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Evaluation of Row Intercropping on Insect Pests and Yield of *Sesamum Indicum* in Ilorin

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Abstract

Row intercropping is the cultivation of two or more crops simultaneously on the same field with a row arrangement with the aim of reducing the insect/mite pest populations because of the diversity of the crops grown**.** Field plot experiment was conducted to study the effect of row intercropping *Sesamum indicum* and *Ceratotheca sesamoides* (cv. Gogoro) on the infestation by *Antigastra catalaunalis* Endl., *Apanteles syleptae* and *Plusia acuta*. The experiment was carried out in a randomized complete block design. There were five treatments with each replicated three times. The treatments were namely sole crop *S. indicum*, sole crop *C. sesamoides* (cv. Gogoro), intercrop 1:1 (1 row of *S. indicum*: 1 row of *C. sesamoides* (cv. Gogoro), intercrop 2:1 (2 row of *S. indicum*: 1 row of *C. sesamoides* (cv. Gogoro), intercrop 1:2 (1 row of *S. indicum*: 2 row of *C. sesamoides* (cv. Gogoro). There was no application of insecticides to the treatments. Counting of selected insects was done three times a week. The crops were harvested 8 weeks after planting for analysis of the yield using ANOVA and the land equivalent ratio (LER). The highest mean number of *A. catalaunalis* was recorded on sole crop *S. indicum* (1.9) and the least mean number of *A. catalaunalis* was on *C. sesamoides* (1.3). Intercrop 2:1 gave the highest reduction in pest number among the three different intercropping patterns. It also had the highest LER value of 4.47 implying that the intercropped area was more productive than the monoculture.

Keywords: *Antigastra catalaunalis*, population, row intercrop, sesame.

1. Introduction

Sesame (*Sesamum indicum*) also known as Beniseed belongs to the family Pedaliaceae. It is an erect annual herb of about 120 cm – 150 cm tall [2], indigenous to Africa and is of ancient cultivation [16]. *Sesamum indicum* occurs wild in West and central Africa and is cultivated there on a small scale [3] and it is closely related to the strictly African genus *Ceratotheca sesamoides* [11]. *Sesamum indicum* is of numerous economic importances, being used in medicine for the treatment of infant cholera, diarrhoea, catarrh and bladder troubles [6]. Edible oil can be extracted from the seeds and young shoots are finely chopped for use in soups or sauces eaten with porridge [6].

The crop is grown mainly for its seeds which contain 50 – 52% oil, 17 – 19% protein and 16 – 18% carbohydrate and are used mainly for cooking purposes, salad oil and margarine [20]. The seed is rich in calcium and high in antioxidants and other healthful features [5]. The oil extracted from sesame is used in soap making, paint making and as a lubricant. The oil can be used in barrier creams to protect the skin from harmful ultraviolet light radiation and is important in the international market [11].

The world production is estimated to be over 15 million acres (6.2 million hectares) and over 57% of the world production is in Asia and most of the Asian production is in India, China, and Burma (Myanmar). Africa grows 15% of the world's sesame, with Sudan, Uganda, and Nigeria being key producers [5]. The potential for sesame production in Nigeria is very high. An estimated 3.5 million hectares of the country's agricultural land are suitable for the production of sesame but the average yield of this crop is about 300kg/ha which is four times lower than the average yield of other oil seed crops like groundnut and soybeans [4]. Biotic factors of which insect pests are

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predominant account for the poor productivity of the crop in Nigeria. All stages of sesame plant are attacked on the field by insect pests causing extensive damage to the crop. In Venezuela the sweet potato whitefly *Bemisia tabaci* is the limiting factor to sesame production [7] while [9] reported that the sesame leaf roller *Antigastra catalaunalis* attacks all parts of the sesame plant except the root causing between 5% - 40% damage. [13] also reported that *A. catalaunalis* usually attacks the sesame crop when it is 15 days oil and continue until the crops mature.

These insect pests have been controlled for years with the use of pesticides which is the most common and fastest method of control used by farmers [10]. The usage of pesticides raises a number of environmental concerns as pesticides not only destroy their target organisms but also contaminate the water bodies and the soil while polluting the air. This has made a search for alternative control methods imperative. The use of cultural practices such as intercropping has been reviewed as a better way to control pests and diseases, being environmentally friendly thus promoting better human, plant and animal health.

The objective of this study is to evaluate the extent to which intercropping of *S. indicum* with *Ceratotheca sesamoides* cv. Gogoro can reduce the infestation and damage caused by *A. catalaunalis* and thereby increase productivity of sesame.

2. Materials and Methods

The experiment was conducted under field conditions at the Teaching and Research Farm, University of Ilorin. The site is located at latitude 08^0 29’N and longitude 04^0 35’E in the Southern Guinea Savanna of Ilorin, Nigeria The annual precipitation is 800-1200 mm [18] and the annual temperature range is $22\text{-}34^0C$ with a marginal soil type suitable for sesame cultivation.

Seeds of sesame (*Sesamum indicum*) and cv. Gogoro (*Ceratotheca sesamoides*) were purchased from Ipata, a local market in Ilorin. The experiment was conducted using a Randomised Complete Block Design. There were 5 treatments i.e. sole sesame, sole cv. Gogoro, intercrop 1:1 (1 row of sesame: 1 row of cv. Gogoro), intercrop 2:1 (2 rows of sesame: 1 row of cv. Gogoro) and intercrop 1:2 (1 row of sesame: 2 rows of cv. Gogoro). Each treatment was replicated 3 times.

The area of land used is 7m x 7m. The land was ploughed and harrowed and prepared into flat beds for planting. The land was divided into 5 blocks. Planting was done using 30cm intra row spacing and the seeds were drilled into the prepared beds. There were 15 plots with each plot measuring 2m x 1m, made up of seven rows. Each plot was separated by 0.5m alley. The spacing was the same for both sole and intercrops. NPK 15-15-15 fertilizer was applied to the crops two weeks after planting. There was no chemical control of insect pests and weeding was done initially prior to planting and later once in every two weeks for the duration the crop was on the field using a hoe. Sampling for insects was done three times a week from 2 weeks after planting. Sampling for insects was done on all rows in each plot. Fresh pods of *S. indicum* and fresh leaves of *C. sesamoides* were harvested 8 weeks after planting and weighed. This was used to compute the yield of the crops. The harvest was obtained from 40 cm length in any two rows randomly selected from the sole crop plots and 40 cm in any two rows randomly selected from the component crops in the different intercrop treatments. The data collected were subjected to square root transformation before analysis using the Analysis of Variance. The means were compared using the Duncan’s Multiple Range Test. The Land Equivalent Ratio (LER) using [9] formula was used to evaluate the productivity of the crop mixtures in relation to their monocultures. All statistical analysis was done using SPSS (version 21).

3. Results and Discussion

Sesamum indicum, intercrop 1:1 and intercrop 2:1 had the highest mean number of *Antigastra catalaunalis* and this was significantly different from intercrop 1:2, while cv. Gogoro had the least mean number of *A. catalaunalis* (Table 1). Sole crop *S. indicum* had the highest mean number of *A. catalaunalis* for the duration the crop was in the field and it was significantly different ($P<0.05$) from cv. Gogoro which had the least mean number of *A. catalaunalis*. The intercropping patterns were able to reduce the mean number of *A. catalaunalis* on *S. indicum* with intercrop 2:1 and intercrop 1:2 appearing to be better in reducing the population of *A. catalaunalis*. Sole *S. indicum* had the highest mean number of *A. catalaunalis* for the duration of the experiment when compared to the other cropping patterns.

This is in agreement with [15] who reported that *A. catalaunalis* is the most serious pest of sesame causing the death of seedlings, damaging leaves, buds, flowers, capsules and reducing the yield of the crop.

Among the 3 intercropping patterns, there was none that gave a consistent reduction in the mean number of *A. catalaunalis* (Table 1).Between week 3 – 6 intercrop 1:2 performed best and it was significantly different (P<0.05) from sole S. indicum, while from week 7 – 10 intercrop 2:1 performed best though it was not significantly different (P>0.05) from Sole *S. indicum* at week 9 – 10. The intercrop 2:1 at week 4 -8 reduced the population of *A. catalaunalis* compared to its population on sole *S. indicum*. This is in support of [1] who reported that the capsule damage due to the gall fly and the leaf webber and capsule borer at harvest were significantly lesser than the intercropped sesame compared with the sole crop sesame. The lowest population of *A. catalaunalis* was recorded on cv. Gogoro. This is not in agreement with the work of [19] who reported that *A. catalaunalis* is the major pest of *C. sesamoides* being present in the field from seedling to harvest. The reason for this observation is uncertain.

The parasite *Apanteles syleptae* first occurred at 4 weeks after planting with sole *S. indicum* having a significantly higher population than sole cv. Gogoro (Table 2). The 3 intercrop patterns were able to significantly lower the population of *A. syleptae* when compared to sole *S. indicum* (Table 2) with intercrop 2:1. The population of *A. syleptae* was observed to be higher on sole crop *S. indicum* where *A. catalaunalis* had its highest population. This could be due to the parasitic nature of *A. syleptae* on *A. catalaunalis*. This observed trend is in agreement with the work of [19] who reported that with increase in the population of *A. catalaunalis,* there was also an increase in population of *A. syleptae* until there was a decrease in population of *A. catalaunalis*.

Plusia acuta populations were low for the duration of the experiment. *Plusia acuta* was present from week 4 – 6 after planting (Table 3). There was no significant difference (P>0.05) between the sole crop *S. indicum* and the 3 intercrop patterns for the duration of the experiment (Table 3). This corroborates the work of [19] who reported that *P. acuta* are minor pests of cv. Gogoro.

Table 1: Effect of intercropping *S. indicum* and *C. sesamoides* cv. Gogoro on the mean number of *A. catalaunalis*

	Mean number of *A. catalaunalis* counted/ Weeks after planting									
Treatments	1	2	3	4	5	6	7	8	9	10
Sole *S. indicum*	0.7a	0.7a	1.7a	1.8a	1.9a	1.9a	1.5a	1.1a	0.8a	0.7a
Sole cv. Gogoro	0.7a	0.7a	1.5c	1.6c	1.6c	1.6c	1.3b	0.8b	0.8a	0.0a
Intercrop 1:1	0.7a	0.7a	1.7a	1.7b	1.7b	1.9a	1.3b	0.9a	0.6a	0.6a
Intercrop 2:1	0.7a	0.7a	1.7a	1.7b	1.7b	1.7b	1.3b	0.7c	0.4a	0.5a
Intercrop 1:2	0.7a	0.7a	1.6b	1.6c	1.7b	1.7b	1.5a	1.1a	0.8a	0.0a
SED	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.4	0.1
LSD	0.0	0.0	0.2	0.2	0.2	0.2	0.2	0.4	0.3	0.3

Transformed data using square root transformation presented. Means not followed by the same letter in a column are significantly different at P<0.05

Table 2: Effect of intercropping *S. indicum* and *C. sesamoides* cv. Gogoro on the mean number of *Apantele syleptae*

	Mean number of *A. syleptae* counted/ Weeks after planting						
Treatments	1	2	3	4	5	6	7
Sole crop *S. indicum*	0.7a	0.7a	0.7a	1.2a	3.5a	1.0a	0.8a
Sole crop *C. sesamoides*	0.7a	0.7a	0.7a	0.8c	1.1d	0.8a	0.7a
Intercrop 1:1	0.7a	0.7a	0.7a	1.0b	2.5c	1.0a	0.7a
Intercrop 2:1	0.7a	0.7a	0.7a	0.9b	2.4c	1.0a	0.7a
Intercrop 1:2	0.7a	0.7a	0.7a	0.9b	2.7b	1.2a	0.7a
SED	0.0	0.0	0.0	0.1	0.2	0.2	0.1
LSD	0.0	0.0	0.0	0.2	0.5	0.5	0.1

Transformed data using square root transformation presented. Means not followed by the same letter in a column are significantly different at P<0.05

Table 3: Effect of intercropping *S. indicum* and *C. sesamoides* cv. Gogoro on the mean number of *Plusia acuta*

	Mean number of *P. acuta* counted/ Weeks after planting						
Treatments	1	2	3	4	5	6	7
Sole crop *S. indicum*	0.7a	0.7a	0.7a	0.7a	0.8a	0.7a	0.7a
Sole crop *C. sesamoides*	0.7a	0.7a	0.7a	1.1a	0.9a	0.8a	0.7a
Intercrop 1:1	0.7a	0.7a	0.7a	0.8a	0.8a	0.7a	0.7a
Intercrop 2:1	0.7a	0.7a	0.7a	0.9a	1.1a	0.9a	0.7a
Intercrop 1:2	0.7a	0.7a	0.7a	0.9a	0.8d	0.7a	0.7a
SED	0.0	0.0	0.0	0.1	0.1	0.6	0.7
LSD	0.0	0.0	0.0	0.2	0.2	0.8	0.9

Transformed data using square root transformation presented. Means not followed by the same letter in a column are significantly different at P<0.05

Table 4: Effect of insect population on yield of sesame and cv. Gogoro

	S. indicum	cv. Gogoro	LER
Treatments		Yield (g)	
Sole *S. indicum*	20.0		
Sole cv. Gogoro		92.0	
Intercrop 1:1	40.7	84.0	2.95
Intercrop 2:1	43.4	212.0	4.47
Intercrop 1:2	51.6	126.0	3.95

LER=Land Equivalent ratio

Sole crop cv. Gogoro had a higher yield (92g) than sole crop *S. indicum* (20g) (Table 4). This low yield of sesame could be due to the high population of *A. catalaunalis* found on the sole sesame in this experiment, confirming the work of [14] who had reported that *A. catalaunalis* is a serious pest attacking sesame on the field. cv. Gogoro had the highest component yield in the 3 different intercrop patterns. The yield in intercrop 2:1 (212g) and intercrop 1:2 (126g) being higher than that of the sole cv. Gogoro. *Sesamum indicum* obtained its highest yields in the intercrop patterns (Table 4), with intercrop 1:1 having the least yield (40.7g) and intercrop 1:2 having the highest yield (51.6g).

Intercrop 1:1 had the least land Equivalent Ratio (LER) value of 2.95 (Table 4), intercrop 2:1 had the highest LER value of 4.47 while intercrop 1:2 had a LER value of 3.95. Intercrop 2:1 had the best LER value indicating that it was the best intercropping pattern which produced the highest productivity in the crop mixtures. This intercrop pattern also accounted for the best reduction in the population of *A. catalaunalis* and *A. syleptae* which could explain the high productivity of the intercrop pattern. **This** result of this study agrees with [12] who stated that one of the advantages of intercropping is the reduction in losses from insects and diseases maybe reduced most probably because the crop mixture creates a less favourable environment for certain pests of one or both of the component crops. The LER value of intercrop 2:1 of 4.47 means that that the intercropped area would produce four times as much as the sole crop. All the intercrop patterns had values above 1.0 indicating that the crops would do better as intercrops than as sole crops. These intercropping patterns support the findings of [17] who opined that under local conditions, intercropping is a rational strategy in terms of profit maximization and/or risk minimization and nutrition.

4. Conclusions

The sesame webworm *A. catalaunalis* showed definite preference for *S. indicum* and infestation on *S. indicum* was reduced by intercropping with *Ceratotheca sesamoides* cv. Gogoro. The population of *A. catalaunalis* was highest on sole crop *S. indicum* while the lowest population was on sole crop cv. Gogoro. *Apanteles syleptae* population was more on sole sesame and the population was also reduced by intercrop 2:1. Intercrop 2:1 was most effective in reducing the pest population among the 3 intercrop patterns. It also had the highest LER value indicating that it had the highest productivity for the component crops. In view of this, cv. Gogoro could be used to protect the more susceptible but more economically important *S. indicum* in the management of *A. catalaunalis*.

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