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# Reducing Pesticide Use on Guatemalan Snow Peas Exported to the United States

**Abstract**

A collaborative project between the University of Florida and the Universidad Rafael Landívar in Guatemala evaluated ways to reduce the amount of insecticide used to manage thrips (*Thrips tabaci*, *Frankliniella occidentalis*, and *F. insularis*) on snow pea (*Pisum sativum*) grown for export. Replicated field trials were carried out at the government agricultural experiment station near Chimaltenango, Guatemala, from 2007-2008. One set of trials compared the effect of applying insecticides at flowering versus germination on densities of thrips and thrips predators. A separate set of trials evaluated faba bean (*Vicia faba*) as a trap crop for thrips when intercropped with snow pea. In addition, maize (*Zea mays*) was evaluated as a source of generalist predators when grown next to snow pea. Results demonstrate that delaying insecticide applications until the initiation of flower production did not increase thrips densities or reduce yields when compared to the common regional practice of applying insecticides soon after plant emergence. Thrips densities were significantly higher in faba bean than snow pea. However, thrips densities on snow pea intercropped with faba bean were not statistically lower than thrips densities on snow pea grown in monoculture, indicating that faba bean does not function as a trap crop for thrips when intercropped with snow pea. Densities of predatory Coleoptera, Neuroptera and Dermaptera were significantly higher on snow pea adjacent to maize than distant (25 meters) from maize, and higher on snow pea receiving delayed insecticide applications than on snow pea sprayed soon after germination. Predator densities were significantly higher in unsprayed snow pea than in either insecticide treatment. However increased predator densities did not result in a significant reduction of thrips densities. This research demonstrated that delayed insecticide applications can contribute to the reduction of insecticide use on snow peas grown in Guatemala. Trap cropping with faba beans is apparently not an option for reducing insecticide use on snow pea. Conservation biological control of snow pea pests by manipulating predators in adjacent maize merits further study. This research was funded by the Foreign Agricultural Service of the USDA.

**Introduction**

Snow pea (*Pisum sativum*) has been grown as an export crop in Guatemala since the late 1970s. Since 2003, over 20 metric tons of snow peas have been imported to the United States from Guatemala each year (AGEXPORT Guatemala). The United States is the primary destination for snow peas produced in Guatemala, and Guatemala is the primary source of snow peas for the United States. There are about 20,000 snow pea farmers in Guatemala (Hart 2005). Guatemalan snow pea growers are overwhelmingly low resource Mayan farmers who produce snow peas on less than two acres, primarily in the western highlands. While the impact of growing non-traditional export crops such as snow peas on poor Guatemalan farmers has been controversial, many highland communities have benefited from growing snow peas (Hamilton and Fischer 2003).

Since 1992, the Food and Drug Administration has imposed an automatic detention program on Guatemalan snow peas entering the US because Guatemalan snow peas consistently tested positive for illegal pesticide residues. Most violations were for chlorothalonil, a fungicide, but insecticides have also been involved. Exporters must provide documentation in the form of laboratory analysis to show that snow peas from Guatemala are free of illegal residues.

Snow peas are exported to the US fresh and frozen. Companies that export frozen snow peas tend to provide pest management assistance to their growers to ensure appropriate pesticide use. Some of these companies carry out in-house residue analysis that enables them to remove growers from their program if the grower delivers contaminated produce. Farmers who grow snow peas for the fresh market tend to operate independently. They are less likely to receive technical pest management support, and more likely to produce snow peas with illegal pesticide residues. They sell to intermediaries who have not typically attached importance to exporting residue-free snow peas. The primary arthropod pests of snow peas in Guatemala are thrips, leafminers, caterpillars, aphids, and grubs (Calderón et al 2000). Most insecticide use is driven by thrips pressure. Thrips feed directly in the snow pea pod and cause scarring that reduces marketability.

In 2004, I (HAS) began working with snow pea growers in Panimatzalam and San Miguel las Canoas in the department of Sololá. Three aspects of snow pea production in particular seemed to have a strong bearing on thrips densities and insecticide use. 1) Growers apply insecticide to snow pea soon after germination in order to suppress thrips. 2) Faba bean (*Vicia faba*) is grown adjacent to snow pea as an export crop, and thrips densities are significantly higher on faba bean than on snow pea. 3) Corn (*Zea mays*) fields adjacent to snow pea often harbor predators that feed on aphids and thrips. These predators include ladybird beetles, lacewings, syrphid larvae, predatory anthocorids and predatory mites.

Three research questions arose from these observations.

1) Snow pea pods are not present until after the flowering stage of the crop. Thrips present in snow pea before the flowering stage may debilitate the plant, but do not cause damage to the marketed portion of the crop. Would it be possible to delay insecticide applications on snow pea until the crop begins to flower? Snow pea grown on the central coast of California does not typically receive insecticide applications until it reaches the flowering stage.

2) Given that thrips densities are consistently higher on faba bean than snow pea, does faba bean function as a trap crop for thrips, as some scientists in Guatemala suggest, or does if serve as an infestation source for thrips on snow pea? A third possibility is that thrips densities in faba bean have no effect on thrips densities in snow pea.

3) If insecticide applications in snow pea are delayed until flowering, will the predators in adjacent corn fields 1) migrate into the snow pea and 2) suppress thrips populations on an economically significant level?

In July 2005, the Foreign Agricultural Service –USDA awarded funds to the University of Florida to address these questions. A subcontract was established with the Universidad Rafael Landivar in Guatemala City to carry out the field work. The in-country arrangements were under the direction of Charles MacVean, dean of the College of Agriculture and Natural Resources at the Landivar University. Ana Cristina Bailey and Luis Calderón, staff researchers at the university, managed the field research. José Manuel Benavente, Rafael Oroxom, and Fredi Xocop, students at the university, assisted with data collection and analysis, and derived their senior research projects from the field trials.

## Research Design and Methodology

Field trials were carried out in 2007 and 2008 at an agricultural experiment station in Chimaltenango belonging to the Guatemalan agricultural research service, ICTA (Instituto de Ciencias y Tecnología Agrícola). The ICTA station in Chimaltenango is 1800 meters above sea level, located at 14° 39’ 38” north latitude and 90° 49’ 10” west longitude.

## Field Trials 2007

Two field trials were carried out in 2007, the first during the rainy season (May – August), the second during the dry season (September – December). The studies in 2007 included five treatments, each of which was replicated four times using a randomized complete block design. The treatments were: 1) snow pea with insecticide applications initiated early in the vegetative stage (~ three weeks after planting); 2) snow pea with insecticide applications initiated at approximately 20% flowering (~ five weeks after planting); 3) snow pea intercropped with faba bean, with insecticide applications initiated at 20% flowering of the snow pea; 4) faba bean with insecticide applications initiated when snow pea was at 20% flowering; and 5) snow pea receiving no insecticide treatment. The variety of snow pea used was Oregon Sugar Pod II. Crops were fertilized and treated for diseases according to regional practices (see Oroxom 2008 for detail).

The insecticides used were dimethoate, endosulfan, and malathion. The insecticide regime used was modeled after the insecticide program of MayaPac, a snow pea export company that collaborated on the project.

Each experimental unit was 15 x 15 meters and included nine crop rows with a between row distance of 1.25 meters. The distance between plants was 5 cm for snow pea and 30 cm for faba beans. Three rows of corn (*Zea mays*) were planted as a source of predators along one end of each block perpendicular to the snow pea and faba bean rows. A local non-hybrid variety of corn was used.

Whole plant samples were collected 35, 50, 65, and 80 days after planting. Four plants were collected per replicate for a total of sixteen plants per treatment per collection date. In order to collect information on the effect of proximity to corn on densities of thrips and predators, two plants were collected at a distance of 1.25 meters from the corn, and two plants were collected 11.25 meters from the corn. Plants were cut at the soil surface and placed in plastic bags. They were transported to a laboratory at the Universidad Rafael Landivar in Guatemala City.

An 18.9-liter (5-gal) plastic water bottle was modified to function as a collection sieve for insects on the snow pea and faba bean. The lower half of the bottle was cut away, and the central portion of the screw-on cap was replaced with organdy cloth by using a glue gun. The half-bottle was placed in a large sink with the cap end down. Plants were washed over the cut-away end of the bottle so that the water carried all insects into the screw-on cap, where material collected on the organdy. The cap was removed after the plant had been thoroughly washed, and its contents were examined under a microscope.

The number of thrips was recorded for each plant, as was the number of thrips predators.

Snow pea harvest was initiated 70 days after planting, and was carried out twice a week. Yield data were gathered in 2007, but not in 2008. The response variables analyzed were: densities of thrips under different treatments and at two distances from corn; densities of predators under different treatments and at two distances from corn; and export quality snow pea harvested from each snow pea treatment. The insecticide treatments were analyzed separately from the faba bean treatments: analysis was carried out comparing data from conventional, delayed spray and untreated snow pea; a separate analysis was carried out comparing data from snow pea intercropped with faba bean, faba bean alone, and snow pea receiving the delayed insecticide treatment. The trials were carried out twice in 2007, once in the dry season and once in the rainy season.

The data were analyzed using analysis of variance, followed by Tukey's means separation when appropriate, with significance declared at $P = 0.05$. The analysis was carried out using ProStat version 4.01.

**Field Trials 2008**

A single field trial was carried out in 2008. Three treatments were compared: 1) early application of insecticide to snow pea; 2) application of insecticide initiated at the flowering stage; and 3) an untreated control. Faba bean treatments were not included in the 2008 trial. Plots were 30 m x 30m and included 10 rows of snow pea. Corn was planted on one side of each block. A quick-growing corn hybrid was grown. Corn was planted the first week of June. Snow pea was planted the first week of July. The same insecticide treatments were used as in the previous two experiments. Insecticide applications were initiated September 5 on the delayed application treatment.

Sampling was initiated ten days after plants germinated, and every two weeks until harvest was completed. The sample dates were Aug 12 and 25, September 8 and 22, and October 6 and 21. In each plot on each sample date, five plants were sampled randomly 2 meters from the stand of corn, and five plants were sampled randomly 25 meters from the stand of corn. Therefore a total of 120 plants were sample per sample date (5 plants x 2 distances x 4 replicates x 3 treatments).

## Results and Discussion

**Insecticide Treatments.** There were no statistical differences between insecticide treatments with regard to thrips densities in either year or with regard to yield in 2007 (Tables 1-3, Fig. 1-2). Delaying insecticide applications until flowering (about 35 days after germination) did not significantly increase thrips densities or reduce yield of export quality snow pea. Unsprayed snow pea had significantly higher thrips densities and significantly lower yield than the two insecticide treatments during the dry season cycle. There were no statistical differences in thrips densities near (2 meters) to corn versus far (25 meters) from corn.

In 2008, the predators collected in snow pea were lowest in the early spray treatment, intermediary in the delayed spray treatment, and highest in the untreated control (Tables 4-7, Fig. 3). Predators collected consisted of ladybird beetles (Coccinellidae), rove beetles (Staphylinidae), lacewings (Chrysopidae) and earwigs (Dermaptera). Densities of predators tended to be higher near (2 meters from) the corn than farther (25 meters from) the corn (Fig. 4). Predator densities in the untreated control were significantly higher near the corn than farther from the corn. Predator densities in the untreated control 25 meters from the corn were not different from predator densities in the delayed spray 25 meters from the corn. The data indicate that even in the absence of insecticides, the predator complex did not disperse in high numbers into the snow pea.

**Faba bean.** During both the rainy and dry season trials, thrips densities were not statistically different between snow pea treatments (snow pea intercropped with faba bean and snow pea in monoculture), and were significantly higher on faba bean than on each snow pea treatment. During the rainy season trial in 2007, there were no statistical differences in thrips densities under the three treatments (intercrop, faba bean monoculture, snow pea monoculture) 35 and 50 days after planting. Thrips densities were significantly higher on faba bean than on either snow pea treatment 65 days after planting and 80 days after planting during that trial. There is no evidence from these studies that faba bean functions as a trap.

## Conclusions

The results from this series of field trials indicate that insecticide applications on snow pea can be delayed until the initiation of flowering without reducing yield. Results support the idea that corn can serve as a source of predators. Thrips densities were not statistically lower near corn, where predator densities were higher. There is no evidence the predator complex collected during sampling contributed significantly to thrips suppression. The predators collected during this study were primarily ladybird beetles, rove beetles, lacewings and earwigs. With the exception of certain rove beetles, this predator complex has not been generally implicated in thrips suppression on an economic level. It is noteworthy that even in the untreated snow pea these predators did not migrate far from the corn plot. The predatory anthocorid and predatory mite detected in corn and snow pea during 2004 near Sololá were not recovered during these trials.

Field trials from 2007 confirm that faba bean does not function as a trap crop for thrips when planted adjacent to snow pea. It cannot be concluded from these studies whether removing faba bean from the crop mix would reduce thrips pressure on snow pea. Since thrips are abundant in corn, which predominates in agricultural landscapes in Guatemala, thrips will presumably always be present in snow pea growing regions of Guatemala.

## Other Benefits

Three undergraduate students from the Universidad Rafael Landivar derived senior thesis projects from this series of studies. The students were José Manuel Benavente Mejia, Rafaél Oroxóm, and Fredi Orlando Xocop Chuy. They graduated in 2008.

## Follow Up Activities

Trials should be replicated in other snow pea growing areas in Guatemala to confirm that insecticide applications can be delayed until flowering without loss of yield. Future insecticide trials for thrips management in Guatemalan snow pea should include insecticides that have favorable environmental and worker safety profiles and some degree of compatibility with biological control. These materials include neonicotinoids, insect growth regulators, and newer chemistries such as the feeding blocker flonicamid. Microbial insecticides such as *Beauvaria* *bassiana* and *Steinernema feltiae* may be effective against thrips in the higher humidity of the rainy season crop cycle.

It would be useful to survey the beneficial arthropods associated with aphids, thrips and other herbivores in corn in different regions of Guatemala. Predators established in the corn refuges used in the studies reported here may have been sparse compared to predators found in larger contiguous corn fields in other parts of the Guatemalan highlands. An inventory of beneficial arthropods associated with corn in the Guatemalan highlands would provide a foundation for future studies in conservation biological control of highland pests.

Finally, the results of this study should be disseminated among the community of agro-exporters in Guatemala as an example of how to carry out long term pest management research in collaboration with research institutions.

**Tables and Figures**

**Table 1. Effect of insecticide application on snow pea yield** (From Xocop thesis 2008)
Analysis of variance of snow pea yield under three insecticide treatments, dry season.
Insecticide Treatment (Sistema de Aplicación) is significant.

| Fuente de Variación | Grados de Libertad | Suma cuadrados | Cuadrado Medio | Valor-F | Pr > F |
|---|---|---|---|---|---|
| Bloque | 3 | 3221.69507 | 1073.89836 | 0.75 | 0.5625 |
| Sistema de Aplicación | 2 | 12637.65602 | 6318.82801 | 4.39 | 0.0668 |
| Error | 6 | 8628.88141 | 1438.1469 | | |
| Total | 11 | 24488.2325 | | | |

C.V. = 24.95979, α = 5%

**Figure 1. Effect of Insecticide Treatment on Snow Pea Yield** (Xocop thesis 2008)
Convencional = early spray treatment; Retardada = delayed spray; testigo = untreated control

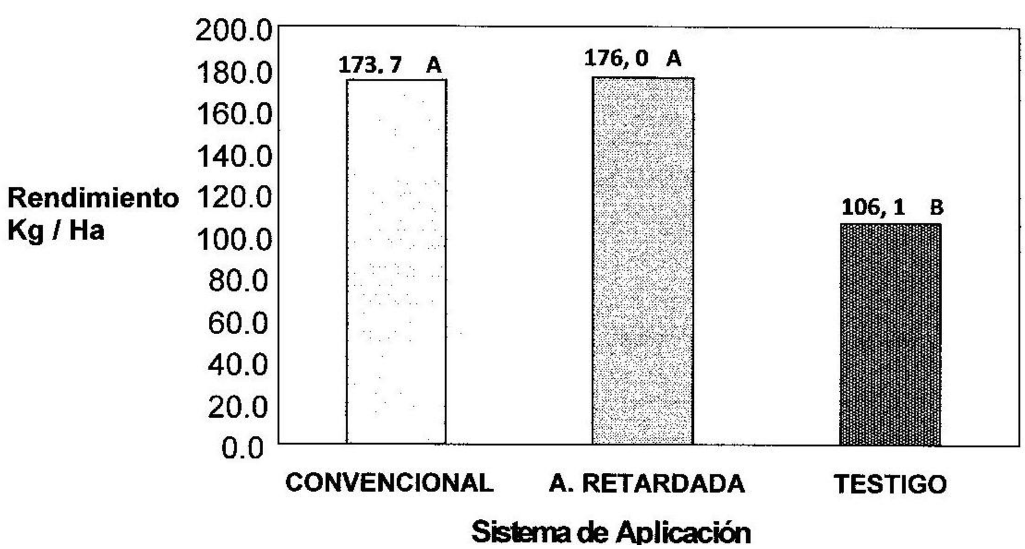


**Table 2. Effect of Insecticide Treatment on Thrips Densities in Snow Pea**

Tests of Between-Subjects Effects
Dependent Variable: thrips (indiv/5 plants)

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 431,750 | 17 | 25,397 | 1,891 | ,024 |
| Intercept | 8836,000 | 1 | 8836,000 | 657,903 | ,000 |
| REGIME | 185,292 | 2 | 92,646 | 6,898 | ,001 |
| DISTANCE | 12,250 | 1 | 12,250 | ,912 | ,341 |
| PHENOL | 66,500 | 2 | 33,250 | 2,476 | ,088 |
| REGIME * DISTANCE | 5,042 | 2 | 2,521 | ,188 | ,829 |
| REGIME * PHENOL | 56,208 | 4 | 14,052 | 1,046 | ,386 |
| DISTANCE * PHENOL | ,667 | 2 | ,333 | ,025 | ,975 |
| REGIME * DISTANCE * PHENOL | 105,792 | 4 | 26,448 | 1,969 | ,103 |
| Error | 1692,250 | 126 | 13,431 | | |
| Total | 10960,000 | 144 | | | |
| Corrected Total | 2124,000 | 143 | | | |

R Squared = ,203 (Adjusted R Squared = ,096)

**Table 3. TUKEY showing higher thrips on unsprayed snow peas than either pesticide regime.**

thrips (indiv/5 plants)
Tukey HSD

| | N | Subset | |
|---|---|---|---|
| pesticide application | | 1 | 2 |
| at flowering | 48 | 7,02 | |
| conventional | 48 | 7,04 | |
| none | 48 | | 9,44 |
| Sig. | | 1,000 | 1,000 |

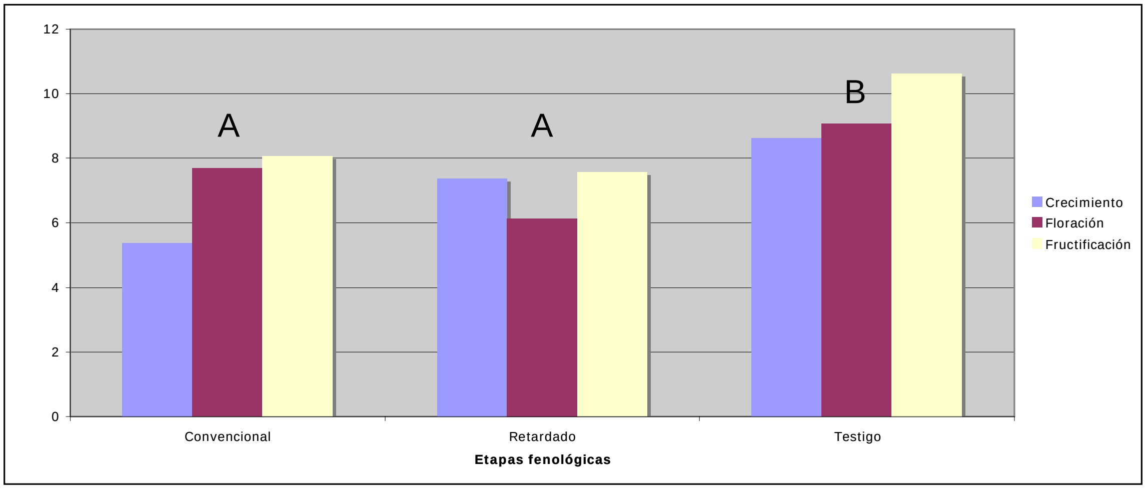
Means for groups in homogeneous subsets are displayed. Based on Type III Sum of Squares The error term is Mean Square(Error) = 13,431.

a Uses Harmonic Mean Sample Size = 48,000.

b Alpha = ,05.

**Figure 2  Insecticide Treatment Effects on Thrips Densities**

**Spray: early**     **Spray: delayed**     **untreated**




Source: Cristina Bailey

**Table 4.  Predators in snow peas**

Factors tested in Analysis of variance for total predators in peas

Between-Subjects Factors

| | | Value Label | N |
|---|---|---|---|
| distance from corn | 1 | near | 72 |
| | 2 | far | 72 |
| pesticide application | 1 | conventional | 48 |
| | 2 | at flowering | 48 |
| | 3 | none | 48 |
| crop phenology | 1 | vegetative growth | 48 |
| | 2 | flowering | 48 |
| | 3 | pod formation | 48 |

Analysis of variance for total predators (transformed by sq. root + .375 for each value, a common transformation to improve normality and equality of variances as suggested by Zar for data that contain zeroes)

**Table 5. Analysis of variance for total predators Tests of Between-Subjects Effects**

Dependent Variable: sq rot totpred + .375

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 85,213 | 17 | 5,013 | 8,405 | ,000 |
| Intercept | 388,642 | 1 | 388,642 | 651,656 | ,000 |
| DISTANCE | 10,771 | 1 | 10,771 | 18,060 | ,000 |
| REGIME | 50,807 | 2 | 25,403 | 42,595 | ,000 |
| PHENOL | 7,957 | 2 | 3,978 | 6,671 | ,002 |
| DISTANCE * REGIME | 10,041 | 2 | 5,020 | 8,418 | ,000 |
| DISTANCE * PHENOL | 1,166 | 2 | ,583 | ,978 | ,379 |
| REGIME * PHENOL | 3,143 | 4 | ,786 | 1,318 | ,267 |
| DISTANCE * REGIME * PHENOL | 1,328 | 4 | ,332 | ,557 | ,694 |
| Error | 75,145 | 126 | ,596 | | |
| Total | 549,000 | 144 | | | |
| Corrected Total | 160,358 | 143 | | | |

a R Squared = ,531 (Adjusted R Squared = ,468)

**Table 6. TUKEY test showing 3 means for predators differ by pesticide regime**

sq rot totpred + .375

| | | N | Subset | | |
|---|---|---|---|---|---|
| | pesticide application | | 1 | 2 | 3 |
| Tukey HSD | conventional | 48 | ,8874 | | |
| | at flowering | 48 | | 1,7023 | |
| | none | 48 | | | 2,3388 |
| | Sig. | | 1,000 | 1,000 | 1,000 |

Means for groups in homogeneous subsets are displayed. Based on Type III Sum of Squares. The error term is Mean Square(Error) = ,596.

a Uses Harmonic Mean Sample Size = 48,000.

b Alpha = ,05.

sq rot totpred + .375

**Table 7. TUKEY for predators in different phenological stages of peas**

Predators are higher in flowering stage than in vegetative growth. Pod formation stage is not statistically distinct from either flowering or vegetative growth (therefore classed in both groups).

sq rot totpred + .375

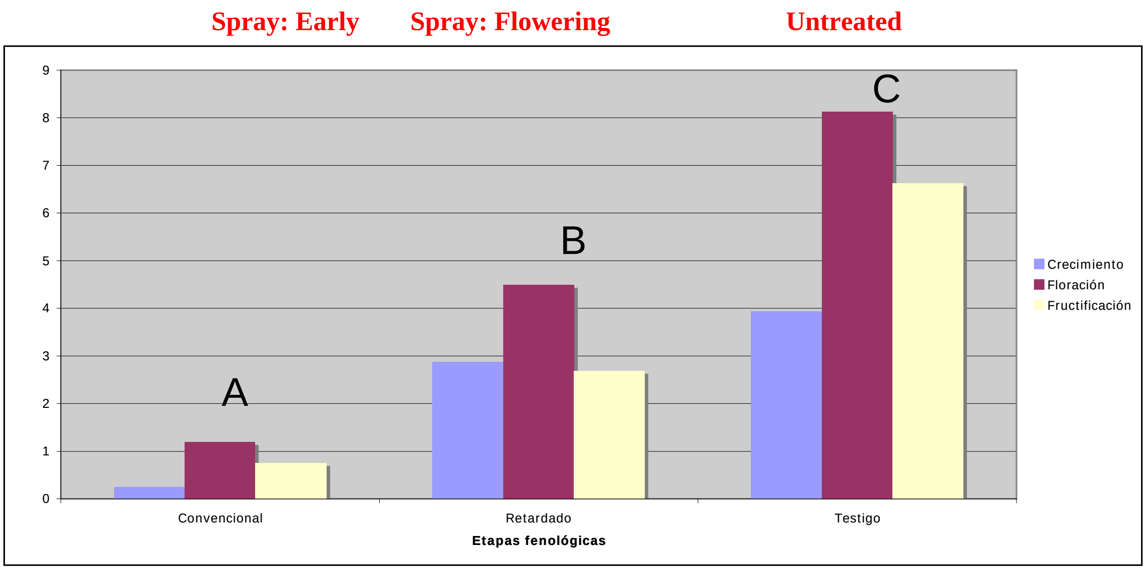
| | | N | Subset | |
|---|---|---|---|---|
| | crop phenology | | 1 | 2 |
| Tukey HSD | veg growth | 48 | 1,3410 | |
| | pod formation | 48 | 1,6730 | 1,6730 |
| | flowering | 48 | | 1,9144 |
| | Sig. | | ,089 | ,276 |

Means for groups in homogeneous subsets are displayed. Based on Type III Sum of Squares The error term is Mean Square(Error) = ,596.

a Uses Harmonic Mean Sample Size = 48,000.

b Alpha = ,05.

**Figure 3. Treatment Effects on Predator Densities**




Effect of crop phenology of snow pea and three insectcide treatments on densities of predatory beetles, lacewings and earwigs. Source: Cristina Bailey

**Figure 4. Effect of Proximity to Corn on Predator Densities**

Predators are significantly higher close to corn (5 m) than farther away (25 m), especially in untreated control. See interaction graph below: i.e. the significant effect of distance is due to the large difference in the untreated check, not so much the other treatments.

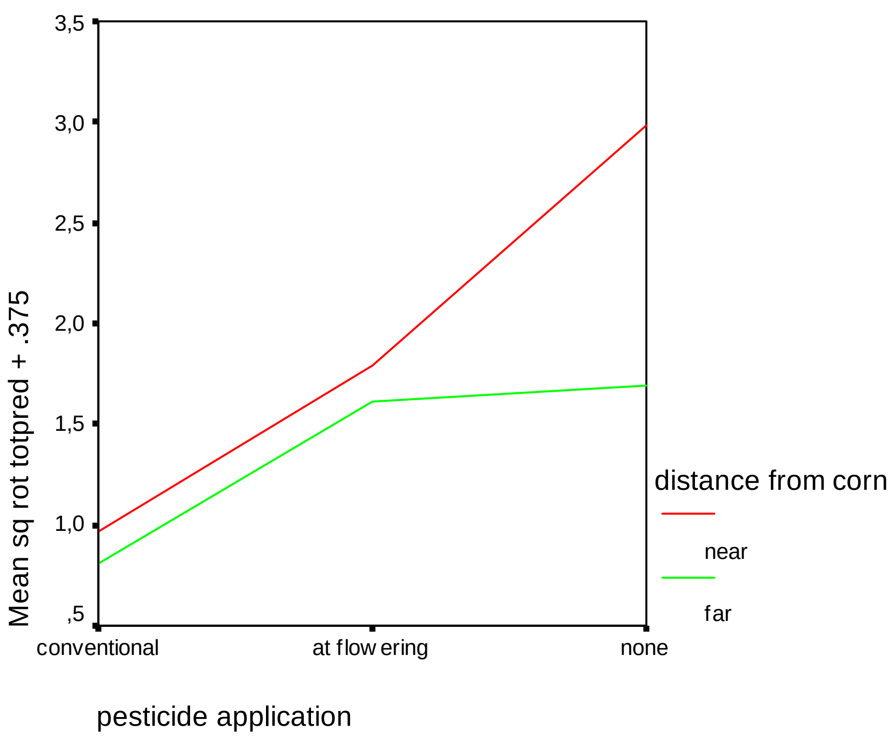


**Table 8. Analysis of Variance and Tukey Means Separation for Thrips Densities on Snow Pea Intercropped with Faba Bean, Faba Bean Alone, and Snow Pea Alone, Rainy Season 2008 (Benavente thesis 2008)**

**Cuadro 5.** ANDEVA y prueba de TUKEY global de todo el ciclo de cultivo de Arveja China en la época lluviosa.

| F.V. | gl | SC | CM | F | P-Value |
|---|---|---|---|---|---|
| Tratamiento | 2 | 726979.1667 | 363489.583 | 14.429 | 0.0051 |
| Bloque | 3 | 123385.4167 | 41128.4722 | 1.6327 | 0.2786 |
| Error | 6 | 151145.8333 | 25190.9722 | | |
| Total | 11 | 1001510.4167 | | | |

Matriz de Diferencia de Medias:

| | Arveja | Asocio |
|---|---|---|
| Asocio | 18.750 | |
| Haba | 531.250 | 512.500 |

Matriz de Rechazo (Grupos de Tukey):

| | Arveja | Asocio |
|---|---|---|
| Asocio | No | |
| Haba | Yes | Yes |

Nivel Crítico al 95% de Confianza:
345.012

**Table 9. Analysis of Variance and Tukey Means Separation of Thrips Densities on Snow Pea Intercropped with Faba Bean, Faba Bean Alone, and Snow Pea Alone 35, 50, and 65 Days After Planting (Benavente thesis 2008)**

**Anexo 3. Resultados estadísticos del análisis de la Densidad Poblacional de Trips.**

**Cuadro 1.** ANDEVA para el Muestreo 1 (35 dds) en la época lluviosa.

| F.V | gl | SC | CM | F | P-Value |
|---|---|---|---|---|---|
| Tratamiento | 2 | 937.5000 | 468.7500 | 0.8182 | 0.4851 |
| Bloque | 3 | 1875.0000 | 625.0000 | 1.0909 | 0.4222 |
| Error | 6 | 3437.5000 | 572.9167 | | |
| Total | 11 | 6250.0000 | | | |

**Cuadro 2.** ANDEVA para el muestreo 2 (50 dds) en la época lluviosa.

| F.V | gl | SC | CM | F | P-Value |
|---|---|---|---|---|---|
| Tratamiento | 2 | 78.1250 | 39.0625 | 0.0520 | 0.9497 |
| Bloque | 3 | 1705.7292 | 568.5764 | 0.7572 | 0.5575 |
| Error | 6 | 4505.2083 | 750.8681 | | |
| Total | 11 | 6289.0625 | | | |

**Cuadro 3.** ANDEVA y prueba de TUKEY para el muestreo 3 (65 dds) en la época lluviosa.

| F.V | gl | SC | CM | F | P-Value |
|---|---|---|---|---|---|
| Tratamiento | 2 | 109296.8750 | 54648.4375 | 10.5013 | 0.0110 |
| Bloque | 3 | 17018.2292 | 5672.7431 | 1.0901 | 0.4225 |
| Error | 6 | 31223.9583 | 5203.9931 | | |
| Total | 11 | 157539.0625 | | | |

Matriz de Diferencia de Medias:

| | Arveja | Asocio |
|---|---|---|
| Asocio | 21.875 | |
| Haba | 212.500 | 190.625 |

Matriz de Rechazo (Grupos de Tukey):

| | Arveja | Asocio |
|---|---|---|
| Asocio | No | |
| Haba | Yes | Yes |

Nivel Crítico al 95% de Confianza:
144.628

**Table 10. Analysis of Variance and Tukey Means Separation of Thrips Densities on Snow Pea Intercropped with Faba Bean, Faba Bean Alone, and Snow Pea Alone 80 Days after Planting (Benavente thesis 2008)**

**Cuadro 4.** ANDEVA y prueba de TUKEY para el muestreo 4 (80 dds) en la época lluviosa.

| F.V | gl | SC | CM | F | P-Value |
|---|---|---|---|---|---|
| Tratamiento | 2 | 250104.1667 | 125052.083 | 7.5582 | 0.0229 |
| Bloque | 3 | 58854.1667 | 19618.0556 | 1.1857 | 0.3913 |
| Error | 6 | 99270.8333 | 16545.1389 | | |
| Total | 11 | 408229.1667 | | | |

Matriz de Diferencia de Medias:

| | Asocio | Arveja |
|---|---|---|
| Arveja | 0.000 | |
| Haba | 306.250 | 306.250 |

Matriz de Rechazo (Grupos de Tukey):

| | Asocio | Arveja |
|---|---|---|
| Arveja | No | |
| Haba | Yes | Yes |

Nivel Crítico al 95% Confianza:
261.842

**Figure 5. Thrips densities on snow pea intercropped with faba bean, faba bean grown alone, and snow pea grown alone 35 days after planting.**

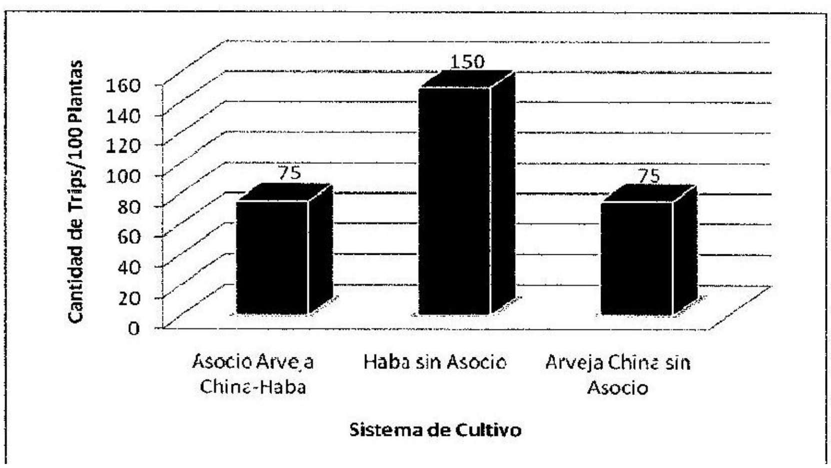


**Figure 6. Thrips densities on snow pea intercropped with faba bean, faba bean grown alone, and snow pea grown alone 50 days after planting. (Benavente thesis 2008)**

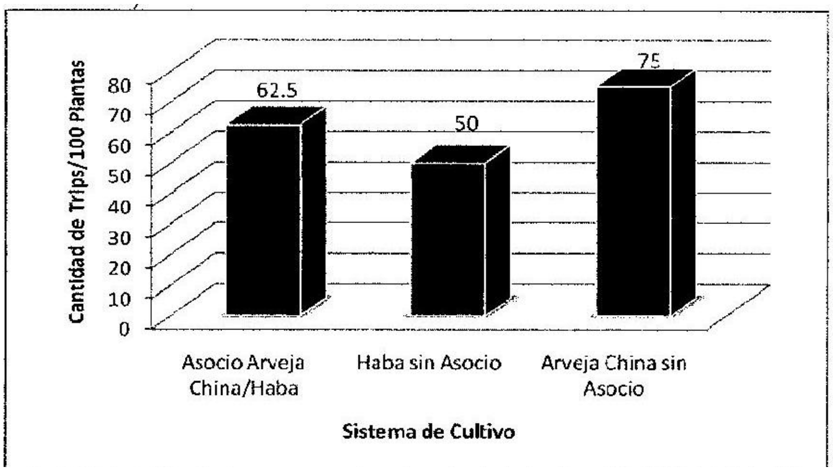
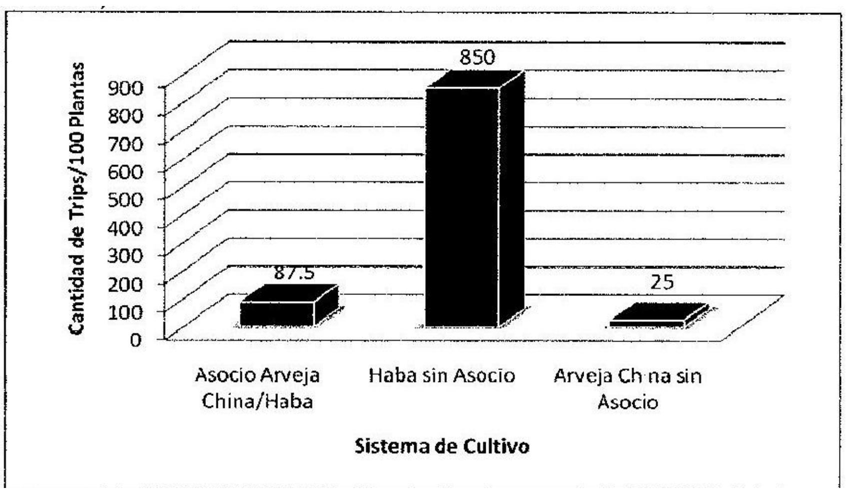
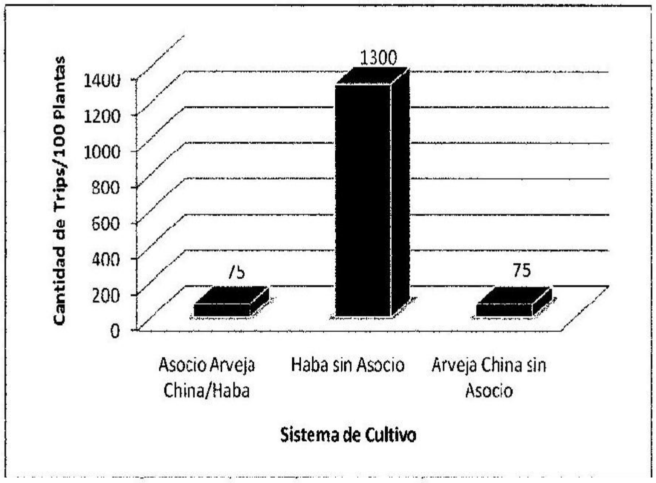



**Figure 7. Thrips densities on snow pea intercropped with faba bean, faba bean grown alone, and snow pea grown alone 65 days after planting.**




| | Época Lluviosa 65 dds | |
|---|---|---|
| **Tratamiento** | **Densidad Poblacional de Trips** | **Grupo de Tukey** |
| **Arveja China sin Asocio** | 25 | a |
| **Asocio Arveja China/Haba** | 87.5 | a |
| **Haba sin Asocio** | 850 | b |

**Figure 8. Thrips densities on snow pea intercropped with faba bean, faba bean grown alone, and snow pea grown alone 80 days after planting.**




| | Época Lluviosa 80 dds | |
|---|---|---|
| **Tratamiento** | **Densidad Poblacional de Trips** | **Grupo de Tukey** |
| **Arveja China sin Asocio** | 75 | a |
| **Asocio Arveja China/Haba** | 75 | a |
| **Haba sin Asocio** | 1300 | b |

Los tratamientos con la misma letra pertenecen al mismo grupo de Tukey por lo que no presentan diferencia estadística.

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