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ENHANCED TOXICITY OF CARBARYL WHEN COMBINED WITH SYNERGISTS AGAINST LARVAE OF THE BOLLWORM AND THE TOBACCO BUDWORM^{1,2}—(Note.) Methyl parathion is combined with carbaryl and recommended for control of the bollworm, *Heliothis zea* (Boddie), and the tobacco budworm, *H. virescens* (F.), in Texas. We do not know whether this mixture is additive,

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²This paper reflects the results of research only. Mention of a pesticide or a proprietary product in this paper does not constitute a recommendation or an endorsement of this product by the USDA.

synergistic, or antagonistic against either species. Therefore, we evaluated ratios of carbaryl and the synergists methyl parathion and 4-chloro-2-nitrophenyl 2-propynyl ether against these *Heliothis* species.

The insecticide-susceptible strains of bollworm and tobacco budworm were reared at the Brownsville laboratory. The average weight of the larvae of both species at the time the insecticides were applied was 34 mg, based on weights of untreated larvae. Thirty to 100 larvae were treated with each treatment (Table 1). The materials were applied topically in 1 ul total volume of acetone solution to the dorsum of the thorax of each larva with a microapplicator.

The tests were designed to determine the LD₅₀ (mg toxicant/g body weight) after 48 hr.

None of the candidate synergists except methyl parathion killed any larvae; thus the mortality data are not presented. The mixture with 4-chloro-2-nitrophenyl 2-propynyl ether and carbaryl in a 2:1 ratio showed the greatest synergistic activity against the bollworm (Table 1). A mixture of methyl parathion and carbaryl in a 1:2 ratio showed the greatest synergism against the tobacco budworm. Only 4-chloro-2-nitrophenyl 2-propynyl ether in a 1:4 ratio with carbaryl showed antagonism against the bollworm (data not shown). However, 4 materials with carbaryl showed antagonism against the tobacco budworm, 2 at a ratio of 8:1 and 2 at a ratio of 4:1. Dan A. Wolfenbarger and Eliud Cantu, Cotton Insects Research Laboratory, Agric. Res. Serv., USDA, Brownsville, Texas 78520.

TABLE 1.—LD₅₀'s AND COTOXICITY COEFFICIENTS AFTER 48 HR WHEN 2 SYNERGISTS WERE MIXED WITH CARBARYL AT VARIOUS RATIOS AND APPLIED TOPICALLY TO LARVAE.

Ratio synergist: carbaryl	Bollworm		Tobacco budworm	
	LD ₅₀ (mg/g)	Cotoxicity coefficient*	LD ₅₀ (mg/)	Cotoxicity coefficient*
<i>Carbaryl</i>				
0:1	0.088		0.033	
<i>Methyl parathion</i>				
1:0	.071		.019	
<i>Methyl parathion + carbaryl</i>				
1:2	.028	123	.0026	1600
<i>4-chloro-2-nitrophenyl 2-propynyl ether + carbaryl</i>				
4:1	.044	201	.0090	367
2:1	.015	586	.017	193
1:1	.017	514	.014	234

* Calculated from LC₅₀'s (ug/larva) according to Sun and Johnson (1960) with equation 3 for the methyl parathion-carbaryl ratios and equation 5 for the remaining ratios; a coefficient above 100 indicates synergism.