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FIELD INFESTATION OF THREE MAIZE (*Zea mays* L.) GENOTYPES BY LEPIDOPTEROUS STEM BORERS IN MAKURDI, NIGERIA.

S. I. OKWECHE, D.A. UKEH AND E.O. OGUNWOLU

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ABSTRACT

Two field experiments were conducted in July and August 2004 to determine the effect of date of planting and rate of application of carbofuran (Furadan 3G) on damage by stem borers to flint, sweet and pop maize (*Zea mays* L) genotypes. Each experiment was laid out in a randomized complete block design (RCBD), with a spilt plot arrangement of treatment, replicated four times. Results from July 2004 cropping season showed significant interactions of maize genotypes and rate of application of carbofuran in percentage bored stem and number of borer cavity. However, borer population density and damage were effectively reduced by carbofuran application at the rate of 1.5 Kg a. i/ha. In August planting, the results showed that borer infestation was approximately five times higher in the control plots than treated plots. Carbofuran at the rate of 1.5 Kg ai/ha could be used to control stem borer population effectively in all the three genotypes, to obtain higher grain yield.

KEY WORDS: Stem Borers, Damage, *Zea mays*, Planting Date, Carbofuran.

INTRODUCTION

Maize or corn, *Zea mays* L. (Poaceae) is one of the most important cereal crops in the world (Ishaya *et al*., 2008). Maize is widely grown across the different agro-ecological zones of Nigeria ranging from the rain forest belt in the south to the northern Guinea savannah as a major source for food for humans, feed for livestock and raw material for agro-allied industries (Agboola and Fayemi, 1999). Annual production is estimated at 5.4 million metric tonnes from about 3.4 million hectares of land in Nigeria (FAO, 2004). However, there is an increasing concern about the sustainability of maize production in Nigeria, as a result of insect pests of the crop. The insect pest complex of maize is large and diverse with, more than 200 species already reported worldwide (Hill and Waller, 1988). The major species of stem borers associated with maize in Nigeria are the maize stalk borer, *Busseola fusca* Fuller (Noctuidae), the pink stalk borer, *Sesamia calamistis* Hampson (Noctuidae), the millet stem borer, *Acigona ignefusalis* Hampson (Pyralidae) and the Africa sugarcane borer, *Eldana Saccharina* Walker (Pyralidae) (Polaszek, 1998; Balogun and Tanimola, 2001).

Stem borer infestation of maize in the field often results to characteristic ‘window pane’ effect on the leaves, ‘dead heart’, stem breakage or lodging as well as a reduction in grain yield (Ajala and Saxena, 1993; Polaszek, 1998). Damage is greater in late crop than early crop (Oigiangbe *et al*. 1997; Kakule *et al*., 1997). Reported yield losses due to lepidopterous borers in Africa vary greatly from 0 – 100% among ecological zones, regions and seasons (Usua, 1966). The severity and nature of stem borer damage depend upon the number of larvae feeding on the plant and the plant’s reaction to borer attack (Appert, 1970; Bosque- Perez and Mareck , 1991). Daramola (1985a) reported that 1.5Kg ai / ha of carbofuran gave better result than carbaryl when applied at planting. Resistant varieties and crop cultural management practices such as fall disking or ploughing and stalk shredding help to reduce stem borer damage (Dowswell *et al.,* 1996). This paper therefore assesses the effect of time of planting on stem borer infestation, the relative susceptibility of three maize genotypes (flint, sweet and pop) to stem borer attack, and determined the efficacy of carbofuran against stem borers.

MATERIALS AND METHODS

Experimental Set up and Design

This field experiment was conducted on a sandy loam soil at the Teaching and Research farm of the Department of Crops and Environmental Protection, University of Agriculture, Makurdi. The experiment was laid out in a randomized complete block design, with a spilt – plot arrangement of treatments in four replicates. The main plot (10 x 75 m) was divided into four blocks each containing six sub plots. The main plot consisted of insecticidal treatment with carbofuran at 1.5 kg a.i/ha and the control (untreated), while the sub – plots consisted of three maize genotypes, namely flint, sweet and pop. Treatments were randomly assigned to plots measuring 5 m long by 3.75 m wide. Adjacent plots were separated by 0.75 m path whilst 1.0 m path separated blocks. Four seeds of each maize type were sown to

designated plots on July 21, 2004 (for early planting) and August 10, 2004 (for late planting) at intra – row spacing of 50 cm. Seedlings were thinned to two plants / hill giving a plant population of approximately 53,333 plants/ ha.

Application of Treatment and Data Collection

S. I. OKWECHE, Department of Crop and Environmental Protection, University of Agriculture, Makurdi, Nigeria.
D.A. UKEH, Department of Crop Science, University of Calabar, PMB 1115, Calabar, Nigeria.
E.O. OGUNWOLU, Department of Crop and Environmental Protection, University of Agriculture, Makurdi, Nigeria.

The insecticide, 1.5 kg carbofuran a.i / ha was applied in two equal doses at 3 weeks after planting (WAP) and at 7 WAP, into the furrow 4 cm away from plants and covered up. At 6 WAP, the number of plants killed by stem borers (dead heart) was expressed as a percentage of total number of plants per plot. At harvest, lodged stems were counted from the two middle rows and expressed as a percentage of total number of plants per plot. Thereafter, a random sample of 10 stems was taken from the two middle rows and examined to record the number bored, number of larvae and pupae, total number of internodes per stem and total number of bored internodes. Percentage of bored stems and bored internodes were computed. Bored stems were split to recover borer larvae and measure borer tunnel length. From the latter, borer cavity units were derived using length of the matured *B. fusca* larva (the predominant species as the divisor $^{y}/_{x}$, where y = tunnel length and x = length of matured *B. fusca*)

Data Analysis

Data for both cropping seasons were subjected to analyses of variance (ANOVA) after transforming percentages to arcsine.

RESULTS

Table 1 shows the composition and relative abundance of maize stem borer species collected at harvest. In untreated plots, *B. fusca* was the most abundant borer species in both early (July 21, 2004) and late (August 10, 2004) plantings. *S. calamistis, E. saccharina, A. ignefusalis and C. partellus* followed in descending order of abundance. Also, *B. fusca* was more abundant on sweet than on flint or pop maize whether planted early or late. In contrast, *S. calamistis* was more on pop than sweet or flint maize in the August planting only. *B fusca* attacked all maize types whether treated or untreated planted early or late. Treated sweet maize stems were not attacked by either *E. saccharina or S. calamistis larva*. The latter was also not recovered from treated pop maize. In untreated plots *A. ignefusalis* was obtained from sweet and pop maize in July planting and flint and sweet maize in August planting. Whereas in untreated plot, it was obtained from all genotypes except pop maize in July planting. Recovery of borers from stems in untreated plots showed infestation was approximately 5 times heavier in the late than in the early crop, whereas in treated plots, infestation was just three times (3x) heavier. The effects of carbofuran insecticide application on damage to maize by stem borers are presented in Table 2. Table 2 also showed significant differences (P<0.05) in percentage dead heart (% DH), % bored stem (% BS) % bored internodes (% BIN), and % lodged stem (% LS) treated and untreated plots during both cropping seasons. The results from both cropping seasons clearly showed that carbofuran significantly reduced damage in the July and August plantings. Grain yields (t/ha) were not affected by carbofuran application (Table 3) during the field trials. Borer damage was not influenced by maize genotype in either the July or August planting. Flint maize gave the highest grain yield ($^{t}/_{ha}$) followed by pop and finally sweet maize, but the difference was not significant. July planting was generally more productive than August planting.

Table 1. Mean composition and relative abundance of Stem borers/10 maize stems at harvest during July and August 2004 trials.

Planting date	Maize type	*Busseola fusca*	*Eldana saccharina*	*Sesamia calamistis*	*Acigona ignefusalis*	*Chilo partellus*
		Treated with Carbofuran				
	Flint	15	2	2	0	0
July, 21	Sweet	5	0	0	0	4
	Pop	13	1	0	0	0
	Flint	11	3	8	0	0
August,10	Sweet	20	6	5	0	0
	Pop	22	3	5	0	0
		Untreated				
	Flint	13	6	4	0	3
July, 21	Sweet	27	7	6	6	3
	Pop	21	7	6	6	0
	Flint	85	52	53	8	2
August,10	Sweet	101	70	30	5	5
	Pop	60	38	99	0	4

Table 2. Main effects of Carbofuran application on damage to maize by Stem borers.

	July, 2004						August, 2004					
Carbofuran Rate Kg a.i./ha	% DH	%BS	%BIN	%LS	NBC	Mean yield (t/ha)	% DH	%BS	%BIN	%LS	NBC	Mean yield (t/ha)
1.5	0.71	33.3	7.07	2.13	0.18	1.5	1.31	50.8	12.9	2.54	0.16	0.62
0	2.71	92.5	29.9	4.12	0.47	1.29	2.16	90	52.3	5.23	0.52	0.49
LSD(0.05)	0.24	10.73	3.09	0.48	0.06	0.22	0.47	11.74	5.98	0.64	0.07	0.12

DH=dead heart, BS=bored stems, BIN=bored internodes, LS=lodged stems, NBC=number of bored cavity.

Table 3. Mean yield (t/ha) of three maize varieties after treatment with Carbofuran during July and August cropping seasons.

	July 2004			August 2004		
Carbofuran rate (Kg a.i/ha)	Flint	Sweet	Pop	Flint	Sweet	Pop
1.5	1.88	1	1.63	0.95	0.37	0.55
0	1.7	0.95	1.22	0.6	0.34	0.5

DISCUSSION

The current study reveals that *B. fusca* was the most abundant borer species in July and August planting (Table 1) at harvest followed by *S. calamistis, E, saccharina, C. partellus* and *A. ignefusalis,* in Makurdi, Nigeria. Harris (1962), and Polaszek (1998) had earlier reported the prevalence of *B. fusca* stem borer in Nigeria. Ukeh *et al.* (2007) also reported the prevalence of *B. fusca* and *S. calamistis* in Calabar, South-Eastern Nigeria. Similar observations have been made in studies carried out in South-Western Nigeria (Adenuga, 1973; Balogun and Tanimola (2001). In contrast, the study by Sosan and Daramola (2001) revealed greater abundance of *S. calamistis* and *E. Saccharina*, respectively. According to Polaszek (1998), populations of these important stem borers fluctuate depending on weather conditions and crop sowing date. Contrary to Adenuga (1973) and Balogun and Tanimola (2001), reported that *A. ignefusalis* was not recovered in treated plots both in July and August planting and the percentage in untreated plot was quite insignificant (3.4%). This was probably because *A. ignefusalis* is not a primary pest of maize; it is restricted to certain areas and in suitable habitats (Polaszek, 1998). *C. partellus*, the least in abundance, was only recovered from sweet maize in treated July planting. Seshu-Reddy and Sum (1992) found granular Carbofuran to be the most economic insecticides for the control of *C. partellus* on maize when accurately applied and in a controlled manner.

Generally, carbofuran applied to the soil at the rate of 1.5kg a.i/ha significantly reduced stem borer infestation and damage to the three maize genotypes in July and August plantings compared to the control. This observation is in agreement with the findings of Egwatu and Ita (1982), Daramola (1985b), Ogunwolu (1987), Bosque-Perez (1992), Polaszek (1998). Residual activity of carbofuran spans approximately 40 days, which is about one-third of the growth period of maize in Nigeria. The split application recommended by Polaszek (1998) and Adetiloye *et al.,* (2002) effectively protects seedlings and mature stems against severe borer infestation. The three maize endosperm types used in the experiment were susceptible to stem borer infestation, but there was no statistical difference with respect to stem borer infestation and severity of damage for July and August cropping, although, sweet corn tended to be more susceptible than the other endosperm types (flint and pop). There were significant differences ($P<0.05$) between the planting dates with respect to stem borer population and damage parameters, because July planting recorded a total of 152 larvae compared to 695 larvae recorded in August planting. These agree with the result of Bosque-Perez and Dabrowski (1989) and Polaszek (1998) that early planting suffers less attack by borer but build up is high in late season planting between July/September. For a reduction in damage and better control of stem borers, early planting of maize and application of 1.5kg a.i/ha of carbofuran are recommended.

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