EFFICACY OF MICROBIAL INSECTICIDES AGAINST POPLAR DEFOLIATOR, *ICHTHYURA ANASTOMOSIS* STEPH (NOTODONTIDAE: LEPIDOPTERA)

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Abstract. *Dipel and Bactospheine, the commercially available microbial insecticides based on* Bacillus thuringiensis, *have been tested against poplar defoliator* (Ichthyura anastomosis *Steph.) first in the laboratory then in the field. Both have shown their efficacy against the pest by giving complete mortality of larvae in 0.1% concentrations. The out-breaks of the defoliator can effectively be controlled without affecting the other biological control agents or the environment.*

Introduction Poplar is an important fast growing tree introduced in Pakistan. Insect defoliators cause heavy set-back in growth by stripping the trees of their leaves. Chaudhry et al (1966) recorded *Ichthyura anastomosis* on poplar at Abbottabad and reported as serious defoliator in Pakistan (1969). Biology, ecology and population dynamics of the pest were studied by Chaudhry and Ahmad (1973). Severe defoliations were found to undermine 30 to 60% of annual growth of trees thereby impairing their fast growing quality to a large extent. Chaudhry and Ahmad (1973) controlled an epidemic of the pest by spraying 0.1% Lebaycid. Shah et al (1978) have recommended Decis, Tamaron and Sevin for the complete mortality of larvae in 0.01% concentration. But large scale insecticidal applications cause serious environmental hazards. Use of parasites and predators, silvicultural practices, behavioural, physical and machanical methods of insect control are becoming more common these days. Microbial control particularly with bacteria, virus and fungi is receiving maximum attention. These micro-organisms being highly specific to their insect hosts and easily multipliable at a tremendous rate have great superiority over broad spectrum toxicants in use for insect control. Considering the efficacy, economics and practicability of the operations the application of microbial insecticides is extremely advantageous over the use of parasites and predators foı insect control.

Review of literature. *Bacillus thuringiensis*, a disease causing bacteria extracted from various lepidopterous pests, has been developed into commercial microbial insecticides. Many workers such as Smirnoff (1963), Sider, (1965), Mihalache et al (1972), Podgwaite and Cambell (1972), Jaque (1972), Yendol et al (1973) and Arru (1975) tried *Bacillus thuringiensis* in the form of Thuricide, Entobacterin, Dendrobacillus and Dipel against different forest defoliators with good success.

Bacillus diffuses in the larval body and causes septicaemia of haemolymph of the larvae. The fore and hind intestines of insects being lined with chitin, the diffusion of

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Bacillus through these parts is retarded, hence application of *Bacillus* alone does not yield tangible results. The efficacy of *Bacillus* can be increased by addition of chitinase, an enzyme which hydrolyses the chitinous layer of intestines and facilitates penetration of the bacteria into the haemolymph.

Smirnoff et al (1972) tried *Bacillus thuringiensis* and chitinase against spruce budworm on small scale in 1972 and as aerial spray on large scale in 1974 with considerable success. Mihalache et al (1972) found Dipel very effective against *Lymantria dispar*, *Malacosma anectria* and *Tertrix viridama*. No work on microbial control of lepidopterous pests has been done in Pakistan. This study was undertaken with a view to find out effective control measure of this serious defoliator of poplar and avoid environmental pollution at the same time.

Material and Method. Dipel, a commercial formulation based on a strain of *Bacillus thuringiensis* var. aleste (Arru 1970) was obtained from Dr. Ole Zethner of Denmark. Bactospheine, another commercial formulation of *B. thuringiensis* was procured from Director, Pest Management Project (A.R.C.) Islamabad. In the laboratory trials poplar shoots fixed in glass tubes containing water were sprayed with 0.05%, 0.1% and 0.5% concentrations of Bactospheine and Dipel and transferred to glass chimneys covered with muslin colth. Third instar larvae of *Ichthyura anastomosis* were released, 10 in each glass chimney, after the sprayed leaf surface dried up. There were three replications. The untreated larval chimneys were kept in separate laboratory with similar temperature and humidity conditions to avoid infection from the treated chimneys. Fresh food of untreated leaves was daily supplied and mortality of larvae was observed. Results are given in Table-I.

In the field trial conducted at Harrichand (Charsadda) in October, 1976 where enough pest population was found in nature Dipel was sprayed on *P. nigra* trees in 0.05%, 0.1% and 0.5% concentrations. There were 5 replications under split plot design. Population counts were taken six days after treatment and the pupae found in each treatment were collected and kept in the laboratory for adult emergence. The mortality of the pest was calculated on the basis of larval pupal population present in check at the time of observation. Results are compiled in Table-II.

A similar field trial was conducted at Charsadda during August, 1977 with Bactospheine and Dipel in 0.1%, 0.5% and 1.0% concentrations sprayed with ordinary sprayer on the foliage of poplar plants. The experiment was replicated thrice keeping check in each. The population of the pest was recorded before treatment and 3 days and 5 days after treatment. The data so collected are given in Table -III.

Results. The data collected on the trial of Dipel and Bactospheine conducted in the laboratory are given below:

TABLE 1

Efficacy of Dipel and Bactospheine against Ichthyura anastomosis *in laboratory*

Microbial Insecticide	Dose %	Mortality of larvae out of 30 larvae in 2 days	3 days	4 days	5 days	6 - 20 days	Total mortality	Percent Mortality of larvae
Dipel	0.05	7	5	12	2	3	†29	96.7
	0.1	7	8	11	4	—	30	100
	0.5	10	7	10	3	—	30	100
	Check	—	—	—	2	6	*8	26.7
Bactospheine	0.05	9	6	11	1	3	30	100
	0.1	6	5	11	1	7	30	100
	0.5	5	9	14	2	—	30	100
	Check	—	—	—	—	8	*8	26.7

†One larva pupated but moth did not emerge
*22 larvae pupated and 17/18 moths emerged.

Both Dipel and Bactospheine proved effective in causing septicaemia in the haemolymph of *Ichthyura anastomosis* larvae. The caterpillars started dying within two days of treatment and all died within six days. In the lowest dose Bactosphine proved slightly better.

The only larva survived and pupated in Dipel treatment did not produce a moth while 35 adult moths emerged out of 44 pupae in check treatment. There was 26.7% natural mortality of larvae in check.

TABLE 2

Effect of Dipel on Poplar defoliator larvae tried at Harrichand (Charsadda) in October, 1976

Concentration %	Pest population 6 days after treatment: Larvae	Pupae	Moths emerged	*Mortality %
0.05	3	13	3	93
0.1	2	7	1	96
0.5	—	5	—	100
Check	47	38	23	18

*Based on pest population in the check.

Dipel proved quite effective in the field trial giving 93%, 96% and 100% mortality of larvae in 0.05%, 0.1% and 0.5% concentrations, respectively, with in a week against a natural mortality of 18% in check.

The observations recorded in another field trial conducted with Bactospheine and Dipel at Charsadda in August, 1977 are compiled below:

TABLE 3

Efficacy of Dipel and Bactospheine on poplar defoliator in a field trial

Microbial Insecticide	Concentration %	Population of Larvae			Percent mortality after	
		Before treatment	3 days after treatment	5 days after treatment	3 days	5 days
Dipel	0.1	35	—	—	100	100
	0.5	104	1	—	99	100
	1.0	77	—	—	100	100
	Check	40	29	9	27.5	77.5
Bactospheine	0.1	115	24	2	79	98
	0.5	71	9	4	87	95
	1.0	109	—	—	100	100
	Check	47	35	25	25.5	47

Dipel proved more effective against *Ichthyura anastomosis* larvae by killing all larvae in three days. Bactospheine also showed 95 to 100% mortality in 5 days against a natural mortality of 47 and 77% in control. The parasites, predators and naturally existing microbes were also very active at the time of this insect epidemic which took heavy toll of the pest and brought it under complete control within a month, of course, after causing heavy growth losses to poplar crop.

In the event of heavy population build up and epidemic of *Ichthyura anastomosis* Dipel or Bactospheine can easily be sprayed on large scale to achieve complete protection from the defoliator without adversely affecting the environment.

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References

1. ARRU, G.M. and G. LAPIETRA. 1975. Results of an attempt to control *Operopthera brumata* L. by aerial treatments with Dipel. Proceeding International Poplar Commission 15th session. Rome. 1-6 December.
2. CHAUDHRY, G.U., M.I. CHAUDHRY and S.M. KHAN. 1966. "Survey of Insect Fauna of Forests of Pakistan". Final Technical Report PL-480 Project. Pakistan Forest Institute, Peshawar.
3. CHAUDHRY, M.I. and M.I. AHMAD. 1973. "Study of Population Dynamics of two poplar defoliators" Final Technical Report PL-480 Project Pakistan Forest Institute Publication.
4. CHAUDHRY, G.U., M.I. AHMAD, I.A. HAFIZ and O.Z. MOLLER. 1969. Insect Pests and Diseases of Poplar in West Pakistan, Pakistan Forest Institute Publication.
5. JAQUE, R.P. 1972. Control of Cabbage looper and imported cabbage worm by virus and bacteria Jr. Econ. Entomol 65(3): 757-760.
6. MIHALACHE, G., M. ARSENESEU and D. PIRVESEU. 1972. Effectiveness of bacterial preparation Dipel for the control of some forest defoliators. Revision Padurilor 87(8): 362-365.
7. PODGWAITE, J.D. and K.W. CAMBELL. 1972. Disease complex of Gypsy moth, 11, Aerobic bacterial Pathogen J. Invertebr. Pathol. 20(3): 303-308.
8. SIDER, C. 1965. Granulosis a second virus disease of larvae of *Pygaera anatomosis* Topola beograd 9(52/54)41-3(F.A. 1966 2, 6344).
9. SHAH, B.H., H. GUL and M.I. CHAUDHRY. 1978. Insecticidal trial for the control of poplar defoliator *Ichthyura anastomosis* Steph. (Notodontidae, Lepidoptera) Pakistan J. For. 28(3) : 149-152
10. SMIRNOFF, W.A. 1963. Test of *Bacillus thuringiensis* var *thuringiensis* and B. Cereas Frankland on larvae of *Choristeneura fumefirana.* Can. Entomologist 95: 127-173.
11. SMIRNOFF, W.A., A. JANEAU and J. VALERO. 1972. Results of experimental aerial spraying of *Bacillus thuringiensis* against spruce bud worm larvae. Bimonthly Research Notes Vol. 28 No. 1 Jan.-Feb.
12. SMIRNOFF, W.A. 1973. Results of test with *Bacillus thuringiensis* and Chitinase on larvae of spruce bud worm J. Invertebr. Pathol. 21(1): 116-118.
13. SMIRNOFF W.A. 1974. Three year Aerial Field Experiment with *B. thuringiensis* and chitinase formulation against spruce bud worm. J. Invertebr. Pathol 24: 344-348.
14. YENDOL, W.G., R.A. HAMLEN and F.B. LEWIS. 1973. Evaluation of *Bacillus thuringiensis* of Gypsy moth suppression Jr. Econ. Entomolo. 66(1) 183-186.