The Cotton Red Bollworm (*Diparopsis castanea* Humps) (Lepidoptera:Noctuidae) and the Quarantine Area in Southern Tanzania

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Abstract

The red bollworm (RBW) Diparopsis castanea (Humps) is a major pest of cotton in countries south of Tanzania. This insect is not yet a pest of cotton in Tanzania. A survey was conducted in 1999 in order to establish the current status of red bollworm in some parts of Tanzania that are in the cotton quarantine zone and in the areas surrounding the quarantine zone. The regions visited with districts surveyed in brackets were: Mbeya (Mbarali, Kyela and Chunya), Rukwa (Sumbawanga and Mpanda), and Ruvuma (Songea). The survey revealed a high infestation of red bollworm in commercial cotton in Chunya district. In view of the results obtained, some recommendations and suggestions were made to address the situation.

Key words: *Red bollworm, Quarantine, Infestation, South of Tanzania*

Introduction

The genus *Diparopsis* is confined to Africa, except for a single area in South Yemen. *Diparopsis castanea* (Humps) occurs South of the equator, from South Africa to Zambia. *Diparopsis watersi* (Roths) is the species found north of the equator, from Senegal to Somalia and northward to the Sahara desert, Sudan and Ethiopia (Munro, 1987). The red bollworm (RBW) *Diparopsis castanea* is a major pest of cotton in the countries south of Tanzania. If insecticides do not protect the crop, losses of up to 75% due to red and American bollworm *(Helicoverpa armigera)* can occur in Mozambique and Zambia, while in Malawi losses due to solely RBW of 10-40% are expected and can be as high as 70% (Treen et al 1982 unpublished paper). Due to its habit of feeding completely enclosed within a fruiting body, with only limited period of exposure on the plant surface, RBW is difficult to control by insecticides. For an insecticide to be effective, control must be directed at young larvae after emergency from the egg and before penetration of a fruiting body. Chemical Control needs to start when the first squares are formed until boll split. For that reason, more sprays are thus needed in the spraying programme, further increasing the cost of cotton production.

Figure 1. Cotton growing areas of Tanzania.

Under the present legislation, cotton growing is prohibited in the southern regions of Tanzania. The northward spread of the Red bollworm led to the establishment of a quarantine zone in 1947, with the objective of placing a barrier between the important cotton-growing areas of western and eastern Tanzania and the countries to the south of Tanzania that habour the pest. Since then the RBW was monitored from time to time.

With increasing pressure from many quarters to introduce cotton growing in the south, the need for the quarantine has to be reviewed in the light of recent technological advances in crop production and protection. The objective of this survey was to assess the status of the RBW, *Diparopsis castanea* (Humps) (Lepidoptera) in the quarantine zone (Fig. 1) and in cotton growing areas neighbouring the quarantine area.

History of the RBW in Tanzania

The RBW was first reported on both upland and kidney cotton in Songea (Harris, 1942). It was recorded in 1946 on cultivated cotton in the Lindi – Ruvuma area, bordering Mozambique, (Swaine *et al*, 1954). A field survey was carried out in 1947 in which the insect was found at Mkwela near Mahiwa

on the Masasi – Lindi road and at Namatola on the Lukuledi – Ruponda road.

The appearance of the RBW on cultivated cotton in Tanzania at that time was correlated with the northward expansion of the cotton belt in Mozambique during the Second World War. This led to the establishment of a cotton quarantine zone by the Government in the southern part of Tanzania to control its northward spread into the Eastern and western cotton growing areas.

The original zone set up in 1947 was 140 miles (224km) wide. This included the whole of Kilwa and Liwale districts and those parts of the Lindi and Masasi districts which are north of Lindi – Songea main road (cotton quarantine Area G.N. 265 of 1946).

In 1951, another survey was carried out at Nachingwea where the Overseas Food Corporation (O.F.C) cultivated cotton. This corporation was given a special permit to grow cotton in large blocks in the quarantine area to investigate the intensity of the RBW infestation. The survey revealed a heavy infestation of RBW on about 50 acres (20 ha) of cultivated cotton at Chiungutwa, 18 miles south of Masasi and about 48 miles from Nachingwea (Swaine *et al.*, 1954)

In 1953 and 1954 the RBW was recorded at Nachingwea, almost on the same area where it was recorded previously, suggesting that there was no fresh infestation from outside sources. By mid June 1954, RBW larvae were easily found in all areas sown with cotton except on two farms in the extreme east. The corporation decided not to grow any more cotton in view of the threat to the cotton growing areas to the north.

In 1965, RBW was reported again in Southern Tanzania, South of the Lindi – Songea road and at Nachingwea and Songea, north of this road. At this time it was felt necessary to redefine the cotton quarantine areas to the present boundaries (Quarantine Area) order, 1965, Section 6 of the Cotton Ordinance).

The Biology and life history of the RBW

The genus Diparopsis is restricted to Africa South of the Sahara and a small area in Western Aden. The species found north of the equator is known as the Sudan Bollworm, *Diparopsis watersi* (Roths) while that found south of the equator is the RBQ, *D castanea* Hmps. The third species, *D. tephragramma* is found in Angola only (Nyambo, 1977)

Damage to cotton plants is caused by the larvae, which feed on flower buds and green bolls. Although RBW infestations are less sudden and sweeping than those of the American bollworm, they are more persistent and usually more severe than those of the spiny bollworm.

The success of the RBW as a cotton pest depends largely on its complex life history. On emergence from the pupal stage, the adult moth is sexually mature, and copulation and oviposition can take place on the same night. It is estimated that a female moth can lay over 200 eggs in its lifetime. The eggs hatch into larvae in 2 to 3 days. The larval stage has five instars and lasts 11 to 14 days, depending on temperature. Larvae can reach maturity by feeding on flower buds alone when six or more may be consumed in its life. However, if mature bolls are available, these will be preferred and this constitutes a loss for which the cotton plant cannot easily compensate. The larva tends to remain within the same boll until it has eaten all the contents and thus is shielded from attack by its natural enemies and control by contact insecticides.

After the 5th instar the larva pupates and undergoes either a short or a long resting period (diapause). While food is not limiting, only short-term pupae are formed, so that several generations develop in a short period. As the season advances and food becomes limiting, more pupae enter into long-term diapause. The optimum temperature for development of the pupae is between 30°c and 36°c, when moths will emerge after 13 to 15 days. As temperatures decrease to 16°c, the pupal period is extended to 8 weeks while above 36°c mortality becomes high. Moths can emerge at the same time from diapause pupae of different ages and so attack the cotton crop when it is most susceptible.

The RBW has few alternative host plants besides cotton. It has been recorded on all commercially cultivated cottons and on the 'local perennial cottons' *Gossypium barbadense* var. *brasilience* and *G. hirsutum* var *marie-galante* watt. The kidney cotton, *G. barbadense* var. *brasiliense* is a common bush in East Africa, and has been recorded in the Songea Highlands and the head of Lake Nyasa. Other host plants south of the equator include *Cienfuegosia* and *Gossypioides* and also *Gossypium herbaceum* race *afrecanum*, the wild cotton of South Africa.

Current status of RBW in the surveyed areas

Mbeya region

Mbarali District

In all villages surveyed i.e Mwakaganga, Mabadaga, Itamboleo and Wimba-Mahango villages no RBW was observed.

Kyela District

All of Kyela is within the quarantine area. No cotton (*Gossypium hirsutum* (L)) was found. However, wild cotton plants (*Gossypium barbadense* (L), the alternative host plant for RBW, was found in the surveyed villages, namely, Ibanda, Lema, Ilima and Kasumulu. Kasumulu is a village at the Tanzania – Malawi border. No RBW was found on the wild plants.

Chunya District

The quarantine border (Appendix 1) passes through Chunya District, and divides the District into two parts (northern part and southern part). The southern part is within the quarantine area while the northern portion is not. Although the southern part of Chunya District is within the quarantine zone, farmers grow is not. Although the southern part of Chunya is within the quarantine zone, farmers have been growing cotton since the 1970s. Surveyed villages in the quarantine area of Chunya were found to have very heavy infestation of RBW larvae. The villages are Mbala, Kanga, Galula, Wanzan and Chang'ombe. The infestation levels increased from north to south. Villages surveyed north of the quarantine area were not infested with RBW.

Rukwa region

Sumbawanga District

Sumbawanga District is within the quarantine area hence farmers do not grow cotton. However, wild cotton *(Gossypium barbadense)* was found along the way to Mpanda at Kalambazite village but was not infested with RBW.

Mpanda District

Mpanda district is not within the quarantine zone. The District Agricultural officials are now trying to introduce the cotton. In 1999, trials were set in some of villages in order to establish the general performance of the crop in the District. The field trials were also examined for RBW infestation. The surveyed villages namely, Kasokola, Songambele and Kakese were found to be free of RBW.

Njombe district

The quarantine border passes across the Njombe district. The surveyed villages in Njombe district, namely, Wanging'ombe and Makambako, are located north of the quarantine area. One cotton field at Wanging'ombe in the quarantine free zone was found to have no RBW infestation. Also, a wild cotton plant at Makambako was free of RBW.

Ruvuma region

Songea District

Songea district is within the quarantine area. Wild cotton plants were surveyed in Mputa, Naikesi and Kitanda villages and were found to be RBW free.

Discussion

The potential for cotton growing in the quarantine area.

In the early 1900 when cotton was first introduced in Tanzania, the southern regions, particularly the highlands of Lindi and Kilwa appeared to be very promising for cotton production. This led to the construction of a railway to Masasi to serve this area. Cotton plantations were opened in the Rift Valley land in Usangu and Rukwa, but by 1913 none were flourishing (Kirkiby, 1930). Despite a lot of efforts, cotton growing in the south never developed as it did in the western cotton growing areas. One of the main drawbacks was the infestation by RBW and other pests. This implies that even in the absence of the RBW, other insect pests infestation would be a limiting factor to cotton production.

Factors associated with control of RBW with insecticides

The larvae of RBW are protected from the action of insecticide for most of their development. As the larvae bollworms grow older they become more difficult to control with insecticides unless the dosage is greatly increased. This, combined with its restricted period of exposure of red bollworm larvae, makes it difficult to kill RBW larvae. Red bollworm larvae can only be controlled at their youngest stage, during the short period after emergence from the egg and before entering a fruiting body.

In Mozambique and Zambia farmers are advised to apply at least eight sprays when using a fixed programme, and ten are often required. In Malawi where they practice scouting, 12-14 sprays are often applied, although not all are for control of RBW.

Insecticides used for the control of American bollworm have no effect on RBW and two insecticides have to be used in the spray programme. With a fixed spray regime, both insecticides need to be applied as a mixture in every spray while a scouting programme decide if only one or if both insecticides are required

depending on the level of each bollworm (Nyambo *et al.*, 1982)

Danger of RBW spreading to the Western Cotton Growing Area (WCGA) and the Eastern Cotton Growing Area (ECGA)

If the quarantine area order were to be relaxed, the RBW, which have been reported to survive on perennial Gossypium spp and on commercial cotton in Chunya District, would spread rapidly through out the cotton growing areas of Tanzania. We are fairly certain that the insect would spread rapidly throughout the southern areas if cotton were to be produced in large scale even if a closed season were to be strictly enforced. This is because the RBW undergoes a long period of diapause in southern Tanzania. There is, however, doubt that if RBW were to be established in the traditional cotton growing areas, the economic consequences to the cotton industry would be disastrous

Conclusions

(1) In previous surveys, the RBW was found over large areas of the quarantine zone on iocal perennial cotton and on alternative wild host plants. In the current surveys, the RBW was found on commercial cotton in the cotton growing areas in Chunya. Continued attempts to grow cotton in these areas will probably fail because of severe RBW infestation.

(2) It is difficult to forecast how soon the spread of the RBW to the WCGA and the ECGA will occur if cotton will continue to be grown on a large scale in the present quarantine area. However, this eventuality is most certain if the cultivation of cotton in the quarantine area is not prohibited.

Recommendations

Cotton production within the quarantine zone in the Chunya District should be phased out immediately. This should start as soon as this report reaches the authorities in Mbeya region and Chunya District. Kabissa and Nyambo (1989) recommended that cotton production in Chunya district be phased out from the south and replaced by suitable alternative cash crops because continued cultivation of the crop in Chunya would threaten the cotton industry in Tanzania.

Since the RBW was found in Chunya District, which is very close to the border of the areas allowed to grow cotton in Mbarali, Chunya itself and Mbeya, all cotton in these districts including Kyela, Mbozi and Ileje should be uprooted and burned immediately. Cotton production in these areas should be banned.

The quarantine zone boundary should be redefined to include Mbeya and Mbarali districts. This will provide the best chance for preventing the spread of RBW to the remaining areas of the ECGA and WCGA.

The remaining quarantine zone boundaries should remain unchanged, be strictly enforced, and production of cotton banned throughout the quarantine zone.

Wild cotton plants, *G. barbadense* (Masapa), grown for domestic purposes should be uprooted and planting should be banned throughout the quarantine zone.

Wild host plants of RBW throughout the quarantine zone should be continuously monitored to detect any further spread.

A map showing the boundaries of the quarantine zone should be distributed to officials in the quarantine zone. The importance of the quarantine zone in protecting cotton production should be explained.

The Ministry of Agriculture and Food Security should look for alternative cash crops to replace cotton in areas under quarantine. Inputs and marketing arrangements for these crops should be investigated, particularly for Chunya and Mbarali districts.

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