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STUDIES ON SUNFLOWER MOTH IN JILIN PROVINCE, CHINA

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ABSTRACT

The studies have been done for the life history, habitus, infestations of sunflower moth, Homoeosoma nebulellum (Denis & Schittermiller) in Jilin province of China during 1981-1985. There are 1 to 2 generations per year in Jilin and the 1st generation infest sunflowers. The moths overwinter underground as mature larvae in their cocoons. The development thresolds and effective accumulative temperatures (DD) are 10.7°C and 42.5 DD for eggs and 7.27°C and 376.41 DD for larvae respectively. Some borer resistant resources have been evaluated. It is indicated that using resistant variety is the best way to control the damages by sunflower moths.

Sunflower moth, Homoeosoma nebulellum distribute in the northeastern China, Innermongolia and northern Xinjiang. In the northeast of China, its infestation come to be seriously after 1960's. Generally speaking, the seed damages caused by sunflower moths would be 5 to 10 per cent. The highest density is 130 larvae per sunflower disc. It would be no harvest in the most seriously infested farm. Some farms have no longer planted sunflower.

LIFE HISTORY

There are 1 to 2 generations per year in Jilin province. The moth of 1st generation harm the crop, but the 2nd generation only cause a light damage since they occur rather late (end of August to middle of September). Pupation of the overwintering larvae begin in the first ten days of July. And adults appear in the middle of August. The moths lay their eggs during middle of July to middle of August. Larvae development is from the 3rd of ten days of July to the middle of September. Most of the larvae of the 1st generation hibernate directly, but the 2nd one, which appear during the 3rd ten days of August to middle of September, can not overwinter.

The development of H. nebulellum is tabulated as table 1 and table 2.

Table 1. The developmental duration of at constant temperatures

T (C)	eggs		larvae		pupae	
	range	mean	range	mean	range	mean
25	2.3-3.7	2.98	17-23	21.23	10-11.7	10.5
30	1.9-2.5	2.20	15-20	16.56	— —	—

* The means of developmental duration are days.

Table 2. The head-width, body-size & developmental duration of the larvae of H. nebulellum at every instar

age		L1	L2	L3	L4
head width (mm)		0.3	0.5	0.8-0.9	1.3-1.4
body size (mm)		1.3-2.8	2.5-5.0	4.0-9.0	8.0-13.0
Duration (day)	range	4-5	2-4	2-5	7-10
	mean	4.23	3.23	3.38	9.15

* The larvae were at the natural temperature 23.3C.

Threshold temperature and degree-day (DD) of the eggs and larvae have been estimated at 25C and 30C constant temperature in our laboratory. Threshold temperature was 10.7C for egg development and 7.27C for larvae. Development from egg to hatching and from newly hatched larvae to pupa required 42.5 DD and 376.41DD, which were calculated from table 1 with the formula (T1-C*) * N1=(T2-C) *N2=K and C= (T1*N1-T2*N2)/ (N1-N2).

According to the field investigations during 1981-1984, the adults of the overwintering generation initial emerge on 17,July. Their peak period was during the 25th of July to 15th of August, and declining period was 16th to 27th of August. They endured for 29 to 40 days. The adults of the next generation accured from the 22th of August to 14th of September, and lasted for 8 to 22 days. The overwintering generation was fourty-one times the population density of the next generation.

LIFE HABIT

The flight ability of sunflower moth is strong. They are essentially nocturnal. The adults lurk in the grasses adjacent to and in the fields of sunflower during daylight hours, and flight for feeding, mate seeking and oviposition at night.

The adults of overwintering generation began flight shortly after dusk at 1930 h (Beijing time). The greatest flight activities took place during 2000 h to 2200 h (table). The next generation's moths began their flight activities some earlier. It may be related to temperature and light etc.

Table 3. Flight activities of overwintering generation moths

Time (Beijing time)	moth numbers	percentage
1900	0	0
1930	1	3.5
2000	9	31
2100	9	31
2200	5	17.2
2300	1	3.5
2400	1	3.5
0100	1	3.5
0200	1	6.8
0300	0	0
0400	0	0

After emergency, the adults flew to sunflower disc to feed hectar. Then sexual activities accured. They laid most of eggs on the inside-wall would lay 1to2 eggs, the maxmum to 6, inner a capitulum.

Table 4. Ovipositing site of sunflower moth

date	total eggs	inside-wall of anther		calyx		style	
		eggs	percentage	eggs	percentage	eggs	percentage
4, Aug.	66	61	92.4	2	3.03	3	4.54

The young larvae (L1 & L2) fed on tubular flower, then bored into the seeds (L3 & L4). They have a habit of spinning silk to disperse by wind. The larvae spin their web with frasses and scraps between thethe seeds to make a filiform tunnel extended to disc centre. They overwinter as usually stay and feed in it. A larvae can harm 5 to 8 seeds They overwinter as mature larvae in soil. Most of them about 66.9%, are between the surface to 5 cm depth. Others, 26.55% are in 5.1 to 10 cm depth and 6.6% in 10.1 to 15 cm depth. The

overwinter sites would be in the fields where host crop were planted. When the overwintering larvae were going to pupate, they got out of the cocoon and up to soil surface about 1 cm depth to spin cocoon again and pupate within it.

POPULATION DYNAMICS

1. Influnce of the florescence

H. nebulellum oviposite during the florescence of sunflower, so the population density depend on the coincidental degree between the florescence and eclosion of the moths. According to the investigation of the rate of seed damage, it was indicate that the plants which were in blossom during the 5th to 14th of August had a higher percentage of damaged seeds (table 5)

Table 5. Relationship of sunflower florescence to seed damage

florescence	percentage of damaged seeds		
	WSH1	Peliedovic	Local cultivar
21-25/7	0.15	0	
26-30/7	0	0	
31/7-4/8	0.1	0.15	
5-9/8	1.15	0.6	48.5
10-14/8	1.25	0	15.9
15-19/8	0.3	0	1.2

2. Influnce of planting date

According to the investigation on the local cultivar, the high percentage of damaged seeds associated with early planted sunflowers. Late planted sunflower had fewer larvae damaged seeds (table 6).

Table 6. Planting date effects on percentage of seed damage

planting date	no. sample seed	no. damaged seed	rate of damage%
17/4	6200	1935	31.2
1/5	2000	712	35.6
10/5	2000	866	43.3
24/5	2000	406	20.3
31/5	2000	42	2.1
5/6	2000	8	0.4

3. Influnce of varieties

Generally speaking, oilseed sunflower varieties show higher resistance to H. nebulellum than edible form varieties do. The higher resistance can be attributed to the existance of a hard carbon layer, which is between the scleren chyma and suberin lamella of the seed coat and can prevent from or reduce the damage by the borer. A borer resistant variety "WSH1" was bred by Jilin Sunflower Institute in 1981, and its extended application have achieved beneficial results.

Screening the borer resistant varietal resource

The resistance to H. nebulellum of 480 varietal materials have been evaluated by natural screening method in the field. The borer resistance of the materials was divided to 5 levels as table 7. There were 150 among all of them at level I.

Table 7. The borer resistance levels

level	classification	percentage of damaged seed%
I	Higher resistant	0-2
II	resistant	2.1-5
III	medium resistant	5.1-10
IV	susceptible	10.1-20
V	higher susceptible	over 20

The mechanism of the resistance to borer may include two aspects. One is that the floreacence is inconsistent with the peak ovipositing period of the moths, thus the damage reduced. Another is the existance of the carbon layer in seed coat.

Forthermore, the chemical identification method of the carbon layer have been studied. The seeds were soaked in the solvent for 20 minutes, which was made by fixing 20% H_2SO_4 (1000 ml) with $K_2Cr_2O_7$ (10 9), to observe the color change of the seed coat. If there is a carbon layer in it, the color would become black. The evaluating results were consistent with the field screening.

CONCLUSIONS

1. There are 1 to 2 generation of H. nebulellum in Jilin province of China. The 1st generation damage sunflower seriously but the 2nd don't.

2. They overwinter underground as mature larvae in their cocoons. Most of them are in the depth about 5 cm. The moth are nocturnal and lay most of eggs on the inside-wall of the symose anther.

3. At 25°C constant temperature, the development duration of the egg, larvae and pupa were 2.3 to 3.7 days, 17 to 23 days and 10 to 11.7 days respectively, temperature threshold were 10.7°C for eggs and 7.27 for larvae, and effective accumulative temperatures for eggs and larvae were 42.5° C and 376.41 DD.

4. Using H_2SO_4 and $K_2Cr_2O_7$ solvent to identify the carbon layer was a easily method for evaluating the resistance to H. nebulellum.

5. Using borer resistant varieties is the best way to control sunflower moth, because the effect of chemical control is not very well. On the other hand, applying insecticides is not easy in florescence of sunflower, but also all of the chemicals currently used are intense toxic to bees. So an excess of application of insecticides will influnce pollination of sunflowers.