PHILIPPINE SUGAR RESEARCH INSTITUTE FOUNDATION, INC.
Victorias Experiment Station, VMC Compound
Victorias City

STATUS REPORT

(December 17, 2010 – December 30, 2011)

A) BASIC INFORMATION

PROJECT TITLE:	**Field Evaluation of Antica for the Control of Sugarcane Smut (***Ustilago scitamenea* Syd.)
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IMPLEMENTING AGENCY:	**PHILSURIN Experiment Station** **Victorias City, Negros Occidental**
FUNDING AGENCY:	**ACHIL LABORATORY INC.** **Cebu City**
PROJECT DURATION:	**One (1) year**

INTRODUCTION:

Sugarcane (*Saccharum spp.)* is especially vulnerable to pest and diseases because of the nature of its growth habit. The roots, stalk and leaves of sugarcane are vulnerable for pest infestations and disease infections which causes tremendous losses on sugar production.

Sugarcane smut caused by the pathogen (*Ustilago scitamenea* Syd.) is one of the most widespread and damaging disease of sugarcane. Infection occurs through sugarcane buds. Germinating buds and very young shoots are most susceptible to infection. Infected shoots have smaller diameter than normal, and early in the season, they grow taller than smut-free plants. A long branched fungal reproductive structure then emerges from the shoot apex. This structure known as "whip" has a core of plant parenchyma tissue that is covered by a fertile layer of fungal cells. For every 50% infection of smut, it causes a 63.30 loss in tonnage (Sampang and Guevarra, 1990).

In the Philippines, Triadimefon at 0.5g a.i./liter of water has been shown to control smut when used as dipping solution for 5 minutes (Guevara and Manlapaz, 1993). The use of propiconazole in Don Pedro, Nasugbo, Batangas was also shown to be effective in controlling smut in Phil56-226. These chemicals were not being used commercially in sugarcane production partly because effective control had not been established.

A successful fungicide treatment that aids in the production of healthy planting materials and that protected planting materials from infection could make a useful contribution to the control of smut. Application to seedpieces at planting is also likely to be the simplest and cheapest method by which chemicals could be used for disease control in sugarcane.

In view of the above concern, a new concept of testing and evaluating the efficacy of a new organic, non-toxic fungicide against smut of sugarcane came into picture. ANTICA is an organic non toxic fungicide and bactericide. Laboratory and field tests revealed that ANTICA inhibits the growth of anthracnose, downy mildew, sigatoka and moko diseases in crops. ANTICA as a fungicide has a single mode of action; it destroys the cell membrane of microorganism causing death of the fungus or pathogenic bacteria. Specifically this project attempts to:

i) To generate parametric data to be submitted to FPA for label expansion purposes;

ii) To evaluate the efficacy of Antica for possible control against sugarcane smut disease; and

iii) To recommend cost effective dosage and suitable time of application of Antica for smut control.

METHODOLOGY

Site Selection, Soil Sampling and Analysis

A field at Hda. Luisita, Cadiz City was chosen as experimental site because it has been identified as having a high inoculum density level of smut pathogen. Soil samples were gathered from the field before the area was prepared and analyzed for pH, organic matter content, available N, P and K. The fertilizer requirement of the experimental field was computed and analyzed by the Soils Laboratory of Philsurin.

Variety and Cultural Practices

The variety, VMC86-550 was used in the test due to its high susceptibility to smut infection. However, despite of its smut susceptibility, it remained one of the major commercial varieties and highly favored by sugarcane planters in Negros because of its stable high sugar content, self-trashiness and erectness.

Agronomic cultural practices as regards to land preparation, planting, cultivation and weeding were followed during the entire duration of the study. The experiment was harvested 11 months after planting.

Experimental Design and Treatments

A Randomized Complete Block Design (RCBD) with plot size of 5 rows by 7 meters was used. Furrows were spaced at 1.0 meter with 1 meter gap between plots. All the data were gathered from 3 center rows. There were 10 treatments replicated 4 times (Table 1).

Table 1. Different Antica rates employed in the trial.

Treatment Code	Rate ml / L (soaking) ml/16 L (foliar)	Mode of Application
T1- Control	-	-
T2- Antica	50	Pre-plant soaking at planting
T3- Antica	50	Foliar at 45 DAP
T4- Antica	50	Pre-plant soaking and Foliar at 45 DAP
T5- Antica	60	Pre-plant soaking at planting
T6- Antica	60	Foliar at 45 DAP
T7- Antica	60	Pre-plant soaking at planting and Foliar at 45 DAP
T8- Antica	70	Pre-plant soaking at planting
T9- Antica	70	Foliar at 45 DAP
T10-Antica	70	Pre-plant soaking at planting and Foliar at 45 DAP

Note: DAP – Days after Planting

Treatment Application

To test the efficacy of Antica against sugarcane smut, two eye cuttings of VMC86-550 were inoculated with fresh population of smut teleospores with viable concentration of $5x10^6$ spores per ml density. The inoculated cuttings were incubated in moistened plastic bags for 48 hours to enhance the infection process. The cuttings were treated with the different concentrations of Antica and planted in the field. The untreated control plants received the same treatment except for the fungicides used which was replaced with distilled water.

At 1.5 months after planting, follow up treatment was applied by foliar spraying with different concentrations of Antica per tankload.

Data Gathered and Statistical Analysis

Germination count and smut infection were taken at 45 to 180 DAP (Days after Planting) while tiller population counts were recorded from 3 to 9MAP (Months after Planting). Observation on the percentage smut infection was continued at weekly interval up to six months. Infected stools were discarded after each observation to prevent secondary infection and error during counting. Cumulative percentage of smut incidence was calculated for each treatment.

Percent infection was computed by taking the ratio of total infected plant and the total plant population multiplied by 100. It is given by the formula as:

$$\% \text{ infection} = \frac{\text{Number of infection}}{\text{Total number of plants survived}} \times 100$$

Ten (10) randomly selected stalks samples were taken from the three center rows of each plot at harvest. Stalks were cut close to the ground and toped at the apical meristem to exclude green and senesced brown leaves. The samples were measured to determine the average stalk size, stalk length as well as average weight per stalk. The same samples were crushed to determine brix, percent pol and apparent purity for the computation of Lkg/TC and TC/Ha. Moreover, total weight of stalk per plot was taken for the computation of TC/Ha. Total number of millable stalks was also taken to determine stalk/m.

All collected data were subjected to statistical analysis using Analysis of Variance (ANOVA) and the treatment means were compared using the Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

To evaluate the efficacy of Antica against sugarcane smut disease, pre-plant soaking at planting and foliar application at forty five (45) days after planting as farmer's practice were tried using different rates of Antica..

Growth Parameters:

Germination was not affected by treatments as shown by statistically similar counts at 45 days after planting. However, effect of the treatments significantly differed three months after planting as exhibited by higher tiller on T1 (Untreated control) and in T4 (50ml Antica pre-plant soaking at planting and foliar at 45 DAP. From 6-9 months after planting, all treatments were generally comparable in terms of population count (Table2).

Table 2. Effect of the Different rates of Antica on the germination and tillering of VMC86-550.

Treatment	Germination (Mean Percentage)	Tillering		
		3 MAP	6MAP	9 MAP
T1 (control)	82.09a	93.00a	76.75a	65.50a
T2 (50ml Antica pre-plant soaking at planting)	88.01a	61.00f	62.50a	56.00a
T3 (50ml Antica foliar at 45 DAP)	86.11a	83.00b	74.75a	69.00a
T4 (50ml Antica pre-plant soaking at planting and foliar at 45 DAP)	80.18a	90.75a	77.75a	70.50a
T5 (60ml Antica pre-plant soaking at planting)	86.11a	77.75c	64.25a	62.75a
T6 (60ml Antica foliar at 45 DAP)	81.64a	71.75d	68.75a	62.75a
T7 (60ml Antica pre-plant soaking at planting and foliar at 45 DAP)	80.56a	65.00e	70.50a	55.75a
T8 (70ml Antica pre-plant soaking at planting)	67.59a	64.25ef	75.00a	57.75a
T9 (70ml Antica foliar at 45 DAP)	76.75a	61.50ef	68.75a	60.00a
T10 (70ml Antica pre-plant soaking at planting and foliar at 45 DAP)	80.55a	62.00ef	70.50a	61.00a
f-test	ns	s	ns	ns
cv	17.56	3.11	15.16	14.90

The cumulative percentage of smut incidence using different rates of Antica are presented in Table 3. The smut infection of the susceptible variety, VMC 86-550 starts at 90 days after planting. Delayed host reaction was probably due to the influence of climatic factors, especially temperature and rainfall on the smut infection process. Disease development is highly dependent on the environmental condition and variety used (Comstock and Lentini, 2005). In this particular experiment, the VMC 85-550 is a highly susceptible variety for smut hence, the environmental factors during the initial stage of the trial maybe unfavourable for the sugarcane disease development.

Experimental data have shown that except for T8 (70ml Antica pre-plant soaking at planting) the use of Antica can reduce the smut incidence by 23.71 to 71.27% over the control in VMC 86-550. Significantly low incidence of smut infection of 4.36% was noted on T3, (50ml Antica foliar at 45DAP). On the other hand, high smut incidence of 19.41% was noted on T8 (70ml Antica pre-plant soaking at planting) with corresponding increase of 27.86% over the control.

Based on the result, foliar spraying at 45 days after planting with the rate of 50ml Antica (T3) was effective in reducing smut infection with 71.27% decrease of smut incidence over the control in VMC86-550.

Fungicidal dip treatments of infected setts has been found effective in controlling smut (Mutsuhamy,1973), but the results of the present study indicates that post-plant spraying is also effective in controlling smut infected setts. Bearing in mind economic, effectiveness and yield post-plant spraying would be practicable for smut control in large scale sugarcane plantations.

In terms of percent germination, there might be some phototoxic effect on the buds with the higher dose of Antica at 70ml/L soaking as exhibited by lowest mean germination of 67.59. Although, it was statistically comparable among treatments but it has significant effect on millable stalk at harvest.

Top borer and thrips infestations were noted from 45 days up to 180 days after planting and insect occurrence was rated slight to moderate.

Table 3. Cumulative percentage of smut incidence in VMC86-550 using different Antica rates after 180DAP.

Treament	Cumulative pecentage of smut incidence	Percentage decrease (-) or increase (+) over control
T2 (50ml Antica pre-plant soaking at planting)	6.74	-55.59
T3 (50ml Antica foliar at 45 DAP)	4.36	-71.27
T4 (50ml Antica pre-plant soaking at planting and foliar at 45 DAP)	5.09	-66.46
T5 (60ml Antica pre-plant soaking at planting)	5.29	-65.15
T6 (60ml Antica foliar at 45 DAP)	8.25	-45.65
T7 (60ml Antica pre-plant soaking at planting and foliar at 45 DAP)	11.58	-23.71
T8 (70ml Antica pre-plant soaking at planting)	19.41	+27.86
T9 (70ml Antica foliar at 45 DAP)	6.05	-60.14
T10 (70ml Antica pre-plant soaking at planting and foliar at 45 DAP)	6.81	-55.13
T1 (control)	15.18	-

Cane and Sugar Yield

Cane and sugar yield of the different treatments are presented in Table 4. In terms of ton cane per hectare (TC/HA), T4 (50ml Antica pre-plant soaking at palanting and foliarat 45 DAP) showed the highest mean of 117.50 TC/HA. The lowest mean however was observed in T2 (50ml Antica pre-plant soaking at planting) with 71.25 TC/HA.

Sweetness, expressed in Lkg/TC, which is an inherent varietal character, was significantly affected by different rates of Antica treatment. The highest mean in LKGTC of 1.40 was observed from the treatment T7 (60ml Antica pre-plant soaking at planting and foliar at 45 DAP). The lowest LKG/TC mean of 1.16 was noted in T5 (60ml Antica pre-plant soaking at planting).

On the other hand, the treatment effects on TC/Ha were reflected in sugar yield (Lkg/Ha). T4 (50ml antica pre-plant soaking and foliar at 45 DAP) showed the highest Lkg/Ha of 133.17 while T2 (50ml Antica pre-plant soaking at planting) had significantly lowest yield of 89.38. The result of this trial suggests that the treatment had inconsistent yield response to Antica product. As earlier stated, T3 had greatly reduced the incidence of smut but it failed to improve sugarcane yield.

Table 4. Yield summary of the Different Rates of Antica on VMC86-550.

Treatment	Stalk Size (cm)	Stalk Length (cm)	Stalk weight (kg)	Millable stalk per sq m	TCHA	LKGTC	LKGHA
T1 (control)	27.02a	182.72a	1.07a	389.38a	104.37b	1.22bcd	128.26ab
T2 (50ml Antica pre-plant soaking at planting)	28.52a	174.12a	1.14a	332.50ab	71.25e	1.25bcd	89.38g
T3 (50ml Antica foliar at 45 DAP)	27.42a	175.45a	1.13a	358.75ab	87.08d	1.28bc	111.90dfe
T4 (50ml Antica pre-plant soaking at planting and foliar at 45 DAP)	27.87a	181.72a	1.16a	405.42a	117.50a	1.25bcd	133.07a
T5 (60ml Antica pre-plant soaking at planting)	26.80a	168.90a	1.02a	323.75ab	91.91cd	1.16d	106.57f
T6 (60ml Antica foliar at 45 DAP)	26.65a	170.40a	1.11a	278.02b	91.50cd	1.31b	119.5cd
T7 (60ml Antica pre-plant soaking at planting and foliar at 45 DAP)	26.97a	170.22a	1.07a	367.49ab	92.10cd	1.40a	129.44ab
T8 (70ml Antica pre-plant soaking at planting)	27.60a	170.20a	1.11a	269.79b	92.25bcd	1.22bcd	118.14cde
T9 (70ml Antica foliar at 45 DAP)	27.92a	171.47a	1.05a	348.54ab	99.45bc	1.22bcd	121.59bc
T10 (70ml Antica pre-plant soaking at planting and foliar at 45 DAP)	27.50a	174.70a	1.06a	345.63ab	92.08cd	1.19cd	110.27fe
f-test	**ns**	**ns**	**ns**	**s**	**s**	**S**	**S**
cv	**6.58**	**4.90**	**12.63**	**18.69**	**18.51**	**14.77**	**4.49**

Note: Any two means followed by the same letter are not significantly different at 5% level of probability.

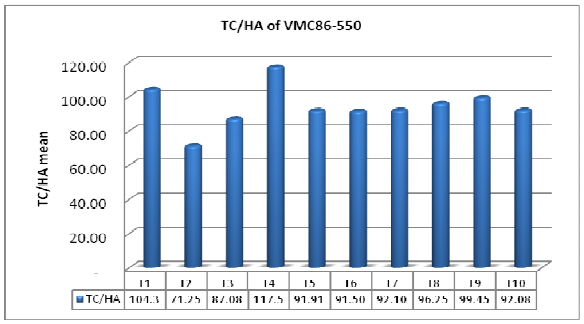


Fig. 1. TC/HA of VMC 86-550 as affected by different rates of Antica

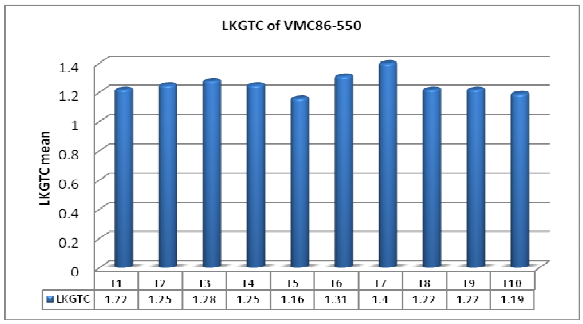


Fig.2. LKGTC of VMC86-550 using different rates of Antica rates.

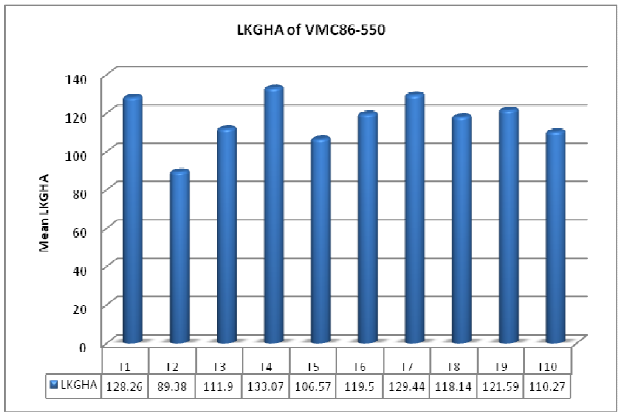


Fig 3. LKGHA of VMC86-550 as affected by different rates of Antica

However, the effects of Antica on yields are not as clear**.** As presented in Table 5, even when there was reduction in smut incidence, significant yield increases were not realized compared with the untreated control. Sugar yields varied but were unreliable to draw conclusions about its effectiveness in terms of preventing yield losses.

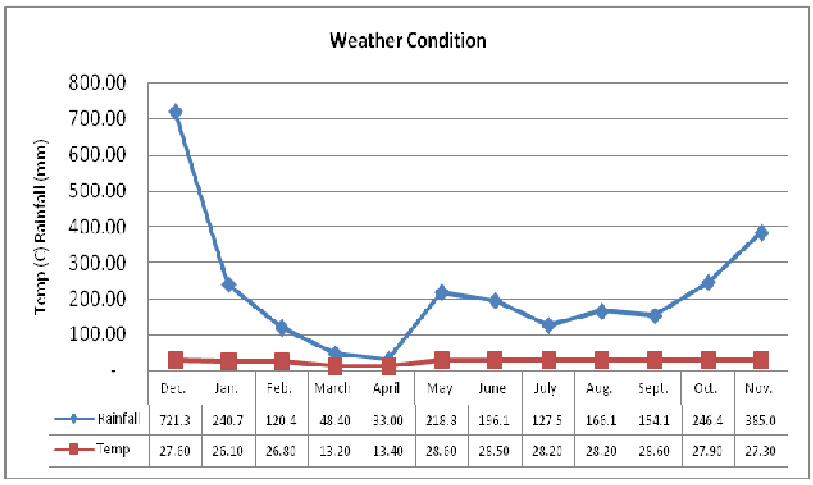
The treatment which showed great reduction in smut incidence and at the same time increased yield at harvest was noted in T4 (50ml Antica pre-plant soaking at planting and foliar spraying at 45 DAP). This observation maybe considered as optimum range of Antica but it should be recommended with great caution. This is partly because disease severity of smut was not severe enough and did not develop early enough to determine with confidence the efficacy of Antica in the trial.

Table 5. Efficacy of Antica on incidence of smut and sugarcane yield

Treatment	Rate ml / L (soaking) ml/16 L (foliar	Smut Incidence (Percent)	LKGHA	Yield decrease (-) or increase (+) over control
T2 (50ml Antica pre-plant soaking at planting)	50	6.74	89.38	-30.31
T3 (50ml Antica foliar at 45 DAP	50	4.36	111.90	-12.75
T4 (50ml Antica pre-plant soaking at planting and foliar at 45 DAP)	50	5.09	133.07	+3.75
T5 (60ml Antica pre-plant soaking at planting)	60	5.29	106.57	-16.91
T6 (60ml Antica foliar at 45 DAP)	60	8.25	119.50	-6.83
T7 (60ml Antica pre-plant soaking at planting and foliar at 45 DAP)	60	11.58	129.44	+0.92
T8 (70ml Antica pre-plant soaking at planting)	70	19.41	118.14	-7.89
T9 (70ml Antica foliar at 45 DAP)	70	6.05	121.59	-5.18
T10 (70ml Antica pre-plant soaking at planting and foliar at 45 DAP)	70	6.81	110.27	-14.02
T1 (control)	-	15.18	128.26	-

Weather Condition

Figure 4 shows the average monthly temperature and rainfall during the duration of the trial. The weather data indicated that it was an optimum temperature for the germination of sugarcane (26.1-28.6^{0}C) except for the months of March and April in which temperature drops to 13.2-13.4^{o}C and likewise enough rainfall which was favorable for the growth of the crop. Number of rain days was more than enough during the set-up December 2010 with 29 days of rain days and also by January 2011 with 26 rain days. These explained why the trial was re-planted due to poor germination because of the heavy rains resulting to poor bud germination due to water logged condition of the experimental area. For the months of March and April 2011 number of rain days was only 4-6 days, the trial was irrigated to ensure the optimal growth of sugarcane.



	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.
Rainfall	721.3	240.7	120.4	48.40	33.00	218.3	196.1	127.5	168.1	154.1	246.4	385.0
Temp	27.60	26.10	26.80	13.20	13.40	28.60	28.50	28.20	28.20	28.60	27.90	27.30

Fig. 4. Mean values for monthly temperature and rainfall during the duration of the experiment at Cadiz City. (PHILSURIN Victorias Weather Data for the months of December 2010 to Novemberr 2011.)

SUMMARY CONCLUSION AND RECOMMENDATION

A field at Hda. Luisita, Cadiz City was chosen as experimental field to test the efficacy of Antica against smut disease in sugarcane. Pre-plant soaking at planting and foliar spraying at 45 days after planting using different rates of 50ml, 60ml and 70ml was tried on smut susceptible variety, VMC86-550.

The experimental design used was RCBD with a plot size of 5 rows by 7 meters by 1 furrow distance. There were ten (10) treatments tried replicated (4) times.

In this particular experiment, the occurrence of smut incidence was delayed due to environmental factors which influence disease infection process. Smut incidence was not great enough and did not develop early enough to evaluate the efficacy of Antica with confidence.

There was a possible indication of phytotoxicity using higher dosage of Antica at 70ml/L when used a pre-plant soaking at planting. This dosage exhibited lowest mean percent germination and millable stalk per meter with 67.59 and 269.79 respectively.

In summary, results showed that post-plant spraying at 45 days after planting with the rate of 50ml Antica was effective in reducing smut infection, with 71.27% decrease of smut incidence over the control in VMC86-550. However, this failed to improve sugarcane yield. Yield increase of 3.75 % was realized with follow-up spraying at 45 days after planting.

The present findings of this experiment suggested that Antica can reduce smut incidence but it underscores the need for further testing of the product to really evaluate its effectiveness in controlling sugarcane smut disease without reducing sugar yield. If natural inoculation and rainfall are relied upon to provide disease severities sufficient to evaluate Antica then the number of locations and years of testing will need to be increased.

REFERENCES

Comstock, J.C and R.S Lentini. 2005. Sugarcane Smut Disease. Florida Sugarcane Handbook. Univ of Florida, Gainsville, FL 32611.

Fauconnier, R. 1993. The Tropical Agriculture: Sugarcane. 3rd edition. Published by the McMullan Press. Ltd. London Basingstoke.

Muthusamy, S. 1973. Fungicides in the control of sugarcane smut. Sugarcane Pathologists. Newsletter.No. 10

Rott, P., Bailey A., Comstock J.C., Croft B.J. and Saumtally A.S. 2000. A guide to sugarcane diseases. Published by CIRAD and ISSCT. 339pp.

Sampang, R.C. & Guevarra. M.M. 1990. IPM Challenges, opportunities and problems in sugarcane. Philsutech Proceedings 37th Annual Convention. 149-153pp.

Sarian, Z.B. 2010. Tropical Fruit Extracts Control Crop Diseases. Philippine Panorama Weekly Magazine. 20-12pp.

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Fig. 5. Visible symptoms of sugarcane smut, "smut whip"'

Fig. 6. Visible symptoms of sugarcane smut- profuse tillering of infected sugarcane stool.

Fig. 7. Smut inoculation of sugarcane seedpieces.

Fig. 8. Pre-plant soaking of seedpieces at different Antica rates

Fig. 9. Field lay-outing

Fig. 10. Set-up of Antica Trial

Fig. 11. Foliar Spraying different rates of Antica at 45 DAP

Fig. 12. Spraying different rates of Antica at 45 DAP

Fig. 13. Data gathering at 45 DAP germination & smut infection count.

Fig. 14. Data gathering at 6 MAP (tillering count, stalk size & smut infection count).

Fig.15. Data gathering at 6 MAP (measurement of 10 randomly selected stalks to derived stalk length)

Fig. 16. Data gathering at 6 MAP (smut count & other pests & diseases)

Fig. 17. Pile of harvested canes from Antica trial.

Fig. 18. Plot weighing of canes during harvest to derive TCHA

Fig. 19. Sample for Juice Analysis from each treatment

Fig. 20. Measurement of stalk samples to get stalk size

Fig. 21. Measurement of stalk samples to get stalk length

Fig. 22. Milling of samples for LKGTC analysis