

## FOOD ATTRACTANT TO CONTROL THE POPULATION OF *Rhagoletis cerasi* L. (Diptera: Tephritidae) AND ITS USE IN ORGANIC SWEET CHERRY ORCHARD IN POLAND

### Summary

The study presents the results of the research on dispensers used to lure cherry fruit flies in biological tests together with yellow sticky-coated visual traps. The field tests showed that yellow Rebell traps with the dispenser containing the food attractant based on the blend of ammonium acetate and ammonium carbonate as well as putrescine (added in a separate container) were the most suitable in control of population of *Rhagoletis cerasi*. Such a combined trap was effective in mass trapping of the flies *R. cerasi* when used one per tree in the sweet cherry orchard with not very high trees (up to 3 m).

**Key words:** cherry fruit fly, sweet cherry, lures, traps, mass trapping, field experiments

## ZASTOSOWANIE ATRAKTANTU POKARMOWEGO DO ODŁAWIANIA NASIONNICZY TRZEŚNIÓWKI *Rhagoletis cerasi* (Diptera: Tephritidae) W EKOLOGICZNYM SADZIE CZEREŚNIOWYM W POLSCE

### Streszczenie

W pracy przedstawiono wyniki badań nad dyspenserami wabiącymi muchówki nasionnicy trześniówki użyte w testach biologicznych razem z żółtymi pułapkami lepowymi. Badania polowe wykazały, że dyspenser z atraktantem opartym na mieszaninie octanu amonu z węglanem amonowym oraz dodaną w oddzielnym pojemniku putrescyną, umieszczony w żółtej pułapce typu Rebell, posiada wysoką skuteczność w odławianiu *Rhagoletis cerasi*. Użycie takiej jednej kombinowanej pułapki na drzewo w sadzie czereśniowym z drzewami niewysokimi (do 3 m wys.), potwierdziło jej dobrą skuteczność w masowym odłowieniu szkodnika.

**Słowa kluczowe:** nasionnica trześniówka, czereśnie, wabiki, pułapki, masowy odłów, doświadczenia polowe

### 1. Introduction

*Rhagoletis cerasi* is a species *Tephritidae* known by the common name cherry fruit fly (CFF). It is a serious pest in both the sweet cherries and the sour cherries. *R. cerasi* is widespread in Europe, where it is considered the key pest on fruit crops [1]. The larvae of CFF feed inside the fruit and causes severe economic losses (up to 100% of the fruit can be infested [3]). Therefore, control measures are frequently required. This is usually made by using insecticides (mainly neonicotinoids or pyrethroids) in different forms [1]. In order to avoid the application of excess chemicals, the detection of first flight of pest becomes increasingly important to schedule precise insecticide applications. It is best to apply the yellow sticky traps. These traps (especially Rebell-type traps) can also be used in "mass trapping" as an alternative for organic cherry production [4]. The effectiveness of the yellow traps can be enhanced by adding food attractants such as lure containing ammonium salts [5]. However, in order for mass trapping strategies to be effective, several traps per tree are needed [6].

In the present paper we report results of the experiments aiming at estimation of the efficacy of food-lure dispensers containing two ammonium salts into a single matrix and 1,4-diaminobutane (putrescine) against CFF in the sweet cherry orchards. In addition, for the most effective trap combination (type of trap and dispenser) obtained in the first part of the experiment, it was intended to test its effec-

tiveness in mass trapping of the pest when it is used for the economical variant (one trap per tree) in organic orchard with small trees.

### 2. Material and methods

**Experimental sites:** The studies were conducted in the sweet cherry orchards in Kędzierówka village (small orchard, region of Piaseczno) and Nowy Dwór-Parcela village (Experimental Ecological Orchard of the Research Institute of Horticulture in Skierniewice), in Poland. Trees were 3-5 m high in Kędzierówka site (*mid- and late-ripening varieties*) and 2-3 m high in Nowy Dwór-Parcela site ('Regina' variety).

**Materials:** The food-lure dispensers formulation consists of the clear grip seal bags (50 x 70 mm) manufactured of different density polyethylene (35 micron (1), ~60 micron (2) and ~100 micron (3)), containing mixture of ammonium salts (3 g of ammonium acetate and 2.6 g of ammonium carbonate - dispenser D1, D2 and D3, respectively) and second component (100 µl of putrescine) which was immediately added to the grip seal bags (dispenser D1P, D2P and D3P, respectively) or placed in a separate container - small Eppendorf type vial at 200 µl (dispenser D1P+, D2P+ and D3P+, respectively). Populations of *R. cerasi* were monitored using yellow sticky traps (Rebell type of dimensions 15 x 20 cm and the traditional panel of 20 x 30 cm - commercial products, provided by Polish



### 3. Results and discussion

The number of cherry fruit fly adults captured in 2009 in the yellow traps with tested dispensers placed inside the trial field in Kędzierówka site is presented in table 1 and fig. 2.

Table 1. Captures of *R. cerasi* in yellow sticky traps with different lures during the flight period in 2009, Kędzierówka site, 12 May to 11 July, 2009

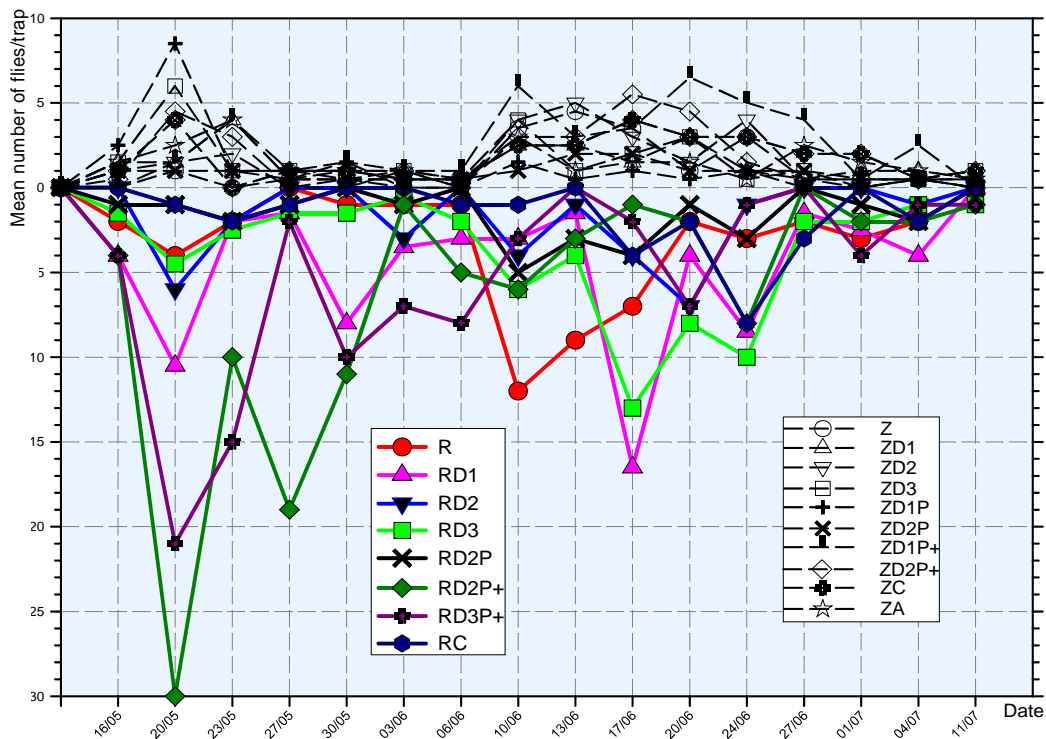
Tab. 1. Odlowy much *R. cerasi* na żółte pułapki lepowe z różnymi dyspenserami w Kędzierówce, w okresie od 12 maja do 11 lipca 2009 r.

No. row	No. tree	Trap	Dis- penser	Number of flies per trap																Total
				16 May	20 May	23 May	27 May	30 May	03 June	06 June	10 June	13 June	17 June	20 June	24 June	27 June	01 July	04 July	11 July	
I	1	R	#	2	4	2	0	2	1	1	12	9	7	2	3	4	9	3	1	62
	2	T	#	0	0	0	0	1	0	0	9	12	10	2	12	2	2	2	0	52
	4	R	D2P	1	1	2	1	0	1	0	4	3	6	1	2	0	1	2	0	25
	6	T	D3	3	10	2	2	1	2	0	8	2	4	6	0	2	0	1	1	44
	8	R	D1	5	15	4	2	14	7	3	6	3	21	5	5	2	4	4	0	100
	11	R	D3	2	8	3	1	1	1	0	7	3	24	9	19	4	1	2	1	86
	15	R	D3P+	4	21	15	4	7	8	8	3	0	20	8	2	1	4	1	1	107
	19	T	D3	0	2	0	0	0	0	1	0	0	0	0	1	0	0	0	0	4
	21	T	C	1	9	0	2	2	0	0	0	6	4	0	0	3	2	0	1	30
	23	T	D2	1	0	0	0	0	1	0	0	2	0	1	0	0	0	0	0	5
	25	T	D1	1	1	4	2	0	0	1	4	1	1	1	0	0	0	1	1	18
	II	1	T	D2P	0	0	0	0	0	0	0	1	0	0	2	3	0	0	0	0
2		R	D3	1	1	4	1	1	0	4	4	7	3	4	0	2	3	3	2	40
4		T	D2	2	1	0	0	1	0	1	2	4	4	3	6	1	0	0	0	25
7		T	D2P	1	2	0	0	1	0	0	1	0	2	0	0	0	2	2	1	12
12		T	D1P	5	13	3	2	2	0	0	3	1	1	1	0	0	0	1	1	33
14		T	D2P+	2	8	7	0	1	1	0	3	5	16	13	2	1	0	2	0	61
17		T	D2	0	4	4	1	0	0	1	11	6	8	3	5	0	0	1	0	44
III	1	T	D1P	0	4	0	0	0	0	0	1	1	0	1	0	0	0	0	0	7
	2	T	#	0	0	1	0	0	0	0	1	0	1	1	0	0	0	0	0	4
	3	R	C	0	1	2	1	0	0	2	2	1	3	2	7	1	0	2	0	24
	5	R	D1	3	6	1	1	1	0	2	1	2	7	2	10	3	0	3	0	42
	7	R	D2P+	4	30	10	3	22	2	8	7	3	1	3	6	0	2	2	1	104
	10	R	D2	0	6	2	0	0	2	2	5	1	3	6	0	0	0	1	0	28
IV	12	T	D1P+	0	1	0	2	1	2	0	2	2	5	8	5	6	1	2	0	37
	1	T	D2	1	1	0	0	0	1	0	1	0	0	0	2	1	0	0	0	7
	5	T	A	1	5	0	0	1	1	1	0	0	0	1	0	3	4	1	2	20
	6	T	C	1	2	0	0	1	0	0	7	3	8	6	6	1	3	0	0	38
	9	T	D1P+	0	2	8	0	0	1	0	1	4	2	4	4	3	2	4	1	36
	11	T	D2P	1	0	0	1	2	2	3	6	7	2	1	0	1	0	0	0	26
V	12	T	#	0	3	0	1	0	0	0	1	0	0	0	0	0	0	0	0	5
	1	T	D2P	2	1	3	1	0	1	0	0	0	0	0	0	0	0	0	0	8
	3	T	A	4	3	11	4	2	3	1	4	2	3	0	0	1	2	0	40	
	5	T	D1	1	0	0	0	2	0	0	3	1	1	8	2	0	0	1	0	19
VI	7	T	D1	3	3	8	1	0	2	1	6	3	0	0	1	3	2	0	34	
	2	T	D2P+	0	3	0	0	0	0	1	0	0	0	0	0	0	0	0	0	4
	4	T	D2P+	0	1	2	0	0	1	0	0	0	0	0	0	1	0	0	5	
VII	6	T	#	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2	
	2	T	C	0	1	0	1	0	1	1	0	0	0	0	2	2	2	0	2	12
5	T	A	0	0	0	0	1	0	0	5	1	1	2	2	3	4	1	0	20	

Specification of symbols: D1 - dispenser involving grip seal bags manufactured in 35 micron density polyethylene; D2 - dispenser involving grip seal bags manufactured in ~60 micron density polyethylene; D3 - dispenser involving grip seal bags manufactured in ~100 micron density polyethylene; D1P, D2P and D3P - dispenser D1 - D3 involving additional putrescine; D1P+, D2P+ and D3P+ - dispenser D1 - D3 involving additional putrescine in a separate container; C - standard dispenser from Csalomon; A - standard dispenser from AgriSense-BCS, # - trap without lure; T - sticky yellow panel type trap; R - Rebell type trap

Oznaczenia: D1 - dyspenser z torebki strunowej wykonanej z polietylenu o gęstości 35 mikronów; D2 - dyspenser z torebki strunowej wykonanej z polietylenu o gęstości około 60 mikronów; D3 - dyspenser z torebki strunowej wykonanej z polietylenu o gęstości około 100 mikronów; D1P, D2P i D3P - dyspensery D1-D3 z dodatkiem putrescyny; D1P+, D2P+, D3P+ - dyspensery D1-D3 z dodatkiem putrescyny w oddzielnym pojemniku; C - dyspenser standardowy Csalomon; A - dyspenser standardowy AgriSense; # - pułapka bez dyspensera; T - żółta pułapka lepowa; R - pułapka typu Rebell

Source: own work / Źródło: opracowanie własne



Source: own work / Źródło: opracowanie własne

Fig. 2. Mean numbers of *R. cerasi* trapped daily in yellow sticky traps with various of food-lure dispensers. Specification of symbols: Z - sticky yellow panel type trap, R - Rebell type trap, D1 - dispenser involving grip seal bags manufactured in 35 micron density polyethylene, D2 - dispenser involving grip seal bags manufactured in ~60 micron density polyethylene, D3 - dispenser involving grip seal bags manufactured in ~100 micron density polyethylene, D1P, D2P, D3P - dispensers D1-D3 involving additional putrescine, respectively, D1P+, D2P+, D3P+ - dispensers D1-D3 involving additional putrescine in a separate container, respectively, C - standard dispenser from Csalomon, A - standard dispenser from AgriSense

Rys. 2. Średnia, dzienna liczba odłowionych much *R. cerasi* na żółte pułapki lepowe z zastosowaniem różnych dyspenserów. Oznaczenia: Z – żółta pułapka lepowa; R – pułapka lepowa typu Rebell; D1 – dyspenser z torebki strunowej wykonanej z polietylenu o gęstości 35 mikronów; D2 – dyspenser z torebki strunowej wykonanej z polietylenu o gęstości około 60 mikronów; D3 – dyspenser z torebki strunowej wykonanej z polietylenu o gęstości około 100 mikronów; D1P, D2P i D3P – dyspensery D1-D3 z dodatkiem putrescyny; D1P+, D2P+, D3P+ – dyspensery D1-D3 z dodatkiem putrescyny w oddzielnym pojemniku; C – dyspenser standardowy Csalomon; A – dyspenser standardowy AgriSense

The highest catches were obtained during the warm and sunny periods in the second week after the beginning of the flight period from 16 to 23 May and on June 10-24, 2009. Trap type R (yellow Rebell trap) captured significantly more flies than trap T (sticky yellow panel trap) irrespective of the type of a dispenser. Among the kinds of tested dispensers, significant differences were also observed (table 1). The most of *R. cerasi* were caught in traps containing dispenser with the blend of ammonium acetate and ammonium carbonate as well as putrescine in a separate container (dispenser D1P+ – D3P+). However, the thickness of the dispenser (the clear grip seal bag) did not have much impact on the amount of the catches of the pest. In most cases, the dispensers D<sub>n</sub>P+ were more active than the standard lures.

The sticky yellow Rebell-type traps with the dispenser D1P+ were used in the method of mass trapping in Nowy Dwór-Parcela site during the season 2010 (table 2 and fig. 3). A total of 2728 cherry fruit flies were captured during the experimental period (May 14 to June 27) in the 65 experimental traps. For comparative purposes, the Csalomon and AgriSense dispensers (dispensers C and A, respec-

tively) were used. The control of traps was carried out at least once in 4 weeks. In the case of the last inspection of traps, we missed counting of insects in the traps which fell down from the trees or were damaged as a result of a strong rainstorm (table 2, the x mark).

The effectiveness of the traps baited with dispenser D1P+ was similar to the action of the traps baited with the lure from AgriSense and better than traps baited with the lure from Csalomon company (fig. 3).

The efficiency of the mass trapping method was evaluated based on the decrease in the amount of fruit damage compared to the control one. The plot where the mass trapping technique was used showed CFF larvae infested cherries at 11% and control plot showed at 72%. The achieved result is good enough taking into consideration conditions used in the experiment, such as one trap per tree and the relatively high population of the pest. The attractiveness properties of the trap combination (RD1P+) used in the mass trapping technique will be further examined during the next seasons.

Table 2. Total catch of *R. cerasi* in yellow sticky Rebell traps with dispenser D1P+ during the flight period in 2010, Nowy Dwór-Parcela site, 14 May to 27 July, 2010

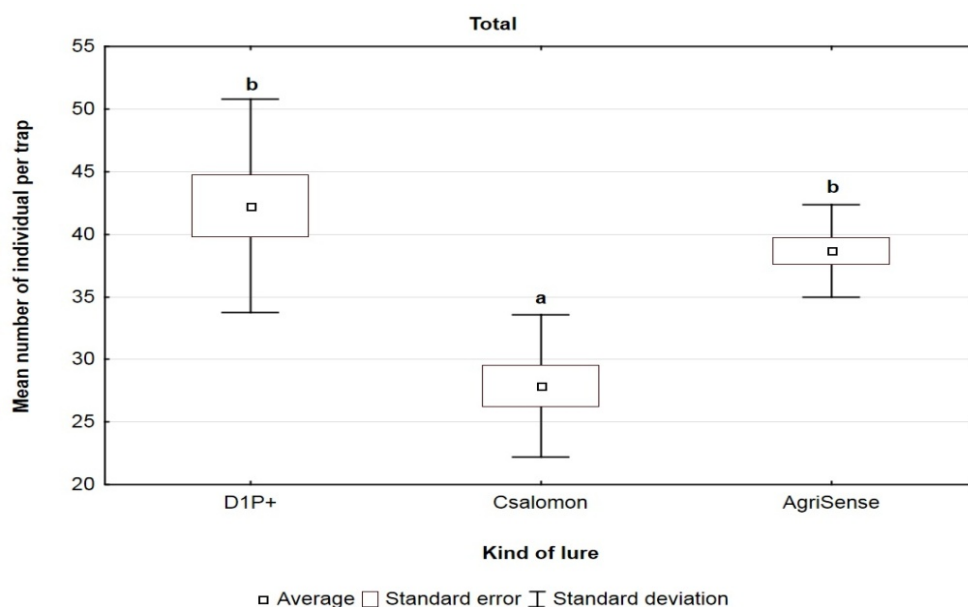
Tab. 2. Liczba odłowionych much *R. cerasi* na żółte pułapki lepowe z dodatkiem dyspenseru typu DIP+ w Nowym Dworze-Parcela w okresie od 14 maja do 27 lipca 2010 roku

No. tree	Inspection dates/Row B7-27			Inspection dates/Row B7-28			Inspection dates/Row B7-29		
	11 June	30 June	27 July	11 June	30 June	27 July	11 June	30 June	27 July
	Total number of flies per trap								
1	5	6	x	14	21	23	17	18	20
2	34	34	35	6	16	16	37	37	x
3	15 <sup>a</sup>	30 <sup>a</sup>	30 <sup>a</sup>	32	45	45	25	25	26
4	46	63	64	31	63	64	46	47	48
5	80	96	x	28	57	57	58 <sup>b</sup>	58 <sup>b</sup>	59 <sup>b</sup>
6	52	70	72	7	8	8	3	3	3
7	40	42	x	16 <sup>b</sup>	17 <sup>b</sup>	18 <sup>b</sup>	20	22	22
8	15	20	22	51	65	66	24	26	27
9	20	21	21	22	24	25	76	78	79
10	50	49	x	#	#	#	30	32	32
11	58	59	59	23	24	24	47	48	49
12	31	46	x	22	24	24	98	99	99
13	40 <sup>b</sup>	41 <sup>b</sup>	41 <sup>b</sup>	23	27	27	30 <sup>a</sup>	31 <sup>a</sup>	31 <sup>a</sup>
14	54	56	64	23 <sup>a</sup>	31 <sup>a</sup>	44 <sup>a</sup>	89	90	91
15	89	89	x	35	37	37	64	64	65
16	40	42	42	31	44	46	58	59	x
17	72	80	82	36	45	45	36	37	37
18	62	68	68	34	46	46	30	31	31
19	28	32	32	33	51	51	33	33	34
20	30	35	36	12 <sup>a</sup>	38 <sup>a</sup>	40 <sup>a</sup>	12	14	14
21	45	45	x	12	27	28	20	22	22
22	29	29	29	6	13	13	4	4	5

<sup>a</sup> - result for standard lure from Csalomon, <sup>b</sup> - result for standard lure from AgriSense, # - lack of tree, x - traps which fell from the trees or were damaged during the experiment.

<sup>a</sup> - wyniki dla pułapki standardowej Csalomon, <sup>b</sup> - wyniki dla pułapki standardowej AgriSense, # - brak drzewa, x - pułapki uszkodzone podczas doświadczenia

Source: own work / Źródło: opracowanie własne



Source: own work / Źródło: opracowanie własne

Fig. 3. Total catches of *R. cerasi* in yellow sticky Rebell traps with D1P+ dispenser and standard lures during the flight period in 2010; Nowy Dwór-Parcela site; 14 May to 27 July, 2010

Rys. 3. Odłowienia much *R. cerasi* na żółte pułapki lepowe typu Rebell z dodatkowymi dyspenserami standardowymi i typu D1P+ w Nowym Dworze-Parcela w okresie od 14 maja do 27 lipca 2010 r.

#### 4. Summary

In this article, we demonstrate the usage of the mass trapping technique in organic orchard to control *R. cerasi*. Results of the trial can be considered as satisfactory:

- In the experiment in Kędzierówka site, the dispensers containing the blend of ammonium acetate and ammonium carbonate as well as putrescine in a separate container as a food attractant showed high attractiveness for *R. cerasi* flies, and they were more active than the standard lure in the most cases. This dispenser combined with the sticky yellow Rebell traps was used with a positive result for control of the insect pest in the organic orchard.

- Using the DIP+ dispenser with Rebell-type traps for *R. cerasi* mass trapping resulted in a significant reduction of damage made on the fruit in the harvest.

Thus, the mentioned dispenser together with sticky yellow Rebell traps is suitable for monitoring the beginning of the flight period, as well as for mass-trapping purposes.

#### 5. References

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*We wish to thank PPH Medchem for providing the yellow sticky traps and the standard lures.*