Bio-control agents / Bio-pesticide Producing unit

1 Introduction

The problem of insect-pest is one of the major constraints for achieving higher production and better income. Problems are there for all crops and especially acute in case of commercial crops. India loses about 30% of its crops due to pests and diseases each year amount to Rs.60,000 crores annually. The use of pesticides has certainly contributed in crop protection, thus minimizing yield losses. With the introduction of intensive cropping, the use of insecticides and pesticides have increased manifolds to control harmful pests such as insects, nematodes, diseases, weeds etc during the past 3 - 4 decades. Practically pesticide applications don't follow any scientific recommendations and quite often the indiscriminate and unscientific use has adversely affected the ecological balance resulting in pest resurgence, development of resistance in the pest species and environmental pollution. However, excessive use of pesticides not only leave residues in soil, water and air but also have adverse effects on the non-target organisms such as pollinators, parasitoids, predators and wild animals.

1.1 Need for Alternate Crop protection practices:

Growing public concern over potential health hazards of synthetic pesticides and also steep increase in cost of cultivation result in low profit making by farmers has led to the need for minimizing the use of chemical pesticides in the management of insect pests. In view of the several disadvantages associated with the poisonous chemicals and their unscientific use in agriculture, there is need for alternate methods of crop protection. Biological control of pests is the eco-friendly pest management practices useful in almost all agro-ecological situations.

1.2 Bio-control Agents:

Biological control agents are living organisms, including parasites, predators and disease causing fungi, bacteria and viruses. These are the natural enemies of pests, which can intervene the life cycle of insect pests in such a way that the crop damage is minimized. They are both less toxic and more flexible than chemical pesticides. Biological control includes a wide range of approaches, from natural predators to biologically produced molecules. Microorganisms, including viruses, bacteria, fungi and protozoan, cause disease or poison their targets through toxin production.

These bio agents can be conserved, preserved and multiplied under Laboratory condition for field release. Once these bio-agents are introduced in the field to build their population considerably, they are capable of bringing down the targeted pest' population below economic threshold level (ETL).

However, the crux lies in their mass production and application at the appropriate time. Among all pest management techniques, the microbial agents are most effective in controlling the target insect-pest and require appropriate formulation and application.

1.3 Major advantages of Bio-control agents

Bio-control agents are preferred over chemical pesticides for the following reasons:

- No harmful residues;
- Target specific and safe to beneficial organisms like pollinators, predators, parasites etc.;
- Growth of natural enemies of pests is not affected, thus reducing the pesticide application;
- Environment friendly;
- Cost effective;
- Important component of IPM as 1st line and 2nd line of defense, chemicals being the last resort.

2 Status of Bio-control agents / Bio-pesticide usage in India

- A tremendous breakthrough in Bio-pesticide is being observed in the last decade, especially on standardization of production techniques of a number of micro-organisms to use them against many insect pests and diseases.
- There are a number of instances where bio control agents have been successfully employed in India. Some examples of these are given below:

1. Growth of lantana weed was controlled by using the bug ***Telonemia scrupulosa***
2. Sugarcane ***pyrilla*** has been successfully controlled in a number of States by the introduction of its natural enemy ***Epiricania melanoleuca and Tetrastictus pyrillae***.
3. ***Trichogramma***, which feeds on the eggs of sugarcane borers, has been used against the borers in the states of Tamil Nadu, Rajasthan, UP, Bihar and Haryana.
4. Similarly, *Trichogramma, Bracon, Chelonus* and *Chrysopa* spp. are being used for the control of cotton bollworms. *Trichogramma* has also been used against rice stem borer and leaf folder.
5. The sugarcane scale insect has been controlled with the help of predatory ***coccinellid*** *beetles* in UP, West Bengal, Gujarat and Karnataka.

- The popularity of bio-pesticides has increased in recent years, as extensive and systematic research has greatly enhanced their effectiveness. Also, techniques for the mass production, storage, transport and application of bio-pesticides have been improved in recent years.

3 Scope for Commercial Production of Bio-control agents

Though there are about 140 bio-pesticide production units existing in the country as on today, they are able to meet the demand of only less than 1% of cropped area. There exists a wide gap, which can only be bridged by setting up of more and more units for production of Bio-pesticides. There is a scope to enhance production and use of biological control agents in the days to come as the demand is on the increase every year. This requires large scale investment and private participation.

3.1 Location of Commercial Bio-control agents Production Unit

To achieve optimum results, bio-pesticide facilities are to be set up in areas which have appropriate climatic conditions. Because temperature control is less costly in locations where there are no extreme conditions. Besides the climatic conditions, the proximity of the location to the market is also important. However, care must be taken that the production facilities are set up at least a quarter of a mile away from farming areas, so as to prevent the contamination of production facilities by insecticides from the farming areas. Also, as air pollution can damage bio-pesticides, the production should be located away from industrial and urban areas.

3.2 Objectives of Commercial Production of Bio-control agents

- The primary objective of bio-pesticide projects is to establish the bankability of mass multiplication of various bio-agents discussed in the models
- To serve as guidelines for extending financial assistance to entrepreneurs who may be interested in setting up bio-pesticide units
- To promote setting up of more bio-control production units
- To disseminate widely the technology

4 Technology

4.1 Bio Agents to be used for production of Bio-inputs:

Table 1 List of Bio Agents

Groups	Bio-agent	Production Process in brief	Remarks
1	*i. Trichogramma* spp. (egg parasite)	Mass multiplied by using stored grain pest as a host. The production involves the multiplication of host insect on sorghum grains, allowed to be parasitized by trichogramma. Then egg is clued in cards as "tricho cards".	Used for control of early shoot borer in sugarcane, bollworms of cotton, sorghum stem borer.
	ii. Crysoperla carnea (Chrysopid predetor)	Mass multiplied in laboratory on the eggs of stored grain pest.	Controls larval pests in pulses, vegetables /fruits
	iii.Cryptolaemus montrouzieri (Ladybird beetle)	Mass multiplied on already mass multiplied mealy bugs with the help of pumpkin as under laboratory conditions.	to control mealy bugs especially on fruits.
2	*i*. NPV of *Helocoverpa armigera*&*Spodoptera litura*	The production starts with raising of pod borer and tobacco caterpillar larvae (host culture) on semi-synthetic diet. NP Virus is smeared on cultured larvae. Then the diseased larvae are collected to obtain virus suspension after blending, filtration, centrifugation.	Used against boll worms in cotton and pod borers.
	ii.Trichoderma Fungal spp.	Multiplied in laboratory and formulated in powder form with the help of carrier material (talc powder).	To control root rot and wilt diseases especially on pulses.
	iii. Pheromone lures for *Helicoverpa armigera*&*Spodoptera litura*	Sex pheromones are filled into plastic lures at required concentration with the help of micro pippets and placed into rubber septa. The septa is fixed to the trap.	To trap reproductive males of gram pod borer and tobacco caterpillar.

The technologies used were indigenous and the scientific aspects of production were standardized by ICAR Research Institutes and State Agricultural Universities. These projects are standardized by grouping the organisms in 2 groups with similar infrastructure requirements. Group-I is developed in the area of mass production of predators and parasites whereas the Group-II is for the multiplication of viral and fungal based products. This will increase the efficiency of all input material and will help to run the unit without any lean period. Machineries and laboratory equipment's are available from various manufacturers and are of BIS standards.

4.2 Basic requirements for establishment of Commercial Bio-control agents Production Unit

Based on the field visits to bio-control production units and in line with the technology and objective of bio-pesticides production, various facilities required for the successful implementation of such projects are indicated below:

4.2.1 Land

Land is required for construction of culture and rearing rooms, processing room, laboratory, office and construction of poly house etc.

4.2.2 Building and civil works

Bio-pesticides production involves rearing of insects. Hence, the basic infrastructure to be created includes only the civil structures built in such a way as to provide suitable environmental conditions for rearing of insects. The production unit has to be located away from industrial unit to avoid pollution problems.

For the proposed installed capacity, an estimated built up area of about 1000 sq mtr is required for group-I (mass production of Trichogramma, Chrysoperla and Cryptolaemous beetles) & for Group-II (production of NPV, Trichoderma and pheromone lures) about 2400 sq.mtr. area is required. Other utilities required are power, water and vehicle. Among others, the civil structure may be designed to have separate room for diet preparation, corcera culture, egg production, host culture etc. The host culture room for NPV production should be kept at a distance with proper hygiene and entry may be restricted to prevent any contamination. Entry to host culture room must be prohibited after visiting a facility, where NPV is extracted from dead infected larvae.

4.2.3 Plant and Machinery

No heavy plant and machinery is required for the production of these Bio-pesticides. Racks, trays and other facilities are required for rearing insects. Apart from this centrifuge, mixers and some fabricated equipment's for insect collection and rearing are required. For production of *Trichoderma* fermenters, laminar flow apparatus etc. are required. All the machinery required are locally manufactured.

4.2.4 Raw material

For rearing of insects special diet is required which comprises of pulses, vitamins, antibiotics etc. For production of *Trichoderma* molasses-yeast medium, is required. All these materials are available locally.

4.2.5 Water

The water requirement is mainly for feed preparation, washing, cleaning, drinking etc. Water quality should be tested to establish the suitability.

4.2.6 Power

Power supply is essential for bio-pesticide units. Electricity charges under recurring cost are considered in the models.

4.2.7 Manpower

Production of bio-pesticides required skilled manpower. There is need for a number of laborers at each stage of production. The project is labour intensive. The manpower requirement is as under:

Table 2 Manpower Required

Sr.No.	Particulars	Model 1	Model 2
1	Technical staff	1	3
2	Skilled labour	2	5
3	Semi-skilled labour	3	10
	Total	6	18

4.3 Scale of production

4.3.1 Unit Size

The unit size of the models in brief is given below:

Table 3 Unit Size

Model	Bio control agent	Capacity per year
1	• *Trichgramma* cards • *Crysopid grub/larvae* • *Cryptolaemus beetles*	16,200 cards per year 6000 per year 5250 beetles per year
2	• Ha NPV & SINPV	Ha NPV-18000 bottles & SINPV- 12,000 bottles

	• *Trichoderma fungi* • Pheromone lures	2000 kg 1000 lures

5 Financials

Based on the various techno-economic parameters**,** income and expenditure have been arrived for the models simultaneously. Further, based on the cash flow, financial parameters and repayment schedule have been worked out to establish the bankability of the project. The summary of financial programme is given below:

Table 4 Project Cost

Particular	Unit cost	Cont.	Total Cost
Land	-	-	7.50
Site Development	11.20	0.56	11.76
Building	237.00	11.85	248.85
Plant & Machinery	16.25	0.82	17.07
Misc. Fixed Assets	4.30	0.22	4.52
Preoperative Expenses	2.00	-	2.00
Security Deposits	5.00	-	5.00
Total	275.75	13.45	296.70

The details of project cost breakup:

5.1 Cost of Technical Infrastructure and Plant and Machinery

The total cost of technical infrastructure Rs. 248.85 Lakhs and Rs. 17.06 Lakhs of the equipment's required. The breakup cost given is as:

Table 5 Infrastructure and Equipment Cost

Particular	Unit Basis	Qty	Unit Cost	Cont.	Total Cost
Technical Building					
Production Units for Bio-Agents	SQM	800	64.00	3.20	67.20
Production Unit for NPV, Pheromones and Trichoderma	SQM	2000	160.00	8.00	168.00
Room for diet preparation, corcera culture, egg production, host culture	SQM	100	8.00	0.40	8.40
Office	SQM	50	5.00	0.25	5.25
SUB-TOTAL			237.00	11.85	248.85

Equipment's					
Micro Centrifuge	LS	1	0.41	0.02	0.43
Laminar Air Flow Cabinet	LS	2	0.92	0.05	0.97
Research Micro Scope	LS	1	1.07	0.05	1.13
Air-conditioning	LS	1	1.00	0.05	1.05
Internal Electrification	LS	1	11.85	0.59	12.44
DG Sets	LS	1	1.00	0.05	1.05
SUB-TOTAL			16.25	0.81	17.06

5.2 Profitability Statement

The profitability statement is below:

Table 6 Profitability Statement

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Income	113.58	129.80	146.03	146.03	162.25	162.25	162.25
Expenditure	33.67	35.32	37.02	38.40	40.25	41.77	43.37
Variable Cost	2.73	3.12	3.51	3.51	3.90	3.90	3.90
Diet for Rearing Insects	2.03	2.32	2.61	2.61	2.90	2.90	2.90
Power	0.70	0.80	0.90	0.90	1.00	1.00	1.00
Fixed Cost	30.94	32.20	33.51	34.89	36.35	37.87	39.47
Administrative Expenses	2.98	2.98	2.98	2.98	2.98	2.98	2.98
Salary	25.08	26.33	27.65	29.03	30.48	32.01	33.61
Repair & Maintenance	2.88	2.88	2.88	2.88	2.88	2.88	2.88
Gross Profit	79.90	94.48	109.00	107.62	122.00	120.48	118.88
Depreciation	10.53	10.53	10.53	10.53	10.53	10.53	10.53
Interest On Term Loan	25.57	25.57	22.23	17.78	13.32	8.87	4.42
Interest On Working Capital	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Preliminary Expenses Written Off	1.75	1.75	1.75	1.75			
Profit Before Tax	41.99	56.57	74.43	77.50	98.09	101.02	103.87

5.3 Sensitivity Analysis

The cash flow statement covering the Internal/financial rate of return (IRR/FRR), breakeven point and payback period have been worked out for the project. The IRR is around 24.02, while payback period is 4.78 Years.

Table 7 Sensitivity Analysis

Key Indicators	Envisaged
	As Per 6th Year
Net Profit After Tax	69.68
Internal Rate of Return	24.02
Break Even Point	30.61
Pay Back Period (Years)	4.78

5.4 Financial Assistance

The projects on manufacturing bio-pesticide products would be considered for refinance support by National Bank. Therefore, all participating banks may consider financing this activity subject to their technical feasibility, financial viability and bankability. The means of finance will be:

Table 8 Means of Finance

MEANS OF FINANCE		Amount
Equity	25%	74.21
Subsidy		50.00
Unsecured Loan		
Term Loan	14.00%	172.64
	TOTAL	296.85