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Full Length Research Paper

Influence of intercrops on pests' populations in upland rice (*Oriza sativa* L.)

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We conducted a 3 x 4 factorial experiment fitted into a randomized complete block design, using three intercrops: cowpea (*Vigna unguiculata* L. Walp) at 0, 50,000, 100,000, 150,000 plants/ha; groundnut (*Arachis hypogea* L.) at 100,000, 200,000, 300,000 plants/ha; and egusi- melon (*Colocynthis vulgaris* L.) at 10,000, 20,000, and 30,000 plants/ha to evaluate their influence on incidence of stem borer (*Chilo zacconius*) (Blesz) and the green stink bug (*Nezara viridula* (L.)) in upland rice (*Oryza sativa* L.) .The experiment was conducted during the wet and dry seasons of 2004. Rice/cowpea recorded the highest incidence of *N. viridula* (3.1, 3.3%) compared to rice/groundnut (1.3, 1.3%) and rice/egusi, (1.8, 1.8%) during the wet and dry seasons respectively. Intercrop with groundnut significantly (p 0.05) reduced stem borer (*C. zacconius*) incidence to 7.4 and 13.2% respectively for wet and dry season cultivation compared with the control (12.0 and 18.0%). Rice and groundnut (100,000 - 200,000 plants/ha) intercrop is recommended for reduced incidence of *C. zacconius* and *N. viridula.* This result demonstrates that a careful selection of crop combination and plant population could lead to reduced insect pests' incidence in upland rice.

Key words: intercrops, plant populations, pest incidence, *Oryza sativa*, *Chilo zacconius, Nezara viridula,*

INTRODUCTION

Rice (*Oryza sativa*), a primarily tropical crop occupies the third position after maize and cassava as a major source of calorie for many Africans. Efforts have been made by various African governments to boost rice production. For example, in Nigeria, the National Cereals Research Institute organized a training programme for farmers aimed at improving rice production (NCRI, 1997). Despite such efforts, rice yield has remained low (1.4 - 2.2 t/ha) in many locations (NCRI, 1997). Insect pests constitute one of the most serious constraints implicated in the low yield of upland rice (De Datta, 1981). Two insect pests of rice that have economic significance are the stripped stem borer *Chilo zacconius* and the green stink bug (GSB) *Nezara viridula*. The stripped stem borer larvae penetrate rice tillers and feed on the inner surface of the stem walls, and this interrupts the movement of water and nutrients within the plant. Tunneling by the larvae weakens rice stems which then break easily. Damage to young rice plants results in dead hearts, whereas damage that occurs after spikelet formation causes panicles to turn white and no grain filling occurs, thus producing white heads (IRRI, 1986). Adults and nymphs of the green stink bug *N. viridula* feed and remove sap causing the plants to turn reddish brown or yellow. Significant damage is done during tillering as the feeding causes stunted growth and reduced tiller number. Again at booting, attacked plants have stunted panicles with many empty grains. The pest also sucks milk from the grains at milk stage. Plants infested with the pest have empty glumes and hence very low yields (IRRI, 1986).

Yield loss to insect pests of rice has been estimated at about 30 - 40% (Heinrichs et al., 1979). Control of these insect pests has been achieved with the use of insecticides. However, it is rather expensive for the resource poor farmers. Further, the injudicious use and over -use of insecticides has evolved countless perturbations in the crop's environment viz-a-viz resurgence of target pests and destruction of pests' natural enemy complex

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Table 1. Plant populations of the three covercrops intercropped with rice (*O. sativa*).

Plant density	Cowpea	Egusi	Groundnut
Low	50,000/ha (0.5 x 0.4)m	10,000/ha (1 x 1)m	100,000/ha (0.5 x 0.2)m
Medium	100,000/ha (0.5 x 0.4)m (2 seeds/hole)	20,000/ha (1 x 1)m (2 seeds/hole)	200,000/ha (0.5. x 0.2)m (2 seeds/hole)
High	150,000/ha (0.5 x 0.4)m (3 seeds/hole)	30,000/ha (1 x 1)m (3 seeds/hole)	300,000/ha (0.5 x 0.02)m (3 seeds/hole)

in rice (Heinrichs et al., 1979), and other environmental hazards including soil and water pollution.

This scenario justifies the need for a safer and yet cheaper system for controlling these pests of rice. Intercropping has been traditionally favoured by farmers since it reduces the likelihood of total crop failure (Balasubramanian and Seka, 1990; Wahua and Miller, 1978). More than 80% of Nigerian farmers practice intercropping (Okeleye et al., 2001).

Intercropping maize with cowpea significantly reduced pest population in the field (Blade et al., 1992) . Cowpea, groundnut and egusi melon share few pests with rice. Therefore, intercropping any of these with rice might help reduce insect pests' infestation in rice. Thus, this study examined the influence of different populations of cowpea (*Vigna unguiculata*), groundnut (*Arachis hypogea*) and egusi (*Colocynthis vulgaris*) on incidence of rice pests.

MATERIALS AND METHODS

A field experiment was conducted between 30th March - 30th June 2004 and repeated between 11th September - 11th December 2004 at the National Cereals Research Institute (NCRI) out station, Owot-Uta Ibesikpo Asutan, Nigeria located at 04'58^0 longitude 08'21^{0}E and 1,500 m above sea level. The first experiment was conducted on a two-year fallow land previously cultivated with fluted pumpkin (*Telfairia occidentalis L.*) while the repeat experiment was conducted on a two-year fallow land previously cultivated with cowpea (*Vigna unguiculata L. Walp*). Rice (ITA 301-medium maturing) was procured from the National Cereals Research Institute, Nigeria. Egusi (local) was purchased from the Uyo market. Cowpea (Ex-sokoto-indeterminate with white seeds) was obtained from the Federal University of Agriculture, Umudike while groundnut (RBBI-red coloured kernel type) was supplied by the Institute of Agricultural Research and Training, Samaru, Zaria. The experiment was a 3 x 4 factorial fitted into randomized complete block [RCB] design. Rice was planted at 0.5 x 0.25 m (2 seeds/hole) giving a plant population of 160,000 plants/ha. A total of 10 treatments were used and these were replicated 4 times. Plot size was 4 x 5 m^2.

The treatments were:

T_1- Sole rice (ITA 301)(zero population of cowpea, groundnut and egusi)
T_2- Rice (ITA 301) + cowpea (Ex-sokoto at low population (L).
T_3- Rice (ITA 301) + cowpea (Ex-sokoto at medium population (M).
T_4- Rice (ITA 301) + cowpea (Ex-sokoto at high population (H).
T_5- Rice (ITA 301) + groundnut (RBBI) at low population (L).
T_6- Rice (ITA 301) + groundnut (RBBI) at medium population (M).
T_7- Rice (ITA 301) + groundnut (RBBI) at high population (H).
T_8- Rice (ITA 301) + egusi (Local) at low population (L).
T_9- Rice (ITA 301) + egusi (Local) at medium population (M)
T_{10}- Rice (ITA 301) + egusi (Local) at high population (H).

Table 1 shows the three different plant populations for each cover crop. GSB incidence was measured by visual observation between flowering and ripening stage at 90 - 95 days after planting (d.a.p) by carefully counting the number of GSB in each panicle within a 1 m quadrat. Percent (%) GSB incidence was calculated as:

$$\%\ \text{GSB incidence} = \frac{\text{No. of GSB counted in panicles within the quadrat}}{\text{No of panicles within quadrat}} \times \frac{100}{1}$$

This was further recorded in a scale of 0 - 5 as follows: 0 = 0%; 1 = 20%; 2 = 40%, 3 = 60%; 4 = 80% and 5 = 100%.

Stem borer incidence was measured by counting the number of "deadhearts" within a 1 m^2 quadrat and again by counting the number of "whiteheads" within a 1 m^2 quadrat at 40 - 45 d.a.p, and thereafter determining the percentage thus:

$$\%\ \text{deadheart} = \frac{\text{No of deadhearts} \times 100}{\text{No of tillers within } 1\ m^2}$$

$$\%\ \text{white head} = \frac{\text{No of whitehead } (1\ m^2) \times 100}{\text{No of panicles } (1\ m^2)}$$

Grain yield was determined in tonnes/ha.

Statistical analysis

The data obtained were subjected to Analysis of Variance (ANOVA) according to procedures of Statistical Analysis System (SAS, 1999). Differences between means were determined using the Least

Significant Difference (LSD) statistic (p 0.05).

RESULTS

Stem borer incidence

There were no significant differences between the intercrops in stem borer infestation. However, stem borer incidence was significantly higher in the rice monocrop than all the intercrops recording 12 and 18% for both wet and dry seasons respectively (Table 2). Both low and medium populations of rice/cowpea had significantly lower stem borer incidence than rice monocrop while the high population of rice/cowpea did not differ from the medium population during the wet season. During the dry

Table 2. Effect of covercrops on incidence of *C. zacconius*, *N. viridula*, and rice yield.

Combination	*C. zacconius* (%)		*N. viridula* (%)		Rice yield (t/ha)	
	Wet season	Dry season	Wet season	Dry season	Wet season	Dry season
Rice monocrop	1 2.0	18.0	2.0	2.5	1.1	1.02
Rice/cowpea (L)	8.5	14.5	2.5	2.5	0.9	0.8
Rice/cowpea (M)	6.5	12.5	3.0	3.0	0.7	0.6
Rice/cowpea (H)	5.0	11.0	3.8	4.5	0.5	0.39
Mean value	6.7	12.8	3.1	3.3	0.7	0.6
Rice/Groundnut (L)	9.0	15.0	1.3	1.5	0.9	0.83
Rice/Groundnut (M)	6.9	12.8	1.3	1.3	0.8	0.83
Rice/Groundnut (H)	6.3	11.8	1.5	1.3	0.88	0.82
Mean value	7.4	13.2	1.3	1.3	0.86	0.83
Rice/Egusi (L)	7.3	13.3	1.8	1.8	0.81	0.71
Rice/Egusi (M)	7.5	13.5	1.8	1.8	0.73	0.63
Rice/Egusi (H)	6.5	12.5	2.0	2.0	0.70	0.60
Mean value	7.1	13.1	1.8	1.8	0.75	0.65
LSD^A (0.05)	1.88	0.77	0.50	0.71	0.074	0.043
LSD^B (0.05)	0.98	0.61	0.50	0.60	0.085	0.29
CV (%)	32.2	17.9	44	45	24.8	27.6

season however, the high population of rice/cowpea resulted in significantly lower stem borer incidence than the medium and low populations. A similar result was obtained in the case of rice/groundnut intercrop with rice during both seasons. In the case of rice/egusi intercrop with rice, no differences were observed in stem borer infestation amongst the different populations during the wet season. However, during the dry season, the high population had significantly lower stem borer infestation than the medium and low populations (Table 2). Between intercrops, low population of groundnut recorded the highest incidence of stem borers, next to rice monocrop. High population of cowpea (150,000) gave the lowest incidence.

Green stink bug incidence

Rice/cowpea intercrop at medium and high populations promoted higher incidence of GSB than rice monocrop during both seasons. In the case of rice/groundnut, all three populations were comparable in terms of GSB incidence (1.3 - 1.5%) and caused significant suppression of GSB than rice monocrop. Rice/egusi intercrop did not have any effect on GSB incidence. The highest GSB incidence was observed in the rice/cowpea intercrop (160,000 plants/ha) with a scale of 3.8 and 4.5 for the wet and dry seasons respectively while the lowest infestation was observed in the rice/groundnut intercrop with a mean incidence value of 1.3 (Table 2).

Grain yield

Yield of rice was significantly higher when planted sole than when intercropped with cowpea, groundnut or egusi. Except for groundnut during the wet season, the low population of all intercrops produced significantly higher yield than the medium population. Generally speaking, except for rice/cowpea, the high population of all intercrops did not differ in rice yield from the medium population. The lowest yield of 0.5 and 0.39 t/ha were obtained from rice/cowpea in the wet and dry season experiments respectively.

DISCUSSION

The various drawbacks of the use of insecticides for insect pests' control both in the field and in the store have necessitated research into non-chemical pest control such as the use of cultural practices including intercropping. Of interest is the fact that many African farmers practice intercropping (Okeleye et al., 2001). Of more significance however is the right crop combination as well as optimum plant population of the component crops. In this study, incidence of stem borer (*C. zacconius*) was lowest in intercropped plots compared to sole rice. The significant high stem borer incidence during both seasons is a clear indication of a favourable thriving environment for the pest. As noted by Bach (1980), intercrops or more diverse systems tend to have high density of predators and parasitoids than monocrops, and hence lower insect infestation. Intercropping studies by Wahua and Miller (1978) and Beets (1981) showed that intercropping reduced pests' incidence. From this study, high population of intercrops of cowpea, groundnut and egusi melon during the dry season and medium population during the wet season are recommended for the control of *C. zacconius*.

The high green stink bug incidence noted in the rice/cowpea combination is probably because the stink bug *N. viridula* is a common pest of rice and cowpea. So, the bug had a more favourable environment to thrive especially in terms of food availability than in other intercrops. Rice/cowpea crop combination is not recommended for green stink bug control. Rather rice/groundnut and rice/egusi melon at low and medium populations of the intercrops are recommended for the control of *N. viridula.* Since no significant differences were found between the medium and high populations, planting egusi-melon and groundnut at high population is uneconomical, and does not bring any added advantages.

Rice/groundnut produced the highest rice grain yield, quite close to the yield of rice monocrop, especially at medium and high populations evidently due to its controlling influence on *C. zacconius* and *Nezara viridula*. The added groundnut yield would give extra income to the farmer. Although rice/egusi-melon had a lower yield, it also is recommended at low population especially during the wet season.

Conclusion

This study shows that intercropping rice with cowpea increases green stink bug incidence over rice monocrops for the wet and dry season cultivations. On the other hand, intercropping rice with groundnut at low and medium populations of groundnut results in lower green stink bug and stem borer infestation.

It is therefore recommended that for reduced infestation by these pests and optimum rice production, rice should be intercropped with groundnut at a population of 100,000 - 200,000 plants/ha.

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