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*Full Length Research Paper*

# Impact of Forest Landscape Degradation on Insect Pest Dynamics and Farmer Perceptions in Southern Cameroon

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**Group surveys were conducted in five villages in each of the three resource-use zones of the humid forest zone of Southern Cameroon, to assess insect pests' incidence and the variation due to forest landscape degradation in the agricultural production systems. 389 farmers were interviewed. The results show that: (1) In annual crop systems, insect pests in general rank together with vertebrate pests and diseases amongst the most important agronomic constraints. No differences were found between the intensification zones, except for weeds, which appeared to be a greater constraint in the slightly degraded area. Within the insect pest, the greatest damage to crops according to farmers originated from borers and scales, followed by variegated grasshopper. Only the termites showed a difference between zones - the problem being greatest in the high -degraded areas. (2) In the young perennial crop systems, all the categories of agronomic constraints were equally important. Within the insect pest, mirids were identified as the greatest constraint, followed by borers and caterpillars. There were more variations in the responses according to zones compared to annual crops. Termites and scales were relatively more important in the high-degraded area. In term of control strategy, we recommended an integrated pest management.**

**Key words:** Farmers, pest, insect, annual crop, perennial crop, integrated pest management.

## INTRODUCTION

In Cameroon, agriculture account for 43% of the Gross Domestic Product (GDP) (Food and Agriculture Organization [FAO], 2004). The annual production of the mains exports crops varies between 3.5 to 1400 million of tones and those of main food crops varies from 25 to 2000 millions of tones. In general, compared to other countries such as South Africa, Nigeria, Ivory Coast and Egypt, the agricultural yields in Cameroon are very low (FAO, 2004). In fact, the rapidly growing populations and the economic requirements in Cameroon have led to an increase in demand for cash and food crops.

Consequently, whereas in the past, farmers could afford to leave land in fallow for periods sufficient to improve soil and disrupt pest and diseases life cycles, they now have to intensify cultivation of the same area, leaving it to fallow only when it becomes impossible to produce on it (Poubom et al., 2005). This situation has led to an increase in diverse production constraints.

Pests and diseases play a determining role in plant productivity (Rao et al., 2000; Schroth et al., 2000) and insects are the most dominant and harmful groups (Kumar, 1991). There are various insect pests of cash and food crops (Banjo et al., 2003). Hill (*In* Kumar, 1991) listed 407 very important species and 778 species of less importance, prevailing on 48 tropical crops. These figures do not hold account of a great number of other species met on these crops nor of the pest tackling the food products, during storage. They include stem and leaf eaters like the caterpillars of certain moths and butterflies; certain beetles and their larvae; the nymphs

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**Table 1.** Some characteristics of the three domains of the FMBA in the humid forest zones of the southern Cameroon.

| Characteristics | FMBA domains | | |
|---|---|---|---|
| | Yaounde | Mbalmayo | Ebolowa |
| Rainfall (mm)* | 1351.00 (Sa'a) | 1643.00 | 1820.00 |
| Annual Temperature ($^{o}$C) | 22 $^{o}$ 9 | 25$^{o}$ | 24 $^{o}$ 4 |
| Rural density (habitant / km$^2$) | 14-88 | 10-41 | 2-15 |
| Distance to the market (km) | 17.00 | 20.00 | 21.00 |
| Average annual surfaces of the cultivable grounds by family (ha) | 1.40 | 0.90 | 1.10 |
| Main ethnic groups | Etons | Ewondoses | Bulus |
| Length of fallow (in year) | 3.90 | 5.40 | 7.50 |

*Average for 10 years. Source: EPHTA (1996); FMBA = Forest Margin Benchmark Area.

and adults of grasshoppers; stem-borers like the corn-borers; feeders on fleshy fruits, seed and storage organs like the bean weevil, tomato fruit worm, etc (Kumar, 1991; Banjo et al., 2003). Many crop losses due to insects have been reported; and acceptance (Gurung, 2006) those of mirids range between 60,000-80,000 tons in Ghana, compared to an effective annual harvest of 200,000-250,000 tons. In Nigeria, attacks of Coleopteran are likely to destroy 70-90% of oil palm trees (Kumar, 1991). One of the largest brakes to the efforts of improvement of the legume productivity is the vast range of devastating insects associated with these crops (Kumar, 1991). The cereal outputs losses are evaluated to nearly 18-27% due to the borers. The damage caused by the yam charancon to the tubers of this crop goes from 5-70% and are always higher than 20% in the principal zones of production (Kumar, 1991).

The extent of insect damage in any system is determined by plant species and the interactions between pest and environmental factors (Rao et al., 2000). Thus, insect pests and their status can change according to the local environment conditions (Kumar, 1991). For example, cocoa pest varies from country to country (Kumar, 1991). The main coffee pests are rarely the same in different tropical regions (Kumar, 1991). The same pest diversity was observed in tea, cotton, sugar cane, rice, coconut and palm tree crops (Kumar, 1991).

Until now, insecticides are the main crop protection strategy in the tropical forest zones. Their utilization, in large areas has been one of the first important factors of crop loss reduction due to pests (Bani, 1990). But, because of their harmful effect on the environment, their utilization became weakly recommended, and the development of the new pest control became the priority. Pest identification and the understanding of the factors of influence of pest behavior are important assets in the installation of a better strategy of profitable and less harmful to the environment.

This paper presents the results of a group survey, administered to the farmers of the humid forest zone of Southern Cameroon, to assess insect pests' incidence and the variation due to forest landscape degradation in the agricultural production systems. The survey approach was justified by the concern of having a fast idea on the insect pest status in the production systems in the southern Cameroon and the need of collaboration between farmers, scientists, and extension services in term of priorities definition about the crop protection strategies. In fact, recent trends in agricultural research and development emphasize the need for farmer participation (Gurung, 2003). There has been increasing interest in the incorporation of farmer's knowledge into agricultural research and development programs (Marcia and Katrina, 2000). Farmers in general are good decision-markers (Goldman *In* Poubom et al., 2005) and their views have contributed to the understanding of various aspects of the bio-ecology of insects and the real situation of others pest. An ethnoentomological study, conducted in a Tharu village in Nepal, offered a basis to improve pest management programs in terms of efficacy and acceptance (Gurung, 2003).

The objective of the study, therefore, is to determine (1) the farmer's perceptions of crop pests, (2) the influence of forest landscape degradation on the variation of the insects' pest pressure and, (3) to show the importance of the integrated pest management strategies for the Southern Cameroon agriculture.

## MATERIALS AND METHODS

### Study site

The survey reported here was conducted between August and October 1998 in 15 villages of the Forest Margin Benchmark Area (FMBA) of the humid forest zone (3°27'-4°10'N and 11°32'-11°49'E) of Southern Cameroon. Serving as a focal point for strategic diagnostic research in the sub- region, the benchmark approach was developed and implemented through the Eco-regional Program for the Humid and Sub-Humid Tropics of Sub-Saharan Africa (EPHTA). In the FMBA there is a gradient of natural resource intensification, represented by 3 domains namely Yaounde < Mbalmayo < Ebolowa (EPHTA, 1996) . These domains differ in several aspects as shown in Table 1. In each Domains, five villages were selected for the study (Nkongmesse, Nkolmelok, Nkometou-II, Akak-II and Etoud for the Yaounde domain, Awae, Evindissi, Ngat,

**Table 2.** Relative importance (%) of the main agronomic constraints on annual and perennial crops in the humid forest zone of Southern Cameroon.

| Crop Types | FMBA domains | Insect pest | Vertebrate pest | Weeds | Crops diseases | Soil fertility | p-value |
|---|---|---|---|---|---|---|---|
| Annual food crops | Highly degraded zone (Yaoundé) | 21.20 | 24.00 | 12.40 | 22.40 | 20.00 | 0.0213 |
| | Fairly degraded zone (Mbalmayo) | 22.40 | 28.80 | 14.40 | 22.80 | 11.60 | 0.0003 |
| | Slightly degraded zone (Ebolowa) | 16.80 | 25.60 | 24.80 | 21.16 | 11.20 | 0.0024 |
| | p-value | NS | NS | 0.0013 | NS | NS | |
| | Mean | 20.13 | 26.13 | 17.20 | 22.30 | 14.30 | <0.0001 |
| Young perennial crops | Highly degraded zone (Yaoundé) | 18.4 | 18.40 | 16.80 | 20.80 | 25.60 | NS |
| | Fairly degraded zone (Mbalmayo) | 20.00 | 22.00 | 12.00 | 24.00 | 22.00 | NS |
| | Slightly degraded zone (Ebolowa) | 20.80 | 15.20 | 24.00 | 24.80 | 15.20 | NS |
| | p-value | NS | NS | 0.0146 | NS | NS | |
| | Mean | 19.73 | 18.53 | 17.60 | 23.20 | 20.93 | NS |

'p-value' is the significance level of Kruskal-Wallis (NS = no significance, P > 0.05). All other values are mean of score percentage of 10 farmer groups interviewed perFMBA domain. FMBA = Forest Margin Benchmark Area.

Mvoutessi and Nkolmetet for the Mbalmayo domain, and Minsélé, Mekoe, Mengomo, Akok and Obang-II for the Ebolowa domain). The level of forest degradation is more pronounced around Yaounde than in the Ebolowa domain, which still has some pockets of primary forest. Mbalmayo constitutes an intermediate zone. Equatorial climate (two unequal dry and rainy seasons) is the climate type of the southern Cameroon. Farmers, practice slash and burn agriculture in which bananas, plantains, cocoyam, cassava, yams and groundnuts are the mains food crops while cucurbits, okra, vegetables and spices are secondary crops (Westphal et al., 1981) . The food crops are cultivated in the poly cultural systems where cassava/maize and groundnut are the main associated crops. In the humid forest zone of the southern Cameroon, 'Affub bidi' is a mixed food crops field while 'Affub owondo' is the groundnut field (Gockwoski et al., 2004). Farmers also practice the garden crop field, marsh field and the dry season's fields. The dry season's fields are commonly used for cucumbers, in the mono crops system. Cucumbers in some cases are cultivated in association with yams, maize and or plantain. Perennials crops are commonly cultivated in mono crops system while cocoa and coffee are the main cash crops.

#### Survey

Information was obtained in each village with the rapid rural appraisal (RRA) methods (Gueye et al., 1991; Dvorak and Izac, 1995; NRI, 1996). The questionnaire was composed of 17 questions. These questions were regrouped in three parts; 5 relating to the annual crops, 5 others relating to the young perennial crops and 7 general questions. The final questionnaire containing open-ended and close-ended questions was prepared based on a preliminary one that was tested in two villages (Bikok and Abang), which were different from those, used in our investigations. Based on the results of this pre-test, we decided to work with two separate farmers' groups per village**.** The informants were farmers growing food or perennial crops. A total of 389 farmers (164 women and 225 men) were interviewed. These were divided into 30 groups (two par villages). Each group had 8 to 21 farmers aged 18 to 50. Interviews lasted for two hours per group at different hours of the same day. Farmers were requested to rank the main agronomic constraints of the humid forest zone of the Southern Cameroon; rank the insect pest, determine the edible plants and the feeding behavior of each insect. Farmers also rated the impact of these insect pests on the different field types in the humid forest zone of Southern Cameroon. Questions were asked in the local language and/or French. During the survey in each village, several samples of insects were shown to the farmers. For the various rankings, scores were used while the farmers answered the other questions directly.

#### Statistical analysis

Statistical analysis was carried out using SAS ver. 8 (SAS Inc., Chicago, Illinois, USA). The averages were calculated by the 'MEANS procedure' and compared by the Kruskal-Wallis test using the 'NPAR1WAY WILCOXON' procedure. All probabilities were appreciated at 5%.

## RESULTS

### Importance of insects among the main agronomic constraints in the Humid Forest Zone of Southern Cameroon.

**In annual crop:** Insect pests in general rank together with vertebrate pests and diseases amongst the most important agronomic constraints. They induce about 69% of crop pressures (Table 2). No differences were found between the domains, except for weeds, which appeared to be a relatively greater constraint in the slightly degraded area (Ebolowa) (Table 2). There was

**Table 3.** Relative importance (%) of the main insect pests on annual food and young perennial crops in the humid forest zone of Southern Cameroon.

| Crop Types | FMBA domains | Termites | Borers | Cater-pillars | Aphids | Mirids | Scale Insects | Variegated grasshopper | Bugs | p-value |
|---|---|---|---|---|---|---|---|---|---|---|
| Annual food crops | Highly degraded zone (Yaoundé) | 9.00 | 16.25 | 9.00 | 10.25 | 6.00 | 19.25 | 16.00 | 14.25 | 0.0003 |
| | Fairly degraded zone (Mbalmayo) | 2.25 | 20.50 | 10.00 | 9.00 | 7.25 | 22.25 | 16.00 | 12.75 | <0.0001 |
| | Slightly degraded zone (Ebolowa) | 3.50 | 22.25 | 11.75 | 12.50 | 4.75 | 17.00 | 13.75 | 14.50 | <0.0001 |
| | p-value | 0.0457 | NS | NS | NS | NS | NS | NS | NS | |
| | Means | 4.92 | 19.67 | 10.25 | 10.58 | 6.00 | 19.50 | 15.25 | 13.83 | <0.0001 |
| Young perennial crops | Highly degraded zone (Yaoundé) | 14.00 | 13.75 | 11.50 | 10.50 | 20.75 | 17.75 | 6.50 | 6.25 | 0.0097 |
| | Fairly degraded zone (Mbalmayo) | 1.00 | 19.25 | 18.75 | 9.75 | 28.00 | 13.25 | 6.75 | 3.25 | <0.0001 |
| | Slightly degraded zone (Ebolowa) | 3.25 | 22.00 | 14.00 | 13.50 | 27.50 | 4.50 | 11.25 | 3.50 | <0.0001 |
| | p-value | 0.0009 | NS | NS | NS | NS | 0.0156 | NS | NS | |
| | Means | 6.08 | 18.33 | 14.75 | 11.25 | 25.42 | 11.83 | 8.17 | 4.42 | <0.0001 |

'P' is the significance level of Kruskal-Wallis (NS = no significance, P > 0.05). All other values are mean of score percentage of 10 farmer groups interviewed FMBA domain. FMBA = Forest Margin Benchmark Area.

also some indication that soil fertility may be more of an issue in the high-degraded area (Yaounde) (Table 2).

**In the young perennial crop***:* All the categories of agronomic constraints were equally important (Table 2). Weeds were again the only agronomic constraint affected by the existing variations between the domains; they appeared to be a relatively greater constraint in the slightly degraded area (Ebolowa). However, in the Ebolowa area, vertebrate pests and soil fertility appeared to be somewhat less of a problem (Table 2).

### Incidence of Main Insect Pests in the Humid Forest Zone of Southern Cameroon

**In annual crops:** The greatest damage to crops according to farmers originates from borers and scales, followed closely by variegated grasshopper. About 39% of crops pressures are due to these two pests (Table 3). The farmers described the scales (60% farmer groups interviewed) and borers (77% farmer groups interviewed) like a polyphagous insect. Monophagous diets are not known at scales whereas 3% of farmer groups described the borers as being specialists of plantains. As regards the variegated grasshopper, it is a generalist polyphagous (67% farmer groups interviewed), never monophagous.

Only the termites' pressure showed significant differences between the domains (Table 3). Despite of the fact that about 52% of the farmer groups interviewed consider the termites such as not harmful insects, these insects represent a more important problem in the highly degraded area (Yaoundé) (Table 3). In their weak harmful effect, termites are especially polyphagous (32% of the farmer groups interviewed). However, 10% farmer groups interviewed observed a monophagous behavior at the termites; in that case, they are specialists of plantains, cucumbers or groundnuts.

**In the young perennial crops:** Mirids were identified as the greatest constraint, followed by borers and caterpillars (Table 3) . For 57, 59 and 60% of farmer groups respectively consider mirid, borers and caterpillars as polyphagous, and seldom as monophagous. (3, 10 and 10% of farmer groups) In their monophagous diets, borers (10% farmer groups) are specialists of palm tree or cocoa-tree, caterpillars are specialists of cocoa-tree or avocado tree whereas while mirids are specialists of cocoa-tree only (3% farmer groups).

There were more variations in the responses according to zones compared to annual crop systems (Table 3). Termites and scales were relatively more important in the highly degraded zone (Yaoundé). However, in the Yaoundé area, Borers appeared to be somewhat less of a problem. Scales and variegated grasshoppers, highly quoted in the annual crops are among the less harmful pests in the young perennial crops (Table 3). Termites (8% farmer groups interviewed), scales (45% farmer groups interviewed) and variegated grasshopper (30% farmer groups interviewed) are polyphagous. The incidence of variegated grasshoppers and termites on the young perennial crops is so low that 40 and 52% of

**Table 4.** Relative importance of mains insect pests damages in different field crop types in the humid forest zone of southern Cameroon.

| Insect pests | FMBA domains | Affub owondo | Affub bidi | Assan | Essep | Garden crop fields | Young perennial field crops | p-value |
|---|---|---|---|---|---|---|---|---|
| **Borers** | Highly degraded zone (Yaoundé) | 6.67 | 33.67 | 17.33 | 20.00 | 10.00 | 12.33 | 0.0004 |
| | Fairly degraded zone (Mbalmayo) | 11.33 | 28.33 | 19.67 | 17.00 | 10.00 | 13.67 | 0.0006 |
| | Slightly degraded zone (Ebolowa) | 9.00 | 27.67 | 21.00 | 21.00 | 7.33 | 14.00 | <0.0001 |
| | p-value | NS | NS | NS | NS | NS | NS | |
| | Means | 9.00 | 29.89 | 19.33 | 19.33 | 9.11 | 13.33 | <0.0001 |
| **Caterpillars** | Highly degraded zone (Yaoundé) | 19.67 | 15.67 | 13.67 | 14.67 | 22.33 | 14.00 | NS |
| | Fairly degraded zone (Mbalmayo) | 14.33 | 18.00 | 12.00 | 6.67 | 16.67 | 22.33 | NS |
| | Slightly degraded zone (Ebolowa) | 21.67 | 23.33 | 14.67 | 14.00 | 9.00 | 17.00 | 0.0030 |
| | p-value | NS | NS | NS | NS | NS | NS | |
| | Means | 18.56 | 19.11 | 13.44 | 11.78 | 16.00 | 17.78 | 0.073 |
| **Aphids** | Highly degraded zone (Yaoundé) | 6.33 | 12.33 | 13.00 | 8.00 | 23.33 | 18.67 | 0.06 |
| | Fairly degraded zone (Mbalmayo) | 13.33 | 20.00 | 10.00 | 6.67 | 26.33 | 23.67 | 0.0037 |
| | Slightly degraded zone (Ebolowa) | 11.35 | 23.67 | 16.67 | 11.67 | 10.59 | 23.33 | 0.0072 |
| | p-value | NS | NS | NS | NS | 0.0113 | NS | |
| | Means | 12.56 | 18.67 | 13.22 | 8.67 | 18.89 | 21.89 | 0.0007 |
| **Termites** | Highly degraded zone (Yaoundé) | 22.33 | 17.67 | 1.67 | 11.67 | 5.33 | 22.33 | 0.0003 |
| | Fairly degraded zone (Mbalmayo) | 1.85 | 14.81 | 0.00 | 2.59 | 0.00 | 2.96 | NS |
| | Slightly degraded zone (Ebolowa) | 7.33 | 9.33 | 0.00 | 15.00 | 0.00 | 8.33 | NS |
| | p-value | 0.0066 | NS | NS | NS | 0.0144 | 0.0160 | |
| | Means | 10.80 | 13.91 | 0.57 | 10.00 | 1.84 | 11.14 | 0.0039 |
| **Variegated Grass-hopper** | Highly degraded zone (Yaoundé) | 10.33 | 34.33 | 21.00 | 9.33 | 19.67 | 5.33 | <0.0001 |
| | Fairly degraded zone (Mbalmayo) | 31.33 | 28.33 | 9.00 | 5.33 | 17.33 | 8.67 | <0.0001 |
| | Slightly degraded zone (Ebolowa) | 19.33 | 28.00 | 20.33 | 12.00 | 6.67 | 13.67 | 0.0004 |
| | p-value | 0.0021 | NS | 0.0125 | NS | 0.0140 | NS | |
| | Means | 20.33 | 30.22 | 16.78 | 8.89 | 14.56 | 9.22 | <0.0001 |
| **Scales** | Highly degraded zone (Yaoundé) | 25.67 | 31.33 | 7.67 | 11.67 | 8.00 | 15.67 | <0.0001 |
| | Fairly degraded zone (Mbalmayo) | 28.00 | 39.67 | 6.33 | 8.33 | 5.33 | 12.33 | <0.0001 |
| | Slightly degraded zone (Ebolowa) | 31.00 | 47.00 | 4.33 | 3.33 | 1.67 | 12.67 | <0.0001 |
| | p-value | NS | 0.0483 | NS | NS | NS | NS | |
| | Means | 28.22 | 39.33 | 6.11 | 7.78 | 5.00 | 13.56 | <0.0001 |
| **Mirids** | Highly degraded zone (Yaoundé) | 0.00 | 21.33 | 4.00 | 13.67 | 4.00 | 57.00 | <0.0001 |
| | Fairly degraded zone (Mbalmayo) | 0.67 | 6.33 | 0.00 | 3.33 | 6.33 | 73.33 | <0.0001 |
| | Slightly degraded zone (Ebolowa) | 2.67 | 20.00 | 5.33 | 5.67 | 6.00 | 60.33 | <0.0001 |
| | p-value | NS | NS | NS | NS | NS | NS | |

**Table 4.** Contd.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Bugs** | Means | 1.11 | 15.89 | 3.11 | 7.56 | 5.44 | 63.56 | <0.0001 |
| | Highly degraded zone (Yaoundé) | 8.00 | 21.00 | 13.33 | 22.33 | 16.00 | 9.33 | NS |
| | Fairly degraded zone (Mbalmayo) | 6.00 | 10.00 | 14.67 | 50.33 | 8.00 | 11.00 | 0.0008 |
| | Slightly degraded zone (Ebolowa) | 4.67 | 8.33 | 19.67 | 57.00 | 2.00 | 8.33 | <0.0001 |
| | p-value | NS | NS | NS | 0.009 | 0.0133 | NS | |
| | Means | 6.22 | 13.11 | 15.89 | 43.22 | 8.67 | 9.55 | <0.0001 |

The values are the percentage of score averages for 10 groups of farmers interviewed per benchmark domain. Affub owondo is Groundnut' field. Essep is dry season' fields. Assan is marsh' fields. 'p-value' is the significance level of Kruskal-Wallis (NS = no significance, P > 0.05). All other values are mean of score percentage of 10 farmer groups interviewed per FMBA domain. FMBA = Forest Margin Benchmark Area.

farmers interviewed, respectively, regard them as undamaging insects (Table 3).

### Insect Pest Incidences In Different Field Crops Types In The Humid Forest Zone Of Southern Cameroon

Insect's pressure were very high in 'affub bidi' except for the mirids and aphids (pressure are very strong in the young perennial crop fields) and bugs (very harmful in 'esseps') (Table 4).

In general, no difference, in insect pests pressure were found between the domains in each field types, except for 'affub owondo' where termites and variegated grasshopper pressure appears to be very high in Yaounde (highly degraded area) and Mbalmayo (fairly degraded area), respectively (Table 4) . Scale pressure was stronger in 'affub bidi' in Ebolowa area. Mbalmayo area, showed in the 'assan', a weak variegated grasshopper pressure. In 'essep', bugs are less harmful in Yaounde. In the young perennial crops field, termites and mirids pressure was very high in Yaounde and Mbalmayo respectively. In the garden crop field aphids, termites, variegated grasshoppers and bugs were very harmful in Yaounde (Table 4).

## DISCUSSION

In the farmers' opinions, insects are among the most agronomic constraints in the annual and young perennial crops in the humid forest zone of Southern Cameroon (Table 2) . This information is close to what was previously reported by Weise (2002) in the forest and preforest zones of Cameroon. Most of the farmers showed a degree of awareness about the insect pest that attack their crops. However, in most cases, they come across the most common harmful insect. In the farmers' opinion, the greatest damage originates from borers, scales and variegated grasshoppers in the annual crop and mirid in the young perennial crops (Table 3). Mirids have been known always as major cocoa pest (Lavabre, 1992; Mossu, 1990; Sonwa et al., 2005) . They are responsible for black pod of about 10- 80% of loss per year in the cocoa production system in West Africa (Duguma et al., 2001). In the annual crop, scale induces crop alterations such as height reduction and root deformation (Braima et al., 2000). But, high scale pressure in the annual crop systems of the southern Cameroon can be linked to the presence of *Stictococcus vayssierrei* (cassava root scale) against which, no control methods are actually known (unpublished).

In the present study a non-significant difference in agronomic constraints pressure between the domains was observed, except for termites, scales and weeds.

According to farmer's opinions, deforestation increases scales and termite severity and reduces that of weeds. This means that scales, termites and weed incidences variations could be important tools in the follow-up of the evolution of the forest ecosystem disturbances. The highly degraded area (Yaounde) conditions can induce the invasion of this domain by savannah termite, which, opposite to forest termites are prejudicial to crop production (Gockwoshy et al., 2004). Weeds emergency can be an indicator of soil degradation (World Bank, 1998) . But when more cropping cycles have elapsed since clearing of the forest, the quantity of weeds seeds stocked in the soil can reduce (unpublished). This situation could justify the high weeds pressure quoted by farmers in the slightly degraded area (Ebolowa).

In general, the difference in pest incidence between the domains of the FMBA can be linked to the biophysical characteristics. In the naturals forest, pest damage is very limited (CTFT, 1974), deforestation destroys the ecological niches and contributes to the rupture of the existing stable biological balance and favor the pest population outbreak (Kekeunou et al., 2005). Factors like floristic diversity, host-plant richness, microclimate, spatial and structural arrangement and tree management affects pest infestation in the area (Rao et al., 2000).

Farmers' perceptions in southern Cameroon showed the necessity to carry out an urgent control strategy in the agricultural production system against scales, borers, mirids and variegated grasshopper *Zonocerus variegatus* as priority. The harmful effect of chemical control on the environment and the high cost related to their use has encouraged the need to develop new pest control strategies. The best control method is that which involves all available means to control pest (Autrique and Perreaux, 1989). Integrated pest management (IPM) strategy is a comprehensive approach that combined all rational strategies to reduce pest densities to tolerable levels while maintaining a safe quality environment (Modder, 1986; Swanton and Weise, 1991; Gray and Steffey, 1999). Numerous authors have developed IPM practices for selected pest species. There is a need to develop a logical sequence of studies that can incorporate the various components of IPM into a systems approach to pest management (Swanton and Weise, 1991).

For the poor countries such as Cameroon, where farmers practice subsistence agriculture, a good integrated approach, must combine the realistic methods that are accessible to the farmers. Trapping lure, biological and genetic controls are generally associated with high cost and their success need the state intervention, institutional and regional cooperation. In the Southern Cameroon, the combination of the preventive methods, cultural methods and the utilization of resistant cultivars must be encouraged (Autrique and Perreaux, 1989). Insecticides should be used only after all other effective insect control alternatives have been considered (Gray and Steffey, 1999).

The prevention can be based on (a) ploughing, (b) good weeding, (c) anti-deforestation and (d) agricultural intensification. Ploughing induces insect egg-pod and egg exposure and reduces the level of weed pressure and infestation (Rouanet, 2000; Modder, 1986); weeding induces the elimination of the damaging insects' host-plants. The removal of weeds (potential host plant) between the rows with one or two passes of an inter -row cultivator constitutes a preventive strategy (Swanton and Weise, 1991). The preventive method allows reducing the utilization of curative methods (though sometimes too expensive for the farmers) such as chemical application and in some cases can contribute to the amelioration of their efficacy.

Cultural practices which are hostile to insect's development are of great importance in the control strategies (Kumar, 1991). Before chemical pest and disease control became available, one of the phytosanitary cornerstones of agriculture with annual crops was crop rotation, and even nowadays it is an important way of controlling pest populations of nematodes, parasitic soil fungi and other pests and diseases in the agricultural systems (Bulloch *In* Schroth et al., 2000). Time of planting has an effect on the pest populations (Poubom et al., 2005). The displacement of the farming cycle of the cassava is used against variegated grasshopper in Congo (Bani, 1990). The cultural practice is not expensive for the farmers and does not necessitate in general, supplement material investments for controlling insects (Kumar, 1991).

Resistant plant varieties application is a simple, economical and very important strategy in pest control. They are not dangerous to the environment and are generally compatible with other pest control methods (Pathak and Saxena *In* Kumar, 1991).

The integration of farmer's knowledge and perception in the control strategies can accelerate and facilitate their adoption in the rural community. The development of traditional control methods is very limited (Poubom et al., 2005). Farmers know the traditional methods, which can be associated beneficially to the modern methods. For example, the influence of trees covers on the development of pest control systems has for long part been part of the traditional knowledge (Sonwa et al., 2005). A diverse number of traditional methods were used by farmers to control pests including the use of wood ashes sprinkled around the base of cocoa and kola trees as well on the vegetables (Banjo et al., 2003). Wood ash is also sprinkled on vegetables to keep away caterpillars (Banjo et al., 2003). In Cameroon, farmers control *S. vayssieri* by intercropping cassava with a species of *Pennisetum* (Pobom et al. 2005).

The success of the IPM requires regular training for the farmers. Efforts need to be focused within selected farmer groups of progressive farmers (Swanton and Weise, 1991). On-farm extension, workshops, tours, and seminars need to be carefully orchestrated to highlight recent changes (Swanton and Weise, 1991). To successfully implement an IPM system, extension personnel must be competently trained in agronomy and ecology. Extension agronomists must be aware of all the important biological and physical components of their cropping systems and must integrate this knowledge at the community level if they are to meet the challenges of economic and environmental sustainability (Swanton and Weise, 1991).

This survey highlights the most important agronomic constraints in the annual and young perennial crops. Borers and scales are the most important constraints relative to other insect pests, particularly in annual crop systems. In the perennial crop systems, mirids where ranked first. Termites and scales' pressure increases and weed pressure decreases in the high-degraded zones. In the opinion of the farmers, these agronomic constraints must be the priority for the national plant protection program.

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