Carbosulfan Seed Dressing, Sowing Date, and Genotype Effects on Maize Stalk Borer

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Abstract

The effects of seed dressing maize with carbosulfan (Marshal 35 ST), sowing date, and maize genotype on damage caused by the maize stalk borer (MSB) *Busseola fusca* (Fuller) were evaluated at two locations during the 1996 crop season. The trial was laid out in a 2 x 3 x 2 factorial randomized complete block design in two replications. Seed dressing with carbosulfan (Marshal 35 T[R]) had no significant effect (P=0.05) on grain yield. Highly significant grain yield differences (P=0.0000) were observed for sowing date, location, genotype, and sowing date by location effects. Early sowing had a yield advantage of more than 58.2% over late sowing. Sowing date also had significant effects on the number of borers per plant, percent infestation, and number of holes per plant; number of cobs per plant was not affected by sowing date. Genotype effects on borers per plant, holes per plant and cobs per plant were significant. Seed dressing had no significant effect on any of these parameters. Interaction effects between sowing date and location were significant for borers per plant (P=0.0463) and percent infestation (P=0.0000). Results of these experiments suggest that seed dressing with carbosulfan does not give effective control of MSB.

Introduction

In Ethiopia, maize is the most important cereal accounting for roughly 27.2% of the total production of all cereals, and second only to tef in hectarage. The 1994/95 main crop season estimates indicate that it occupies more than 1.1 million ha (*ca* 19.2%) with the corresponding annual production of nearly 1.7 million metric tonnes (CSA 1995). The Government of Ethiopia accords the highest priority to maize in its strategy for food security and food self-sufficiency.

Although experimental results show that yields of 3 to 7 t ha^{-1} can be obtained, depending on the variety and agroecological zone, the current national average stands at about 1.5 t^{-1} (CSA 1995). Damage by insect pests is one of the major constraints limiting maize production in Ethiopia (Crowe et al. 1977, Assefa 1985, Assefa et al. 1989, Ferdu 1991, Abraham et al. 1993). Of a large number of insects recorded on maize in this country, the maize stalk borer (MSB) *Busseola fusca* (Fuller) (Lepidoptera: Noctuidae) is the most important pest of maize and sorghum as it is elsewhere in Africa (Abate 1993).

Although there is no information on the effectiveness of seed treatment with carbosulfan or with any other insecticide against stalk borers on maize in Ethiopia, seed dressing with this insecticide (Marshal 35 T) has been included in the Sasakawa Global 2000 package and in the Extension Management Training Plots of the Ministry of Agriculture for the control of MSB. This meant an average extra cost of about birr 75 per ha to the grower. There has been a controversy regarding the effectiveness of the insecticide in the control of the pest. Empirical observations showed that seed dressing with carbosulfan does not give adequate control of stalk borers on maize (Gordon et al. 1995). Our experiments were therefore initiated to resolve the above controversy.

Materials and Methods

This experiment was conducted at Odo Peasant Association (PA) in Goro *wereda* in Gurage Zone and at Aroji PA in Ameya, Oromya; both sites were operated by the NGO Food for the Hungry International. Three genotypes of maize, *viz*. 'BH-660', 'BH-140' and a local variety were planted with and without the insecticide seed dressing in 38.4 m^2 plots (4.8 m x 8 m) replicated twice. Spacings of 75 cm between rows and 30 cm between plants were used. Sowing dates for the Odo PA site were 14 May and 8 June 1996 whereas those for Aroji were 2 April and 16 April 1996; these sowing intervals were chosen on the basis of available moisture for adequate germination of the seed. All cultural practices were as per recommendation for the MOA extension package. That is, diamonium phosphate was applied at the rate of 50 kg P_2O_5 ha^{-1} at seeding while 100 kg of nitrogen in the form of urea was applied in splits (at knee height and at flag leaf stages). Stand counts were recorded at full seedling emergence and at harvest. Records of infested plants were also made and percent infestation was thus calculated. Total yields per plot were recorded and converted to quintals per hectare. The data were subjected to analysis of variance (ANOVA). The maize stalk borer B. fusca was the only species observed at both locations during the experimentation.

Results

Results of the effect of carbosulfan seed dressing on stalk borers per plant, percent infestation, stalk borer holes per plant, cobs per plant, and seed yield of maize are summarised in Table 1. Location, sowing date and genotype (varietal) effects were significant for stalk borers per plant, stalk borer holes per plant, and seed yield but not for percent infestation. Only location and genotype effects were significant for cobs per plant; interactions between locations and sowing dates were highly significant for percent infestation and seed yield (Table 1). By contrast, differences between carbosulfan treated and untreated plots were nonsignificant for all variables mentioned above (Table 1).

Table 1. Probability values for the partial ANOVA on the effects of carbosulfan seed treatment against *Busseola fusca* on three maize genotypes grown at two locations planted early and late, 1996*

Source	DF	Borers/plant	Infestation (%)	Holes/plant	Cobs/plant	Grain yield
L	1	0.0008	NS	0.0002	0.0003	0.0000
S	1	0.0059	0.0032	0.0002	NS	0.0000
G	2	0.0282	NS	0.0037	0.0333	0.0000
I	1	NS	NS	NS	NS	NS
L * S	1	0.0463	0.0000	NS	NS	0.0000
S * G	2	NS	NS	NS	NS	NS
CV (%)		35.9	33.1	22.5	16.0	16.1

**DF=degrees of freedom; L=location; S=sowing date; G=maize genotype; I=insecticide; NS=nonsignificant; CV=coefficient of variation.*

Data on stalk borers per plant, percent infestation and stalk borer holes per plant are presented in Table 2. As stated earlier, carbosulfan seed treatment had no significant effects on any of these variables. On the other hand, sowing date effects were significant for all the three variables (Table 2). It should be noted that sowing date effects were particularly important in influencing percent infestation; it was not so spectacular for stalk borers per plant and stalk borer holes per plant, perhaps because of significant genotype effects and location and sowing date interactions (Table 1).

Varietal differences were nonsignificant for percent infestation, although BH-140 showed a slightly lower infestation (not shown in the table), but were significant for cobs per plant (Table 3). All the three varieties suffered less percent infestation and produced greater number of cobs per plant when planted early than late at both locations.

Yield data are presented in Table 4. Yields of all genotypes were significantly greater in early than late sown maize at both locations. Early sown maize outyielded late sown by about 72.5 and 35.9 percent at Odo and Aroji, respectively (Table 4). The overall yield advantage of early sowing was about 58.2 percent. Both hybrids gave significantly superior yields over the local variety at both locations. BH-660 was the highest yielder.

Table 2. The effects of carbosulfan seed treatment on *Busseola fusca* numbers, percent infestation, and number of holes per plant on maize, 1996*

Parameters & planting time	Seed treatment		Mean
	Treated	Untreated	
Borers per plant			
Planted early	0.87	0.85	0.86
Planted late	0.78	0.57	0.67
Mean	0.82	0.71	0.77
Percent infestation			
Planted early	22.4	22.5	22.5
Planted late	30.4	31.3	30.9
Mean	26.4	26.9	26.7
Holes per plant			
Planted early	6.3	6.7	6.5
Planted late	5.7	4.9	5.3
Mean	6.0	5.8	5.9

**Data are combined over locations & genotypes.*

Table 3. Cobs per plant of three maize genotypes grown with and without carbosulfan seed treatment and two sowing dates at two locations, 1996*

Maize genotype	Location		Genotype mean
	Odo	Aroji	
BH-660	1.10a	0.87ab	0.98ab
BH-140	1.12a	0.92a	1.02a
Local	0.95b	0.80b	0.87b
Location mean	1.05	0.86	

**Means within a column followed by the same letters are not significantly different from each other at the 5% probability level using Duncan's multiple range test (DMRT); data are combined over sowing dates and seed treatment*

Table 4. Seed yield (q ha^{-1}) of three maize genotypes grown at two locations and two sowing dates, 1996*

Location	Genotype	Sowing date		Mean
		Early	Late	
Odo PA	BH-660	121.9a	74.0a	97.9a
	BH-140	115.2a	64.6b	89.9b
	Local	84.8b	48.0c	66.4c
Mean (Odo)		107.3	62.2	84.8
Aroji PA	BH-660	65.2a	46.1a	55.7a
	BH-140	53.0b	41.7a	47.4b
	Local	44.3c	31.6b	38.0c
Mean (Aroji)		54.1	39.8	
Mean (overall)		80.7	51.0	47.0

Means within a column followed by the same letters are not significantly different from each other at the 5% probability level (DMRT); data are combined over seed treatment

Discussion

Our experiments have demonstrated that seed dressing with carbosulfan (Marshal 35 T) does not control maize stalk borer and result in increased yield of maize. The inclusion of seed treatment against stalk borers on maize in the extension package is therefore without justification. First, even the manufacturer does not claim that Marshal 35 ST gives effective control of stalk borers and results in increased yield. One would not expect to achieve effective control of stalk borers using a seed treatment since the onset of damage is sometime around 30 days after emergence, by which time the effectiveness of the insecticide should have diminished greatly (manufacturer claims effectiveness for up to 40 days). Second, there have been no cases, at least in Ethiopia, where a seed dressing insecticide was tested, found effective, and recommended for use against stalk borers.

In the past, application of powder or spray formulations has been recommended or found effective (Crowe & Shitaye 1977, Assefa 1982, Assefa & Tessema 1982). Application of insecticides, where the need has been established, other than sprays may be preferred because of their relatively less adverse effects on the natural enemies.

Our findings that early sowing is advantageous over late sowing to get an effective control of stalk borers on maize are consistent with those reported by Assefa et al. (1989). Their data show that yield loss in maize due to *B. fusca* is minimal in early sown maize with or without insecticide treatment.

Management of stalk borers should emphasise the use of an integrated pest management (IPM) approach where timely sowing is a vital component. If the use of insecticides to control stalk borers on maize could be justified, then only those insecticides and formulations that are compatible with an IPM programme should be used.

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