Plant Defense Responses to Sorghum Spotted Stem Borer, *Chilo partellus* under Irrigated and Drought Conditions

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Introduction

Sorghum [*Sorghum bicolor* (L.) Moench] is one of the most important cereal crops in the semi-arid tropics (SAT), and insect pests are a major yield-reducing factor. Sorghum is attacked by nearly 150 insect species, causing an annual loss of over $1 billion in the SAT (ICRISAT 1992). A number of stem borer species have been reported as serious pests of sorghum, of which spotted stem borer, *Chilo partellus* Swinhoe (Lepidoptera: Pyralidae) is an important pest in India (Jotwani and Young 1972) and South and eastern Africa (Ingram 1958). Responses to stem borer infestation are influenced by environmental factors apart from genetic factors and their interactions. Moisture and nutrient availability influence plant growth, which in turn will influence the extent of losses due to stem borer damage. Therefore, we studied the reaction of a diverse array of sorghum genotypes to stem borer damage under irrigated and drought conditions.

Materials and Methods

The experiments were conducted at the Kenya Agricultural Research Station, Kiboko during the 1990 and 1991 cropping seasons. The test material (27 sorghum genotypes) was sown in four row plots of 2 m row length, and the rows were 75 cm apart. There were three replications in a randomized complete block design (RCBD). Seed were sown five cm below the soil surface. The crop growth was maintained under two moisture regimes i.e., irrigated and non-irrigated (water stressed). Both irrigation regimes received a post-sowing irrigation to maintain uniform plant establishment. Data were recorded on deadheart formation due to stem borer, leaf area (%) damaged, number of larvae per five plants, peduncle damage, and recovery resistance under natural infestation. The number of plants with stem borer deadhearts was recorded at 35 days after seedling emergence (DAE) and expressed as a percentage of the total number of plants. Leaf feeding was evaluated at 20 DAE. The number of larvae was recorded from five randomly selected plants per plot at maturity. The peduncle damage (1 = <10% plants with broken peduncles, and 9 = >90% plants with broken peduncles) and recovery resistance was assessed on a 1 to 9 scale at maturity (1 = most of the damaged plants with 2 to 3 uniform tillers with panicles similar to the main plant, and 9 = <10% plants with tillers and productive panicles). Data were subjected to analysis of variance, and the significance of differences between the genotypes was tested by F-test, while the treatment means were compared by least significant differences (LSD) at P = 0.05.

Results and Discussion

The analysis of variance indicated significant differences due to genotype, treatments (irrigated and non-irrigated), and genotype × treatment interaction in plants with deadhearts, number of larvae, leaf feeding, peduncle damage, and recovery resistance for genotypes, except in case of leaf area damage (Table 1). Deadheart incidence was slightly lower (70.4%) in irrigated plots as compared to drought stressed plots (74.6%). Deadheart incidence ranged from 52.2 to 81.5% under irrigated and 58.0 to 90.3% under non-irrigated conditions. Leaf feeding was greater (94.7%) under irrigated than in the drought stressed plots (91.5%) (except in the case of ICSV 88013, IS 8193, KAT 83368, IS 23509, and ICSV 112). The peduncle damage rating varied from 4.2 to 7.0 under irrigated and 5.3 to 8.3 under drought conditions. Peduncle damage was lower (5.8) under irrigated than under drought stressed (7.0) conditions. The recovery resistance rating varied from 3.5 to 6.5 and 5.3 to 7.7 under irrigated and drought stressed sorghum, respectively. The plant recovery in response to stem borer damage was greater under irrigated condition (5.4) than under drought stress (6.3) (except in the case of ICSH 89020, IS 23509, and ICSV-CM 865132), suggesting that sorghum plants produce more axial tillers following damage by the stem borer to the main plant.

Moisture availability in the soil increases plant growth, and pushes the growing point upwards at a relatively faster rate, and as a result the larvae are not able to cause deadheart formation. Also, optimum moisture results in better nutrient uptake, rendering the plants more healthy and immune to damage by stem borer. Based on significantly lower damage under increased soil moisture, irrigation has been recommended for controlling corn stalk borer, *Elasmopalpus lignosellus* Zeller (All and

Table 1. Reaction of sorghum genotypes to spotted stem borer, *Chilo partellus* damage under irrigated and drought stressed conditions (Kenya, Kiboko 1990–1991).

	Deadhearts (%)		Larvae plants^{-5}		Leaf damage (%)		Peduncle damage score		Recovery score	
Genotype	Irrigated	Drought	Irrigated	Drought	Irrigated	Drought	Irrigated	Drought	Irrigated	Drought
ICSH 871001	66.8	76.0	53.0	28.7	95.3	94.3	5.2	7.3	5.3	5.7
ICSH 88065	63.2	67.0	27.7	19.7	100.0	90.7	5.0	6.7	3.5	6.3
ICSH 89020	70.9	80.0	51.3	31.3	93.7	90.0	6.0	6.7	6.0	5.3
ICSH 89034	70.5	81.0	51.0	28.7	93.7	96.3	5.3	7.0	4.3	6.7
ICSH 89051	72.0	73.7	37.7	22.7	100.0	95.0	6.5	7.3	5.3	6.0
ICSH 89123	72.6	70.3	56.7	23.0	100.0	95.0	6.3	7.3	5.5	6.3
ICSH 90002	78.4	74.3	38.0	23.7	99.0	86.3	5.3	6.7	5.0	7.0
ICSV 88002	73.9	67.7	34.0	24.0	94.0	92.0	5.8	7.0	5.3	7.0
ICSV 88013	68.7	85.0	43.0	31.3	91.0	99.0	6.2	8.3	5.7	7.7
ICSV 88032	80.5	71.3	45.3	34.0	96.0	96.3	6.2	6.7	5.2	5.3
ICSV 89101	73.1	77.3	54.3	30.7	93.3	92.7	6.2	6.0	6.0	6.0
ICSV 89106	76.4	68.3	40.2	27.0	99.3	96.0	6.7	7.7	6.2	7.7
IS 8193	72.9	69.0	57.3	30.0	86.3	90.0	5.7	7.7	4.5	7.0
IS 9302	80.8	68.3	29.0	25.0	94.0	74.7	7.0	7.3	5.3	6.3
5 DX 106	70.2	90.3	37.7	31.0	97.0	95.7	6.8	6.7	5.8	5.7
KAT 83368	74.7	85.0	40.0	25.7	90.7	97.7	6.0	7.0	5.3	7.0
IS 23496	71.9	83.7	40.3	28.7	97.0	95.0	4.8	7.0	5.0	6.7
IS 23509	52.2	90.3	39.3	30.3	93.0	98.7	5.2	6.0	6.5	6.0
ICSV 401	56.7	83.7	39.0	22.7	93.7	94.7	5.2	6.7	4.5	6.7
ICSV 111	76.9	66.0	33.7	29.3	95.0	87.3	6.2	7.3	5.5	6.7
ISIAP DORADO	81.5	82.0	36.7	22.7	98.0	91.3	6.3	8.0	6.2	7.0
ICSV-CM865132	78.3	77.7	35.7	25.0	98.0	92.7	6.8	6.7	6.5	5.7
SPV 468	69.4	73.7	35.7	25.0	99.3	89.0	5.8	7.3	5.2	5.3
SPV 669	68.3	63.0	41.3	28.0	96.0	86.7	4.2	8.0	5.3	7.3
ICSV 112	62.4	72.0	49.7	27.7	88.0	91.3	4.8	5.3	5.3	5.0
ICSH 110	58.2	63.7	38.0	29.7	93.3	85.7	5.5	7.0	4.8	5.3
Local check	59.0	58.0	44.3	31.0	81.0	76.0	5.3	7.0	5.5	6.3
Mean	70.4	74.8	41.8	27.3	94.7	91.5	5.8	7.0	5.4	6.3
For comparing	LSD	Fp	LSD	Fp	LSD	Fp	LSD	Fp	LSD	Fp
Genotypes (G)	11.39	0.009	7.58	<0.001	8.26	0.005	0.97	<0.001	1.02	0.015
Treatment (T)	3.10	0.006	2.06	<0.001	2.25	0.006	0.27	<0.001	0.28	<0.001
G x T	16.11	0.003	10.73	0.019	NS	0.319	1.38	0.053	1.44	0.003

Note = The F-test was nonsignificant for genotype x treatment x environment, and hence the values in the table are means across seasons. Fp = F-probability. LSD = Least significant difference.

Gallaher 1977). In the present study, the numbers of stem borer larvae were greater (41.8 larvae per 5 plants) in irrigated than in the drought stressed (27.3 larvae per 5 plants) plots. The moisture content of 10-day-old sorghum seedlings and the central whorl leaf at 20 DAE have been reported to be positively associated with leaf feeding and larval survival (Sharma et al. 1997). Greater plant biomass and more humidity favored the survival and development of stem borer larvae in irrigated plots. Karaman et al. (1998) reported that reduced water availability affected *Chilo agamemnon* Blesz. activity in sugarcane due to lower relative humidity. However, Reynolds et al. (1959) reported that timely irrigation decimated populations of *E. lignosellus* on sorghums in southern California. Irrigation reduces the deadheart incidence, peduncle damage, and recovery resistance in sorghum due to stem borer, and thus irrigation could be recommended as a component for the management of *C. partellus* in sorghum.

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