A FEASIBILITY STUDY AND COST PERFORMANCE FOR INDUSTRIAL AND COMMERCIAL PRODUCTION OF *TRICHOGRAMMA* SSP. IN EGYPT

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Abstract

Biological control of phytophagous insects by mass release of egg parasitoids has become more practical in recent years. Trichogrammatides and other egg parasitoids are generally part of the local ecosystem and often contribute to control certain lepidopterous pests in the absence of disruptive pesticides. The wide use of Trichogrammatides is mostly due to the easy mass production technique of these parasitoids on numerous hosts which are mainly the lepidopterous insect-pests of stored products, such as Sitotroga cerealella (Olivier), Ephestia kuehniella Zeller and Corcyra cephalonica (Stainton). Eggs of the Mediterranean flour moth, E. kuehniella Zell. are widely utilized as substitution host or prey for rearing different parasitoids and predators. The economical production of great amounts of high quality eggs of E. kuehniella is therefore one of the basic requirements of many rearing systems. Consequently, quality control of E. kuehniella is a part of the complete control system in mass production. The main finding indicated that, the cost of production per 1000 parasitoid (one card) is 0.5 LE. Moreover, the capital recovery period after one year estimated 95% .

INTRODUCTION

During the past 120 years, a large number of natural enemies has been collected and evaluated for use in augmentative biological control programmes. Particularly during the last 30 years many efficient species has been identified and currently at least 230 species are commercially available globally (Van Lantern, 2011). Today, the commercial biological control industry is well organized, has developed mass production and release methods as well as adequate guidance for farmers.

Biological control has been in use for about two millennia, and has become widely used in pest management since the end of the nineteenth century (Van Lantern and Godfray, 2005). *Trichogramma* spp. are the important biological control agents for lepidopterous pests. Several species of *Trichogramma* are reared and released around the world annually on an estimated 80 million acres of agricultural crops in 30 countries (Li, 1994, Olkowski and Zhang, 1990). *Trichogramma* spp. parasitize the eggs over 400 species belonging to at least seven insect orders (Bao and Chen, 1989). Insectaries for mass rearing of *Trichogramma* using factitious hosts have been constructed in many countries. Wide use of factitious host eggs for mass rearing *Trichogramma* based on the relative simplicity and comparative low cost of their production when compared with eggs of the target pest.

The objective of present study was conducted to estimate cost of setting up and performance for producing the biocontrol agents, *Trichogramma* parasitoid in Egypt.

MATERIALS AND METHODS

Feasibility study was made includes two major tasks: the first major one is to produce the factitious host (unit A), *E. kuehniella* Zeller and the second major task is to produce, *Trichogramma* spp. (Unit B) and that's the main target. This study calculates all costs for production during one year. The following inputs were taken in consideration:

1- Fixed Assets.

* Machinery & Utility.

2- Working Capital.

* Raw Materials (variable cost) (Food and other)/ year.

* Salaries and Over Heads.

The following measurements were taken as criteria for evaluating **the obtained data:**

1- Fixed Capital (F. C.).

2- Working Capital (W. C.).

3- Total invested capital = F.C. + W.C.

4- Other fixed cost for year.

5- Depreciation.

6- Value of year profit = Value of year production – Other fixed cost.

7- Percentage of profit =	Value of year profit / Total invested capital	× 100

8- Capital recovery period =	Value of year profit / Value of year profit + Depreciation	× 100

RESULTS AND DISCUSSION

1. Cost production steps of *E. keuhniella* and *Trichogramma* ssp.

1.1. Fixed assets.

Factitious host Unit (A) (*E. keuhniella*), which containing several machinery, such as Closet for collecting adults of *E. keuhniella* with total price 90000 LE, Movable shelves 36000 LE, Metal trays 8960 LE, Oven 3500 LE, UV machine 3200 LE, Egg laying &collecting machine 34800 LE (Gaffar, 2006 and Gaffar *et al.*, 2012) and CO2 bottles 5000 LE, with total price of Unit (A) (181460 LE.).

Bio-agent Unit (B) (*Trichogramma*), which containing several machinery, such as Glass jars total price 450 LE, Ice box 500 LE, Incubator (local) 3000 LE, Cooling room 3000 LE and Wood cells for rearing (400 cell) 1000 LE, with total price of Unit (B) (7950 LE). Finally, the total price of Units (A+B) = 189410 LE (Table 1).

1.2. Working Capital.

1.2.1. Raw Materials (variable cost) (food and other)/ year.

The raw materials containing Corn and wheat (24 unit ×32 tray × corn and wheat 1.55 Kg ×12month×1 pound) (El- Arnaouty, 2001) with total price 10267.2 LE, CO2 bottles (30 bottle/month × 12 month × 29 pound) 10440 LE (El-Arnaouty, 2001), Manila paper (24 unit × 32 tray × 12 month × 0.07 LE) 645.12 LE (El-Arnaouty, 2001), Equipment for sterilization and maintenance 1200 LE (El-Arnaouty, 2001), White paper (A4) 250 LE, Application cards 320000 LE, Honey 80 LE and Glue 45 LE, with total raw materials price 342927.3 LE (Table 2).

The following measurements were taken as criteria for evaluating the obtained data:

1.2.2. Fixed Capital (F.C.):

Containing Building cost/300 m^2 with 300000 LE, Machinery and utility 189410 LE, Cars and transporting 120000 LE, Furniture cost 10000 LE and Costs before production 6000 LE with Fixed Capital total price 625410 LE.

1.2.3. Working Capital (W.C.):

Containing Rents/one year 18000 LE, Salaries/3 months 8100 LE, Water and electricity/3 months according to statistics 2400 LE (El Arnaouty, 2001), Gas costs/ 3 months 1500, Marketing costs/3 months 4500 LE and Other costs/3 months 1500 LE with Working Capital total price 36000 LE (Table 3).

1.3. Total invested capital = F.C.+W.C.

Total invested capital = 625410 + 36000 = 661410 LE.

1.4. Other fixed cost for year:

Containing Rents 18000 LE, Preservation expended 6000 LE, Salaries 32400 LE, Raw materials 342927.3 LE, Energy of electricity and water 9600 LE, Gas 6000 LE, Marketing costs 18000 LE, Other costs 6000 LE and the total of operating expended 438927.3 LE (Table 4).

1.5. Depreciation:

The depreciation of the year are, Machinery & Utility 18941 LE, Building cost 15000 LE, Furniture 1000 LE and cars 24000 LE, with Total depreciation per day 58941 LE (Table 5).

2. Estimation of the production costs of *Trichogramma* ssp.

Data in Table 6 showed the prices of all raw materials in Egypt during 2006 and indicate that the price of one card of *Trichogramma* equal 0.5 LE. The present results are going on a line with those obtained by Garcia, 1982 who found that the cost was about $ 0.02 (0.11 LE) per 1000 parasitoids. Such finding is in agreement with that obtained by Burbutis and Goldstein, 1993 and Goldstein *et al.* 1993. They found that cost was about $ 0.12 (0.66 LE) per 1000 parasitoids. And the value of year were profit reached, 1073072.7 LE. The percentage of profit recorded 162.24%.

Fig. (1) showed that capital recovery period after the 1^{st} year were 95% from the fixed assets and costs.

3. Final considerations.

As shown in this study, a calculate method the feasibility study to helpful researchers to economic production for any bioagents. The objective of mass rearing of *E. keuhniella* is to maximize production of eggs at the lowest possible costs, i.e. defining optimal rearing methodology. Our economic method studying showed the success of mass rearing the Mediterranean flour moth depends on a physical conditions and different machinery for each rearing stages. Therefore, process and production steps with their costs.

Table 1. Machinery and utility in mass production.

Unit	Serial	Machinery	Price of unit (LE)	Number	Total price (LE)
E. keuhniella (Unit A)	1	Closet for collecting adults of *E. keuhniella*	4500	20	90000
	2	Movable shelves	1800	20	36000
	3	Metal trays	14	640	8960
	4	Oven	3500	1	3500
	5	UV machine	3200	1	3200
	6	Egg laying & collecting machine	6960	5	34800
	7	CO2 bottles	500	10	5000
	Total (A)				181460
Trichogramma (Unit B)	8	Glass jars	1.5	300	450
	9	Ice box	500	1	500
	10	Incubator (local)	3000	1	3000
	11	Cooling room	3000	1	3000
	12	Wood cells for rearing (400 cell)	1000	-	1000
	Total (B)				7950
	Total (A + B)				189410

Table 2. Raw materials (Variable cost) (food and others) for one year.

Materials	Unit	Quantity	Price of unit/LE	Total price (LE)
Corn and wheat (24 unit × 32 tray × 1.55 kg × 12 month × 1 LE)	kg	10267.2	1	10267.2
CO2 bottles (30 bottle/month × 12 month × 29 LE)	Bottle	360	29	10440
Manila paper (24 unit × 32 tray × 12 month × 0.07 LE)	Paper	9216	0.07	645.12
Equipment for sterilization and maintenance	/month	12	100	1200
White paper (A4)	Ream	10	25	250
Application cards	Million	4	0.08	320000
Honey	Kg	4	20	80
Glue	Kg	3	15	45
Total	342927.3			

Table 3. Total invested capital.

Serial	Fixed capital/year	Cost/LE	Total cost/LE
1	Building cost/ 300 m^2	300000	
2	Machinery and utility	189410	
3	Cars and transporting	120000	
4	Furniture cost	10000	
5	Costs before production	6000	
Total of fixed capital			625410
Serial	Working capital	Cost/LE	Total cost/LE
1	Rents/ one year	18000	
2	Salaries/ 3 months	8100	
3	Water and electricity/ 3 months according to statistics	2400	
4	Gas costs/ 3 months	1500	
5	Marketing costs/ 3 moths	4500	
6	Other costs/ 3 months	1500	
Total of working capital			36000
Total invested capital			661410

Table 4. Other fixed cost for year.

Serial	Operating expended	Cost/LE
1	Rents	18000
2	Preservation expended	6000
3	Salaries	32400
4	Raw materials	342927.3
5	Energy of electricity and water	9600
6	Gas	6000
7	Marking costs	18000
8	Other costs	6000
Total of operating expended		438927.3

Table 5. Deprecation value.

Serial	Materials	Deprecation % for year	Value of deprecation LE
1	Machinery & Utility	0.10	18941
2	Building cost	0.05	15000
3	Furniture	0.10	1000
4	Cars	0.20	24000
Total deprecation per day			58941

Table 6. Total costs of bio-company for Trichogramma.

	Producible	Productive potential/year			Total
		Quantity	Unit	Salary price/ LE	Salaries L.E
1	Card *Trichogramma* (2 waves).	3024000	Card	0.5	1,512,000

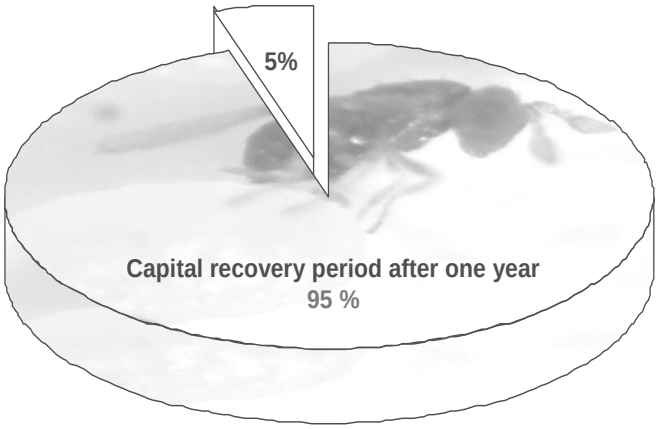

Fig. 1.The capital recovery period after one year.

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دراسة جدوى وتكاليف الآداء للإنتاج الصناعى والتجارى للتريكوجراما فى مصر

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أصبحت المكافحة الحيوية للحشرات نباتية التغذية بطفيليات البيض التى يتم تربيتها والمستخدمة فى الإطلاق أكثر واقعية فى السنين القريبة. تعتبر التريكوجراما وطفيليات البيض الأخرى جزء من النظام البيئى المحلى وغالباً ما تساهم فى فى مكافحة آفات معينة من حرشفية الأجنحة فى غياب المبيدات الضارة. الإستخدام الموسع للتريكوجراما يرجع غالباً لسهولة تقنية الإنتاج الكمى لهذه الطفيليات على عوائل عديدة والتى هى أساساً حشرات حرشفية الأجنحة وآفات مخازن مثل فراشة الحبوب و فراشة دقيق البحر الأبيض المتوسط و فراشة الأرز. يستخدم بيض فراشة دقيق البحر الأبيض المتوسط على نطاق واسع كعائل بديل لتربية المفترسات والطفيليات المختلفة. تعتبر اقتصاديات إنتاج بيض فراشة الدقيق بكميات كبيرة وبجودة عالية واحدة من المتطلبات الأساسية للعديد من أنظمة الإكثار. وبناء على ذلك تعتبر مراقبة الجودة لفراشة الدقيق جزء مكمل لنظام التحكم فى الإنتاج الكمى. أشارت النتيجة الرئيسية فى هذا البحث إلى ان تكاليف إنتاج 1000 طفيل تريكوجراما (كارت واحد) كانت 0,5 جنيه مصرى. علاوة على ذلك، كان العائد من تكاليف رأس المال المستثمر بعد أول سنة حوالى95% من قيمة رأس المال المستثمر.