Some initial results on phosphine resistance of major product insect pests in Vietnam

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Abstract
With the FAO method No 16, the author has been studied on phosphine resistance of 5 strains of Sitophilus oryzae L.; 5 strains of Tribolium castaneum Hbst. and 4 strains of Rhyzopertha dominica F from different locations of the North and the South of Vietnam.

The results pointed out that all local strains of Rhyzopertha dominica F have very high phosphine resistance and one strain of Tribolium castaneum Hbst. in each location has the phosphine resistance. Even though, both local strains of Sitophilus oryzae L. have manifested the phosphine resistance, their tolerance with phosphine is higher than the reference susceptible strain.

Introduction
According to information of the FAO (1976), 346 insect species, of which 250 species damaged to plant and stored products, are insecticide resistance.

Le Truong (1982) showed that excepting Plutella maculipennis, Aphid Myzus persicae, which damaged to vegetables of Cruciferous family in Hanoi, had been found as the resistant species.

Recently, Vu Thi Loan (1989) observed, because of the appearance of insecticide resistance of mosquitoes Anopheles spp., the programme of control and liquidation to malarial fever in Vietnam was broken.

The phosphine fumigant for the stored product insect pests are usually used over recent 30 years and in controlling practice of some instances when we increased dosage up to more than 1.5 - 3 times of normal level but not killing completely individuals of population (Duong Minh Tu et al., 1989), thus up to now there has not been a sufficient research on resistance of the stored product insects. In order to contribute to developing of this subject, we carried out tests on phosphine resistance of some strains from the north and the south of Vietnam of three major stored insect species such as the rice weevil (Sitophilus oryzae L.), the lesser gram borer (Rhyzopertha dominica F.) and the red flour beetle (Tribolium castaneum Hbst.).

Materials and Methods
Reference susceptible strain
Reference susceptible strain with the phosphine fumigant were international standard strains, which were taken from Thailand and their origin was from Australia.

These strains were reared on optimum media at the CHEM postentry plant quarantine station, TU LIEM district, HANOI city.

Collection of local strain for tests
We collected adult insects from stored which were usually used phosphine fumigant in order to fumigate commodities, in Red river delta, north of Vietnam such as Cong moe feet store in Hanoi and the Haiphong mill in Haphong; in Cuu long river delta (South of Vietnam) such as Long an, Tien giang, Satake and Vifon factory in Ho Chi Minh city, Vinh long, Song be and Da lat.

Test conditions
Tests were carried out at centigrade degree temperatures 26 ± 2°C and relative humidity 75 ± 5% rh.

Research method
We used a method for adults of some major pest species of stored cereal with methyl bromide and phosphine (FAO Method No. 16). That is a largely applied method throughout the world nowadays.

Test results were corrected by the Abbott formula (1969) as follows:

\[ R = \frac{(m_1 - m_2) \times 100}{(100 - m_2)} \]

with R is a correcting mortal number by phosphine treatment

\[ m_1 \] is a mortal number in treatment

\[ m_2 \] is a mortal number in control

We used some doses LC50; LC99.9; discriminating dose and above discriminating dose.

Results
We tested with 5 strains of the rice weevil (Sitophilus
oryzae L.), 5 strains of the red flour beetle (Tribolium castaneum Hbst.) and 4 strains of the lesser grain borer (Rhizopertha dominica F.).

Experimental results are shown in Fig. 1a and 1b and at the LC50 of Sitophilus oryzae the phosphine was approximately 0.011 mg/L and LC 99.9 was approximately 0.039 mg/L. When comparing standard concentration with response result of the reference susceptible strain we observed that the local strains of Sitophilus oryzae in Hanoi and Haiphong also in Long an, Ho Chi Minh city and Tien giang were not yet manifested clearly on phosphine tolerance. Particularly, at the LC50 of the reference susceptible strain, a knock-down percentage after 20 hrs fumigation was 100 but on the 14th day after that mortal rate reduced 49%. However, five local strains (two strains of the north and three strains of the south of Vietnam) did not manifested phosphine resistance but their tolerance with phosphine was rather high than reference susceptible strain, for example, at the LC 99.9 mortal rate on the 14th day in Cong moc strain was 89%, in susceptible was 93%.

Test results in five local strains of Tribolium castaneum (Fig. 2a and 2b) showed that at the discrimirating dose (0.04 mg/L) mortal rate in Cong moc strain was 97%, in Haiphong mill strain was 85%; in Satake factory strain was 96% and in Song be strain was also 96%; only in Vinh long strain was 79%. At the LC99.9 mortal rate in Cong moc strain was 84%; in Haiphong mill strain was 82%; in Satake factory strain was 83%, in Song be strain was 89%, only in Vinh long strain was rather low, 67%. The above said results showed that on the 14th day after fumigation at the discriminating dose, a survival rate was 3% in Cong moc strain; 15% in Haiphong mill strain; 4% in both Satake factory and Song be strain. Particularly, at the discriminating dose, a survival rate was 3% in Cong moc strain; 15% in Haiphong mill strain; 4% in both Satake factory and Song be strain. So that phosphine resistance appeared in Haiphong mill strain and in Vinh long strain of Tribolium castaneum; the other local strains (Cong moc, Satake factory and Song be) of this species did not manifested phosphine resistance but their tolerance was higher.

When we increased test dosage upto 2.5 times of discriminating dose (0.1 or 0.2 mg/L) on the 14th day, mortal rate of four local strains were 100%, only Vinh long strain was 96%. Thus the phosphine resistance in the Vinh long strain and in the Haiphong mill strain was higher than 2.5 times in comparison with the standard resistance regulation. This result pointed out that there is two phosphine resistance strains, one in the north (Haiphong mill) and one in the south (Vinh long).

![Fig. 1a. Effect of phosphine on the mortality of different strains of Sitophilus oryzae L. 20 hours after treatment (C: Control; P: Phosphine).](image-url)
Fig. 1b. Effect of phosphine on the mortality of different strains of *Sitophilus oryzae* L. 14 days after treatment (C: Control; P: Phosphine).

Fig. 2a. Effect of phosphine on the mortality of different strains of *Tribolium castaneum* Hbst. 20 hours after treatment (C: Control; P: Phosphine).
Fig. 2b. Effect of phosphine on the mortality of different strains of *Tribolium castaneum* Hbst. 14 days after treatment (C: Control; P: Phosphine).

Fig. 3a. Effect of phosphine on the mortality of different strains of *Rhizopertha dominica* F. 20 hours after treatment (C: Control; P: Phosphine).
The results presented in Fig. 3a and 3b showed that there was the phosphine resistance strains of *Rhyzopertha dominica* in both regions, north and south of Vietnam. According to the Fig. 3a and 3b, we observed clearly the phosphine resistance of both local strains were manifested very highly. Especially with the Cong moc strain at the above discriminating dose (0.1 mg/L) the knock-down rate after 20 hrs fumigation was 4% and on the 14th day was 10%. When increasing dosage upto 0.2 mg/L (more than 5 times in comparison with the discriminating dose) the mortal rate on the 14th day was 15% only. At the LC50, mortal rate on the 14th day was 1% equivalent to the control. Among two local strains in the north Vietnam with the phosphine resistance, the Cong moc strain has got a resistant level higher than the Haiphong mill strain ca. 5 times. Lastly, Fig. 3a and 3b shown that the phosphine resistance of local strains of *Rhyzopertha dominica* in the north Vietnam has been appeared always higher than in the south Vietnam and the resistant level of Da lat strain was lowest. Thus the results of Fig 3a, 3b also demonstrated that the insecticide resistant level belong to the long time and activity of insecticide using in each region of Vietnam.

With those results and the standard resistant regulation, we discovered two strains of Tribolium castaneum Hbst. and four strains of Rhyzopertha dominica F. with phosphine resistance. At the phosphine resistant level, we observed that the Cong moc strain of Rhyzopertha dominica F. and the Vinh long strain of Tribolium castaneum Hbst. had the highest resistant level and perhaps the phosphine resistance has been appeared with Rhyzopertha dominica F. more easier than Sitophilus oryzae L.

### Conclusion

According to the test results on the phosphine resistance of 14 local strains in both regions, north and south of Vietnam with 3 species: *Sitophilus oryzae* L., *Tribolium castaneum* Hbst. and *Rhyzopertha dominica* F. we have found that both local strains of *R. dominica* have very high phosphine resistance and one strain of *T. castaneum* in each region has the phosphine resistance. Even though both local strains of *S. oryzae* have manifested the phosphine resistance, their tolerance with phosphine is higher than the reference susceptible strain.

### References


