Efficacy of Ground-Applied Ultra Low Volume Malathion Plus Hydrolized Protein Against the Mexican Fruit Fly Anastrepha ludens (Díptera: Tephritidae)

Authors: Loera-Gallardo, Jesus, Reyes-Rosas, M. A., and López-Arroyo, J. I.

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EFFICACY OF GROUND-APPLIED ULTRA LOW VOLUME MALATHION PLUS HYDROLIZED PROTEIN AGAINST THE MEXICAN FRUIT FLY *ANASTREPHA LUDENS (*DÍPTERA: TEPHRITIDAE)

JESUS LOERA-GALLARDO[1,*], M. A. REYES-ROSAS[1] AND J. I. LÓPEZ-ARROYO[1]
[1]Instituto Nacional de Investigaciones Forestales Agrícolas y Pecuarias Carretera Matamoros-Reynosa, km 61, Cd. Río Bravo, Tamaulipas, 88900, Mexico

*Corresponding author; E-mail: loera28@hotmail.com

In Mexico on 10% of the agricultural land, 32 species of fruit crops are grown (Gutierrez-Samperio et al. 1993), among which mango (*Mangifera indica* L.; Sapindales: Anacardiaceae) and orange (*Citrus* × *sinensis* (L.) Osbeck; Sapindales: Rutaceae) predominate (SIAP 2009). Production and marketing of these fruits, among others, is threatened by several species of *Anastrepha* of which *A. ludens*, the Mexican fruit fly, is the most important economically (Hernández-Ortiz 1992; Enkerlin et al. 1989; Aluja, 1994; Aluja et al. 1996; Norrbom 2004; Gazit et al. 2004). For chemical control of this insect, malathion and Spinosad GF-120™ are the only insecticides approved (CICOPLAFEST 2004); and for ground application it is recommended that the mixture, 1 L of Malathion 1000 EC + 4 L hydrolized protein + 95 L water, be applied to the foliage at a rate of 150 to 300 mL per tree, in alternate rows every 7 to 10 d (CESAVESIN, 2011).

A study was conducted to determine the effectiveness of ultralow volume ground application of malathion + hydrolyzed protein to citrus tree trunks to control *A. ludens* in 'Valencia' orange groves planted at 8 × 4 m at Hidalgo, Tamaulipas, Mexico (24° 9' 18" N, 1° 5' 12" W). This experiment was conducted from 31 Oct 2010 to 16 Apr 2011.

The details of the 6 treatments are shown in Table 1, Malathion 50, 515 g of a.i./L, (Agricultura Nacional, Guadalajara, Jalisco, Mexico), Malathion 1000, 1000 g of a.i./L (Velsimex S. A. de C. V. Mexico City), and the hydrolyzed protein, Winner 360® (IQcitrus, Mexico City) included as an attractant.

When water was added, the dosage per ha was 10.0 L of the mixture, otherwise, it was 1.0 L/ha (Table 1). The plot size was 1 ha, and the treatments were replicated 4 times. The 4 replications were separated by 50 m between adjacent blocks. Treatments were arranged in a completely randomized design. Only 144 trees, which corresponded to the alternate tree rows, were treated. Treatments were applied through a 10 L capacity hand operated backpack sprayer using a solid stream spray nozzle 2003HVD-SS (JTC Spraying & Purification Technology Co., Ltd., Zhejiang, China). To apply the amount needed on each tree, in absence of a pressure gauge, 20 discharges of the formulation were made into a graduated container. This calibration was done twice, every time before each application, and the volume measured until the corresponding dosage per tree was obtained. No mean droplet size was measured. While spraying the trees, the sprayer was continuously pumped. This is a common practice in more than the 50% of the 30,000 ha of groves in Tamaulipas, Mexico.

During the 4 weeks before the initiation of the experiment, 2 multilure traps/treatment, each baited every week with 3 torula yeast pellets, were installed in 2 central trees 16 m apart in order to determine the pre-treatment fly population density (Aluja 1993; Martinez et al. 2007; OIEA 2005).

Evaluation of results was based on the number of flies captured in these same traps, and the catch was recorded every week until the end of the experiment. Traps were serviced on 31 Oct; 6, 13, 20 and 26 Nov; 4, 11, 18 and 25 Dec; 2, 8, 15, 22 and 29 Jan; 5, 12, 19, and 26 Feb; 5, 12, 19 and 25 March; and 2, 9, and 16 April. Data on the numbers of flies captured were transformed by in order to improve the distribution normality. The transformed data were analyzed with ANOVA

TABLE 1. INSECTICIDE MIXTURES, RATES AND FREQUENCIES OF APPLICATION AGAINST THE MEXICAN FRUIT FLY IN VALENCIA ORANGES GROVES AT HIDALGO, TAMAULIPAS, MEXICO, 2011.

Treatment number	Insecticide mixture	Ratio (v/v)	Rate L/ha	Rate mL/tree	Application frequency
1	Malathion 50 +Winner 360 +water	1:4:95	10.0	70.0	weekly
2	Malathion 50 +Winner 360	1:4	1.0	7.0	weekly
3	Malathion 50 +Winner 360	1:4	1.0	7.0	biweekly
4	Malathion 1000 +Winner 360	1:4	1.0	7.0	weekly
5	Malathion 1000 +Winner 360	1:4	1.0	7.0	biweekly
6	Absolute check	—	—	—	—

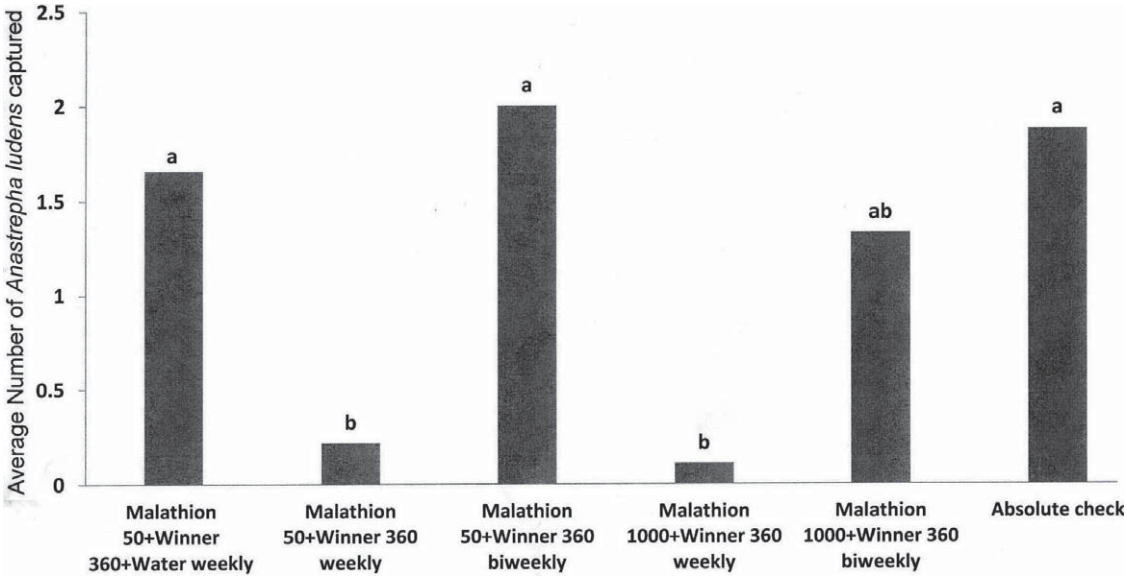

Fig. 1. Average numbers of the Mexican fruit fly, *Anastrepha ludens*, captured per week in Multilure traps baited with torula pellets, after the application of Malathion treatments, in Valencia orange groves, Hidalgo, Tamaulipas, Mexico. 2011. Bars capped with the same letter are not significantly different (LSD, $\alpha = 0.05$).

(SAS, Institute, 1985) and the means were separated by the LSD ($\alpha = 0.05$).

Flies captured each previous week were recorded on 8 and 22 Jan, 26 Feb, 5, 19, and 25 Mar, and 2, 9, and 16 Apr. During the 4 weeks that we had operated the traps before the experiment was implemented, only 2 *A. ludens* flies were captured. Therefore we assumed that the flies were distributed uniformly, and we randomly assigned the treatments to the various experimental plots. Both Malathion 50+Winner 360, and Malathion 1000+Winner 360 were applied on a weekly schedule, and the average numbers of captured flies in these two treatments was 0.22 and 0.11, respectively, i.e., not statistically different (Fig. 1); the FTD (flies/trap/day) in these treatments ranged from 0 to 0.07. When the same treatments were applied biweekly, the average of flies captured was 2.0 and 1.33 (Fig. 1), and the highest numbers for FTD were 0.64 and 0.36, respectively. The average of numbers of flies captured in the absolute check and in the Malathion 50+Winner 360+water treatment applied biweekly treatment were 1.88 and 1.66 (Fig. 1), showing their highest FTD at 0.35 and 0.43, respectively.

The treatments applied on a weekly basis were highly effective against the Mexican fruit fly, but the effectiveness of those applied biweekly was not significantly different than the untreated absolute check. When malathion was applied on a weekly basis withholding water from the tank mix significantly improved its efficacy, whereas when water was added as a carrier in the tank mix, the number of fruit flies captured was not significantly less than in the untreated absolute check. In conclusion the ground application with a backpack sprayer of ultralow volume malathion and hydrolyzed protein resulted increased efficacy as well as savings in time and other costs (data not shown).

Summary

Malathion 50 and Malathion 1000 EC were compared for control of the Mexican fruit fly in northeast Mexico. They were mixed with Winner 360 (hydrolyzed protein), and sprayed directly onto the trunks of Valencia oranges trees by means of a backpack sprayer. Ground applications were made weekly or biweekly and with or without water added. Malathion 50+Winner 360 and Malathion 1000+Winner 360, both without water and applied weekly, maintained the lowest numbers of fly captured in multilure traps baited with torula yeast pellets.

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