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The Effect of Intercropping Cotton and Cowpeas on Populations of African Bollworm and Whiteflies in Zimbabwean Cotton

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ABSTRACT

The African bollworm (Helicorvepa armigera) and whiteflies (Bemisia tabaci) are pests of economic importance in Zimbabwe. H. armigera destroys half a dozen squares, bolls or more during its lifetime, while B. tabaci stains and downgrade cotton lint with honey dew. A study to evaluate the effect of intercropping cotton (Gossypium hirsutum L.) and cowpea (Vigna unguiculata) L. Walp., on populations of the African bollworm and whiteflies was conducted in the 2012/2013 season at Cotton Research Institute of Kadoma, in Zimbabwe. Cowpea variety CBC3 was intercropped with cotton variety CRI MS2 using intercrop ratios of cotton-cowpea of 1:1, 2:1, and 2:2 with sprayed and unsprayed treatment for each ratio. Other treatments were the control treatment and Control of African boll worms and white flies with Lambda-cyhalothrin 5EC and Acetamiprid 20SP. A Randomized Complete Block Design (RCBD) with eight treatments replicated four times was used in the study. Data on H. armigera larval counts and B. tabaci adults on 24 cotton plants per treatment was collected. Data analysis was done using Genstat 14th Edition of 2011. Inter-cropping cotton and cowpea using a ratio of 2:1 reduced H. armigera and B. tabaci populations by 45.5% and 90% in UN-sprayed treatments, while in sprayed crop H. armigera and B. tabaci populations were reduced by 69.7% and 80% respectively. Both the sprayed and UN-sprayed inter-crop ratio of 2:1 resulted in the least populations of the African boll worm and white fly.

Keywords: *Helicorvepa armigera, Bemisia tabaci, Vigna unguiculata, Gossypium hirsutum, Cotton-cowpea intercrop.*

1:0 INTRODUCTION

1.1 Background to the study

Cotton is an important major cash crop in Zimbabwe that is under serious threat from pests and diseases. Recent research has led to focus on ecological management of cotton pests through inter-crops. This practice has the ability to increase natural enemies while reducing pest population densities. About 15-20% of the world`s food supply is estimated to be produced under inter-cropping systems. In the tropics, intercropping is a way of increasing land, water, and solar radiation use (1). This type of cropping system bestows opportunities to maximize land use and resource efficiency by smallholder farmers in cotton growing, (2). The practice of growing cotton and cowpea in mixed cropping has been considered an important alternative in controlling pests and diseases, (3), (4). The practice of growing two or more crop species in one mixed stand remains one of the most important cultural pest management practices resulting in an ecosystem diversity increase as well as a reduction in insect pests. This is achieved through the use of crops in inter-crops that kill or repel insect pests (4.). Inter-cropping cotton and legumes results in crop biodiversity, which attracts a wide range of predatory insects, thus promoting an integrated management of pests in cotton, (5). Insect pest management is a major constraint to higher cotton productivity (6). According to worldwide research data, about 40% of cotton yield losses are experienced due to attack by insect pests, (7). In smallholder cotton farming pest management relies heavily on chemical control methods. Use of Pesticides alone eases pest problems in the short run while leading to problems like public health risks, environmental pollution, pest resistance, secondary pest occurrence and extinction of natural enemies thereby leaving farmers in a "vicious pesticide treadmill", (8). In Africa chemical control of pests is the widely used crop protection method while there is minimal use of alternative pest control practices, Research has established that non-chemical control techniques like trap cropping, inter-cropping, crop rotation, sanitation, cultivation, use of resistant crop cultivars and biological control have been successfully and widely used while chemicals have only been used as the last line of defence, (8). Inter-cropping has been a widely practiced aggro-technique of cultivating two or more crops in the same space at the same time, and this practice has achieved the goal of agriculture (9).

This makes cowpea a favorable trap crop to minimize *H. armigera* and *B. tabacci* damage in cotton. Cowpea are tolerant to drought and poor soil fertility environments, while they enhance conservation biological control by preserving locally found predators, (10).

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2.0 Objectives

The objective of this study was to determine the effect of inter-cropping cotton and cowpea on reducing African boll worm and white fly populations in cotton.

3:0 MATERIALS AND METHODS

This study was conducted at Cotton Research Institute of Kadoma, in Mashonaland West province of Zimbabwe, on latitudes 18^0 19` S and $29^0$ 53` E at an altitude of 1156 above sea level. It lies in the Natural Region 2b and receives 750mm mean annual rainfall. Summer temperatures average 32^0C in October and 22^0C in April. The site is fairly flat with reddish-brown to grayish-brown silt clay. Most of the area has moderate shallow silt clay that are subject to a moderate degree of seasonal wetness, (11). The experiment was laid in a Randomized Complete Block Design (RCBD) with 8 treatments and 4 replications. Plot sizes were 6 rows by 14m with a sampling area of 4 rows by 10m. The treatments were: the control treatment, Chemical control of *H. armigera* and *B. tabaci* in cotton with Lambda-cyhalothrin 5EC and Acetamiprid 20SP as the standard, Cotton-Cowpea inter-cropped at ratios of 1:1, 2:1 and 2:2 with UN-sprayed and sprayed treatments for *H. armigera* and *B. tabaci* in cotton. Cotton was grown using the basic agronomic practices as outlined in (12), standards. The measurements were weekly *H. armigera* boll worm eggs and larval counts and *B. tabaci* adult counts on 24 scouted plants per treatment. Scouting for African boll worm eggs and larvae as well as white fly adults was done twice a week commencing on 05 February 2013. The first scouting was for African boll worm eggs and white fly adults. The second scouting was for African boll worm larvae. Plants to be scouted were picked at random using a random selection of numbered plants in the sampling area. The data for *H. armigera* boll worm egg and larval counts as well as *B. tabaci* adult counts data was checked for normality. Data not normally distributed and low counts were transformed using the square root of count + 3/8, then analyzed using GenStat 14th edition (2011). Significant treatment means were separated using the Duncan`s multiple range test at p = 0.05.

4:0 RESULTS

4.1 Helicorvepa armigeraThe larval populations of *H. armigera* boll worm were least in cotton-cowpea inter-crop treatments ratio of 2:1 in both the UN-sprayed and the sprayed treatments. All other inter-crop treatments were comparable to each other while sole cotton treatments had the highest *H. armigera* bollworm larval populations (table 1).

4.2 Bemisia tabaci

The least white fly adult populations were observed in the cotton-cowpea inter-crop ratio of 2:1 in both the UN-sprayed and sprayed treatments. The other cotton-cowpea inter-crop treatments were comparable to each other and to sole cotton treatments, (table 1).

Table 1: Mean counts for H. armigera boll worm larva and B. tabaci adult populations on 24 plants per treatment

Treatment	Mean counts for African *boll worm* larva and white fly adults
	African bollworm Whitefly Larval counts adult counts
1	3.3^{d} 2.0^{bc}
2	3.3^{d} 2.5^{c}
3	2.3^{bc} 2.75^{c}
4	2.3^{bc} 2.75^{c}
5	1.8^{ab} 0.25^{a}
6	1.0^{a} 0.50^{ab}
7	3.0^{cd} 3.25^{c}
8	2.8^{cd} $2.0b^{c}$
Grand mean	8.09 2.0
LSD	0.7778 1.444
SE	0.3740 0.694
CV%	21.7 29.1

N.B. Values followed by the same letter are not significantly different at the 5% level (Duncan `s Multiple Range Test), *a* indicate the least mean aphid counts, while *d* represents the highest mean aphid counts.

5:0 DISCUSSION

5.1 *Heliothis* boll worm

Larval count was least in the cotton-cowpea inter-crop ratio of 2:1 (both the sprayed and UN-sprayed treatments). This result confirms earlier findings by earlier researchers that inter-cropping of cowpea with cotton is a cultural method that decreases target pests of cotton, (13). Research by (14) showed the least population of *Heliothis* boll worm being observed in cowpea cotton inter-crop as compared to sole cotton. This illustrates that the new technology will not cause boll worm problems when used. This study confirms earlier findings by (15) where he observed that growing of two crops in a mixture reduced pest problems. He also observed that cowpea have extra floral nectarines that attract lots of beneficial insects, the latter would prey on the insect pest in cotton, this may explain the decrease of insect pests in crops grown in a mixture. Sullivan in 2003 (15) further observed that pest levels are often lowered in inter-crops, as the diversity of plants hampers the movement of insect pests and in some cases encourages beneficial insect populations. The high number of Lacewing (*Chroysopa spp)* observed earlier explains the low *Heliothis boll worm* larval count as having been caused by predation of the boll worm eggs and larva by the predator (16). The results from this study further confirm the findings by (16) that boll worm complex outbreak is more in mono-cropping than in mixed cropping. 16 further observed that use of cowpea in inter-crops enhances the population of beneficial insects *Coccinellids* and *Chrysopa spp* in cotton cropping systems during the cropping season. This is very important for the management of the *Helicorvepa* spp by these natural enemies, thus potentially damaging pest species usually are never abundant enough to become actual pests.

5.2 White fly

Results from the current study show that all cotton-cowpea inter crops mixing ratios controlled white fly populations and the mixing ratio 2:1 gave the best result.

Reviewed inter-cropping studies noted that the practice reduced pest densities in 56% of the cases, increased in 16%, and not affected in 28% of the cases (17). The results of this study confirm earlier findings of studies by (16) which established that the presence of cowpea in cotton inter crops significantly enables a high population of beneficial insects in the cotton field on time, prior to the arrival of sucking pests (aphids and white flies). This enhances the efficacy of the beneficial insects in controlling the sucking pests (white fly) leading to a low population of the sucking pests in the inter crops. The lower insect attack is one of the many factors that maximize productivity in inter cropping systems, (14).

(18) observed that cotton pest outbreaks in mixed stands are less, a factor which can be explained by the resource concentration hypothesis and natural enemies hypothesis, these findings concur with the current findings from this research where white fly population was least in the inter-crop ratio of 2:1. (19) also noted that inter-cropping cotton with legumes reduced populations of white flies. (20) noted that growing of diversified crops in one field plot results in weeds and pest population reduction.

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The research established that inter-cropping cotton and cowpea reduce *Heliothis* boll worm and white flies in inter cropped cotton as compared to sole cotton due to the diversity of crops which hampers the movement of the pest. The cotton-cowpea mix ratio of 2:1 gave the least population of *Heliothis* boll worm and white fly populations among the inter-crop treatments.

6.2 Recommendations Basing on the findings, Farmers are encouraged to use a cotton-cowpea inter-crop ratio of 2:1 for better management of *Heliothios* boll worm and white flies in cotton.

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