Studies on control of stored grain pests with botanical grain protectant Anlianxian

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Abstract

Botanical grain protectant Anlianxian was composed of Chinese herbal medicines and chemical insecticides Studies results showed that No 1 Anlianxian had the best effectiveness for control of the main stored grain pest insects, such as *Sitophilus zeamais* (Motschulsky), *Rhizopertha dominica* and *Cryptolestes* existing in the stored wheat and paddy After 7 months, in treated wheat the total number of insect pests inspected decreased 97.3% compared with that of control Reduced 96.9% compared with 0.04% Guchongjing treatment. Control effectiveness of No 1 Anlianxian amounted to 96.9%. Paddy treated with No. 1 Anlianxian, the number of insect pests were less than 5 heads/2 hrs (inspected by trapping method) for 9 months. After 10 months damaged rate of paddy treated was 0.5% and control effectiveness came up to 96.9%.

Introduction

For a long period Chemical grain protectants have mainly been used for controlling stored grain insect pests in China and abroad, retrieving a lot of losses. But three serious problems of pesticide residue, insect resistance to insecticides and pest re-rampancy arose because of its application for a long time So far as the pest resistance to insecticides was concerned, it was reported that about 10% stored grain pest strains were resistant to hydrogen phosphide all over the world. In our country the main stored grain insect pests, such as *Sitophilus zeamais*, *Sitophilus oryzae*, *Rhizopertha dominica*, *Triboleum Castaneum*, *Tribolium confusum* and *Cryptolestes pusillus*, etc , all produced different levels of resistance to malathion, hydrogen phosphide and gamma-BHC. In few districts the index of resistance to phosphine amounted to 1000 times It followed that exploring new approaches and methods become an urgent task

Since the 1970s the studies on botanical pesticides by scholars in China and abroad has become an active field. The study results of botanical pesticides were reported in some foreign countries, such as the United States, Sudan, Australia, Cameroon, Colombia, India, West Germany, Nigeria, Pakistan, etc. Since the 1980s Zhao Shanhuan, Yao Kang et al. in our country studied the control of the stored grain pests with botanical materials, achieving encouraging progress. On the basis of predecessors achievements we made a lot of studies on controlling the stored grain pests with botanical materials in the laboratory from June, 1994 to June, 1995, developing the botanical grain protectants of Anlianzian series. In order to spread and apply this protectant, field trails were conducted in warehouses from July, 1995 to September, 1996 The results were as the following.

Material and Methods

From July 4, 1995 to Feb 13, 1996 expended experiments were conducted with new harvested wheat at warehouses of Shayang Grain Depot in Jinmen City, Hubei Province. Moisture of grain was 12.5%.

From Oct. 14, 1995 to Sept. 15, 1996 field trails were conducted with new harvested middle-season indica paddy at experiment warehouses of Shili grain administrative office in Jinmen City, Hubei Province. Moisture of grain was 13.6%.

Botanical protectants used for treating new wheat were powder of No. 1,3,4,5,6,7,8,9,10 and 11 Anlianxian. The constituents (W/W) of No. 1 Anlianxian were *Alpinia officinarum* Hance 10.0% *Artemisia argyi* Levl. et. Vant 40.0%, deltamethrin 0.01% (A. I.) with 0.1% PB and fenitrothion 0.49% (A. I.); No. 2 Anlianxian were *Cinnamonum loureirii* Nees 10.0%, *A. Argyi* 40.0% and fenitrothion 0.49% (A. I.); No. 3 Anlianxian were *A. officinarum* 10.0%, tangerine peel 40.0% and fenitrothion 0.49% (A. I.); No. 4 Anlianxian were *C. louveirii* 10.0%, tangerine peel 40.0%, deltamethrin 0.01% (A. I.) with 0.1% PB and fenitrothion 0.049% (A. I); No. 5 Anlianxian were *A. officinarum* 10.0% *A. argyi* 40.0% and deltamethrin 0.02% (A. I.) with 0.2% PB; No. 6 Anlianxian were *A. officinarum* 10.0%,

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tangerine peel 40.0% and deltamethrin 0.02% (A.I.) with 0.2% PB; No. 7 Anhianxian were *A. officinarum* 10.0% *A. argyi* 40.0% and fenitrothion 0.49% (A. I.); No 8 Anhianxian were *A. officinarum* 10.0% *A. argyi* 40.0% tangerine peel 40.0% and fenitrothion 0.49% (A. I.); No. 9 Anhianxian were *C. loureiri* 10.0%, *A. Argyi* 40.0% and malathion 0.049% (A. I.); No 10 Anhianxian were *A. officinarum* 10.0% *A. argyi* 40.0% and deltamethrin 0.005% (A. I.) with 0.05% PB Anhianxian were *A. officinarum* 10.0% *A argyi* 40.0% and deltamethrin 0.02% (A.I) with 0.2% PB and No. 11 Anhianxian were *C louveirii* 10.0%, tangerine peel 40.0% and deltamethrin 0.01% (A I.) with 0.1% PB. For every treatment was in two duplicates and 50 kg of wheat and 50g of Anhianxian were used. After thoroughly mixed, wheat was loaded into plastic film lining woven bag, and randomly placed in the warehouse, with the bags open and the stored grain pests infesting freely. At same time, the treatments of 0.5 ppm (A I.) deltamethrin with 5ppm PB, 8ppm(A. I) fenitrothion, 10ppm (A. I) malathion and 0.04% Guchongjing were also set up as controls.

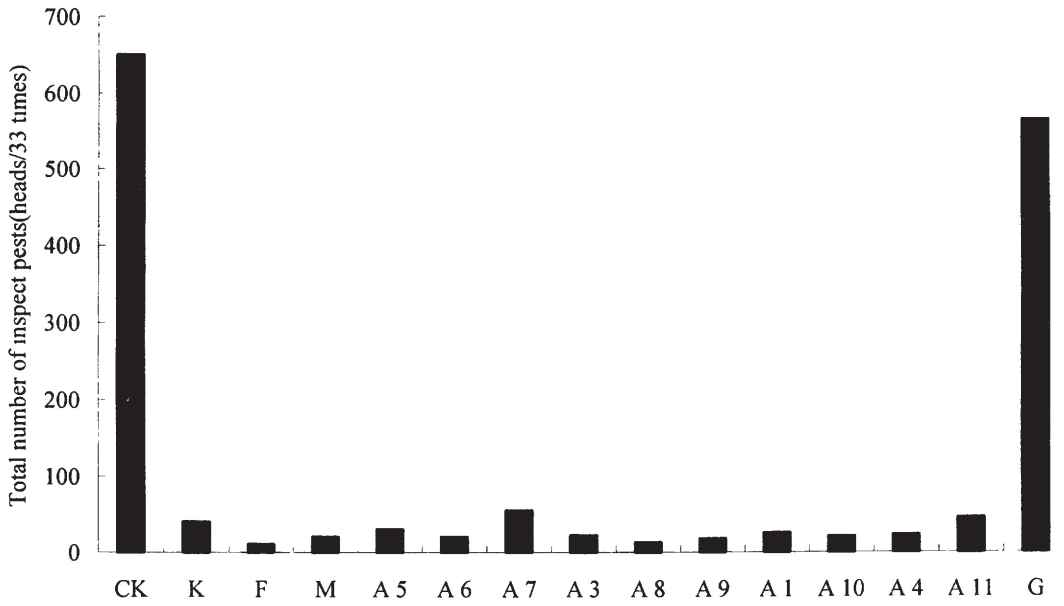

Fig.1A. After 7 months total number of insect pests (Treated from July 4,1995 to Feb.23,1996 at Shayang Grain Depot).

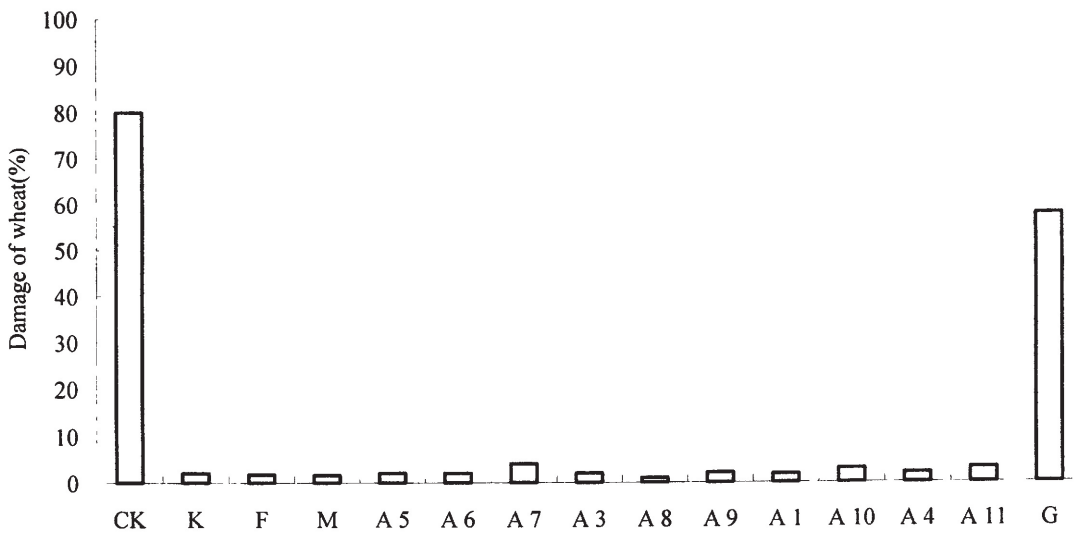

Fig.1B. After 7 months damage of wheat (%) (Treated from July 4,1995 to Feb 23,1996 at Shayang Grain Depot).

Note: K-DELTAMETHRIN F-Fenitrothion M-Malathion A-Anhianxian series G-0.04% Guchongjing

For treating new harvested middle-season indica paddy, same dosages of No. 1, 2, 3 and 4 Anlianxian were used, With 1 kg Anlianxian mixed with 1000kg grain Every treatment was in 2 duplicates and 30000kg of paddy were used. At the same time the controls were also set up. The conventional method was used for storing the paddy.

At the beginning and end of the experiments or trails, the moisture content of grain, the insect variety and density, and the damage rate of grain were inspected.

The temperature and the relative humidity in warehouse, grain temperature, insect variety and its density were inspected weekly The inspections of stored grain insects were conducted with a probe trap made in Shanxi institute of zoology and each inspection took two hours. The damage rate of grain was checked monthly.

Results and Analysis

Results of Anlianxian Series wheat treatment

The cumulative insect pest number of 33 inspections during the experiments and the damaged rate of wheat at the end of the experiments were drawn in Figure 1A and Figure 1B.

In the 223-day period of experiments the largest number of insect pests trapped in the control was 50 heads/2hrs, and the number under 5 heads/2hrs was 6 times, accounting for 18.1% of the total 33 inspections, above 10 heads/2hrs was 24 times, accounting for 72.7%. The cumulative number of insect pests for 33 inspections was 653.5 heads In 0.04% Guchongjing treatments the maximum number of insect pests trapped was 46 heads/2 hours. The number below 5 heads/2 hrs was 9 times, accounting for 27.2% of the total. Beyond 10 heads/2 hours was 21 times, acconting for 63.6%. The cumulative number of insect pests for 33 times was 572.5 heads. In wheat treated with No. 1,3,4,5, 6,7,8,9,10,11 Anlianxian, deltamethrin, fenitrothion and malathion except one time the number of insect pests more than 5 head/2hrs for 0.5ppm Deltamethrin (18 heds/hrs), No.6 Anlianxia (7 5 heads/2 hrs), No 7 Anlianxian (11.5 heads/2 hours), No.3 Anlianxian (10 heads/2 hours), No 10 Anlianxian (6 heads/2 hours) and No. 11 Anlianxian (5.5 heads/2 hours) respectively The number of insects trapped all was lower than 5 heads/2hrs. The total number of insect pests trapped for 33 times was only 17.5 – 56 heads, decreased 91.4 – 97.3% compared with that of the control and reduced 90.2 – 96.9% in comparison to that of 0.04% Guchongjing treatments. The insect pests trapped were *Sitophilus zeamais* first, then *Triboleum castaneum* and *Cryptolestes*.

After 7 months, the damaged rate of wheat for control was up to 79.5%, for 0.04% Guchongjing treatment was 58.5% while the damaged rate of wheat treated with Anlianxian Series protectants and other chemical protectants were only 1.0 – 4.0%. There seems no obvious difference occurred in the total number of insect pests and the damaged rate of wheat treated with Anlianxian series, 0.5 ppm Deltamethrin, 8 ppm fenitrothion and 10 ppm malathion. Provided that the damaged rate reduction of wheat was used as reference index evaluating the control effect, the wheat treated with Anlianxian Series came up to 94.9 – 98.7%, achieving the same control effects of 0.5 ppm deltamethrin, 8 ppm fenitrothion and 10 ppm malathion. At the same time the control effect of 0.04% Guchongjing treatment was only 26.4%

Results of Anlianxian Series treating paddy

The grain temperature curves of various treatments during the field trails were drawn in Figure 2. And the curves of insect pest amount variations in each treatment bulk were shown in Figure 3

From Figure 2 it could be seen that the grain temperatures were between 8.3 – 34.8℃ in the field trail period, at the beginning stage the temperature of control was lower than that of treatments, but the next year it became higher than the treatments gradually.

As shown in the Fig 3, the number of insect pests (mainly including *Sitophilus zeamais*, *Rhizopertha dominica* and *Cryptolestes*) in control bulk was almost still much larger than that of treatments. In every trapping it was all over 10 heads /2 hrs. From the second ten days of April, 1996, the number of pests arose dramatically and after 10 months amounted to 556 heads/2 hrs The damaged rate of grain accounted up 14.67%, with the result that the grain temperature arose obviously On August 20 the controls were fumigated with aluminium phosphide

In paddy treated with No 1 Anlianxian the maximum number of insect pests was only 14.5 heads/2 hrs on August 23, 1996 The number of insect pests was below 5 heads/2 hrs for 9 months and the damaged rate of paddy was only 0.5% for 10 months, reaching 96.6% control effect. In paddy treated with No. 2 Anlianxian the maximum number of trapped insects was 34 heads /2 hrs The number of insect pests was less than 5 heads/2 hrs for 8 months and the damaged rate of paddy was only 1.67%, attaining 88.6% control effect In paddy treated with No. 3 and No 4 Anlianxian the largest numbers of insect pests were 49.5 heads/2 hrs and 150.5 heads/2 hrs, respectively. The number of insect pests was below 10 heads /2 hrs for 8.5 months It was also found from investigations that there were innumerable *Psocids* in the control bulk while the number of *Psocids* in treated paddy bulks was 82 – 376 heads /2hrs. It followed that these botanical protectants also showed inhibition action on population formation of *Psocids*. Comparing the four protectants for controlling *Sitophilus zeamais*, *Rhizopertha dominica*, and *Cryptolestes*, the order of control effect was No 1 Anlianxian > No. 2 Anlianxian > No. 3 Anlianxian > No 4 Anlianxian.

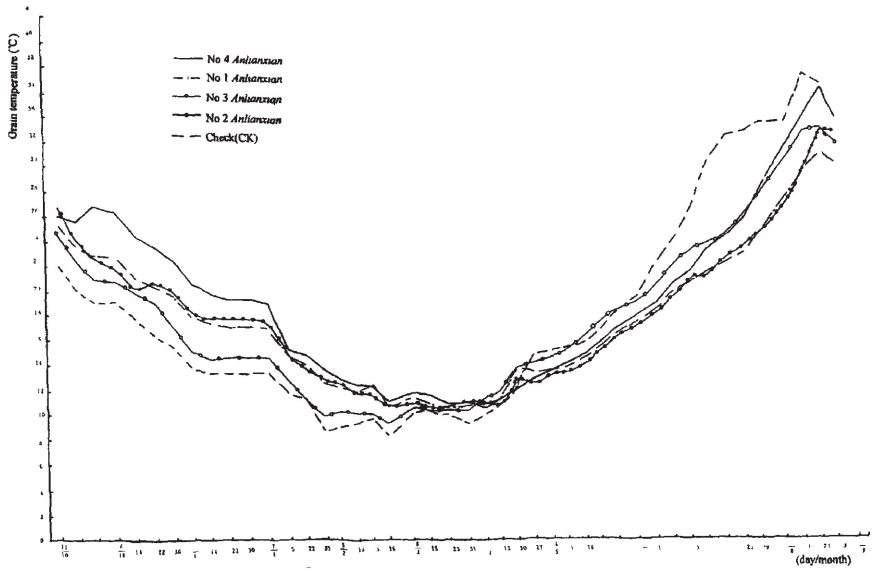

Fig.2. Temperature variation plot of rice (treated at Shili Grain Distribution station in Jinmen City from Oct , 1995 to Sep., 1996).

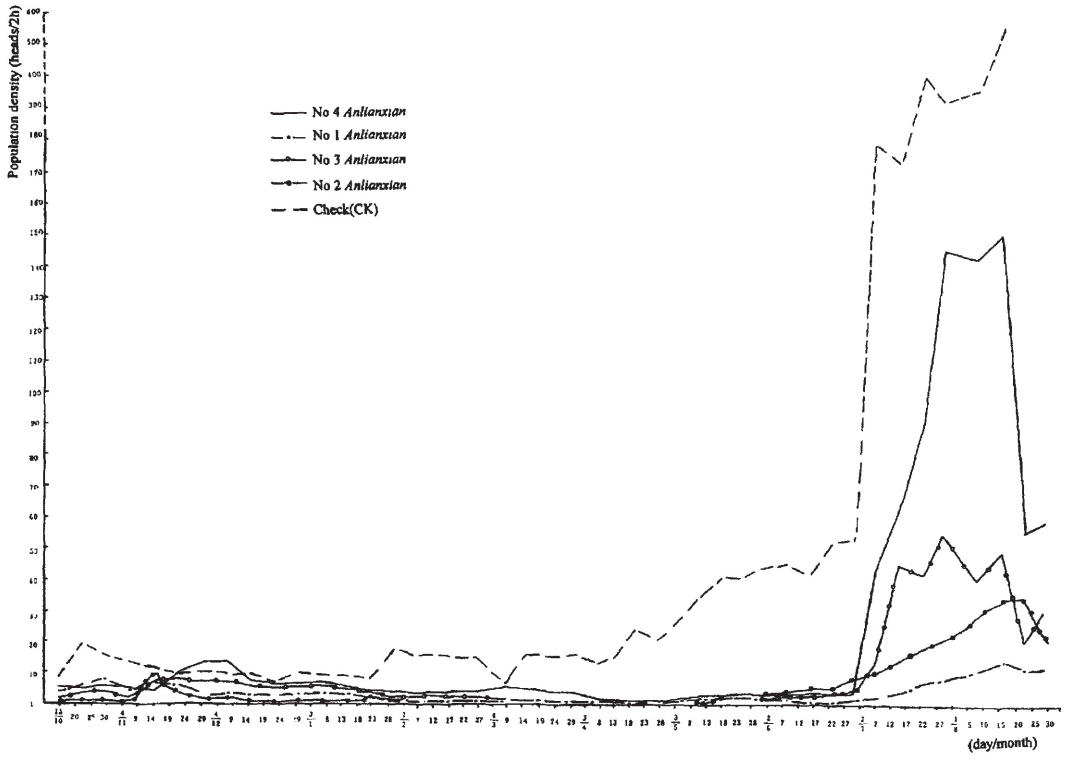

Fig.3. Number varation plot of pests in the rice barns(treated from Oct , 1995 to Sep., 1996)

Note: ①The number of pests included *Sitphilus zeamais*, *rhizopertha Dominica* and *Cryptolestes*, excluding the number of *pyemotes*
②As the population density in the control barn was too high, the control barn was fumigated and treated with aluminum phoshide on August 20, 1996

Conclusion and Discussion

The expanded experiments and field trails have demonstrated that for controlling of stored grain insect pests No. 1 Anlianxinan had the best effect. It could inhibit the population of *Sitophilus zeamais*, *Rhizopertha dominica* and *Cryptolestes* effectively. In the experiments of wheat during 7 months the total number of insect pests trapped was only 17.5 heads, decreasing 97.3% in comparison with the control and 96.9% compared with 0.04% Guchongjing treatment. In field trails of paddy the number of insect pests was below 5 heads /2 hrs for 9 months. The damaged rate of paddy was only 0.5%, and the control effect was 96.6% after 10 months.

The botanical grain protectant No. 1 Anlianxian is characteristic of cheap cost, safety to human and animals, no pollution to the stored grain and lasting control effectiveness. For these reasons, No. 1 Anlianxian is greatly worth popularising and applying.

For No. 5, 6, 7, 8, 9, 10, 11 Anlianxian, it is necessary to carry out the field trails so as to further demonstrate the control effectiveness.

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