II. Chemical Control / New Products
d. Chemical Control
1. *Choristoneura rosaceana*

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Bt products were evaluated using a leaf-dip bioassay method to determine their effect on PLR and OBLR larvae. Treatments were prepared by diluting the appropriate amount of product (see table) in 500 ml water in a glass beaker. A small amount (ca. 2 µl) of wetting agent, X-77®, was added to each treatment. An untreated control was prepared using water plus the wetting agent only. Untreated apple leaves were collected from Red Delicious trees at the WSU Tree Fruit Research and Extension Center, Wenatchee. Leaves were dipped, then allowed to dry. Two punches (2.3 cm diameter) were taken from each leaf. Four punches were placed in a petri dish (Falcon 1006, 50x9 mm). Petri dishes were chosen randomly, and five one- to two day-old leafroller larvae were placed on the leaf disks. The petri dish lids were put in place, and dishes were stored inside a food storage container with a moist paper towel to maintain high humidity and kept at 75°F (± 2°F) constant temperature and 16:8 photoperiod. Petri dishes were examined after seven days and larval survival recorded. Ten dishes were used for each treatment (50 larvae/ treatment).

All products in test one caused significantly higher leafroller larval mortality than the untreated checks (Table 1). In these tables, a mean mortality followed by the letter 'a' indicates no separation from the untreated control. A significant rate response was noted with each of the products tested except Javelin, with most Bt products showing a significantly higher leafroller larval mortality at the 1X compared to the 0.5X rate. When leafroller larval mortality of different products was compared at the same relative rate (comparison down columns - letters in parentheses), there were few differences. Javelin provided highest OBLR larval mortality at the lowest concentrations compared to most other Bt products.

Table 1. Mortality of OBLR larvae exposed to residues of Bt products using a leaf-dip bioassay.

	Field rate	Corrected % mortality				
	(Amt. form.	Rate formulation/100 (times field rate)				
Treatment	per 100 gal.)	4X	2X	1X	0.5X	0.25X
Dipel 2X	4 oz.	94.7c(b)	97.4c(b)	86.8c(bc)	57.9b(b)	36.8b(b)
Javelin WG	4 oz.	94.7b(b)	92.1b(b)	92.1b(c)	89.5b(c)	86.8b(d)
Cutlass	6 oz.	97.4c(b)	92.1c(b)	86.8c(bc)	52.6b(b)	42.1b(b)
Able	4 oz.	100.0d(b)	89.5cd(b)	84.2cd(bc)	60.5b(b)	71.1bc(cd)
Agree	8 oz.	92.1cd(b)	94.7d(b)	71.1c(b)	71.1c(bc)	47.4b(bc)

Means in the same ROW followed by the same letter not significantly different (p=0.05, Fisher's Protected LSD).
Means in the same COLUMN followed by the same letter in parentheses not significantly different (p=0.05, Fisher's Protected LSD).

All of the treatments in test two caused significantly higher mortality than the untreated check except for the two lowest rates of Lepid (Table 2). A rate response was noted with each of the products tested, with a general break in the level of leafroller larval mortality between the 1X and 0.5X concentrations. Lepid consistently gave lower levels of leafroller larvae mortality compared to other products. Biobit and the experimental Bt, MYX-300, seemed to produce slightly higher levels of larval mortality at the lower concentrations compared to Dipel and MVP (comparison down columns - letters in parentheses).

Table 2. Mortality of OBLR larvae exposed to residues of Bt products using a leaf-dip bioassay.

Treatment	Field rate (Amt. form. per 100 gal.)	Corrected % mortality Rate formulation/100 (times field rate) 4X	2X	1X	0.5X	0.25X
Dipel 2X	4 oz.	95.6e(c)	93.3de(c)	77.8cd(cd)	71.1c(c)	20.0b(ab)
Biobit	16 fl.oz.	100.0c(c)	97.8c(c)	93.3c(d)	75.6b(c)	68.9b(c)
Lepid	1 fl.oz.	42.2bc(b)	55.6c(b)	31.1bc(b)	40.0bc(b)	26.7b(b)
MYX-300	16 fl.oz.	88.9d(c)	88.9d(c)	75.6cd(cd)	40.0b(b)	60.0bc(c)
MVP	16 fl.oz.	88.9d(c)	82.2cd(c)	66.7cd(c)	28.9b(b)	64.4c(c)

Means in the same ROW followed by the same letter not significantly different (p=0.05, Fisher's Protected LSD).
Means in the same COLUMN followed by the same letter in parentheses not significantly different (p=0.05, Fisher's Protected LSD).

All products caused significantly higher OBLR larval mortality than the untreated checks at all concentrations. A significant rate response was noted with each of the products tested. Condor was less effective at higher concentrations compared to other Bt products (comparison down columns - letters in parentheses). SAN 415 and SAN 420 caused slightly higher leafroller larval mortality than Dipel at lower concentrations.

Table 3. Mortality of OBLR larvae exposed to residues of Bt products using a leaf-dip bioassay.

Treatment	Field rate (Amt. form. per 100 gal.)	Average corrected % mortality Rate formulation/100 (times field rate) 4X	2X	1X	0.5X	0.25X
Dipel 2X	4.0 oz.	95.7e(cd)	80.4de(c)	58.7cd(c)	56.5bc(b)	34.8b(b)
Cutlass	6.0 oz.	87.0c(c)	82.6c(c)	69.6c(cd)	45.7b(b)	37.8b(b)
Condor	0.5 fl. oz.	56.5c(b)	41.3c(b)	32.6bc(b)	15.2ab(a)	47.8c(b)
SAN 420	2.0 oz.	100.0d(d)	95.7d(c)	67.4c(cd)	69.6c(bc)	32.6b(b)
SAN 415	4.0 oz.	89.1c(cd)	97.8c(c)	84.8c(d)	84.8c(d)	52.2b(b)

Means in the same ROW followed by the same letter not significantly different (p=0.05, Fisher's Protected LSD).
Means in the same COLUMN followed by the same letter in parentheses not significantly different (p=0.05, Fisher's Protected LSD).

A significant rate response was noted with Troy Bt and Dipel but not with Naturalis-L (Table 4). Leafroller larval mortality caused by Troy Bt and Dipel was similar at the higher concentrations, but Dipel consistently produced higher leafroller larval mortality at the lower rates (comparison down columns - letters in parentheses). There was no rate response noted with the Konsume + Dipel treatments.

Table 4. Mortality of OBLR larvae exposed to residues of Bt products using a leaf-dip bioassay.

Treatment	Field rate (Amt. form. per 100 gal.)	Corrected % mortality Rate formulation/100 (times field rate) 4X	2X	1X	0.5X	0.25X
Naturalis-L	54 fl. oz.	51.2bc(b)	58.5c(b)	41.5bc(bc)	31.7bc(b)	24.4ab(ab)
Troy Bt	8 fl. oz.	85.4c(c)	78.0c(bc)	31.7b(b)	12.2ab(ab)	19.5ab(ab)
Dipel	4 oz.	95.1e(c)	73.2de(bc)	68.3cd(cd)	39.0b(b)	46.3bc(bc)
Konsume[1] + Dipel 2X	16 fl. oz. 4 oz.	87.8b(c)	85.4b(c)	75.6b(d)	85.4b(c)	73.2b(c)

Means in the same row followed by the same letter not significantly different (p=0.05, Fisher's Protected LSD).
Means in the same COLUMN followed by the same letter in parentheses not significantly different (p=0.05, Fisher's Protected LSD).
[1] A constant rate of Dipel (1X-field rate) and variable rates of Konsume.