COTTON BOLLWORM CONTROL IN XINJIANG IN 1997-1998

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Abstract

Since 1993, Xinjiang has become the largest cotton producer among provincial administrative units in China. In the same time, the cotton bollworm, *Helicoverpa armigera* (Hubner), increased very rapidly and caused a serious loss in 1996. Then the autonomous government initiated a community-wide control program. Suppressing pupae, trapping moths and spraying small larvae and eggs, which were called " three Battles," were conducted in a vast area and resulted a sound control. The bollworm density was decreased to a low level and the cotton production was increased by 30% in 1997-1998.

Introduction

China has five major cotton growing regions and the Northwest Inland Cotton Region becomes the largest one. A 97% of the northwestern cotton is from Xinjiang Uygur Autonomous Region. The cotton bollworm, the No. 1 pest in China, has caused enormous losses in the country since 1991. In 1992, it occurred in unparalleled outbreaks in the Yellow River Valley Cotton Region and the economic loss was estimated at 1.3-1.7 billion US dollars (Sheng, 1993). Then cotton acreage in Shandong, Hebei, and Henan Provinces decreased dramatically. On the other hand, Xinjiang planted more and more cotton to meet the domestic demand. This change has caused in turn a rapid increase in the bollworm population in the northwestern part of China. In 1996, a 45% of the cotton area was infested and 300 ha was abandoned. Then the autonomous government called for a solution and we suggested a community-wide control strategy (Sheng and Xuan, 1996). Three kinds of control actions, i. e., suppressing pupae, trapping moths and spaying small larvae and eggs, so-called "Three Battles" were taken in most of the infested fields. Fortunately, the control was successful. We report in brief the cotton development, bollworm occurrence and control in Xinjiang in 1997 and 1998.

Cotton Development

Xinjiang is the largest provincial administrative unit in China and accounts for 1/6 of the country's territory. It has a population of 16 million and a farming land area of 3.2 million hectares. This autonomous region is rich in sunlight and good for cotton growing. As the most important crop for the autonomy, cotton is grown in several river valleys around the huge deserts and irrigated with the water from the high snows. Recently, both the planting acreage and yield increased rapidly (Table 1). It is shown that during 1980-1998, the cotton acreage in Xinjiang increased to 5.1 fold, the unit yield increased to 3.1 fold, and the autonomous yield increased to 15.8 fold. At present, it contributes 1/3 of China's cotton. That is a miracle. Meanwhile the grain output, mainly corn and wheat, in the autonomy was doubled from 3.9 to 8.3 million tons. There is a plan to grow 1.1 mil. ha yielding 1.5 mil. tons of lint in 2000. These host plants provided the bollworm with more and better food, and the pest population increased to high levels.

Bollworm Problem

In 1980's, the annual mean of the cotton area infested by the cotton bollworm was less than 50,000 ha in Xinjiang. However, since 1991, the bollworm population has increased obviously in the autonomy. The infested cotton area was 70,000 ha in 1993. In 1996, it increased to 360,000 ha or 45% of the cotton area. The pest density reached the highest level. The number of medium- and large-size larvae was as high as 82 and 45 sampled on 100 cotton plants (ca. 5-8 m^2 due to the high plant density in the autonomy) in Turpan and Kashi Prefectures. In November, the highest number of overwinter pupae was 119/m^2 reported from Kashi Prefecture, setting a new record in China. The cotton crop was damaged very severely. A 30-70% of yield loss was estimated in 52,000 ha and 300 ha of cotton field was wholly abandoned. The damage and yield loss were much more severe in Kashi Prefecture than in the other prefectures.

Because of the warmer and drier weather in 1996 winter to 1997 spring, the mortality of the overwinter pupae was extremely low, merely 5-25%, in the untreated fields in the eastern and southern cotton areas in Xinjiang. For example, it was 11.7% in Kashi Prefecture. Even in Shihezi City (44.3 ^{o}N, 86 ^{o}E) in the northern area, the mortality was 5.3-19.4% in 1996 winter to 1997 spring and 49.2% in 1997 winter to 1998 spring. To the contrary, the mortality was generally 30-70% in the Yellow River Valley Cotton Region and 80-90% in the Yangtze River Valley Cotton Region in China. It was estimated that it was 95% or higher in mid-southern areas in USA.

The moths of overwinter generation occurred in outbreak in Xinjiang in 1997. It was first seen in early April and reached the peak in early May, 2 weeks earlier than usual. In most counties in Kashi Prefecture, 100 or over males were captured in a single night by the pheromone lure with a water-pan trap. A record number was 190 reported from Jiashi County in Kashi Prefecture. In comparison, the number was 10-40 for the same generation in Shandong Province. Mainly in the late May and early June, the 1st generation larvae damaged the cotton severely. In some

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1026-1028 (1999)
National Cotton Council, Memphis TN

fields, 30 or more larvae and pupae were sampled on 100 plants on June 12, and the number of damaged squares was about 300. This was early and not seen before in any cotton region in China.

The majority of the 1st generation moths emerged in middle to late June, and the density was high setting a record for the generation in Xinjiang. In Kashi, the highest number of males caught in a night was 40 by a water-pan trap and 105 by a cone cage. The egg and larval densities of 2nd generation were at medium-to-high level. The cumulative number of eggs was 30-150 on 100 cotton plants and the peak number of small larvae was 5-20.

The occurrence of 3rd generation was relatively low in 1997. The cumulative number of eggs was estimated at 10-80 on 100 cotton plants, so the percentage of damaged bolls was low, because the control actions were effective and a part of the 2nd generation moths turned to corn fields.

Control Efforts and Efficiency

To put the bollworm under control, the growers need the community-wide control strategy that has proven effective (Sheng et al., 1994). We suggested that the growers be organized by the local government, and that "Three Battles" be initiated. This suggestion was accepted by the leaders of the autonomy. The first battle action was to kill the overwinter pupae as possible by means of ploughing, irrigating and excavating. A total of 0.91 mil. ha of cotton and corn fields was ploughed in 1997 fall and winter. 136 tons and 10 tons of insect pupae and larvae was scooped out in 1997 spring and 1998 spring, respectively. In Kashi Prefecture, 84 tons of insects (ca. 30-70% being the bollworm) was collected in the first spring. That was surprising.

Quantities of the bollworm moths of the first two generations were caught with pheromone traps, poplar branches and inter-planted corn plants. In Kashi, the acreage of cotton inter-planted with corn was about 0.2 mil. ha equal to 2/3 of the cotton area each year. One mil. or more pheromone lures were used yearly. A total of 67.9 tons of moths (30-70% being bollworm) was captured in 1997 (ca. 3,200 wet moths weighed 1 kg). The trapping battle was effective and the densities of following generations were much lower. For example, in Jiashi County, the trapping battle was well done and resulted in a decreased population level with time in May to August in 1997 (Fig. 1). While in Shache County in the same prefecture, the moth trapping was not properly done and the pest population increased with time (Fig. 2).

The 3rd control battle was field sprays. We put Bt and NPV first, followed by some kinds of commonly-used chemical insecticides. New economic thresholds and sampling methods were applied. We counted the fertilized eggs (colored yellow, brown or dark) and began to spray when the cumulative number of eggs on 100 plants reached 50 (equal to 20 from one count). In fact, a 1-25% of the cotton fields was sprayed in Kashi Prefecture in these two seasons.

Due to the Three Battles, the bollworm population was reduced to low levels. In Kashi Prefecture, the number of larvae after control was lower than 0.2-2 and the percentage of damaged bolls was lower than 1-3.3 in 1997 and 1998, much lower than that in 1996 (Table 2). In Shule County, the lint cotton yield increased from 16,500 tons in 1996 to 23,300 tons in 1997 and 29,200 tons in 1998. The bollworm control was a guarantee of the bumper harvests.

The cotton bollworm is a key pest world-wide and caused a re-distribution of cotton growing areas in China. At present, it still causes severe losses in the Yellow River Valley Cotton Region and Yangtze River Valley Cotton Region. It is generally agreed that the bollworm control was successful in Xinjiang in 1997 and 1998. Along with the natural check factors, the factors of human being performed well. The governments at different levels in cotton areas in Xinjiang played an important or key role in the organizing of the individual growers (Sheng, 1996). From the standpoint of technology, both the community-wide control strategy and Three Battles" tactics were suitable and effective. Moreover, the technical guidance and service by researchers and extensionists were timely and enduring. A sustainable control may be realized in Xinjiang in the near future, which would be rare in China.

Acknowledgments

This work was supported by the CAS (Chinese Academy of Sciences). The author thanks Messrs. W. M. Fan, H. T. Wang, W. J. Xuan and J. W. Su for their excellent cooperation and assistance.

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Table 1. Cotton acreage and yield in Xinjiang and in the country in selected years.

Year	Acreage (mil. ha.)		Lint (mil. tons)	
	Xinjiang	China	Xinjiang	China
1980	0.18	4.92	0.08	2.71
1983	0.28	6.08	0.21	4.64
1986	0.22	4.31	0.22	3.54
1989	0.37	5.20	0.30	3.79
1990	0.44	5.59	0.47	4.51
1991	0.35	6.54	0.64	5.68
1992	0.64	6.85	0.67	4.51
1993	0.61	4.99	0.68	3.74
1994	0.75	5.53	0.88	4.34
1995	0.73	5.42	0.99	4.77
1996	0.80	4.72	0.94	4.20
1997	0.87	4.49	1.15	4.60
1998*	0.93	4.5	1.25	4.3

* Data estimated for 1998.

Table 2. Estimation of the density of cotton bollworm larvae and percentage of damaged bolls in Kashi Prefecture, Xinjiang in 1996-1998.

Year	No. of larvae/m^2	% of damaged bolls
1996	2 - 9	20 - 40
1997	0.4 - 2	0.8 - 3.3
1998	0.2 - 0.6	0.5 - 2

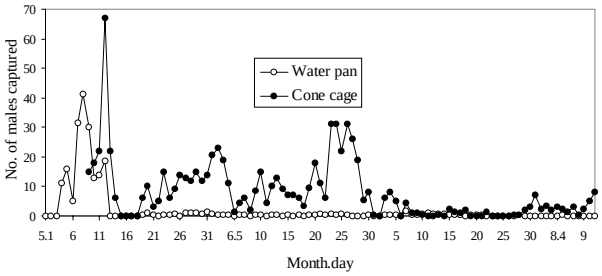

Figure 1. The decreasing population dynamics of cotton bollworm in Jiashi County in 1997, where the community-wide control actions were demonstrated.

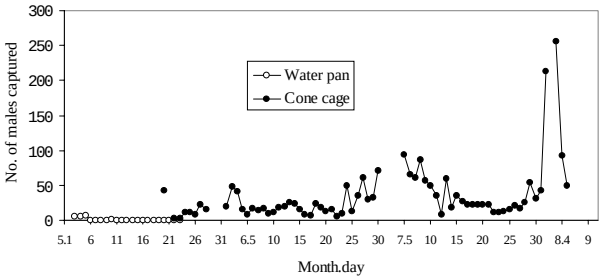

Figure 2. The increasing population dynamics of cotton bollworm in Shache County in 1997, where the community-wide control actions were not taken.