EFFECIENCY OF LOCAL TRAP DESIGN ON *SYNANTHEDON MYOPAEFORMIS* BORKH. IN EGYPT

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Abstract

The clearwing moth *Synanthedon myopaeformis* Borkh. (Lepidoptera: Sesiidae) is considered a serious boring pest in Egyptian apple orchards. The effectiveness of different locally made trap designs (shape, size, height, color and distance between traps) were evaluated in badly infested apple orchard at Tokh district, Qalubia governorate throughout 3 moth's activity seasons (1997 to 1999). It was found that, the most effective and economic tape was made of 2 liters transparent carbonated water bottle hanged at 2.5 meters height and at the rate of 10 traps / feddan.

INTRODUCTION

In Egypt, apples is an economically important crop, occupying an area of about 65 000 feddans. Apple trees are liable to be severely infested with *Synanthedon myopaeformis* Borkh. (Lepidoptera: Sesiidae), which is one of the most destructive wood boring insect pests. Larvae bore their tunnels under the bark of trunk and main branches, reducing the production, causing weakness and finally death of trees (Tadros, 1977).

To avoid the environmental pollution with insecticides and support the role of the natural enemies, alternatives of control methods such as mass trapping by sex pheromone were applied. The aim of this study was to increase the effectiveness of different trap designs (shape, size, height, color and distance between traps). The relative effectiveness, as well as the economic cost and the applicability were highly considered.

The present investigation is pioneer in Egypt as there were no other attempts to evaluate the effectiveness of different designs in trapping *S. myopaeformis* in apple orchards. However, some attempts were conducted in Europe such as Voerman and Deventer (1984), Trematerra (1986), Onucar and Ulu (1995), Trematerra and Facciǫli (1990), Buleza *et al.* (1990), Stuber and Dickler (1988), Kers (1998), and Trematerra (1993), on trap shape, height, color and distance.

MATERIALS AND METHOD

Experiments were conducted in an infested apple orchard (10 feddans and 8 years old) located at Tokh district, Qalubia governorate throughout 1997 to 1999 moths activity seasons.

1. **Trap shape experiments:** Considering the economic aspects, the following 6 different local made traps compared with 2 imported ones were evaluated for their efficiency in trapping *S. myopaeformis* during 1997 peak season of moth's activity (March-May).

1.1. Large empty opaque ice cream cups, 10 cm high and 15 cm wide. The cup cover was fixed 3 cm above the cup by a wire. The inner surface of the cup was lined with a sticky sheet (Figure 1, a).

1.2. Empty transparent mineral water or carbonated water bottles, 25 cm high and 5 cm wide in the upside down position. Three holes were artificially made in the upper third of the bottle with a polyethylene bag fixed in its lower opening (its neck) (Figure 1, b).

1.3. Empty opaque petroleum oil or vegetable oil bottles, 25 cm high and 5 cm wide. Three holes were made as in the previous item no. 2 (Figure 1, c).

1.4. Empty opaque petroleum oil buckets, 25 cm high and 10 x 20 cm base wide x length. Six holes were artificially made in the first third of the bucket (two on each wide side and one on each narrow side) (Figure 1, d).

1.5. The locally made of cardboard pyramid sticky traps (Figure 1, e).

1.6. The funnel traps, locally made of hard plastic with polyethylene bags fixed at their end (Figure 1, f).

1.7. The imported recommended pyramid sticky traps (Traptest: that used in monitoring insects with attractants, from different companies) (Figure 2, g).

1.8. The imported funnel traps (Mastrap: that used in mass trapping of insects with attractants, from different companies) (Figure 2, h).

2. **Trap size experiments:** Four sizes of transparent carbonated water bottles were chosen (0.5, 1, 1.5 and 2 liters) during 1997 (July-October) for their efficiency in trapping *S. myopaeformis* males.

3. **Trap height experiments:** Transparent carbonated water bottles with 2 liters size were hanged at 6 heights from the ground level (zero "on the ground", 0.5, 1, 1.5, 2 and 2.5 meters) were evaluated for their efficiency in trapping *S. myopaeformis* males during 1998 (April-July).

4. **Trap color experiments:** Yellow, red, blue, green, black and transparent bottles of 2 liters size, suspended on trees at 1.5 m above the ground) were evaluated for the effect of color on mass trapping during 1998 peak season (July-October).

5. **Trap distance experiments:** The efficiency of trap distances was evaluated during 1999 peak season of moths activity (March-July). Transparent carbonated water bottles, 2 liters size were hanged on trees at 1.5 m above the ground and distributed at 5, 10, 15 and 20 meters apart (168, 42, 18 and 10 traps per feddan, respectively).

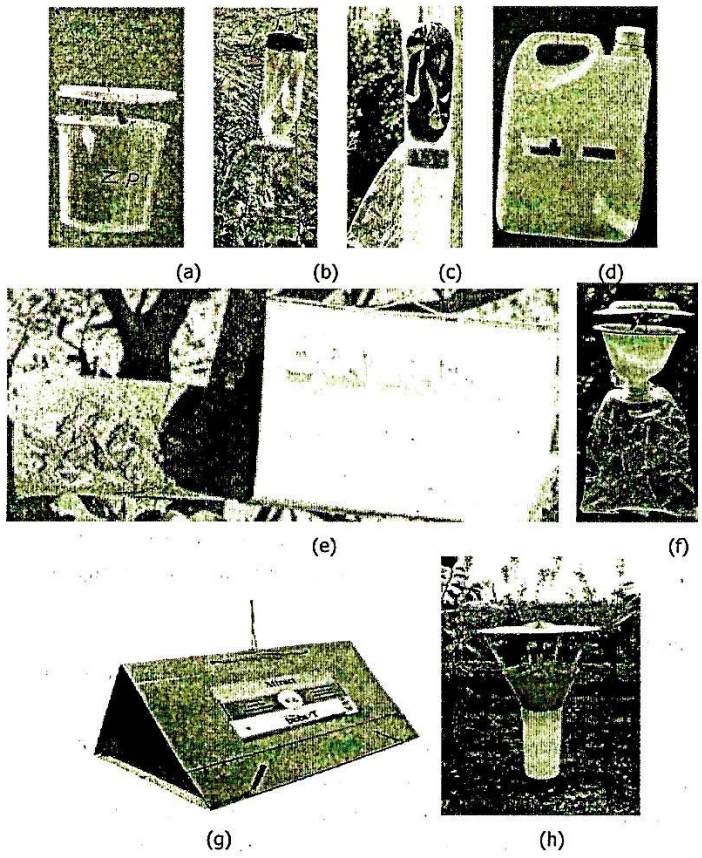

Figure 1. Locally made trap shapes: (a) ice cream cup, (b) transparent carbonated water bottles, (c) opaque oil bottles, (d) petroleum oil buckets, (e) sticky trap and (f) funnel trap and imported trap shapes: (g) sticky trap and (h) funnel trap.

Traps were baited with a septa (pheromone), hanged in the middle of the upper part of each container as shown in Figure (1) and imprignated with 1 mg active ingredient of a blend containing the following isomers:

(Z, Z) 3, 13 – octadecadienyl acetate	84.29%,
(Z, E) 3, 13 – octadecadienyl acetate	2.83%,
(E, Z) 3, 13 – octadecadienyl acetate	9.69% and
(E, E) 3, 13 – octadecadienyl acetate	0.61%.

Ten traps of each shape, size, height, color and distance were randomly distributed on the trees (considering each trap as a replicate). Trapped males were collected, counted and the sticky sheets or polyethylene bags of traps were replaced at weekly intervals. The sptae were replaced at 6-week intervals. Analysis of variance (F test) and least significant differences (LSD) were used for differentiation between treatments.

RESULTS AND DISCUSSION

As imported pheromone traps are very expensive, as well as trap shape, size, height, color and distance between traps are limiting factors in increasing the efficiency of trap attraction, several local and imported trap designs were evaluated for their comparative efficiency in trapping *S. myopaeformis* moths considering the economic and applicable points of view.

1. Trap shape experiments:

Table (1) clarified that during March to June of 1997, the maximum numbers of males (35.68 ± 17.25 moths / trap / week) were caught by the imported sticky pyramid trap. The four shapes, transparent carbonated water bottle, imported funnel, locally made sticky pyramid and locally made funnel traps, captured also large numbers of males (23.83 ± 13.24, 23.42 ± 9.81, 23.18 ± 12.64 and 22.34 ± 11.36 males / trap / week, respectively). Moderate numbers of moths were captured in ice cream cup trap (21.12 ± 9.94 moths) and dry oil opaque bottle trap (19.48 ± 8.59 moths) and. The least capture was in dry oil opaque bucket trap (16.06 ± 7.20 moths). However, funnel trap shapes were favorable to be thrift or lost by children.

Table 1. Mean numbers of *S. myopaeformis* male moths trapped in different trap shapes in an apple orchard at Qalubia governorate during 1997 season.

Date of inspection	Mean no. of male moths per trap caught in different trap shapes							
	Ice cream cup	Trans-parent bottle	Opaque bottle	Opaque bucket	Local sticky pyramid	Imported sticky pyramid	Local funnel	Imported funnel
March 27	Suspending traps							
April 3	13.4	9.5	11.1	7.4	17.6	24.1	14.2	15.9
April 10	27.3	30.4	23.7	12.2	13.5	34.8	19.3	22.4
April 17	16.5	21.2	15.2	18.5	19.2	19.3	23.4	18.2
April 24	24.1	17.5	29.4	14.4	21.3	25.1	11.8	16.7
May 1	35.4	41.3	27.3	29.2	42.7	74.9	49.3	39.6
May 8	42.7	56.7	39.5	24.7	51.4	66.3	36.2	45.1
May 15	14.2	10.6	12.6	27.6	35.6	37.2	29.1	32.3
May 22	29.5	23.8	18.2	15.2	28.4	45.7	30.6	27.6
May 29	15.1	24.8	13.1	12.5	13.7	33.4	21.3	15.8
June 5	16.3	18.4	21.4	17.4	16.5	28.2	13.7	20.1
June 12	11.4	10.2	16.5	9.2	12.4	22.5	18.5	16.5
June 19	17.9	26.5	15.9	12.9	17.3	31.6	10.6	16.4
June 26	10.8	18.9	9.3	7.6	11.8	20.7	12.4	17.9
Total	274.6	309.8	253.2	208.8	301.4	463.8	290.4	304.5
Average	21.12 ±9.94	23.83 ±13.24	19.48 ±8.59	16.06 ±7.20	23.18 ±12.64	35.68 ±17.25	22.34 ±11.36	23.42 ±9.81
	b	b	b	b	b	a	b	b

Statistical analysis (Table 6) emphasized that there were highly significant differences between the mean numbers of catches in the eight different trap shapes. Although imported sticky pyramid trap significantly differed from other trap shapes, yet the other trap shapes were insignificantly differed from each other's. Due to the dusty period of "Khamasien" in Egypt and the density of trapped moths covered the sticky material (Stikem) which spoils the sheet. The locally made transparent carbonated water bottle was the best shape under the Egyptian prevailing conditions. The tested trap shape almost priceless, easier to construct, prepare, handle, use, store and transport, and had more surface area (polyethylene plastic bags) available for capturing mass numbers of males than sticky traps.

2. Trap size experiments:

As shown in Table (2), the mean number of trapped males during the peak activity season of 1997 (July-October) in different trap sizes (0.5, 1, 1.5 and 2 liters) was ascendingly increased as the total bottle size was increased. The maximum average number of male moths was captured (46.38 ± 30.80 moths) by 2 liters size bottle followed by the 1.5 liters bottle (41.25 ± 26.14 males), 1 liter bottle (31.17 ± 18.93 males) and 0.5 liter bottle (23.05 ± 13.80 moths).

Statistically, there were insignificant differences between the mean numbers of captured male moths in different trap sizes (Table 6). However, 2 liters bottle trap showed the best trap size as it caught the largest number.

Table 2. Mean numbers of *S. myopaeformis* male moths trapped in different trap sizes in an apple orchard at Qalubia governorate during 1997 season.

Date of inspection	Mean no. of male moths per trap caught in different trap sizes			
	0.5 liter	1 liter	1.5 liters	2 liters
May 29	Suspending traps			
June 5	14.4	12.8	15.6	17.3
June 12	6.3	10.1	14.4	19.7
June 19	11.7	26.4	21.7	32.2
June 26	27.9	47.7	64.1	73.5
July 3	39.2	59.6	76.5	101.3
July 10	45.6	51.5	87.2	92.4
July 17	34.8	43.2	40.8	57.2
July 24	42.4	60.6	79.3	81.9
July 31	27.7	29.7	31.2	35.6
August 7	15.6	21.1	34.4	24.4
August 14	12.5	17.4	28.7	23.2
August 21	9.3	13.5	22.6	27.8
August 28	12.2	11.6	19.8	16.5
Total	299.6	405.2	536.3	603.0
Average	23.05±13.80	31.17±18.93	41.25±26.14	46.38±30.80
	b	ab	ab	a

3. Trap height experiments:

Table (3) showed the relative efficiency of traps suspended at different heights (0.0, 0.5, 1.0, 1.5, 2.0 and 2.5 meters above the ground) during *S. myopaeformis* activity season (April - July) of 1998. Data in Table (3) indicated that the maximum number of trapped male moths was at 2.5 meters high (62.05 ± 39.33 males / trap / week) followed by at 2.0 meter high (56.02 ± 38.98 males). The average numbers of males caught in traps at 1.5 and 1 meters height were 47.32 ± 27.05 and 42.75 ± 26.20 males / trap / week, respectively while the lower numbers of moths were captured in traps suspended at o.5 meter and the least numbers in traps placed on the ground surface beside the tree crown (0 meter) (31.39 ± 19.41 and 18.64 ± 12.20 males).

Table 3. Mean numbers of *S. myopaeformis* male moths trapped in different trap heights in an apple orchard at Qalubia governorate during 1998 season.

Date of inspection	Mean no. of male moths per trap caught in different trap heights (in meters)					
	0	0.5	1	1.5	2	2.5
April 2	Suspending traps					
April 9	4.9	8.1	14.6	11.8	17.2	21.3
April 16	8.0	13.6	17.4	23.1	29.9	37.1
April 23	17.3	24.3	25.2	37.4	42.1	54.5
April 30	24.5	41.8	53.5	66.8	91.5	96.7
May 7	39.6	55.0	71.0	94.2	107.5	125.3
May 14	35.7	56.1	92.9	87.5	138.6	113.9
May 21	26.5	49.2	69.3	63.7	85.8	109.2
May 28	22.1	54.7	73.5	69.4	54.3	82.5
Jun 4	31.8	47.2	38.1	41.3	59.4	67.1
June 11	10.5	21.5	32.3	48.5	43.6	32.7
June 18	9.2	15.9	26.7	34.9	25.4	25.8
June 25	6.4	9.3	25.4	16.0	18.3	21.2
July 2	5.8	11.4	15.8	20.6	14.7	19.4
Total	242.3	408.1	555.7	615.2	728.3	806.7
Average	18.64 ±12.20	31.39 ±19.41	42.75 ±26.20	47.32 ±27.05	56.02 ±38.98	62.05 ±39.33
	c	bc	ab	ab	ab	a

From the statistical point of view, highly significant differences were recorded between the mean numbers of moths caught in traps at different height above the ground (Table 6). Trap catches increased ascendingly with the increases in trap height to 2.5 meters above the ground. However, there were insignificant differences between trap catches at 2.5, 2, 1.5 and 1 meter high. It could be recommended that the optimum trapping height for *S. myopaeformis* in apple orchards was 2.5 meters above the ground.

4. Trap color experiments:

The efficiency of six different colors (transparent, yellow, green, blue, red and black colors) was evaluated during *S. myopaeformis* peak moth's activity season of 1998 (July - October).

Table (4) showed that the yellow colored trap captured the maximum number of *S. myopaeformis* moths (94.68 ± 39.76 males/ trap / week), followed by red, white, green and black colored traps (77.32 ± 32.03, 75.69 ± 24.25, 68.95 ± 23.44 and 57.78 ± 23.37 moths/ trap, respectively), while the least moths catches was recorded in transparent trap (46.88 ± 23.55 males/ trap / week).

Statistical analysis revealed that there were highly significant differences between average numbers of moths captured by different color traps (Table 6).

Yellow colored trap was the highest catches of moths. Accordingly, yellow colored traps apparently showed superior catches and could be recommended for trapping *S. myopaeformis* moths.

Table 4. Mean numbers of *S. myopaeformis* male moths trapped in different trap colors in an apple orchard at Qalubia governorate during 1998 season.

Date of inspection	Mean no. of male moths per trap caught in different trap colors					
	Yellow	Red	White	Black	Transparent	Green
July 2	Suspending traps					
July 9	68.2	51.7	52.9	28.4	21.6	39.3
July 16	73.5	59.1	63.3	37.5	34.2	43.7
July 23	99.6	83.6	92.5	52.6	50.7	77.5
July 30	153.8	96.9	115.7	75.3	83.6	96.0
August 6	161.7	138.4	103.6	98.6	65.8	102.9
August 13	125.4	106.4	95.8	73.8	69.3	84.4
August 20	84.9	78.2	67.2	58.5	56.2	68.1
August 27	137.2	119.7	73.0	85.3	77.5	75.4
September 3	95.8	76.0	106.2	66.5	58.4	91.6
September 10	84.4	75.5	61.6	73.7	34.7	78.9
September 17	64.3	50.8	59.1	40.4	20.9	65.6
September 24	50.2	42.5	54.7	37.9	21.5	43.8
October 1	31.8	26.3	38.4	22.6	15.1	29.2
Total	1230.8	1005.1	984.0	751.1	609.5	896.4
Average	94.68	77.32	75.69	57.78	46.88	68.95
	±39.76	±32.03	±24.25	±23.37	±23.55	±23.44
	a	ab	ab	bc	c	bc

5. Trap distance experiments:

The efficiency of four distances (5, 10, 15 and 20 meters apart) between traps was evaluated during *S. myopaeformis* peak activity season (April - July) of 1999. Table (5) indicated that traps distributed at 20 meters apart captured 94.47 ± 39.25 moths per trap per week, followed by 15 and 10 meters apart (72.78 ± 35.53 and 66.26 ± 30.68 moths, respectively). The least average numbers of moths were captured when traps were distributed at 5 meters apart showing 55.85 ± 25.89 moths).

Table 5. Mean numbers of *S. myopaeformis* male moths trapped in different trap distances in an apple orchard at Qalubia governorate during 1999 season.

Date of inspection	Mean no. of male moths per trap caught in different trap distance (in meters)			
	5	10	15	20
April 1	Suspending traps			
April 8	32.5	37.0	48.7	51.6
April 15	47.2	53.2	65.1	87.3
April 22	59.9	74.6	84.7	104.0
April 29	72.6	94.4	117.4	129.2
May 6	98.3	71.7	131.8	142.1
May 13	65.4	106.1	83.6	110.7
May 20	54.8	83.8	126.5	97.1
May 27	103.1	119.5	84.9	154.2
June 3	67.0	72.9	51.2	121.8
June 10	48.2	65.1	54.4	98.4
June 17	32.7	37.3	39.6	62.3
June 24	25.1	21.2	33.3	45.9
July 1	19.3	24.6	25.0	23.5
Total	726.1	861.4	946.2	1228.1
Average	55.85±25.89	66.26±30.68	72.78±35.53	94.47±39.25
	b	b	ab	a

Statistical analysis revealed that there were significant differences between the mean numbers of captured moths at different distances (Table 6). Although 20 meters apart between traps was the maximum trapping distance, yet it was insignificantly differed from traps at 15 meters apart. Thus, from the statistical, economical and applicable points of view, 20 meters apart considered the optimum distance between traps for capturing *S. myopaeformis* in apple orchards.

Table 6. One-way ANOVA completely randomized attraction *S. myopaeformis* trap designs in apple orchards at Qalubia governorate during 1997 to 1999 activity seasons.

Trap design	Shape		Size		Height		Color		Distance	
"F" test	3.102		2.587		3.984		4.442		3.136	
Probability	0.005		0.064		0.003		0.001		0.034	
SL 0.05	S**		NS		S**		S**		S*	
LSD 0.05	9.056		18.412		22.594		22.218		26.200	
Means 1	35.677	a	46.385	a	62.054	a	94.677	a	94.469	a
Means 2	23.831	b	41.254	ab	56.023	a	77.315	ab	72.785	ab
Means 3	23.423	b	31.169	ab	47.323	ab	75.692	ab	66.262	b
Means 4	23.185	b	23.046	b	42.746	ab	68.954	bc	55.854	b
Means 5	22.338	b	-		31.392	bc	57.777	bc	-	
Means 6	21.123	b	-		18.638	c	46.885	c	-	
Means 7	19.477	b	-		-		-		-	
Means 8	16.062	b	-		-		-		-	

where: S* : Significant at SL (Significance level) 0.05
S**: Highly significant at SL 0.05
NS : Insignificant at SL 0.05
LSD (0.05): Least significance difference at 0.05

Voerman and Deventer (1984) in the Netherlands, and Trematerra (1986), in Italy reported that the funnel trap was markedly more efficient in trapping *S. myopaeformis* than the sticky delta trap. However, Onucar and Ulu (1995), in Turkey, found insignificant differences between delta and funnel traps.

Trematerra (1986) and Trematerra and Faccioli (1990) in Italy, and Buleza *et al.* (1990), in the USSR, concluded that traps were most effective in trapping *S. myopaeformis* when placed near the top of the trees on the side exposed to sunlight (about 1.5 - 3 m from the ground). However, Stuber and Dickler (1988), in Germany, and Kers (1998), in the Netherlands, reported 1.2 m above the ground level.

The effective trap distance reported by Buleza *et al.* (1990), in USSR, was 50 m apart. Trematerra (1993), in Italy, suggested 12 traps / ha were better than 6 or 24 traps / ha.

Trematerra and Faccioli (1990), in, Italy, found that yellow and green traps captured more males than red, blue, black and brown. On the other hand, Stuber and Dickler (1988), in Germany, reported that more catches were in red traps with a black stripe and Kers (1998), in the Netherlands, didn't found clear differences between colored traps (yellow, green or transparent) in trapping *S. myopaeformis* moths.

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تقييم فعالية التصميمات المحلية لمصايد الفرمونات الجنسية لجذب حفار ساق الحلويات رائق الأجنحة *Synanthedon myopaeformis* في مصر.

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١. *معهد بحوث وقاية النباتات- مركز البحوث الزراعية - الدقي - الجيزة- مصر.*
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تم إجراء بعض الدراسات لتقييم الفعالية النسبية لبعض تصميمات المصايد المحلية الصنع لجذب حفار ساق الحلويات رائق الأجنحة مع مقارنتها بنظيرتها المستوردة في حدائق التفاح بمركز طوخ، محافظة القليوبية خلال ٣ مواسم (١٩٩٦ - ١٩٩٩)، وأظهرت النتائج ما يلي: ١) شكل المصيدة: أتضح أن زجاجة المياه الغازية الفارغة الشفافة المصنعة محليا أفضل من علبة الآيس كريم الكبيرة، وزجاجات المياه المعدنية المعتمة، وجراكن زيوت الذرة أو البترول المعتمة المحلية والمصايد القمعية واللاصقة الهرمية الورقية المحلية أوالمستوردة في اصطياد الفراشات. ٢) حجم المصيدة: أتضح أن زجاجات المياه الغازية الشفافة سعة ٢ لتر هي أكثر الإحجام فعالية في اصطياد الفراشات مقارنة بأحجام المصايد ٠,٥ و ١ و ١,٥ لتر. ٣) ارتفاع المصيدة: أتضح أن الارتفاع المثالي لتعليق المصائد هو ٢,٥ متر فوق سطح الأرض مقارنة بالارتفاعات صفر و ٠,٥ و ١ و ١,٥ و ٢ متر. ٤) لون المصيدة: أتضح تفوق المصيدة الصفراء في اصطياد الفراشات وأختلفت معنويا عن أعداد الفراشات التي تم اصطيادها في المصيدة الشفافة التي تعتبر من الناحية الاقتصادية الأفضل مقارنة بالألوان الأحمر والأبيض والأزرق والأخضر والأسود والشفاف. ٥) المسافة بين المصايد (عدد المصايد في الفدان): دلت النتائج على أن المسافة القصوي بين المصيدة والأخرى ٢٠ متر (١٠ مصايد في الفدان) مقارنة بمسافات ٥ و١٠ و ١٥ مترا (١٦٨ و٤٢ و١٨ مصايد في الفدان). من كل ما تقدم يتضح أن أفضل التصميمات للمصيدة الفرمونية من وجه النظر الإحصائية والاقتصادية والتطبيقية هي زجاجات المياه الغازية الشفافة سعة ٢ لتر على أن تعلق على ارتفاع ٢,٥ متر وبين المصيدة والأخرى ٢٠ متر. ويمكن استخدام المصيدة السابقة بعد دهانها باللون الصفر، نظرا لتفوق المصيدة الصفراء، إلا أن هذا يجب أن يراعي من النواحي التطبيقية والاقتصادية.