REPORT ON RESEARCH OF RICE CROP PRETECTION FROM INSECTS IN VIETNAM, 1968-1969

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I. Introduction

Rice borers, leafhoppers and planthoppers have been found disastrous to rice crop throughout the rice-producing areas of South Vietnam. The infestation of these pests is closely connected with climatic conditions and multiple farming system. The writer have had an opportunity to study on the ecology of these pests and their control with chemicals in the pest two years in Vietnam. The results are presented below:

II. Study on ecological environment of rice borers

Rice borers are the common old enemy of rice in Southern Asia, and are considered rather rampant in other countries too. The seasonal outbreak of the borers is connected with three factors, namely, weather, preference of host plants and environmental conditions. Methods of control have become a serious problem as rice production program is being accelerated in Vietnam.

According to the ecology of the rice borers, the environmental conditions are more important than that of the weather climate, particularly in the Delta rice areas. The relative outbreak of rice borers in Vietnam is given in detail below:

Three species of rice borers are found in Vietnam, namely, paddy borer, *Tryporyza incertulas*, striped rice stem borer, *Chilo suppressalis*, and pink stem borer, *Seasmia inferens*. Besides rice the pink stem borer also attacks the corn, sugarcane, and sorghum, becasuse it belengs to omnivorous habits and has a better chance of survival and multiplication than monophagous paddy borer and oligophagous striped rice borer. Usually borers cause damage. The insects penetrate into the leaf sheath and crowed between the stem and leaf sheath, chewing tissues of rice stems and thus resulting the plants withered. The notable symptoms are "dead heart" at the tillering stage and "white head" at the heading stage. These symptoms, however, were rarely found in the last rice crop season, particularly in the Delta provinces.

After field study of the problem, the writers are of the opinion that the environment of Southern is not favorable for the multiplication of rice borers. The writers have found out that the high level of water in the paddy field during the raining season is fatal to their exsistance. Large quantities of the larvae would have been drowned before their

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getting into the leaf sheath.

The dry season during winter and spring when most of the land are desolated also helps check the spread of the insects. At this time, the borer would find it difficult to survive the long drought without host plants in the field, and its population should be drastically reduced. Some larvae could pupate in the old rice stubbles or old rice stems but the emergincing adults would face the same problem of having no host plants for laying eggs. The hot tropical temperature above 30°C would somewhat reduce hatching.

III. Observation in the outbreak of leafhoppers and planthoppers

Leafhopper and planthopper are increasingly regarded as major insects for rice crop in the rice-growing countries. Records showed that as high as 30-50% loss in rice crop was inflicted by green leafhopper in central Vietnam during 1960-1963. In recent years, hopper were found prevalent in central lowland in the summer of 1969. The new IR-8 variety seems more susceptible to them. Some 2,000 hectare of the rice crop in Phan-Rang area suffered a loss of 10-15%, while another 30 hectares suffered a total loss at harvest. The leafhoppers commonly found in Vietnam are rice green leafhopper, *Nephotettix bipunctatus cincticeps*, zigzag striped leafhopper, *Inazuma dorsalis*, and white winged leafhopper, *Erythroneura subrufa*, belonging to the family Cicadellidae. Planthoppers are such species as brown planthopper, *Nilalaparvata lugens*, white-back planthopper, *Sogatella furcifer*, and yellow planthopper, *Nilaparvata bakeri*, belonging to the family Delphacidae and flour planthopper, *Nisia atrovenosa* of the family Meenoplidae. The *N. bakeri* and *N. atrovenosa* were newly recorded in Vietnam. These insects damage the rice plants either by direct sucking of stem juice, which may results in loss of plant vigor or complete wilting of the plants, or by transitting virus diseases such as *Transitory yellowing*, *Yellow dwarf* and *Dwarf* or *stunt*, chiefly through *Nephotettix* spp., and *Grassy stunt* is transitted by *N. lugens*.

The outbreaks of the leafhoppers and the planthoppers are depending largely on climatic and environmental conditions. Generally, these are more prevalent in central provinces than southern provinces. Planthoppers may become abundant this year, while in other year, leafhoppers may take its turn under favorable conditions.

Results of studies indicate that white-back planthopper is most adaptable under 29-30°C temperature and 80-85% humidity, and the brown and yellow planthoppers under a lower temperature and a higher humidity. This explains why the hoppers have been rarely reported in Delta region where temperature is usually higher. The depth of water in the paddy field and the velocity of wind, which help check the spread of the pests in tillering stage, bear upon their population, which is generally higher in panicle and or heading stages than the tillering stage. Even the population is out of control, there is not much loss inflicted in the rice yield, though the quality of the grain may be affected. Investigation reveals that new varieties such as IR-8 and IR-5 are more susceptible to hoppers than local varieties. For sample, serious outbreak of the pests has been found to cause heavy damage to IR-8 and IR-5 in the rice areas of Phan-Rang, Nha-Trang and Long-Xuyen

this summer.

IV. Studies on the ecology of white-back planthopper in 1968

The tropical climate and environment in Vietnam are most suitable for the multiplication of the white-back hopper, *Sogatella furcifera*. It produces up to sixteen (16) generations in a year. The degree of infestation varies from year to year, but generally it is high in wet season and low in dry and hot season. According to studies made during the year of 1968, the pest caused more damages to rice plants during the differential stage than the tillering stage, because at the latter stage, its multiplication is easily interrupted by external factors such as strong wind velocity, long sunny hours, high water level, etc. The damage of rice plants in irrigated fields where the water is usually at a low level more serious than that in ordinary fields.

V. Investigation on the population dynamics of newly-hatched nymphs of rice planthoppers

This investigation started in mid-April 1969 at the GVN Plant Protection Service aimed at determining relationship between climate and seasonal outbreak of the pests. IR-8 rice variety was used as the host plant. Nine investigations were conducted on the population dynamics of the newly-hatched nymphs. Count was made of all eggs which were completely hatched. According to the data, average number of nymphs found ranged from 4.7 to 17.8 per stem and reached a peak in mid-May. *N. lugens* were found more prevalent than *S. furcifera* probably due to climatic factors. The following table shows results of the investigations:

Population dynamics of newly-hatched nymphs of rice planthoppers, *Nilaparvata lugens* Stal, in 1969

Date of sampling rice stems	No. of rice stems surveyed	Date of newly-hatched nymphs	Hatching duration (days)	No. of hatching nymphs (total)	No. of newly-hatched nymphs/rice stem
4/14	60	14—27/IV	13	580	9.7
4/22	60	25/IV—6/V	13	442	7.4
4/30	60	4—11/V	7	284	4.7
5/ 8	60	11—20/V	9	467	7.8
5/17	60	18—25/V	8	1,070	17.8
5/28	60	28/V—3/VI	6	265	4.4
6/ 2	60	3—15/VI	8	385	6.4
6/ 9	60	10—19/VI	99	257	4.3
6/16	60	17—26/VI	9	596	9.9

IV. Studies on the evaluation of granular insecticides and foliar spray against rice planthoppers of both *N. lugens* and *S. furcifera*

The tests were conducted in the Plant Protection Service from 1968 to 1969, and were dealing with immersing method and pot method. Several kinds of granular insecticides and foliar spray were used in these tests for comparing their effectiveness against rice planthoppers, *S. furcifera* and *N. lugens*.

1. Methods and Materials

1968 Pot tests on nymphal stage were 12 treatments and one check. The New IR-8 variety was cultivated on June 6, in pots of 789.2 cms in size and each pot had 12 hills. The rate of application was at 1.8 kgs of active ingredient per hectare. Insecticides were applied on June 26, 20 days after transplanting, when the population density of eggs was very high. The number of newly-hatched nymphs were determined one time before treatment and 4 times after at 2-day, 13-day, 20-day, and 28-day intervals. One hill of rice plants was taken at random out of each pot with their roots free of soil. Althogether, there were 13 hills. The rice plants of each hill were then transferred into a glasscylinder set up on a large dish filled with water to keep them fresh for about a week. The number of newly-hatched nymphs every day was counted until all eggs had completely hatched. The percent control was computed by using Abbott's formula.

2. Results

According to the data, Thimet, Solvirex, Terracurp-p, Dolmix, Unden, Disyston and Lebaycid gave excellent effectiveness against newly-hatched nymphs of the white-back planthopper. The percent control of thses insecticides ranged from 94.4%-98.6%. There was no significant difference among them, but Sevidol and Ortho Buk were only less effective than others. Gamma BHC, Diazinon and Dol gave inferior rsults. Although Dol was also a gamma isomer of BHC, it was the least effective. Results are given in the following table:

Effectiveness of granular insecticides against nymphal stage of *Sogatella furcifera* at tillering stage in 1968

Treatment	Formulation	Percent control after treatment				
		2-day	13-day	20-day	28-day	Mean
Thimet	10 G	97.2	99.1	99.1	99.0	98.6
Solvirex	5 G	94.6	99.5	98.1	98.8	97.6
Terracur-P.	10 G	94.5	99.4	99.0	98.8	97.9
Dolmix	6—3 G	96.8	99.3	98.5	95.5	97.5

Unden	5 G	96.8	96.5	98.1	97.8	97.3
Disyston	10 G	91.6	99.1	99.9	99.5	96.3
Lebaycid	5 G	88.2	98.1	93.8	97.4	94.4
Sevidol and rBHC	8—8 G	94.1	97.5	85.2	77.5	88.6
Ortho Bux	6 G	33.3	81.0	84.9	91.5	72.7
Gamma BHC	6 G	70.0	94.9	75.9	22.2	65.8
Diazinon	10 G	88.8	8.8	4.8	23.5	31.3
Dol	6 G	19.5	1.5	− 33.3	58.4	11.5

3. Methods and Materials

1969 Pot tests on the nymphal stage were 13 different treatments with certain insecticides and one check in the experiments. The rice variety was the same as former trials and was cultivated into the pot on June 1.3 The size of pots was same as above ones and each pot had 7 hills. The rate of application was at 2.0 kgs of active ingredient per hectare during tillering and was at 4.0 kgs. of active ingredient per hectare during the differential stage of rice plants. The former application was on July 4, 21 days after transplanting, and the latter applicatin was on July 24, 20 days after the first application when the population density of the nymphs of this hopper was more abundant than that of the adults in each time. The number of insects one hill was determined before and after applying insecticides in each treatment. A glass vessel is used to catch insects. The top of glass vessel was filled with the tie of fine cotton to prevent the nymphs and adults from escaping. The number of insects were killed with a glass vessel in the poison bottle before counting them. The percent control of the insects was computed by using the above-mentioned method in each treatment.

4. Results

According to the percent control of the pests, Solvirex, Disyston, Diazinon, Lebaycid, S6625, Unden, Thimet, Dyfonate, Sevidol, Terrcur-p and Temik have been proven to be about equal in effectiveness against this pests, Ortho Bux was only superior to gamma BHC which was found to be the least effective against this pest as shown in the following table:

Percent control of nymphal stage of *N. lugens* after treatment in 1969

Treatment	Formulation	First application					Second application			Mean
		No. of nymphs					No. of nymphs			
		Before	After	% control	After	% control	Before	After	% control	
Solvirex	5 G	16	0	100.0	0	100.0	95	0	100.0	100.0
Diayston	10 G	37	0	100.0	0	100.0	45	1	98.1	99.4
Diazinon	10 G	30	0	100.0	0	100.0	74	2	97.4	99.1
Leveycid	5 G	22	0	100.0	0	100.0	56	6	96.6	98.9
S6625	5 G	45		96.2	0	100.0	89	2	93.4	96.5
Unden	5 G	22	0	100.0	1	85.4	5	0	100.0	95.1
Thimet	10 G	92	0	100.0	2	93.3	73	7	90.8	94.7
Dyfonate	5 G	19		95.5	1	98.3	104	15	86.2	93.3
Sevidol & rBHC	8—8G	44	0	100.0	1	99.3	7	2	73.2	91.1
Terracur-P	10 G	27	3	90.8	24	72.4	135	8	94.4	95.9
Temik	10 G	33	6	84.4	149	81.4	99	23	78.8	81.5
Crtho Bux	10 G	22	2	92.2	1	85.4	20	13	40.0	72.5
Gamma BHC	10 G	38	11	75.2	64	45.7	109	110	4.8	41.9
Check		30	35	—	93	—	158	164	—	—

The results revealed that population dynamics of their nymphs and adults were generally increased with exception of gamma BHC and Temik treatments, because the rice plants in these treatments were already destroyed by the hopper as well as in the untreated pot, but the population of nymphs was still higher than that of adults in each treatment, particularly significant on September 13 and 17, 1969. The number of nymphs in Diazinon, Lebaycid and Dyfonate treatment were highest due to their residule effects being shortest among these insecticides. The symptoms of insect infestation on the rice stems slightly occurred in those treatments. The number of nymphs in S6625, Terracur-p and Sevidol treatments was only lower than above insecticides, but insect infestation of rice stems in those treatments was never found. Disyston, Solvirex, Unden and Ortho Bux have been found to be superiour over the other insecticides in controlling this pest. They limited the multiplication of the hoppers throughout the duration of rice growing in the experiments as shown in the following investigations:

Population dynamics of nymphs and adults in various treatments

Treatment	Formulation	Number fo insects per hill after treatment							
		1/IX		8/IX		13/IX		17/IX	
		Nymphs	Adults	Nymphs	Adults	Nymphs	Adults	Nymphs	Adults
Disyston	10 G	0	5	1	1	0	0	6	3
Solvirex	5 G	19	5	0	0	0	0	13	2
Unden	5 G	10	5	0	0	0	0	24	2
Ortho Bux	10 G	4	3	2	6	67	0	34	3
Thimet	10 G	2	6	4	4	139	1	61	3
Terracur-P	10 G	2	2	6	2	140	1	103	7
S6625	5 G	33	6	9	5	121	5	119	8
Sevidol	8—8G	5	6	7	4	44	0	158	6
Diazinon	10 G	6	8	17	7	257	4	206	3
Lebaycid	5 G	20	15	14	7	294	4	251	4
Gamma BHC	10 G	—	—	—	—	—	—	—	—
Temik	10 G	—	—	—	—	—	—	—	—
Check		—	—	—	—	—	—	—	—

—=All rice stems died during survey

5. Materials and Methods

1969 Foliar spraying tests on nymphal stage were conducted with twelve kinds of insecticides as to as compare their wn effectivness against the hoppers. There was 12 different treatments and one check in the experiments. Rice variety used was the same and was cultivated into pots on July 7, 1969. Each pot had 7 hills. Insecticide spray was applied on August 20 and was repeated on September 10, when the population of nymphs was more abundant than that of adults each time. Dosage of each insecticide spray was 0.05% of active ingredient after dilution in water in each spray. The dosage of application completely covered all parts of rice plants. The process of counting the number of insects and analysing results was carried out by using the same method as mentioned above.

6. Results

The average percent control of the nymphal stage in the first application ranged from 46.7% to 99.2% and in the second application from 3.9% to 94.0%, They indicated that Brdin, Eithion, Sevin and different forms of Dimethoate were more effective in early stage of rice plants than in late stage of the crop against this pest. Unden, Ortho Bux, Barusil and Lebaycid were superior to other insecticides at various stages of rice growing. They were about equal in effectiveness. S6358, Nexion and Dipterex have been found to be the least effective against the pests. Results are given in the following

Percent control of nymphs with foliar spray in 1960

Insecticide & concentrate used at 0.05%	Formulation	First application				Second application		
		Percent control of nymphs after treatment				Percent control of nymphs after treatment		
		5 days	13 days	21 days	(av.)	5 days	10 days	(av.)
Bidrin	27 E.C.	80.4	91.2	97.3	89.6	43.3	− 50.8	− 3.9
Barusil	25 E.C.	55.1	78.1	77.1	70.1	96.4	74.8	85.6
S6358	25 E.C.	50.8	37.9	81.5	56.7	74.4	61.2	67.3
Nexion	25 E.C.	55.8	49.4	85.9	60.8	21.3	82.5	52.1
Dimethoate	25 E.C.	73.0	91.4	81.9	82.1	97.3	52.4	72.9
Lebaycid	50 E.C.	93.7	73.1	79.5	87.8	80.4	88.7	84.6
Ethion	44 E.C.	94.1	100.0	99.5	97.9	80.1	4.0	22.1
Ortho Bux	54 E.C.	77.4	37.9	96.0	70.4	100.0	72.0	86.0
Unden	50 W.P.	100.0	100.0	99.9	99.2	100.0	88.3	94.0
Sevin	50 W.P.	100.0	97.2	98.0	98.4	100.0	− 15.9	40.5
Dimethoate	50 W.P.	83.8	82.5	90.7	85.7	85.7	− 27.7	10.4
Dipterex	95 W.P.	30.1	52.5	57.5	46.7	31.7	− 84.0	26.3

7. Materials and Methods

1968 Tests on the egg stage were conducted twice in the greenhouse. The first series of tests were on June 25, and the second series of tests on July 15, 1968 Althogether, 12 kinds of insecticides were used to test their effectiveness against egg stage of *S. furcifera*. Samples of oviparious rice stems of each treatment were taken from outside and immersed into a glass jar of 45 cms in size containing insecticides diluted in 2.000 cc. of water. The rate of application was at 1.8 kgs. of active ingredient per hectare. Each sample consisted of 3 rice stems. These stems were kept in the jar for one day then transferred individually to glass cylinder set up on small dishes, examination and analysis were the same as the pot tests.

8. Results

The percent control of hatched eggs ranged from 37.7 to 95.3 in the twice tests. It indicated that Thimet, Lebaycid, Unden, Disyston, Dolmix, Solvirex, and Terracur-P gave excellent effectiveness in controlling this stage, there was no significant difference among them. Sevidol, Diazinon and Ortho Bux were less effective. Gamma BHC and Dol have been proven to be poor results, but Dol was the least effective one in the trials as shown in the following table:

Comparative effect of granular insecticides against egg stage at the tillering stage of rice plants in 1968

Treatment	Formulation	No. of newly hatched nymphs before treated		No. of newly hatched nymphs after treated		Percent control for ready hatched eggs		
		25/VI	25/VII	25/VI	15/VII	25/VI	15/VII	(av.)
Thimet	10 G	74	131	6	0	91.5	99.0	95.3
Lebaycid	5 G	71	149	5	5	92.8	95.4	94.1
Unden	5 G	83	160	8	3	89.9	97.9	93.9
Disyston	10 G	94	182	9	3	88.8	97.7	93.3
Dolmix	6—3 G	89	143	6	11	82.4	98.9	90.7
Solvirex	5 G	82	145	11	5	86.0	95.1	90.6
Terracur-P	10 G	90	156	10	9	86.9	91.8	89.5
Sevidol	8—8 G	53	154	7	30	89.2	72.4	80.8
Diazinon	10 G	59	154	19	5	65.6	90.8	78.2
Ortho Bux	10 G	31	126	11	13	62.9	85.4	74.2
Gamma BHC	6 G	77	133	25	45	66.0	52.7	59.4
Dol	6 G	119	138	39	97	65.7	9.7	37.7
Check (untreated)		67	146	64	103	—	—	—

9. Materials and Methods

1969 Tests on egg stage used were the dosage of active ingredient for each of 13 chemicals being 1.6 grams diluted in 2,000 cc. of water. Samples of oviparious rice stems were selected at random from rice pots in the wire-crcened cage when eggs laid on them 4 days after. The freshly-rooted rice stems of 35 days old after transplanting were immersed into the dilution of each insecticides for a duration of 5 days. These treated rice stems were then transferred into a glass cylinder placed on a small dish with water supplied every morning. The number of newly-hatched nymphs were counted 2-10 days after treatment. Also counted was the mortality of eggs by checking under dissecting microscope 10 days after.

10. Results

The relative effectiveness of these insecticides was dependent on the number of newly-hatched nymphs. It revealed that Terracur-P, Thimet, Ortho Bux Dyfonate and Solvirex were about equal in effectiveness and were superior to other ones. S6625, Diazinon, Lebay-cid and Unden were sightly effective, but Cyolane was the least effective. Results are given below:

Mortality of eggs after treatment in 1969

Treatment	Formulation	1st Rep.		2nd Rep.		3rd Rep.		Mortality (av.)
		N o.of mortality of eggs/stem	No. of newly-hatched nymphs/stem	No. of mortality of eggs/stem	No. of newly-hatched nymphs/stem	No. of mort-ality of eggs/stem	No. of newly-hatched nymphs/stem	
Gamma BHC	10 G	x	3	x	2	x	0	—
Terracur-P	10 G	0	0	41	0	0	0	13.7
Thimet	10 G	36	0	0	0	0	0	12.0
Cyolane	10 G	0	9	58	8	44	0	34.0
S6625	5 G	41	2	36	0	16	0	41.0
Diazinon	10 G	0	2	64	0	85	0	49.7
Lebaycid	5 G	31	3	35	0	0	0	22.0
Disyston	10 G	25	0	20	0	67	1	37.5
Unden	5 G	0	2	0	0	60	1	20.0
Ortho Bux	10 G	94	0	53	0	77	0	74.7
Dyfonate	5 G	45	0	33	0	80	0	52.7
Sevidol	8—8G	x	0	x	0	x	0	—
Solvirex	5 G	44	0	22	0	24	0	30.0
Check		0	48	17	94	0	203	—

x=All rice stems died during survey.

11. Materials and Methods

1969 Tests on mature stage of nymphs were divided into two parts: First to test the residual effects of granular insecticides and second to test the accumulative effects of the insecticides.

1) The first test was dealing with 13 kinds of granular insecticides to find out their effectiveness against the mature stage of nymphs of *N. lugens*. The dosage of the insecticides used was the same as above method. Samples of rice stems used were 35 days old after sowing in the pots. Every 3 rice stems was immersed into the dilution for 32 hours before transferred into the glass cylinders which were placed on the small dishes. Inoculations of mature nymphs were made in 3 times-30 hours, 54 hours and 126 hours afterwards. The mortality of nymphs was counted 19 hours later after each inoculation.

12. Results

The relative residual effects of the insecticides may be arranged in the order as shown below:

Comparative effect of granular insecticides against egg stage at the tillering stage of rice plants in 1968

Treatment	Formulation	No. of newly hatched nymphs before treated		No. of newly hatched nymphs after treated		Percent control for ready hatched eggs		
		25/VI	25/VII	25/VI	15/VII	25/VI	15/VII	(av.)
Thimet	10 G	71	131	6	0	91.5	99.0	95.3
Lebaycid	5 G	74	149	5	5	92.8	95.4	94.1
Unden	5 G	83	160	8	3	89.9	97.9	93.9
Disyston	10 G	94	182	9	3	88.8	97.7	93.3
Dolmix	6—3G	89	143	6	11	82.4	98.0	90.7
Solvirex	5 G	82	145	11	5	86.0	95.1	90.6
Terracur-P	10 G	90	156	10	9	86.9	91.8	89.5
Sevidol	8—8 G	53	154	7	30	89.2	72.4	80.8
Diazinon	10 G	59	154	19	5	65.6	90.8	78.2
Ortho Bux	10 G	31	126	11	13	62.9	85.4	74.2
Gamma BHC	6 G	77	133	25	45	66.0	52.7	59.4
Dol	6 G	119	138	39	97	65.7	9.7	37.7
Check (untreated)		67	146	64	103	—	—	—

2) The second test was the same as above one except that rice stems were immersed into the dilution of each chemical for a duration of 21 hours before transferred into the glass cylinder. Mortality of the number of mature nymphs was counted at intervals of 4 hours, 48 hours and 72 hours.

13. Results

The percentage of mortality was particuarly high-ranged from 20.0 to 97.1% when counted 48 hours after inoculation as compared with 16.0% in check. With exception of Cyolane, Diazinon and gamma BHC, all insecticides seem to have equally accumulative toxicity in this stage as shown in the following table:

Accumulative toxicity of various chemicals in controlling nymphs in mature stage

Treatment	Formulation	No. of nymphs inoculated	Percentage of nymphs in mature stage			
			4-hours after inoculated %	48-hours after inoculated %	72-hours after inoculated %	Mortality % (Total)
Terracur-P	10 G	85	16.5	83.5	0	100.0
Thimet	10 G	116	16.4	82.0	1.6	100.0
S6625	5 G	86	12.8	83.7	3.5	100.0
Ortho Bux	10 G	87	15.0	85.0	0	100.0
Dyfonate	5 G	101	12.9	87.1	0	100.0
Solvirex	5 G	84	21.6	78.4	0	100.0
Disyston	10 G	114	13.2	85.1	0	98.8
Sevidol	8—8 G	89	16.5	82.3	0	98.8
Unden	5 G	97	22.7	69.8	0	92.5
Lebaycid	5 G	86	20.9	74.4	3.5	98.8
Gamma BHC	10 G	82	15.9	44.6	8.5	69.0
Diazinon	10 G	115	13.2	21.1	29.0	63.3
Cyolane	10 G	105	17.6	20.0	9.5	47.1
Check		85	14.7	16.0	0	30.7

VII. Summary

The seasonal outbreak of the rice borers, leafhoppers and planthoppers is generally associated with climatic weather and environmental conditions. According to the ecological environment of these pests in Vietnam, the relative outbreak and their damage made to rice plants is concerned with the basic environmental conditions which are more important than weather throughout the year, wheras their infestation of rice plants in central Vietnam is more serious than in Southern Vietnam. Especially the outbreak of the leafhoppers, *Nephotettix* spp., and planthoppers, *Nilaparvata lugens* and *Sogatella furcifera* is more abundant than that of the rice borers, namely, *Tryporyza incertulas*, *Chilo suppressalis*, and *Sesamia inferens*. The new varieties of IR-5 and IR-8 are more susceptible to these pests than local varieties. The damage of rice plants in irrigated fields is more serious than that in ordinary fieldss where the water level is usually high.

Several kinds of granular insecticides were tested against various stages of *N. lugens* and *S. furcifera*, namely, egg, newly-hatched nymphs and mature nymphal stages. All granular insecticides with exception of gamma BHC, Temik, Cyolane, Diazinon and Sevidol were all effective against these stages. The relative effectiveness of the insecticides under discussion appeared to have been more or less influenced by their own residual effect and

varied in different stages of the hoppers.

Foliar spray was tested with twelve kinds of insecticides in the mature stages of nymphs. Bidrin, Ethion, Sevin and different forms of Dimethoate have been found to be effective in tillering stage of rice plants for controlling the pests. Unden, Ortho Bux, Barusil and Lebaycid were superior to other ones in controlling the pests in various stages of rice growing. They were about equal in effectiveness. However, S6358, Nexion and Dipterex have been found to be the least effective against the pests.

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IX. References

1. Britton, G. L. Nguyen-Van-Dam & Tao. C. H. (1962): Preliminarly observation on ecology of rice leafhopper, *Nilaparvata bipunctatus* cincticeps and white-back planthopper, *Sogatella furcifera* and their control measures in Vietnam. Plant Prot. Bull. 4(1): 1-10.
2. Tao. C. H. (1963): Preliminarly report on the investigation of rice leafhoppers and planthoppers and their control measures at Chia-Yi, in Taiwan in 1962. Plant Prot. Bull. 5(2): 90-98.
3. Tao. C. H. (1967): Studies on the outbreak's factors of striped rice stem borer, *Chilo suppressalis* in Taiwan from 1954 to 1965. Plant Prot. 8(4): 407-436.
4. Tao. C. H. (1967): Discussion on the problem of rice production and rice pest control in Taiwan from 1953 to 1966. Res. Asso. of Food and Agric. Vol. 9 : 16-21.
5. Tao. C. H. (1967): Discussion on the problem of forecasting outbreaks of some major rice pests in Taiwan. Res. Asso. of Food and Agric. Eco. Vol. 13: 15-20.
6. Tao. C. H. Studies on the outbreaks of paddy borer *Stryporyza incertulas* in Taiwan. (manuscript)
7. Tao. C. H. Studies on the outbreaks of brown plant-hopper, *Nilaparvata lugens* in Taiwan. (manuscript)
8. Tao. C. H. (1968): Studies on the ecology of white-back planthopper, *Sogatella furcifera* in Vietnam, (manuscript)
9. Tao. C. H. Report on insecticide field test for controlling brown planthopper, *Nilaparvata lugens* in Taiwan, 1962-1968. (manuscript)
10. Lew Gideon T. & Lieu. H. Y. (1964): Example of rice borer forecasting in Taiwan. The major insect pest of rice plant. The Inter. Rice Res. Insit. pp. 195-210.
11. Miyashita. K. (1963) :Outbreaks and population fluctuation of insects, with special reference to agricultural insect pests in Japan. Bull. of the Nat. Inst. of Agric. Sci. (Series

C). 5: 100-170.

12 Mochida. O. (1964): On oviposition in the brown planthopper, *Nilaparvata lugens* (oviposion and environmental factors with special reference to temperature and rice plant). The Bull. of K. Expt. Agric. Station. 10: 257-258.

1968-1969越南稻作害蟲之研究報告

摘　要

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越南水稻螟蟲，稻葉蟬類及稻飛蝨類等之發生對於季節氣候與環境均有相互密切之關係，按其在越南發生環境，據筆者研究結果，其蔓延猖獗之趨勢，認爲環境因子較氣候因子尤爲重要。因此，中越水稻區以適宜蔓延滋生，而構成嚴重之災害時有所聞。但湄公河三角洲水稻區之環境，鮮有聞其爲害成災者。在稻作害蟲中以黑尾葉蟬（*Nephotettix spp.*）及褐飛蝨（*Nilaparvata lugens*）及白背飛蝨（*Sogatella furcifera*）爲害較螟蟲熾烈。螟蟲包括：一點螟蛾（*Tryporyza incertnlas*）條化螟（*Chilo suppressallis*）紫螟（*Sesamia inferens*）等。稻飛蝨類之爲害水稻品種間，亦有顯著差異，其中以 IR—8 及 IR—5 等品種遭其爲害較當地品種慘重。

粒狀劑防治褐飛蝨（*N. lugens*）及白背飛蝨（*S. furcifera*）等卵期，甫孵化之若蟲及老熟之若虫等期，其中除RIBHC, Temik, Diazinon & Sevidol 外均獲顯著成效。至於有關防治成果，亦顯有差別，其中首推藥劑間殘效作用時間及飛蝨類生育不同時期而影響互異。

殺蟲劑噴射試驗防治褐飛蝨之老熟若蟲時期，各藥劑間防治效果，對於水稻生育不同時期，亦有顯著差異，例如 Bidrin, Ehtion & Sevin 及不同性狀之 Dimethoate 均在水稻分蘖時期防治褐飛蝨之老熟若蟲期最有效，但在水稻孕穗及抽穗兩期無效 Unden, Ortho Bux, Barusil & Lebaycid 防治褐飛蝨老熟若蟲期，無論在水稻分孕穗及抽穗期均獲相似成果。偶有在水稻期防治成效上略有差異，對於各藥劑間殘餘作用，頗有相互密切之關係，甚至於水稻生育不同時期，亦有互相密切之關係。茲據本試驗結果顯示 S6538, Nexion 及 Dipterex 等防治成效最劣。

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**越南植物保護所昆蟲組主任。