African Journal of Agricultural Research Vol. 3 (2), pp. 255-258 April, 2008
Available online at http://www.academicjournals.org/AJAR
ISSN 1991-637X © 2008 Academic Journals

Full Length Research Paper

Effect of sorghum cultivars on population growth and grain damages by the rice weevil, *Sitophilus oryzae* L. (Coleoptera: Curculionidae)

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Accepted 24 January 2008

In northern Cameroon, the rice weevil, *Sitophilus oryzae* L. (Coleptera: Curculionidae) is a major pest *of Sorghum bicolor* (Poaceae) during storage. This staple crop is currently damaged by many insects and others pests during storage. To reduce the post-harvest losses due to *S. oryzae,* many control strategies are performed. An important step to achieve successful control is to isolate and characterize the noxious activity of rice weevil present on the sorghum variety currently stored. The present study shows that the two main ecotypes of *S. bicolor,* the "djiigari" ecotype is very susceptible to the 7 weevils strains isolated in the region. In a period of 100 days a single female of one of the most prolific strains produces 24 adults and more than 57% of grains are attacked. In the "safraari" ecotype, the level of attack is very low. This suggests that efforts should be made to advice the farmers to prefer "safraari" ecotype in order to avoid post harvest losses due to *S. oryzae*.

Key words: *Sorghum bicolor*, stored products, *Sitophilus oryzae*, Cameroon.

INTRODUCTION

In northern Cameroon, sorghum is one of the most cultivated staple crops (Seignobos, 2002). Many varieties of this cereal are present, but two cultivars are frequently cultivated and stored by local farmers (Mathieu et al., 2002). These cereals provide food for the family and seeds for agricultural campaigns. More than 80% of the harvested sorghum is stored in granaries (Ngamo Tinkeu et al., 2001).

In this traditional granaries where whole agriculture production is stored, optimal conditions are encountered to favor the development of tropical insect pests (Gwinner et al., 1998). The rice weevil *Sitophilus oryzae* (Coleoptera: Curculionidae) which is a major pest of sorghum stored (Ngamo Tinkeu et al., 2001; Ladang 2004; Ngamo, 2004). *S. oryzae* is a primary pest; able to feed on clean grains, this reduces not only germination efficiency but also nutritional and commercial values (Gwinner et al., 1998; Kossou and Bosque-Perez, 1992). In granaries, this weevil can induce up to 75% of losses of the grains during storage (Dal Bello et al., 2001). The annual losses of grains due to weevils are estimated to an average of 25 to 40% after 6 months of storage (Bell and Posamentier, 1998). According to the crop variety and to the destructiveness of the pest, this loss could reach 50% (Helbig 1995). The present study aims to evaluate the level of post-harvest losses parameters induced by different rice weevil strains (from different locations) on the 2 sorghum varieties currently used in northern Cameroon.

MATERIAL AND METHODS

Collection of sample grains infested in traditional granaries

The samples of infested grains were collected from three provinces in northern Cameroon. The Figure 1 shows the localities of northern Cameroon where samples grains of sorghum infested by *S. oryzae* were collected from in granaries. Table 1 shows the precision of geographic location of sampling sites.

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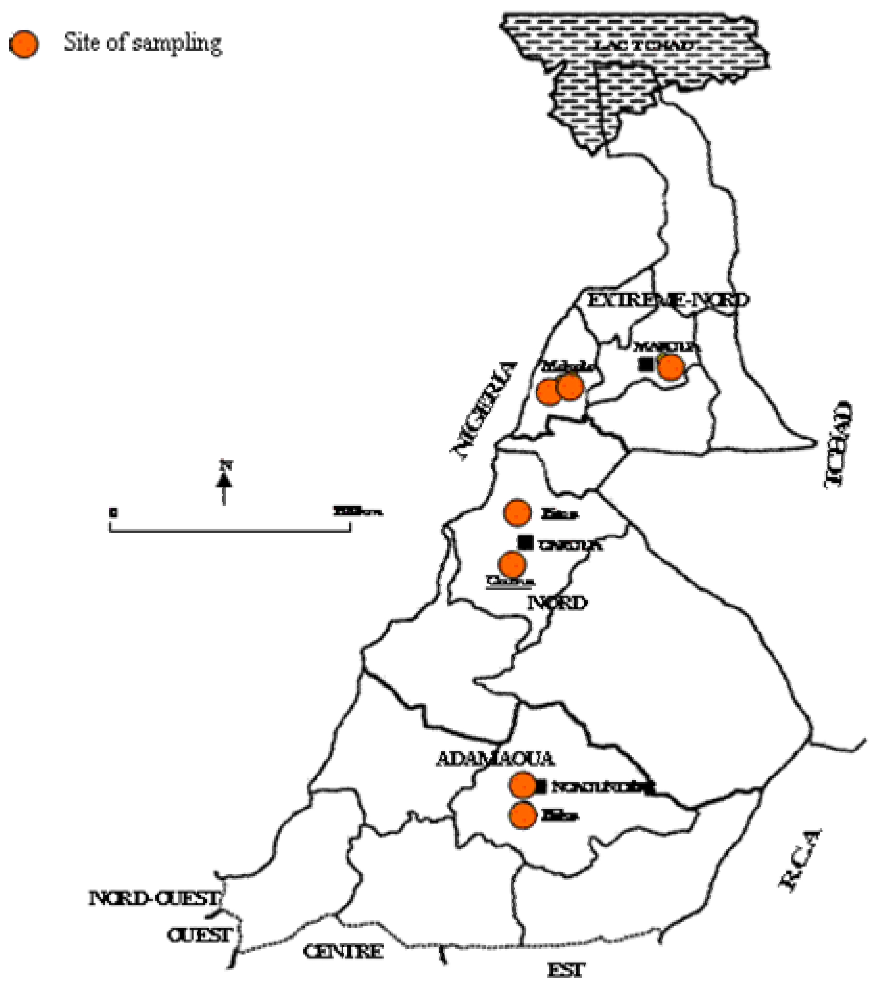

Figure 1. Location of sites where *S. oryzae* were collected.

Table 1. Geographic location of sites where infested sorghum collected in northern Cameroon.

Codes	Sites	Longitude	Latitude
24Z	Béka	13°33'E	7°19'N
41Z	Ngaoundéré	13°34'E	7°19'N
43Z	Pitoa	13°30'E	9°23'N
44Z	Gouna	13°31'E	8°31'N
51Z	Maroua	14°19'E	10°35'N
69Z	Mokolo 1	13°484'E	10°43'N
70Z	Mokolo 2	13°484'E	10°43'N

For each sample of grain, 1 kg was placed in a 1200 ml glass jar labeled according to the sampling location and kept in the laboratory under these conditions (humidity, temperature). During 2 months, these samples are checked daily, Once / twice a week, for emergence of weevils. The emerged weevils are collected and reared separately for further experiences.

Effect of weevil origin and sorghum variety on the destructive activity

For each origin of *Sitophilus oryzae*, five young pairs (3 days old) (which sex? couples?) were placed in 50 ml glass vials containing 10 g of clean grains. 48 h after infestation, all insects were removed. Two main sorghum varieties currently stored in Northern Cameron were used: “njiigari” and “safraari”. Five replications were made for each origin of *S. oryzae* and for each sorghum variety. The breeding were conduct in an incubator at 30°C during 100 days.

After this period, the tubes were removed. The emerged insects were counted and the quantity of bore dust was measured using a “Sartorius” electronic balance type 1264001 MP 68 (Data Weighing Systems, Elk Grove IL). The weight losses (B) were estimated according to the method describe by (Cruz et al., 1988).

$$B(\%) = \frac{P_s N_a - P_a N_s}{P_s(N_s + N_a)} \times 100$$

Table 2. Amount of *S. oryzae* emerged on two sorghum varieties after 100 days of storage.

Sorghum varieties	Origin location of *S. oryzae*						
	24Z	**41Z**	**43Z**	**44Z**	**51Z**	**69Z**	**70Z**
"Njiigari"	23.6±1.4[a]	18.5±1.1[a]	13.8±0,7[a]	24.2±1.6[a]	20.2±1[a]	21.3±1[a]	11.6±1.8[a]
"Safraari"	12.2±1.9[b]	17±1.5[a]	7.6±1.7[b]	9.3±1.2[b]	14.8±1.3[b]	6.8±1[b]	8.6±1.5[b]
t-test	32.14*	10.26[ns]	31.66*	41.87*	65.05**	70.25**	18.39*

Values followed by the same letter in the column do not differ significantly * $p < 0.05$; ** $p < 0.01$; [ns] no significant difference.

Table 3. Quantities of bore dust (mg) after 100 days of storage.

Sorghum varieties	Origin location of *S. oryzae*						
	24Z	**41Z**	**43Z**	**44Z**	**51Z**	**69Z**	**70Z**
"Njiigari"	280±56[a]	296±21[a]	264±10[a]	233±10[a]	277±16[a]	216±12[a]	177±13[a]
"Safraari"	108±32[b]	179±19[b]	64±15[b]	101±18[b]	163±18[b]	81±16[b]	129±11[b]
t-test	13.45*	37.50*	40.68*	36.27*	40.85*	33.20*	40.18*

Values followed by the same letter in the column do not differ significantly * $p < 0.05$.

Table 4. Percentage of weight losses of two sorghum varieties after 100 days of storage.

Sorghum varieties	Origin location of *S. oryzae*						
	24Z	**41Z**	**43Z**	**44Z**	**51Z**	**69Z**	**70Z**
"Njiigari"	11.0±1.3[a]	12.7±2.6[a]	6.4±2.5 [a]	8.0±0.8[a]	6.3±2.5[a]	6.8±1.3[a]	7.6±1.2[a]
"Safraari"	3.6±0.8[b]	3.3±0.6[b]	1.3±0.5 [a]	2.6±0.9[b]	3.0±0.6[a]	2.3±1.0[a]	2.2±0.4[b]
t-test	21.39*	13.51*	6.75[ns]	19.68*	8.09[ns]	12.40[ns]	17.32*

Values followed by the same letter in the same column do not differ significantly * $p < 0.05$; [ns] no significant difference.

Where: N_s = Amount of clean grains; Na = amount of infested grains; P_s = Weight of safe grains; P_a = Weight of infested grains.

RESULTS AND DISCUSSION

After 100 days on sorghum, losses parameters observed are depending on the varieties sorghum and origin of *S. oryzae*. The Table 2, 3 and 4 shows two sorghum varieties, the number of insect emerged; the quantities of bore dust and the weight losses induce by *S. oryzae* come from different locations.

The amount of *S. oryzae* emerging from "njiigari" sorghum variety after 100 days of storage is higher than in "safraari". On "njiigari" variety, *S. oryzae* come from different location, pest number was very high and varied between 24 for the 44Z and 11 for 70Z. On "njiigari" variety, this number is very low and varied between 17 for 41Z and 6 for 69Z. Thus, the "njiigari" variety has very high capacity for *S. oryzae* proliferation.

Based on the quantity of bore dust produced by biological activities of *S. oryzae* on the "njiigari" variety, we observed that all the *S. oryzae* strains are highly destructive on grains, regardless of the origin of the insect strain. The quantity of bore dust which varied between 117 and 296 mg. On "safraari" variety, this biological activity is significantly reduced, and varied between 64 and 179 mg.

The analyses of the percentage of weight losses of two sorghum varieties showed that "Njiigari" variety is more susceptible to harvest losses. These weight losses are very high and between 6.3 and 12.7%. On "Safraari" variety, the percentage of weight losses are inferior at 3.7%.

At 100 days of storage of the two sorghum varieties, the three parameters that we considered (amount of *S. oryzae* emerged, the quantities of bore dust and the percentage of weight losses) showed that "Njiigari" variety is most sensitive to *S. oryzae* which came from the different locations in northern Cameroon. In fact, this sorghum variety was not able to withstand storage at a long duration in northern Cameroon.

The variations observed on post harvest losses parameters between "safraari" and "Njiigari" sorghum varieties, could be explained by a resistance factor. To enhance their own survival, plants can produce chemical substances. These products are able to kill their natural enemy, limit their oviposition or inhibit their development (Arnasson et al., 1997). These substances can be phago-deterent agents or growth regulators as hydroxyciaminic acids occurring in some cereals (Arnasson et al., 1997). The 2,4-dihydroxy-7-methoxy-1,4 benzoxazine-3-one is described as responsible of the resistance of maize to *Ostrinia nubilalis* (Lepidoptera) (Pyralidae) (Kumar, 1991). These chemicals in addition to other factors as the taste, the color, the hardness of envelop and the scent of the plant could act on the pest weevil (Benedict et al., 1983; Roberts, 1989). In return, pest species develop mechanism of resistance to the particular plant on which they are adapted and this resistance can vary according to their geographical origin.

Conclusion

In northern Cameroon, after 100 days of storage of two sorghum varieties, the estimation of parameters of post harvest losses like amount of *S. oryzae* emerged the quantities of bore dust and the percentage of weight losses, allowed us to identify “Njiigari” as the most sensitive sorghum variety to *S. oryzae*. In fact, this sorghum variety is not suitable for long storage in northern Cameroon.

ACKNOWLEDGEMENTS

Authors are grateful to the Belgian cooperation for the funding of this work through the research convention “Storeprotect”, PIC-2003, Cameroon.

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