

EVALUATION OF MITAC ON COTTON, 1978

1. TRIALS IN COLOMBIA

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by

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Objectives

1. To examine the value of MITAC for the control of cotton pests, especially Heliothis spp, when applied by aircraft under practical conditions
2. To evaluate the efficacy of different tank mixtures of MITAC and other insecticides
3. To compare the current MITAC formulation, bfn 6554 with a new formulation, bfn 8051

Note - the original report contained Appendices 1 to 6 but these are not included here as they dealt with prior work done by the collaborating company (Celamerck) and others.

Apart from an analysis, I made no contribution to that earlier work.

SUMMARY

1. Tank mixtures of MITAC, bfn 6554, with Belmark, methyl parathion, Bolstar and Lannate were evaluated in two series of trials in the inland Tolima and Cauca Valley cotton growing areas.
2. MITAC at 300 to 400 g a.i./ha plus Belmark at 75 g a.i./ha, methyl parathion at 960 to 1200 g a.i./ha or Bolstar at 720 g a.i./ha were the most promising of the dosages tested for Heliothis virescens control.
3. MITAC at 300 g a.i./ha plus Lannate at 112.5 to 157.5 g a.i./ha was not effective enough against H. virescens and additionally the higher dose caused a degree of phytotoxicity which probably would prove unacceptable to the users.
4. There was a promising indication of the control of Spodoptera frugiperda by MITAC. This is of particular interest because of the potential use of MITAC as a component of an integrated control programme against lepidopterous pests in conjunction with the release of the parasitic wasp Trichogramma spp during the first 60 days after planting.
5. Customs and transportation delays prevented the evaluation of MITAC bfn 8051.

BACKGROUND

Trials work with MITAC in cotton in Colombia commenced in the second semester of 1976 when a small scale trial comparing the performance of a number of different products was carried out at Valledupar in the northern cotton growing area (Cotton Growers Federation Trial E-3-76 B, see Appendix 1). The level of *Heliothis* infestation was low and under these conditions MITAC at 2.5 l/ha performed as well as all the other products tested with the exception of a relatively high dose of the pyrethroid Ambush (170 g a.i./ha).

In the first semester of 1977 a number of small scale trials were carried out both by Celamerck at their Palmira Research Station in the Cauca Valley and by the Cotton Growers Federation at the ICA (Instituto Colombiano Agropecuario) Nataima Research Station in the Tolima Valley. The Celamerck trials (Appendix 2.1, Trials No. 86, 89 and 5) led to the conclusion that MITAC alone at 3.5 l/ha gave a level of control comparable to the standard methyl parathion and Azodrin treatments. Tank mixtures of MITAC with methyl parathion and MITAC plus Cottinex Triple "New" E.C. 40 gave comparable control to the MITAC alone but with considerable reductions in the dosages of MITAC and the other chemicals ie. MITAC was used at 1.5 to 2.0 l/ha and methyl parathion 48 at 2.0 l/ha compared with the 3.5 l/ha necessary when they were used alone. The Cottinex Triple dose was 1.5 l/ha in mixture with MITAC or 2.5 l/ha alone. Infestation levels were unusually high at Nataima and the trials results (Appendix 2.2, Trial Nos. E-2 1977A and E-3 1977A) were not too promising for any product although the synthetic pyrethroids performed rather better than other types of chemical. Under the severe conditions and despite being applied according to larvicide criteria (10 larvae or more per 100 terminals) MITAC used at 2.5 l/ha performed as well as the standard Toxmetil 4-2-1 + methyl parathion and as well as Orthene.

Celamerck in a letter (see Appendix 3) giving their conclusions on the work in the first semester and outlining their plans for the second semester, concluded that MITAC looked promising and was worthy of larger scale trials both in various mixtures with other insecticides and alone. Appendix 4 details the results of the trials carried out in the second semester of 1977 in the northern coastal growing regions. The best results were obtained with MITAC in mixtures with Bolstar and Padan. MITAC alone at 2.5 l/ha gave good ovicidal action but did not control larvae.

Because neither Bolstar or Padan were commercially available and because of the resistance problems encountered with methyl parathion, Celamerck were reluctant to carry out further development work with MITAC but expressed their willingness to co-operate with a team of Boots' staff in the first semester of 1978 (see Tour Reports by C.J. Hale, February 1978 and B. Taylor, March 1978).

TRIALS PROTOCOL

Following discussions with Celamerck Colombiana and after consideration of potential mixtures and dosage rates a trials protocol for H. virescens was drawn up as follows:

- (a) "Trials at two sites, one in the Tolima valley and one in the Cauca valley.
- (b) Small, ca. 5 ha fields will be treated in their entirety. Four treatments are envisaged (aerial applications by conventional spraying).

MITAC 300 g a.i./ha + Lannate 150 g a.i./ha

MITAC 300 g a.i./ha + methyl parathion 960 g a.i./ha

MITAC 300 g a.i./ha + Bolstar 720 g a.i./ha

Chlordimeform 250 g a.i./ha + methyl parathion 960 g a.i./ha

Adjacent fields with commercial treatments will be assessed as standards.

- (c) Three applications of, first, MITAC bfn 6554 and then MITAC bfn 8051 will be made.

Parallel studies of bfn 6554 and bfn 8051 may be possible; if necessary it is hoped additional bfn 6554 can be obtained from Celamerck Ecuador.

- (d) It may be necessary to evaluate MITAC when sprayed alone at, say, 700 g a.i./ha in order to provide information for a request for further Government efficacy trials".

In the event, chlordimeform was unobtainable (applications under strictly controlled conditions were planned by CIBA-Geigy and Schering but not carried out until late June). The MITAC, bfn 8051 remained in the Customs in Ecuador until mid-June and thus never became available for the trials. A further 200 l of MITAC, bfn 6554 was moved by road from Quito to Cali but this relatively short 800 Km journey took nearly six weeks and the product arrived too late for use in continuing the trials.

It did prove possible, however, to include a MITAC/Belmark mixture in the trials and Belmark alone was used as a commercial standard treatment. The proposal to use Lannate in the trials was not well received by the local agronomist in Cauca although he did permit two applications. In Tolima the use of Lannate was permitted but again its use was not over well received because of fears of phytotoxicity and consequent loss of yield.

Originally it was expected that local farm labourers would be available to assist in assessment but this expectation proved incorrect and all assessment had to be made by the authors plus an agronomist and two agriculture students employed to generally assist in all aspects of the work.

TRIALS IN THE TOLIMA VALLEY

A series of large scale trials using aerial application was carried out to evaluate the efficacy of MITAC mixtures with methyl parathion, Lannate, Belmark and Bolstar. First methyl parathion alone and then Belmark alone were used as standard commercial treatments.

Site

Hacienda La Paz, Chicoral; owner Don Guillermo Saavedra
Agronomist Sr. Hernan Infante

Trials layout

- 1) Field total area 22 ha; approx dimensions 450 m x 500 m
Divided into five approximately equal plots as shown in Fig.1.
- 2) Swath widths 18 m; five swaths per strip, strip width 90 m
(except Plot 1)

Agronomic details

Date of planting: February 26th, 1978

Variety of cotton: Delta Pine 16

Planting: Rows 1 m apart, plants thinned to approx. 70 cm apart

Prior treatments:

(a) Fertilisers; Urea Foliar 46%, 14-14-14 Fertiliser

(b) Herbicide; Treflan 3 l/ha

(c) Insecticides; Lead arsenate (3 applications)

Azodrin-Lannate (1 application)

The condition of the cotton crop was generally good although there were areas of poor growth primarily due to waterlogging earlier in the season. Weed control was good.

Soil type: Sandy

Irrigation by ground flow from canal system

Surrounding crops are also shown in Fig.1.

Climatic details

Data obtained from Nataima, ICA sub-station, about 3 Km distant.
Altitude 420 m a.s.l. Mean temperature 28°C. Annual rainfall 1400 mm.
Climate warm and dry.

Meteorological data recorded during the trials period are given in Table 1.

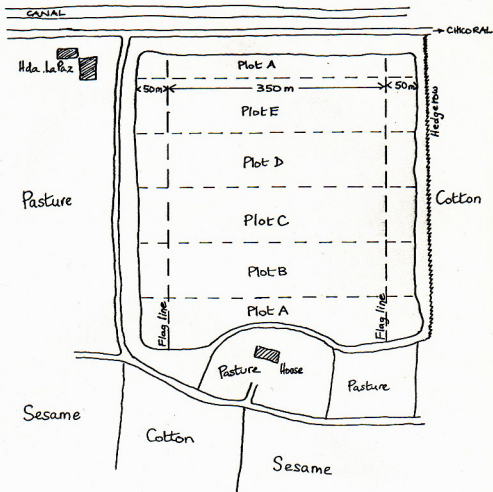


Fig.1 Trials site, Hda. La Paz, Tolima Valley

Table 1Meteorological data from Nataima

Date	Temperature °C		Rainfall
	Maximum	Minimum	mm
May 30	28.6	22.8	1.2
31	30.6	24.0	50.3
June 1	29.6	20.6	0.2
2	26.4	21.2	10.9
3	30.4	20.8	-
4	29.0	21.8	-
5	29.2	20.2	-
6	32.2	21.0	-
7	31.8	20.6	-
8	32.4	21.4	10.8
9	32.4	21.1	-
10	32.4	19.8	-
11	31.0	21.8	-
12	30.2	22.6	8.0
13	31.8	23.9	-
14	29.6	21.8	-

Application details(a) General

The spraying was by a Piper monoplane using a conventional nozzle system giving a spray swath of 18 m in width. The application rate used was 14 U.S. gal/ha. The aircraft and pilots were from the ESTRA Company of Chicoral.

(b) 1st application, 31st May

Spraying between 0900 and 1040 hours. Weather warm, slightly overcast, light winds from SSW.

Plot A Methyl parathion 48 e.c. alone. Intended dose rate was 3.5 l/ha but pilot oversprayed giving a final dose rate of 7.0 l/ha (5460 g a.i./ha)

Plot B MITAC 1.5 l/ha + methyl parathion 48 e.c. 2.0 l/ha

Plot C MITAC 1.5 l/ha + Lannate 90 w.p. 125 g/ha

Plot D MITAC 1.5 l/ha + Bolstar 72 e.c. 1.0 l/ha

Plot E MITAC 1.5 l/ha + Belmark 30 e.c. 250 ml/ha

(c) 2nd application, 5th June

Spraying between 1545 and 1710 hours. Weather warm, light breeze from SE dropping to calm by 1630 hours.

Plot A Belmark 30 e.c. 500 ml/ha

Plot B MITAC 1.5 l/ha + methyl parathion 48 e.c. 2.5 l/ha

Plot C MITAC 1.5 l/ha + Lannate 90 w.p. 125 g/ha

Plot D MITAC 1.5 l/ha + Bolstar 72 e.c. 1.0 l/ha

Plot E MITAC 1.5 l/ha + Belmark 30 e.c. 250 ml/ha

(d) 3rd application, 10th June

Spraying between 0815 and 0915 hours. Weather warm with light breeze from S.

Plot A Belmark 30 e.c. 500 ml/ha

Plot B MITAC 1.5 l/ha + Lannate 90 w.p. 175 g/ha

Plot C MITAC 1.5 l/ha + Lannate 90 w.p. 125 g/ha

Plot D Lannate 90 w.p. 350 g/ha

Plot E MITAC 1.5 l/ha + Belmark 30 e.c. 250 cc/ha

Assessments

Counts of all pest life stages visible on the upper two-thirds of 25 plants per plot were made on the second day after each application and daily thereafter. Exceptions were the 2nd June, due to heavy rain, and the 4th June, national curfew on election day. Note was made of any side-effects of the treatments, such as phytotoxicity.

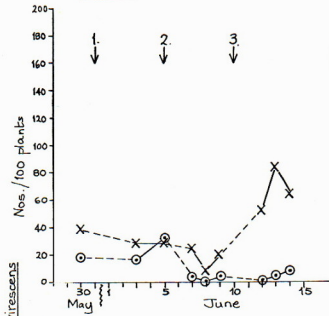
Results and discussion

(a) Heliothis virescens control

The levels of white (newly deposited) eggs and of small L₁₋₂ first and second instar) larvae, expressed as numbers per 100 plants, are shown graphically in Figs. 2 - 4. The level of small larvae, 12 per 100 plants, regarded as the economic maximum before application of insecticide is also shown on the graphs.

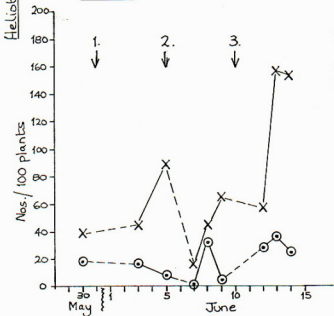
PLOT A received first methyl parathion alone and then Belmark alone at the normal commercial recommended dose of 500 ml/ha. As predicted by the local agronomist, the methyl parathion, despite the overspraying and an effective dose of 7.0 l/ha which caused considerable leaf scorch, did not give adequate control. The Belmark treatment was highly

PLOT A.



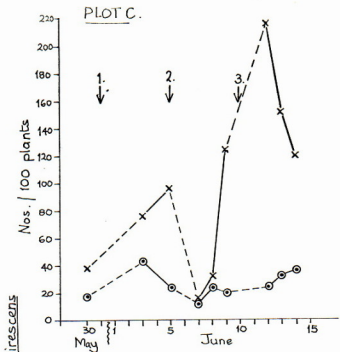
- Treatments
1. methyl parathion 48 ec 3.5 l/ha
 2. Belmark 30 ec 500 ml/ha
 3. " " " "

PLOT B.



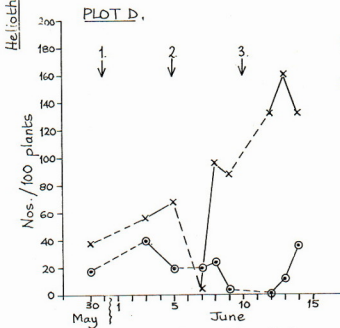
- Treatments
1. MITAC 1.5 l/ha + m. parathion 48 ec 2.5 l/ha
 2. " " " "
 3. MITAC 1.5 l/ha + Lannate 90 wp 175 g/lh

Fig. 2 Trials results in Tolima Valley



Treatments

1, 2, & 3 MITAC 1.5 l/ha
+ Lannate 90 wp 125 g/ha

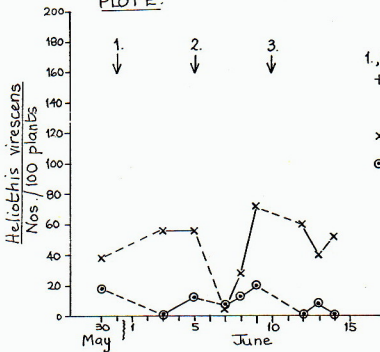


Treatments

1 & 2. MITAC 1.5 l/ha +
Bolstar 72ec 1.0 l/ha
3 Lannate 90 wp 350 g/ha

Fig. 3 Trials results in Tolima Valley

PLOT E.



Treatments
1, 2 & 3. MITAC 1.5L/ha
+ Belmark 30 ec 250 ml/ha

x-x white eggs

o-o L1-2 larvae

Fig. 4 Trial results in Tolima Valley

effective but it should be noted that the oviposition level was relatively low on this plot.

PLOT B was treated first with two applications of MITAC plus methyl parathion. The effect of this treatment was quite satisfactory especially compared with the methyl parathion alone. The drop in larval numbers on the fourth and fifth days after spraying is indicative of the ovicidal effect of MITAC as methyl parathion is effective normally only for two to three days. The MITAC plus Lannate treatment by contrast was not very effective although a drop in levels occurred on the fourth day. In addition this level of Lannate (175 g/ha) led to a fair amount of leaf discolouration which probably would prove unacceptable to users.

PLOT C received treatment with MITAC plus Lannate at a dose (125 g/ha) which gave no phytotoxicity. However, the larval level at no point fell below the 12% level and the results therefore, are unacceptable commercially. The decline in larval levels on the fourth and fifth days after the first two applications again indicates the MITAC effect.

PLOT D had two applications of MITAC plus Bolstar which showed a good level of control after the second application particularly when the MITAC effect became observable on the fourth day. The Lannate only treatment at 350 g/ha gave considerable leaf discolouration and required respraying on the fourth day.

PLOT E was treated three times with MITAC plus Belmark and gave results comparable with the Belmark alone treatment on Plot A. If the higher level of oviposition is taken into account then a commercially acceptable performance clearly was achieved.

(b) Control of other pests

The only pest species, other than H. virescens, which was recorded in sufficient numbers to observe any effects of treatment was the armyworm, Spodoptera frugiperda. The numbers of egg masses observed were not very great and thus the results shown in Table 2 are cumulative counts from the plots over the whole period of post-treatment with a particular insecticide.

As the egg masses each contain in excess of 100 viable eggs, the extremely low numbers of small larvae observed indicate an excellent degree of control by all the treatments.

Table 2

Results of *S. frugiperda* counts in the Tolima valley

Treatment		+Total no. of plants counted	<u>Spodoptera</u>	
			Egg Masses*	Small larvae
Belmark	500 ml/ha	150	8	-
MITAC 1.5 l/ha + methyl parathion	2.5 l/ha	125	4	-
MITAC 1.5 l/ha + Lannate	125 g/ha	200	5	9**
MITAC 1.5 l/ha + Bolstar	1.0 l/ha	125	3	-
MITAC 1.5 l/ha + Belmark	250 ml/ha	200	13	2

+ 25 plants counted per day

* one egg mass may consist of 100 or more eggs

** 8 on one occasion, just hatched from an egg mass

TRIALS IN THE CAUCA VALLEY

A series of large scale trials using aerial application was carried out to evaluate the efficacy of MITAC mixtures with methyl parathion, Lannate and Belmark. Belmark alone was used as a standard commercial treatment.

Site

Hacienda La Dolores, Cali; Lote 8. Owner Caucaseca Ltda.,
Agronomist Dr. Gilberto Dupue

Trials layout

- 1) Total area of field 20 ha; divided into four approximately equal plots as shown in Fig.5.
- 2) Swath widths 22 m; the number of swaths in each plot varied due to the awkward shape of the field but was never less than five

Agronomic details

Date of planting: February 28th, 1978
Variety of cotton: unknown
Planting: Rows 1 m apart, plants thinned to approx. 70 cm apart
Prior treatments:

- (a) Insecticides; Dimethoate-Decis (1 application)

The condition of the cotton crop was generally good with only a few areas of poor growth due to waterlogging. Weed control (mechanical) was good at the start of the trial but got progressively out of hand.

Soil type: Medium clay
Irrigation by over-head water cannon ("rain bird")
Surrounding crops are also shown in Fig.5.

Climatic details

Weather recording facilities were not available near the Cali trial site and thus the data given under the applications is merely a rough guide to the general conditions prevailing at the time.

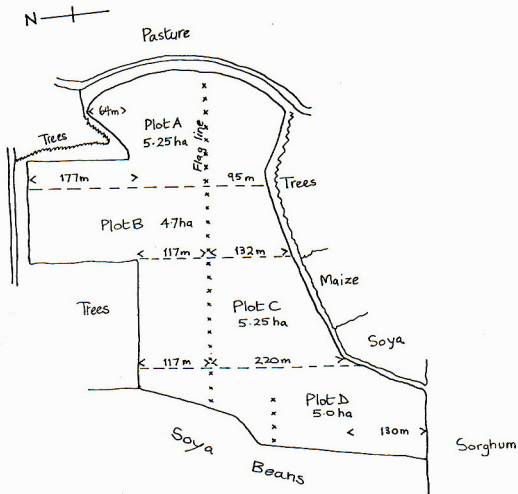


Fig. 5 Trials site, Hda. La Dolores, Cauca Valley.

(a) General

The spraying was by Bell helicopter fitted with two spray booms and using a conventional nozzle system giving a spray swath of 22 m in width. The application rate used was 12 U.S. gal/ha. The helicopters and pilot were from the Helivalle Company of Palmira.

(b) 1st application, 22nd May

Spraying between 0700 and 0800 hours. Weather warm, temperature c. 20°C. Overcast, no winds. Foliage of plants wet from overnight rain.

Plot A MITAC 1.5 l/ha + methyl parathion 48 e.c. 2.0 l/ha

Plot B MITAC 1.5 l/ha + Lannate 90 w.p. 170 g/ha

Plot C MITAC 1.5 l/ha + Belmark 30 e.c. 250 ml/ha

Plot D Belmark 30 e.c. 500 ml/ha

N.B. 1.0 l of Agral wetter was added to the treatments A, C and D.

(c) 2nd application, 29th May

Spraying between 1100 and 1200 hours. Weather hot, temperature 25-30°C, light wind from SW. Plants dry.

Plot A MITAC 1.5 l/ha + methyl parathion 48 e.c. 2.0 l/ha

Plot B MITAC 1.5 l/ha + Lannate 90 w.p. 125 g/ha

Plot C MITAC 1.5 l/ha + Belmark 30 e.c. 250 ml/ha

Plot D Belmark 30 e.c. 500 ml/ha

N.B. 1.0 l of Agral wetter added to treatment D.

(d) 3rd application, Plot A - 3rd June*
Plots B, C and D - 5th June

Spraying between 0930 and 1000 hours both days. On 3rd, weather hot, temperature 25-30°C, wind moderate NE. On 5th, weather warm, overcast, temperature 15-20°C, no wind. Plants dry.

Plot A MITAC 1.5 l/ha + Belmark 30 e.c. 250 ml/ha

Plot B Belmark 30 e.c. 500 ml/ha

Plot C MITAC 1.5 l/ha + methyl parathion 48 e.c. 3.0 l/ha

Plot D MITAC 3.5 l/ha

* The application dates differed as an attempt was made to follow the economic level for application timing. The same applies for the 4th applications.

- (e) 4th application, Plots A and B - 9th June
Plots C and D - 10th June

Spraying between 0800 and 0830 hours on the 9th. Weather warm, temperature 20-25°C, no wind. Upper leaf surfaces dry, squares moist.

Spraying between 0730 and 0800 hours on the 10th. Weather warm, temperature 20-25°C, no wind. Plant foliage moist.

Plot A MITAC 1.35 l/ha* + Belmark 30 e.c. 300 ml/ha

Plot B Belmark 30 e.c. 500 ml/ha

Plot C Belmark 30 e.c. 500 ml/ha

Plot D Belmark 30 e.c. 500 ml/ha

* Insufficient MITAC was left to apply the previous rate of 1.5 l/ha

Assessments

Counts of all pest life stages visible on the upper two-thirds of 25 plants per plot were made on the second day after each application and daily thereafter. The exception was the 4th June, national curfew on election day. Note was made of any side effects of the treatments, such as phytotoxicity.

Results and discussion

- (a) Heliothis virescens control

The levels of white (newly deposited) eggs and of small (L₁₋₂ first and second instar) larvae, expressed as numbers per 100 plants are shown graphically in Figs. 6 and 7. The commercially accepted economic level of small larvae at 12 per 100 plants is also shown on the graphs.

The first application of insecticide on 22nd May was determined by the level of oviposition in order to give the maximum opportunity for evaluation of the effect of MITAC.

PLOT A received two applications of MITAC plus methyl parathion followed by two applications of MITAC plus Belmark. On the basis of the economic larval threshold the MITAC/methyl parathion treatments were not successful but oviposition levels were high and a good degree of control was achieved. The first application of MITAC plus Belmark also did not bring the larval level below the threshold although a good control of emergence was shown. With a decline in the egg levels the second MITAC/Belmark treatment was successful.

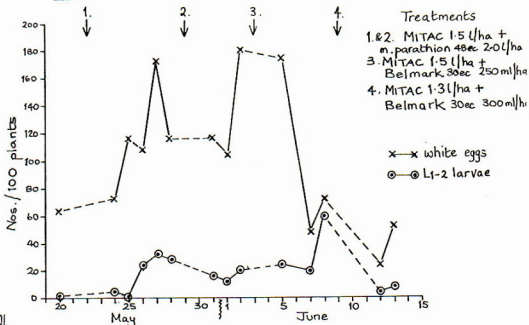
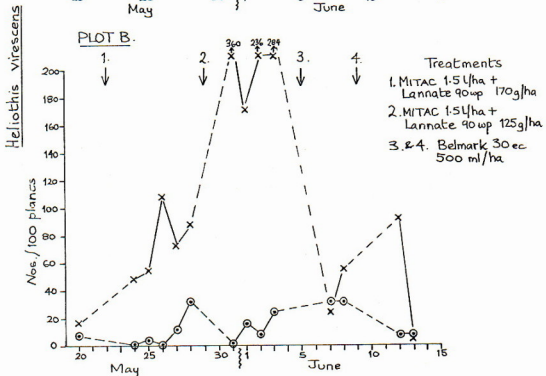
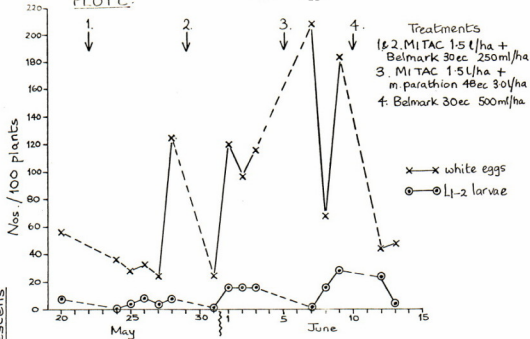
PLOT A.PLOT B.

Fig. 6 Trials results in Cauca Valley

PLOT C.

-18-



PLOT D.

Heliothis virescens

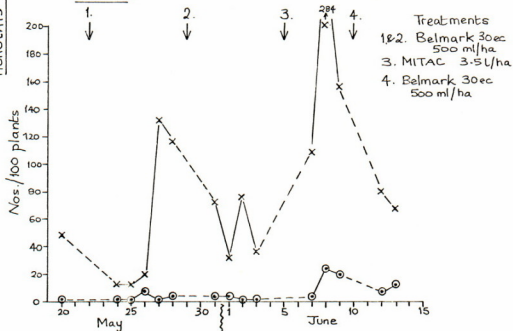


Fig. 7

Trials results in Cauca Valley

PLOT B was treated first with MITAC plus Lannate at 170 g/ha then with MITAC plus Lannate at 125 g/ha. The lowering of the Lannate dose was necessary because of some leaf discolouration, although this was primarily at the ends of the plot and where some swath overlap took place. Both applications gave some five days of acceptable control. The first of the subsequent applications of Belmark in the face of a very high level of oviposition gave 88% control of emerging larvae but this did not reduce the larval level to below the commercial threshold. With the drop in oviposition the second Belmark application was successful.

PLOT C first had two applications of MITAC plus Belmark. The first was successful and the second in the face of increasing egg levels gave a near acceptable performance. The subsequent MITAC/methyl parathion treatment gave what was probably a high degree of ovicidal activity but did not keep the larval level below the commercial threshold. The final application on this plot was of Belmark alone and this performed well.

PLOT D received two successful applications of Belmark alone. The third application was of MITAC alone and this in the face of what probably was an increasing oviposition level was successful enough to indicate that further testing of this dose rate, 3.5 l/ha would be justified. The final application of Belmark alone was successful.

(b) Control of other pests

Alabama argillacea eggs were observed in large numbers during the early part of the trials period but all of the treatments proved to give a very high degree of control and few larvae were seen.

S. frugiperda egg masses were found in low numbers and Table 3. shows the high degree of control given by all the treatments.

Red spider mites, species not determined but probably Tetranychus ludeni, were observed sporadically distributed in the field but although there was no marked increase or spread in the infestations, none of the treatments had any observable effect on this pest.

Aphids, probably Aphis gossypii, were present in fairly high numbers before any applications were made. All the treatments reduced numbers of these insects to a very low level although complete elimination was not achieved.

Table 3

Results of S. frugiperda counts in the Cauca valley

Treatment	+ Total no. of plants counted	<u>Spodoptera</u>	
		Egg Masses*	Small larvae
Belmark	275	9	11
MITAC 1.5 l/ha + methyl parathion 2.0 l/ha	200	7	-
MITAC 1.5 l/ha + Belmark 250 ml/ha	300	10	2
MITAC 1.5 l/ha + Lannate 175 g/ha then 125 g/ha	225	3	-

+ 25 plants counted per day

* one egg mass may consist of 100 or more eggs

CONCLUSIONS

The non-arrival of the additional quantity of MITAC, bfn 6554 and the bfn 8051 from Ecuador, meant that the full scope of the original objectives could not be fulfilled. However, viewed in conjunction with the earlier trials by Celamerck and the government organisations (Appendices 1 - 4), a picture now can be obtained of the potential value of MITAC for the control of cotton pests in Colombia as follows:-

(a) *Heliothis virescens* control

- i) MITAC alone at 2.5 to 3.5 l/ha (500 to 700 g a.i./ha) was shown in the 1976 and 1977 trials to give control comparable to the standard larvicide treatments of methyl parathion, methyl parathion plus Toxmetil 4-2-1, Azodrin and Orthene. Bearing in mind that MITAC is known to have little direct larvicidal action, the comparative performance when used according to larvicide criteria is most satisfactory. The ovicidal action of MITAC was demonstrated in our trials in the Tolima valley by the drop in small larval numbers on the fourth and fifth days after treatment ie. no new first instar larvae were emerging from eggs laid around the time of treatment.
- ii) MITAC in combination with methyl parathion gave a good performance which is particularly significant when the failure of methyl parathion alone at 3.5 l/ha (1680 g a.i./ha) is taken into account. The most effective dose of this combination seems to be MITAC 300 to 400 g a.i./ha plus methyl parathion 960 to 1200 g a.i./ha.
- iii) MITAC plus Belmark at the dosage rates of 300 g a.i./ha plus 75 g a.i./ha gave a performance which in general was as effective as Belmark alone at 150 g a.i./ha. Except under conditions of extremely high oviposition where larval numbers were not reduced quite enough, these treatments both kept larval levels below the 12% economic threshold.
- iv) The use of MITAC plus Bolstar was shown in the second semester of 1977 to have a significant potential and the two applications in Tolima supported this finding. The effective dose rates appear to be MITAC 300 g a.i./ha plus Bolstar 720 g a.i./ha; although in the 1977 trials 500 g a.i./ha of MITAC plus 1080 g a.i./ha of Bolstar were used.
- v) The combination of MITAC with Lannate did not prove quite as successful against *H. virescens* as the 1977 El Salvador results against *H. zea* promised but the mixture still shows potential. However, because of its phytotoxic effects, Lannate is not regarded very favourably by Colombian growers and this mixture is of low priority for future development in Colombia.

- vi) An interesting observation in both the Tolima and Cauca trials was that when Belmark was applied alone or in combination with MITAC, the level of oviposition in general seemed to be depressed or at least maintained rather lower than in the plots receiving other treatments. Conversely the use of Lannate gave an apparent marked rise in the oviposition level.

(b) Control of other pests

Other pests do not appear to have been recorded in the earlier trials in cotton and indeed only one other pest Spodoptera frugiperda was of real significance in our trials. The very large numbers of eggs, around 100 and possibly up to 500, which make up the S. frugiperda egg mass mean that a small number of egg masses can hatch to give what under uncontrolled conditions can be a serious defoliating and boll damaging pest. On a number of occasions in our trials newly emerged larvae were observed to be dead or dying on the fourth and fifth days after treatment by MITAC mixtures. As both methyl parathion and Lannate have short lived activity, these deaths of neonate larvae can be attributed to the MITAC. The significance of this is that MITAC offers a potential answer to the problem of Spodoptera as a pest in the biological control period of 60 days post-planting. MITAC is unlikely to affect the parasitic wasp Trichogramma spp which is a key factor in this biological period but which does not parasitise Spodoptera eggs in their silk covered egg mass.

Future Development

The registration of MITAC in Colombia is dependent on the authorities being convinced of the efficacy of MITAC as an ovicide. This is because any product has to be demonstrated as active in its own right and registration is not given to products intended solely for use in tank mixtures. In fact, tank mixtures cannot be included on the product label. Promotion of tank mixture recommendations is permitted in product leaflets.

As outlined earlier in this report, there is data from the 1976 and 1977 trials on MITAC used alone plus indirect data from our trials to indicate the ovicidal activity of MITAC. ICA were also planning specific ovicide tests for MITAC and these results are awaited (see Appendices 6 & 7). It is hoped that in the near future further talks can be had with Dr. L. Posada, the ICA Director of Entomology, and his approval obtained for what should be the last stages of development.

Trials in the 1978 second semester north coast cotton area to further evaluate MITAC alone at 700 g a.i./ha, MITAC 300 g a.i./ha plus methyl parathion 960 g a.i./ha and MITAC 300 g a.i./ha plus Belmark 75 g a.i./ha are desirable. Attention should be given to both Heliothis and Spodoptera control.

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APPENDIX 7

Products used in trials in Colombia

<u>Trade Name</u>	<u>Common name</u>	<u>Company</u>	<u>Chemical type</u>
Azodrin Nuvacron	monocrotophos	Shell Ciba Geigy	organophosphate
Celathion	chlorthiophos	Celamerck	organophosphate
Cottinex Triple "New" EC-40	200 g a.i. methyl parathion + 100 g a.i. dimethoate + 100 g a.i. mevinphos/l		organophosphates
Ambush	permethrin	I.C.I.	synthetic pyrethroid
Belmark (Pydrin)	fenvalerate	Shell (Sumitomo)	synthetic pyrethroid
Curacron	profenofos	Ciba Geigy	organophosphate
Decis	decamethrin	Roussel - (Procida)	synthetic pyrethroid
FMC - 33297 (Pounce)	permethrin	FMC	synthetic pyrethroid
Bolstar	sulprofos	Bayer	organophosphate
Fundal Galecron	chlordimeform	Schering Ciba Geigy	formamidine
Toxmetil	Toxaphene (camphechlor) + methyl parathion	Hercules	organochlorine + organophosphate
Padan	cartap	Takeda	carbamate
Thrithion	carbophenothion	Stauffer	organophosphate
Ripcord (SD 43467)	cypermethrin	Shell	synthetic pyrethroid
Orthene	acephate	Chevron	organophosphate
UC 51762		Union Carbide	carbamate
Lannate	methomyl	Du Pont	carbamate