Appendix A. Multi-Active Ingredients Product Analysis for *Lambda*-Cyhalothrin

The Agency does not routinely include, in its risk assessments, an evaluation of mixtures of active ingredients, either those mixtures of multiple active ingredients in product formulations or those in the applicator's tank. In the case of the product formulations of active ingredients (that is, a registered product containing more than one active ingredient), each active ingredient is subject to an individual risk assessment for regulatory decision regarding the active ingredient on a particular use site. If effects data are available for a formulated product containing more than one active ingredient, they may be used qualitatively or quantitatively (USEPA, 2004; USFWS/NMFS/NOAA, 2004).

Acute oral toxicity data (i.e., LD_{50} values) from mammalian studies for formulated products that contain *lambda*-cyhalothrin and one or more additional active ingredients are summarized in Table A.1 below. The results of an open literature search for data on formulated products that contain *lambda*-cyhalothrin using the EPA ECOTOX database are listed on page 7.

Currently, the Agency's guidance for assessing the potential risk of chemical mixtures is limited to human health applications (USEPA, 2000); however, the guidance includes principles for evaluating mixtures to assess potential interactive effects that are generally applicable. Consistent with EPA's Overview Document (USEPA, 2004), the Agency's mixture guidance (USEPA, 2000) discusses limitations in quantifying the risk of specified mixtures when there is differential degradation, transport and fate of chemical components following environmental release or application. The LD_{50} values are potentially useful only to the extent that a wild mammal would consume plants or animals immediately after these dietary items were directly sprayed by the product. Increasing time post application, the differential rates of degradation, transport, etc. for the active ingredients in the formulation only permit a qualitative discussion of potential acute risk (USEPA, 2004).

As discussed in USEPA (2000), a quantitative component-based evaluation of mixture toxicity requires data of appropriate quality for each component of a mixture. In this mixture evaluation LD_{50}s, with associated 95% confidence intervals, are needed for the formulated product. The same quality of data is also required for each component of the mixture. Given that some of the formulated products do not have LD_{50} values of the required quality and since LD_{50} values are not available for all the components of these formulations, a quantitative analysis of potential interactive effects is not possible.

While a quantitative evaluation of the data is not possible with currently accepted scientific methods, as a screening tool, a qualitative analysis can be used to indicate if formulated products exhibit interactive effects (e.g., synergism or antagonism). In the case of *lambda*-cyhalothrin, a qualitative examination of the trends in LD_{50} values, with the associated confidence intervals, across the range of percent active ingredient, reveals no definitive conclusions but suggests synergistic (i.e., more than additive) interactions. In addition, when the product LD_{50}s, and associated confidence intervals, are adjusted for the percent *lambda*-cyhalothrin (a conservative assumption that attributes all of the observed toxicity of the formulated product to *lambda*-cyhalothrin), the adjusted 95% confidence intervals of the formulated product do not overlap with the TGAI *lambda*-cyhalothrin LD_{50} in eight instances. In two instances, the adjusted 95%

confidence intervals for the formulated product overlap with the TGAI *lambda*-cyhalothrin toxicity values. For all other formulated products, the LD_{50} was non-definitive, thus there are no confidence intervals and the toxicity values cannot be compared. Additionally, one open literature study (Wang et al. 2005) examined the synergistic effects of a number of chemicals mixed with abamectin, it was found there were no significant increases in toxicological effects when *lambda*-cyhalothrin and abamectin were mixed. Another open literature study (Hardke et al. 2005) found that *lambda*-cyhalothrin (insecticide) mixed with glyphosate (herbicide) resulted in significantly lower phytotoxicity damage than glyphosate alone. Although the target organisms (insects versus plants) are not the same, this study does document an instance where mixing *lambda*-cyhalothrin with another chemical decreases the efficacy of the other chemical. Measurements of *lambda*-cyhalothrin's efficacy were not performed in this study.

Based on this qualitative evaluation of the best available data and the Agency's existing guidance, it is reasonable to conclude that these formulations may exhibit additive or synergistic effects in some instances. Given that the active and inert ingredients would not be expected to have similar mechanisms of action, metabolites or toxicokinetic behavior it is also reasonable to conclude that an assumption of dose-addition would be inappropriate. However, the limited size of the data set and the variation in co-formulated pesticides prohibits any definitive conclusions. Consequently, an assessment of *lambda*-cyhalothrin's potential effect when it is co-formulated with other active ingredients will be based on the toxicity of *lambda*-cyhalothrin.

Table A.1. Pesticide products formulated with *lambda*-cyhalothrin and other pesticide active ingredients[1]

Product/Trade Name	EPA Reg. #	Formulation	Registrant Submitted Studies MRID	Product		Adjusted for Active Ingredient	
				LD_{50} (mg/kg)	95% CI (mg/kg)	LD_{50} (mg/kg)	95% CI (mg/kg)
Lambda-cyhalothrin TGAI	NA	*Lambda*-cyhalothrin (100%)	Accession 259805	56	N/A	56	N/A
Endigo ZC	100-1276	*Lambda*-cyhalothrin (9.48%) Thiamethoxam (12.6%)	47038503	310.2	175-550	29.4*	16.6-52.1
Thiamethoxam 0.02/Lambda-cyhalothrin	100-1304	*Lambda*-cyhalothrin (0.04%) Thiamethoxam (0.2%)	47234703	>5000	N/A	>2	N/A
Voliam Xpress Insecticide	100-1320	*Lambda*-cyhalothrin (4.63%) Chlorantraniliprole (9.26%)	47424203	98.11	55-175	4.5*	2.5-8.1
Thiamethoxam 0.40/Lambda-cyhalothrin 0.16 ME Concentrate	100-1334	*Lambda*-cyhalothrin (0.16%) Thiamethoxam (0.4%)	47579705	3129	1750-5000	5*	2.8-8
Thiamethoxam 0.010/Lambda-cyhalothrin 0.004 ME RTU	100-1336[2]	*Lambda*-cyhalothrin (0.004%) Thiamethoxam (0.01%)	47579705	3129	1750-5000	5*	2.8-8
Difenoconazole 0.170/thiamethoxam 0.010/lambda-cyhalothrin 0	100-1366[3]	*Lambda*-cyhalothrin (0.004%) Thiamethoxam (0.01%) Difenoconazole (0.17%)	47934904	5000	3074 – 20,000	8*	4.9-32
Difenoconazole 0.66/thiamethoxam 0.40/lambda-cyhalothrin 0.1	100-1367	*Lambda*-cyhalothrin (0.16%) Thiamethoxam (0.4%) Difenoconazole (0.66%)	47934904	5000	3074 – 20,000	8*	4.9-32
Besiege insecticide	100-1402	*Lambda*-cyhalothrin (4.63%) Chlorantraniliprole (9.26%)	47424203	98.11	55-175	4.5*	2.5-8.1
Derby	100-1436	*Lambda*-cyhalothrin (3.5%) Thiamethoxam (11.6%)	48579703	1750	1239-4450	61	43-156
Tandem	100-1437	*Lambda*-cyhalothrin (3.5%) Thiamethoxam (11.6%)	48579703	1750	1239-4450	61	43-156

Product/Trade Name	EPA Reg. #	Formulation	Registrant Submitted Studies MRID	Product		Adjusted for Active Ingredient	
				LD_{50} (mg/kg)	95% CI (mg/kg)	LD_{50} (mg/kg)	95% CI (mg/kg)
Imi-lambda granular T&O insecticide	228-610	*Lambda*-cyhalothrin (0.04%) Imidacloprid (0.2%)	47692303	>5000	N/A	2	N/A
Whitmire micro-gen TC200 injection system	499-471	*Lambda*-cyhalothrin (0.05%) Prallethrin (0.03%)	44355603	>2000	N/A	2.5	N/A
Saber extra insecticide ear tags[4]	773-75	*Lambda*-cyhalothrin (10%) Piperonyl butoxide (13%)	48225601	N/A	N/A	N/A	N/A
Double barrel VP insecticide ear tag[5]	773-81	*Lambda*-cyhalothrin (10%) Pirimiphos-methyl	N/A	N/A	N/A	N/A	N/A
Ultra saber	773-92	*Lambda*-cyhalothrin (1%) Piperonyl butoxide (5%)	46844701	>300	N/A	3	N/A
Chemsico aerosol insecticide el-a	9688-187	*Lambda*-cyhalothrin (0.01%) Prallethrin (0.025%)	45515403	>5000	N/A	0.5	N/A
Chemsico wasp & hornet killer LE	9688-190	*Lambda*-cyhalothrin (0.01%) Prallethrin (0.025%)	45515403	>5000	N/A	0.5	N/A
Chemsico aerosol insecticide LD	9688-230	*Lambda*-cyhalothrin (0.01%) d-trans-Chrysanthemum monocarboxylic ester of dl-2-allyl-4-hydroxy-3-methyl-2-cyclopenten-1-one (0.5%)	46466204	>5000	N/A	0.5	N/A
Chemsico wasp & hornet killer DL	9688-233	*Lambda*-cyhalothrin (0.01%) d-trans-Chrysanthemum monocarboxylic ester of dl-2-allyl-4-hydroxy-3-methyl-2-cyclopenten-1-one (0.5%)	46466204	>5000	N/A	0.5	N/A
Chemsico aerosol insecticide LI	9688-246	*Lambda*-cyhalothrin (0.025%) Imiprothrin (0.1%)		>5000	N/A	>1.25	N/A
Chemsico aerosol insecticide AKR	9688-253	*Lambda*-cyhalothrin (0.03%) Prallethrin (0.025%)		>5000	N/A	>1.5	N/A
Chemsico granules LAH	9688-274	*Lambda*-cyhalothrin (0.039%)	47443503	>5000	N/A	1.95	N/A

Product/Trade Name	EPA Reg. #	Formulation	Registrant Submitted Studies MRID	Product		Adjusted for Active Ingredient	
				LD_{50} (mg/kg)	95% CI (mg/kg)	LD_{50} (mg/kg)	95% CI (mg/kg)
		Atrazine (1.51%)					
Chemsico aerosol insecticide FAF	9688-282	*Lambda*-cyhalothrin (0.01%) Prallethrin (0.025%)	45515403	>5000	N/A	0.5	N/A
Chemsico insecticide RTU LG	9688-287	*Lambda*-cyhalothrin (0.03%) o-Phenylphenol, sodium salt (0.21%)	48206705, 48371501	>5000	N/A	1.5	N/A
Chemsico aerosol LEG	9688-288	*Lambda*-cyhalothrin (0.01%) o-Phenylphenol, sodium salt (0.1%) Prallethrin (0.025%)	48206805	>5000	N/A	0.5	N/A
IMI-lambda G insect granules	53883-230	*Lambda*-cyhalothrin (0.1%) Imidacloprid (0.5%)	47175603	>5000	N/A	5	N/A
Lambda pour-on plus topical insecticide	53883-248	*Lambda*-cyhalothrin (1%) Piperonyl butoxide (5%)	46844701	>300	N/A	3	N/A
Dominion 1.47% plus lambda 0.5% liquid	53883-252	*Lambda*-cyhalothrin (0.5%) Imidacloprid (1.47%)	47530105	>5000	N/A	25	N/A
Olive fly attractant and kill (A&K) target device for commercial[6]	56336-51	*Lambda*-cyhalothrin (0.05%) Ammonium bicarbonate (12.7%) 1,7-Dioxasprio[5.5] undecane (0.16%)	N/A	N/A	N/A	N/A	N/A
Olive fly attract and kill (A&K) target device for ornamentals[6]	56336-53	*Lambda*-cyhalothrin (0.05%) Ammonium bicarbonate (12.7%) 1,7-Dioxasprio[5.5] undecane (0.16%)	N/A	N/A	N/A	N/A	N/A
Cobalt advanced	62719-615	*Lambda*-cyhalothrin (1.44%) Chlorpyrifos (28.12%)	47901103	179.8	101-320	2.6*	1.5-4.6

*Indicates that the adjusted LD_{50} of the product is lower than the technical, indicating the formulation may be more toxic than the technical alone.
[1]From registrant submitted data to support registration. Compiled by the Office of Pesticide Programs Health Effects Division. LD_{50} values are derived from small mammal studies.
[2]Cited the toxicity data from registration 100-1334
[3]Cited the toxicity data from registration 100-1367
[4]Oral rat toxicity study waived
[5]DER relied on data from respective TGAIs for the respective active ingredients

[6]Precautionary labeling language as specified in Agency letter to registrant (March 10, 2004), which cited registrant letter (2/18/03) for assigning the toxicity categories, with "labeling for these products are based on the toxicity categories for *lambda*-cyhalothrin."

ECOTOX Database literature with mixtures
***Lambda*-cyhalothrin – Screen of Ecotox Records for Possible Mixture Data**

1. Hammond, A. M.; Story, R. N.; Murray, M. J.; McCown, C. R., and Ring, D. Evaluation of Selected Soil Insecticides and Foliar Insecticides for Control of Banded Cucumber Beetle, White Grub, and Whitefringed Beetle, 1997. POPENV,MIXTURE; 1998; 23, 144-147 (91E).
   Notes: EcoReference No.: 150745
   Chemical of Concern: CBL,CFP,EP,FPN,LCYT,MP,PSM

Research Description:

A test was conducted in St. Landry Parish, LA to determine the efficacy of two soil insecticides and six foliar treatments for control of the insects listed above. Treatments were arranged in a CRB design with four replications. Plots were 4 rows wide (4 ft!row) and46 ft long. Soil insecticides were applied on 10 Jun. The cultivar 'Beauregard' was transplanted14 Jun. Folim insecticide applications began three weeks after transplanting and were made at approximately weekly intervals. A C02- pressurized back pack sprayer was used (30 psi) with a single row boom (20 inches wide) containing three nozzles (Cone Jet SX-10) and calibrated to deliver 15 gpa. Sweet potatoes were harvested on 13 and 14 Oct and field graded into U.S. number 1, 2, or 3. From each plot, in each of the 3 grades, 25 potatoes were randomly selected and evaluated for insect damage. The number of holes present caused by banded cucumber beetle, the number of potatoes with white grub feeding scars, and the number of potatoes damaged by whitefringed beetle were counted.

Cucumber beetle damage was moderate, with an average 1.12 holes per root in the untreated check. All treatments had less damage than the check. This damage reduction was significant in all treatments except for treatment 5 (no soil insecticide, only foliar treatment with Imidan, Sevin, and Penncap rotation) and treatment 7 (Mocap as a soil insecticide, foliar treatment with Imidan, Sevin, and Penncap rotation). Agenda used as a soil insecticide without foliar sprays did as well as treatments using foliar sprays. All treatments with Mocap as a soil insecticide had less damage than the treatment without a soil insecticide (treatment 5), with one exception (treatment 7).

While grub damage was moderate with 9.7% damaged roots in the check. All insecticide treatments had less root damage than the control, ranging from 0.7% to 8.7% damaged roots. Treatment 5 had no soil insecticide (only foliar sprays) and had damage equivalent to the check (8.7%). Treatments using Mocap as a soil insecticide followed with foliar sprays (Treatments 6-15) provided a good level of control that had significantly lower damage when compared with the check, with a single exception (treatment 15).

Whitefringed beetle damage was low. No significant differences were found among the treatments. All insecticide treatments had less damage than the check.

2. Hardke, J. T.; Lorenz III, G. M.; Colwell, K., and Shelton, C. Effects of Tank Mixes of MON 3539 and Selected Compounds in Roundup Ready Flex Cotton - 2005. PHY,POPSOIL,ENV,MIXTURE; 2005: 150-155.
   Notes: EcoReference No.: 101808
   Chemical of Concern: ACP,CYF,CYP,DCTP,DMT,EMMB,IDC,IMC,LCYT,MFZ,OML,SS,TMX

Research Description:

The test was conducted on Hooker Farms at Pine Bluff in Jefferson County, Ark., in 2005. MON-B2RF, a non-commercial Monsanto cultivar, was planted on 6 May. The planted field was subdivided into plots of 4 rows (38-inch spacing), 30 feet in length. Plots were set up in a randomized complete block with four replications. Treatments were made according to statewide threshold recommendation. Treatments were applied with a CO backpack applicator using a 4-row boom with Tee-Jet TXVS 6 nozzles on 19-inch spacing. Operating pressure was 40 psi and volume applied was 10 gal/acre. Three separate applications were made in this test. The first application was made 26 May at the 1- to 3-leaf stage. All plots were treated with MON 3539 (glyphosate) at a rate of 0.75 lb ae/acre. The second application was made 14 June at the 6- to 8-node stage and consisted of MON 3539 alone as a control, or MON 3539 tank-mixed with selected insecticides or mepiquat chloride to determine the potential for crop injury (phytonecrosis) and/or loss of weed control. Treatments included MON 3539 at 0.75 lb ae/acre alone or mixed with one of the following: Orthene® (acephate) at 1 lb a/acre; Bidrin® (dicrotophos) at 0.5 lb ai/acre; Vydate C-LV® (oxamyl) at 0.47125 lb ai/acre; Dimethoate® at 0.5 lb a/acre; Trimax® (imidacloprid) at 0.0469 lb ai/acre; Centric® (thiamethoxam) at 0.05 lb ai/acre; Mustang Max® (zeta-cypermethrin) at 0.025 lb ai/acre; Karate Z® (lamba-cyhalothrin) at 0.04 lb ai/acre; Baythroid® (cyfluthrin) at 0.05 lb ai/acre; Intrepid® (methoxyfenozide) at 0.16 lb ai/acre; Steward® (indoxacarb) at 0.11 lb ai/acre; Tracer® (spinosad) at 0.085 lb ai/acre; Denim® (emamectin benzoate) at 0.015 lb ai/acre; and Mepichlor® (mepiquat chloride) at 24 oz/acre. The third application was made 30 June at the 12- to 14-node stage. All treatments remained the same as in the second application, except that Bidrin, at a rate of 0.312 lb ai/acre, was added to the tank mix with Mustang Max, Karate Z, and Baythroid. Weed control was visually rated on a scale of 0 to 100% where 0 = no control and 100 = all weeds dead. Crop injury was visually rated on a scale of 0 to 100% where 0 = no crop injury and100 = total crop injury. Observations were conducted for crop injury on 21 June at 7 days after treatment two (DAT2), and for weed control on 29 June at 15 DAT2. For the third application, crop injury ratings were taken on 7 July at 7 DAT3 and ratings for weed control were taken on 14 July at 14 DAT3. Data were analyzed using Agricultural Research Manager Version 7 using Analysis of Variance and LSD (P=0.10).

3. Palumbo, J. C. Control of Lepidopterous Larvae in Broccoli, 1995. POPENV,MIXTURE; 1996; 21, 89-(7E).
Notes: EcoReference No.: 155245
Chemical of Concern: CFP,LCYT

Research Description:

Broccoli was direct seeded into double-row beds on 19 Sep at the Yuma Valley Agricultural Center, Yuma, Az. Each plot consisted of four 30 ft long beds spaced 42 inches apart and bordered on each side by an untreated bed. Plots were arranged in a RCB design with 4 replicates. A single foliar application was made on 15 Oct with a hand-held CO_2 sprayer operated at 60 psi, delivering 20 gal/acre. Spreader-sticker (Kinetic) was included in all spray treatments at a rate of 0.25% of the total volume. Insecticide efficacy was determined by counting the total number of small (1^{st} and 2^{nd} instars) and large (>2^{nd} instar) BAW and CL larvae on 10 randomly selected broccoli plants per replicate. Insect counts were conducted the day of application, 15 Oct, and at 4 days after treatment, 19 Oct (4 DAT).

Populations were low-moderate during the experimental period. There were no differences in the number of small BAW and CL larvae among treatment in both the precount and 4 DAT samples. All rates of the Alert, Biobit and Warrior + Xentari treatments significantly reduced the number of large BAW larvae per planted at 4 DAT. All treatments contained significantly fewer large CL larvae than the untreated check at 4 DAT. Alert appeared to provide excellent control of both BAW and CL under fall growing conditions. No phytotoxicity was observed.

4. Palumbo, J. C.; Mullis, C. H., and Reyes, F. J. Evaluation of Conventional Insecticides for Western Flower Thrips Control in Lettuce, 1997. POPENV,MIXTURE; 1998; 23, 109-110 (50E).
   Notes: EcoReference No.: 150749
   Chemical of Concern: ACP,CYP,DMT,ES,LCYT,MOM,NMX

Research Description:

A field trial was conducted at the University of Arizona Yuma Agricultural Center. Lettuce was direct seeded Dec 2 into double-row beds on 42-inch centers. Plots consisted of 4 beds, 60 feet long with a two-bed buffer between the plots. Plots were arranged in a RCB design with four replications. The foliar treatments were applied in 40 gpa total volume at 160 psi. A spreader/sticker was used with all treatments (Latron at 0.25% v/v). Three disc-type cone nozzles were used per bed. Two applications were made in each trial; 12 and 24 Feb. Evaluations of thrips control were based on the number of live adults and nymphs per plant sampled from the center 2 rows of each replicate on 11, 18 Feb, and 2 Mar. Numbers of thrips from 5 plants per replicate were recorded on each sample. Samples were taken by removing plants and beating them vigorously against a screened pan. Inside of the pan was a sticky trap to catch the dis-lodged thrips. Sticky traps were then taken to the laboratory where adult and immature thrips were identified to species and counted. Data were analyzed as a one-way ANOVA using a protected LSD F test to distinguish treatment mean differences.

The number of adult thrips was high at the initiation of the test. The botanical products, pyrellin and neemix did not provide significant control as compared with the untreated control. The Lannate + Ammo and Orthene + Mustang combinations provided the best control (>80% reduction), and appear to be the best available choices for managing thrips in lettuce. However, the endosulfan combinations also provided fair control (>60% reduction), and could provide viable alternatives for rotation. Although all materials appeared to control nymphs better than adults, our data may not reflect the rapid development of nymph populations or the immigration of adults from surrounding fields during the study.

5. Shields, E. J.; Sher, R. B., and Taylor, P. S. Corn Rootworm Control in Field Corn, 1989. POPENV,MIXTURE; 1991; 16, 176-177 (61F).
   Notes: EcoReference No.: 155179
   Chemical of Concern: CBF,CEX,CPY,FNF,LCYT,PRT,TBO,TFT.

Research Description:

Experimental plots measuring 42 rows x 100 ft were planted at Rich-a-Lu farm in East Aurora, N.Y., on 19 May with a 2-row corn planter at 31,000 seeds/acre, and fertilized with 400 lb of 10-10-10 fertilizer banded at planting. Soils were silt loam with 4 % organic matter. Adult beetle counts averaged between 4 and 6 beetles/plant during the 1988 oviposition period in this field. Each treatment was 1 row by 100 ft. Forty-two treatments were replicated 4 times in a complete randomized block design. Supplemental nitrogen was provided with a preplant incorporated application of 40 ton manure/acre. Granular insecticides were applied at planting with Noble granular applicators mounted on the planter. Stand counts were taken on 50 ft of row on 9 Jun. Five plants in each row were dug and the roots washed before rating root damage using the Iowa 1-6 root rating scale on 26 Jul.

Larval feeding pressure was light during 1989 in spite of the high beetle counts during the 1988 oviposition period. Frequent rains and 6 wk of field capacity soils during the larval hatching seemed to be responsible for the low level of larval feeding pressure.

6. Wang, Q.; Cheng, J. A.; Liu, Z. M.; Wu, S. G.; Zhao, X. P., and Wu, C. X. Influences of Insecticides on Toxicity and Cuticular Penetration of Abamectin in Helicoverpa armigera.
ACC,MORENV,MIXTURE,TOP; 2005; 12, (2): 109-119.
Notes: EcoReference No.: 93106
Chemical of Concern: ABM,ACYP,ALSV,CPY,CYH,DZ,EFV,FPP,HFR,PPB,TBF

Abstract:

Synergistic actions for mixtures of abamcctin with other insecticides in some insect pests were evaluated, and the possible synergistic mechanism was studied by the comparison in toxicity and cuticular penetration of abarnectin between with and without other insecticides or synergists in *Helicoverpa armigera* larvae. The results of bioassay showed that horticultural mineral oil (HMO), hcxaflumuron, chlorpyrifos, and some other insecticides were synergistic to abamectin with 152.0-420.0 of co-toxicity coefficient (CTC) in some agricultural insect pests. In topical application tests, HMO or piperonyl butoxide (PBO) increased the toxicity of abamectin in larvae of *H. armigera,* but the mortality was not affected by s,s,s-tributylphorotrithioate (DEF) and triphenylphosphate (TPP). The synergistic action of HMO was obviously higher than PBO, and when treated simultaneously with abamectin, HMO gave a more significant synergism than if treated 2
hours ahead. The highest synergistic effect (SE) was found in the mixture of 'abamectin+HMO (1 :206)'. The mortality did not increase or the toxicity drop, when a synergist or HMO was added into the mixture of 'abamectin+HMO' or 'abamectin+synergist', respectively. Results from the isotope tracing experiments showed that HMO significantly enhanced the penetration of 1H-abamectin through the cuticle of *H. armigeYa* larvae, which resulted in the synergism of the mixture. The cuticular penetration of3H-abamcctin was not accumulatively affected by chlorpyrifos, nor by hexaflumuron, though there was an inhibition within 30 seconds or 1 hour after treated by these two chemicals respectively. Results suggested that the synergism of abamectin mixed with hexaflumuron or chlorpyrifos might be related to inhibition of metabolic enzymes or target sites in the larvae.