# The capture effect of probe traps on stored-product insect natural enemies

Chen Chuan, Yao Wei, Wang Yan and Wang Jianbin[1]

*Abstract*

The effect of GJ89 traps on insect natural enemies in bulk stored grain was investigated in Sichuan and Shaanxi provinces of china. The results showed that the predacious bug, *Xylocoris sp.* was abundant in newly stored wheat in Sichuan province. The captures in vertical direction varied with grain depth In Shaanxi province, the insect natural enemies in stored wheat or paddy were hymenopterous parasites, such as *Anisopteromalus calandrae* (Howard), *Pteromalus sp* and *Lariophagus distinguendus* (Forster), they were well distributed within the grain mass. Population changes of hymenopterous parasites showed that they had one peak in August to September each year. The fluctuation dynamics curve for them is similar to that of *Sitophilus zeamais* (*Motsch*) in stored wheat or paddy, which explains that the number of parasites may depend on that of *S zeamais*. The comparison of standard grain trier with the probe trap technique was conducted. The capture of hymenopterous parasites complex in probe traps and in standard grain trier samples of wheat and paddy were described by linear equations

## Introduction

There is increasing interest in exploring the benefits of using natural enemies to control storage insects. Because chemical control methods may pollute stored grain, and result in resistance development of insects Insect natural enemies mainly include predacious and parasitoids. Some research on the predacious bug *Xylocoris flavipes* (Reuter) indicated that it has potential (Jay et al 1968, Arbogast 1978,1988, Lecao et al 1977, 1979) Parasitoids also are important in the biological control on storage pests (Ryoo and Shin 1992, Huang Xinhui 1986, Wang Wengxue 1991) In the past, insect natural enemies in storage grain were only studied under laboratory conditions and but not in grain bins. It is difficult to determine the distribution and population of natural enemies in storage grain. Because it took much time to carry out this test, and adequate sampling tools were unavailable for such a study. The development of GJ89 type probe trap by Yao-Wei had made it easier to sample insects and their natural enemies in grain bulks Such as GJ94 type probe trap and the computer remote control system for monitoring the dynamic of insect population, temperature and moisture in stored grain (Yao Wei et al 1993, 1995), further development has improved the sampling efficiency So the GJ89 or GJ94 probe traps (Yao Wei 1993,1995, Chen Chuan 1995) can detect both the insects and natural enemies.

We researched them to determine the species of predators and parasitoids in bulk-stored grain by GJ89 traps; to determine the distribution and population fluctuation of insect natural enemies monitored by GJ89 type probe traps; to compare probe traps with the standard grain trier in capturing insect natural enemies

## Materials and Methods

### The devices for testing

The probe traps developed and made by Shaanxi Institute of Zoology and Shaanxi Service Department of Optical Instrument, which were fixed for needing.

### Test of detecting predacious bugs *Xylocoris SP*

This test was carried out at Huangxu Grain Reserve Storage in Sichuan province. The sampled granary is a high storehouse. It has 1500 tons of paddies that was stored in March, 1991, and not fumigated since storage. We investigated insect natural enemies at April 24 this year. Twenty sample points were chosen. Every point was divided into four layers: the surface to 50 cm, 50 – 100 cm, 100 – 150 cm and 150 – 200 cm. The traps were checked 24h late. The captured insects were counted and identified. In the test 80 probe traps were used

### Test of monitoring the complex population of hymenopterous parasites

The test was carried out in two wooden bins in Shaanxi Institute of Zoology The bins were one meter wide and one meter long and two meter high . Two ton wheat were stored in July 1993 in one bin, and two ton paddy in the other. The grains were not fumigated since then.

[1] Shaanxi Institute of Zoology, 710032, Xian, China

Before test, surface of the stored grain was leveled then 9 monitored spots were installed equally, which were monitored at following depths: surface – 50 cm, 50 – 100 cm, and 100 – 150 cm et Time that insects were captured with GJ89 type probe traps was 24 h. there were 27 traps in each bin. Test began at April 1994. The test was done every month for a year; first the adult insects were removed for counting and identification, then were put back to their original place in the grain mass Probe traps and triers were used at 9 points. The 9 points were same as 9 points monitored with probe traps at the six different depths: the under surface, 35 cm, 70 cm, 105 cm, 140 cm and 175 cm to sample (the five former depths in stored wheat) Weight of sampled grain with a trier was 500g. After screening the living adult insect natural enemies were counted and identified, let them to the original location in bins

### Analysis of trap catches data

In Sichuan, insects were found in newly stored paddy. All insects were counted and identified The percentage of *Xylocoris* SP. In the total capture was calculated and their vertical distribution was analyzed with Duncan's multiple range test. All insects of each trap and grain sample of 500g in stored wheat and paddy was counted and identified. We studied the vertical distribution of the parasitoids, which were captured with probe traps at monthly interval with Duncan's, multiple range tests respectively in both stored wheat and paddy. The living adults of the parasites and that of the pest insects, such as *Sitophilus Zeamais* Motsch. *Tribolium Castaneum* ( Herbst ), *Oryzaephilus Surinamensis* (L ) and *Rhizopertha dominica* captured with probe traps were also counted According to the relation between the parasites to every major pest, respectively calculated mean number of complex population of hymenopterous parasites captured with one trap and in 500g sampled grain, and studied the relation of them with simple lineal regression analysis.

## Results

### Result of detecting predacious bugs *Xylocoris* sp.

Insect natural enemies in new-stored paddy in Sichuan were mainly predacious bug *Xylocoris* sp. representing about 80% of the total capture, which indicated that insect natural enemies were abundant in new-stored grain in Sichuan. In the vertical distribution, mean number of *Xylocoris* sp. that were captured in depth of 50 – 100 cm with one trap in stored paddy were seventy five, which were different from the capture in the depth of surface to 50 cm in a very marked manner ($\alpha = 0.05$), and the capture in the other layers aren't different from each other (Table 1).

### Results of monitoring the complex population of hymenopterous parasites with probe traps

The parasites were captured in August, September and October, the results showed that all parasites in stored wheat and paddy were made up of three species: *Lariophophagus distinguendus* (Förester), *Pteromalus* sp. and *Anisopteromalus calandrae* (Howard). The table 2 showed that the parasites in stored paddy a year were even in vertical distribution Table 3 showed that the capture of the parasites in stored wheat in depth of 100 – 150 cm with probe traps were different from them in the other area in a very marked manner in the July ($\alpha = 0.01$), the capture of the complex population of hymenopterous parasites in depth 50 – 100 cm were different from them in the other area in a very marked manner in August ($\alpha = 0.01$), and the capture in rest area were not different each other In the other months the capture in all area were not different each other

**Table 1.** The vertical distribution and comparison difference of *Xylocoris* sp. in stored paddy.

| Detection Depth(cm) | Mean per trap | Significant difference* 5% | 1% |
|---|---|---|---|
| 50 – 100 | 75.05 | a | A |
| 100 – 150 | 59.16 | ab | A |
| 150 – 200 | 57.42 | ab | A |
| S – 50 | 23.26 | b | A |

* Means followed by different letters are significantly different (Duncan's Multiple Range Test)

**Table 2.** The vertical distribution and comparison difference of the parasites in stored paddy (1994).

| Detection Time | Grain depth(cm) | Mean per trap | Significant difference* 5% | 1% |
|---|---|---|---|---|
| | 50 – 100 | 1 | a | |
| June | surface – 50 | 0 | a | A |
| | 100 – 150 | 0 | a | A |
| | 50 – 100 | 1 | a | A |
| July | 100 – 150 | 0.78 | a | A |
| | Surface – 50 | 0.44 | a | |
| | 50 – 100 | 1.11 | a | A |
| Aug. | 100 – 150 | 0.44 | a | A |
| | Surface – 50 | 0.33 | a | A |
| | 50 – 100 | 1.56 | a | A |
| Sep. | 100 – 150 | 0.89 | a | A |
| | Surface – 50 | 0.67 | a | A |
| | Surface – 50 | 0 44 | a | |
| Oct. | 50 – 100 | 0 33 | a | A |
| | 100 – 150 | 0.22 | a | A |
| | Surface – 50 | 0 | a | |
| Nov | 50 – 100 | 0 | a | A |
| | 100 – 50 | 0 | a | A |

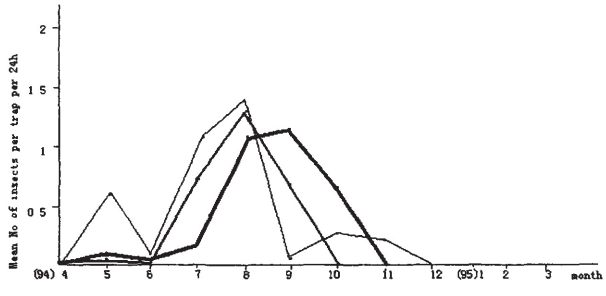
* Means followed by different letters are significantly different (Duncan's Multiple Range Test)

**Table 3.** The vertical distribution and comparison difference of the parasites in stored wheat (1994).

| Detection Time | Grain depth(cm) | Mean per trap | Significant difference* 5% | 1% |
|---|---|---|---|---|
| | Surface－50 | 0.11 | a | A |
| May | 50－100 | 0.11 | a | A |
| | 100－150 | 0 | a | A |
| | Surface －50 | 0.11 | a | A |
| June | 50－100 | 0 | a | A |
| | 100－150 | 0 | a | A |
| | 100－150 | 0.56 | a | A |
| July | Surface－50 | 0 | b | B |
| | 50－100 | 0 | b | B |
| | 50－100 | 2.22 | a | A |
| Aug. | 100－150 | 0.67 | b | B |
| | Surface－50 | 0.33 | b | B |
| | 50－100 | 1.78 | a | A |
| Sept. | Surface－50 | 1.33 | a | A |
| | 100－150 | 0.44 | a | A |
| | 100－1 | 0.89 | a | A |
| Oct. | Surface－50 | 0.67 | a | A |
| | 50－100 | 0.44 | a | A |
| | Surface－50 | 0 | a | A |
| 94.11 | 50－100 | 0 | a | A |
| | 100－150 | 0 | a | A |

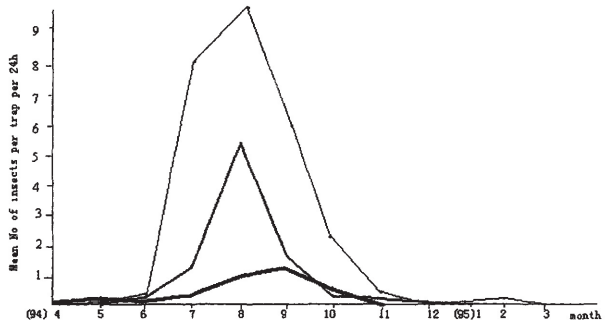
* Means followed by different letters are significantly different (Duncan's Multiple Range Test)

In stored wheat and paddy, the results from the fluctuation dynamic of complex population of hymenopterous parasites showed that it had one peak from August to September a year. The fluctuation dynamics curve of them is similar to that of *Sitophilus zeamais*, which explains that the number of the adult living parasites may vary, depending on that of *Sitophilus zeamais* (Figure 1, 2, 3, 4).



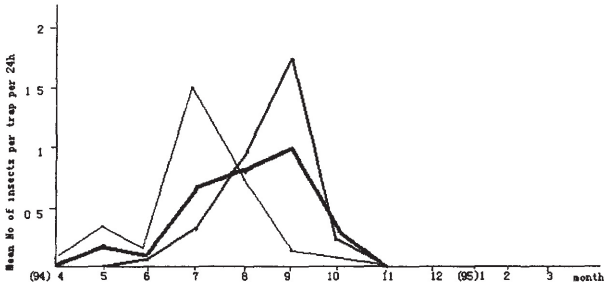

*Parasites*: ■ *S. zeamais*: —— *R. castaneum* ■

**Fig. 1.** The trends of population dynamic for the parasites, *S. zeamais* and *R dominica* in stored wheat.



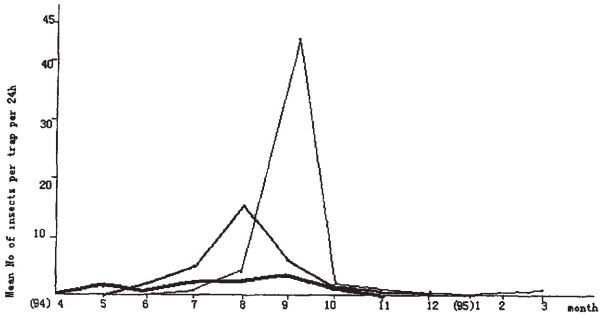

*Parasites*: ■ *O. zeamais*: —— *T. castaneum* ■

**Fig. 2.** The trends of population dynamic for the parasites, *O surinamensis* and *T. castaneum* in stored wheat




*Parasites*: ■ *S. zeamais*: —— *T. castaneum* ■

**Fig. 3.** The trends of population dynamic for the parasites, *S. zeamais* and *T castaneum* in bulk paddy




*Parasites*: ■ *R. zeamais*: —— *O. castaneum* ■

**Fig. 4.** The trends of population dynamic for the parasites, *R dominica* and *O. surinamensis* in bulk paddy

## Comparison between two methods of the parasites detecting in stored wheat and paddy

Average amount of the complex population of hymenopterous parasites captured with probe traps every test was regarded as independent variable ($x$), and that of them captured with the standard grain trier were regarded as dependent variable ($y$), to study the relation of them with regression analysis. $\pm 2 \times 0.4900$, $r = 0.9184$ and $y =$

$0.0043x + 0.7709 \pm 2 \times 0.2328$, $r = 0.7828$ respectively in stored wheat and paddy, their relations were significant, which explained that sampling technique with probe traps was reliable.

## Discussion

Sampling techniques for stored-product insects with traps in bulk-stored grain is an advanced method at present. Compared with the standard grain trier, sampling techniques with traps may save time and labor. Probe traps have uniquely advantage on detecting insects in deep layers of the stored grain. With the result of the tests, it is applicable to study the fluctuation dynamic, distribution of insect natural enemies and relations between them to pests with the probe traps. But their functions need further to be studied.

The investigation showed that the insect natural enemies were abundant in stored grain in China, so trap technique has a good future of application. They can offer one new method for integrated pest management in stored grain.

## Acknowledgments

This research was supported by funds from National Science Foundation of China.

We thank professor Yang Zhongqi, Northwester Forestry College in china, for identifying the parasites.

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