FIELD TRIAL ON CHEMICAL CONTROL FOR THE COTTON BOLLWORM *Heliothis armigera* Hubner, IN THAILAND*

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Abstract

The cotton bollworm, *Heliothis armigera* Hubner, is the most serious pest of cotton in Thailand. A programme of screening chemicals for this insect in the field has been conducted since 1965 to discover the most effective insecticides and to establish a control strategy. This report gives a brief account of the history of insecticide use, beginning with endrin plus DDT, and toxaphene plus DDT during 1966-1983. Details of recent findings include some organophosphate compounds, one carbamate compound, one organic hydrocarbon, many synthetic pyrethroid compounds and some interesting insecticide tank mixtures. Insect resistance to the synthetic pyrethroids and some side-effects of certain insecticides are also discussed in the text. Alternate sprays between 2 different groups of chemical compounds is proposed for as one control measure.

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INTRODUCTION

Cotton in Thailand is mostly grown under rainfed conditions. The farmers grow cotton in small plots which average 1-2 hectares in size. These plots are scattered among fields of corn, sorghum and soybean. The main areas of cotton production are in the Central and Northeast zones where the temperature varies between a mean minimum of 15.C and a mean maximum of 36.C. The average annual amount of rainfall is about 1,200-2,000 mm. Since 1962, the Thai Government has initiated a drive to increase cotton production. However, actual cotton production has not yet reached the specified level of production level.

The maximum amount of land planted in cotton was about 160,000 hectares in 1983 with the National yield averaging 1,250 kilograms of seed cotton per hectare.

At present, Thailand can produce only 25 per cent of its local textile factory requirement.

Failure of cotton production to reach the target production level in this country is mostly due to the lack of insect control. There are three major insect pests:

The cotton bollworm (Heliothis armigera Hubner),

The cotton leafhopper(Armasca biguttula Ishida),

The cotton aphid (Aphis gossypii Glover).

Other sporadic pests include cotton leaf thrips (Thrips palmi Palmer) and the cotton whitefly (Bemisia tabaci Gennadius).

The cotton bollworm has played the most important role in cotton production in the last 2 decades. To deal with this notorious pest, insecticide field trials have been conducted on an annual basis since 1965 to find the best chemical.

This paper gives a brief account of some interesting chemicals selected from these field experiments and discusses some problems that are arising at the present time.

Materials and Methods

The experiments were annually conducted at 4 Field Crops Experiment Stations. Cotton seeds were sown in 75-100 m2 plots with 3-6 replications in a randomized complete block design.

Insecticide treatments were sprayed weekly with a motorised knapsack mistblower that applied 250-500 litres of finished spray per hectare. The programme was started at about 30 days after planting and constituted a total of 12 to 14 sprays. The bollworm egg and larvae were counted on 40-45 randomly selected plants in the 4 middle rows of each plot on the day before each spray. Other insects where present occurred in the treated plots and phytotoxicity was recorded if it occurred.

After harvest, clean dirt and seed cotton were obtained and weighed separately. The heights of cotton stalk were also measured. Percent control was calculated by the formula:

$$\frac{C - T}{C} \times 100$$

where as : C = number of larvae found in the untreated plot

T= number of larvae found in the treated plot

Yield increased means the seed cotton in treated plot is already deducted by the seed cotton in check plots.

Result

Early field trials for selecting the insecticides for H. armigera revealed that endrin plus DDT, carbaryl plus DDT, endosulfan plus DDT and azinphos methyl plus were among the best products prior to 1966 but failed to control this insect in later years.

Toxaphene plus DDT became the best product since 1967 and was one of the most popular insecticides until it was banned in 1983. However, during the long period of toxaphene plus DDT use, chordimeform was discovered in 1972.

Many chemicals, whether used singly or in combinations, have been tested. Some chemicals illustrated in figure 1 are interesting products which can be best commented upon by their chemical classification:

1. Organophosphates (OP) consist of sulprofos, profenofos and triazophos. The bollworm control efficacy of the last chemical tends to be poor in comparison to the other two but there is no evidence of resistance building up in the OP group (Wangboonkong, 1986) and all chemicals can suppress the major sucking insects as well.

2. Organic hydrocarbon (OH), endosulfan. This chemical had been tested several times in the last 2 decades without good results. It was obtained in 1984 and 1985 and the high rate of application (1750 g/ hectare) is preferable.

The combination of endosulfan and amitraz (OH+OP) is presently one of the best products available.

3. Carbamate (CAR), Thiodicarb

This is an outstanding bollworm insecticide but it performs poorly on the cotton leafhopper (see Fig 2) and it causes phytotoxicity to the cotton as shown by the amount of cotton stunt in Table 1.

4. OP plus OP, EPN plus methyl parathion and acephate plus naled.

The performance of these two combinations were only moderately effective but they can be chosen to substitute for other OP compounds in the case that sulprofos or profenofos are not available.

5. Insect Growth Regulator (IGR)

Many IGR chemicals have been tested in a similar manner as the other chemical groups since 1983. It was found that chlorfluazuron gives strong bollworm control and gave a good result on the cotton leafhopper as well (Fig.2).

6. Synthetic Pyrethroids (SP)

Four SP : fenvalerate, cypermethrin, deltamethrin and cyfluthrin were initially tested in 1976, 1977, 1978 and 1980 respectively. All gave excellent control. Even though their efficacies dropped for some extent in 1979 (Wangboonkong,1981) but recovered four years later. The indication of insect resistance to these compounds became obvious in 1984 (see Fig.3). In 1985, the most effective SP was cyfluthrin.

New SP that were tested during 1981 to 1983 included flucytrinate, fluvalinate, cyhalothrin, cyhalothrin L, alphamethrin, biphenthrin, alphaphenvalerate, cypermethrin high cis. These performed similarly in controlling the cotton bollworm as the original four SP compounds. Cyhalothrin L at 25 g/hectare gave the best results of all. More interesting, the mixture of cyhalothrin L and chlorfluazuron was highly effective.

Piperonyl butoxide (PBO) mixed with SP shows some level of synergistic effect. These are fenvalerate/PBO and alphamethrin/PBO.

After applying the SP, cotton whitefly populations increases (Fig.2). This data supports the findings of Wangboonkong (1981).

Discussion

The problem of H. armigera resistance to synthetic pyrethroids in Thailand is serious. At present, this problem seems spread throughout cotton areas and is not concentrated at certain areas as reported in Tropical Pest Management (Wangboonkong, 1986). Some of the recent findings of the insecticide trials show that sulprofos, profenofos, endosulfan, amitraz/endosulfan, thiodicarb and chlorfluazuron are all promising products but the cost of their application is very high (at least double that of the pyrethroids). Recommendations for Thai farmers in order to solve this problem gives emphasis on an insect counting programme in order to reduce the number of sprays. The control strategy has been aimed at delaying resistance, preventing the outbreak of sucking insects and avoiding phytotoxicity. Any future control programme should aim at alternating the standard insecticides (profenofos, sulprofos, endosulfan and endosulfan/amitraz) with the other insecticides such as thiodicarb, chlorfluazuron and some of the pyrethroids (eg. cyhalothrin L).

References

Wangboonkong, S. 1981. Chemical control of Cotton Insect Pests in Thailand.

Tropical Pest Management. 27(4):495-5DD.

Wangboonkong, S. (1986). An Indication of Pyrethroid Resistance in the Cotton 8ollworm, Heliothis armigera Hubner, in Thailand.

Tropical Pest Management (in press).

TABLE 1 AVERAGE HEIGHT OF COTTON STANDS AFTER PICKING, 1985.

TREATMENT	HEIGHT (CM)
THIODICARB	86.16
SULPROFOS	91.52
FENVALERATE	115.99
CHECK	78.26

FIG. 1 EFFICACY OF SOME CHEMICALS IN HELIOTHIS BOLLWORM CONTROL

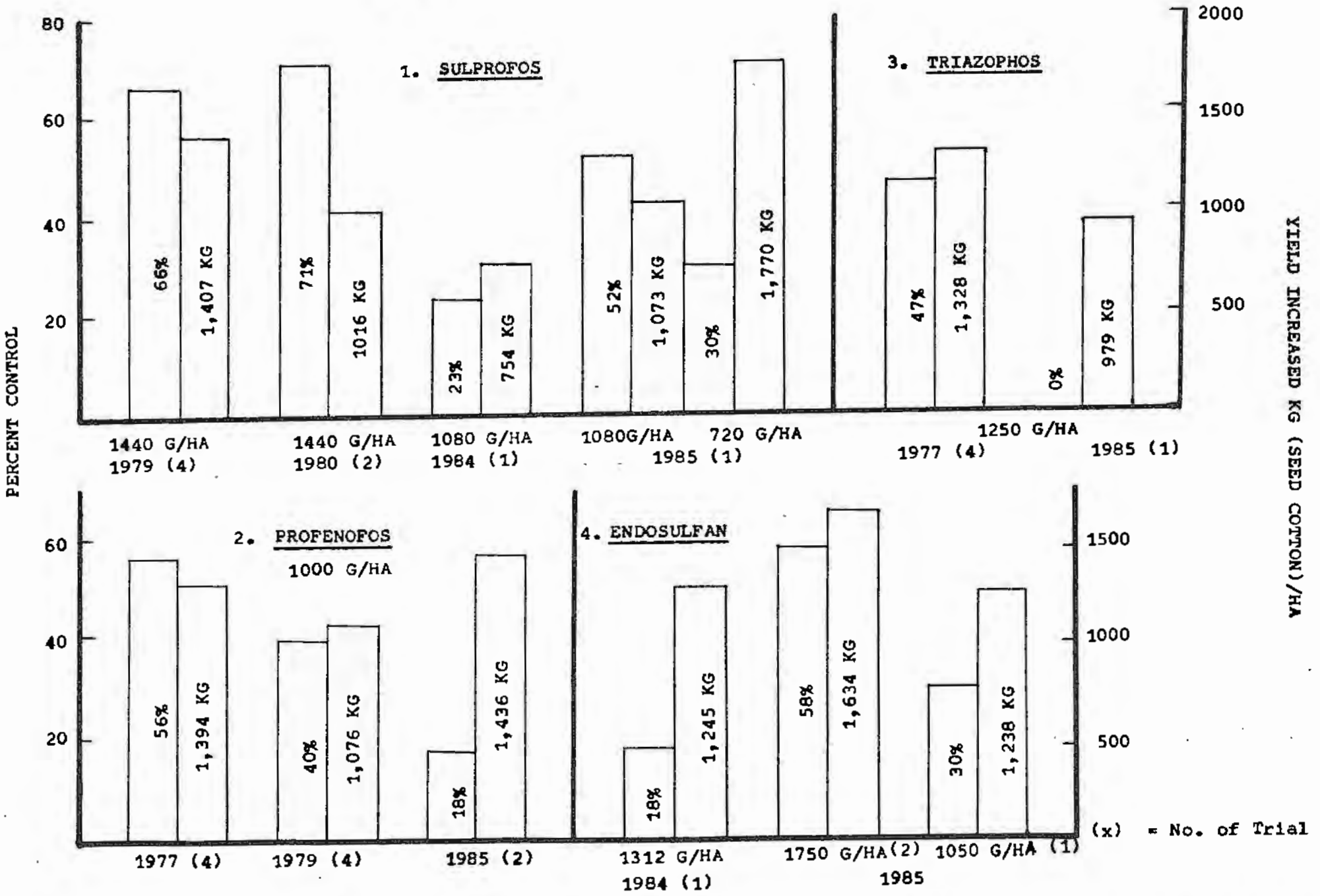


FIG. 1 (CONT.)

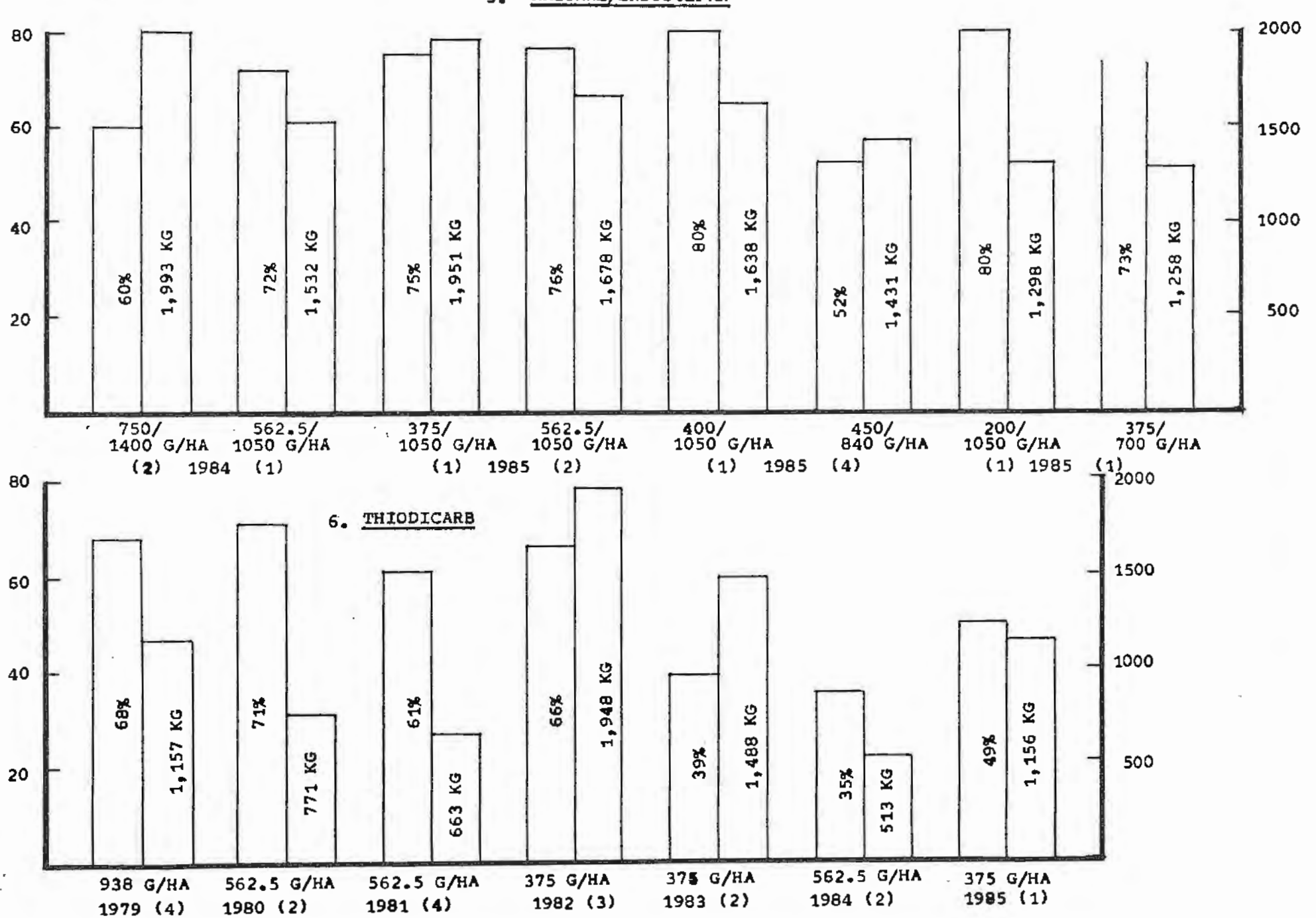

5. AMITRAZ/ENDOSULFAN
80
60
40
20
2000
1500
1000
500
60%
1,993 KG
72%
1,532 KG
75%
1,951 KG
76%
1,678 KG
80%
1,638 KG
52%
1,431 KG
80%
1,298 KG
73%
1,258 KG
750/ 1400 G/HA (2) 1984 (1)
562.5/ 1050 G/HA
375/ 1050 G/HA (1) 1985 (2)
562.5/ 1050 G/HA
400/ 1050 G/HA (1) 1985 (4)
450/ 840 G/HA
200/ 1050 G/HA (1) 1985 (1)
375/ 700 G/HA
6. THIODICARB
68%
1,157 KG
71%
771 KG
61%
663 KG
66%
1,948 KG
39%
1,488 KG
35%
513 KG
49%
1,156 KG
938 G/HA 1979 (4)
562.5 G/HA 1980 (2)
562.5 G/HA 1981 (4)
375 G/HA 1982 (3)
375 G/HA 1983 (2)
562.5 G/HA 1984 (2)
375 G/HA 1985 (1)

FIG. 1 (CONT.)

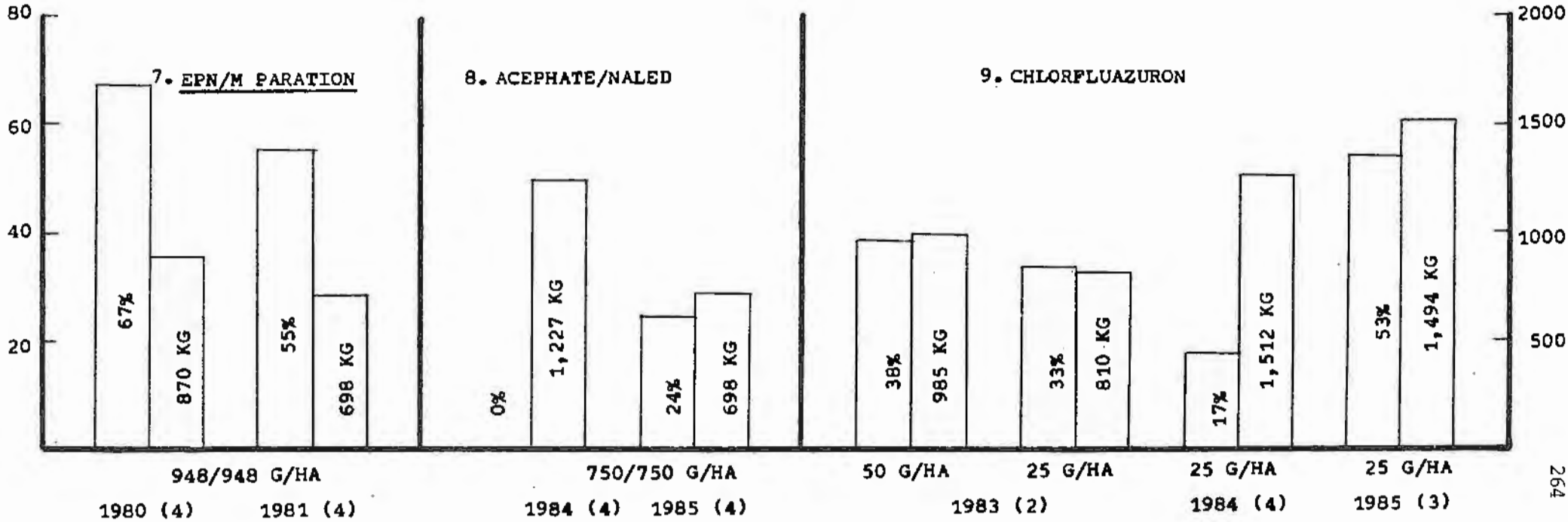
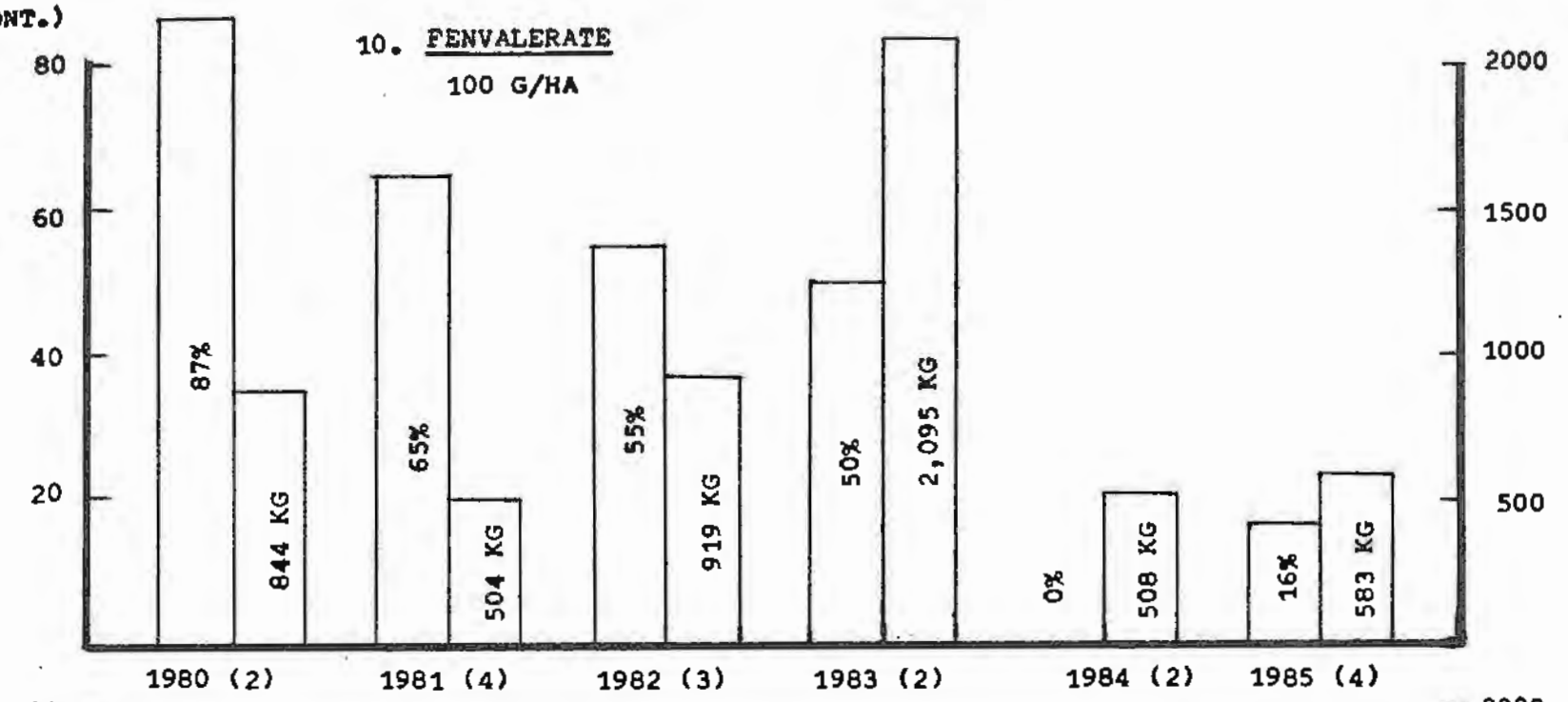

80
60
40
20
2000
1500
1000
500
7. EPN/M PARATION
8. ACEPHATE/NALED
9. CHLORFLUAZURON
67%
870 KG
55%
698 KG
0%
1,227 KG
24%
698 KG
38%
985 KG
33%
810 KG
17%
1,512 KG
53%
1,494 KG
948/948 G/HA
750/750 G/HA
50 G/HA
25 G/HA
25 G/HA
25 G/HA
1980 (4)
1981 (4)
1984 (4)
1985 (4)
1983 (2)
1984 (4)
1985 (3)

FIG. 1 (CONT.)


10. FENVALERATE
100 G/HA
80
60
40
20
2000
1500
1000
500
87%
844 KG
65%
504 KG
55%
919 KG
50%
2,095 KG
0%
508 KG
16%
583 KG
1980 (2)
1981 (4)
1982 (3)
1983 (2)
1984 (2)
1985 (4)

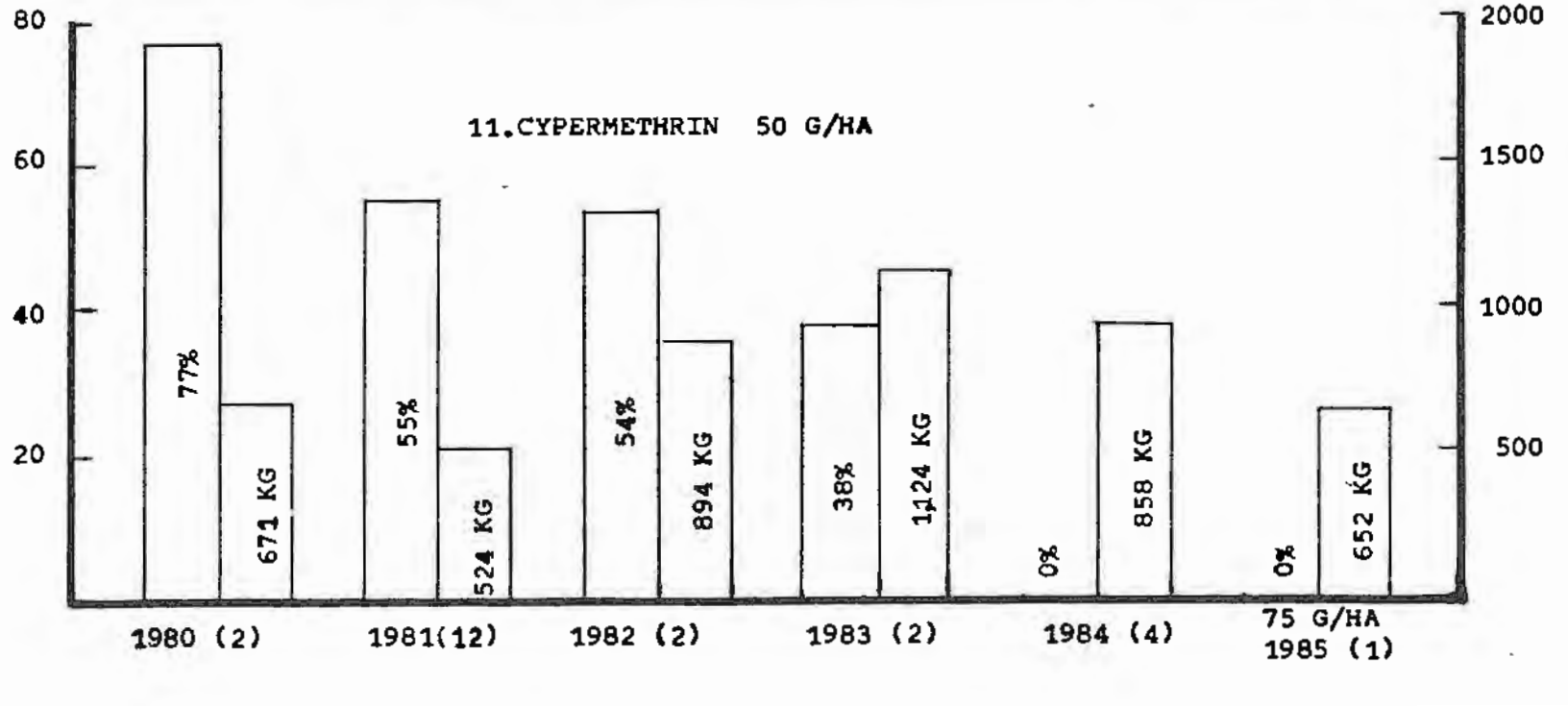
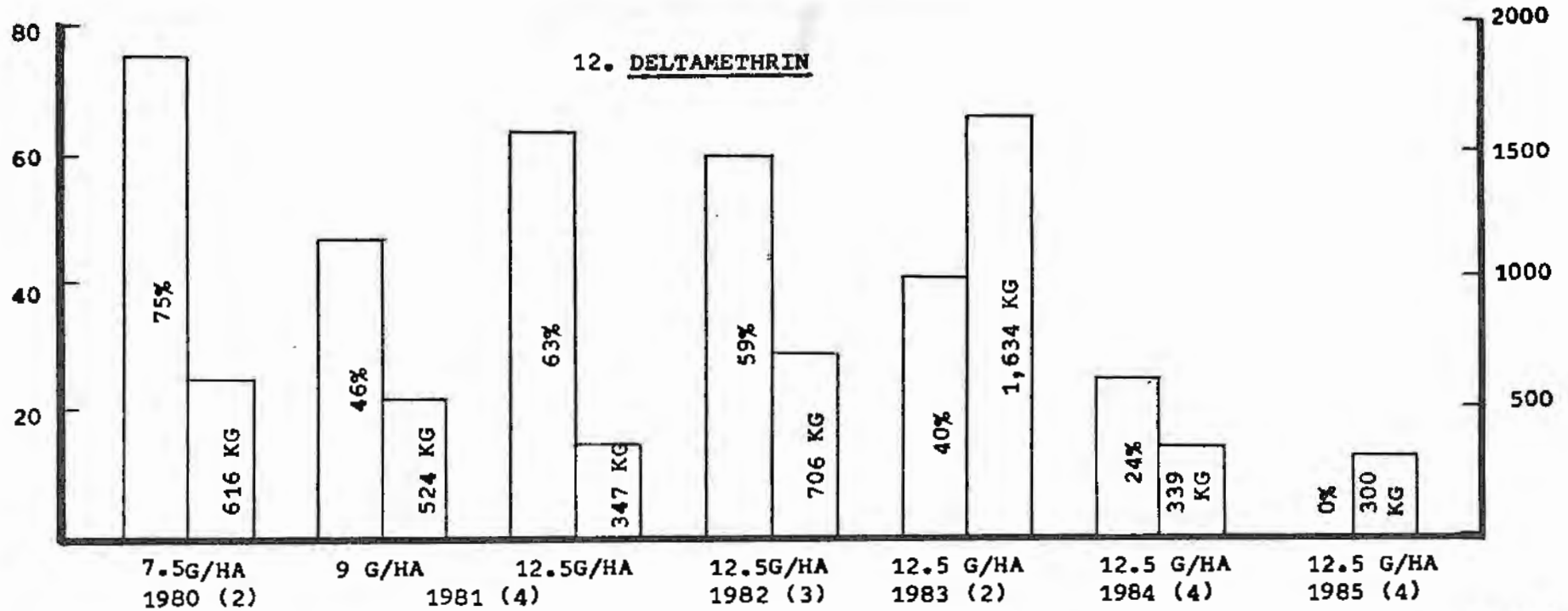

11.CYPERMETHRIN 50 G/HA
80
60
40
20
2000
1500
1000
500
77%
671 KG
55%
524 KG
54%
894 KG
38%
1124 KG
0%
858 KG
0%
652 KG
1980 (2)
1981(12)
1982 (2)
1983 (2)
1984 (4)
75 G/HA
1985 (1)

FIG. 1 (CONT.)


12. DELTAMETHRIN
80
60
40
20
2000
1500
1000
500
75%
616 KG
46%
524 KG
63%
347 KG
59%
706 KG
40%
1,634 KG
24%
339 KG
0%
300 KG
7.5G/HA 1980 (2)
9 G/HA 1981 (4)
12.5G/HA 1981 (4)
12.5G/HA 1982 (3)
12.5 G/HA 1983 (2)
12.5 G/HA 1984 (4)
12.5 G/HA 1985 (4)

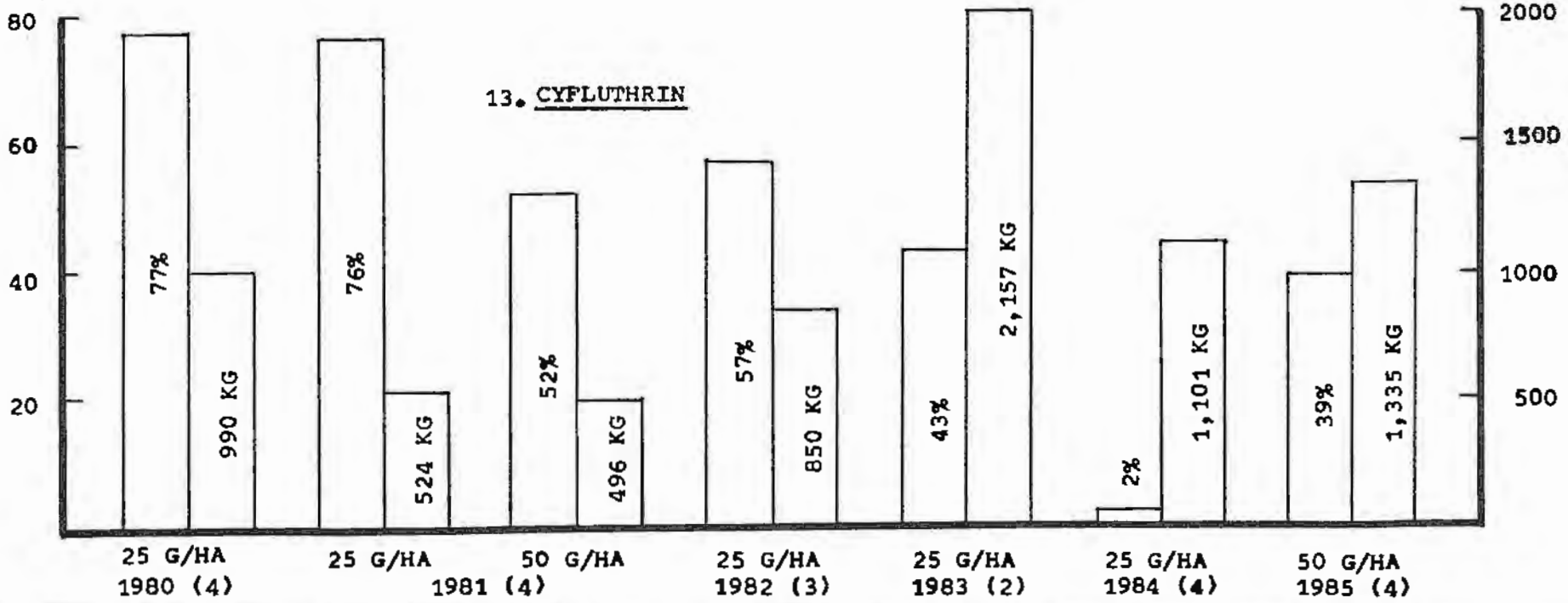

13. CYFLUTHRIN
80
60
40
20
2000
1500
1000
500
77%
990 KG
76%
524 KG
52%
496 KG
57%
850 KG
43%
2,157 KG
2%
1,101 KG
39%
1,335 KG
25 G/HA 1980 (4)
25 G/HA 1981 (4)
50 G/HA 1981 (4)
25 G/HA 1982 (3)
25 G/HA 1983 (2)
25 G/HA 1984 (4)
50 G/HA 1985 (4)

FIG. 1 (CONT.)

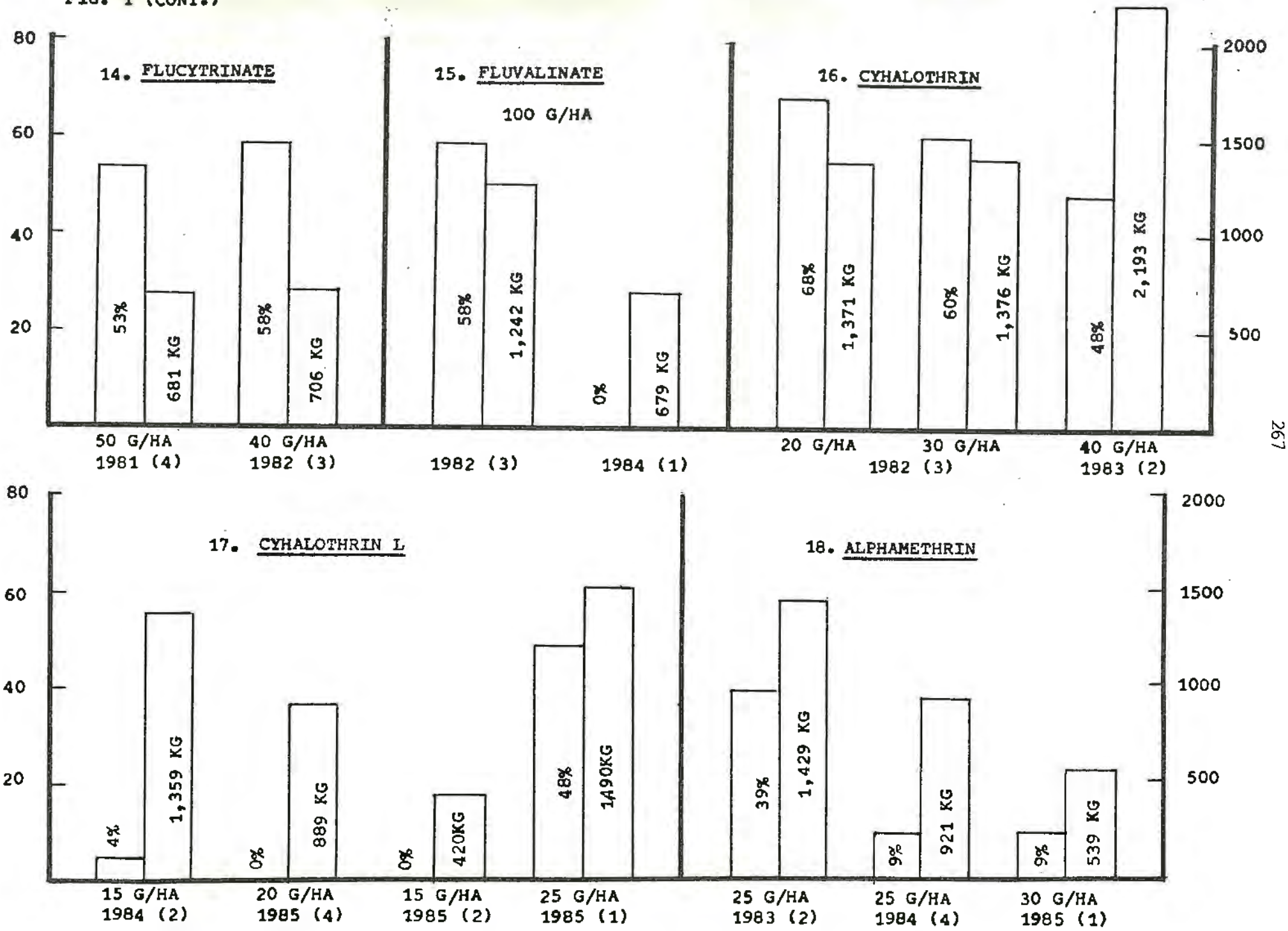
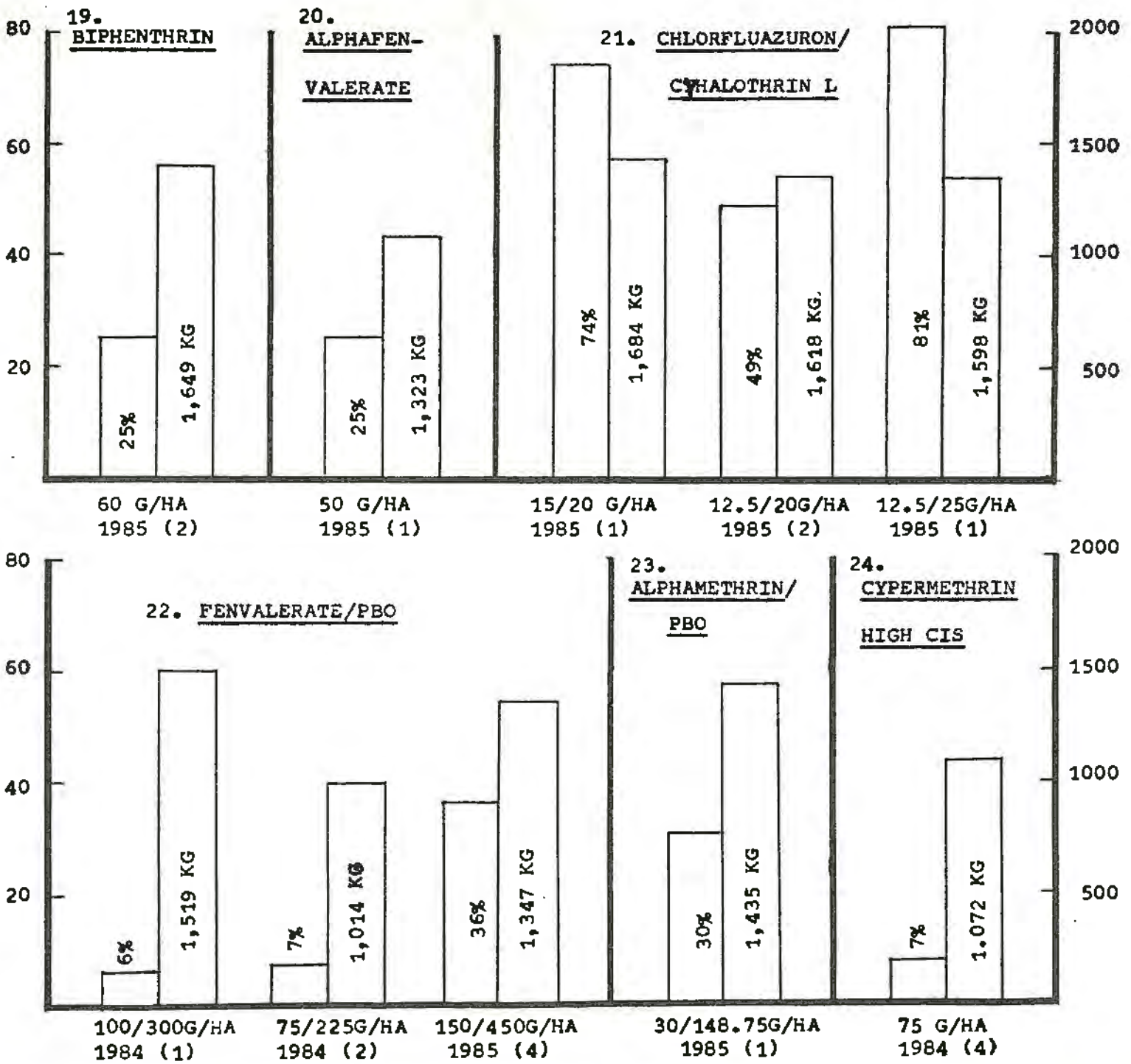

14. FLUCYTRINATE
15. FLUVALINATE
100 G/HA
16. CYHALOTHRIN
17. CYHALOTHRIN L
18. ALPHAMETHRIN
80
60
40
20
2000
1500
1000
500
53%
681 KG
58%
706 KG
58%
1,242 KG
0%
679 KG
68%
1,371 KG
60%
1,376 KG
48%
2,193 KG
50 G/HA
1981 (4)
40 G/HA
1982 (3)
1982 (3)
1984 (1)
20 G/HA
30 G/HA
1982 (3)
40 G/HA
1983 (2)
4%
1,359 KG
0%
889 KG
0%
420KG
48%
1490KG
39%
1,429 KG
9%
921 KG
9%
539 KG
15 G/HA
1984 (2)
20 G/HA
1985 (4)
15 G/HA
1985 (2)
25 G/HA
1985 (1)
25 G/HA
1983 (2)
25 G/HA
1984 (4)
30 G/HA
1985 (1)

FIG. 1 (CONT.)


19. BIPHENTHRIN
20. ALPHAFEN-VALERATE
21. CHLORFLUAZURON/CYHALOTHRIN L
22. FENVALERATE/PBO
23. ALPHAMETHRIN/PBO
24. CYPERMETHRIN HIGH CIS
80
60
40
20
2000
1500
1000
500
25%
1,649 KG
25%
1,323 KG
74%
1,684 KG
49%
1,618 KG.
81%
1,598 KG
6%
1,519 KG
7%
1,014 KG
36%
1,347 KG
30%
1,435 KG
7%
1.072 KG
60 G/HA 1985 (2)
50 G/HA 1985 (1)
15/20 G/HA 1985 (1)
12.5/20G/HA 1985 (2)
12.5/25G/HA 1985 (1)
100/300G/HA 1984 (1)
75/225G/HA 1984 (2)
150/450G/HA 1985 (4)
30/148.75G/HA 1985 (1)
75 G/HA 1984 (4)

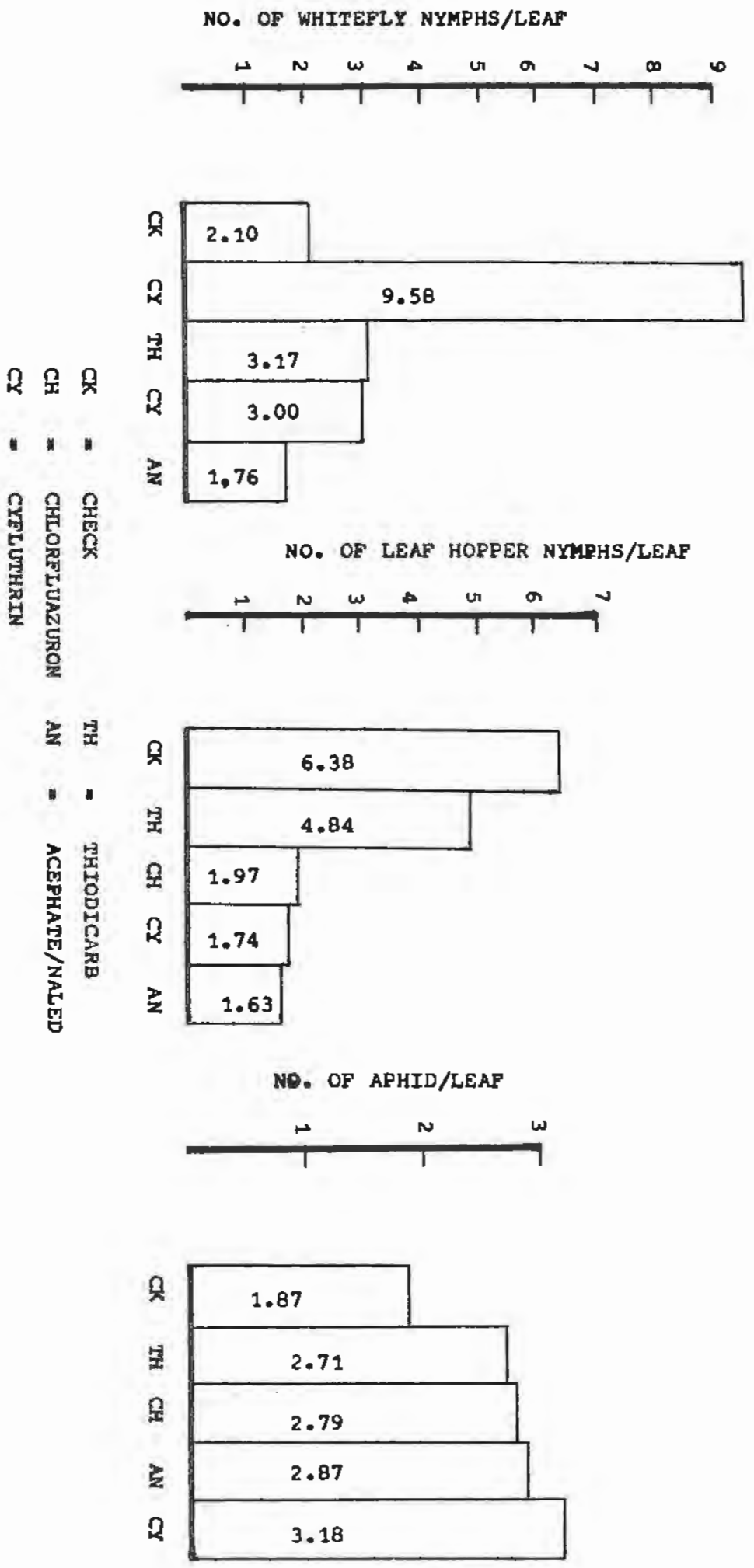
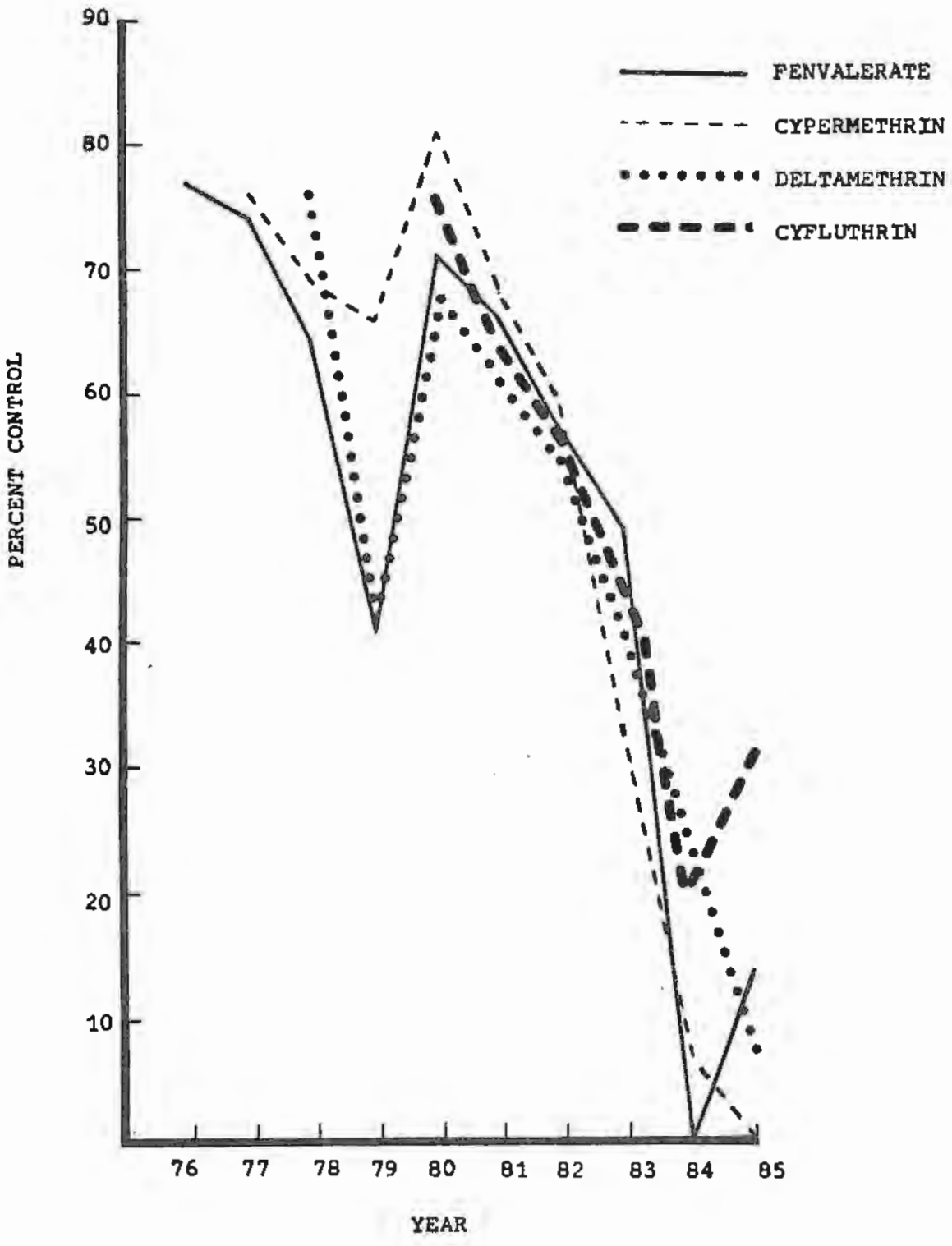
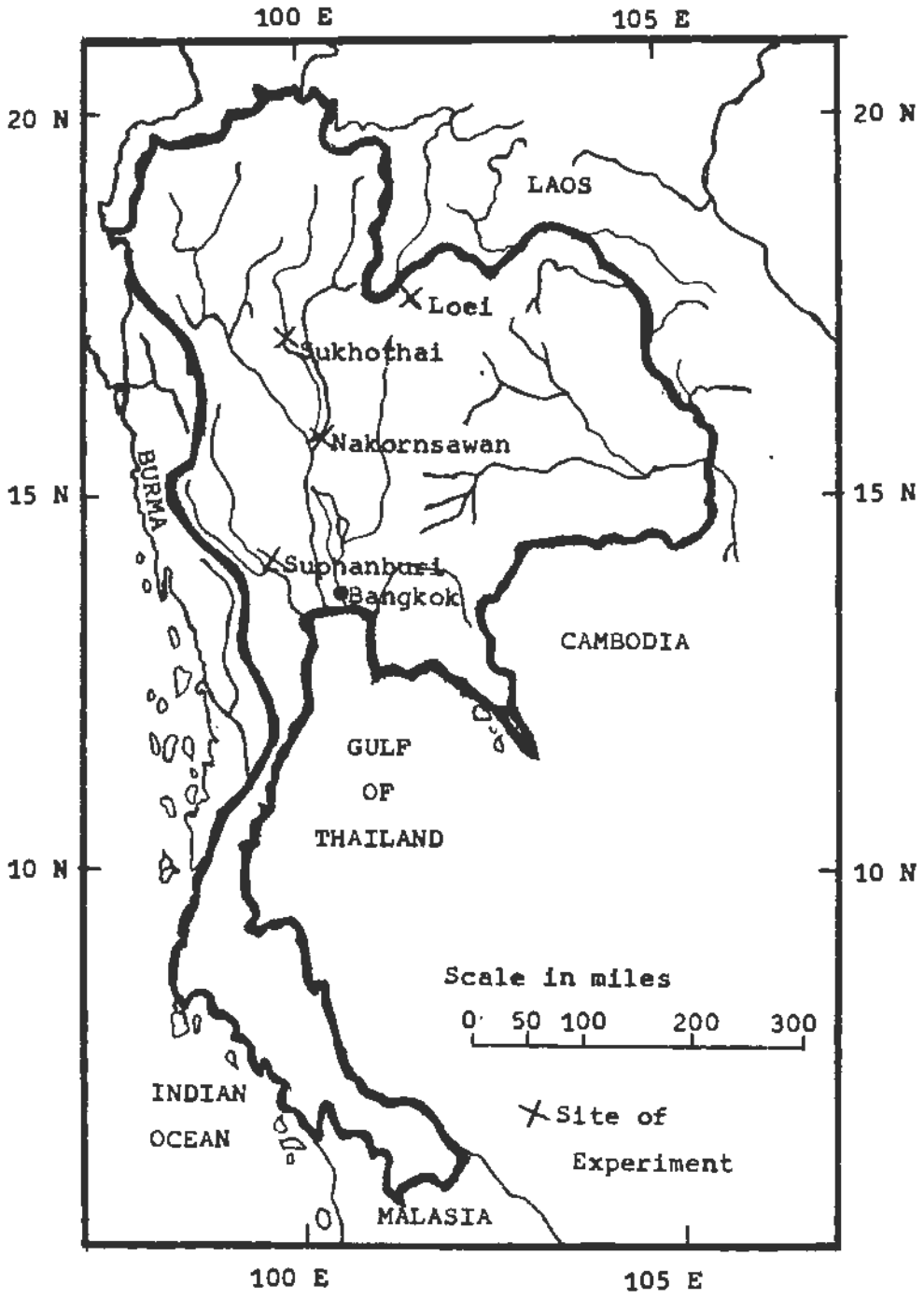


FIG. 2 EFFECT OF SOME CHEMICALS ON SUCKING INSECTS, 1984

FIG. 3 TREND OF SYNTHETIC PYRETHROIDS EFFICACY IN CONTROLLING THE COTTON BOLLWORM IN THAILAND





MAP OF THAILAND