Discussion

I. MANTI: I would like to know the role of insecticides in the control of DBM in Canada and any information that might be available on the effect of these chemicals on predators and parasites.
G. S. LIM: You showed data indicating high (70-80%) parasitism of DBM. Is such high parasitism common in farmers' fields over a good number of years?
D. G. HARCOURT: These two questions are related. In southern Ontario, crucifers are attacked by a complex of Lepidoptera that includes the imported cabbageworm and the cabbage looper. In most years, insecticides are routinely applied to control populations of the imported cabbageworm which is the major pest on both early and late crops. These materials also control DBM and have a negative impact on its natural enemies. As a consequence, rates of parasitism are much lower in farmers' fields than in protected plots. However, the parasites tend to build up quickly when pesticides are withheld; in such cases, high rates of parasitism will persist.

G. S. LIM: Is there any significant hyperparasitism that might adversely affect the effective contribution of DBM parasites?
D. G. HARCOURT: In practical terms, the answer is no. In our studies, we occasionally found *D. insulare* to be attacked by *Eupteromalus viridescens* (Walsh) in the late fall. However, the incidence was extremely low.

O. MOCHIDA: What stage(s) does the DBM overwinter in cold or cooler areas of the world?
D. G. HARCOURT: In Canada and the northern US, the DBM does not survive the winter in any stage. In Canada, each year the adults migrate from the southern US.

B. ROWELL: Is DBM capable of long distance migration? If so, is this migration by means of long distance flights or by slow movement through successive crucifer crops?
D. G. HARCOURT: The migration is a long distance phenomenon. During early to mid May each year gravid adults are captured in light traps following two or three days of strong southerly wind flow from the US. Further evidence comes from the simultaneous discovery of freshly laid eggs on cruciferous weeds.

T. H. CHUA: I noticed that the population of *D. insulare* is low during the first and second generations of DBM, but it increases in the third to fifth generation. It is possible to increase the natural biological control of DBM by *D. insulare* by releasing laboratory reared insects. Could you comment on this?
D. G. HARCOURT: *D. insulare* starts showing each year because it must rediscover its host. If laboratory-propagated wasps were released at the appropriate time following discovery of the first generation eggs, we might induce higher rates of attack on the second, third and fourth host generations.

H. CHI: Do generations of DBM overlap? If so, how do you take this into account in the use of life tables?
D. G. HARCOURT: There is some slight overlap, of course. However, with intensive population sampling at two to three day intervals, we had no difficulty in isolating and tracking the generations.

R. REJESUS: Rainfall is one of the major mortality factors which dislodges young larvae from plants. Will overhead irrigation work?
D. G. HARCOURT: It definitely holds promise because the young larvae drown very quickly. However, the key will lie in cost effectiveness and the type of crucifer under protection. This idea is currently being pursued by at least two groups of scientists that I know of.

V. HARRIES: Dr. Harcourt mentioned the DBM immigration to southern Ontario from the US as a long distance phenomenon. Are these data available about the local/short distance distribution/migration of DBM during the mating/pre- oviposition period? What is the active flight distance of the DBM adult?
D. G. HARCOURT: The active flight distance is short. It has not been measured, but light trap studies suggest that the males are pulled from not more than 150 m, and the females even less.

R. REJESUS: Reduced fecundity is attributable to protein deficiency due to plant age. How about the possibility of genetic degeneration due to very high rates of population in a short period of time.
D. G. HARCOURT: I would discount the possibility of degeneration, in fact, our data has included information from all generations.

L. C. CHANG: In certain animals fecundity is influenced by lipid content. Do you think this is true in DBM?
D. G. HARCOURT: There is some evidence that the fat body increases with decreasing fecundity, but this has not been studied in any detail.

O. MOCHIDA: How do you keep the susceptible strain or standard strain?
P. A. C. OOI: The work on quantifying resistance was carried out by Dr. Sudderuddin and his colleagues. He used a susceptible strain from France and maintained the population on insecticide-free crucifer. The insect is available for laboratory breeding.

E. Y. CHENG: Have you ever tried mevinphos for DBM control? In Taiwan mevinphos is a rather resistance-free compound in comparison to other insecticides.
P. A. C. OOI: I believe mevinphos is not yet registered in Malaysia, and hence not used.

A. SIVAPRAGASAM: I wonder what the government is doing in the implementation of the IPM program in Malaysia.
P. A. C. OOI: Recognising the importance of managing the DBM at farm level, greater efforts are being made to intensify extension to the farmers.

H. OOUCHI: What was the distance between control plot and sterile male release plot?
SOELAKSONO S.: There were two types of sterile male release experiments. In one we released the sterile males in a caged field and in the other release was made in the open fields. In the cage experiment, the controls were located in the same plot as the treated ones while in the open field, the distance between the control and the treated plots was 100 m.

T. MIYATA: You showed that certain insecticide application resulted in 60% parasite mortality. At this concentration do you get good control of DBM?
SOELAKSONO S.: Parasitoid mortality of up to 60% occurred with methamidophos (0.20%) and endosulfan (0.20%) treatments. The mortality of DBM was lower than 60%.

O. MOCHIDA: In your last slide you showed that the number of larvae in the dichlorvos plot was greater 11 days after treatment than before treatment, what is the reason?
T. KOSHIHARA: Probably due to degradation of dichlorvos its insecticidal efficacy against DBM was reduced. Hence the larval population remained the same or increased slightly after insecticidal treatment.
E. Y. CHENG (COMMENT): Dr. Mochida raised the question of why dichlorvos treatment has more insects 11 days after treatment than before the treatment. This is because dichlorvos has very short residual life. So the population on the 11th day will depend on the number of DBM eggs laid two to three days after dichlorvos treatment, since larvae will survive due to lack of dichlorvos residue. On the other hand prothiophos has longer residual life and newly hatched larvae will be killed as soon as they emerge from the eggs.

E. Y. CHENG: What is the reason for using WP and granular formulation of acephate in Japan?
T. KOSHIHARA: Acephate EC formulation is not available in Japan. This is possibly due to the technical problems in commercial scale synthesis and EC formulation of this product. Acephate shows systemic activity agaist DBM larvae. Therefore, its granules can be conveniently applied onto young plants and/or on the soil surface soon after planting, or into the soil just before transplanting.

N. S. TALEKAR: You showed that DBM is important only in summer in Japan. What happens to DBM in winter? Do they overwinter? Is there migration from other countries?
T. KOSHIHARA: In the southern and the central parts of Japan, DBM occurs all year round, while in some parts of the central highlands and in cool areas in the north the insect appears exclusively from spring to autumn. Research work on its overwintering in cooler areas and migration from the warmer areas in the south to the north is being carried out now.

O. MOCHIDA: How is the survival of DBM during the winter?
SIVAIPRAGASAM (COMMENT): We are actually doing some experiments at sub-lethal temperatures in order to see whether DBM is able to survive at sub-threshold temperatures of development. But no proper conclusions could be drawn at this moment, although pupation was affected when larvae (3rd- 4th instar) were exposed to ca $5 \pm 1°C$ under laboratory conditions.

E. D. MAGALLONA: The figures on parasitism that you quoted, which are rather high, were they in field-parasitism?
O. P. BHALLA: Yes, under field conditions.