Science Letters (2020) 118-120

Contents list available at Science Letters

Science Letters

journal homepage: http://www.scienceletters.org/

Expression of Antibiosis Resistance in Sorghum Composites to Stem borer, *Chilo partellus swinhoe* Under Greenhouse Conditions

Chand Asaf* and S. Arivudainambi

Department of Entomology, Faculty of Agriculture, Annamalai University, Annamalai Nagar - 608 002, India

ARTICLE INFO

Article History:
Received 05 July 2020
Revised 10 September 2020
Accepted 14 September 2020
Available Online 16 September 2020

Keywords:
Chilo partellus
Antibiosis
Resistance
Sorghum composites

ABSTRACT

The antibiosis components of resistance to the stemborer, Chilo partellus (Swinhoe) was studied on three different sorghum composites under greenhouse conditions. Significant differences were observed between the resistant composites and susceptible check in regards to larval survival, larval duration, pupal mass, and percentage pupation and adult emergence. It has been concluded that high mortality of larvae on resistant composites is due to antibiosis and hence the possibility of selection of parents to breed should be based on the information to increase the levels and diversify the bases of resistance to C. partellus in sorghum.

Introduction

Sorghum (*Sorghum bicolor* L. Moench) is an important food and fodder crop in the semi-arid tropics (SAT). Grain yields of sorghum on peasant farmers are generally low, (700 - 900kg ha^{-1}), and one of the major yield limiting factor is insect pests, which cause an average loss of 32.1% (Borad and Mittal, 1983). The sorghum stem borer, *Chilo partellus* has been regarded as a serious pest, not only from the Indian subcontinent but also from a number of African countries (Seshu Reddy, 1985). Pest- resistant varieties are vital components of integrated pest management programmes. A number of sources of resistance to this pest have been identified and up till now 14,000 sorghum germplasm lines have been screened against stem borer (Taneja and Leuschner, 1985).

All 3 mechanisms of resistance as suggested by Painter (1951) are known to exist in sorghum for resistance to stem borer (Srivastava, 1985). The important mechanism of resistance is antibiosis (Kalode and Pant, 1967; Jotwani *et al*., 1978; Lal and Sukani, 1982; Singh and Rana, 1984). The objectives of the present study were to determine the antibiotic effects of sorghum composites on the life cycle of stem borer, *Chilo partellus.*

Materials and Methods

Antibiosis components of resistance to the stem borer, *Chilo partellus* were studied in three different sorghum composites under laboratory conditions. For carrying out the present studies, the self-pollinated ears of the few plants that survived in the best genotypes during the previous trials were further improved and the three resistant composites (SR-1, SR-2, and SR-3) were formed . SR-1 was constituted by bulk pollination among the best genotypes (AS 4599, AS 5812 and AS 8262). SR-2 was formed by the bulk pollination among the best genotypes (IS 10556, IS 21726, IS 21444) and SR-3 was made by bulk pollination among the best genotypes (MS 7933, MS 8034, MS 4959). The *C. partellus* neonates which were used for the present study were reared in the laboratry at 27± 2^0 C and 75 - 90 % RH. The newly formed pupae were transferred to jars containing 10cm moist sand layer. Newly emerged moths were released in pairs inside the oviposition chamber and fresh sorghum leaves were provided for egg laying.

The sorghum genotypes were grown in a Randomized Block Design with 5 treatments (including three composites, a resistant check and a susceptible check) replicated 4 times. The plants were raised on medium sized pots (60 cm Dia.) and the potting mixture consisted of red soil and FYM (2:1). Before sowing, DAP was applied @ 50 gm/pot and 10 seeds were sown in each pot. At 10 DAE, three healthy seedlings were retained in each pot. Urea @ 10 g /pot was applied after thinning.

The stem pieces (10 cm) length obtained from the respective genotype was supplied individually to the neonate larva kept in a glass rearing jar and reared up to adult emergence. The stem pieces were replaced by the new ones of the respective genotype once in two days. Observations on larval survival and development on the stem pieces were made. Duration of larval development was recorded, as number of days from the release of the larvae up to the date of pupation. The emerged pupae were sexed on the basis of their relative size and genital openings (Sithanantham and Subramaniam, 1975). Duration of pupal development was recorded in terms of number of days and to achieve this, pupae were kept in glass vials separately.

* *Corresponding Author: Chand Asaf*
E-mail Address: chandmuba@gmail.com
DOI: 10.46890/SL.2020.v01i05.004

Table - 1: Survival and development of C. partellus on stem pieces of different genotypes

Genotypes	*Larval survival (%)	Larval duration (days)	•Pupae formed (%)	Pupal weight (mg)	Pupal duration (days)	□Adult emerged (%)	Adult longevity (days)	□ Sex ratio	
								Male	Female
SR-1	21.67 (27.69)	31.15 (5.58)	21.67 (27.69)	29.33 (5.42)	8.33 (2.88)	8.33 (2.89)	2.5 (1.58)	66.67 (8.17)	33.33 (5.77)
SR-2	11.67 (19.91)	31.70 (5.63)	11.67 (19.91)	31.04 (5.57)	10.17 (3.18)	5.00 (2.24)	2.84 (1.68)	100 (10.00)	0.0 (0.00)
SR-3	8.33 (16.74)	32.34 (5.68	8.33 (16.72)	32.26 (5.68)	8.50 (2.91)	6.67 (2.58)	2.50 (1.58)	58.21 (7.63)	41.79 (6.46)
IS 18551	18.32 (25.33)	28.04 (5.29)	18.32 (25.33)	34.71 (5.89)	7.10 (2.66)	13.83 (3.72)	2.69 (1.64)	100 (10.00)	0.0 (0.00)
CSH 1	65.00 (53.73)	27.28 (5.22)	65.00 (53.73)	58.67 (7.66)	6.92 (2.63)	63.33 (7.96)	3.00 (1.73)	54.71 (7.40)	45.29 (6.73)
SED	0.36	0.03	0.36	0.01	0.41	0.36	0.05	0.44	0.005
CD (0.05%)	0.83	0.05	0.83	0.03	0.87	0.83	0.09	1.02	0.01

Percentage of pupation and adult emergence were calculated from the total number of larvae released during each replication.

Results and Discussion

The data on various development parameters of *Chilo partellus* are presented in Table 1. Under green house conditions, percentage larval survival varied from 8.33% on composite SR-3 to 21.67 % on SR-1. No significant differences were observed in percentage larval survival among the other composite. This indicates the presence of some antibiotic factors in both resistant composites, which may be either owing to the lack of certain essential nutrients in the leaf whorls or presence of certain toxic compounds. Swarup and Chaugale (1962) observed the differences between stem and leaf whorl proteins with respect to their amino acid complement of resistant and susceptible sorghum varieties. They also found a higher percentage of total nitrogen in susceptible varieties, but no specific compound has so far been determined which can be considered as mainly responsible for the antibiotic effects. However, antibiosis mechanism of resistance in sorghum to stem borer may be dependant on some biochemical agents. As in maize, Klun and Brindley (1966) reported that lines highly resistant to the European Corn Borer contained 10 times more 6-MBOA (6-methoxybenzoxazolinone), a phenolic compound. Thus biochemical factors of sorghum plants at different stages should be examined thoroughly to confirm the biochemical bases of antibiosis mechanism for stemborer resistance. It may be due to the high susceptibility of younger borer larvae to the antibiotic factors present in the plant as older larvae showed resistance and good establishment in the plant, of the resistant lines.

Larval duration was adversely affected on the resistant composites. Larval duration varied from 31.15 to 32.34 days (Table 1). Prolongation of larval period has been reported with respect to *C. partellus* on sorghum (Kalode and Pant, 1967; Saxena, 1990; Verma *et al.* 1992, and Saxena, 1992). The pupal period was significantly longer on composite SR-2 than other composites and the prolongation of the pupal period has been reported by Verma *et al* (1992). Higher pupal mass was observed in pupae from composite SR-3 (32.26 mg) as compared to the susceptible check, CSH-1 (58.67 mg) which indicates that the pupal weight was significantly less on resistant lines than on susceptible ones. Similar results were reported by Lal and Sukhani (1982). Significantly low pupation percentage was recorded on composite SR-2 (11.67 %) as compared to check, CSH-1 (65.0 %) which is in conformity with the results of Singh and Verma (1988) indicating that percentage pupation was adversely affected on borer-resistant genotypes.

Percentage adult emergence (of the total No. of larvae released) varied from 5.0 % to 8.33 % on the resistant composites and showed a reduction in emergence of adults.

To explain the effects of resistant genotypes on the developmental biology of the stem borer, the following probable reasons have been presented:

Singh and Rana (1984) suggested that the sorghum varieties appear to posses some antibiotic factor(s) which exist either in the leaves or in the stem or in both and influence the larval duration adversely. Prolongation of larval period ultimately results in the reduction of number of generations in a season/year. The adverse effects on the post-embryonic development of stem borer might possibly be because of the antibiotic factors (Lal and Sukhani, 1982). Thus, it can be concluded that the adverse effects of the resistant composites on prolonged larval and pupal period, lower pupal mass and pupation, and adult emergence may be due to some nutritional abnormalities. The results indicate that selection of parents to breed should be based on these information to increase the levels and diversify the bases of resistance to *C. partellus* in sorghum.

References

Borad, P. K. and V. P. Mittal. 1983. Assesment of losses caused by pest complex to sorghum hybrid CSH 5. In: Crop Losses due to Insect Pests. (eds. Krishnamurthy Rao B.H. and K.S.R.K. Murthy). Special issue of Indian *J. Ent.,* Entomological Society of India, Rajendranagar, Hyderabad, Andhra Pradesh, India.

Jotwani, M.G., S. Chaudhari and S.P. Singh. 1978. Mechanism of resistance to *Chilo partellus* (Swinhoe) in sorghum. *Ind. J. Entomol*., 40: 273-276.

Kalode, M.B. and N.C. Pant. 1967. Effect of host plants on the survival, development and behaviour of *Chilo zonellus* (Swinhoe) under laboratory conditions. *Indian J. Ent*., 29: 48-57.

Klun, J. A. and T. A. Brindley. 1966. Role of 6-methoxybenzolinone inbred resistance of host plant (maize) to first brood larvae of European corn borer. *J. Econ. Ent.* 59, 711-718.

Lal, G. and T.R. Sukhani. 1982. Antibiotic effects of some resistant lines of sorghum on post-larval development of *Chilo partellus* (Swinhoe). Indian J. Agric. Sci., 52: 127-129.

Saxena, K.N. 1990. Mechanisms of resistance/susceptibility of certain sorghum cultivars to the stem borer *Chilo partellus*: role of behaviour and development. *Entomol Exp. Appl*., 55: 91-99.

Saxena, K.N., 1992. Larval development of *Chilo partellus* (Swinhoe) (Lepidoptera: Pyralidae) on artificial diet incorporating leaf tissues of sorghum lines in relation to their resistance or susceptibility. *App. Ent. Zoo.*, 27: 325-330.

Seshu Reddy, K.V., 1985. Biology of the stem borer *Chilo* (zonellus) *partellus* S. on hybrid jowar (CSH-1) *Sorghum vulgare* Pers. *Andhra Agri. J*., 16**:** 131-136.

Singh, B.U. and B.S. Rana. 1984. Influence of varietal resistance on oviposition and larval development of stalk-borer *Chilo partellus* (Swin). and its relationship to field resistance in sorghum. *Insect Sci. App.,* 5: 287-296.

Singh, S.P. and A.N.Verma. 1988. Antibiosis mechanism of resistance to stem borer, *Chilo partellus* (Swinhoe). *J. Insect Sci*., 9: 579-582.

Sithanantham, S and T. R. Subramaniam. 1975. Sex determination of pupae of sorghum stalk borer, *Chilo zonellus* (Swinhoe). *Madras Agricultural Journal* 62: 62-63.

Srivastava, K. P. 1985 Screening of sorghum stem borer resistance. Proc. *International Sorghum Entomology Workshop*, 15-21 July 1984, Texas A&M University College station, Texas, USA, pp. 189 -200.

Swarup, V. and D.S. Chaugale. 1962. A preliminary study on resistance to stem borer (*Chilo zonellus* Swinh.) infestation on sorghum (*Sorghum vulgare* Pers.). *Curr. Sci*., 31: 163-164.

Taneja, S.L. and K. Leuschner. 1985. Methods of rearing, infestation and evaluation of *Chilo partellus* resistance in sorghum. pp. 175-188. **In:** *Proceedings*

of the International Sorghum Entomology Workshop, July 15-21, 1984, Texas A&M University, College Station, Texas, USA. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patencheru, Andhra Pradesh 502 324, India.

Verma, O.P., J.P. Bhanot and A.N. Verma. 1992. Development of *Chilo partellus* (Swinhoe) on pest resistant and susceptible sorghum cultivars. J. Ins. Sci., 5: 181-182.