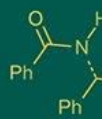


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Biochemical bases of resistance against stem borer in sorghum

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Abstract

A study was conducted at Agronomy Instructional Farm, C. P. College of Agriculture, S. D. Agricultural University, Sardarkrushinagar during *kharif* seasons of year 2021 and 2022 to assess the relationship between biochemical traits in sorghum and susceptibility to the stem borer (*Chilo partellus*). The results showed a significant correlation between stem borer infestation and various biochemical factors. Among twenty-five different genotypes/ varieties genotype IS-2205 exhibited the lowest levels of moisture (73.05%), nitrogen (3.18%), protein (19.87%), and total soluble sugars (7.48 mg/g), correlating with its resistance to stem borer. In contrast, genotype DJ-6514 and variety Swarna had higher levels of nitrogen (4.48%), protein (28.02), and TSS (10.98 mg/g), contributing to their higher susceptibility. Total phenol content showed an inverse relationship with infestation, with the highest phenol levels (4.85 mg/g) in DS-318 linked to lower pest incidence. The findings highlight the critical role of moisture, nitrogen, protein, TSS, and phenols in influencing the resistance or susceptibility of sorghum genotypes to *C. partellus*.

Keywords: Sorghum, stem borer (*Chilo partellus*), biochemical traits, resistance, susceptibility

Introduction

Sorghum is a vital cereal crop, serving as both food and fodder for some of the world's most vulnerable populations. In 2022–23, global sorghum grain production was 55.09 million tonnes, with India as the top producer, followed by Mexico and Nigeria. Sorghum is the third most consumed cereal in India, after rice and wheat, with *kharif* (2022–23) production estimated at 1.69 million tonnes from 2.94 million hectares (Anon., 2022) [1].

The spotted stem borer (*Chilo partellus*), a major pest from the family Crambidae and order Lepidoptera, causes significant damage to sorghum and other crops such as maize, sugarcane, rice, and finger millet. This pest damages the crop from the vegetative stage to maturity, leading to substantial yield losses. Its life cycle, lasting 3–4 weeks, supports multiple generations under favorable conditions (Saranya and Samiayyan, 2017) [6].

Host plant resistance is one of the most sustainable methods for managing stem borer infestations. Key biochemical traits in sorghum significantly influence pest resistance. For instance, phenolic compounds act as natural deterrents, discouraging pest feeding and reproduction. The role of nitrogen is dual—while excessive levels may promote pest growth, optimal levels can enhance plant defense. Similarly, protein content can impact the development of the pest, and moisture levels in plant tissues influence pest establishment and survival.

Given the variability in resistance across sorghum genotypes, identifying varieties with robust resistance mechanisms is crucial. Incorporating biochemical factors such as phenols, nitrogen, proteins, and moisture into screening programs can help develop more resilient sorghum lines, offering a long-term solution for managing *C. partellus*.

Objective

1. Biochemical bases of resistance against stem borer in sorghum

Methodology

The investigations on “Biology, population dynamic and management of stem borer, *Chilo partellus* (Swinhoe) on grain sorghum (*Sorghum bicolor* L.)” were carried out at Agronomy

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Instructional Farm, C. P. College of Agriculture, S. D. Agricultural University, Sardarkrushinagar during *kharif* seasons of year 2021 and 2022. The material used and methodology adopted during the course of investigation are described under here. The investigation on biochemical parameters was carried out at the Center for Oilseeds Research Station, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar. Thirty five days old leaves and were collected from each genotype and subjected to biochemical analysis to assess the total soluble sugar (TSS), total phenol, protein, nitrogen and moisture content using various laboratory equipment. The correlation study was carried out between pest infestation and biochemical parameters.

Results and Discussion

Biochemical bases of resistance against stem borer in sorghum

Phenol

The perusal of data on phenol content from leaves of different genotypes of pearl millet are presented in Table 1. The total phenol content was observed between 1.09 to 2.11 mg/g in various genotypes. The genotype, IS-2205 held highest amount of total phenol (6.59 mg/g) whereas the

Variety, GJ43 (2.20 mg/g) held lowest amount of total phenol with an average of 3.79 mg/g. Rest of the genotypes revealed total phenol content in the range from 4.80 to 2.45 mg/g.

Total soluble sugar

The results on TSS from leaves of genotypes of sorghum are presented in Table 1 and graphically displayed in Fig. 4.8. The minimum amount of TSS was detected in genotype, IS-2205 (7.48 mg/g) whereas, it was maximum in genotype, Swarna (10.98 mg/g). The TSS content in rest of the genotypes recorded between 10.56 and 7.58 mg/g. The average TSS content in leaf of all the varieties/genotypes was 9.03 mg/g.

Total nitrogen

The results on total nitrogen content in the leaves of different genotypes of pearl millet are presented in Table 1. The results revealed that minimum nitrogen was found in genotype, IS-2205 (3.18%) whereas, it was maximum in genotype, DJ-6514 (4.48%). The remaining genotypes revealed the total nitrogen content in the leaf from 3.23 to 4.43 (Av. 3.87%).

Table 1: Biochemical parameters of sorghum genotypes/varieties

Sr. No.	Varieties/ Genotypes	Phenol (mg/g)	TSS (mg/g)	Moisture (%)	Nitrogen (%)	Protein (%)
1	SRF 332	4.20	8.70	77.78	3.68	22.98
2	GSF 19	3.80	9.85	82.38	4.28	26.77
3	CVS 31	3.20	9.20	80.87	4.33	27.08
4	GSF 211	3.58	9.35	83.78	4.03	25.19
5	SR 3048	4.80	8.32	78.35	3.79	23.69
6	GSF 5	3.15	9.95	85.68	3.90	24.36
7	Swarna	2.58	10.98	86.57	4.43	27.68
8	DJ 6514	2.85	10.18	84.98	4.48	28.02
9	GSF 12	4.68	8.28	79.65	3.57	22.31
10	GNJ 1	2.85	10.03	84.62	4.36	27.24
11	GSF 218	4.58	8.65	80.32	3.54	22.15
12	IS 2205	6.59	7.48	73.80	3.18	19.87
13	CSV 21 F	2.45	9.85	83.64	4.08	25.47
14	DS 318	4.85	8.64	76.65	3.32	20.75
15	SR 2980	3.20	9.98	81.20	3.98	24.89
16	SSG 593	3.58	8.48	83.64	4.11	25.67
17	CSV 20	2.98	7.58	84.65	4.23	26.43
18	DS 226	3.58	8.30	81.36	3.70	23.14
19	DS 189	3.85	8.17	80.26	3.36	21.03
20	DS 224	3.24	8.98	82.31	4.20	26.22
21	DSF 213	2.95	10.56	85.38	4.46	27.86
22	GJ 43	2.20	9.45	83.31	3.73	23.30
23	GFS 6	4.00	8.68	82.21	3.45	21.56
24	IS 1851	4.85	7.98	74.60	3.23	20.18
25	GFS 209	3.98	8.25	76.82	3.41	21.30
MIN.		2.20	7.48	73.80	3.18	19.87
MAX.		6.59	10.98	86.57	4.48	28.02
AVG.		3.70	9.03	81.39	3.87	24.21

Moisture

The results on moisture content from leaves of different genotypes of sorghum are presented in Table 1. The genotype, IS 2205 contained minimum amount of moisture (73.05%). Whereas, variety Swarna contained highest amount of moisture (86.57%). The moisture content in remaining genotypes varied from 74.60 to 85.68 (Av. 81.39%).

Total protein

The outcome of total protein content from various genotypes and varieties are presented in Table 1. The total protein was

fluctuated between 19.87 (IS 2205) and 28.02 (DJ 6514) with an average of 24.21 percent. Previously, Chamarthi *et al.* (2010) [2] at Hyderabad recorded 91.04 to 92.43 percent moisture content, 23.24 to 25.44 percent protein and 2.70 to 3.16 total soluble sugar from leaf of sorghum. Patel *et al.* (2021) reported that the phenol in leaf of sorghum varied from 2.75 to 7.12 mg/g and total soluble sugar in the different genotypes ranged between 6.37 to 8.34 mg/g. Patil and Bagde (2017) [5] revealed that leaf of sorghum exhibited 81.45 to 90.39 percent moisture at Kolhapur, Maharashtra. Patel *et al.* (2021) at Anand, Gujarat, reported that nitrogen and protein content in leaf of sorghum varied between 1.47

to 3.06 and 9.16 to 19.12 percent, respectively. Thus, present findings are in range reported by earlier worker.

Correlation between stem borer on sorghum varieties/ genotypes and biochemical parameters

Total phenol

The correlation analysis between total phenol content and dead hearts by stem borer presented in table 2. Revealing stem borer infestation ($r = -0.803^{**}$) exhibited highly significant and negatively correlation with total phenol content. Patel *et al.* (2021) revealed that total phenol had highly significant but negative correlation with stem borer infesting sorghum. Hence, the outcome of present study is consist with the finding of former workers.

Total soluble sugar

From the correlation analysis (Table 2) it could be seen that stem borer infestation expressed highly significant and positive relationship ($r = 0.823^{**}$) with TSS content of different genotypes of the sorghum varieties/ genotypes. Earlier, At Hisar, Haryana, Lokesh and Mehla (2017) [3] noticed that TSS content from leaves of maize established highly significant and positive relationship with stem borer incidence. Hence, the findings of present investigations are very close with the findings on relation of TSS and stem borer infested as observed by above worker.

Table 2: Correlation between stem borer on sorghum varieties/ genotypes and biochemical parameters

Pest incidence	Biochemical parameters				
	Phenol (mg/g)	TSS (mg/g)	Moisture (%)	Nitrogen (%)	Protein (%)
Dead heart (%)	-0.803**	0.823**	0.849**	0.839**	0.839**

Note: (A) * Significance at 5 percent level of significance (B)** Significance at 1 percent level of significance

Moisture

The results of correlation study presented in table 2 revealed that moisture content of leaf expressed highly significant positive relationship with stem borer incidence ($r = 0.849^{**}$). At Anand, Gujarat, Patel *et al.* (2021) [4] revealed that moisture had highly significant and positive correlation with stem borer infesting sorghum. Hence, the outcome of present study are same as finding of former workers.

Total nitrogen

Correlation analysis between stem borer infesting various varieties/ genotypes of sorghum and biochemical parameters presented in table 2 revealed that stem borer infestation had highly significant positive correlation ($r = 0.839^{**}$) with total nitrogen content of leaf. Patel *et al.* (2021) reported that total nitrogen had highly significant and positive correlation with stem borer infesting sorghum. Hence, the outcome of present study are matching with the finding of former workers.

Total protein

The results of correlation study presented in table 2 revealed that total protein content of leaf expressed highly significant positive relationship with stem borer incidence ($r = 0.839^{**}$). In past, at Anand, Patel *et al.* (2021) observed that the protein content had highly significant and positive correlation with stem borer infesting sorghum. Hence, the

outcome of present study are matching with the finding of former workers.

Conclusion

The study confirms that biochemical traits significantly impact sorghum's resistance or susceptibility to stem borer infestation. Higher moisture, nitrogen, protein, and TSS levels were positively correlated with greater infestation, suggesting these factors favor pest growth and development. Conversely, higher phenol content was associated with reduced pest incidence, demonstrating its role in enhancing plant defense. Genotype IS-2205 showed the most promising resistance due to its optimal biochemical composition, while DJ-6514 and Swarna were the most susceptible. These findings provide valuable insights for breeding programs aimed at developing sorghum genotypes with improved resistance to stem borers.

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