STUDIES ON THE RICE BORER ATTACKING RICE PLANTS IN KAFR EL-SHEIKH REGION

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INTRODUCTION

Rice, Oryza sativa L. is considered to be one of the main exported crops from Egypt after cotton beside using the rice grains for human consumption, this crop gives many products such as rice bran, rice germ and rice oil. Unfortunately, during the last decade this crop is liable to be attacked by the rice stem borer Chilo agamemnon Bles., that is considered the most important pest causing a great annual losses for this crop. Moreover, the chemical control of this pest is very difficult to be applied accoding to the larval behaviour as it bores inside the rice plant after hatching until emerging as an adult. Therefore, the seek for other control measures such as agricultural practices are found to be inevitable. Hence, for reducing the bores attack this work was conducted at the Faculty of Agriculture, Kafr El-Sheikh Governorate during four seasons; 1974, 1975, 1976 and 1977 for the following objectives :

1. To find out the relative susceptibility of seven rice varieties for the rice stem borer infestation .

2. The effect of sowing date, method of cultivation and seedling spacing at transplanting on the rice stem borer infestation .

3. The relationship between some levels of nitrogenous, phosphorous and potassium fertilizers on the rice stem borer infestation .

4. The convenient date of harvesting for removing the majority of the full grown larvae inside the rice straw .

5. The distribution of the rice stem borer larvae in both rice straw and stubbles which were cut at different levels to find the adequate length of the rice stubbles that could be left after harvesting and harbour the lowest number of the hibernated larvae .

6. The fate of the hibernated larvae which left inside rice stubbles after harvesting .

I. REVIEW OF LITERATURE

Many investigators studied the rice stem borer, Chilo agamemnon Bles. (= Chilo suppressalis Wlk. = Chilo simplex Bult.) from many aspects. It was recorded as a pest of several graminaceous crops in different countries .

1. Effect of rice variety on the rice stem borer infestation:

Goot (1925) observed that bearded varieties were more susceptible than unbearded ones .

Kuwana (1929) found that tall varieties with soft stalks and deeply coloured are most readily attacked by Chilo simplex.

Nakayama (1929) stated that Chilo simplex prefers rice varieties that have thick stalks .

Shen and Shen (1934) found that the borer caused great loss, chiefly to the medium-late and late varieties. They added that strain which formed heads ten days later than the other strain, was even less damaged.

Kawada (1942) found a high correlation between infested stems and the number of eggmasses. He recorded direct correlation between the number of eggmasses and the quick growth of stems and leaves and length, width and hardness of leaves. No correlation was existed between leaf colour and the number of eggmesses laid .

Wada (1942) observed that no correlation was found between leaf colour and number of stem borers eggs laid on them.

Fukaya (1947) and Jodon and Ingram (1948) observed that the stem borer incidence was positively correlated with the size of the stalks, in (1950), he found that the survival rate of the stem borers larvae was affected considerably by varietal differences .

Seko and Kato (1950 a and 1950 b) attributed the resistance of some varieties to the difficulty that larvae encountered in boring within the stem because of thick scleranchymatous tissues, close vascular bundles and narrow lumen .

Painter (1951) stated that " in practical agriculture, plant resistance represents the ability of a certain variety to produce a large crop of good quality than do ordinary varieties at the same level of insect population ".

Koshiary et al. (1957) concluded that the resistance to stem borers was polygenic .

Okamoto and Ale (1958) found that wide and long leaves, a large number of tillers per hill and tallness rendered plants more susceptible to stem borers .

Israel et al. (1959) found that the correlation between the number of tillers and the percentage of borer-

attacked tillers at the early seedling stage and that of white heads at the heading stage was negative .

Kanno (1962) stated that the distribution of the larvae of Chilo suppressalis during the various stages of their development on rice plants in the field is not random, each plant showed differential attractiveness to them .

Tamura and Suzuki (1963) reared the larvae of Chilo suppressalis on steam-sterilized seedlings of rice varieties. They found that the pupal weight was greater on later-than on early heading varieties and on heavy-ear than on multi-ear varieties .

Djamin and Pathak (1967) mentioned that there was a positive correlation between the number of eggmasses and the percentage of dead hearts and the number of larvae per plant .

Israel (1967) observed that in hybrids of Iswarakora (resistant) x Pishanam (susceptible) cross, the incidence ranged from 2.0 to 80.0 percent, while the resistant parent recorded 1 percent infestation. In the hybrids of two resistant varieties, Co. 25 x Iswaracora, the incidence ranged from 0.5 to 1 percent. This indicated that the hybrids of such cross combination could be screened and exploited for hybrid vigor .

Munakata and Okamoto (1967) mentioned that stems of heavy tillering varieties were resistant to borer attack because of the recovery of **lost** tillers by succeeding vigorous tillers .

Patankamjorn and Pathak (1967) stated that varieties with hairy leaf surface were less infested than the glabrous varieties .

Pathak (1967) stated that, in general. Indica varieties were more susceptible during dead heart formations than Japonica varieties, but this distinction did not exist during white head formations; many Japonicas became even more susceptible than **I**ndica varieties. He also stated that the weight of the plants, length and width of flag leaf and diameter of the stalk and pith were all directly correlated with the percentages of infested tillers. Tall varieties with bigger stems and wider leaves were more susceptible . There was no correlation between infestation and thickness of the stem walls indicating that the thickness of the walls did not adequately prevent the larvae from boring inside the plants. The percentages of infested tillers were negatively correlated with the number of tillers per hill and larval survival was significantly lower on resistant than on susceptible varieties .

In Egypt, El-Nahal et al. (1970) studied the varietal resistance of rice plants to the rice stem borer, Chilo

agamemnon . They found that no significant degree of resistance among the different varieties could be detected at high level of the borer population. Adding a high level of nitrogen fertilizer decreases varietal resistance in both national and international varieties. The local varieties Nahda and Giza 159 were less infested than the international varieties such as French 3 and Italy 36, but variety Sabeni was more infested .

Pathak et al. (1971) found that the susceptibility of most varieties appeared to be positively correlated with the preference of the moths for oviposition. Only a few varieties that were preferred for oviposition also had antibiosis effects on the hatching larvae . Susceptibility to the borer was positively correlated with plant height, width and length of flag leaf , size of culm, glabrous leaf blades and lossness of the leaf sheath round the stem.

Oliver et al. (1972) evaluated the resistance of 100 rice lines attacked by Chilo plejadellus Zk., they found that the mean percentage of stems damaged ranged from 0 to 98 and was 75 for the commercial variety Saturn. Generally, they found that lines with late panicle formation had fewer stems damaged and fewer larvae than lines with early formation .

Pathak and Dyck (1973) found that the integration of insecticidal control with varietal resistance offers the

best possibility, and the number of frequency of insecticidal treatments depends largely on the level of resistance passessed by a given variety .

Lee et al. (1974) tested a group of varieties for resistance to Chilo suppressalis . They found that there was a small difference between the larval weights on seedlings seven days old, but on plants 60 days old, weights were less in the resistant variety than in the susceptible one .

Das (1976) stated that larvae on susceptible varieties had higher survival and growth and were more injurious than those on resistant ones .

2. Effect of certain agricultural operations on the rice stem borer infestation :

A) Date of sowing :

Hussain (1928) stated that in the early sown crop , the damage varied from 28 to 68.4 percent. He found 37 borers hibernating in the stubbles of the early sown crop, while in late sown crop there were as many as 352 in 1000 stubbles .

Kuwana (1930) recommended the late transplanting as a control method for the stem borers .

Seko (1954) stated that egg-masses were numerous in rice transplanted from nurseries which were sown late, and supplied with much nitrogenous fertilizer .

Ishikura (1956) found that the moths of both the over-wintered and first generation of Chilo suppressalis appear later in parts of Japan in which rice is transplanted later. Therefore, late transplanting can be used as a mean of reducing the crop damage .

Oho and Kiritani (1961) showed that since the introduction of early planting in Japan, the two generations of Chilo suppressalis have tended to overlap, possible because some insects of the second generation emerge early . Breeding experiments indicated that early planting reduced the period of larval development in the first generation by ten days, but retarded larval development and increased the percentage of diapausing in the second generation .

In Egypt, Bishara (1966) stated that the date of sowing nurseries or age of seedlings at transplanting did not show any effect on the percentage of rice stem borers in 1963 . The result may be attributed to the low level of the borer infestation in that year .

Kiritani and Iwao (1967) mentioned that in several countries delaying seedling and transplanting have been practiced effectively to evade the first generation moths.

Tsutsui et al. (1967) stated that the first generation of Chilo suppressalis caused considerably less damage to transplanted rice on 1st or 15th of May than to that transplanted in early June. They added that the first generation

of the borer caused much less damage in plots that were seeded directly in April and May than in transplanted rice, but this was considered to be due to the use of unsuitable plants , which showed poor growth because of lack of fertilizer . Damage by the second generation was severe in the seeded plots .

El-Tantawy (1973) in Egypt, found no relationship between the degree of borer infestation and the dates of rice planting. He added that rice field sown during May were subject to relatively higher infestation than rice sown in April or June .

B) Method of cultivation :

Israel (1967) observed that stem borers attacked broadcasted as well as transplanted crops, but he added that the transplanted crop attracted the pest better because of its luxuriant growth .

Koyama et al. (1968) found that the rice stem borer Chilo suppressalis was less injurious in the directly sown fields than in transplanted ones .

Zaazou et al. (1971) in Egypt, stated that the percentage of infestation of rice by Chilo agamemnon was virtually the same in fields where the rice had been broadcast as it was in those in which it had been transplanted .

El-Tantawy (1973) indicated that transplanted rice was subjected to a relative higher infestation than broadcasted rice .

C) Hill spacing of seedlings at transplanting :

Israel and Rao (1962) mentioned that the borer incidence was significantly higher during the vegetative phase of the plant in the 12 x 12 -inch spacing and least in the 3 x 6 -inch spacing. They added that the infestation at the heading stage did not differ significantly in the above treatments .

El-Tantawy (1973) stated that the crowdness of rice hills in the field decreased the borer infestation .

D) Fertilization :

In different rice growing regions, many investigators studied the effect of the different doses and kinds of fertilizers on the rice stem borer incidence as follows :

Kuwana (1929) stated that heavy infestation by the rice borer follows the use of manure on the growing crop .

Kawada (1942) stated that ovipositional preference was positively correlated with the nitrogen absorbtion capacity of the rice varieties .

Ishikura and Wetanable (1955) determined the relationship between manuring and infestation by rice stem borer . There was no remarkable difference between low and high nitrogen plots in the infestation by first brood of the borer, but difference was significant in the second brood . Infestation also increased with increase nitrogen and potash application, but nitrogen seemed to cause borer infestation more than potash .

Ishii and Hirano (1950) mentioned that the greatest damage in the rice plant caused by borer larvae is frequently due to the increase of nitrogenous fertilizer applied to the crop. Their results indicated that all the diets composed of the rice plant stems grown in a low nitrogen soil had a marked effect on the growth of the rice stem borer larvae, where significant reduction in the larval weights was found as compared with high nitrogen levels .

Hirano and Ishii (1959) showed that the use of fertilizer containing phosphorous has little or no effect on the growth of the larvae of Chilo suppressalis on rice in Japan.

Sasamoto (1960) studied the relation between the silica content in rice plant and the stem borer infestation. He found that the silicated rice plants are resistant to the rice stem borer .

Nakano et al. (1961) reported that the infestation of the rice by Chilo suppressalis and the number of adults taken in the light-trap was found to be much greater in a distinct in which the soil and consequently the plants, had a lower content of silicon than in one about three miles away where the silicon content was higher .

Djamin and Pathak (1967) stated that, in general, the silica content of the nodal areas, which the larvae penetrated more readily, was lower than that of internodal areas. The high silica content interfered with the larval feeding, this was confirmed by observation of the larval mandibles ; those of larvae feeding on varieties with a high silica content were severely warn, whereas those of larvae feeding on varieties with a low silica content were not .

Khan (1967) stated that Chilo infestation was observed to increase with increased nitrogen and potash applications but nitrogen seemed to cause borer infestation more than potash .

Pathak (1967) observed that rice fields receiving high rates of nitrogenous fertilizer were preferred by stem borer moths for oviposition, and rice plants containing higher levels of nitrogen were more suitable for larval growth .

Pathak et al. (1971) stated that high silica content interfered with the feeding of the larvae of Chilo suppressalis by wearing out their mandibles and caused low larval

survival. The silica cells were large and densly distributed in resistant varieties, but small and sparsely distributed in susceptible ones .

Zaazou et al. (1971) stated that the infestation by Chilo agamemnon generally appeared to be increased by the use of nitrogenous fertilizers at rates in excess of 26 kg./feddan.

El-Tantawy (1973) showed that the borer infestation increased with the increase of nitrogen in the rice fields . The number of larvae found and the losses in rice yield due to infestation took the same trend .

E) Date of harvesting :

Dammerman (1915) revealed that large number of borers remain in the stubbles after rice is harvested in April and May . They pupate and moths emerge with the rains in the next season .

Kuwana (1929) showed that if the rice is harvested in early autumn and stacked, the larvae leave the straw and enter other graminaceous plants. Most of the larvae pupate in the straw but some migrate to neighbouring straw or rubbish.

F) Level of harvesting :

Kuwana (1929) found that, at harvest, the larvae were usually in the stems, 4 - 10 inches above soil. The majority of larvae were found in the straw and the minority in stubbles.

In Egypt, Metwally (1976) stated that the percentage of hibernating larvae in rice stubbles, gradually decreased as the harvest level was exactly at the soil surface, and vice-versa in straw .

3. Fate of rice stem borer larvae hibernated inside rice plant stubbles :

Harukawa (1935) found that larvae in both stubbles in the field and in heaps during hibernation were subjected to similar fluctuations. The death rate did not seem to be correlated with weather conditions during the coldest months (January and February), but it was high in year when the rainfall was abundant in April and very scanty in May and June .

Heshamul (1972) noticed that in west Pakistan the larvae of Pyralid borers hibernate in rice stubbles from November to March and occur in overlapping generations from April to August .

El-Tantawy (1973) mentioned that there was gradual decrease in the counts of the overwintering larvae in rice stubbles, whether the land was under fallow or under winter crops. He added that larval decrease due either to decay of the harbouring tissue or to the usual death of the larvae inside the stubbles .

II. MATERIALS AND METHODS

In the present investigation, the relationships between the rice stem borer Chilo agamemnon Bles. infestation and rice varieties, certain agricultural operations such as date and method of planting, hill spacing of seedling at transplanting, fertilization and date and level of harvesting were studied . Fate of hibernating borer larvae in rice stubbles during winter season was also studied .

1. Effect of rice variety on the rice stem borer infestation:

This experiment was conducted through three successive seasons; 1975, 1976 and 1977 . Each variety(Table 1) was transplanted in four replicates (each of 4 x 5 m^2) in completely randomized block design . Seedling spacing was 20 cm. between rows and 20 cm. between hills, and about three to four seedlings were used per hill . The rice plants were fertilized with ammonium sulphate, 20.5 % nitrogen (30 units / feddan) by two weeks after transplantation .

From each variety, nine, eight and four samples, each of 20 hills were taken at random during seasons, 1975, 1976 and 1977, respectively. No artificial infestation by the borer was made considering that the natural infestation is quite sufficient in such investigation . The following determinations were taken in each sample : the number of tillers in every hill were counted and they carefully dissected to determine the number of eggmasses , different larval instars and

pupae / 1000 plants and any symptoms of borer infestation to find out the percentage of borer infestation. Plant height, leaf colour and nature of leaf surface and some other morphological characters were also recorded .

Table 1. Tested rice varieties and dates of sowing and transplanting during three consecutive seasons; 1975 , 1976 and 1977 .

Season	Rice varieties	Date of sowing	Date of transplanting
1975	Giza 159, G.170, G.171, G.172, Nahda , Philipp.. IR 579 and Philipp.IR 1561	May 28	July 20
1976	G.159, G.170, G.171, G.172, Philipp. IR 579 and Philipp.IR 1561.	May 15	July 1
1977	G.159, G.170, G.171, G.172, Philipp. IR 579 and Philipp.IR 1561.	May 18	July 5

2. Effect of certain agricultural operations on the rice stem borer infestation :

A) Date of sowing :

This experiment was conducted during two successive seasons, 1975 and 1976. Giza 172 was sown in four plantations on first and mid May and on first and mid June in 1975, and 1976, respectively. The fourth plantation of the second experimental year was not applied .

Transplantation was occured about forty days from sowing date . Each plantation was replicated four times (each replicate 3 x 3 m^2). After transplanting by two weeks the rice field was manured with 30 units of nitrogen / feddan . Twelve samples were taken at random from every plantation . Every sample consisted of twenty hills (five hills from each replicate) which were also taken at random . Data were recorded for : plant height, average number of tillers / hill , rate of infestation, the number of larvae / 1000 plants and the percentage of white heads .

B) Method of cultivation :

Two methods of rice cultivation were used , broadcosting and transplanting in two successive seasons 1976 and 1977. Giza 172 was sown by both methods on May 15 and 25 for seasons 1976, and 1977 , respectively . Evey treatment was replicated four times, each 10 x 10 m^2 .

For trnasplanting method rice was transplanted on July 1 and 10 for 1976 and 1977, respectively. The experimental field was fertilized with 30 units of nitrogen/feddan after broadcasting by thirty days and after transplanting by two weeks . From the two methods of cultivation , seven samples were taken at random, beginning from August 10 until November 10 for season 1976, and from August 5 to November 5 for season 1977. Each sample contained 20 hills which were taken

at random and were carefully dissected to determine the plant height, percentage of infestation and the average number of eggmasses , larvae and pupae / 1000 plants . Also, the percentage of white heads were recorded through the later three samples .

C) Hill spacing of seedling at transplanting :

In this study, Giza 170 was sown on May 28 , 15 and 25 and transplanted on July 19, 1 and 15 for the three successive seasons 1974, 1975 and 1976, respectively. Three to four seedlings were planted in each hill. The spaces used between hills and rows were as follows : 20 x 10 , 20 x 20 , 20 x 30, 20 x 40 and 30 x 30 cm. for season 1974, and 20x10, 20 x 20 , 20 x 30 , 20 x 40 , 30 x 30 and 20 x 50 cm. for seasons 1975 and 1976. Each treatment was replicated four times (each 3 x 4 m^2) adopting randomized block design . Ammonium sulphate (20.5 % nitrogen) was added after transplanting by two weeks (30 units of nitrogen / feddan). Fourteen, nine and eight samples were taken at random from each treatment during the growing seasons of rice of 1974, 1975 and 1976, respectively . From each treatment, a sample of 20 Hills was taken and examined to estimate plant height, average number of tillers / hill , plants having any symptoms of borer infestation , the number of eggmasses, larvae and pupae/ 1000 plants and the percentage of white heads .

D) Fertilization :

Effect of kind and level of some fertilizers on the rice stem borer infestation was studied during two seasons of 1975 and 1976 . Giza 170 was sown on June 8 and May 5 and transplanted on July 23 and July 2 for season 1975 and 1976, respectively . The experimental field was divided into 36 plots (each of 4 x 5 m^2) for each season . The completely randomized block design was adopted. Nine treatments were conducted (Table 2), each was replicated four times for both season 1975 and season 1976. Four levels of ammonium sulphate (20.5 % nitrogen) and one level of both calcium superphosphate (15 % P_2O_5) and potassium sulphate (50 % potassium) were used as fertilizers for rice plants in 1975 and 1976 , respectively . Phosphorous and potassium compounds were added one day before transplantation, while nitrogenous compound was added two weeks after transplantation . Six and four samples, each consisted of twenty rice hills were taken at random from each treatment of season 1975 and 1976, respectively . Phants were carefully dissected to estimate the rate of borer infestation, average number of larvae / 1000 plants. Percentage of white heads and the average number of tillers/ hill were also recorded .

Table 2. The various levels of nitrogenous, phosphorous and potassium fertilizers / feddan, used during the two seasons 1975 and 1976 .

Treatment	Nitrogen	Phosphorous (kg.)	Potassium
1	0	0	0
2	15	0	0
3	15	15	0
4	30	0	0
5	30	15	0
6	45	0	0
7	45	15	0
8	45	0	24
9	45	15	24

E) Date of harvesting :

This investigation was done to study the distribution of the full grown larvae which hibernated inside the straw and stubbles . Giza 172 was sown on May 18 in four treatments, each was replicated four times (each replicate of 4 x 4 m^2) . The distance between hills and rows were 20 cm. for each. Rice field was fertilized by 30 units of nitrogen / feddan . Rice plants were harvested at five centimetres above the ground level in four consecutive dates with a week interval; October

22 and 29 and November 5 and 12 . Thousand from both straw and stubbles were taken at random (250 from each replicate) after harvesting . Then these straw and stubbles were carefully examined for the number of the full grown larvae in each .

F) Level of harvesting :

Two experiments were conducted in two successive years; 1976 and 1977 to study the relationship between the height of stubbles left in the ground after harvesting and the number of hibernoted borer larvae inside straw and stubbles. Rice variety of Giza 172 was sown on May 18 and 28 and harvested on October 22 and 15 of seasons 1976 and 1977, respectively . The heights of stubbles left in the ground were 0, 5, 10, 15 cm. above the soil surface . Every treatment was replicated four times (each 4 x 4 m^2) and the distances between hills and rows were 20 for each . Rice plants were manured by 30 units of nitrogen / feddan . Thousand from both straw and stubbles (250 from each replicate) were taken at random and carafully examined for the distribution of the hibernoted larvae inside straw and stubbles .

3. Fate of rice stem borer larvae hibernoted inside rice plant stubbles :

The aim of this investigation is to study the life of the remained borer larvae inside the stubbles and to find

out the beginning of activation of this borer . Hence, two experiments were carried out in two successive years, the first in the end of season 1975 and the beginning of 1976 and the second in the end of season 1976 and the beginning of 1977 . After harvesting the rice, about one feddan of the rice field was left fallow without any agricultural process. About 1000 hills were collected in the laboratory and caged in a wire screen cage (70 x 70 x 80 cm.). Three and four samples were taken at random every two months from seasons 1975/1976 and 1976/1977, respectively from both the field and laboratory . Each sample of 1000 stubbles (70 hills). Rice stubbles were dissected to count the survival larvae . The first resulted pupae and the emerged moths were also recorded by light trap in the field and laboratory observations .

III. RESULTS

The present study was made for testing the relative susceptibility of certain rice varieties to the rice stem borer infestation to be used as a guide for the plant breeders . Such agricultural processes were also detected to use the most efficient of them among the different methods used for decreasing the insect population . Also, the behaviour of the hibernating larvae in winter was detected to find the best way for eliminating the larval number .

1. Effect of rice variety on the rice stem borer infestation:

A) Season 1975 :

No significant differences were found for the borer infestation among Giza varieties but there were significant differences between Giza varieties and the other tested varieties which did not significantly differ .

Table (3) showed that the highest borer infestation was recorded for Giza varieties, while the lowest rate of infestation was found for Philippini varieties . Nahda variety had the moderate borer infestation . Furthermore, Giza varieties received the highest number of eggmasses and harboured the highest number of larvae / 1000 plants than Nahda and Philippini .

Table 3. Susceptibility of seven rice varieties to Chilo agamemnon infestation (sowing date, May 28th of 1975).

Rice variety	Av. length (cm.)	Av. No. tillers/ hill	% in- festation	Av. No./1000 plants			% white heads
				Eggmasses	Larvae	Pupae	
G. 159	87.60	11.40	10.04	4.4	13.2	2.9	2.7
G. 170	85.20	10.64	9.24	4.7	16.2	2.6	3.2
G. 171	95.30	10.38	11.02	4.3	19.3	3.8	2.4
G. 172	90.80	9.38	8.18	4.7	17.2	2.4	3.4
Nahda	86.20	12.00	5.93	0.9	10.7	0.5	2.4
IR 579	69.20	13.24	3.52	1.7	6.7	2.5	1.8
IR 1561	63.20	16.42	2.84	1.0	4.1	2.7	1.6

No significant differences were found between the number of larvae of Giza varieties, whereas there was a significant difference between the number of larvae of Giza varieties and the other tested varieties . No significant differences were recorded between the larvae of Nahda, IR 579 and IR 1561.

The most susceptible variety to C. agamemnon infestation was Giza 171 which had 11.02 % infestation and harboured 19.3 larvae / 1000 plants followed by Giza 159 , G. 170 and G.172 which had 10.04 , 9.24 and 8.18 % infestation and harboured 13.2 , 16.2 and 17.2 larvae / 1000 plants, respectively . On the other hand, the most resistant variety was Philippini IR 1561 which had 2.84 % infestation and harboured 4.1 larvae / 1000 plants followed by IR 579 which had 3.52 % infestation and harboured 6.7 larvae / 1000 plants . Nahda was relatively less susceptible rice variety which had 5.93 % borer infestation and 10.7 larvae / 100 plants .

Generally, Giza varieties were the longest and had the lowest tillering capacity . On the other hand, the shortest varieties were Philippini which possessed the highest tillering capacity .

There was a significant difference between the length and the average number of the tillers / hill of the rice plants .

A remarkable positive correlation between the average length of the rice plants and the degree of borer infestation was recorded .

Also, there was a negative correlation between the borer infestation and the average number of tillers / hill. Therefore, the highest borer infestation may be attributed to the length of rice plant and the average number of tillers / hill, i.e. Giza 171 is the longest and had a few number of tillers and the highest borer infestation and harboured the highest number of larvae / 1000 plants . On the other hand, Philippini variety IR 1561 was the shortest and had the highest tillering capacity , in the same time, it had the lowest percentage of infestation and harboured the lowest number of larvae / 1000 plants .

The highest number of pupae / 1000 plants was found for Giza 171 (3.8), while the lowest one was recorded for Nahda (0.5) . The other tested varieties had approximately the same number of pupae .

Statistically, no significant differences were found between the percentages of white heads of the tested varieties . Relatively, the highest percentage of white heads was found for Giza 172 followed by Giza 170. The moderate infestation was recorded for Giza 159, G.171 and Nahda , while the lowest one of white heads was found for Philippini.

B) Season 1976 :

Data in Table (4) clearly showed that there was a negative correlation between the number of tillers / hill for the tested varieties and the rate of borer infestation. In the same time there was a significant difference between the borer infestation of the tested varieties .

The highest number of tillers / hill was recorded for Philippini varieties IR 1561 followed by IR 579 as found in the previous season which received the lowest rate of borer incidence . On the other hand, the lowest number of tillers / hill was counted for Giza varieties which had a high level of borer infestation .

The highest degree of infestation was recorded for Giza 171 (15.31 %) followed by G. 159 (11.66 %), G. 170 (8.25 %) and G. 172 (7.71 %). On the opposite side , the lowest percentage of infestation was found for Philippini variety IR 1561 (4.80 %). This trend was nearly similar to that obtained during the previous season , 1975 .

Table 4. Susceptibility of six rice varieties to Chilo agamemnon infestation (sowing date , May 15th of 1976) .

Vice variety	Av. No. tillers/ hill	% in-festation	Av. No. / 1000 plants			% white heads
			Eggmasses	Larvae	Pupae	
G. 159	16.75	11.66	2.3	28.4	3.9	3.9
G. 170	17.82	8.25	1.4	29.6	4.0	1.7
G. 171	16.72	15.31	2.2	39.6	1.5	1.9
G. 172	18.88	7.71	2.0	26.3	3.7	1.8
IR 579	22.51	5.26	0.6	15.0	0.8	3.7
IR 1561	24.94	4.80	0.8	11.1	1.3	3.3

The number of eggmasses of the tested varieties was significantly differ . The lowest number was obtained for Philippini varieties; IR 579 and IR 1561, While the highest number / 1000 plants was recorded on Giza 159 and Giza 171 followed by Giza 172 and Giza 170 .

No significant differences were found between the number of larvae / 1000 plants of Giza varieties, but the number of larvae of these varieties was significantly higher than that obtained for Philippini varieties . Apparently, the same trend of the larval distribution which was recorded in the previous season, 1975 was obtained in 1976, where Giza 171 harboured the highest number of larvae (39.6 / 1000 plants) followed by Giza 170, Giza 159 and Giza 172 . On the other hand, Philippini varieties harboured the lowest number of larvae, i.e. IR 1561 (11.1 individuals / 1000 plants) followed by IR 579 (15.0 individuals / 1000 plants).

The highest number of pupae was recorded for Giza 170 followed by Giza 159, Giza 172 and Giza 171, while the lowest number of pupae was for IR 579 followed by IR 1561 .

No significant differences were recorded for the precentages of white heads of the tested rice varieties. The highest percentage was recorded for Giza 159 followed by the two Philippini varieties, which reached more than 3 percent . Then, the rate of white heads dropped to less than two percent for the other tested varieties .

C) Season 1977 :

Results obtained from Table (5) revealed that there were significant differences between the number of tillers / hill of the tested varieties . The two Philippini varieties had the highest average number of tillers / hill than that Giza varieties which possessed the lowest average number . From Giza varieties, G. 170 had the highest average number of tillers / hill followed by Giza 171 and Giza 159, while Giza 172 had the lowest tillering capacity .

There was a negative correlation between the average number of tillers / hill and the degree of borer infestation of the tested rice varieties .

Philippini varieties which had the highest average number of tillers / hill received the lowest borer infestation and the vice-versa was found in case of Giza varieties .

Table 5. Susceptibility of six rice varieties to Chilo agamemnon infestation (sowing date, May 18th of 1977).

Rice variety	Av. No. tillers/ hill	% infestation	Av. No. / 1000 plants			% white heads
			Eggmasses	Larvae	Pupae	
G. 159	17.63	11.55	3.5	25.5	3.1	1.9
G. 170	18.95	8.18	2.0	20.5	2.0	1.8
G. 171	17.78	13.15	4.2	46.4	3.5	2.8
G. 172	16.31	8.58	1.5	23.8	3.1	1.5
IR 579	22.00	6.31	0.6	15.3	1.1	1.2
IR 1561	23.69	5.75	0.5	13.2	1.6	1.5

Nearly, the same trend was found for the number of eggmasses, larvae and pupae / 1000 plants . Giza varieties received the highest number of eggmasses, while Philippini IR 579 and IR 1561 varieties received the lowest ones. The highest number of eggmasses was found for Giza 171 which harboured the highest number of larvae and pupae followed by Giza 159 .

Generally, the same trend was detected for the percentage of white heads as the highest degree of white heads was recorded for Giza varieties than Philippini .

From data obtained through three consecutive seasons, 1975, 1976 and 1977 , it could be concluded that Philippini varieties were relatively resistant to C.agamemnon attack where they received the lowest borer infestation, the lowest number of eggmasses, larvae and pupae / 1000 plants. The most susceptible rice variety was Giza 171 which exhibited the highest percentage of borer infestation and harboured the highest number of larvae followed by Giza 159.

This phenomenon may be attributed to the morphological characters of the rice varieties (Table 6). The most resistant Philippini varieties have short stems, high tillering capacity, light green leaf colour, tough hair leaf surface and narrow short leaves . On the other hand, Giza 171 represented the most susceptible variety which have long stems, low tillering capacity, dark green leaf colour, glabrous leaves, soft stems and long wide leaves .

2. Effect of certain agricultural operations on the rice stem borer infestation :

A) Date of sowing :

Rice plants were sown on different dates to find a suitable sowing date in which rice plants will have the lowest precentage of injury. Therefore, two experiments were conducted during two successive seasons, 1975 and 1976. The obtained results are summarized in Tables 7 & 8 .

Table 6. Morphological characters of the tested rice varieties .

Variety	Av. plant height	Tillering capacity	Stem hardness	Leaf colour	Nature of leaf surface	Leaf measurements	
						Length (cm.)	Width (cm.)
G. 159	87.60	11.40	Hard	D.green*	Glabrous	33.02	9.63
G. 170	85.20	10.60	Soft	D.green	Moderate	34.81	9.30
G. 171	95.30	10.40	Soft	D.green	Glabrous	36.89	9.77
G. 172	90.80	9.40	Hard	Green	Moderate	37.04	9.15
Nahda	86.20	12.00	Moderate	Green	Moderate	37.01	9.10
IR 579	69.20	13.20	Moderate	L.green**	Pubscence	27.52	9.07
IR 1561	63.20	16.40	Moderate	L.green	Pubscence	25.77	8.57

* D.green = Dark green .

** L.green = Light green .

1. Experiment of season 1975 :

Data in Table (7) clearly indicated that the late cultivations were liable to a heavy borer attack than the early ones. The highest borer infestation was recorded for rice plants sown on the first of June followed by that sown on mid June. On the other hand, the lowest percentage of infestation was found for rice plants sown on the first of May followed by that sown on mid May .

Table 7. Effect of sowing dates on the rice stem borer infestation (season 1975).

Sowing date	Av.length (cm)	Av. No. tillers/ hill	% infestation	Av. No. larvae/ 1000 plants	% white heads
1-5-1975	118.30	15.29	6.93	19.2	0.3
15-5	112.93	13.99	7.16	22.8	1.0
1-6	91.23	10.43	9.91	23.4	1.1
15-6	89.00	9.96	9.09	28.6	1.0

Nearly, the same trend of borer infestation was recorded for the percentage of white heads where the rice plants of the third cultivation received the heaviest borer injury (1.1 %), while the first cultivation exposed to the lightest injury (0.3 %) .

When rice sown in mid June, thousand of rice plants harboured the highest number of larvae followed by that planted on the first of this month. On the opposite side, rice plants of the early cultivation harboured the lowest number of larvae / 1000 plants followed by the second cultivation date .

Data also revealed that the average length of rice plants and the average number of tillers / hill were gradually decreased by lateing the sowing date .

2. Experiment of season 1976 :

Data obtained in Table (8) markedly revealed that rice plants of the third cultivation, sown on the first of June were subjected to the highest rate of borer infestation (8.66 %), furthermore, this plantation harboured the highest number of larvae / 1000 plants and suffered from heavy attack of white heads (1.8 %) . On the other head, the lightest percentage of infestation and white heads were recorded for rice plants sown on the first of May, meantime the lowest number of larvae was recorded / 1000 plants.

Also, as the previous season, the average length of rice plants and the number of tillers / hill markedly declined by delaying the sowing date .

Table 8. Effect of sowing dates on the rice stem borer infestation (1976).

Sowing date	Av.length (cm.)	Av. No. tillers/ hill	% infestation	Av. No. larvae/ 1000 plants	% white heads
1-5-1976	111.33	15.30	6.43	14.2	0.4
15-5	108.15	14.93	6.28	18.1	1.0
1-6	85.38	11.41	8.66	24.5	1.8

From forementioned results obtained during the two successive seasons, it could be concluded that rice plants sown during June were subjected to higher infestation than rice sown in May, while were subjected to the highest borer injury .

B) Method of cultivation :

Results obtained are shown in Table 9. Data clearly indicated that there was no obvious differences between the average length of transplanted rice and that broadcasted for both years 1976 and 1977, but transplanted rice was subjected to a higher degree of borer infestation than broadcasted one. The rate of borer infestations were 2.1 and 2.6 % for broadcasted rice and 5.9 and 5.6 % for transplanted one of seasons 1976 and 1977, respectively .

No differences were found between the infestation by C.agamemnon either by using broadcasting or transplanting method is season 1976 or 1977. Transplanted rice received the highest number of eggmasses, furthermore, transplanted rice plants harboured apparently two times of larvae and pupae than broadcasted plants during two seasons. The percentages of white heads had the same trend of larvae and pupae which were higher than broadcasted plants .

From the forementioned results, it could be concluded that transplanted rice plants were subjected to a higher rate of the borer's infestation and white heads than the broadcasted plants . Moreover, transplanted plants received higher number of eggmasses, larvae and pupae . This result may be due to a good and luxuriant growth of transplanted rice plants .

C) Hill spacing of seedling for transplanting :

The relationship between the hill spacing of seedlings at transplating and the infestation were studied . Results obtained were summarized in Tables 10, 11 and 12 .

Table 9. Planting methods and the borer's infestation .

Method of planting	Av. length (cm.)		% infestation		Av. No. / 1000 plants						% white heads	
					Eggmesses		Larvae		Pupae			
	1976	1977	1976	1977	1976	1977	1976	1977	1976	1977	1976	1977
Broadcast-ing	79.6	79.3	2.1	2.6	0.6	1.2	10.8	12.6	0.6	1.8	0.4	0.6
Trans-planting	80.8	78.9	5.9	5.6	1.3	2.2	27.4	28.9	1.3	2.2	1.0	0.8

1. Season 1974 :

Data in Table (10) clearly showed that there was a consistent increase in the percentage of borer infestation by increasing the hill distance until reached 20 x 40 cm. The rate of borer infestation increased from 5.7 % to 9.7% when the space increased from 20 x 10 to 20 x 40 cm., respectively. No increasing infestation was found in the widest space, 30 x 30 cm.

The previous trend of borer infestation was recorded for the number of larvae and pupae / 1000 plants where the smallest numbers were recorded at 20 x 10 cm., and the greatest was found at 20 x 40 cm.

Table 10. Spacing at seedling transplanting and the rice borer infestation (Season 1974).

Transplanting spacings cm.	Av. length	Av. No. tillers/ hill	% infestation	Av. No./1000 plants	
				Larvae	Pupae
20 x 10	95.80	13.50	5.70	12.9	3.2
20 x 20	97.10	16.20	8.90	16.1	3.3
20 x 30	90.60	20.40	9.60	20.1	4.2
20 x 40	98.50	20.40	9.70	24.4	5.8
30 x 30	97.00	19.80	8.80	23.9	3.8

The number of tillers / hill gradually increased until the distances between hills and rows reached 20 x 40 cm. No clear differences were observed between the height of rice plants when rice plants were transplanted at different spaces .

2. Season 1975 :

Data in Table (11) obviously indicated that the number of tillers / hill progressively increased by increasing the hill spacing although the differences between different treatments were not significant .

The rate of borer infestation did not significantly differ. The highest percentage of borer infestation was found for 30 x 30 cm. (11.92) while the lowest one was for 20 x 10 cm. (7.69) .

Rice plants transplanted at 20 x 10 cm. received the lowest number of eggmasses / 1000 plants (2.1) while the highest (7.0) was obtained for 30 x 30 cm., in this case rice plants harboured the greatest number of larvae (28.4/ 1000 plants). The highest number of pupae was recorded for the widest distance, 20 x 50 cm.

No significant differences were found between the percentage of white heads of the tested distances. The highest

percentage (2.5) was recorded for 20 x 20 cm., while the lowest rate (1.2) was obtained for 30 x 30 cm.

Table 11. Spacing at seedling transplanting and the rice borer infestation (Season 1975) .

Trans-plant-ing spacing (cm.)	Av. length (cm.)	Av. No. tillers/ hill	% in-festation	Av. No./1000 plants			% white heads
				Eggmasses	Larvae	Pupae	
20 x 10	71.19	8.33	7.69	2.1	19.1	0.0	2.3
20 x 20	73.81	11.09	9.60	4.8	17.5	2.1	2.5
20 x 30	73.24	13.92	8.93	5.1	19.0	2.5	2.0
20 x 40	72.45	15.16	9.70	2.7	17.1	0.8	2.3
30 x 30	77.33	14.31	11.92	7.0	28.4	2.9	1.2
20 x 50	76.28	15.31	8.76	5.8	14.6	3.8	1.4

Generally, from the present results it could be concluded that the wider hill space assist in growing excessive number of tillers / hill which associated with the highest rate of borer infestation and the highest number of eggmasses and larvae .

3. Season 1976 :

Results obtained are shown in Table (12) clearly indicated that the recorded data in the present season are

almsot similar to that obtained during the two previous years .

The number of tillers / hill, rate of borer infestation and the number of larvae / 1000 plants were progressively increased by increasing the distances between rows and between hills until reached the highest at 30 x 30 cm. However, no significant differences were found between the number of tillers / hill, rate of borer infestation and the number of larvae . The borer infestation at the heading stage did not differ significantly in the tested hill spacings .

Table 12. Spacing at seedling spacing at seedling transplanting and the rice borer infestation (Season 1976) .

Transplanting spacing (cm.)	Av. No. tillers/ hill	% infestation	Av. No./1000 plants			% white heads
			Eggmasses	Larvae	Pupae	
20 x 10	15.41	12.09	2.8	23.1	0.8	4.3
20 x 20	15.84	14.12	2.8	23.3	1.6	3.0
20 x 30	17.71	15.43	2.1	26.8	3.5	3.6
20 x 40	18.11	16.05	2.1	31.8	3.5	3.0
30 x 30	18.46	18.12	2.7	30.1	4.4	2.9
20 x 50	18.31	15.87	2.4	28.0	3.1	2.5

From the data recorded during the three successive seasons, it could be concluded that the tillering capacity

increased by increasing the hill spacings until reached 30 x 30 cm. The dense population of rice plants was the cause of a great decline in the rate of borer infestation and number of larvae and pupae harboured / 1000 rice plants.

D) Fertilization :

1. Season 1975 :

The effect of nitrogenous, phosphorous and potassium fertilizers on the degree of borer infestation, number of borer larvae / 1000 plants and the percentage of white heads were verified . The obtained results are tabulated in Table 13 .

(a) Effect of nitrogen :

Results in Table (13) clearly showed that the rice borer incidence increased steadly with the increase of supplied nitrogen dosages .

The highest level of nitrogen / feddan (45 kgs.) recorded the highest percentage of borer infestation as compared with the lower levels (15 and 30 Kgs.). Adding nitrogen to the rice plants increased in the degree of borer damage than that of non-nitrogen treatments . The percentages of borer infestation were 7.8, 10.1, 10.3 and 10.9 for 0, 15, 30 and 45 kgs. nitrogen / feddan. No significant differences

were found between the rate of borer infestation of the different treatments .

Table 13. Effect of some levels of three fertilizers on the rice stem borer infestation (Season 1975).

Treatments kgs./feddan			% infestation	Av. No. larvae/ 1000 plants	% white heads
N*	P**	K***			
0	0	0	7.8	14.5	1.5
15	0	0	10.1	23.7	1.3
15	15	0	7.5	24.8	0.6
30	0	0	10.3	26.2	2.0
30	15	0	10.6	28.7	1.4
45	0	0	10.9	29.3	2.8
45	15	0	10.4	19.6	1.8
45	0	24	12.6	25.8	1.7
45	15	24	10.2	15.7	1.5

* N = nitrogen .
** P = phosphorous .
*** K = potassium .

The number of larvae /1000 plants exhibited the same trend of borer infestation . Unmanured rice plants harboured 14.5 larvae / 1000 plants, while adding 15, 30 and 45 kgs. nitrogen / feddan increased the larval number to 23.7, 26.2 and 29.3 larvae / 1000 plants, respectively . Also, the differences between the larval numbers of the different treatments were not significant .

The percentage of white heads were 1.3, 2.0 and 2.8 % for fertilized rice with 15, 30 and 45 kgs. nitrogen / feddan, respectively as compared with 1.5 for unfertilized rice plants . No significant differences were found between the percentages of white heads of the different treatments.

(b) Effect of phosphorous fertilizer :

One constant level of phosphorous fertilizer (15 kgs./feddan) was used together with three levels of nitrogen (15, 30 and 45 kgs. / feddan). No significant differences were found between the percentages of borer infestation of the different treatments .

Generally, the presence of phosphorous compound plus nitrogen declined the degree of borer incidence as compared to treatments receiving nitrogen alone . The percentages of borer infestation were 7.5, 10.6 and 10.4 % for rice plants

treated with 15, 30 and 45 kgs. nitrogen, respectively in the presence of 15 kgs. phosphorous / feddan .

The number of borer larvae / 1000 plants were 24.8, 28.7 and 19.6 for 15, 30 and 45 kgs. nitrogen plus 15 kgs. P_2O_5 / feddan, respectively . No significant differences were recorded for the numbers of the different treatments supplied with phosphore .

It was clear that adding phosphorous compound to nitrogen material greatly declined the rate of white heads as compared with treatments receiving of nitrogen alone .

Increasing nitrogen level from 15 to 45 kgs. / feddan with the constant level of phosphorous fertilizer caused an increase in the percentage of white heads from 0.6 to 1.8 %, but the differences were not significant .

(c) Effect of potassium :

Treatment receiving 45 kgs. nitrogen plus 24 kgs. potassium / feddan was the most suitable for borer infestation (12.6 %) as compared with that received 45 kgs. nitrogen only (10.9 %) or unfertilized treatment (7.8 %).

Concerning to the larval number, it was found that treatment received nitrogen plus potassium harboured 25.8 larvae / 1000 plants, while that fertilized with 45 kgs. nitrogen only harboured 29.3 larvae / 1000 plants, but the difference was not significant .

Also, adding potassium plus nitrogen to the rice plants did not affect the percentage of white heads significantly, whereas the percentage decreased from 2.8 to 1.7 for treatments received 45 kgs. nitrogen alone and that received 45 kgs. nitrogen plus 24 kgs. potassium / feddan, respectively.

(d) Effect of nitrogen, phosphorous and potassium combination :

When rice plants were supplied with nitrogen (45 kgs.), phosphorous (15 kgs.) and potassium (24 kgs.) / feddan, received lower rate of borer infestation than rice plants treated with nitrogen plus phosphorous or nitrogen plus potassium . The degree of infestation of rice plants treated with combination of the three fertilizers was higher than nonfertilized treatment .

Almost similar finding was found when the larval number was taken into consideration as thousand rice plants fertilized with the three fertiliers together harboured the lowest

larval number than rice treated with nitrogen alone, nitrogen plus phosphorous or nitrogen plus potassium, but it was higher than nonfertilized rice plants .

The percentage of white heads declined by adding the three fertilizers together (1.5) than that of rice treated with nitrogen alone (2.8), nitrogen plus phosphorous (1.8) or nitrogen plus potassium (1.7). Using a combination from the three fertilizers together gave the same rate of white heads of nonfertilized treatment .

2. Season 1976 :

(a) Effect of nitrogen :

It was found that the higher levels of nitrogen (45 kgs. / feddan) gave a higher degree of borer attack as compared with the lower levels of this fertilizer (Table 14). When nitrogen was used the degree of damage overpassed significantly that of non-nitrogen treatment . The percentage of borer infestation steadly increased to 14.4, 15.0 and 17.2 after adding 15, 30 and 45 kgs. / nitrogen / feddan, respectively , while that of unmanured was 10.5 % . No significant differences were found between treatments receiving nitrogen alone .

Table 14. Effect of some levels of three fertilizers on the rice stem borer infestation (1976) .

Treatments kgs./feddan			Av. No. tillers / hill	% infestation	Av. No. larvae / 1000 plants	% white heads
N	P	K				
0	0	0	12.9	10.6	21.3	1.4
15	0	0	12.9	14.4	27.8	2.2
15	15	0	13.4	14.0	25.0	0.4
30	0	0	14.9	16.0	41.1	2.6
30	15	0	14.0	14.9	26.8	2.1
45	0	0	14.6	17.2	52.3	3.7
45	15	0	16.4	16.3	27.4	2.0
45	0	24	20.0	20.9	54.5	3.5
45	15	24	16.0	16.6	29.9	2.1

The previous trend was recorded when the larval number / 1000 plants was taken into consideration . There were significant defferences between the number of larvae of untreated rice plants and those treated with 30 and 45 kgs. of nitrogen /feddan, while the difference was not significant between untreated plants and that treated with 15 kgs. nitrogen / feddan . Thousand rice plants treated with the highest level

of nitrogen (45 kgs. / feddan) harboured the highest number of larvae (52.3) than that of rice treated with the lower levels (15 and 30 kgs. / feddan) which represented by 27.8 and 41.1 larvae, respectively . On the other hand, the lowest number of larvae / 1000 plants (21.3) was recorded for untreated rice field .

The percentage of white heads markedly increased when nitrogen was used, but no significant differences were found between fertilized and unfertilized rice plants . The percentage of white heads were 2.2, 2.6 and 3.7 % for rice treated by 15, 30 and 45 kgs. nitrogen / feddan, respectively as compared by 1.4 % for untreated rice plants .

Rice plants fertilized with high level of nitrogen showed a high rate of borer infestation than that fertilized with lower or unfertilized ones. This phenomenon probably could be attributed to the fact that adding nitrogen improved the nutritive quality of rice plants which is necessary for the borer development .

Also, the presence of nitrogen increased the tillering capacity which strongly associated with the high borer attack as previously mentioned when the relationship between density of rice plants and the degree of borer attack was

studied . It is very clear from Table (14) that the number of tillers / hill progressively increased by increasing the nitrogen level until it reached the highest number (14.6 tillers / hill) , when rice plants receiving 45 kgs. nitrogen / feddan . No significant differences were recorded between the tillering capacity of rice treated with the different levels of nitrogen and that untreated .

(b) Effect of phosphorous fertilizer :

A constant level of phosphorous (15 kgs. P_2O_5/ feddan) was added together with three levels of nitrogen (15, 30 and 45 kgs./feddan). Data obviously revealed that the presence of phosphorous compound with nitrogen decreased the rate of borer infestation as compared with treatments which received nitrogen alone . The percentages of borer infestation were 14, 14.9 and 16.3 % for rice plants treated with 15, 30 and 45 kgs. nitrogen / feddan respectively in the presence of 15 kgs. P_2O_5 for each nitrogen level . These percentages correspond with the high percentages of borer attack of 14,4, 16.0 and 17.2 % when 15, 30 and 45 kgs. of nitrogen were added alone respectively, but no significant differences were found between the degree of borer infestation of treatments treated with nitrogen plus phosphorous and that received nitrogen alone .

Adding phosphorous with nitrogen greatly reduced the average larval number of C.agamemnon to 25.0, 26.8 and 27.4 larvae when 15 kgs. of phosphorous were added to the above three levels of nitrogen respectively . The average number of larvae did not significantly differe between treatments receiving 15 and 30 kgs. nitrogen and that received the above two levels with 15 kgs. phosphorous, while a significant difference was found between rice treated with 45 kgs. nitrogen alone and that fertilized with the same level of nitrogen plus phosphorous .

Adding phosphorous to rice plants also declined the rate of white heads from 2.2 to 0.4, 2.6 to 2.1 and from 3.7 to 2.0 % when rice plants treated with 15, 30 and 45 kgs. nitrogen alone or plus phosphorous respectively. No significant differences were found between the percentages of white heads when nitrogen used alone or with phosphorous.

The tillering capacity was not affected when it was added with the low levels of nitrogen, 15 and 30 kgs. / feddan, while it affected the number of tillers / hill by using the highest level of nitrogen (45 kgs. / feddan).

(c) Effect of potassium :

Adding 24 kgs. potassium with 45 kgs. nitrogen / feddan increased the rate of borer incidence from 17.2 % in

case of nitrogen alone to 20.9 % when rice fertilized with nitrogen plus potassium, but the difference was not significant . The same trend was found for the number of larvae as the average number / 1000 rice plants slightly increased by adding potassium with nitrogen than that of nitrogen alone without no significance .

Concerning the percentage of white heads, it was found that a slight decrease was detected by adding potassium with nitrogen .

The number of tillers / hill for rice treated with potassium plus nitrogen was significantly higher than that of rice received nitrogen alone .

(d) Effect of nitrogen, phosphorous and potassium combination :

When rice field was fertilized with a combination of the three fertilizers used, the percentage of borer infestation was significantly lower than that of rice treated with nitrogen plus potassium. No significant differences were recorded between fields treated with the three fertilizers together and those treated with nitrogen alone or nitrogen plus phosphorous. Similar trend was observed when the larval number was taken into consideration

as the average larval number/ 1000 plants for rice treated with the three fertilizers together was significantly lower than rice treated with nitrogen alone or with nitrogen plus potassium, while no significant difference was found between treatment received the three fertilizers together and that fertilized with nitrogen plus phosphorous .

The percentage of white heads clearly declined by using the three fertilizers together than that of rice fertilized with nitrogen alone or nitrogen plus potassium .

E) Date of harvesting :

Table (15) obviously indicated that the percentages of borer larvae progressively decreased inside the straw as the date of harvest gradually being late .

When rice plants were harvested early on October 22nd, the larval percentage in the straw reached 27.1 %, then greatly decreased to about a half 13.0 % when the cutting date delayed three weeks until 12th November . On the other hand, the percentage of the hibernated larvae inside stubbles gradually increased by delaying harvesting . The lowest percentage of the full grown larvae inside stubbles (72.9) was recorded for rice plants harvested early on October 22nd, then gradually increased until reached the majority (87.0) on November 12th.

From the forementioned data, it seems that 27.1 % of the hibernated larvae removed inside the straw in the early date of harvesting (October 22nd) then it was decreased to 13.0 % in the late harvesting (November 12th) .

On the opposite side, the greatest percentage of larvae hibernated inside stubbles in the late harvesting date and remained in the rice field to the next season to start the following borer infestation .

Table 15. Distribution of larvae inside rice straw and stubbles harvested in four dates .

Harvesting dates	Larvae / 1000 plants		Larval percentage	
	Straw	Stubbles	Straw	Stubbles
22-10-1977	39	105	27.1	72.9
29-10-1977	25	124	16.8	83.2
5-11-1977	15	90	14.3	85.7
12-11-1977	15	100	13.0	87.0

Therefore it could be recommended that the rice plants might be harvested as early as possible with no more than five cms. above the soil surface .

F) Level of harvesting :

This experiment was carried out during two successive seasons, 1976 and 1977 to verify the adequate length of the rice stubbles that could be left after harvesting which harbour the lowest number of the full grown larvae . The results obtained are :

1. Season 1976 :

Table (16) showed that the percentage of hibernated larvae of the rice stem borer inside the rice straw gradually decreased from 42.6 % at Zero level to 4.8 % at 15 cm. level. On the other hand, the number of larvae inside the stubbles gradually increased from 57.4 % at Zero cm. level to 95.2 % at 15 cm. level . This reveals that when rice plants were harvested at the soil surface , the straw harboured 42.6 % from the total number of larvae leaving 57.4 % inside the stubbles . At 5 cm. level above the ground 15.7 % of the larvae were recorded inside the straw and 84.3 % in the stubbles . Increasing the length of the stubbles to 10 cm., 87.1 % of the larvae were found inside the stubbles, while only 12.9 % of them were counted inside the straw . When the cutting level reached 15 cm. above the ground, 95.2 % of the larvae recorded inside the stubbles leaving no more 4.8 % of them inside the straw .

Table 16. Percentage of the rice stem borer larvae inside the straw and stubbles harvested at different levels . (Season 1976) .

Harvesting levels (cm)	Larvae / 1000 plant		Larval percentage	
	Straw	Stubbles	Straw	Stubbles
0	52	70	42.6	57.4
5	19	102	15.7	84.3
10	16	108	12.9	87.1
15	7	139	4.8	95.2

2. Season 1977 :

Data in Table (17) clearly indicated that the results obtained during this season were similar to that recorded during the previous season .

The percentage of the full grown larvae inside straw persistently decreased from 36.5 at Zero cm. level to 10.1% when the stubbles reached 15 cm. above the ground . On the hand, the number of larvae markedly increased from 63.5 % at just above the soil surface to 89.9 % at 15 cm. level inside the stubbles . The majority of the borer larvae

(63.5 %) was found in the stubbles just at the soil surface, while the minority percentage (36.5 %) was recorded inside the straw . When rice plants were harvested at 5 cm. level above the ground, the higher percentage of the larvae (70.1%) was recorded inside the stubbles while the lower (29.9 %) was recorded inside the straw . At 10 cm. above the ground level, the larval percentage increased to 86.4 % inside the stubbles, while it declined to 13.6 % for the straw . When the cutting level reached 15 cm. above the ground, the majority of the larvae (89.9 %) were recorded for the stubbles leaving no more than 10.1 % inside the straw .

Table 17. Percentage of the rice stem borer larvae inside the straw and stubbles harvested at different levels (Season 1977).

Harvesting levels (cm)	Larvae / 1000 plants		Larval percentage	
	Straw	Stubbles	Straw	Stubbles
0	38	66	36.5	63.5
5	38	89	29.9	70.1
10	17	108	13.6	86.4
15	15	133	10.1	89.9

It could be concluded that when rice plants were harvested just above the soil surface, the greatest numbers of the hibernated larvae were removed from the rice field inside the straw .

It could be recommended that rice plants must be harvested at the lowest level as possible as the length of the stubbles might be no more than 5 cm. above the ground surface. This practice will guarantee many of the borer larvae that will be collected inside the straw and eventually will be killed by threshing, burning, pressing into bales or eating by animals .

3. Fate of rice stem borer larvae hibernated inside rice plant stubbles :

The main goal of this investigation is to study the fate of the hibernated larvae inside rice stubbles to estimate the survived larvae which pass the hibernation conditions and produce moths of the first borer generation in the next rice season .

Data in Table (18) markedly indicated that the number of the borer larvae progressively decreased during a period elapsed from the harvesting date until the beginning of the next rice growing season .

Table 18. Number of hibernated borer larvae / 1000 stubbles left on the fallow field and laboratory .

Inspection dates	No. of larvae / 1000 stubbles			
	Fallow field		Laboratory	
	1975/1976	1976/1977	1975/1976	1976/77
November 1st	40	52	41	48
February 1st	27	26	17	30
May 1st	20	22	21	24
May 15th	--	18	--	22

Forty and fifty two larvae were recorded / 100 stubbles on the beginning of November decreased to 27 and 26 larvae on the beginning of February of season 1975 / 1976 and 1976 / 1977 , respectively . Then the number of the hibernated larvae declined to 20 and 22 larvae on the beginning of May of 1975 / 1976 and 1976 / 1977 seasons respectively . On mid-May of season 1976 / 1977 only 18 larvae were recorded in the fallow field / 1000 stubbles .

The coninciding numbers of borer larvae in the laboratory were 41 and 48 on the beginning of November, declined to 17 and 30 on the beginning of February and 21 and 24 larvae / 1000 stubbles on the beginning of May of season

1975 / 1976 and 1976 / 1977, respectively, then the number of larvae declined to 22 larvae / 1000 stubbles of season 1976/1977 .

The initial pupation was occured on May 19th in the field and May 16th in the laboratory of both two seasons . The first moth emergence was recorded by light trap on May 23rd, while it was observed on May 28th in the laboratory of both seasons .

It could be stated that at 10 cm. above the ground level, 108 larvae / 1000 stubbles (87.1 %) were found when rice was harvested on October 22nd, 1976 (Table 16) . Table (18) showed that 18 larvae (34.62 %) from hibernated larvae were able to survive and emerged as moths from 1000 stubbles in the next jrowing rice season for season 1976 / 1977 under the fallow field conditions. The larvae constitute an important source of borer infestation in the following year . The average number of larvae / hill at harvest time was $\frac{108}{70}$ = 1.54 larvae, where 70 hills contain about thousand rice stubbles . Supposing that there are 105000 hills of rice plants / feddan. The hibernating larvae inside rice stubbles reached 1.54 x 105000 = 161700 larvae . The average number of moths which emerged from

one feddan of rice left fallow would be $\frac{161700 \times 34.62}{100}$

= 55980 moths. This number of moths will form the first borer generation on the new rice plants .

IV. DISCUSSION AND CONCLUSION

1. Effect of rice variety on the rice stem borer infestation:

In Egypt rice plants are usually attacked by the rice stem borer, Chilo agamemnon Bles. and its chemical control is very difficult as the larvae remain inside the plant until adult emergence. After hatching the larvae crawl to reach and live between the stem and leaf sheath for some time to feed on the inner surface of the sheath. Then, in the second and third instars, the larvae bore inside the stem. For this reason another control measure must be done. Therefore, the plant breeder has to put in consideration the varietal characteristics that must help in the field of plant resistance to injurious insects .

From the obtained results, obvious differences were found for the susceptibility to the rice stem borer infestation between the tested rice varieties . Philippini varieties, IR 579 and IR 1561 were found to be relatively resistant to the borer infestation, while Giza 171 and Giza 159 were the most susceptible varieties . Giza 170, Giza 172 and Nahda suffered from moderate borer infestation. This

result might be due to the morphological characters of these rice varieties . The most resistant Philippini varieties possess short stems, high tillering capacity and their leaves are short, narrow, pubescence and light green colour. On the other hand, susceptible variety such as Giza 171 possesses long stems, low tillering capacity, its leaves are long, wide, glabrous and dark green in colour . Attractiveness to egg laying was observed with the green and dark green varieties more than light green varieties having high tillering capacity which can tolerate the infestation by new shoots as it was observed for Philippini varieties . This result goes in accordance with the findings of Israel et al. (1959) , Munakata & Okamoto (1967) and Pathak (1967) as they mentioned that heavy tillering varieties were resistant to borer attack because of the recovery of last tillers by succeeding vigorous tillers, while it does not agree with that of Okamoto & Ale (1958). Kuwana (1929), Okamoto & Ale (1958), Pathak (1967) and Pathak et al. (1971) found that tall rice varieties were not readily attacked by this borer . Also, this finding did not agree with that of Goot (1925) as he mentioned that bearded varieties were more susceptible than unbearded ones . Okamoto and Ale (1958), Pathak (1967) and Pathak et al. (1971) confirmed this result when they indicated that varieties

of wide and long leaves were more susceptible to the stem borer . Kawada (1942) and Wada in the same year observed no correlation between leaf colour and the number of the stem borer eggs laid on them , while Kuwana (1929) found deeply coloured are most readily attacked .

2. Effect of certain agricultural operations on the rice stem borer infestation :

A) Date of sowing :

To avoid a heavy borer infestation to the rice crop , it was sown in four dates during seasons 1975 and 1976 . Results obtained revealed that late cultivations suffered from the heavy borer attack than the early ones . The highest borer infestation was recorded for rice plants sown on the first of June followed by that sown on mid of June . On the other hand, the lowest degree of attack was found for rice plants sown on the first of May followed by that sown on mid of May . For decreasing the heavy borer attack to the rice plants at Kafr El-Sheikh Governorate , it could be recommended that rice plants must be sown during the first half of May . Bishara (1966) mentioned that the sowing date did not exhibit any effect on the percentage of the rice stem borer infestation .

B) Method of cultivation :

From data obtained during two successive seasons 1976 and 1977 it was found that transplanted rice plants were subjected to a heavy borer attack, as the percentage of infestation, number of eggmasses, larvae and pupae / 1000 plants and the percentage of white heads greatly over-passed that recorded for broadcasted rice plants . This result may be attributed to luxuriant growth of transplanted rice plants which attracted more of the borer larvae . This finding agrees with that of Israel (1967), Koyama et al. (1968) and El-Tantawy (1973) they indicated that trans-planted rice was subjected to a relative higher infestation than broacasted rice . Zaazou et al. (1971) found that C. agamemnon attacked broadcast as well as transplanted rice .

C) Hill spacin of seedlings at transplanting :

From the results of three consecutive years 1974 , 1975 and 1976, pronounced differences were recorded between the tested distances between both hills and rows . When rice plants were transplanted in the narrower spaces 20x10 cm., the degree of borer infestation was relatively lower than wider spaces of 20 x 20 , 20 x 30, 20 x 40 and 30 x 30 cm. According to Israel and Rao (1962), the borer incidence was significantly higher during the vegetative phase of the

plant in case of 12 x 12-inch. spacing but it was less in 3 x 6-inch spacing. El-Tantawy (1973) mentioned that narrow distances of 10 x 15 cm., received lower borer incidence than wider spaces 15 x 20 and 20 x 30 cm., this might be interpreted by the fact that the crowded fields produce lesser vigorous plants and consequently less susceptible than rice plants transplanted at wider spaces .

D) Fertilization :

Rice plants fertilized with high levels of nitrogen showed an obvious high level of borer infestation than that manured with lower levels or unmanured ones . This phenomenon probably could be attributed to the fact that adding nitrogen improved the nutritive quality of rice plants which is necessary for the borer development . This finding agrees with many investigators such as Kuwana (1929), Kawada (1942), Ishii and Hirano (1958), Pathak (1967), Zaazou et al. (1971) and El-Tantawy (1973) as they mentioned that the greatest damage in the rice plant caused by borer larvae is frequently due to the increase of nitrogenous fertilizers supplied to the crop . They also found that nitrogenous fertilizers increase the succelence of the stem, thereby increasing the stem borer incidence . The results of this study obtained indicated that fertilizing the rice fields with phosphorous

and nitrogen together decreased the percentage of the borer infestation, white heads and the larval number / 1000 plants.

Rice plants receiving potassium plus nitrogen were more suitable to borer infestation than either nonfertilized or those treated with nitrogen plus phosphorous . Ishikura and Wetanable (1955) and Khan (1967) explained that borer infestation increased with increase of nitrogen and potash , but nitrogen seemed to cause borer infestation than potash. When rice plants were supplied with a combination of nitrogenous, phosphorous and potassium fertilizers together lower rate of borer infestation was recorded than rice plants treated with nitrogen plus potassium or the highest rate of nitrogen alone, meantime the degree of infestation of rice plants treated with this combination was higher than nonfertilized ones .

From the previous results , it could be concluded that in order to minimize the rate of the borer infestation , fertilization of the rice fields should be in the form of mixture of phosphorous, nitrogen and potassium, at the levels of 15, 45 and 24 kgs. / feddan , respectively .

E) Date of harvesting :

From the forementioned data, it seems that 27.1 % of the hibernated larvae were removed inside the straw in the early date of harvesting (October 22) decreased to 13.0 % in the late date (November 12) . On the other hand, the greatest number of the full grown larvae hibernated inside stubbles in the late date of harvesting and remained in the rice field to the next rice season . Metwally and Abd El-Rahim (1975) mentioned that the C.agamemnon larvae start to move downward towards the lower parts of the rice stubbles and roots to hibernate from the end of September and the beginning of October . Therefore, it could be recommended that rice plants must be harvested as early as possible, and the cutting level might be no more than 5 cm. above the soil surface .

F) Level of harvesting :

The obtained results exhibited that the majority number of the full grown larvae of the borer were removed from the rice field inside the rice straw which was cut just above the soil surface . The minority number was removed at 15 cm. above the ground level . On the other hand, at just above the soil surface, the lowest number was found inside the stubbles gradually increased until it reached 15

cm. above the ground. This was fully supported by the finding of Metwally (1976) who indicated that the percentage of the hibernated larvae inside the stubbles gradually decreased by decreasing the stubbles length and the vice-versa inside the straw . Kuwana (1929) found that at harvest the larvae were usually in the stems, 4 - 10 inches above soil . The majority of larvae were found in the straw and the minority in stubbles .

3. Fate of rice stem borer larvae hibernated inside rice plant stubbles :

The hibernated larvae progressively declined after harvesting until reached about less than fifty percent under the fallow field and laboratory conditions. The initial pupation was occured on May 19 in the field and on May 16 in the laboratory . The first moth emergence was recorded on May 23 in the field and on May 28 in the laboratory . At 10 cm. above the gound level, 108 larvae / 1000 stubbles (87.1 %) were found when rice was harvested on October 22 during season 1976 (Table 16). Data in Table (18) showed that 18 larvae (34.62 %) from 52 were able to survive and emerged as moths from 1000 stubbles in the next growing rice season under the fallow field conditions .

These larvae constitute an important source of borer infestation in the following year . The average number of larvae/ hill at harvest time was $\frac{108}{70}$ = 1.54, where 70 hills contain about 1000 stubbles . Supposing that there are 105000 hills of rice plant / feddan , the hibernating larvae inside rice stubbles reached 1.54 x 105000 = 161700 larvae . The average number of moths which emerged from one feddan of rice left fallow would be $\frac{161700}{100}$ x 34.62 = 55980 moths . This number of moths will form the first borer generation on the new rice plants . El-Tantawy (1973) indicated that there was a gradual decrease in the counts of the overwintering larvae in rice stubbles and he supposed that the average number of emerged moths from one feddan of rice left fallow would be 28607 moths .

S U M M A R Y

Rice, Oryza sativa (L.), is subjected to some insects in Egypt , specially the rice stem borer Chilo agamemnon Bles. which is considered the most important insect pest . To minimize the borer infestation under the economic level, some experiments were conducted in the Farm of the Faculty of Agriculture at Kafr El-Sheikh to study the effect of some rice varieties and some agricultural operations on the borer infestation . The following are the obtained results :

1 - Philippini varieties, IR 579 and IR 1561 were found relatively resistant to the borer attack, while Giza 171 and Giza 159 were the most susceptible varieties. Giza 170, Giza 172 and Nahda were infested by moderate infestation . This result may be attributed to the differences in the morphological characters of the tested rice varieties .

2 - The late cultivation suffered from the heavy borer attack than the early ones . The highest borer infestation were recorded for rice plants sown on the first of June followed by that sown on mid of June . The

lowest degree of borer attack was found for rice plants sown on the first of May followed by that sown on mid May .

3 - Transplanted rice plants were subjected to a heavy borer attack . The percentage of infestation, number of eggmasses, larvae and pupae / 1000 plants and the percentage of white heads for broadcasted rice plants greatly overpassed that recorded for transplanted rice plants .

4 - Pronounced differences were recorded for the tested distences between both hills and rows . When rice plants were trandplanted in the narrower spaces ; 20 x 10 cm., the degree of borer infestation was relatively lower than the wider spaces of 20 x 20 , 20 x 30 , 20 x 40 and 30 x 30 cm.

5 - Fertilized rice plants with high levels of nitrogen had higher infestation than that manured with the lower levels or unmanured ones . When rice received phosphorous (15 kgs,) plus nitrogenous (45 kgs.) fertilizers / feddan, the percentage of borer infestation markedly decreased . Rice plants received potassium (24 kgs.) plus nitrogenous (45 kgs.) fertilizers / feddan were more suitable to borer infestation than either nonfertilized ones or those treated by nitrogenous and

phosphorous fertilizers . When rice plants were supplied with a combination of nitrogenous (45 kgs.), phosphorous (15 kgs.) and potassium (24 kgs.) fertilizers / feddan together, a lower rate of borer infestation was recorded than rice plants treated with nitrogen plus potassium or the highest rate of nitrogen alone .

6 - It was found that 27.1 % of the hibernated larvae were removed inside the straw in the early date of harvesting, October 22, decreased to 13.0 % in the late date of harvesting, November 12. On the other hand, the greatest number of the full grown larvae hibernated inside stubbles in the late of harvesting and remained in the rice field to the next rice season .

7 - The majority number of the full grown larva of the borer were removed from the rice field inside the rice straw which was cut just above the soil surface. The minority number was removed at 15 cm. above the ground level . On the other hand, at just above the soil surface, the lowest number was found inside the stubbles gradually increased until reached the highest at 15 cm. above the ground .

8 - The hibernated larvae progressively declined after harvesting until reached about less than fifty percent under the fallow field and laboratory conditions. The initial pupation was occured on May 19 in the field and on May 16 in the laboratory . The first moth emergence was recorded on May 23 in the field and on May 28 in the laboratory . The number of moths which would emerged from one feddan of rice left fallow found to be 55980 moths for the next rice season .

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بسم الله الرحمن الرحيم

جامعة طنطا ـ كلية الزراعة بكفر الشيخ
قسم وقاية النبـــــات

الملخص العربى لرسالة الماجستير المقدمـــــة
من الطالب / محمـود رمـزى شـــــريف

عنوان الرسالـة : دراســـات على ثاقبـة الأرز التى تصيب الأرز فى محـافظة كفر الشيخ

Studies on the rice borer attacking rice plants in Kafr El-Sheikh region

يعتبر محصول الأرز من محاصيل التصدير الهامة فى مصـر ، بالاضافة الى أهميته كغذاء بشرى ، الا أنه يتعرض للاصابة بعض الحشرات وخاصة ثاقبة ساق الأرز Chilo agamemnon Bles. ، والتى تعتبر أهم آفاته الحشرية حيث أنها تسبب فقـدا سنويا كبيرا فى محصول الحبوب . ومن عادات هذه الحشرة هو اختفاء يرقاتها بعد التفقس بمدة أيام داخل سيقان الأرز ، لهذا كان من الصعب مقاومتها كيماويا بعد دخولهـا هذه السيقان ، كما كان من الضرورى البحث عن العمليات الزراعية المختلفة التى تمكـن النباتات من الهروب من الاصابة ، أو تقليلها الى أقل حد ممكـن .

لهذا اجريت دراسات خلال أربعة أعوام متتاليـة ٧٤ ، ٧٥ ، ٧٦ ، ١٩٧٧ فى مزرعـة كلية الزراعة بكفر الشيخ ، وكانت أهم النتائج المتحصل عليها هى :ـ

أولا : تأثير صنف الأرز على الاصابـة بالثاقبـة :

تم اختبار قابلية سبعة أصناف أرز تجارية للاصابة بثاقبة الأرز ، وهى جيزة ١٥٩ وجيزة ١٧٠ وجيزة ١٧١ وجيزة ١٧٢ ونهضـة و IR 579 و IR 1561 والصنفان

الأخيران من الأصناف الفلبينية ، وذلك خلال ثلاث مواسم متتالية ٧٥ ، ٧٦ ، ١٩٧٧ حيث زرع كل صنف في ٤ مكررات (مساحة المكرر ٤ × ٥ م٢) بطريقة القطاعات الكاملة العشوائية وتم الشتل على مسافة ٢٠ سم بين كل من الصفوف والجور ، وبعد الشتل باسبوعين سمدت النباتات بمعدل ٢٠ كجم أزوت للفدان ، ثم اخذت عينات كل منها يحتوي على ٢٠ جورة لحصر عدد الخلفات في الجورة وطول النباتات وعدد كتل البيض واليرقات والعذارى ونسبة الاصابة ، وبعد ظهور السنابل قدر عدد السنابل المصابة ، كما تم تسجيل لون الاوراق وملمسها وطولها وعرضها .

وقد وجد أن الصنفين الفلبينين IR 579 ، IR 1561 مقاومان نسبيا للاصابة في حين كان الصنفان جيزة ١٧١ وجيزة ١٥٩ هما أكثر الاصناف قابلية للاصابة ، أما الاصناف جيزة ١٧٠ وجيزة ١٧٢ والنهضة كانت متوسطة الاصابة . ولقد ظهرت هذه الاختلافات في درجة الاصابة على أساس الصفات المورفولوجية للاصناف ، حيث أن الاصناف الفلبينية تتميز بقدرة أكبر على انتاج الخلفات ، كما أن الاوراق ضيقة وقصيرة وذات لون أخضر فاتح . ومن ناحية أخرى فان الصنف جيزة ١٧١ الاكثر قابلية للاصابة كانت قدرته على انتاج الخلفات أقل ، وكانت أوراقه طويلة عريضة ملساء ذات لون أخضر غامق .

ثانيا : تأثير ميعاد الزراعة على الاصابة بالثاقبة :

أجريت تجربتان في موسمين متتاليين لدراسة درجة اصابة العروات المختلفة بالثاقبة حيث زرع الصنف جيزة ١٧٢ في أربع عروات هي : أول ومنتصف مايو ، وأول ومنتصف يونيو في موسم ١٩٧٥ ، وفي ثلاث عروات هي أول ومنتصف مايو وأول يونيو في موسم ١٩٧٦ ، وتم الشتل بعد الزراعة بحوالي أربعين يوما ، وزرعت كل عروة في ٤ مكررات بطريقة القطاعات الكاملة العشوائية (مساحة المكرر ٢ × ٣ م٢) ، ثم سمدت النباتات بعد الشتل باسبوعين بمعدل ٢٠ كجم أزوت للفدان . وتم تسجيل عدد الخلفات للجورة الواحدة وطول النباتات وعدد اليرقات ونسبة الاصابة وعدد السنابل المصابة واتضح من النتائج المتحصل عليها :

أن العروات المتأخرة قد تعرضت للاصابة بدرجة أكبر من العروات المبكرة ، وقد سجلت أعلى اصابه للارز المزروع في أول يونيو يليه حقل المنزرع في منتصف يونيو ، بينما كانت أقل اصابة للنباتات التي زرعت في أول مايو ثم العروة المنزرعة في منتصف مايو .

ثالثا : تأثير طريقة الزراعة على الاصابة بالثاقبة :

تمت دراسة تأثير طريقة الزراعة على الاصابة بالثاقبة ولهذا زرع الارز بطريقتى الشتل والبدار فى موسمين متتاليين هما ١٩٧٦ ، ١٩٧٧ ، وكان الصنف المستعمل هو جيزة ١٧٢ الذى زرع فى ٤ مكررات (مساحة كل منها ١٠ × ١٠ م^{٢}) وبعد الشتل باسبوعين سمدت النباتات بمعدل ٢٠ كجم أزوت للفدان ، كما سمدت النباتات المنزرعة بطريقة البدار بنفس المعدل بعد شهر من الزراعة . وتم أخذ العينات من الأرز المنزرع بالطريقتين السابقتين لتسجيل متوسط طول النباتات ونسبة الاصابة وعدد كتل البيض واليرقات والعذارى وعدد السنابل المصابة . وقد أوضحت النتائج أن نباتات الأرز المنزرعة بطريقة الشتل قد تعرضت للاصابة بالثاقبة بدرجة أعلى من تلك المنزرعة بطريقة البدار .

رابعا : تأثير مسافات الشتل على الاصابة بالثاقبة :

لدراسة تأثير مسافات الشتل بين الجور وكذلك بين الصفوف على درجة الاصابة بالثاقبة أجريت تجربة فى ثلاث مواسم متتالية هى ٧٤ ، ٧٥ ، ١٩٧٦ . وفى هذه الدراسة زرع الصنف جيزة ١٧٠ على مسافات ٢٠ × ١٠ ، ٢٠ × ٢٠ ، ٣٠ × ٢٠ ، ٢٠ × ٤٠ ، ٣٠ × ٣٠ سم فى موسم ١٩٧٤ ، وفى موسمى ٧٥ ، ١٩٧٦ اضيفت الى المسافات السابقة الزراعة على مسافة ٢٠ × ٥٠ سم ، وتم تكرار كل معاملة أربع مرات (كل مكرر ٣ × ٤ م^{٢}) بطريقة القطاعات الكاملة العشوائية ، وأضيف سماد سلفات الأمونيوم بمعدل ٢٠ كجم للفدان بعد الشتل باسبوعين ، وعند الفحص سجلت أطوال وعدد الخلفات فى الجورة وعدد كل من كتل البيض واليرقات والعذارى وكذلك عدد السنابل المصابة . ولقد أوضحت النتائج أن هناك فروق واضحة فى معدل الاصابة بين مسافات الشتل المختلفة ، ووجد أن أقل درجة للاصابة كانت للارز المنزرع على مسافات ضيقة (٢٠ × ١٠ سم) ، فى حين سجلت الزراعة على مسافات واسعة درجة عالية من الاصابة .

خامسا : تأثير التسميد على الاصابة بالثاقبة :

لمعرفة تأثير نوع وكمية السماد المضاف للارز على معدل الاصابة بالثاقبة ، تم اجراء تجربة في موسمين متتاليين هما ١٩٧٥ ، ١٩٧٦ ، زرع فيها الصنف جيزة ١٧٠ ، وقسمت الارض الى ٣٦ قطعة تجريبية وزعت عليها المعاملات بطريقة القطاعات الكاملة العشوائية واشتملت المعاملات على ٤ مستويات من الازوت (صفر ، ١٥ ، ٣٠ ، ٤٥ كجم للفدان) ومستوى واحد من البوتاسيوم (٢٤ كجم للفدان) وكذلك مستوى واحد من الفوسفور (١٥ كجم للفدان) . وتبع يوم واحد من الشتل اضيف كل من السماد الفوسفاتي والبوتاسي الى الارض . وبعد الشتل بأسبوعين اضيف السماد الازوتي للنباتات . وكما في التجارب السابقة اخذت العينات لتحديد النسبة المئوية للاصابة وعدد اليرقات وكذلك عدد الخلفات في البورة والنسبة المئوية للسنابل المصابة . ولقد أظهرت النتائج مايلي

النباتات المسمدة بنسب كبيرة من الازوت قد استقبلت نسبة عالية من الاصابة عن تلك المسمدة بنسب قليلة أو الغير مسمدة بالمرة . وعندما اضيف الفوسفور (١٥ كجم للفدان) مع الازوت (٤٥ كجم للفدان) فان النسبة المئوية للاصابة قد انخفضت عن مثيلتها المسمدة بالازوت فقط . وكانت نباتات الارز المسمدة بالبوتاسيوم (٢٤ كجم للفدان) والازوت (٤٥ كجم للفدان) هي أكثر النباتات ملائمة للاصابة عن تلك التي لم يتم تسميدها أو الاخرى التي تم تسميدها بالسمادين الازوتي والفوسفاتي معا . وعندما امدت النباتات بالسماد الازوتي (٤٥ كجم للفدان) والسماد الفوسفاتي (١٥ كجم للفدان) والسماد البوتاسي (٢٤ كجم للفدان) في آن واحد ، فان درجة الاصابة كانت أقل من المعاملات المسمدة بازوت (٤٥ كجم للفدان) والبوتاسيوم (٢٤ كجم للفدان) معا ، أو المسمدة بالازوت وحده بمعدل ٤٥ كجم للفدان .

سادسا : تأثير ميعاد الضم على توزيع يرقات الثاقبة في كل من قش وكموب الارز :

لدراسة تأثير ميعاد ضم الارز على توزيع اليرقات التي دخلت البيات الشتوي في كل من القش والكموب ، زرع الصنف جيزة ١٢٢ في ١٨ مايو موسم ١٩٧٧ وتم ضمه في أربعة مواعيد متتالية هي ٢٢ ، ٢٩ أكتوبر ، ٥ ، ١٢ نوفمبر وذلك على ارتفاع ٥ سم عن

وقد أخذت عينات من كل من القش والكوب واتضح أن :

١٧ ٪ من اليرقات كانت موجودة بالقش في حالة الحصاد المبكر (٢٢ أكتوبر) انخفضت الى ١٢ ٪ عند تأخير الحصاد (١٢ نوفمبر) . وفي الوقت نفسه وجد أن الكوب احتوت على أكبر عدد عند تأخير الضم وأن هذه اليرقات بقيت في حقول الارز للموسم التالي .

سابعا : تأثير مستوى الضم على توزيع يرقات الثاقبة في كل من قش وكوب الأرز :

اجريت تجربة في موسمي ١٩٧٦ ، ١٩٧٧ لدراسة العلاقة بين مستوى الضم وتوزيع اليرقات في كل من القش والكوب ، حيث زرع جيزة ١٧٢ في ١٨ ، ٢٨ مايو وتم الحصاد في ٢٢ ، ١٥ أكتوبر في كل من الموسمين على التوالي ، وتم اجراء الضم على مسافات صفر ، ٥ ، ١٠ ، ١٥ سم فوق سطح الارض ، ووجد أن العدد الاكبر من اليرقات كان موجودا بالقش الذي تم ضمه فوق سطح الارض تماما في حين كان أقل عدد به عند الضم على ارتفاع ١٥ سم ، وبالمثل في حالة الكوب كان أقل عددا عندما تم الارز عند مستوى سطح التربة تماما ولكنها تزايدت تدريجيا حتى وصلت الى أعلى عدد عندما تم الضم على ارتفاع ١٥ سم .

ثامنا : مصير اليرقات الباقية داخل كوب الأرز :

لدراسة بداية نشاط الثاقبة ومعدل نموها البيات وكذلك مصير اليرقات التي دخلت البيات الشتوي فقد أجريت التجربة التالية في موسمين متتاليين :

بعد ضم الارز توالى فدان بورا بدون أي عمليات زراعية ، وفي نهاية نوفمبر جمعت حوالي ١٠٠٠ جورة ونقلت الى المعمل ووضعت في قفص من السلك . وتم أخذ عينات كل ثلاثة شهور من كل من الحقل والمعمل وذلك لحساب عدد اليرقات التي بقيت حية في ألف كوب من الارز ، كما سجل ميعاد ظهور أول فراشة وكذلك معدل

خروج أول فراشة . وبهذه النتائج تتناقص عدد اليرقات تدريجيا حتى وصل الى حوالى ٥٠ ٪ من عددها الأصلى تحت الظروف المعملية . وهذه النسبة الباقية من اليرقات هى التى تشكل الخسائر فى الموسم التالى حيث ستكون مصدرا للاصابة . وبدأ التذكير فى ١٩ مايو بالحقل و ١٦ مايو بالمعمل بينما ظهرت أول فراشة فى الحقل فى ٢٢ مايو وفى المعمل فى ٢٨ مايو .

وعند حساب عدد الفراشات التى يمكن الحصول عليها من فدان واحد متروك به كوز الأرز وترك بدون زراعة حتى الموسم التالى وجد أنها ٥٥٩٨٠ فراشة وهى تمثل مصدرا هاما للاصابات الجديدة للأرز .