

Factors Affecting a Farmer's Willingness to Adopt Intercropping in Cotton: A Case Study of Farmers in Magoye, Zambia

Mutibo Chijikwa

Cotton Development Trust

Zambia

Abstract

Although crop trials have shown that two crops that are agronomically compatible potentially produce a combined economic yield superior to the yield of a sole crop grown on the same area of land, there is little evidence of widespread adoption of this practice among smallholder farmers in Zambia. A survey was conducted among 80 randomly selected farmers in Magoye during the months of September and October 2010/11. This was to assess the use of cultural practises such as intercropping patterns in cotton production. Participatory Rural Approval (PRA) techniques, using questionnaires, interviews, focused group discussions (FGD), and transect walks were used to identify the various intercropping patterns used in the area.

The survey revealed that farmers in Magoye area were using two types of cultural practices to control insect pests in their cotton fields, these were; crop rotation (72.5%) and intercropping plus crop rotation (27.5%). The intercrops were grown either as a strip/single row pattern alongside the cotton crop or in between each row of cotton. The farmers in this area were using four different types of crops namely: maize, cowpea, beans and groundnuts with cowpea and beans being the most common combination (22%) of intercrops used. Qualitative responses to the survey indicated that the gender and educational level of a farmer were one of the main factors that affect a farmer's willingness to adopt intercropping.

Introduction

Cotton, *Gossypium hirsutum* L, plant belongs to the family Malvaceae (Paterson, 2009). It is a shrub native to tropical and subtropical regions around the world, including Africa. Ideal growing conditions are in regions with long vegetation periods without frost, high temperatures (30°C), ample sunshine, and a rather dry climate (Harvey, 1958). Cotton, considered as white gold, is one of the most important cash crops that are cultivated among small and medium scale farmers in Zambia. One of the major constraints to increasing cotton production is that it is attacked by many pests at every stage of the production cycle (Williams, 2006).

Cotton pests can be divided into two groups: early and late season pests. Early pests are those which attack the plant from planting until peak flowering and then gradually decline in numbers. They have a major effect on the yield quantity. These include: Aphids (*Aphis gossypii*), Jassids (*Empoasca spp*), and Cotton white fly (*Bemisia tabaci*). Late pests are those which begin their attack at the peak of flowering and continue up to harvesting. They affect mainly the quality of cotton. The major late pests in Zambia include Cotton stainers (*Dysdercus spp*), American bollworm (*Heliothis armigera*), Spiny bollworm (*Earias biplaga*) and Red bollworm (*Diaparopsis castanea*) (Braun, 1991).

Cultural control is the deliberate alteration of the production system, either the cropping system itself or specific crop production practices, to reduce pest populations or avoid pest injury to crops (Kogan, 1986). The primary aim of these cultural techniques is to reduce colonization of a

crop by a pest and/or to increase pest dispersal from that crop. Often these are by far the best methods of control since they combine effectiveness with minimal extra labour costs. Intercropping is a cultural control method that involves growing two or more crop species simultaneously on the same piece of land. (Hokkanen, 1991; Capinera *et al.*, 1985). Intercropping is a vital tool that is used in cotton Integrated Pest Management (IPM). This control strategy is highly favoured among small-holder farmers as it offers a diversity of food items and farmers are also protected against loss of any one of these if a specific pest outbreak occurs. The intercrop also provides shelter for natural enemies which in turn feed on the insect pests that attack the main crop. The presence of a more diversified flora has a negative effect on the ability of the insect pests to find and use their host plant (Dent, 1991).

Materials and Method

The study was conducted in Magoye area which is situated in the Southern Province of Zambia in Mazabuka district. Mazabuka district lies at an altitude of approximately 975 M.a.s.l. Magoye is located $16^{\circ} 2' 0''$ South and $27^{\circ} 37' 0''$ East. The map below shows Cotton Development Trust situated at plot 670/m (figure 3.1).

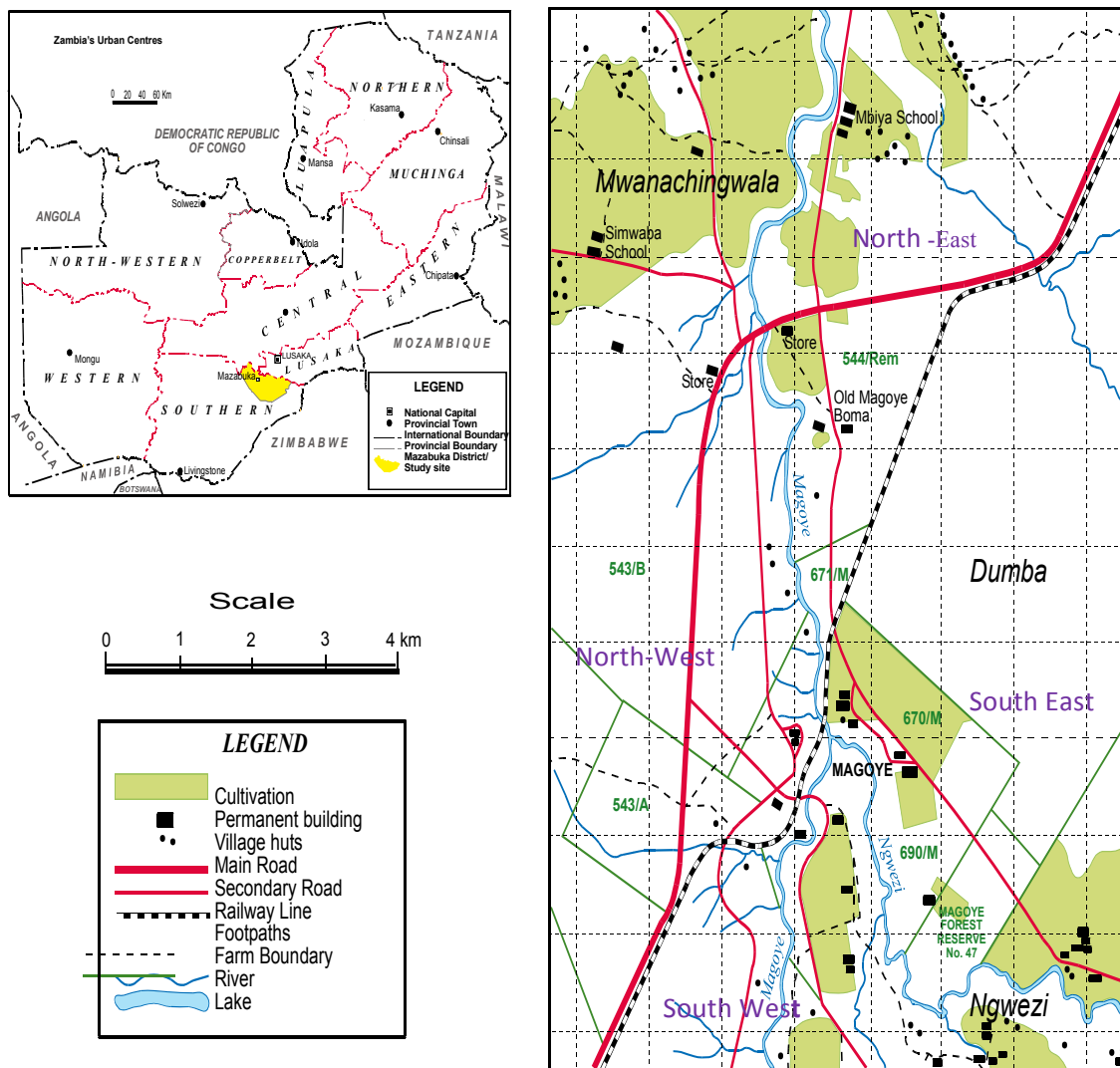


Figure 0.1: General map showing surveyed area and location of field study site
 (Source: Cartography department, Geography department, UNZA)

The survey was aimed at identifying the different types of intercropping patterns that occur in Magoye area and the farmer's attitudes towards intercropping. The study was carried out primarily through a survey of 80 randomly selected small holder cotton farmers in the months of September and October 2010. In obtaining the sample for the survey, stratified random sampling was used. Using the main rail line and secondary feeder road running through CDT, Magoye was divided into four areas namely North-East, North-West, South-East and South-West (figure 3.1).

Twenty farmers were interviewed from each of the four areas to make a total of eighty farmers. Participatory Rural Approval (PRA) techniques, using questionnaires was used to identify the various intercropping patterns that were being used in cotton production in Magoye area. The questionnaire was divided into four sections:

The data was summarized into frequency tables using the statistical package SPSS 16. The summarized data on number of farmers using intercropping, type of intercrops and intercropping patterns used in Magoye was entered into Microsoft excel to generate tables and bar graphs. Chi-square test was used to determine which socio-economic factors had any influence on farmers' attitude towards intercropping.

RESULTS

A total number of 80 households were surveyed to determine the type of intercropping patterns used by cotton farmers to control bollworms in Magoye (Table 4.1). Seventy- five percent of the farmers interviewed were males while 25% were females. The farmers interviewed ranged from ages 27 to 77 years old, with 44% of the respondents falling in age group three (48 -57 years old). The farm size of each individual farmer ranged from 1 to 160 hectares, though most of the farmers interviewed had farm establishments in group one (1 – 40 hectares). In terms of literacy

level, 81 % of the farmers interviewed were falling in group two (primary education) with only 2.5 % falling in group one (illiterate).

Table 0.1: Background information on small holder famers who participated in the survey.

Background characteristics	Description of group	Frequency	Percentage (%)
Sex	Male	60	75
	Female	20	25
Age	27-37	7	8.8
	38-47	23	28.8
	48-57	35	43.8
	58-67	11	13.8
	68-77	4	5
Hectarage	1-40	57	71.2
	41-80	20	25
	81-120	2	2.5
	121-160	1	1.2
Literacy level	Illiterate	2	2.5
	Primary	65	81.25
	Secondary	6	7.5
	Tertiary	7	8.75

The survey revealed that farmers in Magoye area were using two types of cultural practices to control insect pests in their cotton fields (figure 4.1), these were; crop rotation (72.5%), intercropping plus crop rotation (27.5%). Among the 28% of farmers who had used intercropping to control cotton pests, the intercrop was grown either as a strip or single row pattern alongside the cotton crop or in between each row of cotton. The majority of farmers (72 %) did not use any form of intercropping (figure 4.2)

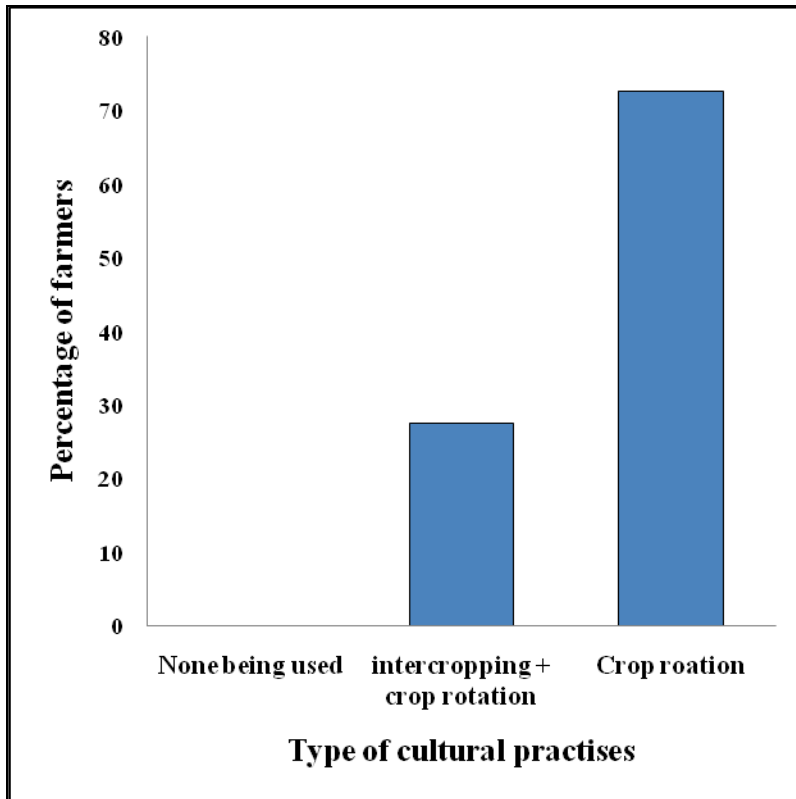


Figure 0.2: Percentage of farmers using different types of cultural practices in Magoye, Mazabuka district, Zambia.

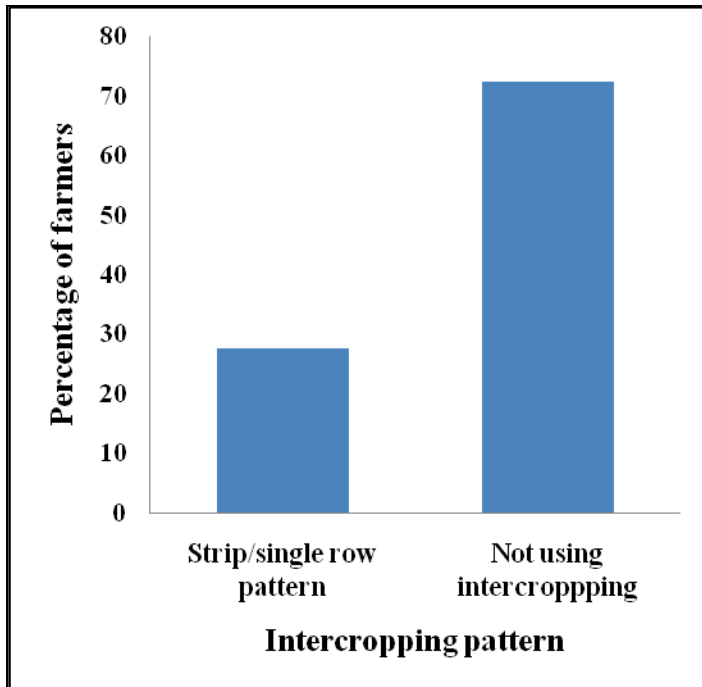


Figure 0.3: Percentage of farmers using row pattern intercropping pattern in Magoye, Mazabuka district, Zambia.

Farmers using intercropping indicated four different types of crops that served as intercrops in their fields. These were maize, cowpea, beans and groundnuts. These crops were either grown as a single intercrops or a combination of multiple intercrops grown along with cotton. Cowpea with beans was the most common combination practice (22%), while the combination of groundnuts, cowpea and beans; maize and cowpea were only used by two percent of the farmers (figure 4.3). Among the five intercrops identified, only cowpea and maize were selected to be incorporated in the experimental field study, alongside sorghum, pigeon pea and sunflower.

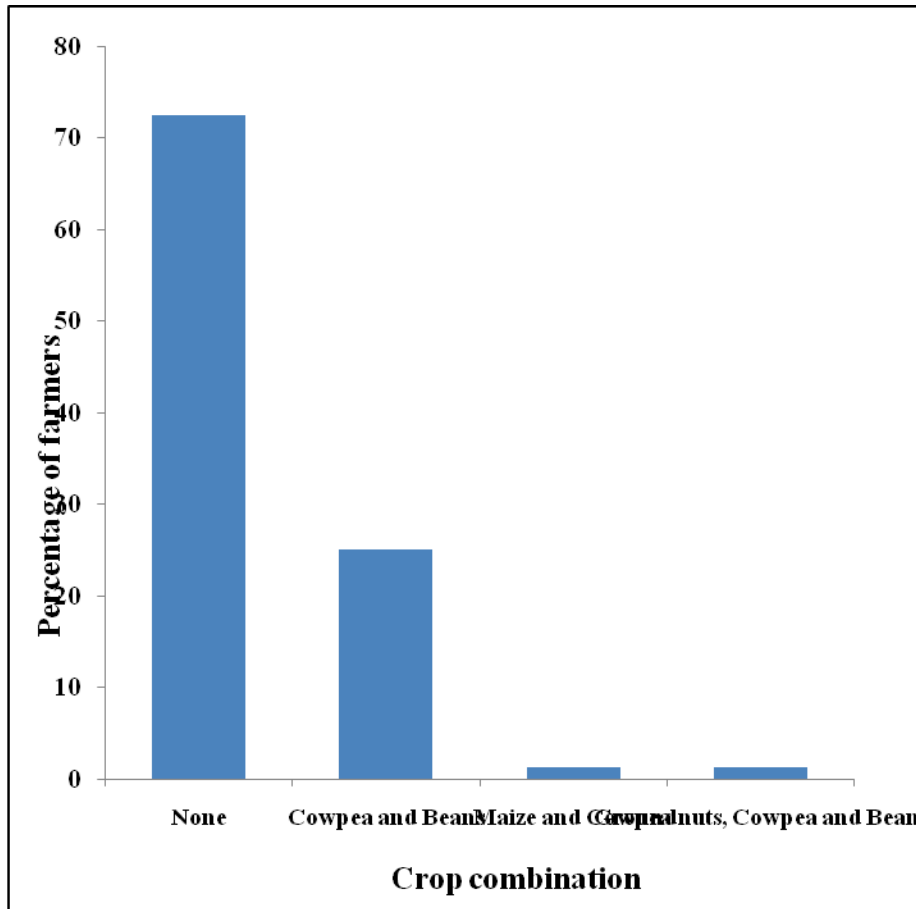


Figure 0.4: Different crop combinations used for intercropping by farmers in Magoye, Mazabuka district, Zambia.

4.1.1 Farmers attitude towards intercropping

Table 4.2 showed that the probability of gender ($X^2=5.938$, $df = 1$, $P = 0.015$) and literacy level ($X^2= 14.618$, $df= 3$, $P = 0.002$) of the farmer, affected the farmers' willingness to incorporate intercropping into his/her farming system. Farmers with little or no education showed no willingness to incorporate intercropping into their farming systems even if a suitable intercrop was identified (Figure 4.4). Farmers who have attained secondary and tertiary education were more willing to use intercropping. Figure 4.5 showed that among all the farmers interviewed male farmers had a higher percentage (92%) of willingness to adopt intercropping as compared to female farmers (70%) who showed less interest.

Table 0.2: Attitude of farmers in Magoye towards intercropping.

Background characteristics	Probability (<i>P</i>)
Region in Magoye where farmer resides	P (0.319) > 0.05
Literacy level of the farmer	P (0.002) < 0.05
Agricultural camp affiliated with	P (0.298) > 0.05
Ginning company affiliated with	P (0.672) > 0.05
Gender of farmer	P (0.015) < 0.05
Ownership type of farm land.	P (0.235) > 0.05
Age of farmer	P (0.608) > 0.05
Hectarage of farm	P (0.822) > 0.05

Where $P \leq 0.05$ there is a significant probability; where $P > 0.05$ there is no significant probability

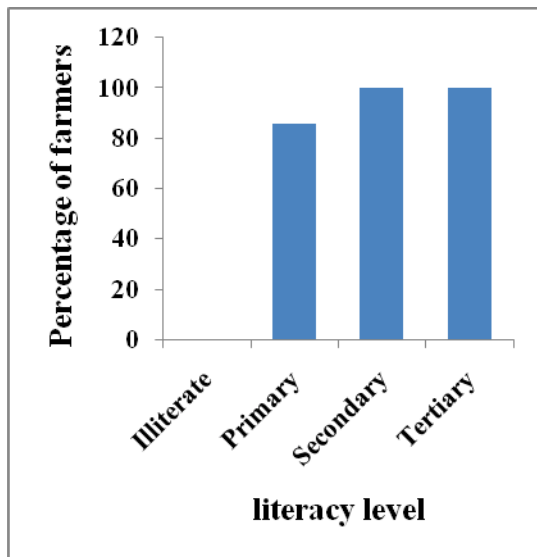


Figure 0.5: Willingness of farmers to adopt intercropping if a useful intercrop is identified.

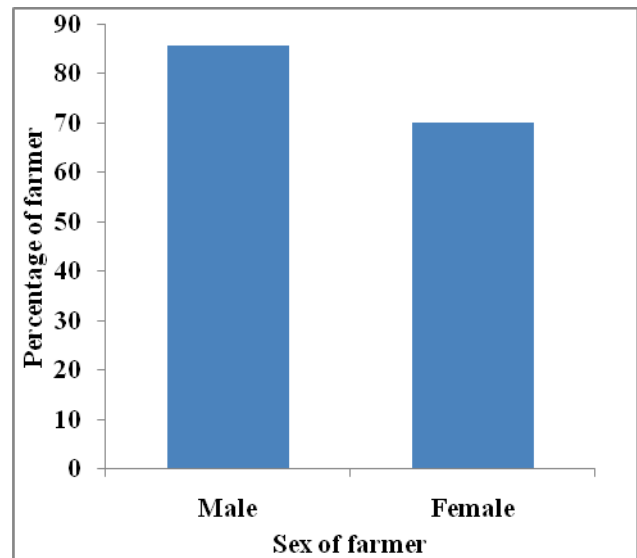


Figure 0.6: Sex ratio of farmers who were willing to incorporate intercropping into their farming system.

Discussion

The single – strip or row intercropping pattern, used among farmers in Magoye, is usually encountered in small-scale agriculture. Traditional agriculture, as practiced through the centuries, has always included different forms of intercropping. Farmers grew a variety of crops, often intermingled in the same field, to sustain themselves and their families (MacRoberts *et al*, 2007). Farmers using intercropping have adopted a more sustainable approach to cotton production as compared to modern monocropping systems (Ecological Agriculture Projects, 1997).

Despite some farmers in Magoye using intercropping, it was clear from this study that there was no definite pattern in how the intercrops were planted; row(s) of the intercrop were planted either beside the cotton field or in single rows in-between several rows of cotton. These types of intercropping patterns are more traditional practices used over many generations than the refined intercropping systems being promoted in sustainable agriculture (Jalloh, 2001). This shows a low adoption rate for modern intercropping systems among farmers in Magoye. This is despite the efforts made by the government and Non-governmental organizations (NGOs) such as Conservation farming unit (CFU) to introduce intercropping as a pest management strategy to cotton farmers in Southern province (Haggblade and Tembo, 2003).

The study further showed that gender and literacy level of a farmer had a significant influence on the attitude of a farmer towards intercropping. Figure 4.4 showed that with increased education, the farmer was more likely to practice intercropping. Adeoti (2009), working with Ghanaian small-scale farmers reported similar results. Gender also had a significant effect on the likelihood of a farmer to adopt intercropping. Ninety- two percent of the male farmers and only 70% of the

female farmers in the study area were willing to adopt intercropping. In the African set - up, gender inequalities in agriculture means that women farmers have limited access to financial resources and they have no or minimal involvement in the decision making process regarding agricultural development at household level.

Therefore female farmers are less likely to adopt intercropping as they may not have the financial resource to experiment with the technology, the required labour to manage the crop and the power to make the decision about the technology (Adeoti, 2009). Availability of labour is a major socio economic factor that affects the adoption of agricultural technology among African small -scale farmers (Kwesiga *et al.*, 1999). The majority of female farmers will not have the extra skilled man power required to manage an intercropping pest management strategy. Therefore the dominance of gender inequality in the agricultural sector presents a bottleneck to the development of IPM cotton in Zambia.

The survey further showed that multiple-cropping is quickly diminishing among small holder farmers in Magoye. As more and more farmers are encouraged to enter market systems by planting monocrops to produce marketable surplus, intercropping becomes unfavourable. This is despite all the information available on the negative effect of monocultures concerning insect pest problems (Perrin, 1997; Pimentel and Goodman, 1978; Smith,1973) and the positive attributes of crop diversity for decreasing pest impact (Perrin, 1997; Cromartie, 1981; Litsinger *et al* 1980). The 22 farmers who were using intercropping used five different crops (Figure 4.3). These included: - Cowpea; Beans; Maize; and Groundnuts. Cowpea and beans were the most commonly practiced combination of intercrops among small-holder farmers in the area. These crops were economically important to the farmers as they acted as a food source for the household (Kombiok *et al.*, 2005). Since cowpea had the additional advantage of being able to

fix nitrogen in the soil, it was selected alongside maize, sorghum, pigeon pea and sunflower for the field trial (Part B).

Farmers generally avoid taking unnecessary risks unless the advantages are clearly visible (Eponou, 1996). Farmer adoption of intercropping methods are usually strongly constrained by the need for the intercrop to show significant direct economic benefits and this will depend on many factors that are unrelated to cotton pest management (Russel, 2004).

Conclusion

The present study indicated that intercropping was being used by few small-scale farmers in Magoye, Mazabuka district of Zambia. The intercrops were grown as strips or single row intercropping patterns. The most common combination used was cowpea and beans. This study shows that this technology has been poorly adopted by small holder farmers in Magoye.

References

- Adeoti, A.I. 2009. Factors Influencing Irrigation Technology Adoption and its Impact on Household Poverty in Ghana. *Journal of Agriculture and Rural Development in the Tropics and Subtropics* 109 (1): 51–63.
- Braun M. 1991. *IPM Training Manual: Tanzanian German IPM project GTZ.PPD*. Chinyanga. Tanzania.
- Capinera, J. L., T. J. Weissling and E. Schweizer. 1985. Compatibility of intercropping with mechanized agriculture: Effects of strip intercropping of pinto beans and sweet corn on insect abundance in Colorado. *Economic Entomology* 78:354-57.
- Cromartie, W. J. 1981. The environmental control of insects using crop diversity. *In CRC Handbook of Pest Management in Agriculture*. Boca Raton.
- Dent D. 1991. *Insect Pest Management*. Redwood Press Ltd. UK.
- Ecological Agriculture Project. 1997. *Intercropping*, McGill University, Canada
- Eponou, T. 1996. *Partners in technology generation and transfer: linkages between research and farmers organizations in three selected African countries*. ISNAR. The Hague, Netherlands.
- Haggblad, S and G. Tembo. 2003. *Development, diffusion and impact of conservation farming in Zambia*. Food security Research Project. Working paper no 8.

Harvey L.F. 1958. *Cotton growing*. Melmont Publishers, inc. USA.

Hokkanen, 1991. Trap cropping in pest management. *Annual Review of Entomology*. 36:119-138.

Jalloh, A. 2001. *Promoting appropriate intercropping technologies for sustainable agriculture production in Africa: A farmer centered approach*. Institute of Agricultural Research. Sierra Leone.

Kogan, M and P. Jepsson (eds). 2007. *Perspectives in ecological theory and integrated pest management*. Cambridge university press.

Kombiok, J.M., E.Y. Safo and C. Quansah .2005. Yield and Nitrogen fixation of cowpea as affected by tillage and cropping system in Northern Savanna zone of Ghana. *West African Journal of Applied Ecology*. 7: 95- 108.

Kwesiga, F.R., S. Franzel, F. Place, D. Phiri and C.P Simwanza (1999) *Sesbania sesban* improved fallows in eastern Zambia: Their inception, development and farmer enthusiasm. *Agroforestry Systems* 47:49 -66.

Litsinger, A., E. C. Price and R. T. Herrera. 1980. Small farmer pest control practices for rain fed rice, com and grain legumes in three Philippine provinces. *Philippine Entomology*. 4:65-86.

MacRoberts, A.L., P. Kosina and J. Jones. 2007. *Maize intercropping in Africa*. International Maize and Wheat improvement Centre (CIMMYT).

Paterson, A.H. 2009. *Genetics and Genomics of Cotton*. Springer. New York, USA.

Perrin, R.M. 1977. Pest management in multiple cropping systems. *Agro-Ecosystems* 3:98- 118.

Pimentel, D. and N. Goodman. 1978. Ecological basis for the management of insect populations. *Oikos* 30:422-37.

Russell, D. 2004. Insect Pest Management for least Developed Countries. In Horohz. A. R and I Ishaaya (eds) *Insect pest management: field and protected crops*. Springer-Verlog Berlin Heidelberg 141-179.

Smith, R. F. 1973. Management of the environment and insect control. *Proceedings of FAO Conference in Ecology in Relation to Pest Control*. Rome: FAO.

Williams M. R. 2006. Cotton losses: 2005 In: *2006 proceedings of Beltwide Cotton Conference*, South Antonio, Texas. National cotton council pp 1151-1204.