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EFFECTS OF CROPPING PATTERNS ON THE CONTROL OF *PODAGRICA* SPP. (COLEOPTERA: CHRYSOMELIDAE) ON OKRA (*ABELMOSCHUS ESCULENTUS* (L.) MOENCH)

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ABSTRACT

Two years field experiments were conducted at the Teaching and Research Farm of Abubakar Tafawa Balewa University, Bauchi, Nigeria (Latitude 10° 17N and Longitude 9°49E) with a view to determining effect of intercropping okra with groundnut, cowpea and cotton and on reducing the population of *Podagrica* spp. on okra plant. Results of the experiments indicated that manipulations of cropping pattern using cotton, groundnut and cowpea as intercrop with okra not only reduced the population of *Podagrica* spp. on okra but also increased crop performances as well as improved fruit yield. The findings of these investigations strongly recommend the intercropping of okra with groundnut, cowpea or cotton for protection of the plant against *Podagrica* spp.

KEYWORDS: *Podagrica* spp., Cropping Patterns, Population and Okra

INTRODUCTION

In Nigeria, cropping pattern is generally is generally defined as the simultaneous cultivation of different crop species in close association on the same piece of land. The main objective of practice is to reduce the population of insect pests attacking crops in a particular field (Kumar, 1984). It is a common traditional practice among the farmers of Northern Nigeria (Udom, 1995). The Northern Guinea Ecological Zone in which, Bauchi State of Nigeria lies (latitude 10° 17N and longitude 9° 49E) supports a high density of settled population. However, the total food production is lower than the requirement (Norman, 1971). This is mainly due to poor yield resulting from frequent crop failures as a result of activities of insects pests, diseases and some other unfavorable growing conditions like drought that is commonly encountered in this part of the country. It is important to note that up till toady the demand of the Nigerian small scale farmers for standard method of managing insect pest population through the various cropping arrangements still remain largely unsatisfactory. This has already resulted into the present production trend of low quality okra that is even far below the requirement of the average Nigerian. This is as a result of the roles played by insect pests in limiting crop production especially in the tropics where man is always in competition with them for available natural resources (Ahmed, 2000). Food and Agriculture Organization of United Nation (1997) reported that the estimated annual losses due to insect pests alone stand at between 15-20% and 18-20% during production and storage, respectively. Such losses are even higher in developing countries, for example in Nigeria, the Federal Department of Agriculture in 1995 reported that about 60% of the total food and fibres currently being produced are lost to insect pests. These figures clearly show how insect pests are devastating our crops both in the field and storage. From the foregoing it is evident that much need to be done on intercropping especially on the aspect of entomology and hence the need to carry out more trials.

It was in the light of the above and coupled with the seriousness of damage caused by *Podagrica* spp, on okra as well as the hazards involved in the use of agro-chemicals particularly in Bauchi State of Nigeria, that it was considered desirable to carry out a study to determine the effect of cropping patterns on the control of *Podagrica* spp. on okra.

MATERIALS AND METHODS

Field experiments were conducted in randomized complete block design for two consecutive farming seasons (1998 and 1999). Both in the 1998 and 1999 trials, the land was first cleared, ploughed and harrowed twice before planting. Nigerian kwando short local and Indian long white variety of okra were intercropped with some selected varieties of groundnut (s-dakar), cowpea (kananado) and cotton (S1-cotton) during the trial. The two varieties of okra were independently planted on different plots of land to serve as control. The plot size was 6 x 4.2m² and was separated from each other by a distance of 1m on all the sides and 2m between replication. A total of eight treatments were used during the experiments and each was replicated three times. Both in the 1998 and 1999 trials, the land was first cleared, ploughed and harrowed twice before planting. Additionally, the seeds of both Nigerian kwando short local and Indian long white varieties were soaked in water for 24 hours before they were taken to the field for sowing. This was done in order to promote germination (Tindall, 1986). Sowing of seeds for the three different crops (cotton, cowpea and ground nut) and the two varieties of okra was done at a distance of 60cm between rows and 30cm within rows, which gave rise to a population of 84 plants per plot while cotton, groundnut and cowpea were intercropped with varieties of okra in a ratio of 1:1 per plot. All the agronomic practices for raising good vegetable crops (weeding, sanitation and fertilizer application) were strictly followed.

Damage caused to okra plant by *Podagrica* spp. was assessed by counting the number of damaged and undamaged leaves as well as measuring the height of okra both at vegetative and fruiting growth stages. The observations were done at an interval of 20, 30, 40, 50, 60, 70, and 80 days after planting. For the purpose of damage assessment, five plants from the two middle rows of each of the plot were randomly selected and tagged for recording observation on number of leaves per plant. Heights of the tagged plant were recorded at vegetative and flowering/ fruiting growth stages of the plants using a meter rule. Similarly, assessment of population of *Podagrica* spp. was made on five randomly selected plants from each of the 24 plots. Numbers of Podagrica spp. on both the upper and lower surfaces of the leaves of sampled plants was recorded. The counting was done early in the morning or late in evening (when the beetles

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were less active) at an interval of 20, 30, 40, 50, 60, 70, and 80 days after planting as recommended by Rao and Willey (1989). Harvesting of fresh fruit started when they were due and continues until when senescence set in and no more fruits were produced on them. For fruit yield, fresh fruits from the plants were picked once a week and the cumulative weight of harvested fruits were determined at the end of the crop's life. Additionally, number of fruits per plants was also recorded. Data obtained were subjected to the analysis of variance (ANOVA). Least significant difference (LSD) was used to differentiate between and among the treatment means (Steel and Torie, 1981).

RESULTS AND DISCUSSIONS

Effects of cropping two okra types along with cotton, groundnut and cowpea on leaf formation during the wet seasons of 1989 and 1999 are presented in Table 1. In the two years of trials, intercropping had significantly influenced leaves formation in okra. The number of leaves in okra intercrop mixtures was found to be higher than in the okra sole crop treatments throughout the period of observation. The number of leaves in the okra plant in the intercropped plots was consistently higher when compared with those from okra plants sole cropped plots. Highest number of 39.48 numbers of leaves per plants was recorded in Indian long white variety/cowpea mixtures. Iremerin (1988) had earlier reported that leaves being site of photosynthesis contribute immensely to the performance of okra plant. The result of this finding is also in line with the finding of Jodhan (1979) who reported that cropping arrangements in okra plant has serious effects on the number of leaves and can greatly affect the yield. In a similar study with cowpea, Raheja (1977) had indicated that higher numbers of cowpea leaves is likely to be obtained when intercropped with sorghum. Reasons on why number of okra leaves was consistently high on okra intercrop may be attributed to the low population densities of okra in the okra intercropped plots. It might also be due to the fact that the stems and minor crops (groundnut, cotton and cowpea) had served as protectant/breakers against the effects of wind on the leaves of okra plant which if not could have result in a serious defoliation. Furthermore, the nitrogen fixation properties of groundnut and cowpea could be an added advantage.

Table 1: Number of leaves per Okra Plant during the Rainy Seasons of 1998 and 1999

Treatments	Number of Leaves per Plant						
	20DAP	30DAP	40DAP	50DAP	60DAP	70DAP	80DAP
Data for the 1998							
SLV	2.01	2.95	4.00	6.17	8.22	7.59	8.00
ILWV	3.00	4.12	5.17	7.16	10.11	8.43	10.13
SLV and Cotton	2.98	4.00	5.14	8.89	13.40	13.00	14.25
ILWV and G/nut	3.27	5.00	7.01	10.41	16.00	17.00	16.11
SLV and Cowpea	2.85	4.00	5.80	9.00	13.70	15.11	15.30
ILWV and Cotton	2.81	4.99	8.00	9.02	15.43	15.70	17.74
SLV and G/nut	2.93	4.11	5.46	9.09	15.00	13.86	15.00
ILWV and Cowpea	3.11	6.00	9.24	10.11	17.11	16.22	19.48
LSD (p= 0.05)	0.61	1.61	1.00	1.81	4.72	6.00	2.60
Data for the 1999							
SLV	2.32	3.03	3.60	6.47	8.69	5.52	7.58
ILWV	2.05	3.66	4.81	7.62	11.38	8.00	11.53
SLV and Cotton	2.15	4.11	6.32	9.04	13.51	10.54	14.71
ILWV and G/nut	2.44	4.28	6.05	10.10	15.28	12.58	17.06
SLV and Cowpea	2.88	3.89	5.71	8.06	14.01	13.75	16.00
ILWV and Cotton	2.98	4.30	7.45	9.04	15.70	15.70	18.15
SLV and G/nut	2.72	4.24	5.60	9 .00	13.26	14.00	14.34
ILWV and Cowpea	3.53	5.73	10.00	12.87	17.98	18.31	20.00
LSD (p= 0.05)	0.53	1.48	0.81	2.06	4.07	5.77	2.29
Average Data for the 1998 & 1999							
SLV	4.33	5.98	7.60	12.64	16.91	13.11	15.58
ILWV	5.05	7.78	9.98	14.78	21.49	16.43	21.66
SLV and Cotton	5.13	8.11	11.46	17.93	26.91	23.54	28.96
ILWV and G/nut	5.71	9.28	13.06	20.51	31.28	29.58	33.17
SLV and Cowpea	5.73	7.89	11.51	17.06	27.71	28.86	31.30
ILWV and Cotton	5.79	9.29	15.45	18.06	31.13	31.40	35.89
SLV and G/nut	5.65	8.35	11.06	18.09	28.26	27.86	29.34
ILWV and Cowpea	6.64	11.13	19.24	22.98	35.09	34.53	39.48
LSD (p= 0.05)	1.14	3.09	1.81	3.87	8.79	11.77	5.52

ILWV = Indian Long White Variety, SLV = Short Local Variety
DAP = Days After Planting, G/nut = Groundnut

Populations of *Podagrica* spp. on okra plant obtained during the wet seasons of 1998 and 1999 are presented in Table 2. Statistical analysis of the results shows that population of *Podagrica* spp. in some treatments were significantly reduced as a result of the various cropping arrangements.

The result also shows that all the okra intercropped plots in 1998 and 1999 trials had lower populations of *Podagrica* beetles when compared with okra sole cropped plots. The reduction of *Podagrica* spp. in okra-intercropped plots could be expected because there was no freedom for the movement of *Podagrica* spp. in okra-intercropped plots as in okra sole crop treatments. This is because the continues feeding attitude operated by *Podagrica* beetles in sole cropping is disrupted in the intercropping plots as the insects have to fly or crawled a longer distance over the intercropped plots. The lack of freedom of movement of *Podagrica* spp., which makes it difficult for the insects to multiply rapidly as in the case of sole cropping. Absence of alternate host plants in the okra sole crop treatments could be another reason for the high population of *Podagrica* spp. among the pest spectrum of cowpea. Uvah (1978) had indicated the potentials of some insect pests of cowpea as natural enemies of insect pests of other crops.

Table 2: Population of *Podagrica* spp. on Okra Plant during the Rainy Seasons of 1998 and 1999

Treatments	Population of *Podagrica* spp. on Okra Plant						
	20DAP	30DAP	40DAP	50DAP	60DAP	70DAP	80DAP
Data for the 1998							
SLV	5.11	12.05	11.15	13.40	15.11	15.00	11.23
ILWV	7.46	12.16	13.22	21.45	17.15	20.00	18.20
SLV and Cotton	2.02	7.11	6.00	5.11	7.16	8.12	5.33
ILWV and G/nut	2.36	6.15	4.98	5.28	7.00	7.50	6.04
SLV and Cowpea	2.45	5.00	5.10	4.87	5.28	5.11	4.11
ILWV and Cotton	2.12	5.00	5.28	6.00	7.51	7.05	5.81
SLV and G/nut	1.48	6.00	5.98	6.15	7.00	7.18	6.00
ILWV and Cowpea	1.00	4.80	4.20	5.00	4.25	5.61	3.50
LSD (p= 0.05)	1.20	1.10	0.91	1.05	1.28	1.60	1.82
Data for the 1999							
SLV	4.02	8.46	14.23	17.10	14.89	15.96	10.57
ILWV	8.00	15.00	16.11	15.19	22.48	18.04	9.49
SLV and Cotton	3.06	7.15	6.12	5.88	7.08	6.89	5.65
ILWV and G/nut	3.06	6.45	6.56	5.68	7.29	7.62	5.02
SLV and Cowpea	2.48	4.14	5.08	4.69	4.65	5.27	4.22
ILWV and Cotton	3.17	4.79	6.66	6.18	6.75	8.19	6.00
SLV and G/nut	2.30	5.41	5.68	6.66	7.26	7.48	5.86
ILWV and Cowpea	0.96	4.28	4.20	4.06	5.60	4.02	3.30
LSD (p= 0.05)	1.11	1.05	0.86	0.83	1.18	1.56	1.90
Average Data for the 1998 & 1999							
SLV	9.13	20.51	25.38	30.50	30.50	30.96	21.80
ILWV	15.46	27.16	29.33	36.69	39.63	38.04	27.69
SLV and Cotton	5.08	14.26	12.16	10.99	14.24	15.01	10.98
ILWV and G/nut	5.42	12.60	11.54	10.96	14.29	15.24	11.06
SLV and Cowpea	4.93	9.14	10.18	9.56	9.93	10.38	8.33
ILWV and Cotton	5.29	9.79	11.94	12.18	14.26	15.24	11.81
SLV and G/nut	3.78	11.41	11.66	12.81	14.26	14.66	11.86
ILWV and Cowpea	1.96	9.08	8.40	9.06	9.85	9.63	6.80
LSD (p= 0.05)	2.31	3.15	1.77	1.88	2.46	3.16	3.72

ILWV = Indian Long White Variety, SLV = Short Local Variety
DAP = Days After Planting, G/nut = Groundnut

Effects of intercropping pattern on the height of okra plant during the 1998-1999 wet season are presented in Table 3. During the period, individual cropping arrangements seriously influenced the height of both the Nigerian kwando short local and Indian long white varieties of okra that were intercropped with the selected crops (groundnut, cotton and cowpea). The reason for the good performance of okra plant under intercropping environments is probably because of the low population trend of *Podagrica* spp. in the intercropped plots while possible reason for the poor performance of okra plant in sole cropped plots maybe attributed to the high population of *Podagrica* spp. in those plots and hence more damage to the plant by the pests which will subsequently lead to the poor yield of the plant.

The yield of fresh okra fruits obtained during the wet season of 1998 and 1999 is also presented in Table 3. Analysis of the result shows that quantity of yield obtained corresponded with the performance of the crops during the periods in question. The quantities of fruit yield obtained in okra inter crop plots were significantly higher than the corresponding sole crop plots. The low incidence of *Podagrica* spp. and the high number of leaves recorded in the okra-intercropped plots were responsible for the high fruit yield.

In conclusion, farmers stand a good chance of increasing okra production via intercropping with cotton,

cowpea or groundnut. This is because the result of the present investigation has shown and confirmed the importance of intercropping. Additionally, the method is economically viable in the sense that the cost of the practice is affordable to the small scale farmers in Nigeria. The method is also humane and compatible with the farmers because it does not involve the use of sophisticated equipments. However, much remain to be learnt about the range of interaction between pests and crops as well as the mechanism operating in mixed cropping systems. Extensive studies on the farmer's field are therefore required in this regard.

Table 3: Effects of Cropping Pattern on the Height and Yield of Okra during the Rainy Seasons of 1998 and 1999

Treatments	Heights of Okra Plant (cm)		
	Vegetative Growth Stage	Flowering/ Fruiting Growth Stage	Fruit Yield (Kg/ha)
Data for the 1998			
SLV	23.11	30.00	295.11
ILWV	31.14	48.10	326.11
SLV and Cotton	25.00	48.11	970.95
ILWV and G/nut	43.10	94.17	2,230.10
SLV and Cowpea	25.00	52.00	137.00
ILWV and Cotton	44.11	90.43	2,401.41
SLV and G/nut	24.11	50.00	1,810.18
ILWV and Cowpea	51.00	108.00	2,529.15
LSD (p= 0.05)	6.11	5.74	10.12
Data for the 1999			
SLV	24.58	29.87	294.39
ILWV	31.29	47.03	319.39
SLV and Cotton	24.30	49.25	954.95
ILWV and G/nut	41.00	88.47	2,264.70
SLV and Cowpea	25.00	51.81	260.55
ILWV and Cotton	43.52	90.00	2,366.99
SLV and G/nut	25.25	48.33	1,798.22
ILWV and Cowpea	49.35	105.21	2,539.15
LSD (p= 0.05)	6.13	6.15	189.38
Average Data for the 1998 & 1999			
SLV	47.69	59.87	589.5
ILWV	62.43	95.13	645.5
SLV and Cotton	49.30	97.36	1,925.9
ILWV and G/nut	84.93	182.64	4,494.8
SLV and Cowpea	50.00	103.81	2,742.5
ILWV and Cotton	87.63	180.43	4,768.4
SLV and G/nut	49.36	98.33	3,608.4
ILWV and Cowpea	100.35	213.21	5,068.3
LSD (p= 0.05)	12.24	11.89	379.5

ILWV = Indian Long White Variety, SLV = Short Local Variety
DAP = Days After Planting, G/nut = Groundnut

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