 5 in the Annex for information about the yield dynamic of these clones across years as related to some weather variables.

Breeding for Witches' broom resistance

First Breeding scheme

As earlier reported, planting of the first clones (group 1 and 2) in this trial started by mid 2006 and was completed in 2007. These are currently under development in the so called Lote "Las Tecas" (698 clones, four replications, and three plants per plot). Table 7 in the Annex shows the accumulated yield, sanitary and related data registered up to April 2012.

Top five yielding clones are INIAPT 632 (CUR 3 x TIP 1); INIAPT 484 (AMAZ 14 X EBC 148); INIAPT 384 (CCN 51 x TAP 3); INIAPT 405 (CCN 51 x TAP 3); INIAPT 302 (EET 382 x A 645) and INIAP 352 (Brisas 13 x EB 103). The accumulated yields are: 2.80 kg, 2.74, kg, 2.47 kg, 2.38 kg and 2.29 kg of dry bean weight per plant. The control CCN 51 yielded 2.36 kg. The dry bean weight for EET 103, a Nacional type clone used as a control, reached 0.97 kg. Another control, JHV 10, a commercial clone multiplied and sold by a farmer (apparently segregation from a CCN 51 progeny as suggested by recent DNA data) in the zone of Milagro, yielded 1.94 kg.

Main result from this experiment is the preliminary selection of several clones which yield close to or higher than CCN 51. The standing of EET 103 as compared to CCN 51 is in agreement with earlier results showing that CCN 51 usually yielded twice or more than this, certainly a large difference. With the exception of INIAP 384 which exhibits a low seed index (0.87), the

seed index of the remaining top yielders fit in the range 1.25 – 1.55. INIAP 632 and INIAPT 405 showed the lowest percentage of diseased pods, while INIAP 384 presented the lowest number of vegetative witches´ brooms. Pods of INIAPT 384, INIAPT 405 and INIAPT 352 are red. Refer to Figs. 6, 7, 8, 9, 10, 11, 12 and 13 in the Annex to see how the top yielding clones and controls have evolved through the years regarding the number of healthy and diseased pods as related to some weather variables. Combination of a heavy rain season and increasing self shading in the plots may be the cause for the number of diseased pods to be on the rise in the first quarter of the year.

By mid 2009 an early clone selection based on several traits of interest was made in this trial. Multiplication of the selections was gradual because not all were able to produce enough budsticks at the same time to fulfill grafting needs. As the planting material was made available 100 plant plots were set up for each clone. We ended up with a comparative clone trial with two replications and 16 clones. This total includes other superior selections (products of the so called IPGRI cocoa project finalized in 2009), as well as the controls EET 103 and CCN 51.

This move was made to gain time to validate the performance of the selected clones but now in large plots. Based on these, planning for a cocoa field day within the next 5 years is being considered in order to release, at least a couple of new improved high yielding cocoa varieties, for the benefit of producers in the zone of Quevedo (an important cocoa producing zone). Some of the data collected until April 12 for all the tested clones are presented in Table 8 (see the Annex).

In these large plots the top four clones: INIAPT 302, INIAPT 656, T7/R2/A3 and INIAPT 484, accumulated dry bean yields equal to 0.55 kg, 0.45 g, 0.33 kg and 0.32 kg during the last 12 months of evaluation. These values are very close to that of CCN 51 and higher in two of the cases. EET 103 is left quite behind but for the time being is close to others participating in the trial. The low diseased pod percentage for INIAPT 302 is a promising result. Pod index values are quite good while the seed index range goes from 1.42 to 1.58. It is too early to advance any conclusion but the perspective looks interesting. It is necessary to note that these plots have been irrigated more often than other cocoa fields. This may partly explain the large size of the beans in most clones, apart from their particular genetic base.

Groups 3 and 4 of the breeding populations generated by this first breeding scheme are developing normally in the so called Lote "Ganadería". In total 420 clones, four replications and three plants per plot are subjected to comparison in this trial. Table 9 in the Annex shows yield, sanitary and other accumulated data per plant until April 2012 (32 month of evaluation completed).

Regarding yield the top five clones were INIAPG 006 (CCN 51 x TIP 1), INIAPG 069 (AMAZ 11 x TAP 6), INIAPG 026 (TAP 6 x UNAP 2), INIAP 029 (CCN 51 x TAP 12) and INIAPG 059 (UNAP 12 x TIP 1). In the same order these yielded 1.76, 1.67, 1.65, 1.19 and 1.18 kg of dry bean yield per plant. Pod and seed indexes, with one exception (TAP 6 x UNAP 2), are close to those of CCN 51. The controls CCN 51 and EET 103 yielded 0.57 and 0.32 kg, respectively. This particular trial has been strongly affected by the drought (it was irrigated only once during the past dry season) which is definitively limiting yield expression. In the next year we hope to improve this situation by implementing an irrigation system. See Figs. 14, 15, 16,

17, 18, 19, 20 and 21 in the Annex for more details about the behavior of these clones as related to some weather variables.

Second Breeding scheme

Planting of clones originated from hybrid seedlings selected within the segregating populations generated by the implementation of a second breeding scheme (in this case crosses belong to groups 5, 6 and 7) began in early 2010. This trial has three replications and is located in the so called Lote "Las Malvinas". Each replication contains 431 treatments, including several controls, with three plants per plot. Progress achieved in planting reached 93 % until April 2012. The empty spaces were filled with the planting of seedlings of IMC 67 since no more plants will be produced for those selections that have proved hard to clone.

Table 10 in the Annex shows accumulated yield data during the period April 2011-April 2012 for the top 15 yielding clones in groups 5, 6 and 7, including the controls CCN 51 and EET 103. These are INIAPM 357 (TAP 6 x D 147), INIAPM 092 (TAP 6 x B60), INIAPM 283 (CCN 51 x EET 416), INIAPM 032 (AMAZ 11 x A 2699), INIAPM 158 (TAP 3 x A 2634) and INIAPM 360 (TAP 6 x D 147) with 0.41, 0.25, 0.23, 0.22, 0.21 and 0.21 kg of dry bean yield per tree, in the same order. CCN 51 and EET 103 yielded 0.03 and 0.04, respectively, at a great distance from the top yielders. CCN 51 is currently showing a heavy load of pods so figures and the relative position of the different clones are surely going to change in the next future.

INIAPM 357, the highest yielding clones, exhibited one of the lowest diseased pod incidences so far but has small pods and seeds. INIAPM 283 had the lowest incidence of diseased pods and also showed one of the highest fresh beans weight per pod; this suggests a low pod index. Anyway, it is too early to draw any solid conclusion about the performance of the clones under comparison in this trial. We have to wait and see how yield figures evolve in the next couple of years.

Planting of clones of the group 8 originated from hybrid seedlings also selected within segregating populations of the second breeding scheme began on April 2011. This trial has three replications and is also located in the so called Lote "Las Malvinas". Each replication contains 445 treatments, including several controls, with three plants per plot. Progress achieved in planting reached 65% up to April 2012. To speed up progress in the planting of this trial a number of seedlings from IMC seeds were planted in the first and second replication, Later these will be grafted with buds of corresponding treatments.

Planting of clones for the group 9 which (they originate from hybrid seedlings selected in segregating populations of the second breeding scheme) began on April 2012. This trial has three replications and is located in the so called Lote Herrera. Each replication contains 539 treatments, including several controls, with three plants per plot. Progress achieved in planting reached 40% up to April 2012. The remaining planting is actively being multiplied in the nursery and the aim is to complete the planting of most treatments in the next rainy season. Figs 22, 23 and 24 in the Annex show the field distribution of the clones from selections made in groups 5, 6, 7, 8 and 9.

Evaluation of selected high yielding clones for disease resistance

Evaluation for witch´s broom resistance in the high yielding selections emerging from the project is ongoing using the SAI methodology to inoculate very young leaf tissues. Table 11 shows response data for 9 clones compared with the controls SCA 6 and SCA 12. The clone INIAPT 527 (TAP 6 x TIP 1) with 24 % disease incidence exhibited the least vulnerability. On the opposite, the clones INIAPT 405 (CCN 51 x TAP 3) and CCN 51 showed the highest vulnerability (80 and 82%).

The correlation of the responses to inoculation with number of vegetative witches´ broom was 0.7. The correlation with the numbers fruits infected by this disease was 0.59. The high witches´ broom incidence of CCN 51 raises some questions because it has been observed this clone has a moderate resistance to this disease, and the difference is large when compared to EET 103, a more vulnerable genotype. Unfortunately, EET 103 was not included in this particular test. We plan to do it in the future to help in the interpretation of these and later data. However, a general view of the large plots (100 plants) planted with the highest yielding clones selected in the project usually suggests a lower than the average incidence in commercial and traditional cacao fields.

Activities are also ongoing to test a group of high yielding clones for resistance to Moniliasis, Mal del Machete and Phytopthora. One thing that should be noted is that the incidence of Phytopthora is a growing problem in Ecuador and it needs to be addressed as soon as possible. Fortunately, methodologies to carry out these assays are straightforward so we expect to make quick progress in differentiating the degree of resistance to these diseases for the different clones emerging from the project we are reporting on.

ANNEX

Table 1. Monthly dry bean yields (kg/ha) of a mix stand of the clones EET 559, EET 576, EET 577 y EET 103 in a demostration plot in the zone of Milagro.

Month	Year				Average
	2008	2009	2010	2011	
January	358.7	255.9	170.6	127.3	228.1
February	350.3	250.3	147.5	141.2	222.3
March	282.5	240.5	109.8	124.5	189.3
April	138.4	227.9	200.0	163.0	182.3
May	85.3	236.3	132.8	77.6	133.0
June	13.3	53.8	44.7	68.5	45.1
July	15.4	62.2	46.1	60.8	46.1
August	18.9	109.8	65.0	65.7	64.9
September	14.7	143.3	82.5	90.2	82.7
October	130.0	179.7	228.6	178.3	179.2
November	141.2	160.1	307.0	230.0	209.6
December	180.1	232.8	412.5	215.4	260.2
Total	**1,728.8**	**2,152.6**	**1,947.1**	**1,542.5**	**1,842.8**

- Demostration plot area: 0.65 ha.; dry bean yield data has been extrapolated to 1 ha.

Table 2. Ranking of highest yielding clones (period February 2011-May 2012) among the new genotypes introduced into the CGN Collection. EET-Pichilingue.

Clone	Dry bean yield, kg/plant	Diseased pods, %	Number Witches´ broom/plant	Pod index	Seed index
Arbol 9	1.70	31.0	1.1	14.4	1.6
Arbol 5	1.62	31.7	2.5	17.6	1.4
B. Eskes (2)	1.57	22.3	7.6	22.0	1.3
ESS-6	1.34	3.9	2.1	40.3	1.0
ESS-1	1.23	19.9	1.5	20.0	1.4
JHV-10	1.19	16.3	1.3	16.4	1.7
ESS-2	1.05	13.8	3.3	28.6	1.4
ESS-5	0.97	0.9	1.9	34.7	1.1
CCAT 4668	0.94	31.3	1.5	22.8	1.2
ESS-8	0.76	15.2	2.8	36.8	0.9
SNA 0602	0.75	22.8	3.9	29.9	1.1
Brisas-1	0.66	28.9	3.5	16.9	1.5
ESS-7	0.61	4.7	0.9	45.6	0.9
A 2126	0.61	41.8	4.0	31.2	1.1
ESS-3	0.51	14.8	0.1	25.3	1.2
ESS-4	0.19	33.3	3.6	28.8	1.5

Date of planting: March 2007

ESS : Superárboles

Each figure is an average per tree for the period Feb. 2011-May 2012

Table 3. Evaluation of a group of clones in the Colection ALLEN # 1. Data were acumulated during the period October 2009 – April 2012. EET-Pichilingue.

Ranking	Code	Healthy pods	Total numbers pods	% Diseased pods	Dry bean weight	Chorellea Wilt	Number vegetative witches' broom	Pod index	Seed index	Number of seeds/pod
1	EBC - 126	149	155	3.9	10266.0	67	7	23	1.47	29
2	LCTENN - 77	77	98	21.7	4240.0	24	4.25	34	1.48	19
3	LCTEEN-227	59	70	16.4	3495.0	13	5			
4	LCTEEN - 195	58	68	14.7	3245.0	45	1.5			
5	EBC - 142	54	84	34.9	2530.0	20	1.2			
6	LCTEEN - 258	57	85	33.1	2436.7	1	6.67			
7	LCTENN - 326	42	47	9.7	2390.0	0	0			
8	EBC - 138	50	68	26.0	2323.6	15	1.6			
9	LCTEEN - 278	34	51	33.2	2110.0	24	4			
10	LCTEEN - 30	48	65	25.1	2008.8	6	1			
11	LCTEEN - 329	32	69	53.4	1812.0	11	2			
12	LCTENN - 255	32	51	37.3	1740.0	8	1.25			
13	EBC - 148	34	51	33.5	1650.0	21	0.8			
14	LCTENN - 26	45	49	8.2	1647.5	1	0.5			
15	LCTENN - 347	31	60	47.7	1432.0	0	0.4			

Table 4. Evaluation of a group of clones in the Collection ALLEN 2. Data were accumulated during the period October 2009-April 2012. EET-Pichilingue.

Ranking	Code	Healthy pods	Total numbers pods	% Diseased pods	Dry bean weight	Cherelles Wilt	Number vegetative witche's broom
1	LCTEEN - 130	36	60	40.40	1822	12	8.2
2	LCTEEN - 436 S/2	27	39	31.85	1315	65	2.25
3	LCTEEN - 15	20	24	15.83	1178	14	7.2
4	LCTEEN - 6 S/3	22	40	43.72	1170.8	16	3.4
5	LCTEEN - 169	14	14	0.00	890	0	0
6	LCTEEN - 6	16	18	11.36	890	6	2.8
7	LCTEEN - 6 S/7	14	14	0.00	855	3	0
8	LCTEEN - 20	12	16	26.83	848	4	1.6
9	LCTEEN - 92	18	22	18.02	848	8	2.6
10	LCTEEN - 70	26	30	15.23	834	14	6.6
11	LCTEEN - 76	23	25	8.06	753.6	15	3.6
12	LCTEEN-376	14	17	16.67	752.5	3	7.5
13	LCTEEN - 348	15	21	28.85	740	8	5.8
14	LCTEEN - 5 S/2	12	17	28.99	735	1	1.25
15	LCTEEN - 26 S/6	10	13	25.00	730	4	0.5

FECHA DE SIEMBRA: ENERO, AGOSTO Y SEPTIEMBRE DEL 2009

UBICACIÓN: SECTOR 2 "A"

NUMERO DE 157 ACCESIONES

Distancia de siembra: 3m X 3m

Periódo de siembra: Enero 2009 - Marzo 2010

N

LCT	24 S/8	P	x	x	x	x	LCT	101 S/2	x	x	x	x	x
LCT	86 S/4	x	x	x	x	x	LCT	6 S/5	x	x	x	x	P
LCT	338 S/8	x	x	x	x	x	LCT	404 S/3	x	x	x	P	x
LCT	399	x	P	x	x	x	LCT	244 S/9	F	x	x	x	x
LCT	371	P	P	x	x	x	LCT	405 S/6	x	x	x	x	x
LCT	214 S/4	x	x	x	x	x	LCT	22 S/6	x	x	x	x	x
LCT	59 S/3	x	x	x	x	x	LCT	5 S/10	x	x	x	x	P
LCT	67 S/1	x	x	x	x	x	LCT	336 S/5	x	x	x	P	x
LCT	404 S/6	x	x	x	x	P	LCT	72 S/6	x	x	x	x	x
LCT	403 S/1	x	x	P	x	x	LCT	77 S/7	x	x	x	x	x
LCT	405 S/4	x	x	x	x	x	LCT	404 S/2	x	x	x	x	x
LCT	85 S/4	x	x	x	x	x	LCT	401	x	x	x	x	x
LCT	403 S/3	x	x	x	x	x	LCT	72 S/4	x	x	x	x	x
LCT	82 S/1	x	x	x	x	x	LCT	130 S/3	x	x	x	x	x
LCT	76 S/1	x	x	x	x	x	LCT	436 S/5	x	x	x	x	x
LCT	404 S/4	x	x	x	x	x	LCT	19 S/6	x	P	x	P	x
LCT	437 S/6	x	x	x	x	x	LCT	163	x	x	x	x	x
LCT	424 S/3	x	x	x	x	x	LCT	78 S/1	x	x	x	x	x
LCT	437 S/5	x	x	x	P	x	LCT	164	x	x	x	x	x
LCT	90 S/10	P	x	x	x	x	LCT	59 S/6	x	x	x	P	x
LCT	10 S/7	x	x	x	x	x	LCT	246 S/3	x	x	x	x	x
LCT	403 S/9	x	x	x	P	x	LCT	6 S/6	P	x	x	x	P
LCT	430 S/10	x	x	x	x	x	LCT	436 S/8	x	x	x	x	x
LCT	437 S/3	x	x	x	x	x	LCT	76 S/3	x	x	x	P	x
LCT	246 S/6	P	x	x	x	x	LCT	62 S/6	x	x	x	x	x

LCT	203 S/2	x	x	x	x	x							
EBC	121 S/1	x	x	x	x	x							
LCT	182 S/10	x	x	x	x	x	LCT	339 s/4	x	x	x	x	x
EBC	147 S/2	P	P	x	x	x	EBC	38 S/5	x	x	x	x	P
LCT	136 S/8	x	x	x	x	P	LCT	201 S/1	P	F	P	P	x
LCT	358 S/7	P	x	x	x	P	EBC	10 S/10	P	F	x	P	x
LCT	148 S/7	x	x	x	P	P	LCT	342 S/3	P	F	x	x	x
LCT	405 S/1	x	x	x	P	P	LCT	132 S/7	x	x	x	x	x
LCT	93 S/2	P	x	P	x	P	LCT	403 S/7	x	x	x	x	x
LCT	85 S/5	P	x	x	P	P	LCT	201 S/8	x	x	x	x	x
LCT	87 S/4	x	x	x	x	x	LCT	182 S/4	x	x	x	x	x
LCT	85 S/3	x	x	x	x	x	LCT	182 S/6	F	x	x	x	x
LCT	130 S/10	x	x	P	x	x	LCT	338 S/7	x	x	P	x	x
LCT	83 S/3	x	x	x	x	x	EBC	135	x	P	x	x	x
LCT	77 S/5	x	x	P	x	x	LCT	296 S/8	x	x	x	x	x
LCT	405 S/2	x	x	x	x	x	LCT	357 S/4	x	x	x	x	x
LCT	62 S/9	x	P	x	x	x	LCT	132 S/5	x	x	x	x	x
LCT	76 S/7	x	x	x	x	x	EBC	148 S/9	x	x	x	x	x
LCT	115 S/4	x	x	P	x	x	LCT	248 S/6	x	x	x	x	P
LCT	58 S/7	x	x	x	x	x	LCT	340 S/7	x	x	x	x	x
LCT	344 S/5	x	x	x	x	x	LCT	336 S/1	P	x	x	x	x
LCT	82 S/9	x	P	x	P	x	LCT	182 S/3	x	x	x	x	x

LCT	10 S/3	x	x	x	x	x							
LCT	61 S/5	x	x	x	F	x	LCT	347 S/2	x	x	F	x	x
LCT	84 S/3	F	x	x	x	x	LCT	348 S/4	x	x	x	x	x
LCT	10 S/8	F	P	x	x	P	LCT	214 S/3	x	x	x	x	x
LCT	215 S/5	x	x	x	x	x	LCT	321 S/2	x	x	x	x	x
LCT	300 S/3	P	P	P	x	x	LCT	343 S/8	x	x	x	x	x
LCT	351 S/1	x	P	x	x	P	LCT	321 S/8	x	x	x	x	x
LCT	283	x	x	x	x	F	LCT	343 S/6	x	x	x	x	x
LCT	199 S/3	F	x	x	x	x	LCT	72 S/8	x	F	F	F	F
LCT	148 S/10	x	F	x	x	x	LCT	67 S/9	F	x	x	x	F
LCT	126 S/6	F	x	x	x	F	LCT	4 S/10	x	F	x	F	F
EBC	48 S/10	F	x	x	x	F	LCT	62 S/5	x	x	x	F	x
LCT	201 S/9	x	x	x	F	x	LCT	23 S/4	F	x	F	F	F
LCT	196 S/4	x	x	x	F	x	LCT	22 S/9	F	x	x	F	F
LCT	132 S/3	x	x	x	x	x	LCT	24 S/6	x	x	x	x	x
EBC	122	x	x	x	x	x	LCT	8 S/8	F	F	F	F	x
EBC	6 S/10	x	x	F	F	x	LCT	8 S/5	x	F	x	F	F
LCT	405 S/3	F	x	x	F	x	LCT	74 S/4	F	x	x	x	x

LCT	248 S/9	x	x	x	x	F	LCT	300 S/2	x	x	x	x	x
LCT	212 S/5	x	x	x	x	x	LCT	137	x	x	x	x	x
LCT	320 S/5	x	x	x	x	x	LCT	335 S/8	x	x	x	x	x
LCT	271 S/1	x	x	x	x	x	LCT	356 S/3	x	x	x	x	x
LCT	241 S/1	x	x	x	x	x	LCT	340 S/5	x	x	x	x	x
LCT	306 S/2	x	x	x	x	F	LCT	348 S/1	x	x	x	x	x
LCT	336 S/3	x	x	x	F	F	LCT	205 S/7	x	x	x	x	x
LCT	5 S/4	x	x	F	F	x	LCT	341 S/9	x	x	x	x	
LCT	62 S/3	F	x	F	F	F	LCT	341 S/8	x	x	x	x	x
LCT	338 S/3	x	x	x	x	x	LCT	94	x	x	x	x	x
LCT	244 S/10	x	x	x	x	x	LCT	182 S/1	x	x	x	x	x
LCT	10 S/5	x	x	x	x	x	LCT	337 S/4	x	x	x	x	x
LCT	241 S/2	x	F	x	x	x	LCT	337	x	x	x		
LCT	4 S/5	x	x	F	F	F	LCT	338 S/4	x	x	x		
LCT	77 S/2	F	x	F	F	F	LCT	80	x	x	x	x	x

GUARDARRAYA

* Fecha de siembra último bloque 10-11 de Marzo del 2010.

Fig. 1. Field distribution of new accessions of cocoa in the Allen collection introduced from the EE-Napo. EET-Pichilingue.

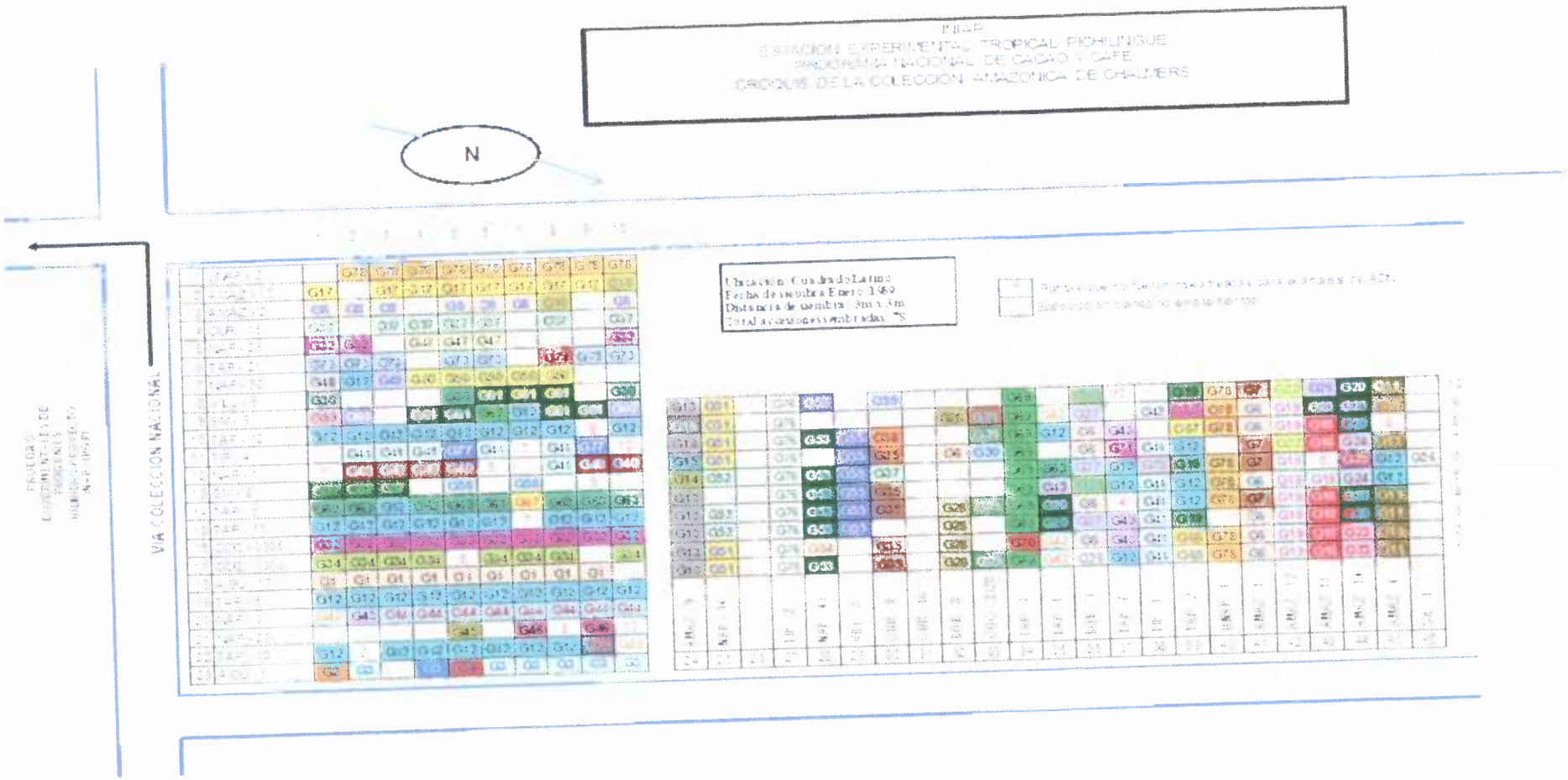

Fig. 2. Field distribution of the different accessions in the CHALMERS ´collection according to the individual DNA identification. EET- Pichilingue.

Table 5. Top 10 high yielding clones in the Chalmer´s Collection according to data collected during the periodo December 2011-May 2012.

Clone (original code)	DNA Identification	Number of plants	# Healthy pods	Total number of pods	Diseased pods, %	Dry bean yield, kg/tree
TAP 3	G 70	1	78	110	29.1	3.32
AMAZ-11	No identity	1	35	78	55.1	2.25
BOB-3	G 26	1	35	47	25.5	1.96
AMAZ-11	G 19	1	30	68	55.9	1.58
AGU-5	G 5	1	20	23	13.04	1.09
CUR-3	G 35	5	18	66	72.4	1.05
AMAZ-11	G 21	1	25	39	35.9	1.05
NAP 34	G 51	2	20	27	25.9	0.92
TAP 10	G 42	1	30	44	31.8	0.88
TAP 5	G 67	1	33	40	17.5	0.88

Data are given per tree

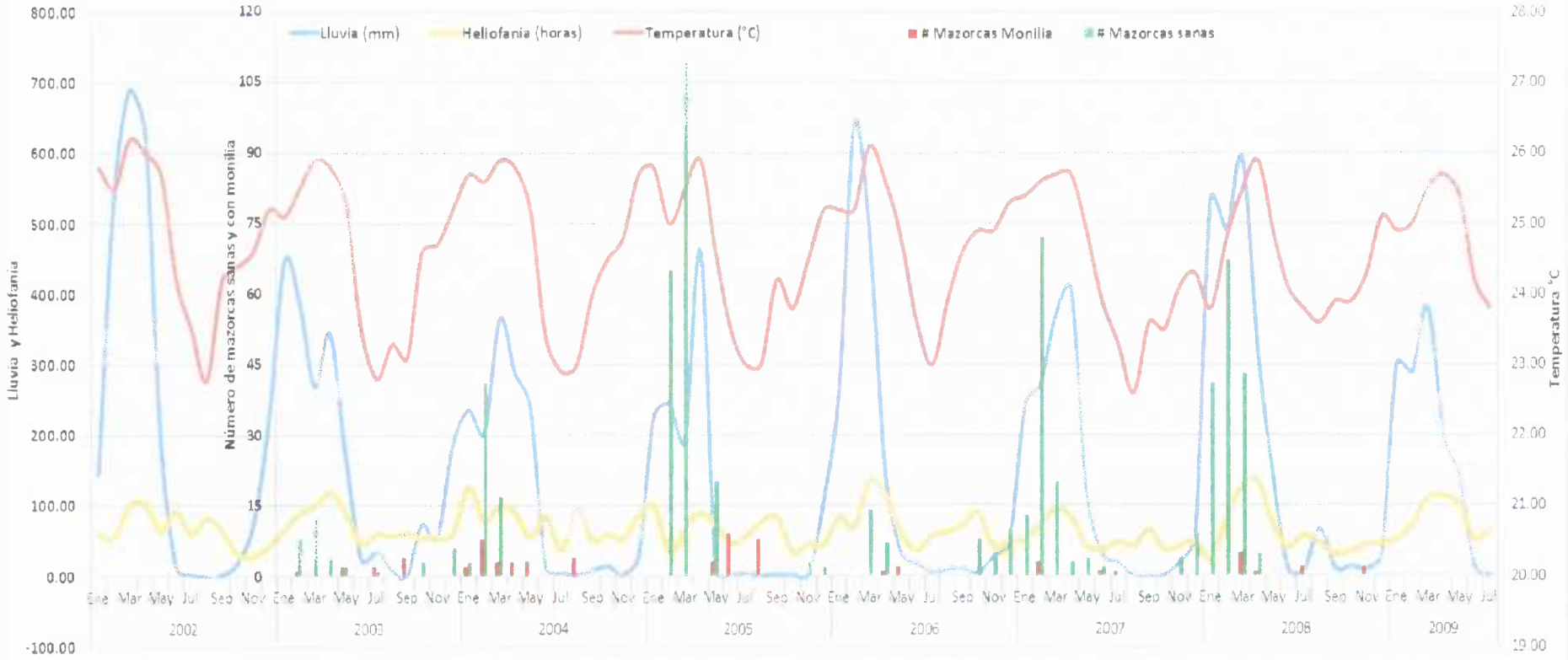

Fig. 3. Dynamic of number of healthy and diseased pods (average per tree) during the period January 2003- December 2008 as related to some weather variables for the clone 179 (lote "7A" sección "A"). EET-Pichilingue.

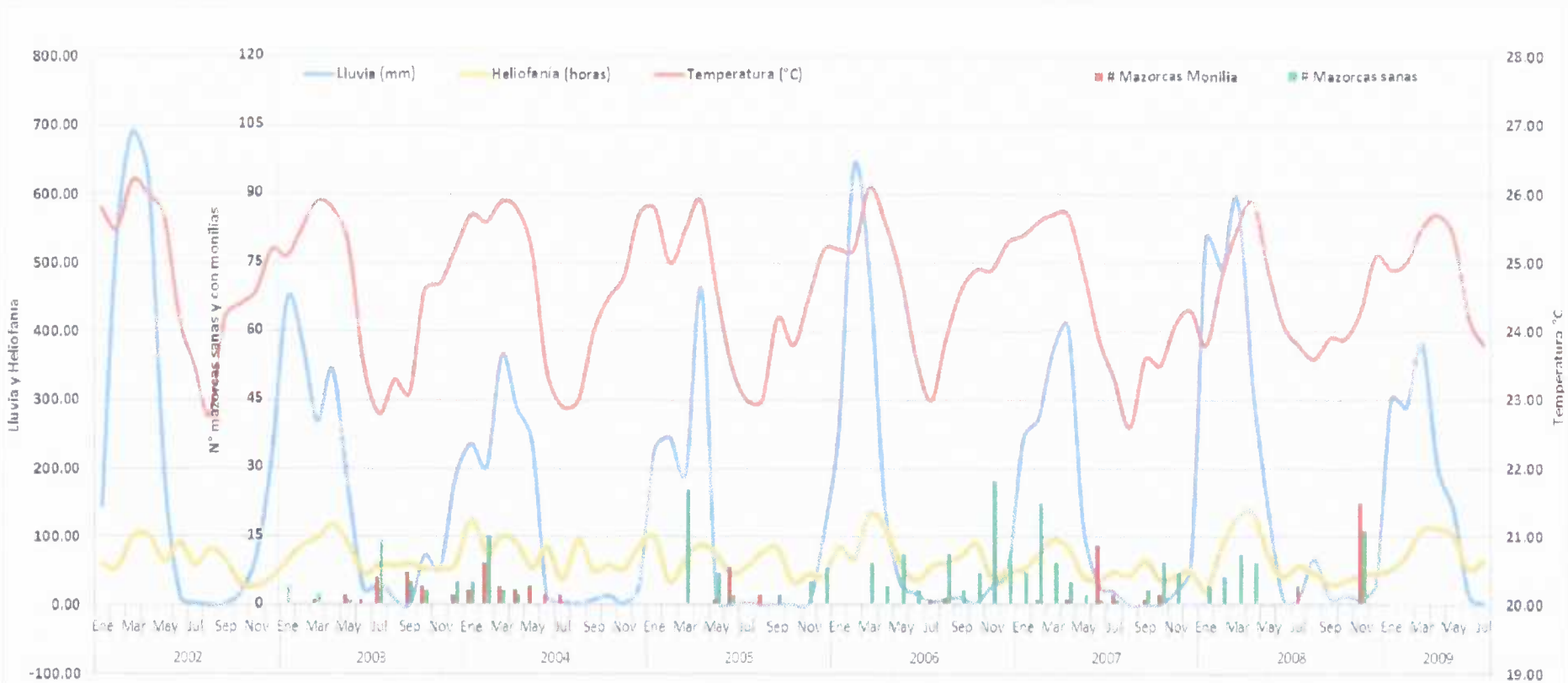

Fig. 4. Dynamic of number of healthy and diseased pods (average per tree) during the period January 2003- December 2008 as related to some weather variables for the clone 196 (lote "7A" sección "A"). EET-Pichilingue.

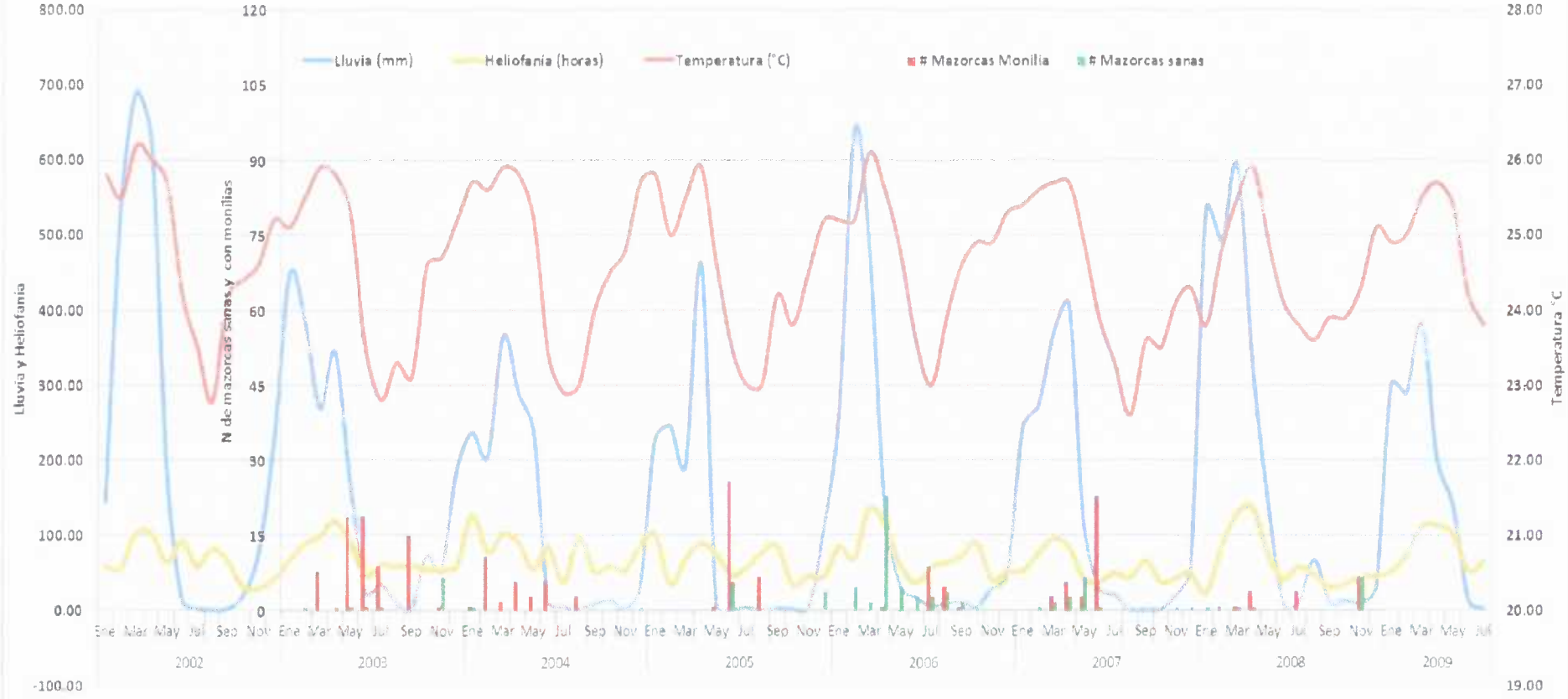

Fig. 5. Dynamic of number of healthy and diseased pods (average per tree) during the period January 2003- December 2008 as related to some weather variables for the clone 745 (lote "7A" sección "A"). EET-Pichilingue.

Table 7. Top yielding clones in the trial to compare selections of the groups 1 and 2. (First breeding scheme). Lote "Las Tecas". EET-Pichilingue.

Ranking	Code	Cross	Dry bean weight, kg/tree	Diseased pods, %	Number vegetative witches´ broom	Pod index	Seed index
1	INIAPT- 632	Gloria-17 x EB-2237 (CURARAY)	2.57	15.9	10.8	22	1.30
2	INIAPT- 484	AMAZ-14 x EBC-148	2.52	36.2	18.4	16	1.55
3	INIAPT- 405	CCN-51 x TAP-3	2.22	17.8	11.5	19	1.22
4	INIAPT- 384	CCN-51 x TAP-3	2.22	25.4	3.2	24	0.87
6	INIAPT- 302	EET-387 x A-645	2.04	11.1	4.6	23	1.28
7	INIAPT- 352	BRISAS-13 x EB-1013	1.97	32.2	7.3	17	1.35
8	INIAPT- 374	EET-387 x A-645	1.94	21.7	10.3	21	1.31
9	INIAPT- 364	CCN-51 x TAP-3	1.88	24.5	10.8	21	1.00
11	INIAPT- 533	SIL-1 x B-60	1.84	18.8	11.2	22	1.22
12	INIAPT- 462	CCN-51 x TAP-6	1.82	11.5	3.2	17	1.35
13	INIAPT- 072	CCN-51 x B-60	1.79	20.7	4.9		
14	INIAPT- 527	TAP-6 x TIP-1	1.74	8.5	0.1	30	1.02
15	INIAPT- 281	EET-387 x D-147	1.64	3.9	2.4	23	1.02
5	INIAPT- 680	CCN-51	2.19	35.0	8.8	17	1.35
113	INIAPT- 694	EET-103	0.86	26.1	14.3	17	1.40
10	INIAPT- 697	JHV-10	1.88	19.0	3.0	19	1.13

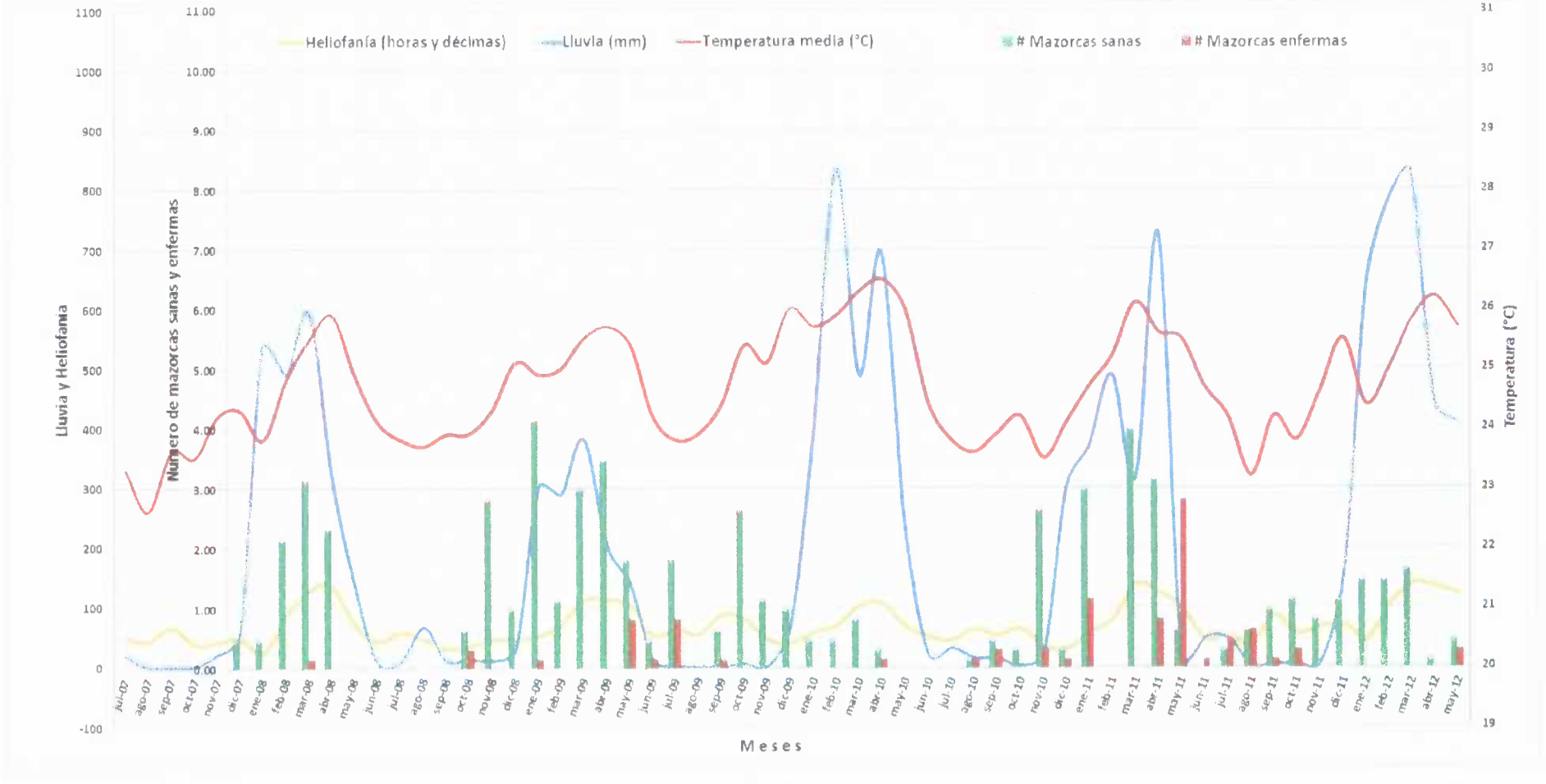

Fig. 6. Dynamic of number of healthy and diseased pods (average per tree) during the period December 2007 - May 2012 as related to some weather variables for the clone INIAPT-632 (Lote Las Tecas). EET- Pichilingue.

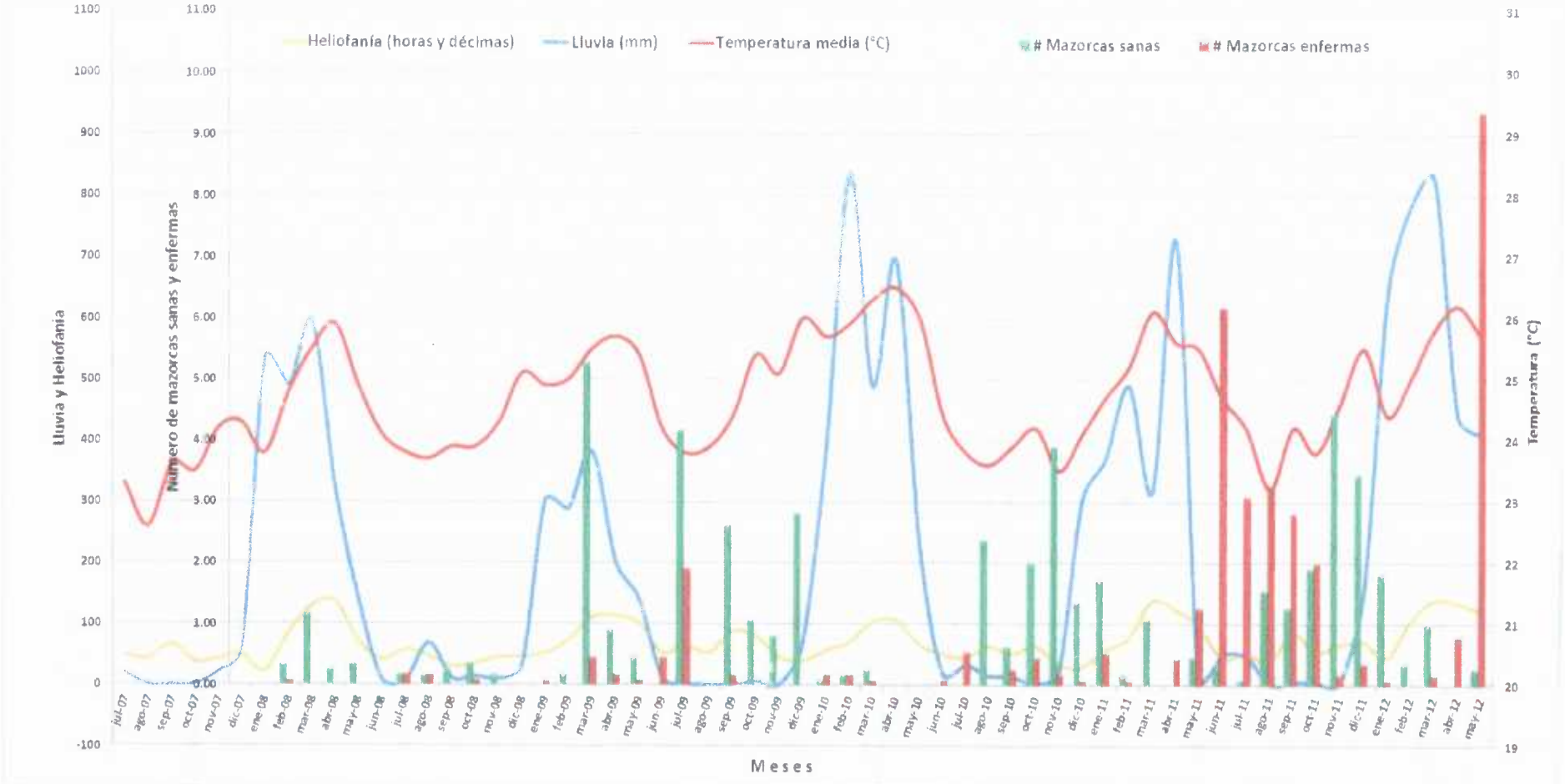

Fig. 7. Dynamic of number of healthy and diseased pods (average per tree) during the period December 2007 - May 2012 as related to some weather variables for the clone INIAPT-484 (Lote Las Tecas). EET- Pichilingue.

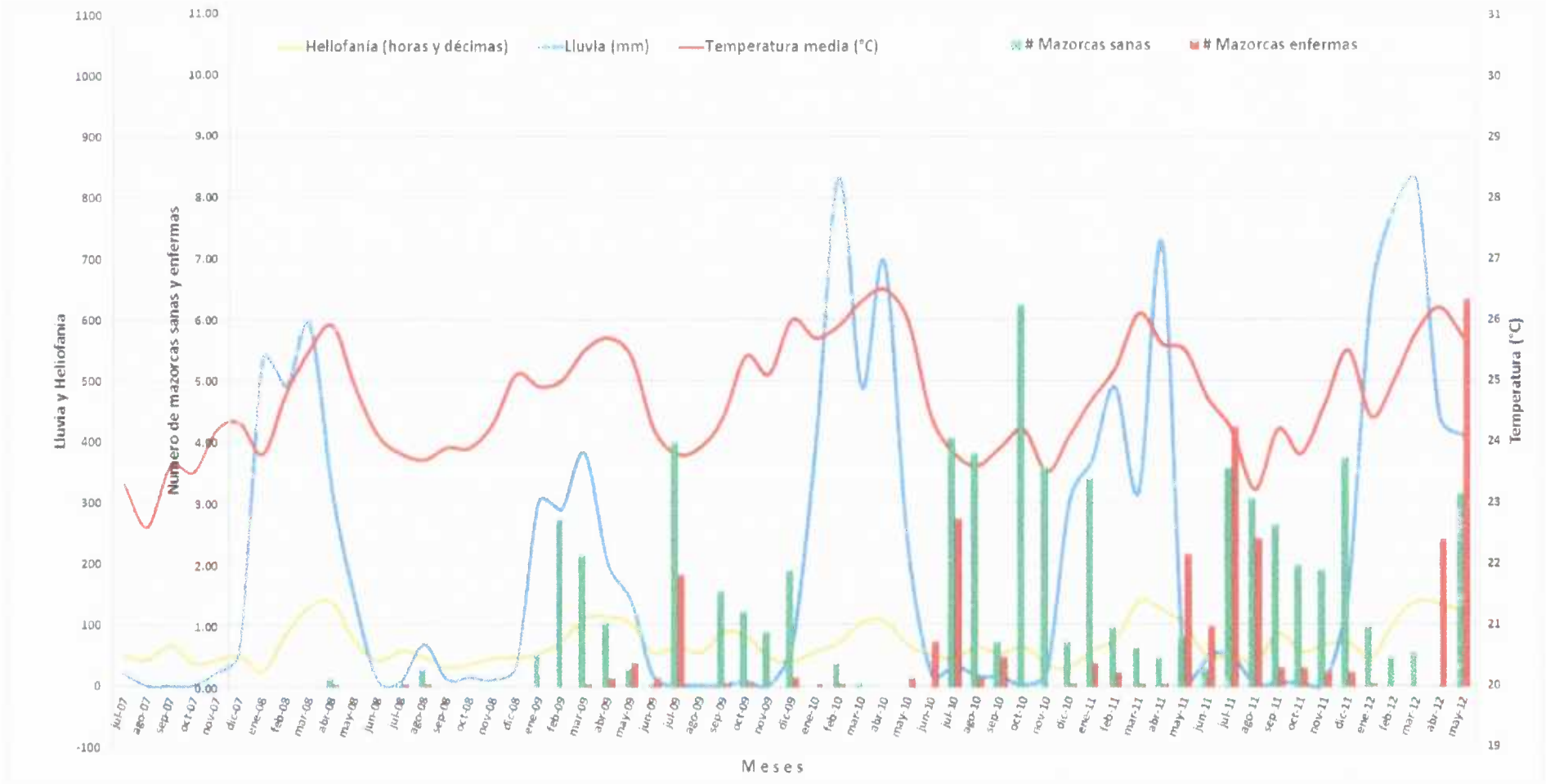

Fig. 8. Dynamic of number of healthy and diseased pods (average per tree) during the period December 2007 - May 2012 as related to some weather variables for the clone INIAPT-384 (Lote Las Tecas). EET- Pichilingue.

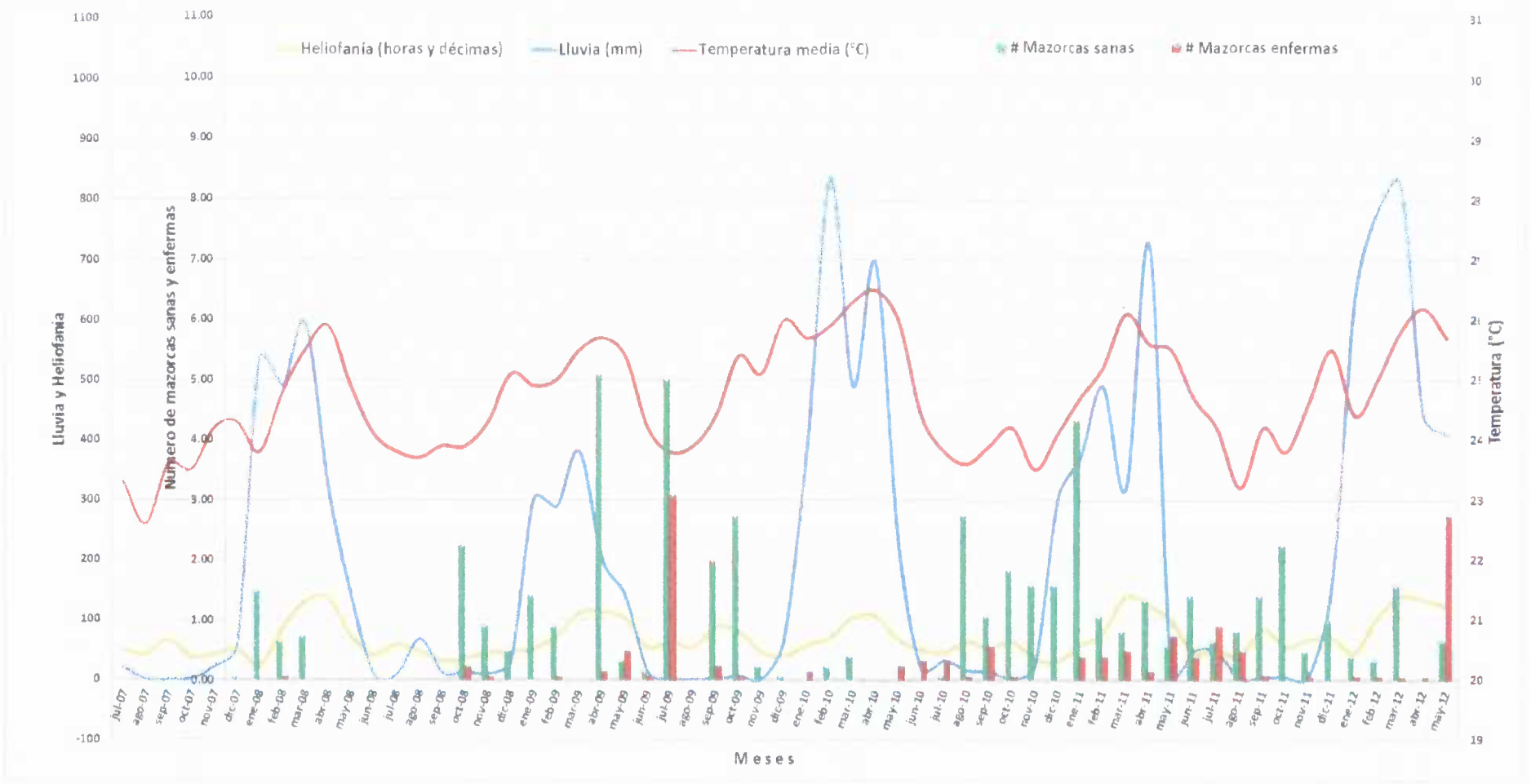

Fig. 9. Dynamic of number of healthy and diseased pods (average per tree) during the period December 2007 - May 2012 as related to some weather variables for the clone INIAPT-405 (Lote Las Tecas). EET- Pichilingue.

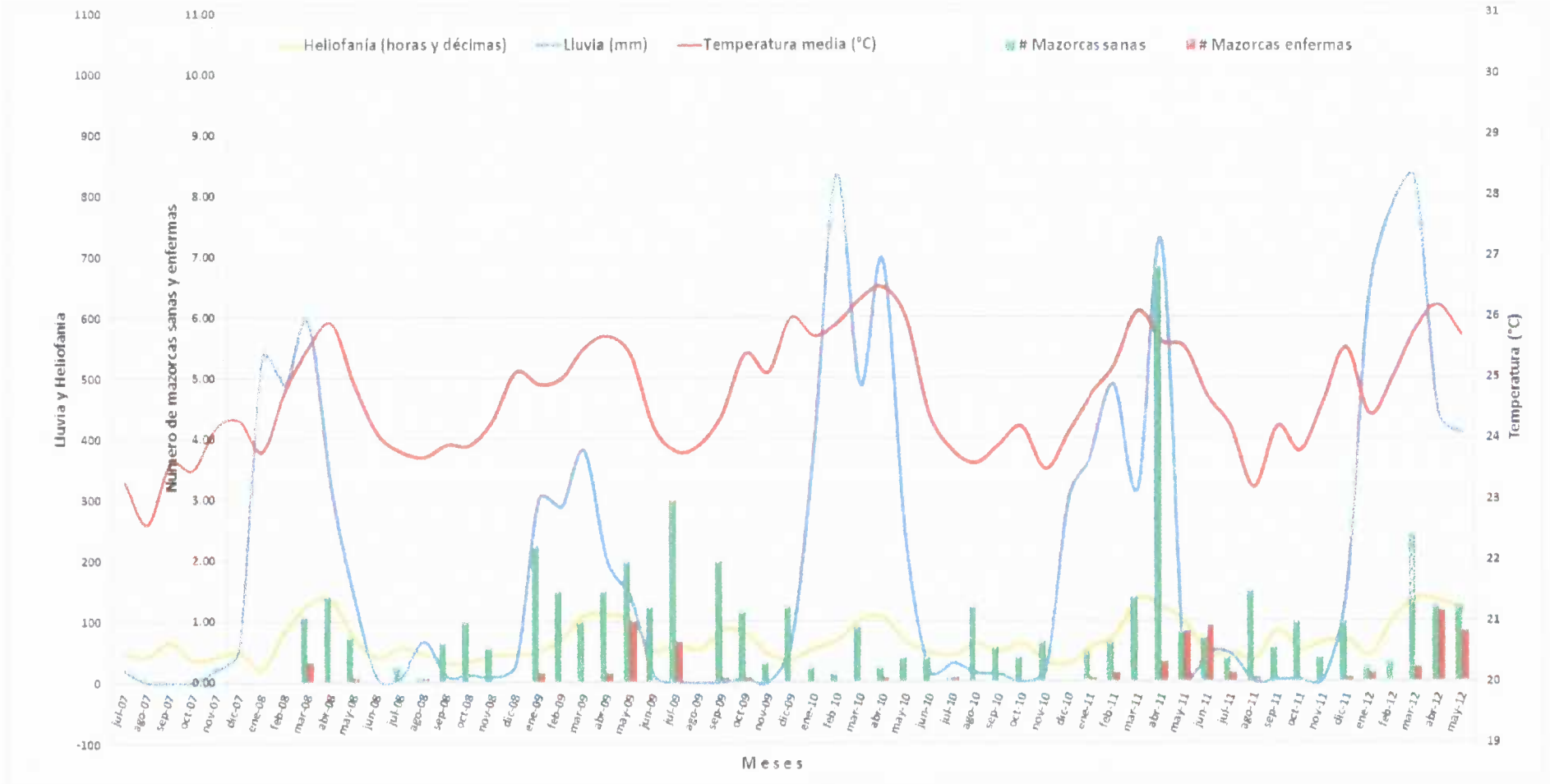

Fig. 10. Dynamic of number of healthy and diseased pods (average per tree) during the period December 2007 - May 2012 as related to some weather variables for the clone INIAPT-302 (Lote Las Tecas). EET- Pichilingue.

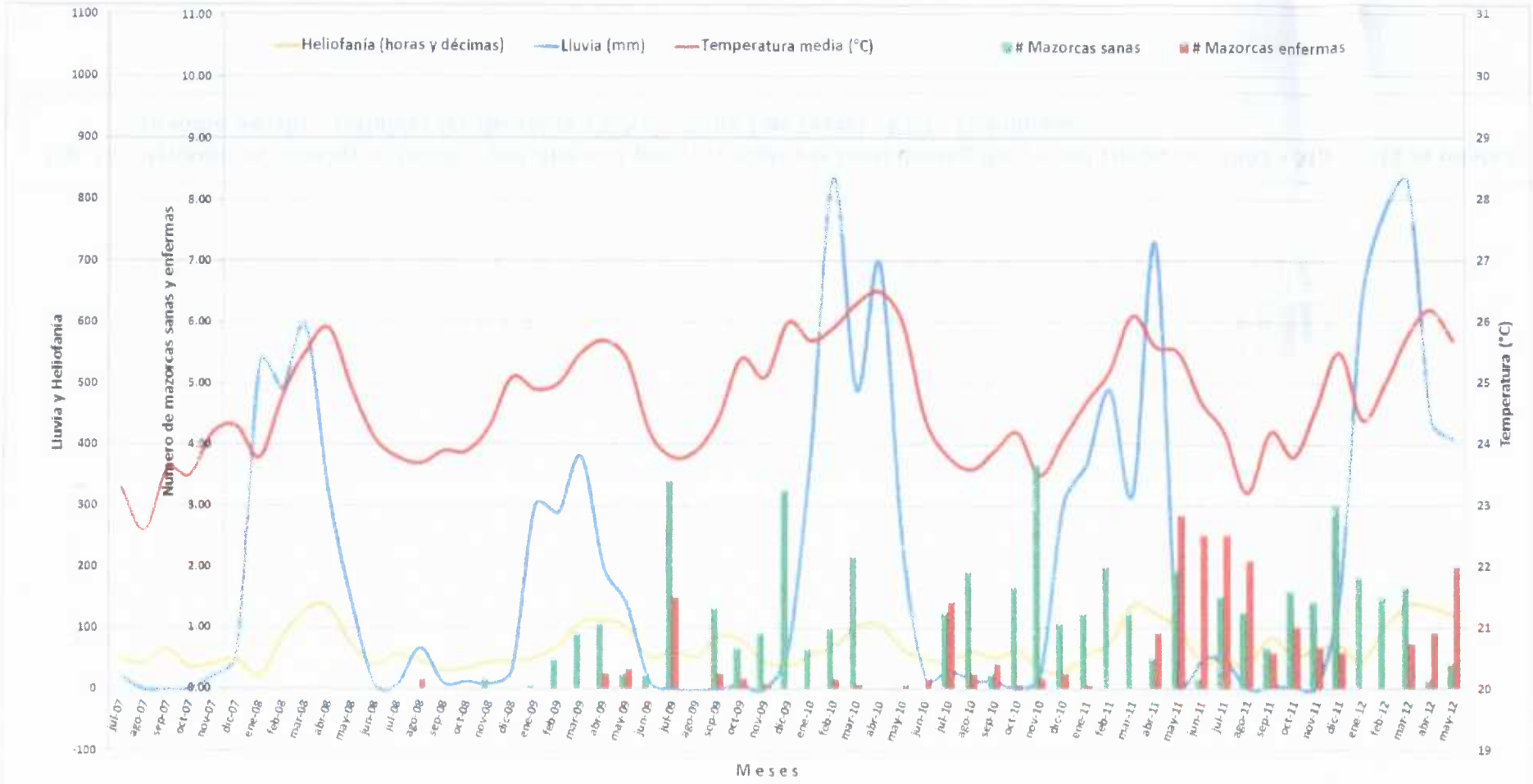

Fig. 11. Dynamic of number of healthy and diseased pods (average per tree) during the period December 2007 - May 2012 as related to some weather variables for the clone INIAPT-352 (Lote Las Tecas). EET- Pichilingue.

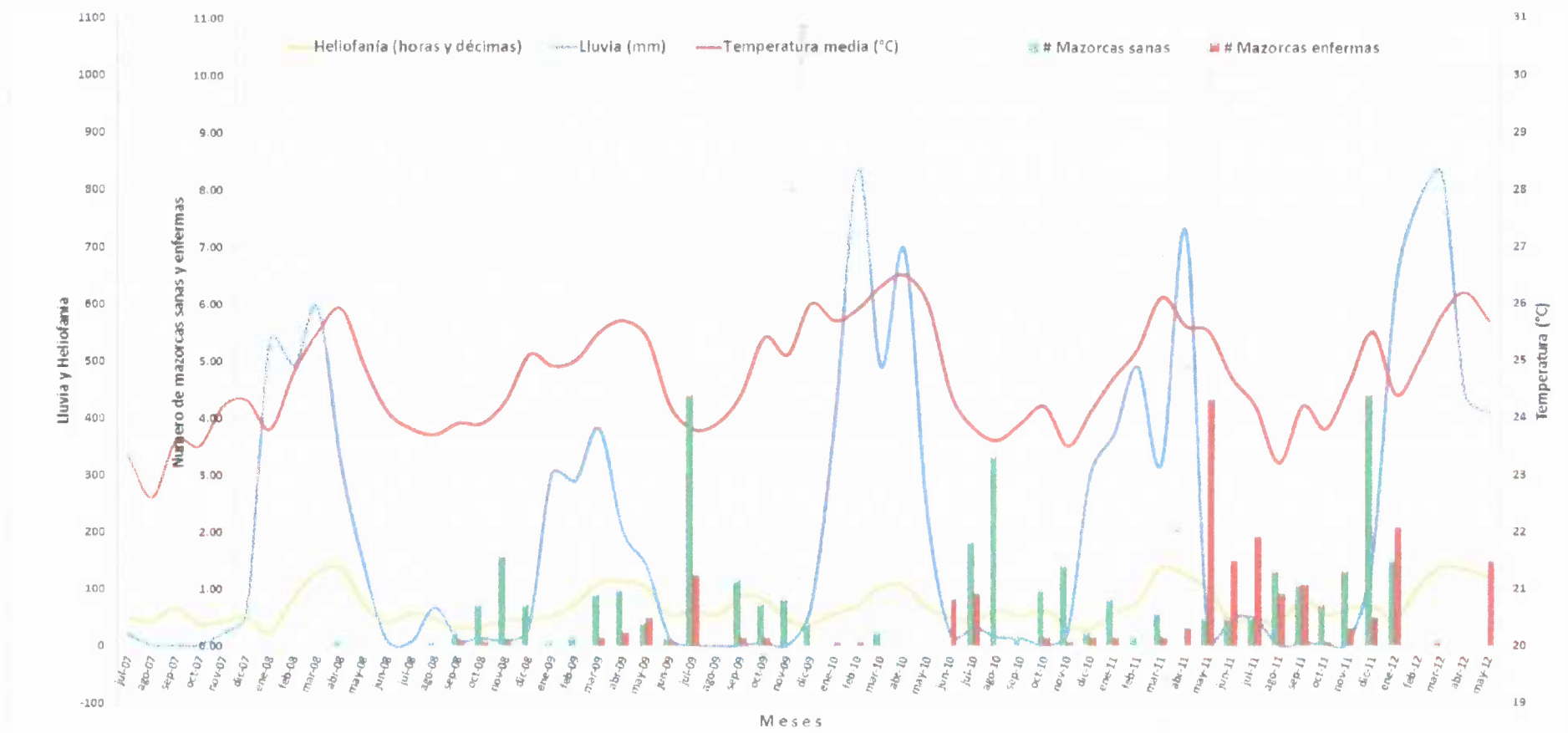

Fig. 12. Dynamic of number of healthy and diseased pods (average per tree) during the period December 2007 - May 2012 as related to some weather variables for the clone CCN-51 (Lote Las Tecas). EET- Pichilingue.

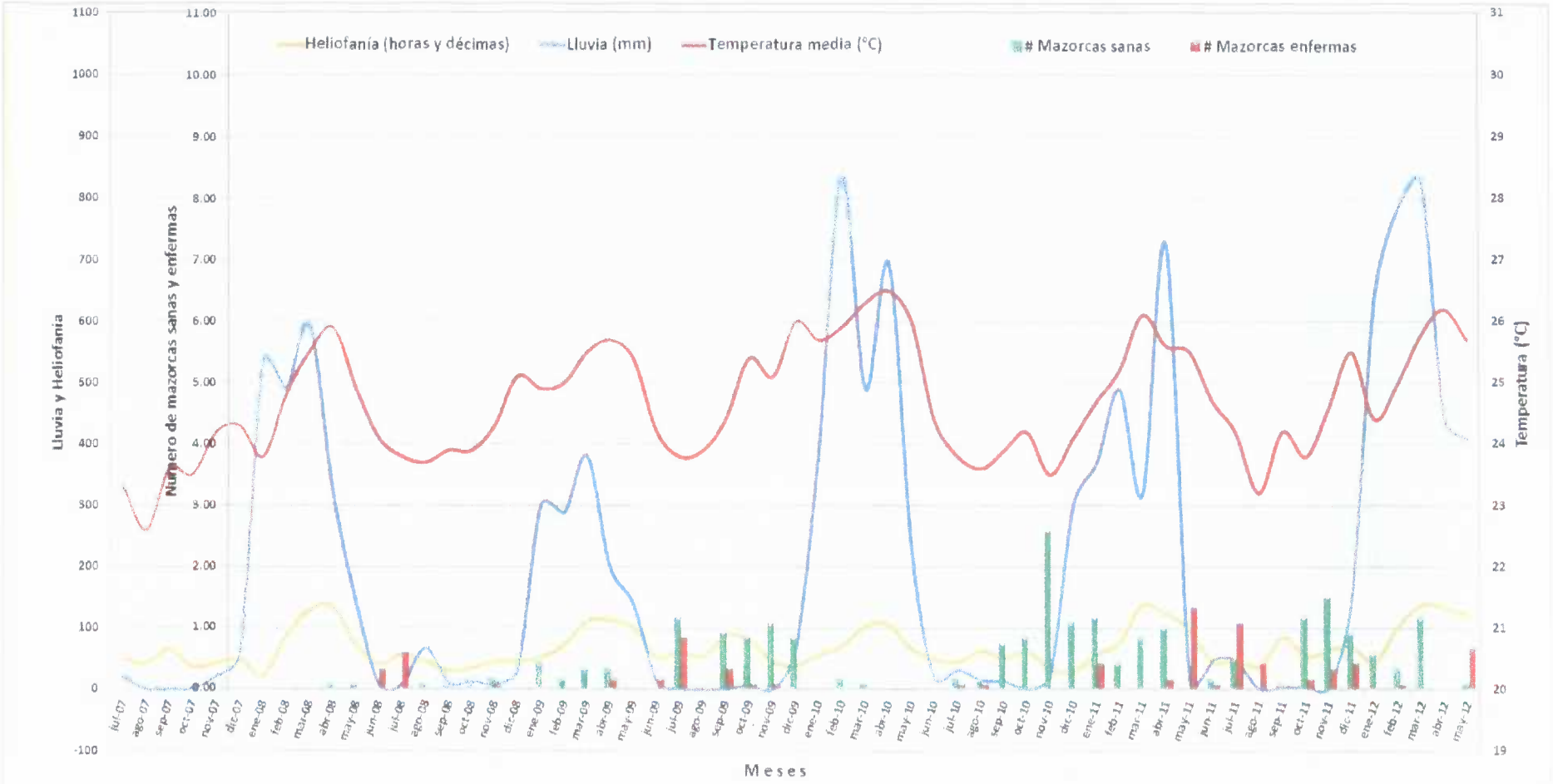

Fig. 13. Dynamic of number of healthy and diseased pods (average per tree) during the period December 2007 - May 2012 as related to some weather variables for the clone EET 103 (Lote Las Tecas). EET- Pichilingue.

Table 8. Evaluation (period April 2011-April 2012) of selected high yielding clones from two cocoa breeding projects in large plots (planting made in the period Juanuary-August 2010) made up of 100 plants.

Ranking	Code	Cross	Dry bean weight, kg/plot	Diseased pods, %	Pod index	Seed index
1	INIAPT - 302	EET-387 x A-645	5.99	1.6	25	1.31
2	INIAPT - 641	TAP-3 x TIP-1	2.11	21.2		
4	INIAPT - 632	Gloria-17 x EB-2237 (CURARAY)	1.77	8.6	27	1.43
6	INIAPT - 656	TAP-6 x EBC-148	0.74	10.0	20	1.48
7	INIAPT - 374	EET-387 x A-645	0.66	0.0	23	1.35
8	T7 / R4 / A5	CCN-51 X EET 450	0.62	6.7		
9	INIAPT - 484	AMAZ-14 x EBC-148	0.41	0.0		
10	T7 / R4 / A9	CCN-51 X EET 450	0.30	14.3	14	1.63
11	INIAPT - 533	SIL-1 x B-60	0.28	0.0		
12	T11 / R3 /A5	CCN-51 X L-46-H-75	0.15	0.0		
13	T7 / R2 / A3	CCN-51 X EET 450	0.07	0.0		
14	N - 8	Naves-8	0.02	0.0		
3	CCN - 51	(ICS-95 x IMC-67) x Canelo	2.04	3.5	13	1.48
5	EET - 103	Nacional Venezolano Amarilo	1.08	29.3	16	1.53

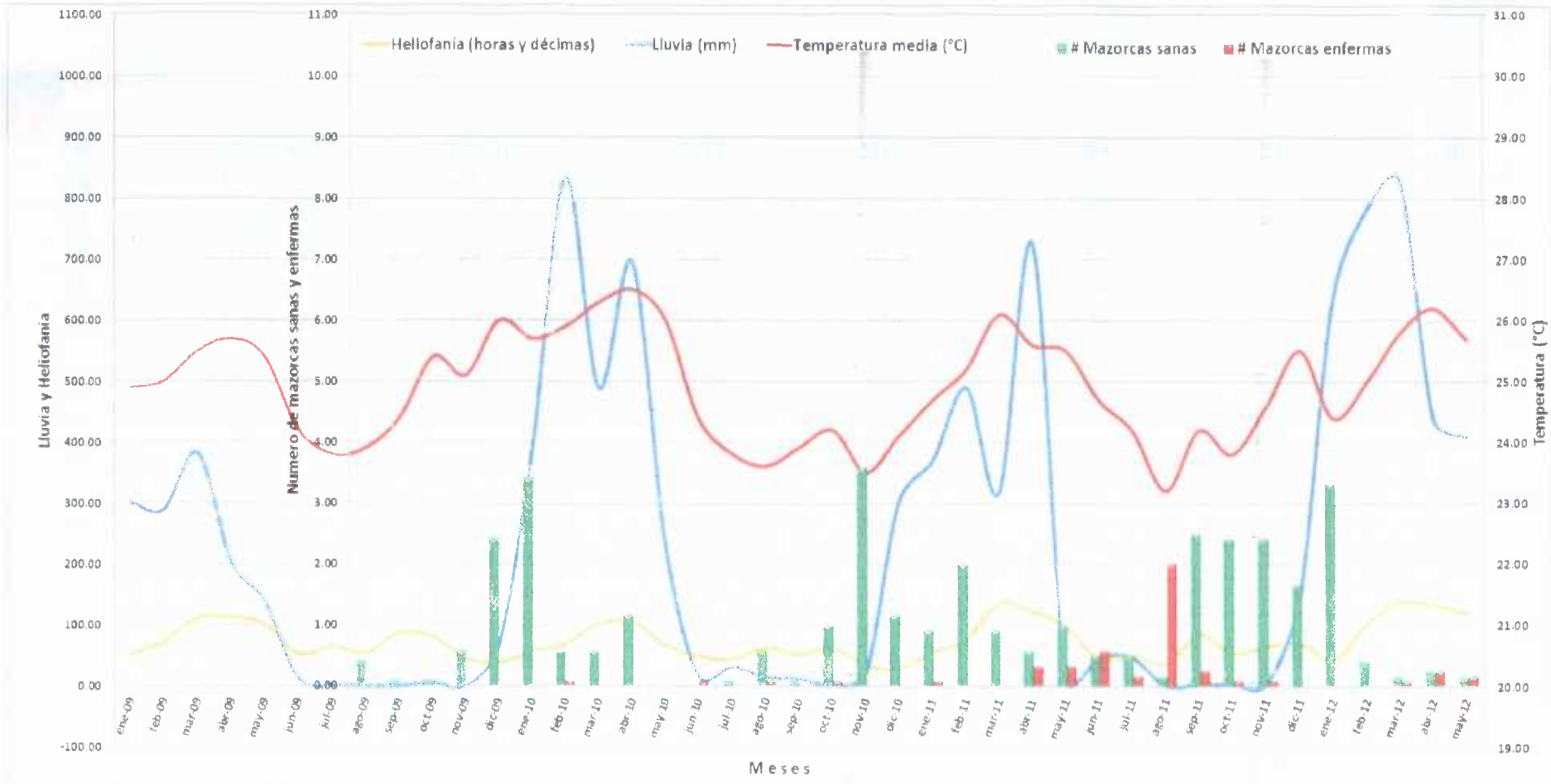

Fig. 14. Dynamic of number of healthy and diseased pods (average per tree) during the period August 2009 - May 2012 as related to some weather variables for the clone INIAPG-069 (Lote Ganadería). EET- Pichilingue.

Table 9. Accumulated data per tree for the top yielding clones (period August 2009 – April 2012) in the trial to compare selections of the groups 3 and 4 (First breeding scheme). Lote "Ganadería". EET-Pichilingue. Planting: May 2008.

Ranking	Code	Cross	Dry bean weigth, Kg/tree	Diseased pods, %	Number vegetative Witches´ broom	Pod index	Seed index
1	INIAPG 006	CCN-51 x TIP-1	1.76	17.1	3.36	18.6	1.36
2	INIAPG 069	AMA-11 x TAP-6	1.67	7.1	14.92	17.4	1.33
3	INIAPG 026	TAP-6 x UNAP-2	1.65	15.5	2.78	18.03	1.06
4	INIAPG 029	CCN-51 x TAP-12	1.19	8.5	5.66	18.4	1.28
5	INIAPG 059	UNAP-2 x TIP-1	1.18	10.7	8		
6	INIAPG 118	CCN-51 x TIP-1	1.08	17.3	4	35.5	0.95
7	INIAPG 038	CCN-51 x TAP-12	1.05	9.6	2.83	25.5	1.63
8	INIAPG 018	AMA-11 x TAP-6	1.04	20.9	5.8	18.4	1.29
9	INIAPG 149	CCN-51 x 2057	1.00	26.4	7.83	17.3	1.37
10	INIAPG 152	CCN-51 x CUR-3	0.96	19.4	7		
11	INIAPG 268	EET-233 x D.147	0.93	7.3	7	34.9	1.04
12	INIAPG 085	TAP-10 x TIP-1	0.90	19.7	4	23.1	1.25
13	INIAPG 072	CCN-51 x UNAP-2	0.88	20.4	6		
14	INIAPG 249	LCT-37 x EBC-148	0.88	13.8	7.33		
22	INIAPG234	Brisas-30 x EB-2237	0.78	20.4	5.58	20.8	1.4
24	INIAPG 306	Brisas-30 x EB-2237	0.76	10.2	9		
53	INIAPG 405	CCN-51	0.57	8.6	0	12.31	1.55
108	INIAPG 419	JHVH-10	0.40	8.5	2.56		
148	INIAPG 416	EET-103	0.32	20.9	8.64	28.34	1.10

Mazorcas de color rojo

Controles

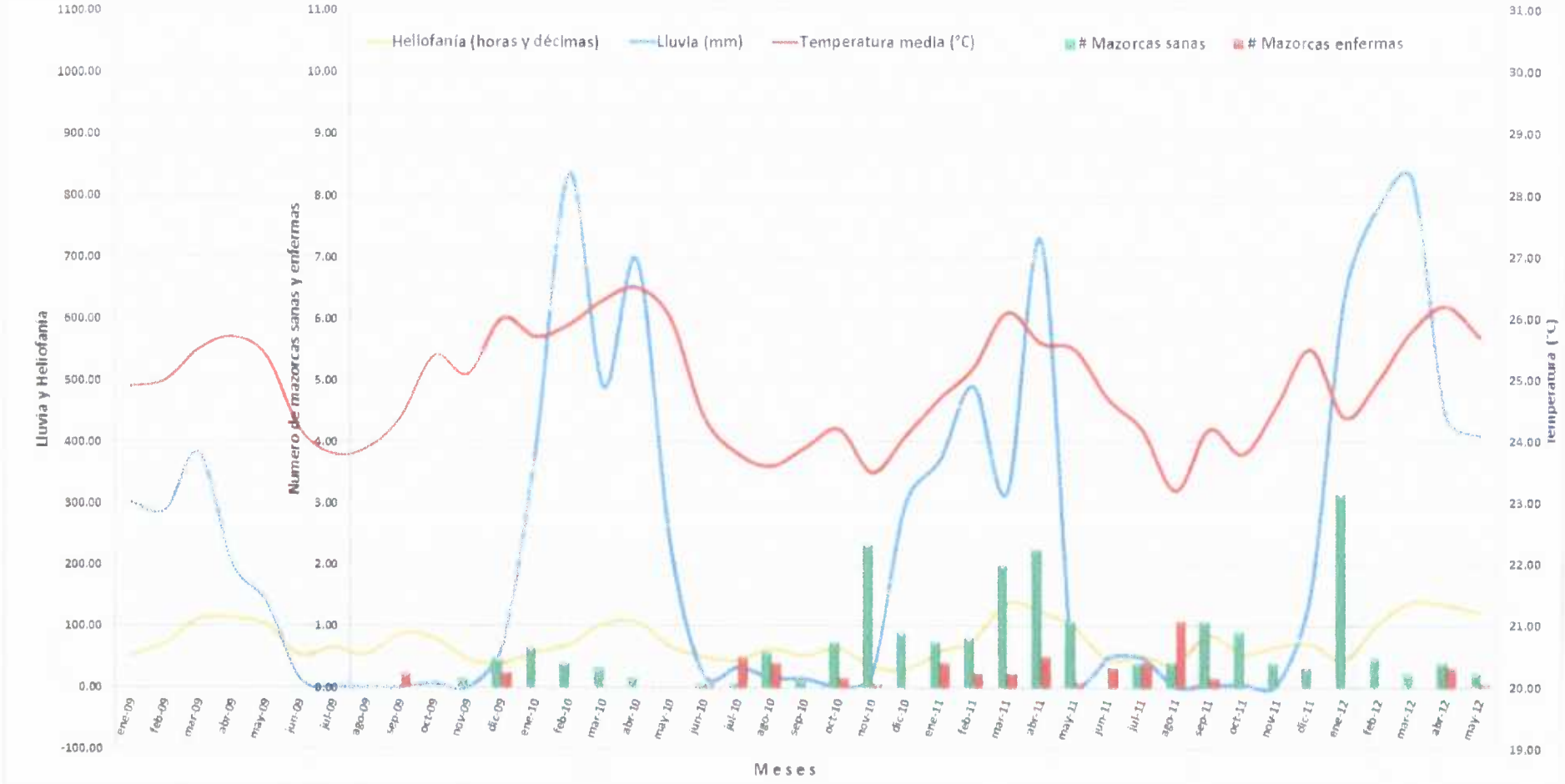

Fig. 15. Dynamic of number of healthy and diseased pods (average per tree) during the period August 2009 - May 2012 as related to some weather variables for the clone INIAPG-006 (Lote Ganadería). EET- Pichilingue.

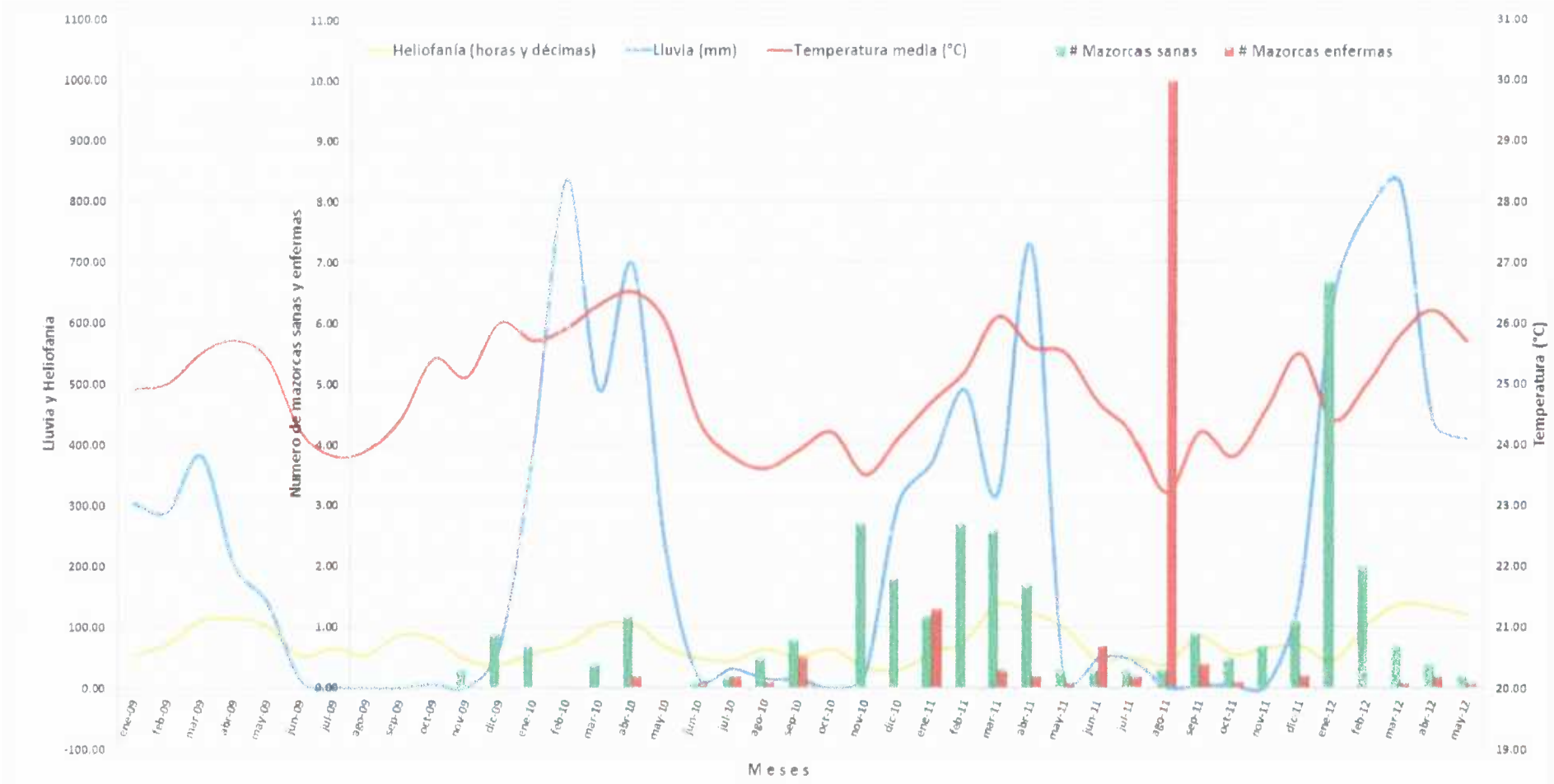

Fig. 16. Dynamic of number of healthy and diseased pods (average per tree) during the period August 2009 - May 2012 as related to some weather variables for the clone INIAPG-026 (Lote Ganadería). EET- Pichilingue.

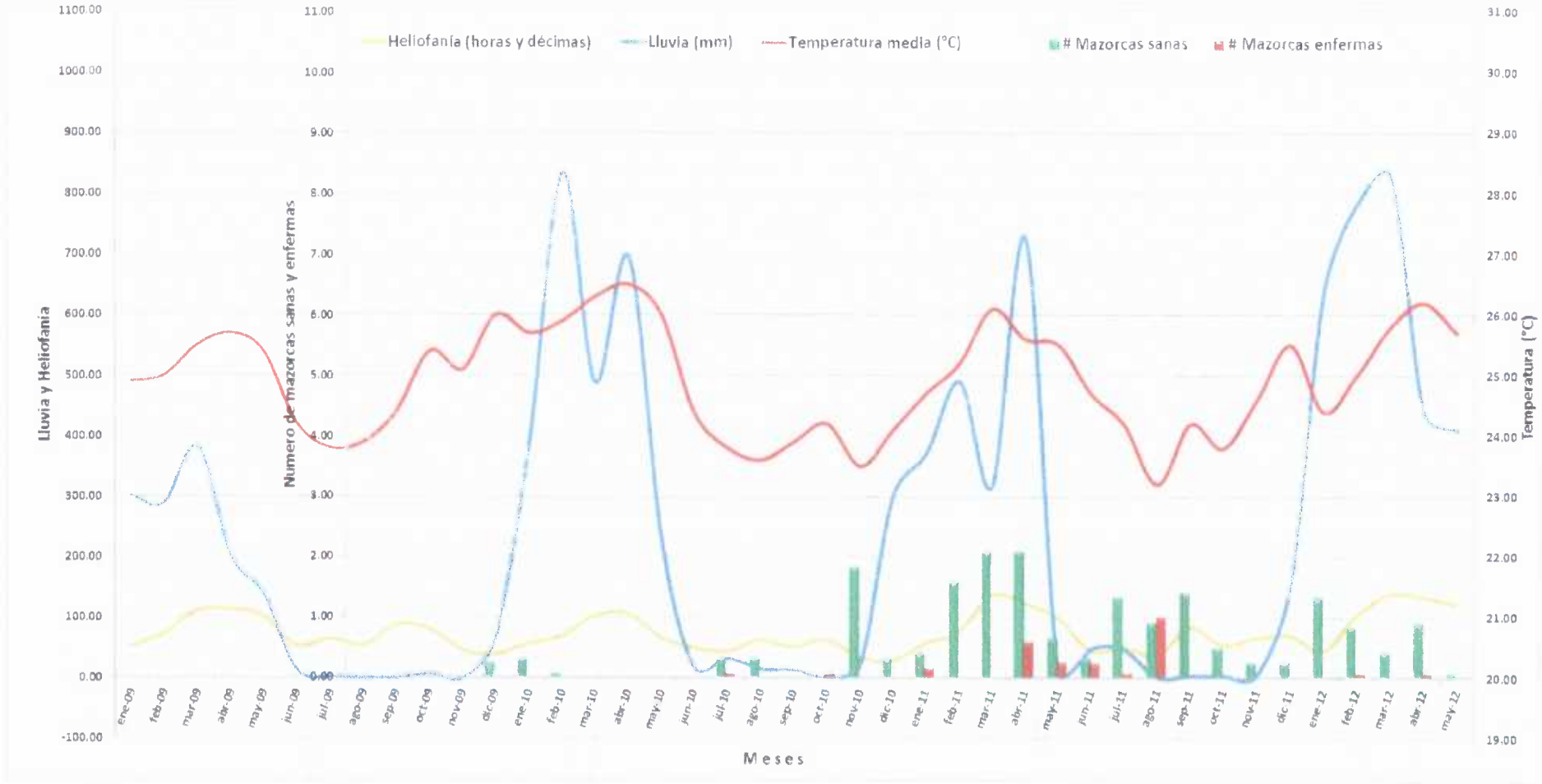

Fig. 17. Dynamic of number of healthy and diseased pods (average per tree) during the period August 2009 - May 2012 as related to some weather variables for the clone INIAPG-029 (Lote Ganadería). EET- Pichilingue.

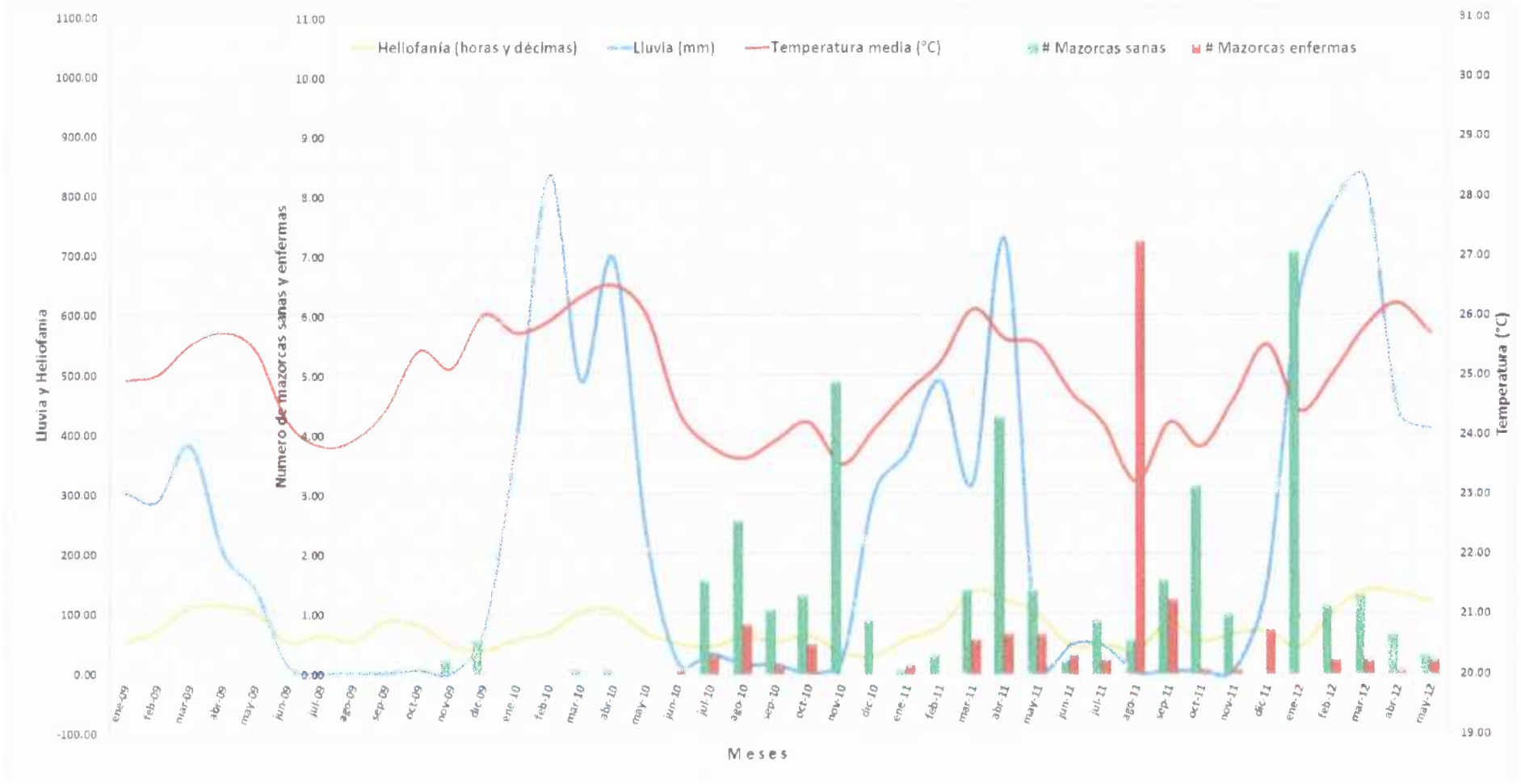

Fig. 18. Dynamic of number of healthy and diseased pods (average per tree) during the period August 2009 - May 2012 as related to some weather variables for the clone INIAPG-118 (Lote Ganadería). EET- Pichilingue.

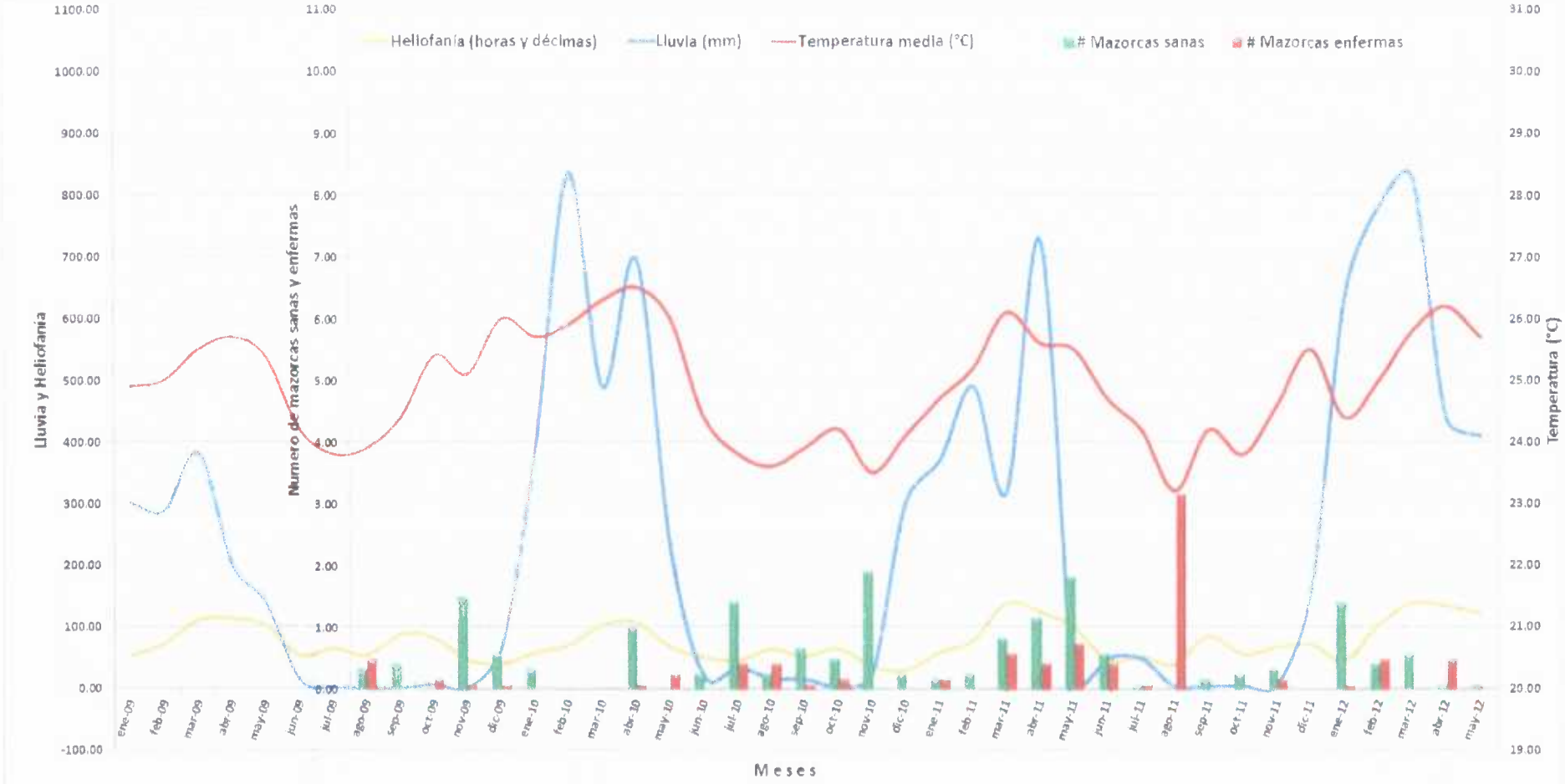

Fig. 19. Dynamic of number of healthy and diseased pods (average per tree) during the period August 2009 - May 2012 as related to some weather variables for the clone INIAPG-149 (Lote Ganadería). EET- Pichilingue.

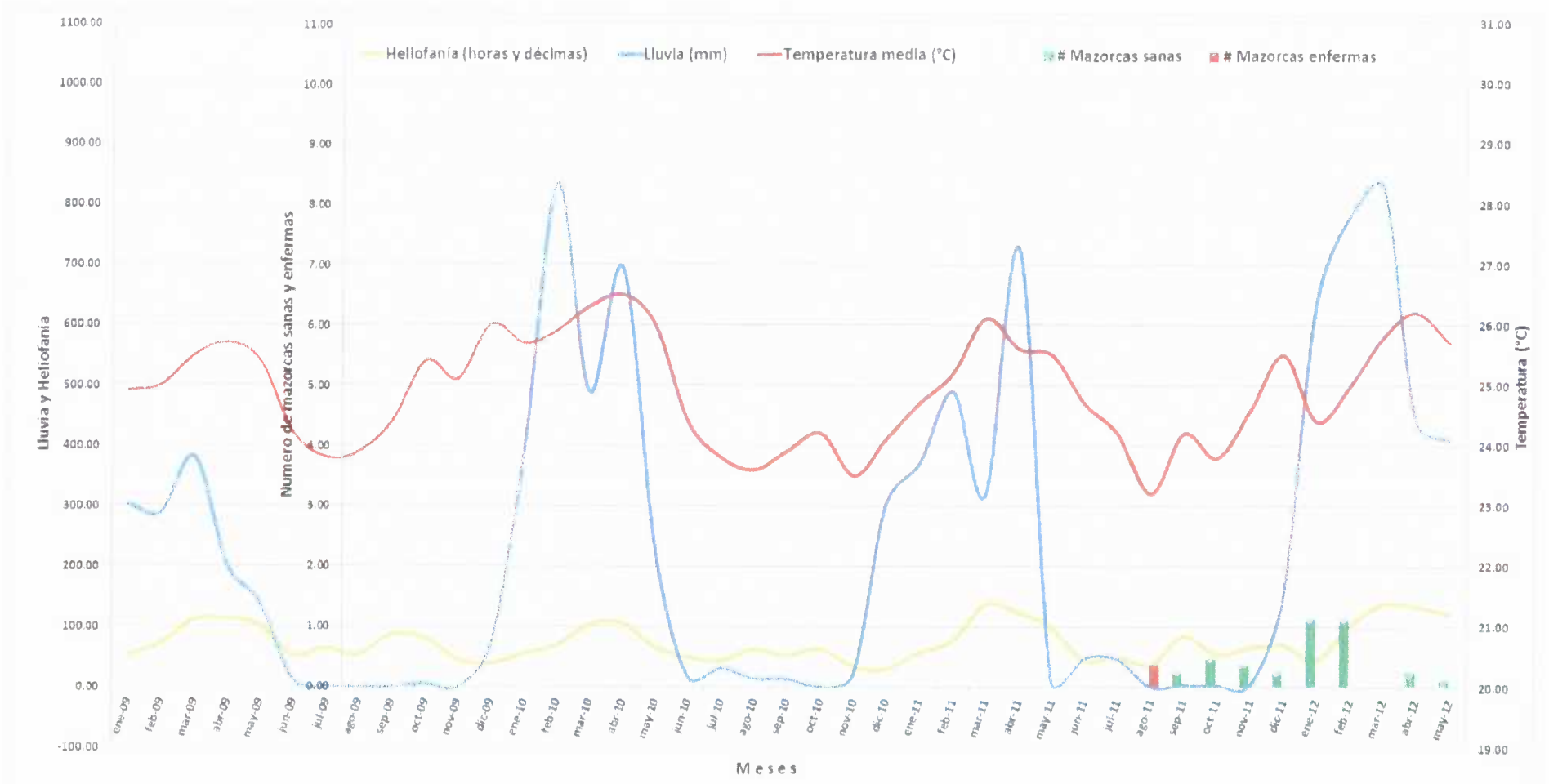

Fig. 20. Dynamic of number of healthy and diseased pods (average per tree) during the period August 2009 - May 2012 as related to some weather variables for the clone CCN-51 (Lote Ganadería). EET- Pichilingue.

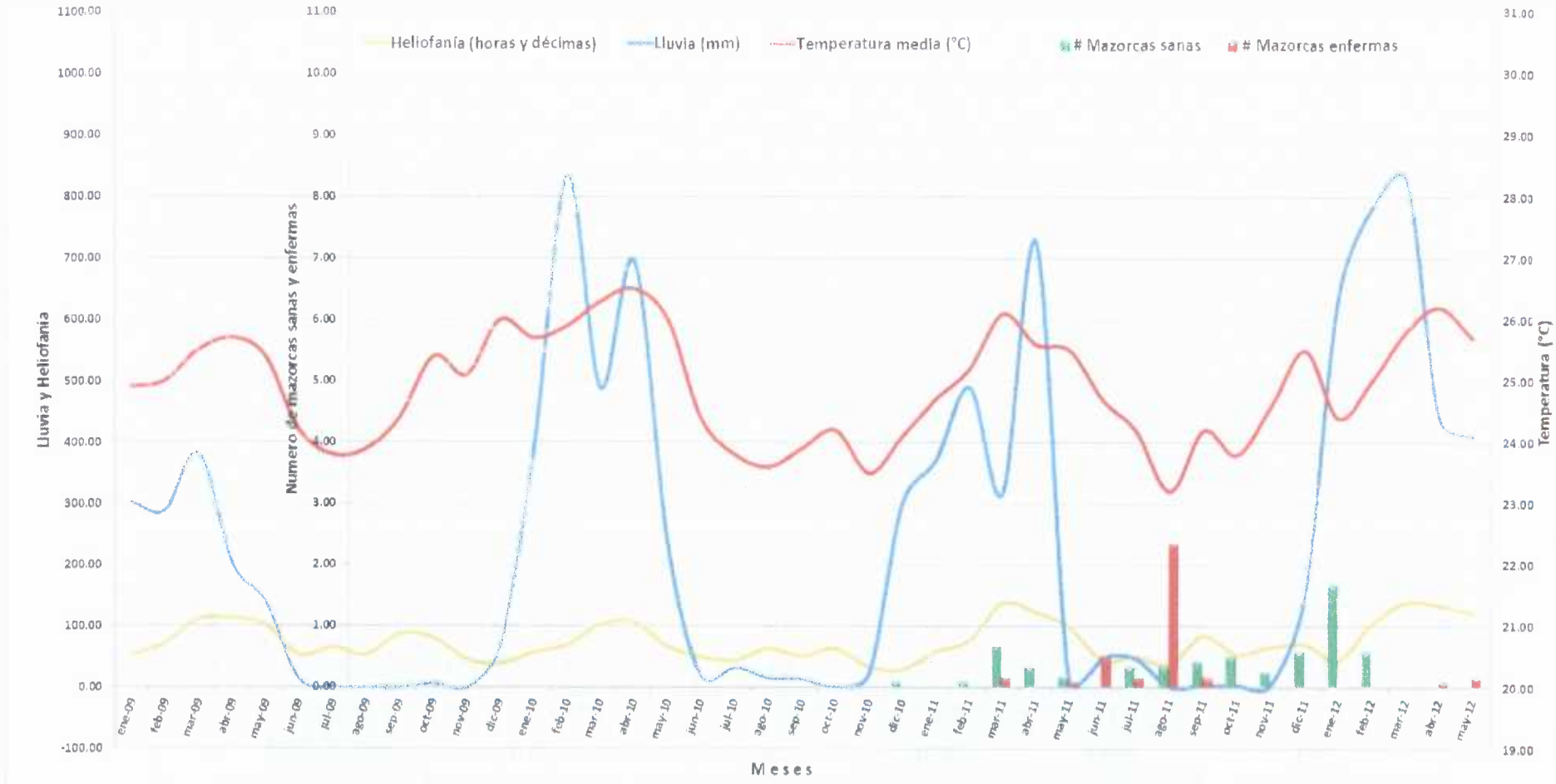

Fig. 21. Dynamic of number of healthy and diseased pods (average per tree) during the period August 2009 - May 2012 as related to some weather variables for the clone EET-103 (Lote Ganadería). EET- Pichilingue.

Table 10. Data per tree for the top yielding clones (April 2011 – April 2012) in the trial to compare selections of the groups 5, 6 and 7 (Second breeding scheme). Lote Las Malvinas". EET-Pichilingue. Planting began in 2010.

Ranking	Code	Family	Healthy pods	Diseased Pods, %	Dry bean Weight, g/tree	Fresh bean Weight, g/pod
1	INIAPM 357	TAP 6 x D 147	17,7	7,5%	416,7	59,0
2	INIAPM 092	TAP-6 x B 60	5,3	45,8%	248,9	116,7
3	INIAPM 283	CCN 51 x EET 416	3,9	2,9%	226,7	145,7
4	INIAPM 032	AMAZ 11 x A 2699	4,9	18,2%	224,4	114,8
5	INIAPM 158	TAP 3 x A 2634	6,8	4,9%	206,7	76,2
6	INIAPM 360	TAP 6 x D 147	2,3	57,1%	206,7	221,4
7	INIAPM 168	CCN 51 x LCT 368	3,4	19,4%	184,4	133,9
8	INIAPM 157	TAP 3 x A 2634	3,9	17,1%	177,8	114,3
9	INIAPM 356	TAP 6 x D 147	5,7	8,8%	173,3	76,5
10	INIAPM 226	CCN 51 x A 2076	3,7	0,0%	170,0	115,9
11	INIAPM 148	CUR 3 x D 147	4,6	2,4%	168,9	92,7
12	INIAPM 083	TAP 6 x A 645	3,4	29,6%	166,3	123,1
13	INIAPM 147	CUR 3 x D 147	2,6	26,1%	163,3	159,8
14	INIAPM 091	TAP-6 x B 60	4,2	10,5%	157,8	93,4
15	INIAPM 170	CCN 51 x LCT 368	3,1	3,6%	156,7	125,9
119	INIAPM 427	CCN 51	0,7	0,0%	33,3	125,0
104	INIAPM 426	EET 103	1,8	7,1%	37,5	53,6

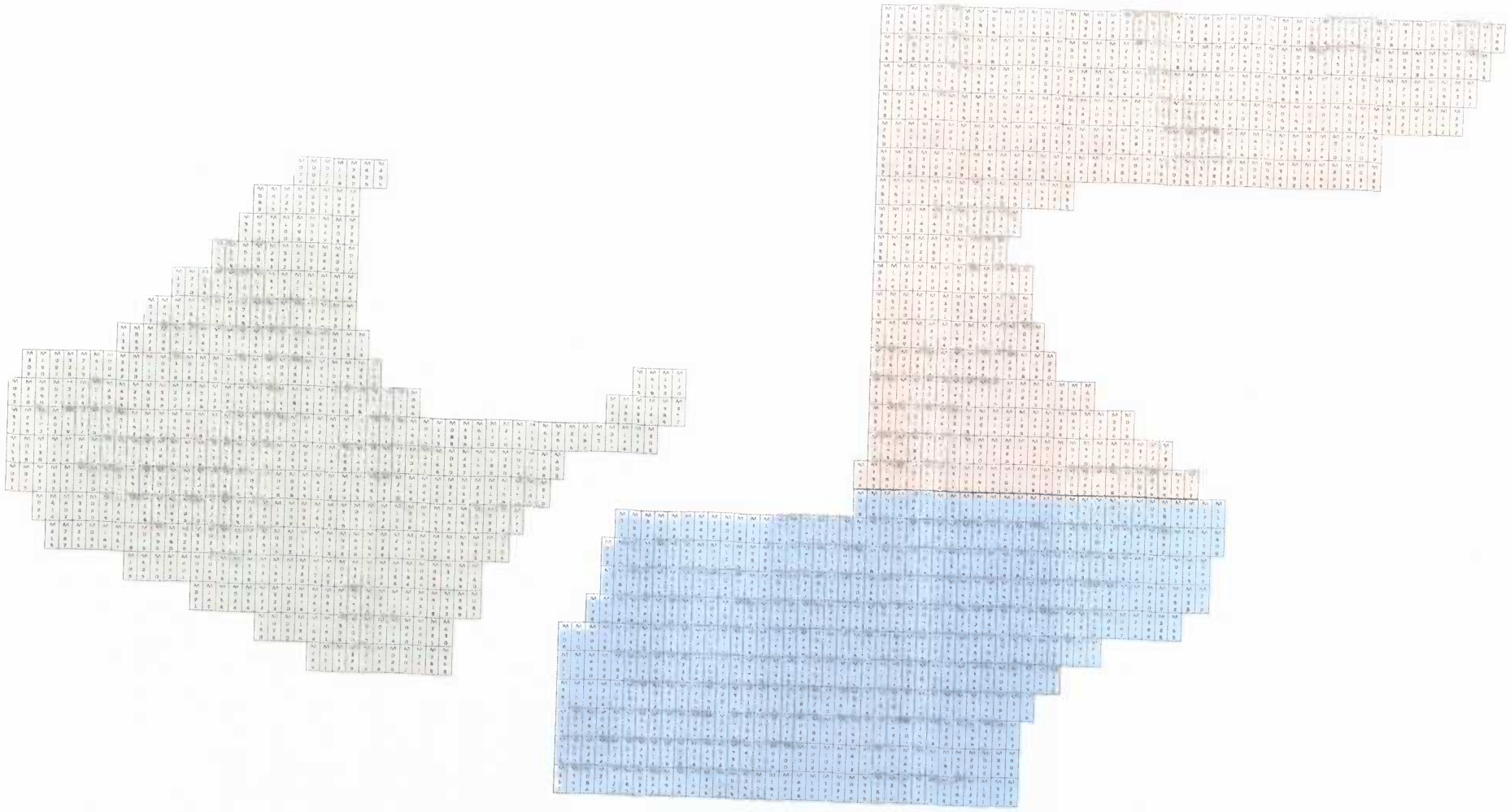

Fig. 22. Field distribution of treatments in the trial to compare clones from selections made in the groups 5, 6 and 7 (seedlings populations in the second breeding scheme). Planting began on January 2010. Lote "Las Malvinas"

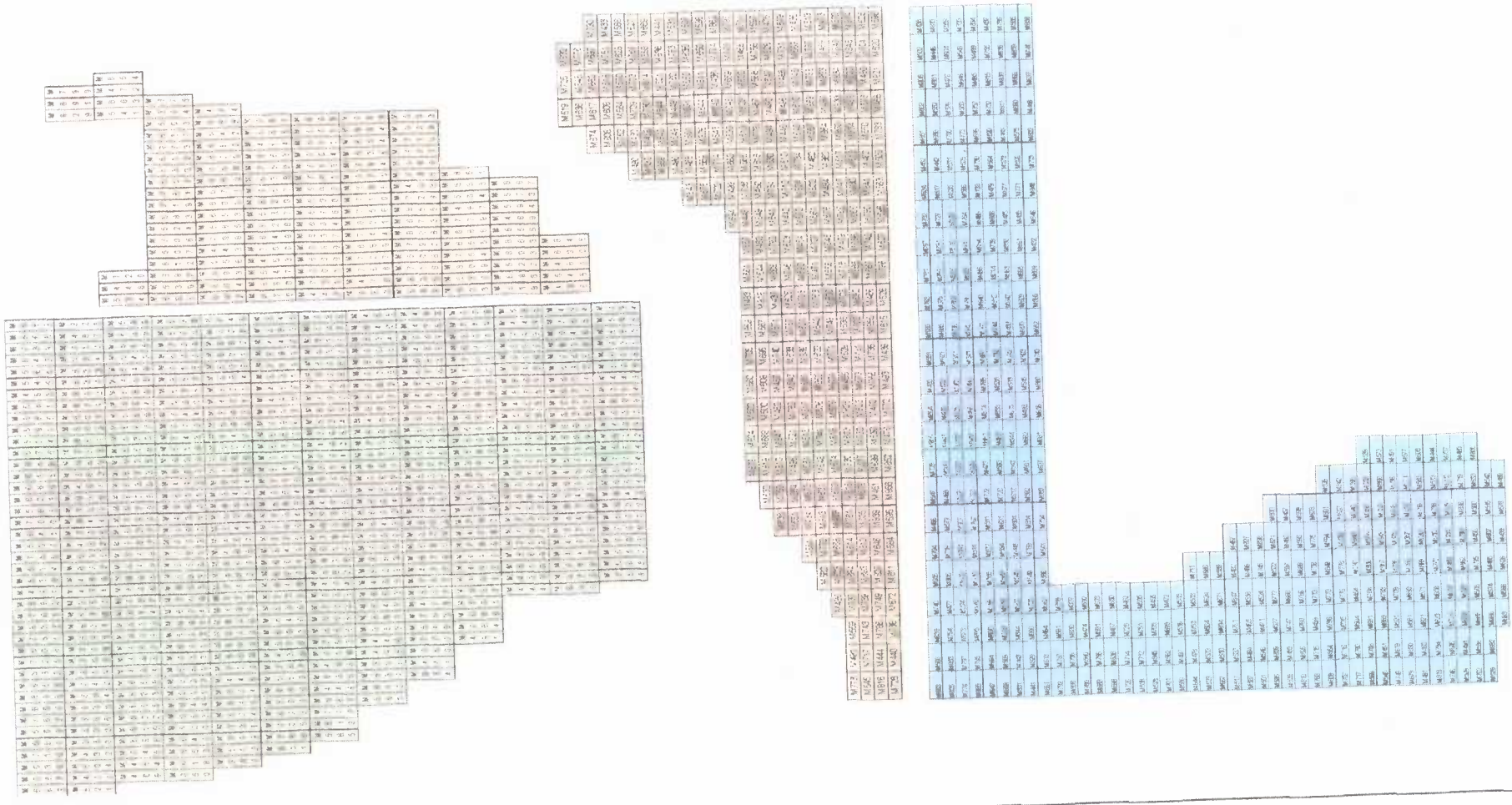

Fig. 23. Field distribution of treatments in the trial to compare clones from selections made in the group 8 (seedlings populations from the second breeding scheme). Planting began on April 2011. Lote "Las Malvinas".

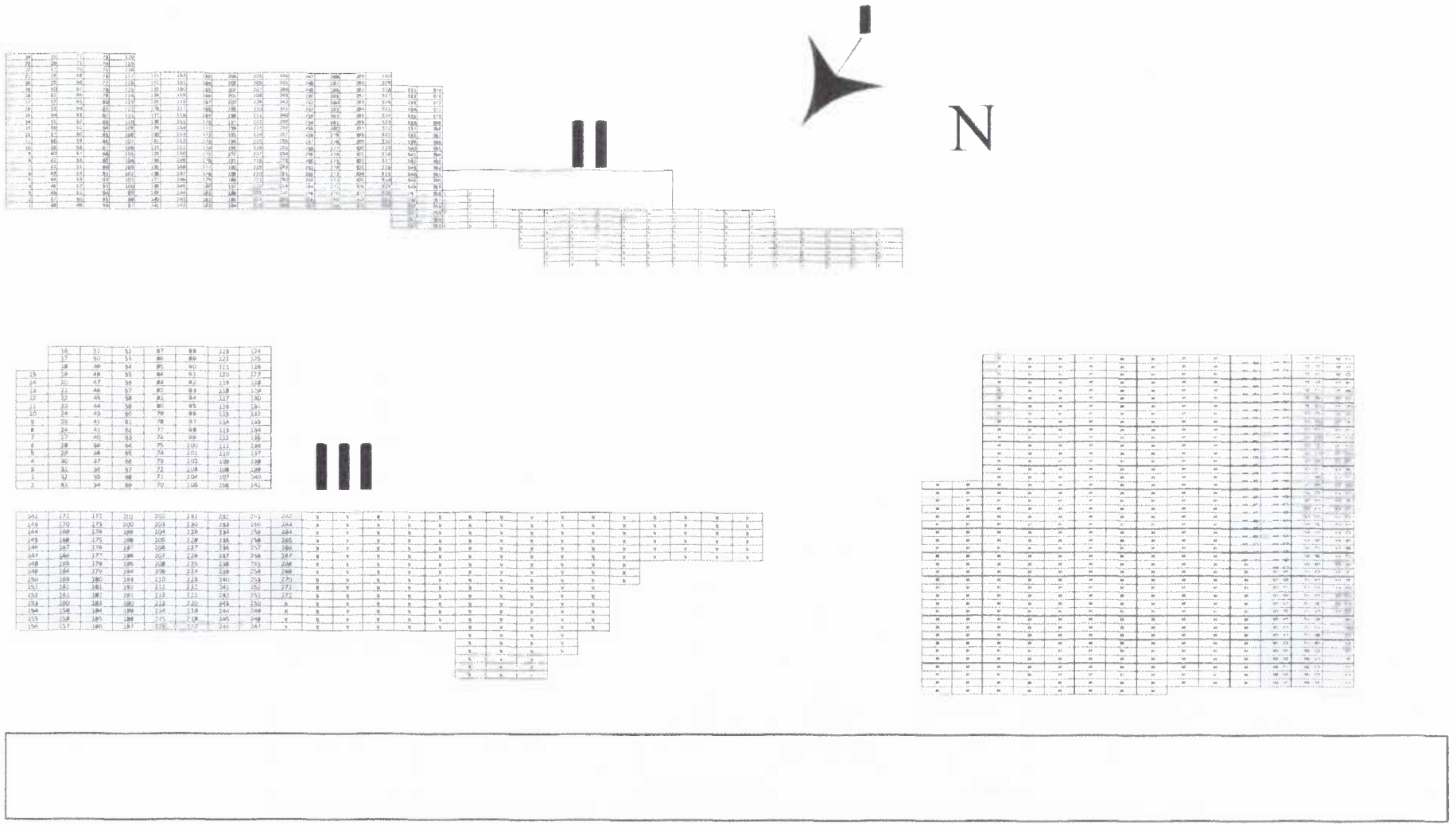

Table 11. Responses of some of the top high yielding clones from the project to controlled inoculation with witches´ brooms spores and correlations with field incidence data. EET-Pichilingue.

Code	Family	Greenhouse	Field		
		Incidence, %	Diseased pods, %	# Vegetative witches´ brooms	# Witches´broom Diseased pods
INIAPT- 527	TAP-6 x TIP-1	24	8,55	0,08	4,08
INIAPT- 641	TAP-3 x TIP-1	31	20,09	2,67	8,83
INIAPT- 302	EET-387 x A-645	52	11,1	4,58	4,25
INIAPT- 484	AMAZ-14 x EBC-148	63	36,21	18,36	11
INIAPT- 533	SIL-1 x B-60	63	18,75	11,18	7
INIAPT- 632		67	15,87	16,83	7,67
INIAPT- 374	EET-387 x A-645	70	21,67	10,25	9
INIAPT- 405	CCN-51 x TAP-3	80	17,84	11,5	9,17
INIAPT- 680	CCN-51	82	35,03	8,82	10,09
Correlación			0,53	0,7	0,59
SCA 6		45,6[1]			
SCA 12		49,8			

[1] Los clones SCA 6 y SCA 12 no ingresaron en el análisis de correlación por falta de datos de infección natural en campo