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Antibiosis mechanism of resistance to spotted stem borer, *Chilo partellus* in sorghum, *Sorghum bioclor*

V. Kishore Kumar[a,b], H.C. Sharma[a,*], K. Dharma Reddy[b]

[a]*International Crops Research Institute for the Semi-Arid Tropics (ICRSAT), Patancheru 502 324, Andhra Pradesh, India*
[b]*ANGR Agricultural University, Rajendranagar, Hyderabad 500 030, Andhra Pradesh, India*

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Abstract

Spotted stem borer, *Chilo partellus* (Swinhoe), is the most important pest of sorghum in Asia and South and Eastern Africa, and host plant resistance is an important component for controlling this pest under subsistence farming conditions. Therefore, we studied the antibiosis mechanism of resistance in a diverse array of 20 sorghum genotypes at the seedling stage by incorporating the freeze-dried leaf powder into artificial diet. Freeze-dried sorghum leaf powder at 12.5 g per 250 ml of the standard artificial diet or replacement of chickpea flour in the artificial diet by 50% with sorghum leaf powder can be used to quantify the extent of antibiosis mechanism of resistance to *C. partellus* in sorghum. There was a significant variation in larval survival, larval and pupal weights, larval and pupal periods, and percentage pupation and adult emergence in diets impregnated with freeze-dried leaf powder of different sorghum genotypes. Sorghum genotypes such as IS 1044, IS 2123, IS 1054, IS 18573, and ICSV 714 showed antibiosis to *C. partellus* in terms of reduced survival and development. Principal component analysis indicated that there is considerable diversity in sorghum genotypes for antibiosis to *C. partellus*. Genotypes placed in different groups can be used in resistance breeding programs to diversify the basis of resistance to this pest.

Keywords: Sorghum; Stem borer; *Chilo partellus*; Plant resistance; Resistance mechanism; Antibiosis

1. Introduction

Sorghum is one of the major cereal crops in the semi-arid tropics (SAT). Grain yields of sorghum on peasant farms are generally low (500–800 kg ha^{-1}), and one of the major factors limiting sorghum yields are insect pests. Sorghum is damaged by over 150 insect species from sowing to the crop harvest, of which sorghum shoot fly (*Atherigona soccata* Rondani), spotted stem borer (*Chilo partellus* Swinhoe), sorghum midge (*Stenodiplosis sorghicola* Coquillett), and head bugs (*Calocoris angustatus* Lethiery and *Eurystylus oldi* Poppius) are most important worldwide (Sharma, 1993). Several species of stem borers attack sorghum in different sorghum-growing regions (Nwanze, 1997), of which the spotted stem borer, *C. partellus* is predominant in Asia and eastern and southern Africa. Stem borers cause an estimated loss of US $266 million annually (ICRISAT, 1992). The spotted stem borer, *C. partellus* attacks sorghum plants from two weeks after germination until crop harvest. The young larvae feed on leaf whorl leaves at the seedling stage, while the older larvae leave the whorl and bore into the stem where they damage the growing point and cause a characteristic "deadheart" symptom. In older plants, the larvae feed inside the stem causing extensive tunneling, which may cause lodging and interfere with nutrient supply to the developing grains. Insecticide application for stem borer control is uneconomic under subsistence farming, and is largely beyond the means of resource poor farmers. Therefore, host plant resistance (HPR) assumes a pivotal role in

*Corresponding author. Tel.: +91 40 30713314.
E-mail address: h.sharma@cgiar.org (H.C. Sharma).

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controlling stem borer damage either alone or in combination with other methods of control.

Systematic screening of the world germplasm collection for resistance to spotted stem borer has been undertaken in the Indian national sorghum improvement program (Singh et al., 1968; Pradhan, 1971; Jotwani, 1978) and at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), and over 30,000 germplasm accessions have been screened for resistance (Taneja and Leuschner, 1985; Sharma et al., 1992, 2003). Amongst the identified sources, a number of mechanisms contribute to sorghum resistance to the stem borer, including non-preference for oviposition, reduced feeding by the first-instars on young leaves, low deadheart formation, reduced tunneling, and tolerance to leaf damage and stem tunneling (Chapman et al., 1983; Dabrowski and Kidiavai, 1983; Woodhead and Taneja, 1987; Sharma and Nwanze, 1997). Knowledge of the resistance mechanisms and associated factors is essential for effective utilization of resistant sources in the crop improvement programs. However, because of large genotype × environment interactions, it becomes difficult to quantify different mechanisms of resistance under field conditions. Therefore, we studied the antibiosis mechanism of resistance to *C. partellus* in a diverse array of stem borer-resistant and -susceptible sorghum genotypes by impregnating the freeze-dried leaf powder into artificial diet under laboratory conditions.

2. Material and methods

The survival and development of *C. partellus* was studied on artificial diet (Sharma et al., 1992), impregnated with freeze-dried leaf powder of a diverse array of 20 sorghum genotypes. The test material consisted of 11 germplasm accessions showing resistance to stem borer under field conditions (IS 1044, IS 1054, IS 2123, IS 2263, IS 2269, IS 5469, IS 5566, IS 12308, IS 13100, IS 18333, and IS 18573) (Sharma et al., 1992, 2003), two improved stem borer-resistant lines developed at ICRISAT (ICSV 705 and ICSV 714), three landraces from Africa (S 21444—a *guinense* sorghum from West Africa, Seredo—a red grain variety from East Africa, and Naga White—a chalky grain sorghum variety from Ghana), and two commercially released cultivars from India (ICSV 1 and ICSV 112). This represented a diverse array of stem borer-resistant and borer-susceptible material from different regions/races of sorghum.

The sorghum seedlings were grown under greenhouse conditions during the postrainy season (December 1998 to March 1999) at the ICRISAT, Patancheru, Andhra Pradesh, India. The plants were raised on medium sized pots (60 cm dia, 30 cm deep) in the greenhouse at ambient atmospheric conditions ($30\pm5\,^{\circ}C$, $65\pm5\%$ RH, and 12 h photoperiod). The potting mixture consisted of red soil and farmyard manure (2:1). Before sowing, diammonium phosphate was applied at 50 g per pot, and 10 seeds were sown in each pot. At 10 days after seedling emergence, three healthy seedlings were retained in each pot. Urea at 10 g per pot was applied after thinning. The plants were watered as and when needed. Antibiosis to *C. partellus* in different sorghum genotypes was studied by incorporating lyophilized leaf powder into the artificial diet. For this purpose, leaves of the test genotypes were collected from 25-day-old plants raised under greenhouse conditions. Two to three whorl leaves were removed with scissors at the growing point from each plant (on which the larvae feed under natural conditions). The leaves were washed and then freeze dried for 36 h in a lyophilizer ($-50\,^{\circ}C$) to avoid changes in chemical composition of the leaves. The dried up leaves were powdered in a Willey mill to 80 mesh size for use in the artificial diet.

2.1. Effect of different amounts of sorghum leaf powder on survival and development of Chilo partellus

To obtain an idea of the optimum amount of sorghum leaf powder needed in the artificial diet to measure antibiosis to *C. partellus*, experiments were conducted on the effect of different amounts of leaf powder in the artificial diet on survival and development, and the effect of different proportions of chickpea flour and sorghum leaf powder in the artificial diet on survival and development of *C. partellus*. For studying the effect of different amounts of sorghum leaf powder in the artificial diet on survival and development of *C. partellus*; 0, 7.5, 12.5, 17.5, and 22.5 g of sorghum leaf powder of sorghum hybrid CSH 1 was added in 250 ml of standard artificial diet used for rearing *C. partellus* (Sharma et al., 1992) (Table 1). Sorghum leaf powder was soaked in 100 ml warm water ($70\,^{\circ}C$), and blended with Fraction A ingredients for 2 min. Agar–agar was boiled in 80 ml water (Fraction B), cooled to $40\,^{\circ}C$, and then poured into the blender containing the Fraction A. Formaldehyde was added finally and all constituents blended for 3 min. The diet thus prepared was poured in to plastic cups of 50 ml capacity. Each cup had 20 ml diet. The diet was allowed to settle for 4 h. Ten first-instar larvae were released into each cup. There were five replications in a completely randomized design. At 10 days after infestation, data were recorded on larval survival and larval weight.

In another experiment, leaf powder from three sorghum genotypes (IS 5469—a germplasm line with high levels of resistance to stem borer, ICSV 705—an improved line with moderate levels of resistance to stem borer, and ICSV 745—an improved variety highly susceptible to stem borer under field conditions) was impregnated into the artificial diet. For each genotype,

Table 1
Artificial diet used for rearing spotted stem borer, *Chilo partellus* in the laboratory

Ingredient	Quantity
Fraction A	
Water	80.00 ml
Chickpea flour	12.00 g
Brewers yeast	1.28 g
Sorbic acid	0.16 g
Vitamin E (Viteolin capsules)	0.18 g
Methyl parahydroxy benzoate	0.26 g
Ascorbic acid	0.42 g
Sorghum leaf powder	12.00 g
Fraction B	
Agar-agar	1.64 g
Water	65.00 ml
Formaldehyde	0.13 ml

there were five treatments with different proportions of chickpea flour and sorghum leaf powder (0:6, 2:4, 3:3, 4:2, and 5:1—chickpea flour:sorghum leaf powder). The diet was prepared as described above. There were five replications for each treatment in a completely randomized design. Ten first-instar larvae were released into each cup. Ten days after infestation, data were recorded on larval survival and larval weight.

2.2. Survival and development of Chilo partellus on artificial diet impregnated with lyophilized leaf powder of different sorghum genotypes

Antibiosis component of resistance to *C. partellus* in 20 sorghum genotypes was assessed by impregnating a 1:1 proportion of chickpea flour:sorghum leaf powder in a standard artificial diet (based on the results obtained above). There were three replications for each genotype in a completely randomized design. Diet was poured into 250 ml capacity plastic cups and each cup had 150 ml diet. Larval survival and larval weight were recorded at 10 days after releasing the larvae. After pouring the diet into the cups, it was allowed to cool for 2–3 h on the laboratory table. Ten first-instar larvae were released into each cup, using a fine camel hairbrush. The cups were kept in the rearing room in the dark for three days (because the first-instar larvae have a strong photosensitive behavior, and settle better on the diet in darkness). In the rearing room, temperature was maintained at 28 ± 1 °C, 60–70% RH, and 12 h photoperiod. Observations were recorded on larval survival and larval weight at 10 days after releasing the larvae into the artificial diet, pupation and adult emergence. Pupal weight was recorded for each sex separately on the second day after pupation. The pupae were sexed on the basis of their relative size and genital openings (Sithanantham and Subramaniam, 1975). Percentage pupation and adult emergence were calculated in relation to the total number of larvae released in to each cup.

Data on percentage larval survival at 10 days after initiating the experiment, and larval weight were subjected to angular and square root transformation before analysis of variance. Data were subjected to analysis of variance using GENSTAT release 5.0. The significance of differences between the treatments was measured by *F*-test at *P* 0.05, while the treatment means were compared using the least significant difference (LSD) at *P* 0.05. Data on larval survival, larval and pupal weight, percentage pupation and adult emergence, and duration of post-embryonic development was subjected to principal component analysis to assess the genotypic diversity for resistance to spotted stem borer, *C. partellus*.

3. Results

3.1. Effect of different amounts of sorghum leaf powder on survival and development of C. partellus

Larval survival ranged from 72% in artificial diet without sorghum leaf powder and the diet having 22.5 g of freeze-dried sorghum leaf powder (per 250 ml artificial diet) to 86% in the diet having 12.5 g sorghum leaf powder (Fig. 1). Larval weight was lowest in larvae reared on artificial diet without sorghum leaf powder, while maximum larval weight was recorded in larvae

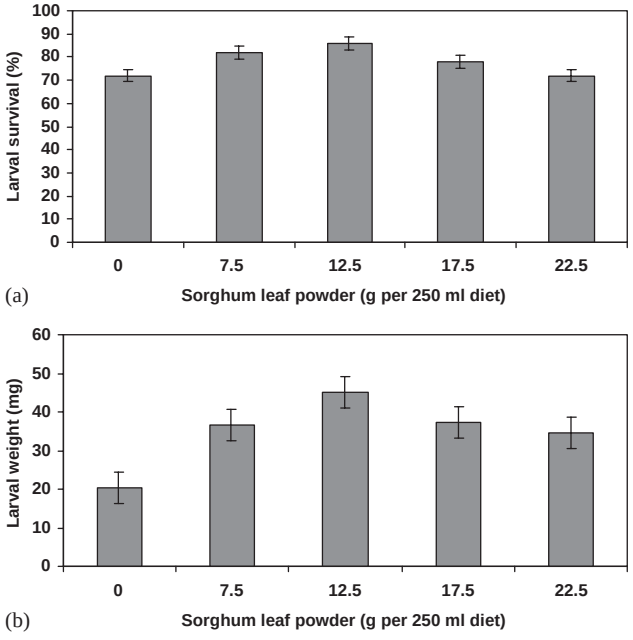

Fig. 1. Survival (Fig. 1a) and weight (Fig. 1b) of *Chilo partellus* larvae (mean ± SE) at 10 days after inoculation on artificial diet impregnated with different amounts of CSH 1 leaf powder (ICRISAT, Patancheru, India).

reared on diet having 12.5 g sorghum leaf powder per 250 ml diet. The results suggested that 12.5 g sorghum leaf powder is optimum for larval development, while adverse effects of sorghum leaf powder were apparent at 22.5 g leaf powder per 250 ml diet.

Larval survival and larval weight were significantly lower when the complete amount of chickpea flour in the artificial diet was substituted with sorghum leaf powder (Fig. 2). Larval survival ranged from 64.7% to 72.7% when the chickpea flower was substituted with leaf powder in different proportions. Mean larval survival in artificial diet with leaf powder of ICSV 743, ICSV 705, and IS 5469 was 66.4%, 67.8%, and 75.2%, respectively. Maximum differences (24%) in larval survival between the genotypes tested were observed at a 3:3 proportion of chickpea flour:sorghum leaf powder. Larval weight across genotypes ranged from 10 to 54 mg at 10 days after inoculation. Larval weight was maximum in artificial diets having a 3:3 ratio of chickpea flour:sorghum leaf powder. Maximum differences in larval weight were observed in diets having 2:4 or 3:3 proportion of chickpea flour:sorghum leaf powder. Larval weight across different proportions of chickpea flour:sorghum leaf powder was 29 mg on ICSV 705 and 34 mg on ICSV 743 and IS 5469. Therefore, chickpea flour can be substituted by 50% (3:3 proportion) with sorghum leaf powder to evaluate sorghum genotypes for antibiosis component of resistance to *C. partellus*.

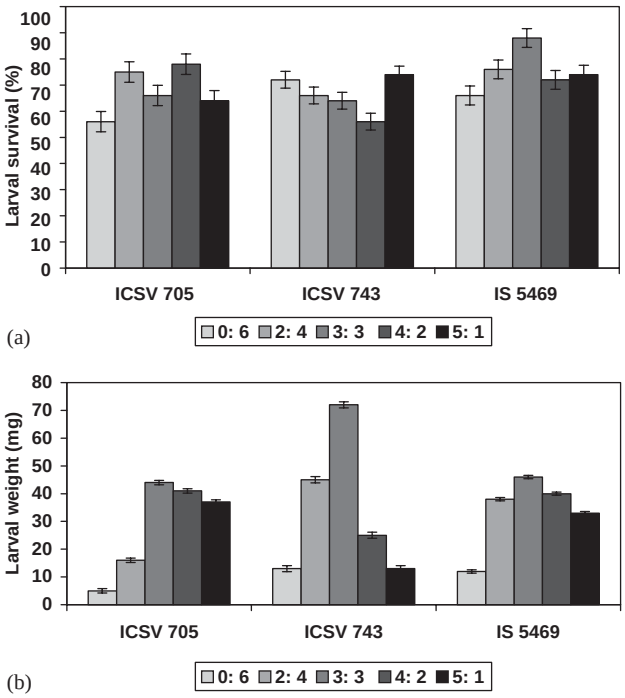

Fig. 2. Survival (Fig. 2a) and weight (Fig. 2b) of *Chilo partellus* larvae (mean ± SE) at 10 days after inoculation on artificial diet with different proportions of chickpea flour:sorghum leaf powder (0:6, 2:4, 3:3, 4:2, and 5:1, respectively) of three sorghum genotypes (ICRISAT, Patancheru, India).

3.2. Survival and development of *C. partellus* on artificial diet impregnated with lyophilized leaf powder of different sorghum genotypes

Antibiosis component of resistance to *C. partellus* in 20 sorghum genotypes was studied in terms of survival and development on artificial diet impregnated with freeze-dried leaf powder of different sorghum genotypes. Data on larval survival, larval weight, duration of larval and pupal development, post-embryonic development period, pupal weight, and pupation and adult emergence were taken as a measure of antibiosis component of resistance to *C. partellus*. Larval survival and larval weight of *C. partellus* larvae reared on artificial diet impregnated with lyophilized leaf powder showed significant differences between the genotypes tested. Larval survival was <70% in diets with freeze-dried leaf powder of IS 1044, IS 2269, IS 18573, IS 21444, and ICSV 714 compared to >90% survival in artificial diet impregnated with leaf powder of AF 28, Seredo, and Naga White (Table 2). The larval weight was <2.5 mg on artificial diets with IS 1044, IS 1054, IS 2269, IS 5566, IS 18573, IS 21444, ICSV 705, and ICSV 714 leaf powder compared to 6.5–11.1 mg on AF 28, Seredo, and ICSV 1. Low larval survival and larval weight at 10 DAI were recorded on IS 1044, IS 1054, IS 18573, IS 21444, ICSV 705, and ICSV 714. Weight of the male pupae was significantly lower than that of the female pupae. Pupal weight varied from 46.0 to 72.5 mg for the males and from 81.1 to 143.5 mg for the females. Significantly lower pupal weight was observed in male and female pupae from the larvae reared on diets with leaf powder of IS 1044, IS 5566, IS 13100, IS 18573, and ICSV 705, and ICSV 714 as compared to those insects reared on IS 5604, IS 18333, Seredo, and ICSV 1.

Percentage pupation varied from 15% to 76%, while the adult emergence varied from 10% to 40%. Comparatively lower pupation (<30%) and adult emergence (<10%) were recorded in artificial diets impregnated with leaf powder of IS 2123, IS 2269, IS 5566, IS 18573, IS 21444, ICSV 705, and ICSV 714 as compared to those reared on diets with leaf powder of IS 5469, IS 5604, IS 12308, IS 13100, IS 18333, AF 28, and Seredo (>50% pupation and >30% adult emergence). The larval period varied from 24.5 to 38.0 days for males, and from 23.3 to 39.0 days for the females on artificial diet impregnated with leaf powder from different sorghum genotypes (Table 3). Larval duration for the males was prolonged by 10 days on IS 1044, IS 2269, ICSV 705, and ICSV 714 as compared to that on IS 13100. Duration of larval period for the females was significantly longer on IS 1044, IS 2123, IS 5566, and ICSV 714 as compared to the larvae reared on AF 28.

Pupal period was >10 days on IS 1054, IS 5604, and Naga White for the males, and IS 5604, and Seredo for the females compared to 6.0 and 6.3 days for the males and females on AF 28, respectively. Post-embryonic development period for the males and/or females was prolonged by over 10 days when reared on diets with freeze-dried leaf powder of IS 1044, IS 2123, IS 2269, IS 5469, IS 18573, Naga White, ICSV 705, and ICSV 714.

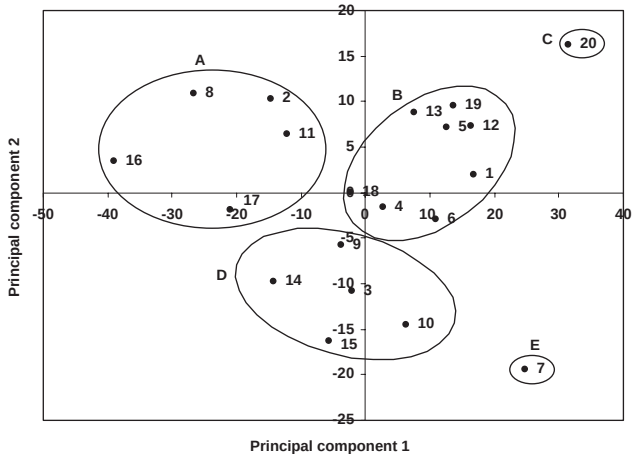

Fig. 3. Principal component analysis of 20 sorghum genotypes for diversity of resistance to *Chilo partellus* based on larval survival and development on artificial diet impregnated with freeze-dried leaf powder (ICRISAT, Patancheru, India). [1 = IS 1044, 2 = IS 1054, 3 = IS 2123, 4 = IS 2263, 5 = IS 2269, 6 = IS 5469, 7 = IS 5566, 8 = IS 5604, 9 = IS 12308, 10 = IS 13100, 11 = IS 18333, 12 = IS 18573, 13 = IS 21444, 14 = AF 28, 15 = Naga White, 16 = Seredo, 17 = ICSV 1, 18 = ICSV 112, 19 = ICSV 705, and 20 = ICSV 714].

Principal component analysis of the 20 genotypes tested (based on larval survival, larval and pupal weight, percentage pupation and adult emergence, and duration of post-embryonic development) indicated that there is considerable diversity in sorghum genotypes for antibiosis component of resistance to *C. partellus* (Fig. 3). The test genotypes were placed into five groups of (A) IS 1054, IS 5604, Seredo, IS 18333, and ICSV 1; (B) IS 1044, IS 2263, IS 2269, IS 5469, IS 18573, IS 21444, ICSV 705, and ICSV 112; (C) ICSV 714; (D) IS 2123, IS 12308, IS 13100, AF 28, and Naga White; and (E) IS 5566. The genotypes placed in different groups, and showing antibiosis to *C. partellus* can be used in resistance breeding programs to diversify the basis of resistance to this pest.

4. Discussion

Adverse effects of stem borer-resistant lines on survival and development of *C. partellus* under field

Table 2
Survival and development of spotted stem-borer, *Chilo partellus* larvae on artificial diet impregnated with leaf powder of different sorghum genotypes

Genotype	Larval survival (%)	Larval weight (mg)	Pupal weight (mg)		Pupation (%)	Adult emergence (%)
	10 DAI	10 DAI	Males	Females	Total	Total
IS 1044	70 (56.9)*	0.8 (1.1)**	49.0	98.6	30.0	20.0
IS 1054	75 (63.0)	2.0 (1.5)	60.8	127.9	56.7	10.0
IS 2123	88 (69.5)	2.8 (1.7)	63.3	106.3	25.0	10.0
IS 2263	75 (63.5)	3.3 (1.9)	62.3	104.5	40.0	30.0
IS 2269	68 (55.6)	0.7 (1.1)	53.5	—	15.0	10.0
IS 5469	73 (58.6)	2.6 (1.7)	62.4	96.8	53.3	30.0
IS 5566	85 (67.3)	1.0 (1.2)	51.4	81.1	30.0	10.0
IS 5604	78 (62.2)	4.3 (2.1)	65.2	136.9	50.0	26.7
IS 12308	82 (67.8)	4.4 (2.2)	61.7	108.9	55.0	40.0
IS 13100	86 (73.0)	4.6 (2.2)	50.6	98.0	60.0	33.3
IS 18333	74 (59.6)	4.1 (2.1)	69.5	120.1	76.7	33.3
IS 18573	65 (53.9)	1.3 (1.3)	46.0	101.7	20.0	10.0
IS 21444	65 (54.4)	1.8 (1.5)	56.5	107.0	30.0	10.0
AF 28	90 (76.0)	11.1 (3.3)	61.2	116.3	56.7	36.7
Naga White	94 (81.0)	2.8 (1.8)	62.2	107.0	55.0	20.0
Seredo	90 (76.0)	8.1 (2.9)	72.5	143.5	50.0	30.0
ICSV 705	65 (54.6)	0.5 (1.0)	52.8	—	20.0	10.0
ICSV 714	50 (45.0)	0.5 (1.0)	49.8	91.4	30.0	10.0
ICSV 1	86 (73.1)	6.5 (2.6)	67.8	125.0	55.0	20.0
ICSV 112	78 (62.2)	2.4 (1.7)	58.8	111.8	46.7	20.0
Mean	76 (63.4)	2.9 (1.7)	58.8	104.6	34.2	16.8
SE±	4.95	0.090	2.82	4.82	4.45	2.51
LSD at 5%	13.72	0.25	8.01	13.68	12.65	5.04

—Data not recorded due to fungal infection.
*Angular transformed values.
**Square root transformed values.

Table 3
Duration of larval, pupal, and post-embryonic development (days) of spotted stem borer, *Chilo partellus* larvae on 25 sorghum genotypes (ICRISAT Center, Patancheru, 1999 rainy season).

Genotype	Larvae		Pupae		Post-embryonic	
	Males	Females	Males	Females	Males	Females
IS 1044	35.1	34.0	7.0	—	42.1	38.0
IS 1054	28.6	30.7	10.0	—	38.6	—
IS 2123	31.5	34.3	—	8.0	—	42.3
IS 2263	27.5	28.0	8.5	8.0	36.0	36.0
IS 2269	38.0	—	—	—	43.0	—
IS 5469	29.8	32.4	8.0	8.0	37.8	40.4
IS 5566	33.0	38.5	—	—	38.0	—
IS 5604	25.5	24.6	10.0	10.3	35.5	34.9
IS 12308	26.3	27.6	7.8	—	34.0	31.6
IS 13100	24.5	24.1	6.7	8.9	30.2	33.0
IS 18333	27.4	28.0	7.8	8.7	35.0	36.7
IS 18573	31.0	33.0	—	8.0	—	41.0
IS 21444	28.7	30.7	—	7.5	—	38.2
AF 28	26.1	23.3	6.0	6.3	32.1	29.7
Naga White	27.3	32.9	11.0	8.0	38.3	40.9
Seredo	26.5	26.0	8.5	11.0	35.0	37.0
ICSV 705	37.0	—	9.0	—	46.0	—
ICSV 714	37.0	39.0	8.0	—	45.0	—
ICSV 1	25.3	27.1	9.0	8.0	34.3	35.1
ICSV 112	29.3	30.2	7.0	7.0	36.3	37.2
Mean	29.8	30.2	8.3	8.3	37.5	37.8
SE ±	0.89	1.03	0.36	0.45	0.8	1.2
LSD at 5%	2.53	2.93	1.01	1.28	2.29	3.26

—Data not recorded due to fungal infection.

conditions have been reported by Lal and Pant (1980), Singh and Verma (1988), and Woodhead and Taneja (1987). However, expression of resistance to *C. partellus* under field conditions is quite variable due to variation in environmental conditions, differential growth of the test genotypes, and the nutrient status of the soil. Impregnation of freeze-dried leaf powder into the artificial diet is helpful to overcome the variation in borer infestation observed under field conditions to allow a comparison of the test genotypes under uniform conditions.

Freeze-dried sorghum leaf powder at 12.5 g per 250 ml of the standard artificial diet (Sharma et al., 1992) can be used to quantify antibiosis component of resistance towards *C. partellus*. Alternatively, chickpea flour in the standard artificial diet can be substituted by 50% with the freeze-dried sorghum leaf powder to quantify the extent of antibiosis towards the larvae of *C. partellus*. There was a considerable variation in larval survival, larval and pupal weight, larval and pupal development period, and percentage pupation and adult emergence in diets impregnated with freeze-dried leaf powder of different sorghum genotypes. Low larval survival and larval weight were recorded in artificial diets impregnated with freeze-dried leaf powder of IS 1044, followed by IS 1054, IS 18573, and IS 21444 at 10 days after larval inoculation, while lower pupal weight was observed in larvae reared on IS 1044, IS 5566, IS 13100, IS 18573, and ICSV 705, and ICSV 714. Low pupation (<30%) and adult emergence (<10%) were also recorded in artificial diet impregnated with leaf powder of IS 2123, IS 2269, IS 5566, IS 18573, IS 21444, ICSV 705, and ICSV 714, while total development period for the males and/or females was prolonged by over 10 days on IS 1044, IS 2123, IS 2269, IS 5469, IS 18573, Naga White, ICSV 705, and ICSV 714.

Genotypic differences in larval establishment in the field have been reported on different sorghum genotypes (Jotwani et al., 1978; Woodhead and Taneja, 1987; Singh and Rana, 1989; Berg van den and Westhuizen van der, 1997). Larval, pupal, and the total development period is also prolonged (Jotwani et al., 1978; Lal and Sukhani, 1979, 1982; Singh and Rana, 1984, 1989; Saxena, 1990, 1992; Verma et al., 1992). Antibiosis is also expressed in terms of reduced pupal weight (Lal and Sukhani, 1982; Singh and Rana, 1984; Singh and Verma, 1988; Verma, et al., 1992) and low pupation and adult emergence (Singh and Verma, 1988). The antibiotic effects of the resistant genotypes on the development of *C. Partellus* may be because of secondary plant substances in the leaves and/or poor nutritional quality of the food. Low sugar content (Swarup and Chaugale, 1962), and greater amounts of amino acids, tannins, total phenols, neutral detergent fiber (NDF), acid detergent fiber (ADF), and lignins (Khurana and Verma, 1982, 1983), and silica content (Narwal, 1973) are associated with resistance to *C. partellus* in sorghum. Larval mortality is greater in diet impregnated with petroleum ether extract of the borer-resistant lines. Methanolic extracts from the susceptible line IS 18363 showed greater feeding stimulation than the extracts from the less susceptible cultivar, IS 2205. IS 18363 had greater phenolic and sugar contents than the less susceptible cultivar, IS 2205 (Torto et al., 1990). These biochemical constituents might influence the insect survival and development adversely. Reduced survival and establishment will reduce the insect population and the resultant crop damage. Prolongation of development period will also result in reduction of number of generations in a season/year. These effects of the resistant varieties will have a constant and cumulative effect on the stem borer population over seasons (Sharma, 1993), and can be utilized as an environmental friendly method to reduce the damage by this pest under subsistence farming conditions. Principal component analysis indicated that there is considerable diversity in sorghum genotypes for antibiosis component of resistance to *C. partellus*. Genotypes placed in different groups, and showing antibiosis to *C. partellus,* can be used in resistance breeding programs to diversify the basis of resistance to this pest.

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