Research Article

Comparative Biology of Shoot Fly, *Atherigona Soccata* (Rondani) on Susceptible, Resistant Genotypes and Its F_1 Hybrid of Sorghum

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Abstract

Comparative biology of *Atherigona soccata* (Rondani) was studied on susceptible (K8), resistant (IS 2205) sorghum genotypes and its F_1 hybrid. Significant differences were observed between resistant susceptible genotypes and its F_1 hybrid with regard to larval, pupal and adult developmental parameters. Developmental periods of egg, larva and pupa was maximum on IS 2205, F_1 hybrid and minimum on K8. Total life cycle of shoot fly was prolonged on resistant genotype, IS 2205 (24.98 ±1.87 days) and its F_1 hybrid (22.04 ±1.67 days) than susceptible genotype, K 8 (20.1±105 days). Length and width of egg, larva, pupa and growth indices like pupation (%), adult emergence (%), fecundity (nos./ female) ovipositional period (days) and adult longevity (male and female) were minimum on IS 2205 indicating higher degree of antibiosis in the resistant genotype. Observation on female: male ratio showed no significant variation between IS2205, F_1 hybrid and K 8.

Keywords: Shoot fly, biology, IS 2205 (Resistant genotype), K8 (Susceptible genotype)

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Introduction

Sorghum is an important food and fodder crop in India. More than 150 species of insect pests were found to attack sorghum crop during different stages of its growth [5]. Among them, the shoot fly, *Atherigona soccata* (Rondani) is one of the most serious and destructive pests at seedling stage. Ballard and Rao (1924) [1] described some aspects on the behaviour and biology, while the eco-biology of *A. soccata* has been reviewed extensively by Barry (1972) [2]. Shoot fly infestation decreases plant stand and also causes severe losses in grain and fodder yield. Being a dry land crop, farmers rarely rely on chemicals for pest management. Hence, host plant resistance plays a pivotal role in pest management in grain millets. Plant resistance to insect pests should be one of the major criteria in the development and release of new crop genotypes, in order to ensure prolonged genotype life and cost effective production. Preliminary screening carried out at Agricultural Research Institute, Kovilpatti revealed that genotypes IS 2205 was relatively resistant and K8 as susceptible to sorghum shoot fly. Understanding the mechanism of resistance in these genotypes and its F_1 hybrid will pave way for the development of resistant varieties / hybrids through molecular breeding. Keeping this in view, the present investigation was carried out to understand the resistant mechanism in IS 2205 and its F_1 hybrid in comparison with the susceptible genotype, K8.

Materials and Methods

Susceptible (K 8), resistant (IS 2205) sorghum genotypes and its F_1 hybrid (K 8 x IS 2205) were sown in an area of 300 sq. m. during *Rabi* 2017 at Millet Breeding Station, Department of Millets, Tamil Nadu Agricultural University (TNAU), Coimbatore. All the recommended package of practices (Crop Production Guide, 2014) [3] were followed except plant protection measures up to 40 days for biological studies of shoot fly. Three hundred plants in each entry were tagged at 10 days after emergence. Length and breadth of eggs, different larval instars and pupae were measured separately by destructive sampling for each entry using ocular microscope. For each stage, 20 samples were used. For biology studies, seedling with dead heart was collected from field and kept in cage or shoot flies were collected from Fish-meal trap kept in infested sorghum fields in the morning hours between 07.30 to 09.00 h in 200 ml plastic bottles through an aspirator and released inside the wire-mesh screened cages (30 × 30 × 30 cm) in the greenhouse (28 ± 20°C and 75 ± 5% RH). The emerging shoot fly adults were separated from other saprophytic flies and then released in a separate cage for mating. The shoot fly adults were provided with 20 per cent sucrose solution in a cotton swab

and a mixture of brewer's yeast and glucose (1:1) in a petri dish. The sucrose solution was changed daily. After three days of mating period, the shoot flies @ 15 females/entry were released on the test seedlings (45 seedling/entry) raised in small plastic cups kept in wire mesh screened cages (75 x 60 x 60 cm) at 9 days after emergence (five leaf stage) for 24 h. After 24 h, the shoot fly females were removed from the cages. Observations on the biological parameters *viz.,* duration of different stages of shoot fly (days), pupation (%), adult emergence (%) and F: M ratios were recorded on each entry by destructive sampling of 7 seedlings per entry for each parameter. For studying the ovipositional period (days), adult longevity (male and female) and fecundity (nos. /female) on each genotype, ten pair of freshly emerged flies was released in cage containing sorghum seedlings (@30 seedlings / entry) raised in small plastic cups. The shoot fly adults were provided with 20 per cent sucrose solution in a cotton swab and a mixture of brewer's yeast and glucose (1:1) in a petri dish. The sucrose solution was changed daily, while the yeast powder-glucose mixture was changed once in three days. Observations on the ovipositional period, adult longevity and fecundity were recorded daily until all adults dead. (Mate *et al.,* 1988 and Karibasavaraja *et al.,* 2007) [7, 6]. The data obtained from various experiments were subjected to Analysis of variance (ANOVA) using software SPSS. The significance of differences was tested by F-tests, while the significance of difference between the treatment means were compared by LSD at 5 and 1 per cent probability.

Results and Discussion

The results on the relative growth of shoot fly on K 8, IS 2205 and its F_1 hybrid are presented in **Table 1**. The length and width of eggs was 1.89±0.16 and 0.52±0.07 mm on K 8, 1.59±0.10 and 0.47±0.03 mm on IS 2205 and it was 1.57±0.16 and 0.47±0.04 mm on F_1 hybrid. The larval instars grown on susceptible genotype, K 8 were healthier, having higher length and width than resistant genotype, IS 2205. The fourth instar larvae measured 7.70±0.44, 6.00±0.28 and 5.48 ±0.49 mm in length and 1.27±0.14, 0.99±0.11 and 0.94±0.11 mm in width on K 8, IS 2205 and F_1 hybrid, respectively. The pupa measured 5.30±0.65, 4.12±0.29 and 3.93 ±0.17 mm in length and 1.30±0.14, 1.21±0.24 and 1.17±0.21 mm in width on K 8, IS 2205 and its F_1 hybrid, respectively (Table 1). These findings corroborate with the results of Rajasekharan and Venugopal (1979) and Karibasavaraja *et al.* (2007) [8, 6] who reported that the egg, larval instars and pupa developed on susceptible genotype (CSH 16) were healthier with higher length and width than resistant genotype (IS 2312).

Table 1 Comparative growth of *A. soccata* on susceptible (K8), resistant (IS 2205) genotypes and its F_1 hybrid of sorghum

Life stage*	**K 8 (susceptible genotype)**				**IS 2205 (resistant genotype)**				**K8 x IS 2205 (F_1 hybrid)**			
	Length (mm ± SE)		**Width (mm ± SE)**		**Length (mm ± SE)**		**Width (mm ± SE)**		**Length (mm ± SE)**		**Width (mm± SE)**	
Egg	1.89	±0.16	0.52	±0.07	1.59	±0.10	0.47	±0.03	1.57	±0.16	0.47	±0.04
I instar	1.46	±0.13	0.40	±0.03	1.22	±0.06	0.37	±0.04	1.21	±0.03	0.37	±0.03
II instar	2.88	±0.17	0.66	±0.02	2.50	±0.13	0.60	±0.05	2.34	±0.16	0.63	±0.03
III instar	5.98	±0.24	1.05	±0.11	4.77	±0.21	0.99	±0.10	4.52	±0.34	0.97	±0.11
IV instar	7.70	±0.44	1.27	±0.14	6.00	±0.28	0.99	±0.11	5.48	±0.49	0.94	±0.11
Pupa	5.30	±0.65	1.30	±0.14	4.12	±0.29	1.21	±0.24	3.93	±0.17	1.17	±0.21

*Mean of 20 samples

Results on the duration of egg, larval and pupal stages revealed significant difference among susceptible, resistant and F_1 hybrid (**Table 2**). The incubation period of egg was 2.27 ±0.13, 2.88 ±0.18 and 2.75 ±0.23 days on K 8, IS 2205 and its F_1 hybrid, respectively. These findings were in agreement with Dhawan *et al.* (1993) [4] who observed an egg incubation period of 2.0 and 1.9 days on resistant (IS 18551) and susceptible (JS 20) genotypes, respectively. The larval and pupal period prolonged on IS 2205 (12.36 ±0.66 and 9.89±0.21 days, respectively) and F_1 hybrid (11.39 ±0.77 and 9.68 ±0.21 days, respectively) than on K8 (9.43 ±0.55 and 8.46 ±0.17 days, respectively) (Table 2). These results were in conformity with Karibasavaraja *et al.* (2007) [6] who reported prolonged pupal period of 9.95±1.61 days on resistant genotype, IS 2312 than the susceptible genotype, CSH 16. In the present study, total life cycle of shoot fly was 20.1±1.5, 24.98±1.87 and 22.04±1.67 days on K 8, IS 2205 and its F_1 hybrid, respectively

which was in close agreement with Karibasavaraja *et al.* (2007) [6]. According to them, the total life cycle was 20.39±1.5 and 25.50±1.86 days on susceptible (CSH 16) and resistant genotype (IS 2312), respectively. Per cent pupation and adult emergence were maximum (78.38 and 83.05%, respectively) on K8 compared to IS 2205 (54.76 and 70.48%) and its F_1 hybrid (64.95 and 61.90%). Fecundity of females were maximum on K 8 (40.4 eggs/ female) compared to IS 2205 and its hybrid which recorded 12.20 eggs/ female and 14.50 eggs/ female, respectively. The period of oviposition, adult longevity of female and male were maximum on K 8 (10.34, 14.64 and 8.45 days, respectively) compared to IS 2205 (7.43, 9.43 and 5.56 days, respectively) and its F_1 hybrid (7.84, 8.54 and 6.25 days, respectively) (**Figure 1**). No significant differences were observed on female and male ratio between K 8, IS 2205 and F_1 hybrid (Figure 1). Present findings corroborate with the results of Karibasavaraja *et al.* (2007) [6] who reported that the growth indices like pupation (%), adult emergence (%), fecundity (nos./ female) ovipositional period (days), and adult longevity (male and female) were minimum on resistant genotype than susceptible genotype. Results on the biological parameters showed that the resistant genotype, IS 2205 and its F_1 hybrid may have higher degree of antibiosis which ultimately influenced the biology of the shoot fly compared to susceptible genotype, K8.

Table 2 Comparative biology of *A. soccata* on susceptible (K8), resistant (IS 2205) genotypes and its F_1 hybrid of sorghum

Life stage *	**K 8 (susceptible genotype)**		**IS 2205 (resistant genotype)**		**K8 x IS 2205 (F1 hybrid)**		**SEd**	**CD (0.01)**	**CD (0.05)**
	Duration (Days ± SE)								
Egg	2.27	±0.13	2.88	±0.18	2.75	±0.23	0.09	0.20	0.28
I instar	1.38	±0.10	1.93	±0.27	1.79	±0.20	0.12	0.35	0.25
II instar	2.52	±0.13	3.39	±0.13	3.25	±0.20	0.12	0.36	0.26
III instar	2.91	±0.16	3.70	±0.12	3.61	±0.13	0.07	0.21	0.15
IV instar	2.63	±0.16	3.34	±0.14	2.75	±0.23	0.09	0.28	0.28
Larva	9.43	±0.55	12.36	±0.66	11.39	±0.77	0.18	0.58	0.38
Pupa	8.46	±0.17	9.89	±0.21	9.68	±0.21	0.10	0.30	0.22
Total Life Cycle	20.1	±1.5	24.98	±1.87	22.04	±1.67	0.23	0.68	0.49

*Mean of seven replications

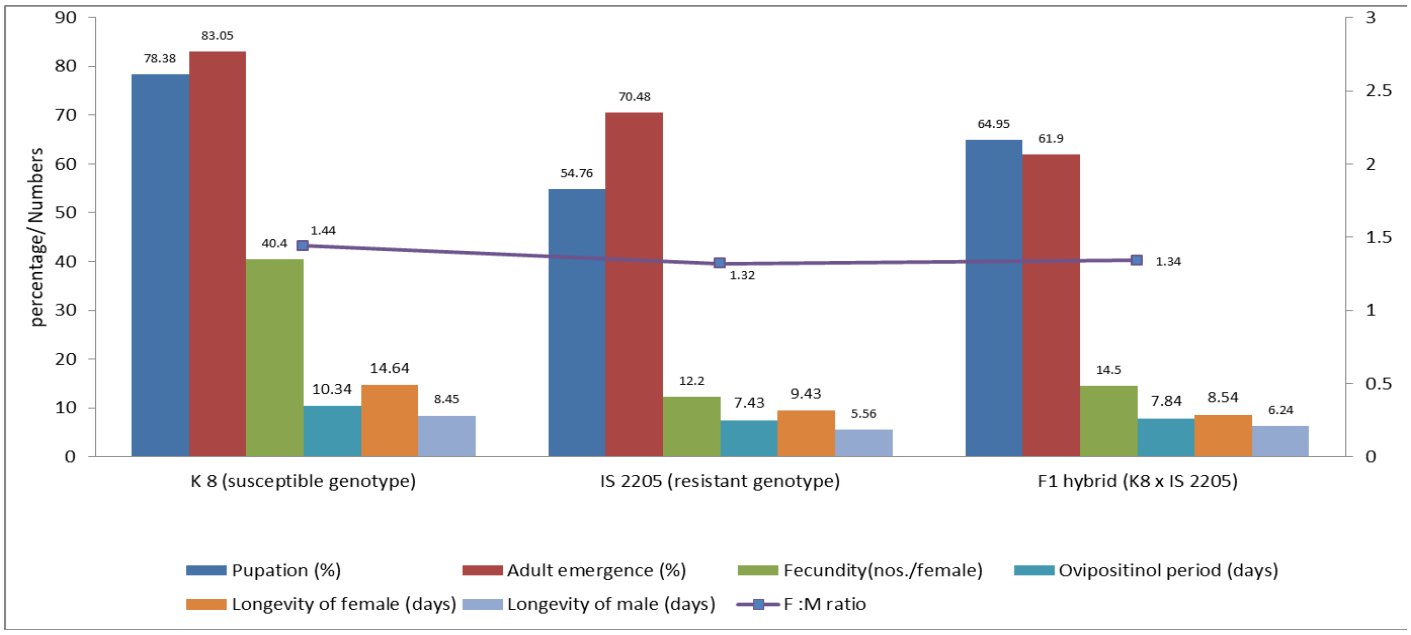

Figure 1 Comparative growth indices of *A. soccata* on susceptible (K8), resistant (IS 2205) genotypes and its F_1 hybrid of sorghum

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