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zacariascbpv@fcav.unesp.br

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Zacarias do Amaral, Maria Alice; Barcellos Magalhães da Rocha, Christiane Maria;  
Faccini, João Luiz; Furlong, John; de Oliveira Monteiro, Caio Márcio; de Azevedo Prata,  
Márcia Cristina

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# Strategic control of cattle ticks: milk producers' perceptions

Controle estratégico do carrapato dos bovinos: percepção dos produtores de leite

Maria Alice Zacarias do Amaral<sup>1\*</sup>; Christiane Maria Barcellos Magalhães da Rocha<sup>2</sup>; João Luiz Faccini<sup>3</sup>;  
John Furlong<sup>4</sup>; Caio Márcio de Oliveira Monteiro<sup>5</sup>; Márcia Cristina de Azevedo Prata<sup>4</sup>

<sup>1</sup>Centro de Experimentação Animal, Instituto Oswaldo Cruz – FIOCRUZ

<sup>2</sup>Universidade Federal de Lavras – UFLA

<sup>3</sup>Departamento de Parasitologia, Universidade Federal Rural do Rio de Janeiro – UFRRJ

<sup>4</sup>Embrapa Gado de Leite, Empresa Brasileira de Pesquisa Agropecuária – EMBRAPA

<sup>5</sup>Universidade Federal de Juiz de Fora – UFJF

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## Abstract

In order to evaluate milk producers' knowledge about tests on tick sensitivity to acaricides, efficiency tests and strategic control, questionnaires were delivered to 670 producers. From these, 163 responses were received. These producers had sent ingurgitated female ticks to be subjected to tests on tick sensitivity to acaricides at Embrapa between 2001 and 2005. Most of the completed questionnaires came from the State of Minas Gerais, Brazil. After descriptive analysis and correlation of variables, it was found that 48.5% of the properties owned herds of up to 100 head of cattle and 57.3% of the producers belonged to a cooperative. Among the respondents, 157 (98.7%) applied the acaricide indicated by the efficiency test, and 144 (92.9%) said that they applied strategic control but incorrectly. There was improvement in some control stages. However, only 12 (7%) showed comprehension of all the stages of strategic control. It was concluded that there is a need for continuing assistance, so as to achieve effective improvement in controlling *Rhipicephalus (Boophilus) microplus*.

**Keywords:** *Rhipicephalus (Boophilus) microplus*, knowledge, milk producers.

## Resumo

Objetivando avaliar o conhecimento dos produtores de leite que usufruíram do teste de sensibilidade dos carrapatos aos carrapaticidas – teste de eficácia e controle estratégico – foram enviados questionários a 670 produtores. Desses, 163 foram respondidos. Esses produtores representam aqueles que enviaram fêmeas ingurgitadas para proceder aos testes de sensibilidade dos carrapatos aos carrapaticidas pela Embrapa, de 2001 a 2005. Dos respondidos, a maioria localiza-se no Estado de Minas Gerais. Após análise descritiva e cruzamento de variáveis, constatou-se que 48,5% das propriedades possuem rebanho até 100 cabeças de gado; 57,3% produtores pertencem a uma cooperativa. Um total de 157 (98,7%) entrevistados aplicou o acaricida indicado pelo teste de eficácia, e 144 (92,9%) respondentes afirmaram ter seguido o controle estratégico, porém, não de forma correta, havendo, entretanto, melhora em algumas etapas do controle. No entanto, apenas 12 (7%) demonstraram compreender todas as fases do controle estratégico, apesar de terem recebido informações técnicas de como proceder com o controle. Conclui-se que há necessidade de assistência continuada para melhoria efetiva do controle de *Rhipicephalus (Boophilus) microplus*.

**Palavras-chave:** *Rhipicephalus (Boophilus) microplus*, conhecimento, produtores de leite.

\*Corresponding author: Maria Alice Zacarias do Amaral  
Centro de Experimentação Animal, Instituto Oswaldo Cruz – FIOCRUZ,  
Av. Brasil, 436, CEP 21040-900, Rio de Janeiro - RJ, Brazil;  
e-mail: Maria.alice@ioc.fiocruz.br

## Introduction

One of the biggest obstacles to cattle rearing around the world is losses due to endo and ectoparasites. In Brazil, the continental dimensions, size of the cattle stocks and climate favor proliferation of parasites, with repercussions on milk production and body weight gain among the animals (GRISI et al., 2002).

Angus (1996) stated that *Rhipicephalus (Boophilus) microplus* was the most important cattle tick worldwide, because of the economic losses that it causes. Jonsson et al. (2001) reported that cattle ticks caused major losses to the milk industry in Queensland, Australia. Some of these losses come from producers' and technicians' lack of knowledge about how to deal with the problem (JONSSON; MATSCHOSS, 1998). Because of the evolution of resistance to acaricides among cattle ticks and difficulty in developing new products, there is concern regarding the future of chemical control methods against ticks (GEORGE et al., 2004).

Motivated by this reality, Mendes et al. (2007) stated that one of the priorities in tick control is to avoid selection and proliferation of resistant populations. In this respect, in Costa Rica, Thullner et al. (2007) conducted studies on strategic rotation of acaricides in an attempt to delay the progress of resistance. Furthermore, in New Caledonia, an accumulation of resistance mechanisms against acaricides was observed among ticks (FREITAS et al., 2005).

The assessments that have been made so far have been limited to evaluations on product performance in certain regions of Brazil, such as Mato Grosso, São Paulo (SOARES et al., 2001); Paraná (SOUZA et al., 2003) and Pernambuco (SANTANA et al., 2001), and also in some other countries (JONSSON; HOPE, 2007). Given that linking between the problem of resistance and producers' comprehension is essential for changing the understanding of tick control methods, the aim of the present study was to investigate whether, with greater importance for the process of understanding and adopting strategic control methodologies, producers are in a position to understand and apply strategic control, in order to assess what information should be provided and how to do this.

## Material and Methods

Data were gathered by means of semi-structured interviews between December 2005 and May 2006, using questionnaires that has previously been tested (ROJAS, 2001). The questions had the aim of obtaining information to characterize the farm properties and producers and ascertain producers' perceptions about information received from Embrapa Dairy Cattle, in order to quantify and quality their capacity to understand the control process and biology of cattle ticks.

Every producer (n = 670) that, between 2001 and 2005 had requested a test on tick sensitivity to acaricides from Embrapa Dairy Cattle, was sent the abovementioned questionnaire by post.

Content analysis (BARDIN, 1977) was performed on the results from the questionnaires, in accordance with the studies by Rocha (1995) and Rocha et al. (2006). The data were categorized (MINAYO, 2006) and a database was constructed using the Epidata 3.1 software.

To ascertain associations between qualitative variables of interest, the chi-square test ( $\chi^2$ ) was used, or Fisher's exact test when one of the cells of the contingency table presented fewer than five repetitions. For schooling levels, the chi-square test for trend was used.

The 95% confidence intervals were used to determine whether the associations were significant. These analyses were done using the Epi Info 6.04 software and the Statistical Package for the Social Sciences (SPSS, version 12.0).

Using the chi-square test, and taking questions/responses about biology and control to be dependent variables, associations between these and the following independent variables were investigated: 1) schooling level (elementary school, high school and university level); and 2) membership of a producers' cooperative (yes or no).

## Results and Discussion

Out of the 670 producers investigated, only 163 provided responses to the questionnaires, thus totaling 24.3% of the sample studied. The producers studied were concentrated mostly in the southeastern region of Brazil (91%), and mostly in the State of Minas Gerais (Table 1). This could probably be explained by their proximity to Embrapa Dairy Cattle, which is located in Juiz de Fora, Minas Gerais, and because this state is the biggest milk producer in Brazil (MILKPOINT, 2001). Since tick infestations cause losses of milk-producing animals and diminish milk production, milk producers felt the need to combat such infestations effectively. This motivated them to seek the test of tick sensitivity to acaricides, which is provided free of charge by Embrapa Dairy Cattle. Most of these producers (57.3%), independent of the region, were organized into cooperatives, and 107 (66.5%) of these producers were only involved in cattle rearing activities.

Among the farm properties analyzed, crossed cattle predominated (80.4%), and 116 (71.2%) of these farms had herds of up to 100 head of cattle, with a median daily milk production of 350 L (percentiles 170 and 790). On 143 farms (89.4%), there were between one and ten horses (median = 4).

Among the interviewees, 92 (59.4%) reported that they had observed fewer than 50 ticks per animal, independent of the type of activity developed on the property (dairy cattle rearing or subsistence farming) and of the cattle breed ( $p > 0.05$ ) (Table 2). Although Veríssimo et al. (2004) demonstrated clear differences in tick resistance between cattle breeds, the infestation levels observed by the producers were similar.

Jonsson and Matschoss (1998) observed in Australia that most producers said that they had small quantities of ticks in their herds and, for this reason, they did not believe that it was necessary to implement a more specific and rational control program. When necessary, they used acaricides that were chosen according to advertising or the lowest price (HONER et al., 1990).

With regard to reasons for changing the acaricide that they were using, 87 (54.4%) cited inefficiency of the products, in the same way as in the study by Rocha (2005). This finding demonstrates two worrying factors: use of an acaricide until reaching "saturation" and changing it without proper proof (through an acaricide test) that the inefficiency was due to resistance among the population.

**Table 1.** Characterization of the farm properties and producers that used tests on acaricide efficiency against ticks and that participated in an investigation on strategic control of cattle ticks: perceptions of milk producers that used the test on tick sensitivity to acaricides at Embrapa Dairy Cattle, Juiz de Fora, Minas Gerais, between 2001 and 2005.

Characteristics*	Categories				Respondents** (% losses)	
Regions in which the farm properties were located	Southeast 148 (91%)	Northeast 7 (4%)	Center-West 7 (4%)	North 1 (1%)	- -	163 (0)
Participation in cooperatives	Yes 90 (57.3%)	No 67 (42.7%)	- -	- -	- -	157 (3.7)
Activities on the farm properties	Livestock rearing 107 (66.5%)	Livestock rearing with agriculture 54 (33.5%)	- -	- -	- -	161 (1.2)
Farm properties that only carried out livestock-rearing activities	Milk production 84 (78.5%)	Milk and beef production 16 (14.9%)	Beef production 6 (5.6%)	No indication of activity 1 (1%)	- -	107 (34.4)
Farm properties that carried out livestock-rearing activities together with agriculture	Milk production 40 (71.4%)	Milk and beef production 11 (19.6%)	Beef production 3 (5.4%)	No indication of activity 2 (3.6%)	- -	56 (65.6)
Cattle breeds***	Crossed 131 (80.4%)	Friesian 48 (29.4%)	Jersey 12 (7.4%)	Gir 6 (3.7%)	Zebu (0.6%)	163 (0)
Number of head of cattle	Up to 100 head 79 (48.5%)	Between 100-200 37 (22.7%)	Between 300-400 27 (16.5%)	Between 200-300 20 (12.3%)	- -	163 (0)
Presence of horses	Yes 143 (89.4%)	No 17 (10.6%)	-	-	-	160 (1.8)

\*The percentages do not take losses into consideration; \*\*Respondents – corresponding to the absolute number of producers that provided information; (% losses) percentage of questionnaires in which this question remained unanswered, taking n = 163; \*\*\*More than one answer to this question was accepted.

According to Furlong and Martins (2000), it is important to ascertain whether there have been any failings in relation to preparation or application of the acaricide, since some of the ticks may survive because they have not been sufficiently reached by the product, and this may be confounded with resistance. Changes of acaricide had taken place as a result of efficiency tests on the product in the cases of only 43 of the farms (26.9%).

Independent of the reasons that had led to changing the products, 128 producers (84.2%) were using more than three products on their properties, without taking into account the mechanism of action, which may have favored the establishment of multiple resistance among the ticks. For this reason, Mendes et al. (2007) stated that there is an urgent need to assess the degree of resistance among ticks to groups of chemicals, in order to establish efficient management. Souza et al. (2003) observed that all the products presented efficacy of less than 95% on at least one farm property. Santos Junior et al. (2000) also observed in the state of Rio de Janeiro that populations resistant to all the acaricides used in the experiment were present. This resistance could be explained by an accumulation of mechanisms for tick resistance to acaricides, as also observed by Chevillon et al. (2007) in New Caledonia.

In the present study, it was found that changes of acaricide were being made with the proper indications outlined above. Only a few producers reported that they had not yet made any changes, i.e. only 24 farm properties (15.8%) had used only one product. Among these were the following products: amidines (n = 10; 42%); phosphorates (n = 4; 18%); phenylpyrazoles (n = 3; 12%); pyrethroids + phosphorates (n = 3; 12%); fluzaron (n = 3; 12%) and macrocyclic lactones (n = 1; 4%). These producers could now be advised to change the acaricide that was being used, for

products with a different chemical basis and mode of action. There have been studies indicating that selection of resistant populations occurs very rapidly and, for this reason, the hypothesis that the same chemical basis, or different chemical bases with the same mechanisms of action, should not be used for more than six successive applications, as shown by Thullner et al. (2007), is starting to be accepted.

Among the 80 farm properties on which acaricide use for between zero and two years was reported, 24 producers (30%) had changed the product following g recommendations from Embrapa Dairy Cattle (FURLONG; PRATA, 2003a), while 14 (17.5%) had changed products for a variety of other reasons, such as human or animal poisoning. Also in relation to this total, 42 (52.5%) stated that they had noticed that the product had lost its effectiveness within this two-year period. This may have occurred because frequent use of a product selected individuals that were better adapted, from which descendants with increasing degrees of resistance would be produced, to the point that most of the population would be descended from resistant ticks (FURLONG; MARTINS, 2000).

With regard to the use of personal protection equipment (PPE), 67.5% of the producers affirmed that they used such equipment when applying acaricides, while only 15 (13.6%) used PPE effectively, i.e. correctly and completely (Table 2) and 38 (23.3%) said that they did not use it. Out of all the producers, 15 (13.6%) did not answer the question. Among those that used PPE, 77 (70%) said that they did so for safety reasons, while three (2.7%) had only started to use PPE after a bad experience of poisoning. The remainder of the producers did not report the reasons for using PPE.

**Table 2.** Characterization of the cattle tick control on the farm properties that participated in the investigation: perceptions of milk producers that used the test on tick sensitivity to acaricides at Embrapa Dairy Cattle, Juiz de Fora, Minas Gerais, between 2001 and 2005.

Information from producers*	Responses in order of frequency								Respondents** (% losses)
	1 <sup>st</sup> place	%	2 <sup>nd</sup> place	%	3 <sup>rd</sup> place	%	4 <sup>th</sup> place	%	
Mean infestation at the time of greatest incidence (ticks/ animal)	10-50		>50		<10		-		155
	77	49.7	62	40	15	9.7	-	-	(4.9)
Other animals that became infested***	Horses		Dogs and horses		Dogs		Wild animals		144
	63	43.8	48	33.3	9	6.3	8	5.6	(11.7)
Reasons for changing the acaricide	Inefficient		Recommendation from Embrapa		Other responses		-		160
	87	54.4	43	26.9	30	18.7	-	-	(1.8)
Number of acaricides used before the acaricide test	More than three		One						152
	128	84.2	24	15.8	-	-	-	-	(6.7)
Length of use of acaricide	0 to 2 years		> 2 years		Not known		For as long as it was efficient		154
	80	51.9	33	21.4	26	16.9	15	9.7	(5.5)
Use of personal protection equipment (PPE)	Yes		Yes		Not used		-		148
	Incomplete		Complete						
	95	86.4	15	13.6	38	23.3	-	-	(13.6)

\*The percentages do not take losses into consideration; \*\*Respondents – corresponding to the absolute number of producers that provided information; (% losses) percentage of questionnaires in which this question remained unanswered, taking n = 163; \*\*\*(16) 11% did not observe infestation in other animals.

Regarding the 38 producers (23.3%) that did not use PPE, six (16%) justified this in terms of the discomfort caused by the equipment; four (11%) in terms of lack of habit; and five (13%) in terms of unawareness. Twenty-three (60%) did not answer this question. A hypothesis can be raised that some producers might not have known what PPE is, given that, erroneously, this was not explained in the questionnaire. However, these data are worrying, given that for farm workers performing activities in which toxic products are used, the use of overalls or plastic covers, masks, boots and gloves is recommended (ZOLDAN, 2005). Therefore, the only justifications for not using such equipment when the farm property makes PPE available are lack of knowledge and lack of adequate training. If there is a lack of awareness regarding PPE and the risks of exposure to the products, training should be prioritized (CARVALHO; AMARAL, 2003).

In relation to the acaricide efficiency test (DRUMMOND et al., 1973), only 16 producers (10%) reported difficulties in obtaining or sending ticks to Embrapa Dairy Cattle. Problems with the postal service and complaints about the cost of sending samples through the post were cited (Table 3).

With regard to the service for testing acaricide efficiency against ticks that was provided by Embrapa Dairy Cattle, 93.1% of the producers considered that it was effective, while 6.3% rated it poorly, mainly because they had not received the results from the efficiency tests. After receiving the results from the efficiency test, 157 producers (98.7%) said that they had applied the recommended acaricide. This high rate of acceptance of the product that resulted from the test is a satisfactory result, but for the control process really to be effective, the acaricide also needs to be applied correctly and at the right time.

Associations of pyrethroids with phosphorates (Colosso®, Aspersin®) were the contact acaricides that presented the best

efficiency results in the acaricide tests. These associations were recommended for these producers by Embrapa (n = 47; 40.2%), followed by associations of phosphorates (Caberson®, Ectofós®) (n = 45; 38.5%), phenylpyrazoles (Top-line®) (n = 15; 12.8%) and others (n = 10; 8.5%). Similar results have also been found by several other authors (SOARES et al 2001; ROCHA 2005). Thus, it could be seen that for a large proportion of the farm properties, associations between active agents were the only means for controlling ticks efficiently. This is worrying, because mixtures of active agents increase the chances of poisoning the animals and the acaricide operator, and contaminating the environment and the milk.

Out of the 157 producers that applied the product recommended from the test, 146 (93%) said that they had acquired the product easily, while eight (5.1%) encountered difficulties. Because the prices of other products were more affordable, three producers (1.9%) chose to buy the recommended product only as the second choice. This demonstrated that most of the products tested by Embrapa Dairy Cattle could easily be found on the market in the regions sampled, and that it was possible to indicate acaricides more rationally, even at a distance. Moreover, out of the 157 producers that affirmed that they had used the acaricides recommended, 144 (92%) said that they had followed the strategic control. With regard to opinions about strategic control, 79% of the producers considered that the results were good to excellent, after observing the implementation of the controls.

All the producers participating in the present study were already inclined towards changing their acaricide. For this reason, it would be expected that most of them would follow other recommendations relating to tick control. In addition to asking whether the producer used a control strategy, several questions were asked seeking to understand which real changes had occurred



**Table 3.** Perceptions of milk producers that used the test on tick sensitivity to acaricides at Embrapa Dairy Cattle, Juiz de Fora, Minas Gerais, between 2001 and 2005, with regard to the acaricide efficiency test and strategic control over ticks

Information from producers*	Responses in order of frequency								Respondents** (% losses)
	1 <sup>st</sup> place	%	2 <sup>nd</sup> place	%	3 <sup>rd</sup> place	%	4 <sup>th</sup> place	%	
Difficulty in sending female cattle ticks to Embrapa	Acquisition of female ticks		Postal service		-		-		16
	10	62.5	6	37.5	-	-	-	-	(90)
Opinion on the acaricide efficiency test	Positive		Negative		Don't know		-		159
	148	93.1	10	6.3	1	0.6	-	-	(2.5)
Application of acaricide recommended by Embrapa	Yes		No		-		-		159
	157	98.7	2	1.3	-	-	-	-	(2.5)
Recommended acaricides used	Pyrethroids + Phosphorates		Phosphorates		Phenylpyrazoles		Others		127
	47	40.2	45	38.5		12.8	10	8.5	(28.2)
Application of acaricide using backpack pump	Yes		No		-		-		159
	135	84.9	24	15.1	-	-	-	-	(2.5)
Producers who followed strategic control	Yes		No		Don't know		-		155
	144	92.9	10	6.5	1	0.6	-	-	(5)
Advantages of strategic control***	Lower cost		Longer intervals between spraying the animals		Easy to implement		Less labor needed		138
	76	55.1	72	52.2	68	49.3	37	27	(15.3)

\*The percentages do not take losses into consideration; \*\*Respondents – corresponding to the absolute number of producers that provided information; (% losses) percentage of questionnaires in which this question remained unanswered, taking n = 163; \*\*\*More than one answer to this question was accepted.

on the farm properties and what each producer's understanding about control strategies was.

Out of the 144 producers that followed the guidance to implement strategic control against ticks, 33 (23%) reported that they had been motivated by confidence in Embrapa Dairy Cattle. The other producers did not answer this question. After using strategic control and the recommended acaricide, 133 producers (92.4%) affirmed that they had observed a decrease in tick numbers, and 131 (91%) had observed that the animals presented considerable improvements in their general state. According to Rocha (2006), producers wanted to have a control method that would increase the interval between applications, in order to diminish the costs and labor required. Likewise, in the present study, all the 163 producers interviewed pointed out some advantages in using strategic control: 1) 76 (46.6%) mentioned diminished costs; 2) 72 (44.2%) cited the longer intervals between spraying the animals; and 3) 37 (22.7%) cited the ease of operation, which required little labor.

Some studies have concluded that even though tick infestations represent significant losses for milk producers, tick control is also very expensive (JONSSON et al., 2001; LEAL et al., 2003). There are many advantages when the farm owner correctly applies the control strategy, not only for consumers and the milk industry but also for the environment and for delaying the process of establishment of resistance (FURLONG et al., 2007).

Among the 133 respondents (81.6%) that noted a decrease in the number of tick attacks on the cattle after implementing the strategic control, some of them highlighted other advantages that they had noted, such as: diminished cost (n = 75; 56%); increased intervals between spraying the animals (n = 70; 52.6%); and diminished need for labor (n = 35; 26%). Furthermore, 130

producers (79.8%) out of those that noted improvements in the animals after implementing the strategic control also observed advantages such as diminished cost (n = 72; 55%); increased intervals between spraying the animals (n = 68; 52%); and diminished need for labor (n = 35; 27%).

In the present study, it was observed that backpack pumps were the equipment most used by these producers, on 135 (84.9%) of the farm properties studied. Similar results were found by Rocha (2005) and Santana et al. (2001). One of the critical factors relating to acaricide spraying is that if the equipment is used inappropriately, this may limit the effectiveness of the spray treatment. Thus, if the quantity of acaricide solution is insufficient to cover the animal's entire body area, the ticks will not be killed (FURLONG et al., 2007). When asked to describe the procedure of acaricide spraying, out of the 46 producers (28%) that answered the question, only 29 (63%) described it correctly (Table 4).

It is emphasized that among the producers that said that they were following strategic control (144 producers), only 29 (54%) of them correctly described the treatment program recommended by Embrapa Dairy Cattle (FURLONG; PRATA, 2003b).

When asked to describe how to dilute the product, out of the total number of respondents (n = 32), 29 (90.6%) stated that they followed the instruction sheet correctly, and this was confirmed through the responses to the questionnaire. Only 12 producers (7%) answered all the questions relating to strategic control correctly. This demonstrates that out of the 144 producers who believed that they were following strategic control (Table 3), only 12 (8.3%) were capable of grasping all of the content through the material that was sent to them.

**Table 4.** Perceptions of milk producers that used the test on tick sensitivity to acaricides, regarding spraying the animals with acaricide.

Characteristics*	Categories		P value (OR)	Respondents** (% losses)
Form of acaricide application	Correct	Incorrect	> 0.05	46
Modified	18	14	-	-
Not modified	11	3	-	-
Total	29 (63%)	17 (37%)	-	(72)
Interval between acaricide applications	Correct	Incorrect	0.02	54
Modified	27	17	-	-
Not modified	2	8	-	-
Total	29 (54%)	25 (46%)	-	(67)
Dilution of acaricide	Correct	Incorrect	> 0.05	32
Modified	21	3	-	-
Not modified	8	-	-	-
Total	29 (90.6%)	3 (9.4%)	-	(80)

\*The percentages do not take losses into consideration; \*\*Corresponds to the absolute number of producers that provided information; \*\*\*Fisher test.

## Conclusion

The results from this investigation and the analyses performed show that almost all of the producers had difficulty in understanding the parameters required for implementing strategic control against cattle ticks.

In order to obtain real improvements in tick control within the sphere of milk-producing farm properties, i.e. for the technology available to be used correctly, there is a need to seek effective improvements in communication between researchers, public and private agents and rural producers, and to establish training of a more adequate nature for producers.

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