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RESEARCH PAPER

Effect of staggered sowing on shoot fly, *Atherigona soccata* Rondani (Muscidae: Diptera) and stem borer, *Chilo partellus* Swinhoe (Crambidae: Lepidoptera) in parching sorghum genotype

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Abstract: Parching/Hurda sorghum is one of the special sorghum varieties. This special variety of sorghum grains are suitable for making good quality hurda and well fit it into commercial utility. Field experiment was carried out at the Regional Agricultural Research Station, Vijayapura, to study the effect of staggered sowing on shoot fly and stem borer in SMJ-1 hurda sorghum genotype. The present study revealed that, among different sowing dates, hurda genotype (SMJ-1) sown on 1st fortnight (FN) of September had highest number of shoot fly eggs (3.80/plant) and dead heart (70.47%). With late sowing in 1st fortnight of November the shoot fly incidence was declined by recording lowest number of eggs (0.37/plant) and dead heart (17.44%). The stem borer dead heart percentage is relatively consistent ranging from 1.51 to 2.14 per cent. The correlation studies indicated that, dead heart per cent due to shoot fly and stem borer revealed a significant negative correlation with plant height, grain and stover yield. Plant growth and yield parameters recorded optimal yields during 2nd fortnight of September and 1st fortnight of October with minimum pest damage.

Key words: Shoot fly, Stem borer

Introduction

Sorghum [*Sorghum bicolor* (L.) Moench] holds a prominent position among cereal crops worldwide, ranking fifth after wheat, rice, maize, and barley. In India, it is commonly referred to as 'Jowar' due to its substantial grains and is also known as the 'Camel crop' for its resilience in arid soils and ability to withstand prolonged droughts. Grain sorghum is abundant in fiber (6.7g) and essential minerals like phosphorus (16%), magnesium (0.1%), iron and zinc (0.02%) alongside containing ample quantities of carbohydrates (72%), protein (11.6%), and fat (1.9%) (Ratnavathi and Komala, 2016).

Globally, sorghum is cultivated on a total area of 44.0 million hectares, yielding 62.18 million tonnes of grain with a productivity rate of 1.40 tonnes per hectare. Sorghum cultivation in India spans 3.64 million hectares, resulting in a production of 4.03 million tonnes and a productivity of 1.10 tonnes per hectare (Anon, 2023). India contributes approximately 16 per cent of the world's sorghum production.

The Committee on "Doubling of farmer's income" submitted its final report to the Government in September, 2018 containing the recommendations for "doubling of farmers' income" through various policies, reforms and programmes. In the report, remunerative prices on farmers' produce was one of the sources for doubling of farmers' income (Anon, 2024). This can be achieved by adding value to the products of existing crop varieties. Currently, there is an increasing focus on hurda sorghum, a unique type of sorghum used for ready-to-eat snacks (Mate *et al*., 2020). Hurda, also known as parching sorghum, refers to tender sorghum, which falls under the category of specialty sorghum and is recognized as "Hurda" in Maharashtra, "Ponk" in Surat, Gujarat and "Seethani" in Karnataka. Typically available during winter when sorghum grains are juicy and tender, this young sorghum is harvested from fields, roasted, and enjoyed for its delicious flavour. Hurda is commonly consumed with its hull intact, which retains a wealth of nutrients, including high levels of fiber and iron, along with notable protein content and good amounts of phosphorus and thiamine. Additionally, hurda is abundant in antioxidants, and since all sorghum varieties have the added advantage of being inherently gluten-free and has been demonstrated to be safe for people with celiac disease (Ciacci *et al*., 2015).

However, the yield of most speciality sorghum varieties is lower compared to grain-type varieties. This can be attributed to factors such as higher moisture content in the tender grains, smaller earhead size, and other abiotic and biotic stresses. Among the biotic factors, insect pests play a significant role. Sorghum crops are susceptible to infestation by approximately 150 insect species (Reddy and Davies, 1979; Jotwani *et al*., 1980). Notably, shoot fly (*Atherigona soccata* Rondani) and stem borer (*Chilo partellus* Swinhoe) are major pests that attack sorghum at seedling stage.

Currently, there's a notable demand for commercializing hurda sorghum, valued for its role as a ready-to-eat snack and its potential in various value added products. Nevertheless, the agro-ecosystem profoundly influences sorghum yield and quality, with various insect pests presenting significant challenges. Therefore, it is essential to examine various weather scenarios to develop effective control strategies and address insect-related challenges.

Material and methods

The study was carried out during *rabi* season 2023-24 at Regional Agricultural Research Station (RARS), Vijayapura. SMJ-1 hurda genotype was sown at staggered intervals on five different dates, starting from the 1st fortnight of September 2023, and subsequently evaluated for insect pest reactions under protected irrigation. The number of dead hearts caused by shoot fly and stem borer were recorded at 28 and 45 DAE (Days after emergence), respectively and same was expressed in percentage. Observations were also made on plant growth and yield parameters such as, plant height, days to 50 per cent flowering, panicle parameters, grain and stover yield. Data so obtained were then subjected to the analysis of variance (ANOVA) and simple correlation co-efficient (r) was worked out between insect pest reaction and plant growth parameters.

Table 1.Influence of staggered sowing of hurda genotype (SMJ-1) on shoot fly and stem borer incidence in *rabi* season (2023-24)

Date of sowing	Shoot fly	Stem borer	
	Number of eggs per plant at12 DAE*	Dead heart (%) at 28 DAE**	Dead heart (%) at 45 DAE**
I FN of September	3.80 (2.07)	70.47 (57.08)	2.14 (8.41)
II FN of September	2.67 (1.78)	35.99 (36.86)	1.86 (7.84)
I FN of October	1.91 (1.55)	31.27 (34.00)	1.51 (7.06)
II FN of October	1.13 (1.28)	28.71 (32.40)	1.79 (7.69)
I FN of November	0.37 (0.93)	17.44 (24.68)	1.57 (7.20)
S.Em ±	0.08	1.58	0.44
C.D.(0.05)	0.24	4.74	NS
CV (%)	9.03	8.20	11.20

Note: Figures in paranthesis show *(H(x+ 0.5) transformed values and ** Arc sine transformed values used for statistical analysis, DAE: Days after emergence, FN: Fortnight

Results and discussion

The findings of the current investigation on the effect of staggered sowing on shoot fly and stem borer in parching sorghum genotype is presented in table 1 and 2, respectively.

Shoot fly, *A. soccata* (Rondani)

Date of sowing significantly influenced the hurda genotype SMJ-1 by recording the highest number of shoot fly eggs per plant and dead hearts in the first fortnight of September and gradually decreased thereafter. Among the different sowing dates, the SMJ-1 variety sown in the first fortnight of November recorded the lowest shoot fly eggs (0.37/plant) and per cent dead heart (17.44). Significantly highest number of shoot fly eggs and per cent dead heart was recorded in the first fortnight of September (3.80/plant & 70.47%), respectively (Table 1).

Keerthi *et al.* (2017) reported that shoot fly oviposition peaked during the 35th MSW (Meteorological Standard Week) (3.10 eggs/ plant) and was almost equal during the 33rd MSW (2.90 eggs/plant). Karibasavaraja and Balikai (2006) also found that shoot fly oviposition peaked during the 33rd standard week (3.2 eggs/plant) and gradually declined by the 44th standard week. Sable *et al.* (2009) reported that sorghum sown on 16 August exhibited the highest infestation, which declined from 16th August to 1st September which is in conforming to the present findings.

The correlation coefficient analyzed between shoot fly infestation and plant growth parameters revealed a non-significant positive correlation with days to 50% flowering (r = 0.804), panicle length (r = 0.207), panicle breadth (r = 0.313) and panicle weight (r = 0.416). In contrast, a significant negative correlation was observed with plant height (r = -0.895). Additionally, there was a non-significant negative correlation between shoot fly dead heart and both grain (r = -0.352) and stover yield (r = -0.324). The results are in accordance with Tirkar *et al*. (2024), Gomashe *et al*. (2010), Kamatar *et al*. (2010).

Stem borer, *C. partellus* (Swinhoe)

There were no significant differences in the percentage of dead hearts caused by stem borer at 45 DAE across different sowing dates. However, the infestation levels ranged from 1.51 to 2.14 per cent.

Singh *et al.* (2012) reported non-significant and negative association between grain yield and stem borer dead heart. Reddy *et al.* (2020) reported highly significant negative correlation between stem borer dead heart and plant height. Similarly, in the present investigation the correlation coefficients between stem borer dead heart and plant growth parameters had a non-significant positive correlation with days to 50% flowering (r = 0.876), panicle length (r = 0.228), panicle breadth (r = 0.130), and panicle weight (r = 0.040). In contrast, there was a non-significant negative correlation with plant height (r = -0.812), grain yield (r = -0.034), and stover yield (r = -0.072).

The various sowing dates did not significantly effect on the days to 50 per cent flowering and plant height. However, crop sown in the second fortnight of October recorded comparatively highest plant height of 223.99 cm. Different sowing dates significantly influenced panicle and yield parameters. Among different sowing dates highest panicle length, breadth and weight was recorded in 1st fortnight of October (12.28 cm, 7.23 cm and 52.20 g/plant) and lowest in 1st fortnight of November (9.42 cm, 2.28 cm and 18.67 g/plant) respectively. Similarly maximum grain and stover yields recorded in 1st fortnight of October (2229 kg/ha and 58.67 q/ha) followed by 2nd fortnight of September (1988 kg/ha and 52.07 q/ha)

Conclusion

The study examines the effect of staggered sowing on shoot fly and stem borer in SMJ-1 hurda genotype. Early sowing in the 1st fortnight (FN) of September results in the highest number of shoot fly eggs (3.80 per plant) and the highest shoot fly dead heart (70.47%). Conversely, the first fortnight of November shows the lowest shoot fly incidence. While the stem borer dead heart percentage is relatively consistent. In addition, shoot fly and stem borer infestation had a significant negative correlation with plant height, grain and stover

Table 2. Influence of staggered sowing of hurda genotype (SMJ-1) on plant growth and yield parameters in *rabi* season (2023-24)

Date of sowing	Days to 50 per cent flowering(days)	Plant height (cm) at harvest	Panicle Length (cm)	Panicle Width (cm)	Panicle Weight (gm)	Grain yield (kg ha^{-1})	Stover yield(q ha^{-1})
I FN of September	75.43	205.25	10.47	4.62	39.01	1860	49.03
II FN of September	74.92	213.74	10.81	4.75	43.62	1988	52.07
I FN of October	70.72	220.74	12.28	7.23	52.20	2229	58.67
II FN of October	72.55	223.99	9.60	2.66	20.14	1503	40.78
I FN of November	68.25	220.74	9.42	2.28	18.67	1446	39.58
S.Em ±	2.88	3.05	0.51	0.21	1.95	81.43	2.79
C.D.(0.05)	NS	NS	1.59	0.65	6.00	250.93	8.61
CV (%)	7.97	8.35	10.00	9.83	11.23	9.02	11.64
Correlation co-efficient (r)							
Shoot fly	0.804^{NS}	-0.895*	0.207^{NS}	0.313^{NS}	0.416^{NS}	-0.352^{NS}	-0.324^{NS}
Stem borer	0.876^{NS}	-0.812^{NS}	0.228^{NS}	0.130^{NS}	0.040^{NS}	-0.034^{NS}	-0.072^{NS}

Note: **Correlation is significant at the 0.01 level, *Correlation is significant at the 0.05 level, NS- Non significant, FN-Fortnight yield. While they had non-significant positive correlation with panicle parameters *viz*., panicle length, breadth and weight. Among different sowing dates, maximum grain and stover yields recorded in 1st fortnight of October (2229 kg/ha & 58.67 q/ha) followed by 2nd fortnight of September (1988 kg/ha & 52.07 q/ha) balancing pest management and plant growth.

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