days interval. After eight days, larvae were reared individually and food was provided *ad libitum.* Larvae pupated in the sterilized, sand kept at the bottom of the vial. Observations were recorded on larval survival, larval period, pupal period, pupation and adult emergence. Growth index and success index (Tripathi *et al.,* 1982) were also computed to compare various levels of test chemicals.

Lihocin failed to show any effect on larval period, however, little reduction in pupal period was observed when larvae were reared on artificial diets fortified with 0.32 and 0.64% of lihocin (Table 1). No significant difference in % pupation and adult emergence was recorded. Growth and success indices were also more or less similar at all concentrations. It is apparant that a significant reduction in larval period at 0.0625% and higher concentrations of chamatkar. No marked difference was observed in pupal period. Similarly, % pupation and adult emergence were also not affected. Growth and success indices varied within the narrow range of 3.831 to 4.298 and 1.001 to 0.964, respectively, indicating that this chemical failed to show any adverse effect on the insect. Therefore, it can be included that lihocin and chamatkar were unable to contribute in induction of resistance against *S. litura.* Worthing (1969) also did not record any effect of B 995, chlormequat chloride and chlorphonium chloride against *M. persicae.*

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Bio-efficacy of Methofenozide in Management of *Helicoverpa armigera* in Chickpea

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Helicoverpa armigera (Hübner) is the key pest of chickpea in India. Although several insecticides have been reported to be effective against this pest, there are reports of developing resistance to

many insecticides (Armes *et al.*, 1992). Very limited studies have been conducted on field efficacy of molting hormone mimics. Keeping this in view, a new insecticide methofenozide (RH2485) - a molt accelerating compound which mimic the natural molting hormone (20-hydroxy ecdysone) was evaluated to manage the pest effectively.

Field studies were laid at the Crop Research Centre of G.B.P.U.A.T. Pantnagar, Uttaranchal in R.B.D. for two consecutive years i.e. 1995-1996 and 1996-1997. During 1995-1996, six doses of methofenozide *viz.* 100, 150, 200, 250, 300 and 400 g a.i./ha and during 1996-97 only four doses *viz.*, 200, 250, 300 and 400 g a.i./ha were tested with endosulfan and untreated control. Chickpea var. C 235 was sown on 13.12.1995 and 10.12.1996 in the plots of 15m^2 (10 rows each of 4 m long and 30 cm apart) during both years. The first application of insecticidal treatment was made on 30.3.96 and 19.3.97, respectively and second application 15 days after first application. Observation on % pod damage was recorded by counting a total number of pods and damaged pods from 20 randomly selected plants in each plot. Yields were recorded from each plot by leaving border rows.

The spray application of methofenozide and endosulfan were significantly effective in reducing pod borer damage as compared to untreated control (Table 1). However, four doses (200, 250, 300 and 400 g) of methofenozide were only effective over endosulfan. Among the four effective doses two doses i.e. 300 and 400 g were most effective and significantly superior in reducing pod damage to rest of treatment and recorded a pod damage of 35% and 38%, respectively as against 90% in the untreated control. In 1996-97, four doses of methofenozide, were found superior over endosulfan in the preceding year, were again tested to confirm the results. Pod borer damage in 1996-97 was relatively low in comparison to previous year and it varied from 7.3% to 17.6% in insecticidal treatments with 39% in the untreated control. The three doses i.e. 250, 300 and 400 g were statistically at par in preventing pod borer damage. The pod damage in these treatments varied from 7.3% to 10.1% as compared to endosulfan and untreated control where it was 38 and 66%, respectively.

It is clear that pod borer damage had direct impact on grain yield of chickpea crop. During 1995-96, grain yield significantly varied from 422 to 2285 kg/ha among insecticidal treatments as against 179 kg/ha in the untreated control. Methofenozide at 200, 250, 300 and 400 g were at par in respect of grain yield and gave greater yield over endosulfan and untreated control (Table 1). All four dose of methofenozide in 1996-97

Table 1. Effect of methofenozide on pod borer damage and grain yield in chickpea

Treatments	Doses (g a.i)	Pod borer damage (mean%)			Grain yield (mean kg/ha)		
		1995-96	1996-97	Mean	1995-96	1996-97	Mean
RH 2485	100	66.6(54.7)	-	-	422	-	-
RH 2485	150	62.8(52.6)	-	-	1497	-	-
RH 2485	200	45.4(42.3)	13.2(21.3)	29.3	2167	2321	2244
RH 2485	250	40.0(3.9.3)	10.1(18.5)	25.1	2028	2362	2195
RH 2385	300	35.2(36.3)	7.3(15.7)	21.1	2123	2450	2292
RH 2485	400	37.9(38.0)	7.3(15.7)	22.6	2285	2569	2427
Endosulfan	350	57.5(49.4)	17.6(24.7)	37.6	917	2006	1461
Control	-	93.7(76.6)	38.6(38.3)	66.2	179	1633	906
CD (P=0.05)	9.29	5.20		613.32	561.34		

* Figures in parentheses are angular transformed values

significantly produced greater seed yield (2321 to 2569 kg/ha) over untreated control (1633 kg/ha). The endosulfan was found to be at par with untreated control. On the basis of mean yield of two years, methofenozide at 400 g gave maximum grain yield followed by 300, 250 and 200 g a.i./ ha. All the four doses had an edge over endosulfan. Thus, methofenozide might be helpful in managing resistant population of *H. armigera* and also had synergistic effect with biopesticides and insecticides on chickpea crop. Synergistic effect of related compound diflubenzuron when used with endosulfan was reported by Rajasekhar *et al.* (1996). The effect of diflubenzuron as ovicidal and sterilant was reported by Arora and Sidhu (1994).

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Effect of Atrazine and Oxyfluorfen Against Earthworm (*Eisenia fetida*)

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Earthworm activities are extremely important in maintaining soil fertility in many ways. In several habitats, earthworms are the key organism in breaking down the plant organic matter. These days herbicides are used against weeds which effect earthworm population in soil either directly or indirectly by lessening the amount of soil organic matter derived from weeds upon which they feed. Therefore, it is important to assess the toxicity of different herbicides against several species of earthworm. *Eisenia fetida* has been specified as a test species under international standards for testing the acute lethality of chemicals to earthworm (OECD 1984; EEC 1985). This is a compost dwelling species convenient for captive breeding. Thus, from ecotoxicological point of view, it is important to know the susceptibility of *E. fetida* against different chemicals. In present study, toxicity of two commonly herbicides, namely atrazine and oxyfluorfen were tested against *E. fetida* (OECD 1984).

Two commercial formulations of herbicides i.e. atrazine (50 WP) and oxyfluorfen (25% EC) were used for toxicity tests. Double distilled water was used to prepare different concentrations, i.e. 0.001, 0.01, 0.05, 0.1, 0.2, 0.4, 0.6% for atrazine and 0.01, 0.02, 0.03, 0.04, 0.05, 0.06 for oxyfluorfen. Mature earthworms were selected on the basis of their sexual maturity with well developed clitellum, each weighing nearly 100 ± 20 mg. Before testing, the worms were acclimatized in medium of mud in darkness for seven days at room temperature (25 ± 1°C).

Filter paper tests were performed following guidelines proposed by European Economic Community (Edward, 1983). Filter paper was fitted into glass vial (8 x 3 cm) after treating with