

SURVIVAL FOLLOWING POST-LEPIDOPTERAN INSECTICIDE APPLICATIONS IN SOYBEANS

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The purpose of the refuge in a resistance management programme is to allow survival of susceptible individuals to delay the development of resistant insects. The objective of this study was to quantify the levels of survival at different levels of damage and insecticide application. The experiment was carried out at INTA EEA Reconquista, Santa Fe (Argentina), in a soybean crop (Munasqa, GM VIII) under no tillage with a 52cm row spacing. Treatments were arranged in a randomized complete block design in plots of 41.6m², with three replications. The crop was exposed to natural attack by Lepidopteran pests. Treatments were: i) 1-5 no residual insecticide (100 cc/ha cypermethrin 25%), ii) 6-10 residual insecticide (120 c/ha methoxyfenozide 24% (IGR), applied when defoliation levels 5, 10, 15, 20 and 30% were reached, regardless of the phenological state, and iii) 11 control treatment. Analyzing the evolution of the percentage of leaf area damaged, treatments clearly differed and generated two groups with different percentages of damage. The group less damaged, (treatments 1, 2, 6 and 7) was maintained throughout the growing season below 10% defoliation, whereas the group with the most damage (treatments 3, 5, 10, 9, 8 and 4) reached 35% defoliation at R1 and remained in a range of 25- 35% at R2, which started to decline in R4-R5 to reach percentages of damage similar to the less damaged group. The control treatment (11) accompanied the evolution of this group, but extended its period of maximum defoliation to R3. The first group differed significantly from other treatments and showed the lowest values (<10%) of average leaf area damaged throughout the crop cycle. When comparing the number of larvae in the treatment maintaining the percentage of leaf area damage of <10% (co-incident with the threshold set by INTA of 8-10% leaf area damage at R3-R6) with the control treatment, this group can be proposed as refuge management according to this threshold. This would generate 50% of susceptible individuals in comparison to an untreated refuge without yield decreases. Treatments 1, 2, 6 and 7 produced the highest yield (3.662kg/ha average) and were statistically different from other treatments using insecticide (2.637kg/ha average) and with the control (1.607 kg / ha). In conclusion, the management of the refuge strip must be in accordance with thresholds using INTA and IGR insecticides, so that the refuge produces the maximum number of susceptible individuals without affecting grain production.

Survival post-lepidopteran insecticide applications in soybeans

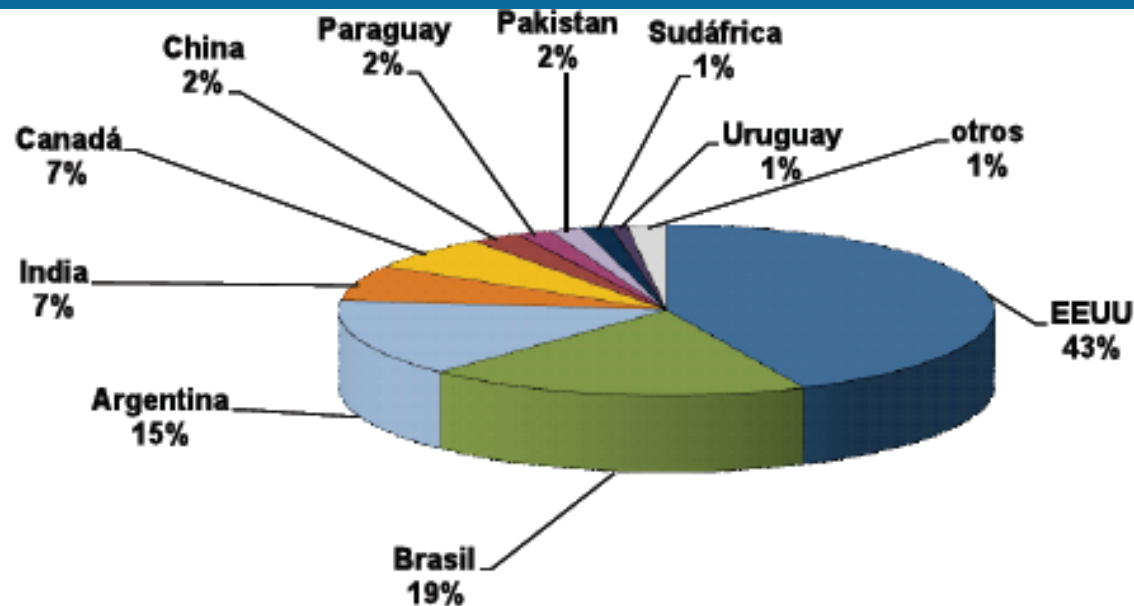
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Introduction

- The first GM crop incorporated to Argentina was soybean RR in 1996. (Trigo y Cap, 2006)
- GM crops have been used extensively worldwide.
- GM Bt crops have proven to be an effective insect control tool and are used on a significant scale in agriculture. (Ferré et al, 2008).

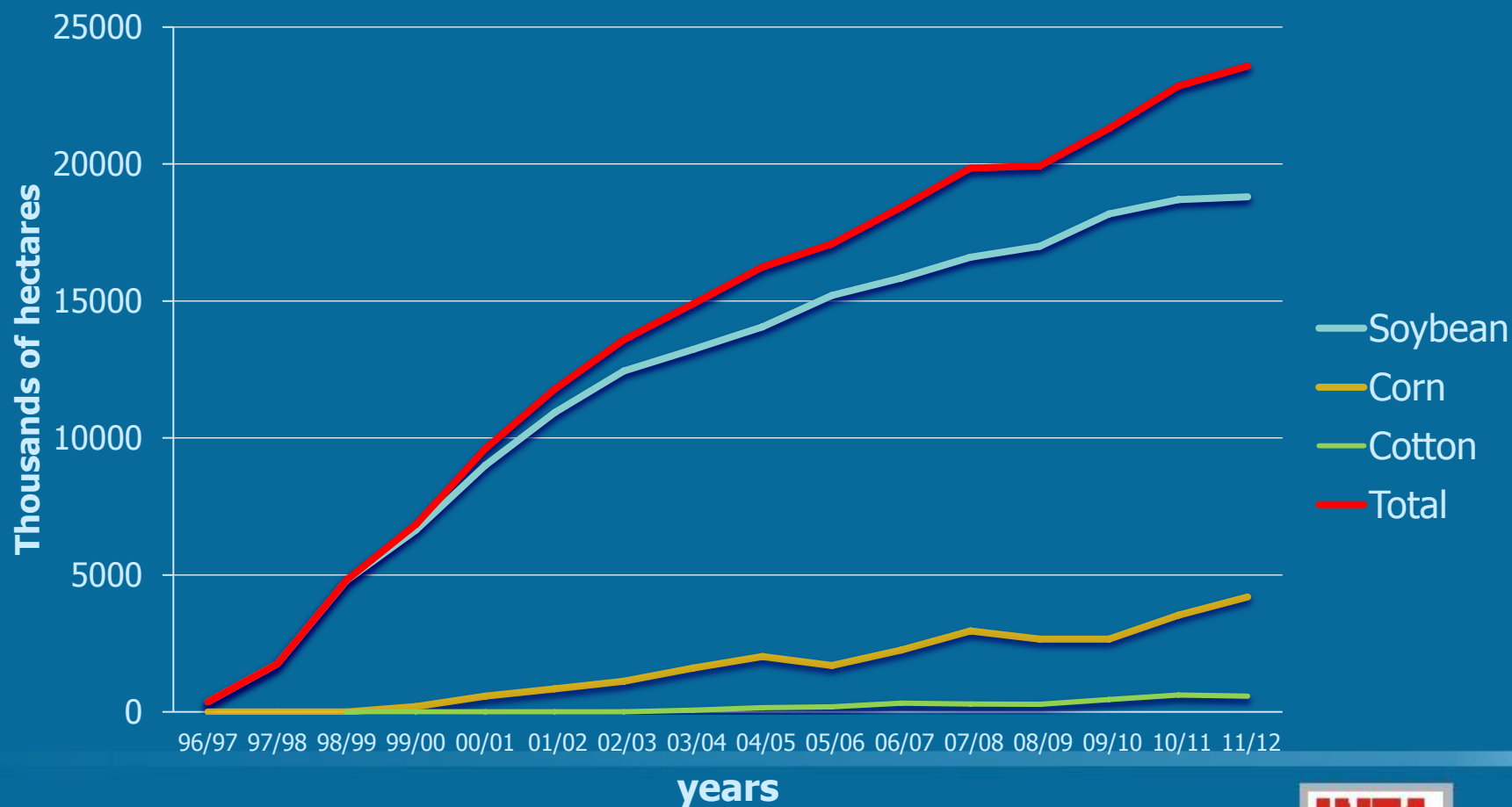
Global area planted with GM, by country (over 160 million hectares)



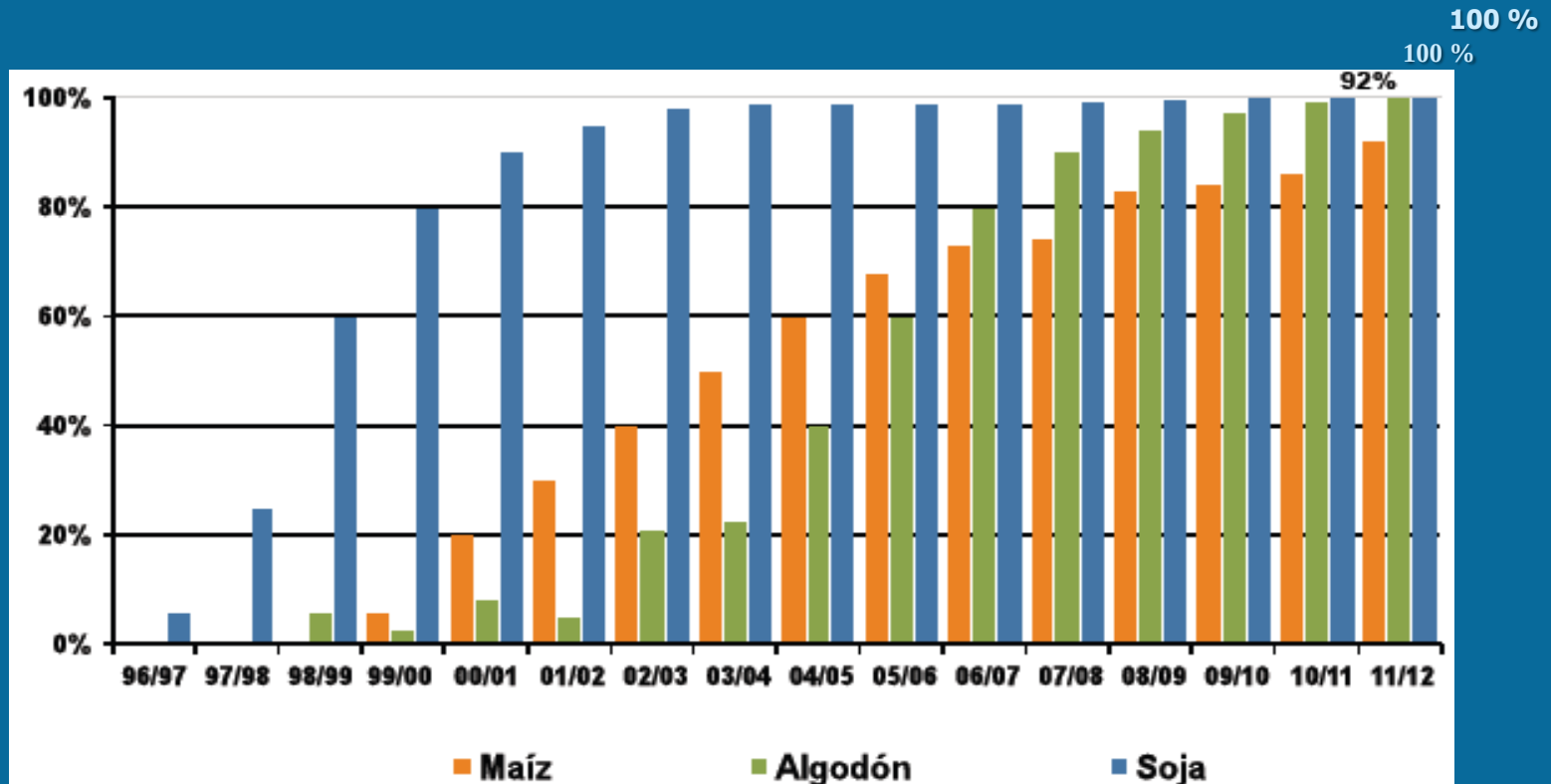
Fuente: ISAAA, 2011

Otros: Bolivia, Australia, Filipinas, Myanmar, Burkina Faso, España, México, Colombia, Chile, Honduras, Portugal, República Checa, Polonia, Egipto, Eslovaquia, Costa Rica, Rumania, Suecia, Alemania. Total: 29

Argentina: Evolution of the area planted with GM crops (thousands of hectares)



Argentina: Evolution of the area planted with GM crops (as % of each crop)



Fuente: ArgenBio - Minagri

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Insect resistance management (IRM)

- The main threats to this technology: the potential for insects to evolve resistance to GM insecticidal plants.
- Resistance to Bt sprayable products has been demonstrated.
- A high dose of the insecticidal protein along with an adjacent refuge plot of non-Bt plants has been chosen as the most effective strategy to IRM (Ferré et al, 2008).

Insecticide Resistance Management

- After 15 years of intensive use of Bt maize and Bt cotton, about four (4) major target pests of Bt crops remain susceptible to Bt toxins in the USA and Canada (Huang et al, 2011). *Ostrinia nubilalis*, *Diatraea grandiosella*, *Heliothis virescens* and *Pe..*
- Field resistance due to control failure to a Bt crop has been clearly documented in three situations: fall armyworm [*Spodoptera frugiperda* JE Smith] in Puerto Rico, African stem borer [*Busseola fusca* Fuller (Lepidoptera: Noctuidae)] in South Africa, and pink bollworm *P. gossypiella* in India. (Huang et al, 2011).

Insecticide Resistance Managment

- Factors associated with these cases include: failure to use high-dose Bt cultivars and lack of sufficient refuge.
- These observations support the claim that implementation of the 'high-dose / refuge' IRM strategy has been successful in substantially delaying field resistance to Bt crops. (Huang et al, 2011).
- The purpose of the refuge in a resistance management program is to generate individuals susceptible to delay the appearance of resistant insects.

Objective

- The aim of this study was to quantify the levels of lepidopteron survival at different levels of damage and insecticides.

Reconquista

Methods

- INTA EEA Reconquista, Santa Fe (Argentina).
- Soybean crop (Munasqa, MG VIII).
- Zero tillage.
- 52 cm between rows.
- Randomized complete block design in plots of 41.6 m², with three replications.
- The crop was exposed to natural attack of lepidopteron pest.



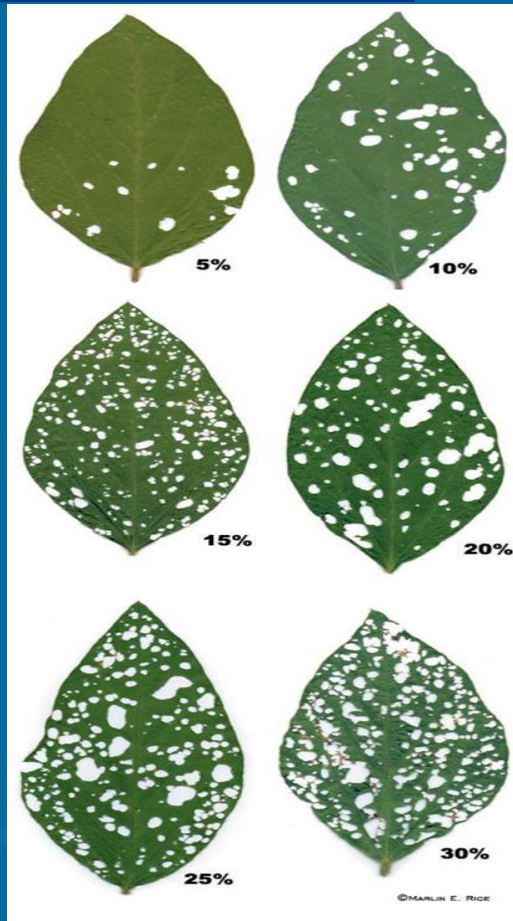
Tecnología Agropecuaria



Sampling of larvae was made with Vertical Cloth (3 meter/plot)



Estimation of damage



- 40 folioles extracted
- 20 of the upper stratum
20 the middle stratum

Treatments

Treatment	Description	Defoliation threshold
1	100 cc Cipermetrina 25 %	5%
2	101 cc Cipermetrina 25 %	10%
3	102 cc Cipermetrina 25 %	15%
4	103 cc Cipermetrina 25 %	20%
5	104 cc Cipermetrina 25 %	30%
6	120 cc/ha metoxifenocide 24 %	5%
7	120 cc/ha metoxifenocide 24 %	10%
8	120 cc/ha metoxifenocide 24 %	15%
9	120 cc/ha metoxifenocide 24 %	20%
10	120 cc/ha metoxifenocide 24 %	30%
11	Control without insecticide	

Non Residual

Residual IGR

Results

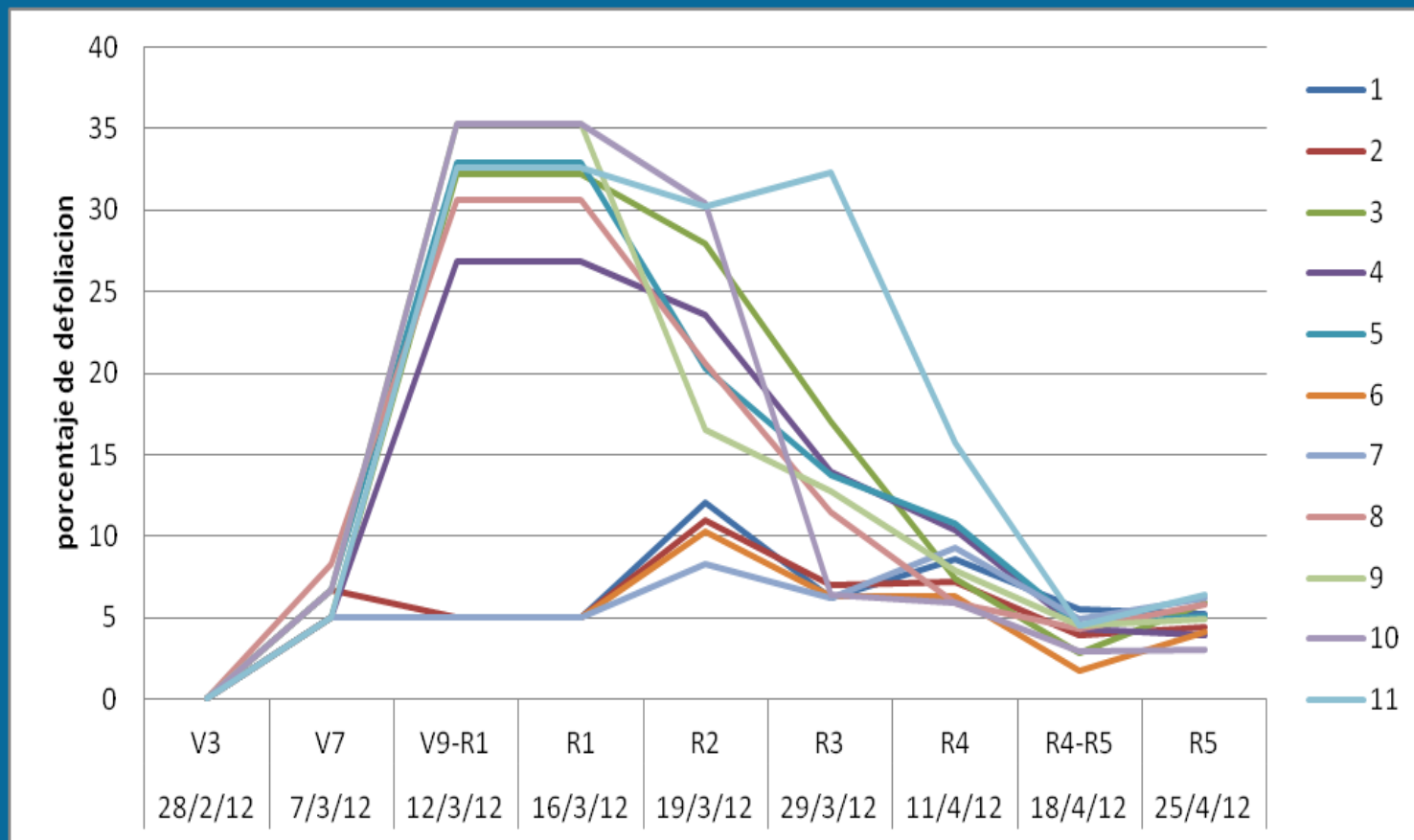
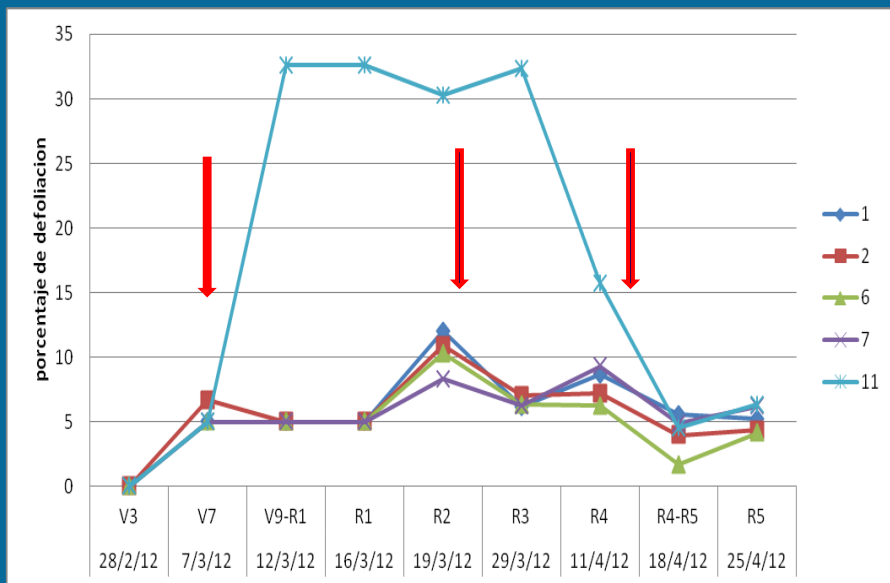


Figure 1. Evolution of foliar damage for each treatment (1-11) during the development of the soybean crop. Reconquista, Santa Fe, 2011-2012.

Evolution of foliar damage during the development of the soybean crop.

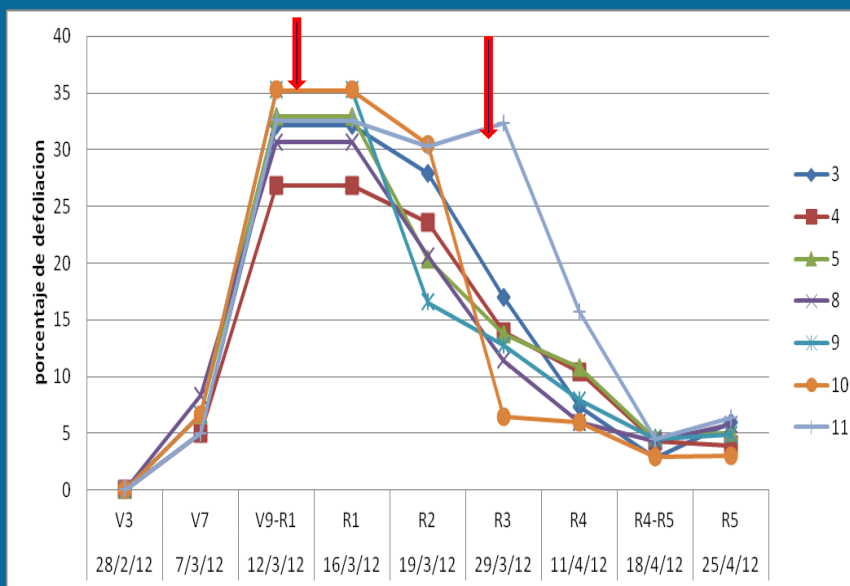


- The first group differed significantly from other treatments showed the lowest values of average leaf area damaged throughout the crop cycle below 10%.

Treatments 1, 2, 6, 7 and 11

Evolution of foliar damage during the development of the soybean crop.

- The group of most damaged, reached 35% defoliation at R1 and remained in a range between 25 and 35% to R2.
- Then decline to similar level to the less damaged group.



Treatments 3, 4, 5, 8, 9, 10 and 11



Control



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Control

Parcial view of the experiment

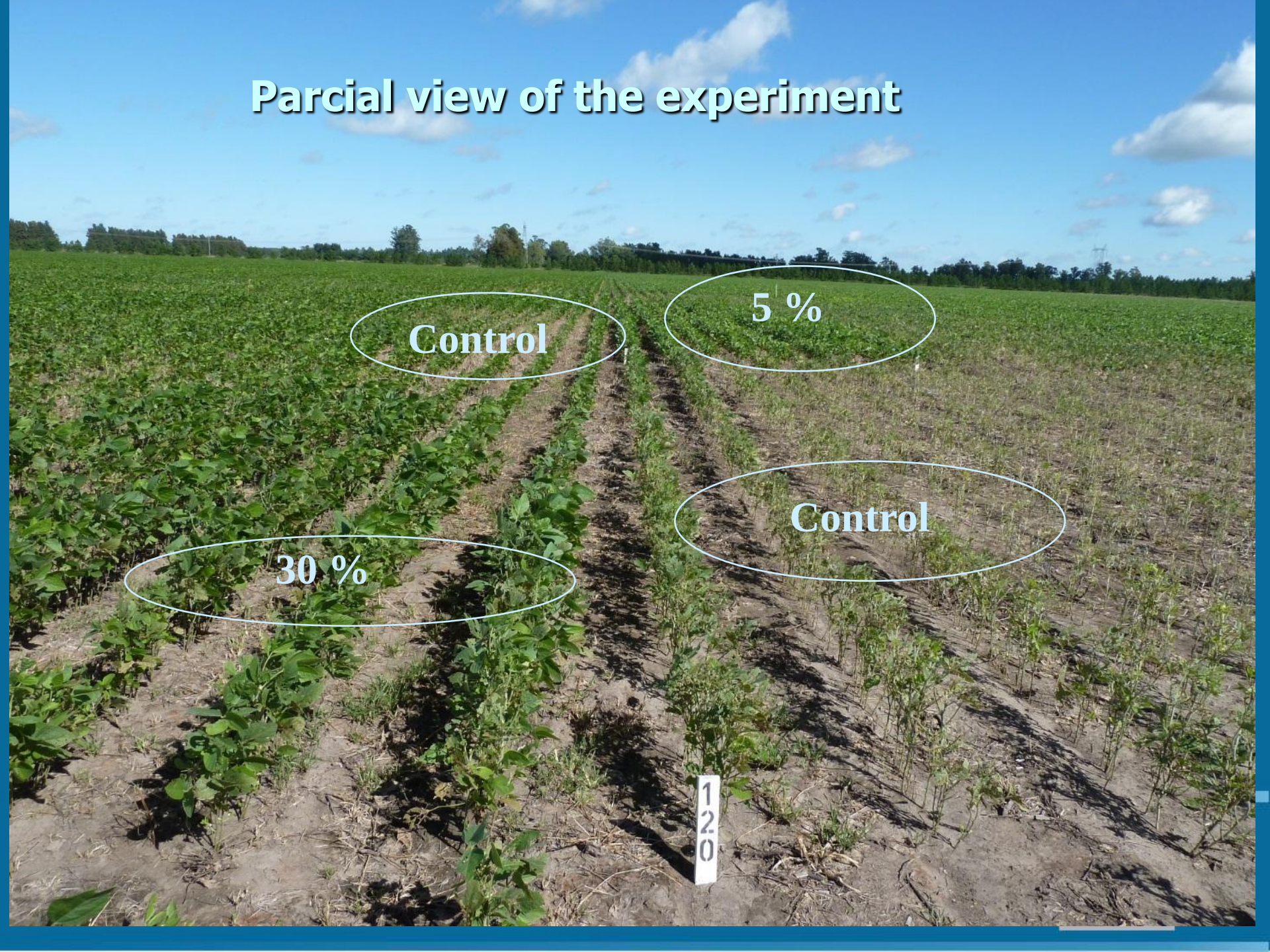
Control

5 %

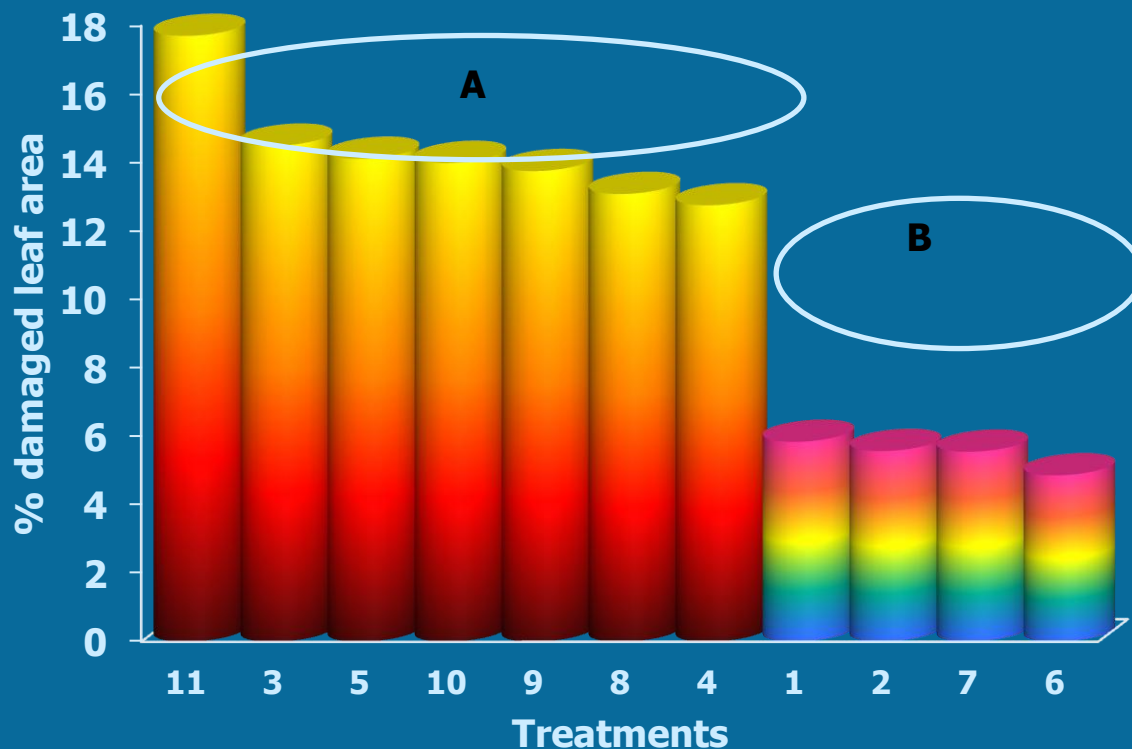
30 %

Control

1
2
0



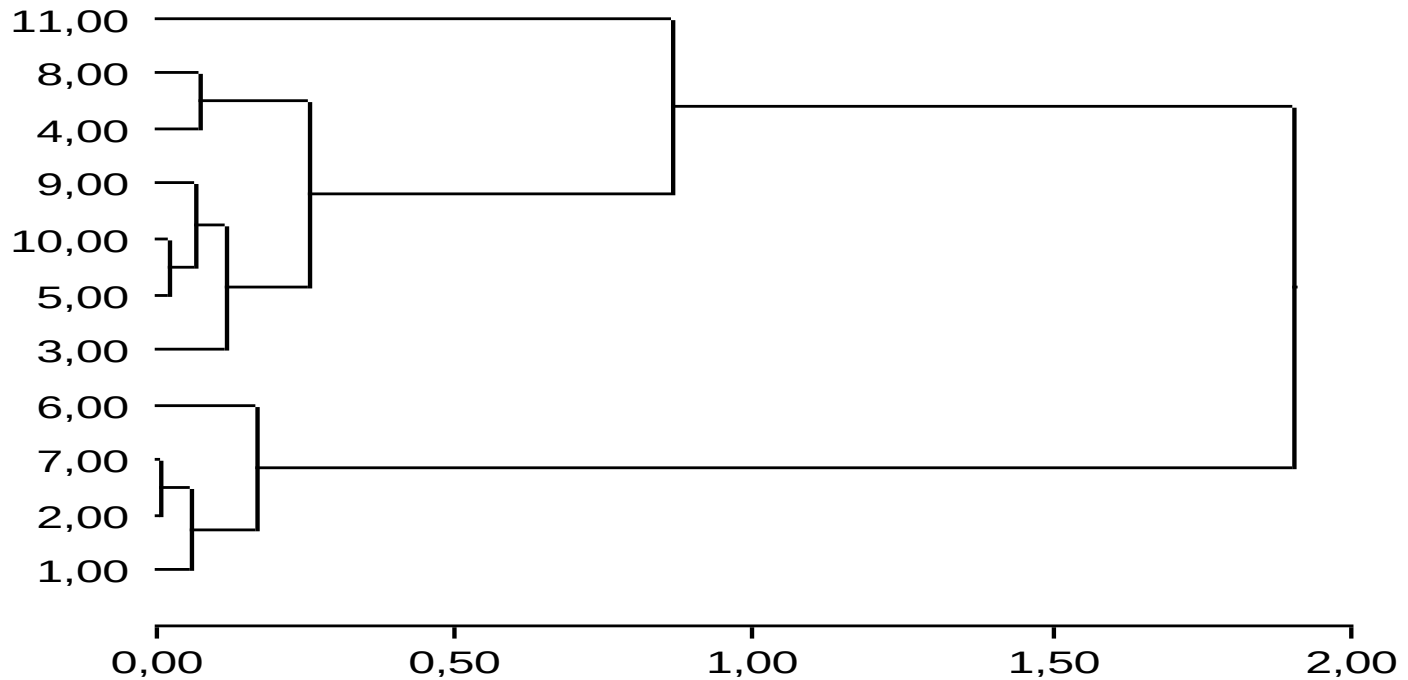
Percentage of damaged leaf area average of all the soybean crop cycle. Reconquista, Santa Fe, 2011-2012.



Means with a common letter are not significantly different ($p \leq 0.05$)

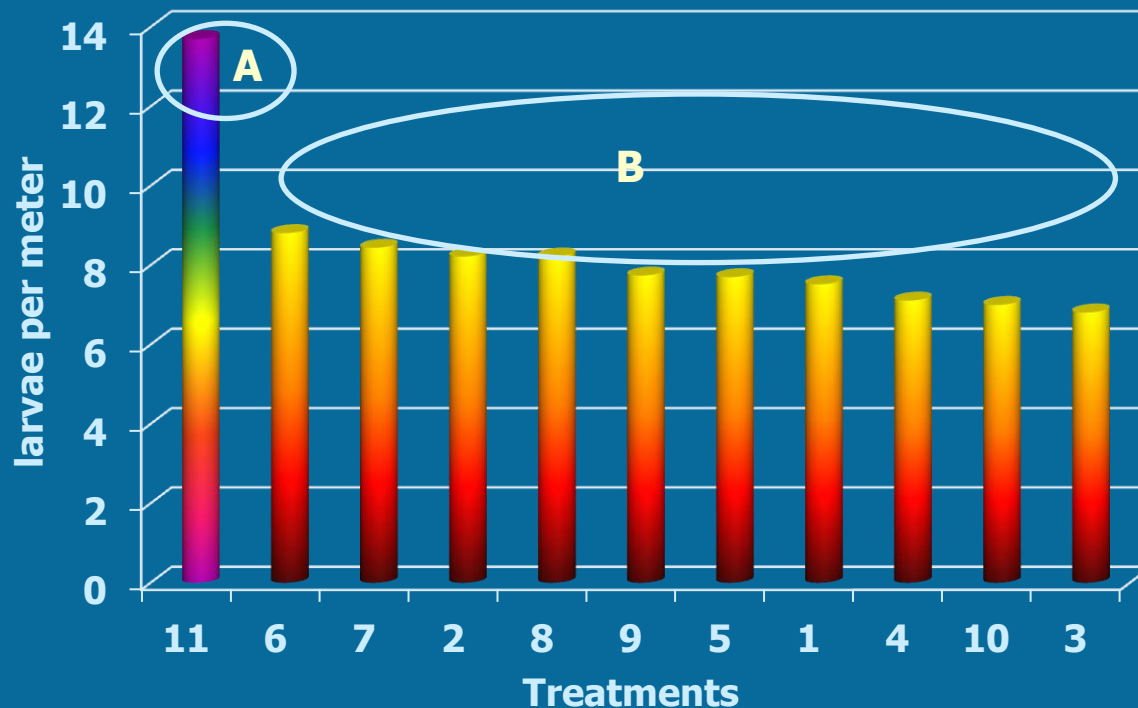
Promedio (Average linkage)

Distancia: (Euclidea)



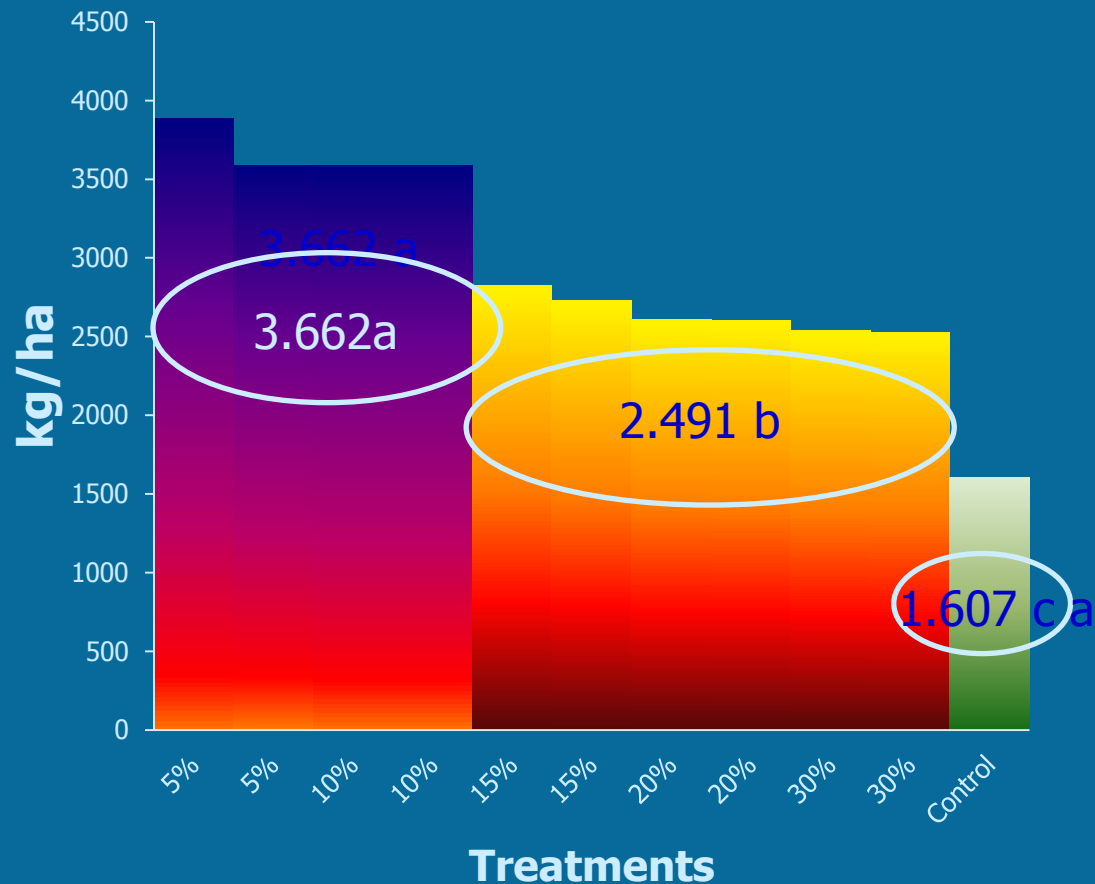
Dendrogram for the variable percentage of leaf area damaged (1-11 are treatments).

Average number of larvae per meter of the entire soybean crop cycle.



Means with a common letter are not significantly different ($p \leq 0.05$)

Yield of each treatment.



Means with a common letter are not significantly different ($p \leq 0.05$)

Reasons for proposing refuges management with 10% defoliation

- INTA threshold: 8-10% damage leaf area in R3-R6.
- Number of larvae in the treatment with damaged below 10%.
- This would generate 50% of susceptible individuals in comparison to an untreated refuge without yield decreases.
- The ones that produced (10%) the highest yield (3.662 kg / ha average) and statistically separated from other treatments with insecticide (2.637 kg / ha average) and with the control treatment (1.607 kg / ha).

Conclusion

- Management of the refuge strip must be in accordance with thresholds proposed by INTA and IGR insecticides, thereby, the refuge would produce the maximum amount of susceptible individuals without affecting grain production.

Acknowledgement

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Thanks

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