STUDIES ON THE ROLE OF INSECTS IN COTTON BOLL BLACK ROT OCCURRENCE

by

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Introduction

Cotton boll black rot caused by *Diplodia gossypina* Cooke is one of the most serious diseases attacking cotton in cotton growing areas around the world (2, 3, 5, 6, 7). The disease causes fall of cotton bolls. It has heen recorded that percentage of boll falling were more than 30% to 40% in Louisiana (2), 20% in Puerto Rico (4) and Florida (7), and 50% to 95% in Taiwan (5).

Infection of the black rot of cotton through wounds of mechanic injuries or insect damages has been discussed by some workers (3,5). Tsai and Yu (5) reported that damage of the pink bollworm (*Pectinophora gossypiella* S.) may lead to a serious occurrence of black rot. These results indicate that the disease may be initiated by insects in various ways,but no detail information has been given to explain the insects involved and their role in black rot development. Relationship between the infection of boll black rot and injuries of insects is discussed in this paper.

Materials and Methods

The methods described by Bagga and Laster (1) were used in this experiment with some modifications. The pink bollworm (*Pectinophora gossypiella* S.), spiny bollworm (*Earias fabia* S.), and cotton stainer (*Dysdercus megalopygus* B.) were collected from the field and treated with the following two methods: a) the cotton stainer was held on one-month-old culture with numerous germinating spores of *D. gossypina* for 24 hr., b) the pink bollworm and spiny bollworm were sprayed with spore suspension of the same source. The germination percentage of spores tested varied from 80.3% to 94.6% at 30°C after 8 hours submerged in tap water. Insects tested were individually caged in a bottle cap, 2.5 cm in diameter and 0.7 cm in height, which was secured with adhesive tape to the middle of cotton boll valve. A hole was drilled through the cap to provide ventilation for the insects. After 4 days of incubation at 28°C, the bottle caps and insects were removed for the observation of insect punctures and fungal infection, then the bolls were placed in plastic bags and again incubated at 28°C for further observation of disease development. Fifty cotton bolls (variety: Stoneville) of 3-5 weeks old, green and healthy, were used in each test.

In order to confirm the results obtained from laboratory tests, a same study was also conducted in the greenhouse. The insects were treated according to the methods described above, then confined in a 5.5×7.0 cm cage (Fig. 2) covering cotton bolls. Two insects were introduced in one cage and 40 bolls were tested for each kind of insect. Af-

ter 4 days feeding, the insects were removed and one half of cotton bolls were placed individually in tightly closed plastic bags to increase the relative humidity. As a control, the cotton bolls were first artificially injured, then sprayed with spore suspension.

Results

The pink bollworm and spiny bollworm could penetrate into boll valves and transmit the inoculum to cotton bolls, resulted in 33.4% and 42.86% infection of the disease respectively. After the bolls were placed in plastic bags for 2 days, the percentage of boll black rot greatly increased. Feeding of the cotton stainer caused 31.25% transmission. Artificial inoculation through mechanic wounds showed comparatively high percentage of infection. It was found that infection occured 4 days after inoculation, and 100% infection was brought about by placing the bolls in plastic bags for 2 days.

Greenhouse studies with cotton plants bearing bolls obtained almost the same results as the laboratory test. Of the bolls covered with plastic bags, 46.5%, 50.0%, and 42.2% infection of the disease were obtained 5 days after the removal of insects. However, only 18.06% to 27.33% of cotton bolls were infected by the disease when they were remained uncovered. The results of laboratory and greenhouse tests are shown in Table 1 and 2.

Table 1. The transmission percentage of cotton boll black rot by insects (laboratory test)

Vector	No. of insect holes	Per cent bolls diseased	
		4 days after treatment	6 days after treatment (bolls placed in plastic bags for 2 days)
Pink bollworm	1.0	33.45	42.00
Spiny bollworm	2.4	42.86	57.14
Cotton stainer		31.25	43.75
CK*		73.77	100.00

* Artificial inoculation

Table 2. The transmission percentage of cotton boll black rot by insects (greenhouse test)

Vector	No. of insect holes	Per cent bolls diseased			
		5 days after removal of insects		10 days after removal of insects	
		Plastic bag	Screen cage	Plastic bag	Screen cage
Pink bollworm	1.3	46.50	22.50	56.50	22.50
Spiny bollworm	1.87	50.00	27.33	100.00	42.85
Cotton stainer		42.20	18.06	53.36	18.06
CK*		63.51	20.11	77.44	20.11

* Artificial inoculation

Discussion and Conclusion

The occurrence of cotton boll black rot is believed to have a close relationship with insects, but there are very few literatures dealing with this problem. Bagga and Laster (1) reported a simple technique for evaluating the role of insects in cotton boll black rot development and reported that the trenished plant bug (*Lygus lineolaris* (Palisot de Beauvois)) and fruit fly (*Drosophila melanogaster* Meigen) could cause the infection of boll rot of cotton (*Fusarium moniliforme* Sheldon or *Alternaria tenuis* Auct.) after their feeding.

Pink bollworm, spiny bollworm, and cotton stainer are the most destructive cotton boll insects in the island, but the information about their roles in the boll black rot transmission is still lacking. The results reported herein presents a strong evidence to show that these cotton insects are the vectors of boll black rot and can transmit spores of *D. gossypina* to cotton bolls at a very high percentage (Table 1 and 2).

There was also a tendency of increase in diseased bolls when cotton bolls were kept in plastic bags after insect feedings and artificial inoculation. For instance, 50% infection of the disease occurred 5 days after removing the spiny bollworm, then increased to 100 % during another 5 days. No considerable increase in the percentage of infection was observed if the cotton bolls remained uncovered throughout the period of experiment (Table 2). The results seem to imply that a humidity of 95% to 100% is essential for the development of cotton boll black rot.

Summary

The causal organism of cotton boll black rot can be transmitted by the spiny bollworm, pink bollworm, and cotton stainer at a very high percentage. More than 42% to 100% infection of the disease is caused by feedings of these insects sprayed with spore suspension.

High humidity is another factor favorable to the disease development regardless of insect transmission or artificial inoculation.

Acknowledgment

The author wishes to express his sincerest thanks to Mr. C. C. Fan, the former Laboratory Assistant of Tainan Fiber Crops Experiment Station, for providing outstanding assistance during the progress of this work, and he is also very grateful to Mr. T. T. Lo of Joint Commission on Rural Reconstruction and to Mr. Y. S. Pan of Taiwan Sugar Experiment Station for their help and comments during the preparation of this manuscript. This work was supported by the Joint commission on Rural Reconstruction.

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棉鈴黑化病之發生與昆蟲之關係研究

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本研究之目的在究明一些常見的棉鈴害蟲如金鋼鑽，紅鈴蟲及赤星椿象等之喰害對棉鈴黑化病病原菌之傳播及侵染媒介情形。本研究分室內試驗與溫室試驗進行之。室內試驗，先使害蟲黏附病原菌孢子後，置二頭同類害蟲於一瓶蓋下黏附在健全棉鈴上，在 28°C 定溫下任其蛀食 4 日，再取去瓶蓋及蟲體，幷改套塑膠袋；觀測棉鈴黑化病之發生率。溫室試驗則改在棉株上利用銅網代替瓶蓋；固定處理後之昆蟲在一定棉鈴上，4 日後取去蟲體幷將半數供試棉鈴改套塑膠袋；相互比較黑化病之發生情形。

本研究結果證實處理過棉鈴黑化病病原菌分生孢子之金鋼鑽，紅鈴蟲及赤星椿象在棉鈴上蛀食後可使42～100 %之棉鈴發生黑化病。三種供試害蟲中咀嚼式口器害蟲（金鋼鑽及紅鈴蟲）對棉鈴黑化病之傳播比刺吸式口器害蟲（赤星椿象）容易。高濕度對病原菌侵染後之病勢進展有利。供試三種昆蟲之傳播黑化病順序爲金鋼鑽，紅鈴蟲，赤星椿象。

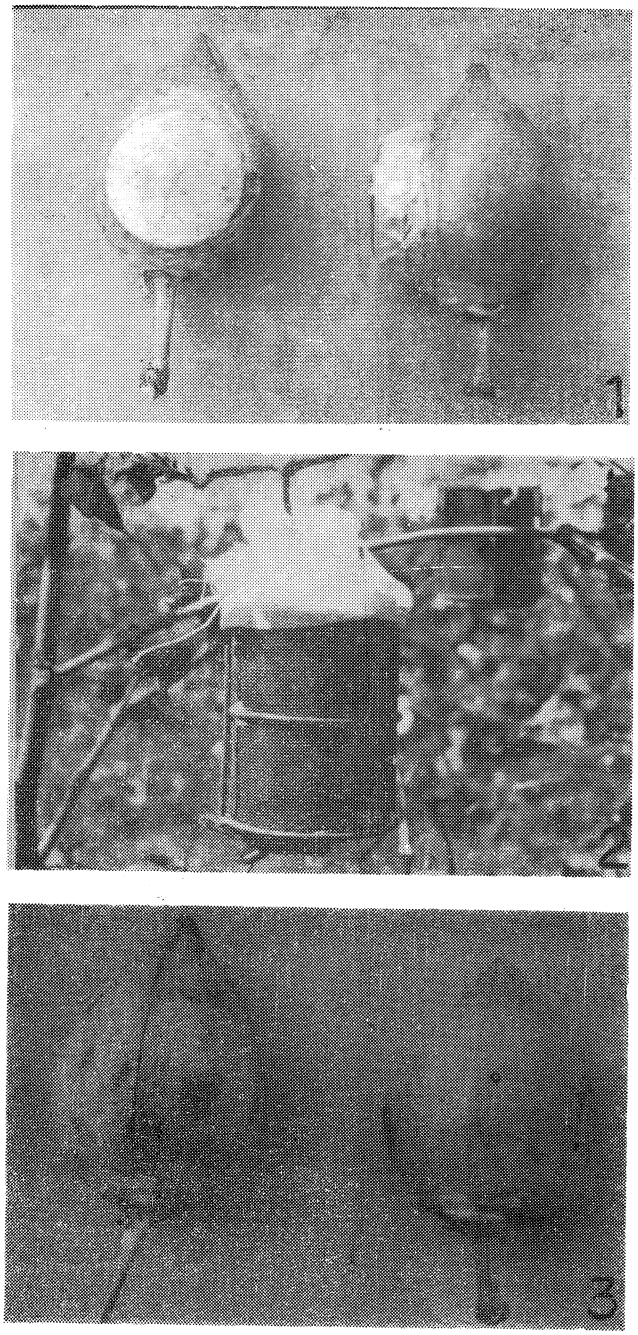

Fig. 1–3. 1) Cotton boll with a bottle cap used to confine insects being tested for their relationship to boll black rot in laboratory. 2) Insects confined on cotton bolls with screen cages being tested for their relationship to boll black rot in greenhouse. 3) Successful infection along the edges of insect holes (left) campared with uninfected insect hole (right).