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Screening of newly released wheat varieties from IGKV (Chhattisgarh) against *Sitophilus oryzae* L.

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Abstract
Experiment was conducted at Department of entomology, BTC CARS, Bilaspur, (C.G) during September to December 2024 to know the suitability of wheat varieties during storage. Varietal screening studies reported the minimum adult orientation (1.00), adult emergence (3.00 adults) and minimum percent weight loss (0.1%) were recorded in Ratan variety. The highly preferred variety for rice weevil in terms of orientation, development and feeding is CG 1036 with maximum number of adult orientation (16.33), adult emergence (81.00 adults) and percent weight loss (5.00%) under free choice test whereas in no choice test the minimum adult emergence (16.5 adults) at 65 DAI, percent weight loss (1.50%) at 65 DAI and grain damage percentage (11.00%) at 120 DAI were recorded in Ratan, CG 1040 and Ratan, respectively. The highly preferred variety for rice weevil with maximum adult emergence (161.30 adults) at 65 DAI, percent weight loss (6.00%) at 65 DAI and grain damage percentage (51.30%) at 120 DAI was CG 1036 variety.

Keywords: Adult emergence, free choice, no choice, orientation, rice weevil, screening, varieties

Introduction
The rice weevil, *Sitophilus oryzae*, originated in India and has since spread globally. This pest is responsible for significant grain losses, estimated to the tune of 18.30%. Its rapid developmental time allows populations to increase quickly, making it a persistent threat to stored grains (Aitken, 1975) [1]. The presence of a large population of rice weevils in stored grains can create a microclimate conducive to further deterioration. The aggregation of these insects generates heat and moisture, which can facilitate the growth of molds and attract other insect species. This can lead to changes in the colour, smell, and taste of the grain, contamination with toxins and pathogens, a decline in nutritional value, and a loss of viability. Furthermore, the generated grain dust acts as an attractant for secondary invaders, such as the saw-toothed grain beetle (*Oryzaephilus surinamensis*), the red flour beetle (*Tribolium castaneum*), the rusty grain beetle (*Cryptolestes ferruigineus*) and various species of mites.
Preventing losses in stored grains due to insect pests is crucial. Breeding resistant or tolerant varieties of crops is a promising approach to managing stored grain pests. Screening different wheat varieties for resistance to *Sitophilus oryzae* can be highly effective, as varying levels of susceptibility exist among different cultivars (Tiwari and Sharma, 2002) [2].

Materials and Methods
Experiment was conducted at Department of entomology, BTC CARS, Bilaspur, (C.G) during September to December 2024. Newly released varieties wheat varieties from Indira Gandhi Krishi Viswavidyalaya were procured from college farm of BTC CARS, Bilaspur. Screening of wheat varieties for susceptibility or resistance to *Sitophilus oryzae* was tested through no choice and free choice tests. Observations on adult orientation, adult emergence, percent weight loss and percent grain damage were recorded.

Experimental details
Test insects: Newly emerged adult rice weevil
Test commodities (treatments): 8 wheat varieties

Replication: 3
Design: Completely Randomized Design (CRD)

Result and discussion

Adult orientation

The obtained results of adult orientation in free choice test among all the tested hosts are depicted in table 3 indicating that CG 1036 is the highly preferred host to rice weevil with 14.00 adults in day 1.00 and 16.33 adults in day 7. The next maximum adult orientation was observed in CG 1018 and CG 04 with 10.70 adults in day 1 with 12.33 and 14.00 adults, respectively in day 7 which were statistically at par with each other in both days. The variety with 9.00 and 7.33 adults was observed in day1 and day 7, respectively in CG 1023 followed by CG 03 with 4.33 and 2.00 adults in day 1 and day 7, respectively which were statistically at par with CG 1040 having 5 and 2 adults in day 1 day 7, respectively. The lowest adult orientation was observed in CG 1029, Two adults in day 1 and the negligible adult orientation was observed in Ratan with 1.00 adult which was superior among the other varieties in day 1. Same trend was followed at 7th day the adult orientation was lowest in Ratan and CG 1029 with 1 adult orientation considered as least preferred variety to rice weevil under storage conditions.

Table 1: Orientation of Rice weevil towards different wheat varieties under free choice test

S. No	Wheat varieties	No. of adult oriented 1 day after release	No. of adult oriented 7 days after release
1	CG03	4.33 (2.30)^{d}*	2.00 (1.73)^{d}*
2	CG1029	2.00 (1.73)^{e}	1.00 (1.41)^{e}
3	CG1018	10.70 (3.41)^{b}	12.33 (3.65)^{b}
4	CG1023	9.00 (3.16)^{c}	7.33 (2.88)^{c}
5	CG04	10.70 (3.41)^{b}	14.00 (3.86)^{b}
6	CG1040	5.00 (2.44)^{d}	2.00 (1.73)^{d}
7	CG1036	14.00 (3.87)^{a}	16.33 (4.16)^{a}
8	Ratan	1.00 (1.41)^{f}	1.00 (1.41)^{e}
	S.E. m (±)	0.08	0.07
	C.D. (5%)	0.24	0.23
	C.V. (%)	5.1	5.2

*Figure in parentheses are square root transformed values

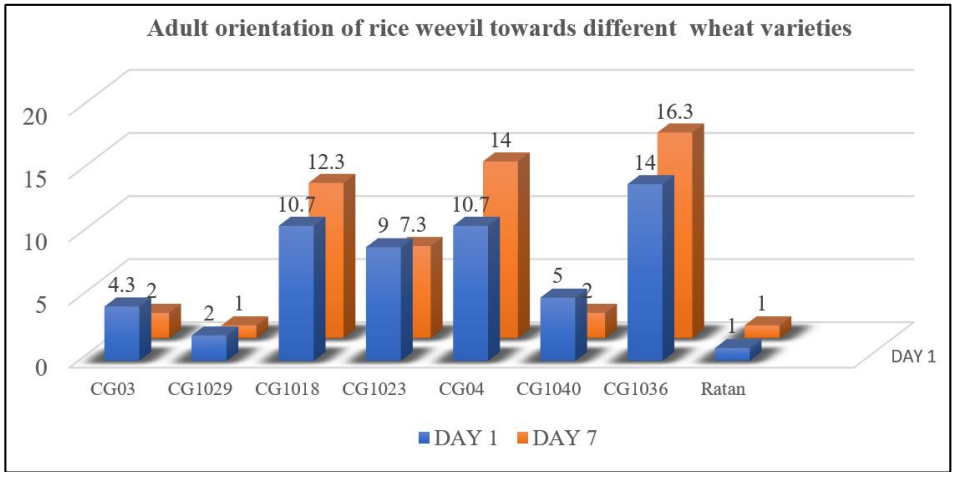

Fig 1: Adult orientation of rice weevil towards different wheat varieties

Adult emergence

A. Free choice test

Adult emergence (f_1 progeny) in eight different newly released varieties after 35 DAI ranges from 0.00 to 24.30 under free choice test. The zero adult emergence was observed in CG 1040, CG 1029 and Ratan which were statistically superior and were at par with CG 04 and CG 03 with 0.7 adult emergence which were statistically at par with each other. Variety with highest adult emergence of 24.3 adults was observed in CG 1036 which was least suitable for storage.

Same trend was also observed at 50 DAI and the adult emergence (f_1 progeny) ranges from 1.70 to 76.77. The lowest population build-up was observed in Ratan with 1.70 and CG 1040 with 2.33 adults which were statistically superior and at par with each other. Variety with another lowest adult emergence was observed in CG 1029 with 6.33 adults followed by CG 03 with 8.00 adults. The highest multiplication rate with maximum adult emergence 76.77 was observed in CG 1036 which was most prone variety to rice weevil.

Results after 65 DAI revealed that the emergence of adult ranges from 7.33 to 172.00 under free choice test. The lowest adult emergence (f_1 progeny) was observed in Ratan with 7.33 which was superior among all tested wheat varieties. Varieties with next lowest adult emergence were CG 1040 with 13.33 adults followed by CG 1023 with 13.33 and CG 03 with 15.33 adults which were statistically at par with each other. The highest adult emergence was recorded in CG 1036 with 172.00 adults which is most preferred variety by rice weevil considered as most susceptible variety.

The mean adult emergence was reported highest in CG 1036 with 81.00 adults which was statistically inferior among all tested varieties. The lowest mean adult emergence was reported in Ratan with 3.00 adults which was statistically superior among all other tested wheat varieties.

The kernel diameter, hardness, 1000 kernel weight, thickness of grain influences the growth of rice weevil. The antioxidant activity and phenol content in varieties acts as repellent and antifeedant, reduces the weevil reproduction (Arnason *et al*., 1992) [3]. Small sized grain with good

amounts of phenols and antioxidants in Ratan variety leads to resistance against rice weevil under storage conditions.

B. No choice test

Adult emergence (f_1 progeny) in eight different newly released varieties after 35 DAI ranges from 0.00 to 28.33. The zero number of adults emergence were recorded in CG 1040, Ratan and 0.33 adults emerged in CG 1029 which were statistically superior and were at par among each other. The next best variety with second lowest multiplication rate was observed in CG 04 with 1.00 adult followed by 2.33 adults in CG 03. Variety with highest population buildup with more adult emergence was observed in CG 1036 recorded 28.33 adults which was least suitable for storage.

Same trend was also observed at 50 DAI and the adult emergence (f_1 progeny) ranges from 15 to 100.33. Lowest population build-up was observed in Ratan with 15.00 adults, CG 1029 with 17 and CG 1040 with 19.33 adults which were statistically superior and at par among each other. The wheat variety with next lowest adult emergence was observed in CG 1023 recorded 63.77 adults followed by CG 04 with 74.00 and CG 03 with 75.00 adults which were statistically at par with each other. The highest multiplication rate with maximum adult emergence was observed in CG 1018 reported 100.33 adults which was most prone variety to rice weevil under no choice test.

Results after 65 DAI revealed that the emergence of adult ranges from 31.67 to 367.3. The lowest adult emergence (f_1 progeny) was observed in CG 1040 with 31.66 adults followed by Ratan with 34.67 adults which were statistically superior among the other wheat varieties and were at par with each other. Varieties with next lowest adult emergence were reported to be CG 1029 with 57.33 followed by CG 03 with 87.3, CG 1023 with 115.33 adults. The highest adult emergence 367.33 was recorded in CG 1036 which was most preferred variety by rice weevil considered as susceptible.

The mean adult emergence was reported in variety CG 1036 with 161.33 adults whereas, in variety Ratan reported 16.5 adults after 65 days of storage.

CG 1036 is a bold seeded variety with 6.80 mm length and 3.30 mm width of kernel that show more preference for the oviposition and development that leads to more adult emergence considered as most susceptible variety to rice weevil.

The present findings are in accordance with Yadav *et al*., 2018 who also reported that the minimum number of adults emergence on the variety Raj 4037 (71.85%), followed by Raj-3765 (73.25%), Raj-4083 (74.00%).

The findings of Rohit kumar *et al*., 2022 also revealed that under both choice and no-choice tests, WH 1105 and C 306 exhibited the lowest ovipositional preference for *S. oryzae* with the fewest adult emergences, with only 66.68 and 76.01 adults emerging from 250 grains of C 306 and WH 1105, respectively.

Earlier, Jha *et al*., (2012) [6] observed minimum emergence of adults in C306 whereas the minimum loss occurred in DDW12variety of wheat.

Percent weight loss

A. Free choice test

The results revealed that infestation on different wheat varieties after 35 DAI varied from (0.1% to 1.03%) and the minimum weight loss were observed in CG1040, CG 03, CG1029, CG1018 and Ratan with (0.1%) which were found superior and were statistically at par among each other. The next suitability was observed in CG 04 (0.6%) followed by CG 1023 (0.22%). The maximum weight loss was found in CG 1036 with (1.03%).

The observations on weight loss percentage after 50 DAI recorded in eight different varieties varied from (0.1 to 6.22%) and the minimum weight loss were recorded in CG 03, Ratan and CG 1040 with (0.11%) which were superior among all the varieties and statistically at par with each other. In wheat varieties CG 1023 and CG 1029 showed (0.80%) weight loss and were statistically at par with each other. The maximum weight loss was found under CG 1036 (6.22%) which was least suitable variety under storage.

The weight loss percentage was revealed after 65 DAI varied from (0.1% to 7.90%). The most suitable variety with minimum weight loss found in Ratan (0.1%) which was statistically superior among the other varieties. Varieties with second most importance were CG 1040 and CG 03 with (0.40%) found no significant difference. The maximum weight loss was observed in CG 1036 (7.90%) which was considered as highly susceptible among the other varieties.

The mean weight loss percentage was observed lowest in Ratan with (0.1%) found statistically superior followed by CG 1040 with (0.13%), CG 03 with (0.20%). The highest mean weight loss was observed in CG 1036 with (5.00%) under free choice test.

The Ratan variety performed the best in storage conditions with negligible weight loss of (0.1%) after 65 DAI. The zinc and iron content leads to resistance against insect pests (Yousuf *et al*., 2025) [7]. Ratan variety having high zinc and iron content with 38.3 ppm and 36.1 ppm, respectively. This biochemical property showed negative impact on the growth and development that reduces the feeding intensity of rice weevil.

B. No choice test

The results revealed that infestation on different wheat varieties after 35 DAI varied from (0.1% to 1.90%) and the minimum weight loss was observed in CG1040 (0.1%) which was found superior over all varieties. The next suitability was observed in CG 1029 and Ratan with (0.50%) followed by CG 1023 (0.60%) which were statistically at par with each other. The maximum weight loss was observed in CG 1018 (1.95%) found statistically inferior.

Observations after 50 DAI revealed that weight loss percentage in eight different varieties varied from (1.1 to 7.3%) and the minimum weight loss was recorded in CG 1040 (1.11%) statistically superior over all the varieties and statistically found to be at par with Ratan (1.33%). Varieties which found next better were CG 1029 (2.40%) and CG 1023(2.77%) were statistically at par with each other. The maximum weight loss was found in CG 1036 (7.33%) which was least suitable variety under storage.

The weight loss percent was recorded after 65 DAI varied from (3.33% to 9.40%). The most suitable variety with minimum weight loss found in CG 1040 (3.33%) which was statistically superior among the other varieties. Varieties with second most importance were Ratan (4.00%) and CG 1029 (4.33%) which were statistically at par with each other followed by CG 1023 (4.66%) weight loss and was statistically at par with CG 1029. The maximum weight loss was observed in CG 1036 (9.40%) which was considered as

highly susceptible among the other varieties.

The mean weight loss percentage was observed lowest in CG 1040 with (1.50%) which was statistically superior among all tested wheat varieties followed by Ratan with (1.90%). The highest mean weight loss percentage was observed in CG 1036 with (6.00%) found statistically inferior.

The CG 1036 wheat variety is known for high chapati quality index with a score of 8.5/10, exceeding the popular sharbati varieties. The softness and puffiness of the variety may be showing more preference to rice weevil attack in storage.

Earlier, S. P. Kakde *et al*., (2014) [8] observed that minimum weight loss (11.00, 16.67 and 18.00%) was recorded on variety Raj-3765, Raj-911 and HD-2329, respectively. Earlier findings of R. K. Dwivedi and Anurag Shukla (2019) [9] revealed that wheat varieties HD-2733 and K-307 were found moderately resistant against *Sitophilus oryzae* in which higher hardness, lower moisture, lesser eggs, progeny and population with longer developmental period and lesser grain weight loss and damaged grain were recorded. Rohit Kumar *et al*., 2022 weight loss due to infestation, with C 306 (5.65%) and WH 1105 (6.19%) showing the least weight loss.

Table 2: Adult emergence and percent weight loss of grains caused by rice weevil on different wheat varieties under free choice test

Wheat varieties	Adult emergence				Percent weight loss			
	35 DAI	50 DAI	65 DAI	MEAN	35 DAI	50 DAI	65 DAI	MEAN
CG03	0.70 (1.13)^{de}*	8.00 (2.99)^{e}	15.30 (3.76)^{e}	8.00 (2.62)^{f}	0.1 (1.81)^{d}**	0.1 (1.81)^{e}	0.40 (3.76)^{e}	0.20 (2.46)^{e}
CG1029	0.00 (1.0)^{e}	6.30 (2.70)^{f}	12.00 (6.95)^{d}	6.10 (3.55)^{e}	0.1 (1.81)^{d}	0.80 (4.90)^{d}	1.50 (6.95)^{d}	0.80 (4.55)^{d}
CG1018	8.30 (3.05)^{b}	68.77 (8.34)^{b}	130.77 (10.40)^{c}	69.23 (7.26)^{b}	0.1 (1.81)^{d}	2.33 (8.59)^{c}	3.33 (10.40)^{c}	1.90 (6.93)^{c}
CG1023	3.00 (2.0)^{c}	19.77 (4.54)^{d}	33.77 (7.03)^{d}	18.88 (4.52)^{d}	0.20 (2.56)^{c}	0.80 (5.23)^{d}	1.55 (7.03)^{d}	0.83 (4.94)^{d}
CG04	0.77 (1.27)^{d}	52.00 (7.27)^{c}	118.33 (11.38)^{b}	56.90 (6.64)^{c}	0.66 (4.56)^{b}	2.83 (9.57)^{b}	3.90 (11.38)^{b}	2.43 (8.50)^{b}
CG1040	0.00 (1.00)^{e}	2.33 (1.82)^{g}	13.33 (3.60)^{e}	5.23 (2.14)^{f}	0.1 (1.81)^{d}	0.20 (2.06)^{e}	0.40 (3.60)^{e}	0.13 (2.49)^{e}
CG1036	24.33 (5.03)^{a}	76.77 (8.81)^{a}	172.00 (16.28)^{a}	81.00 (10.04) ^{a}	1.03 5.831^{a}	6.20 (14.45)^{a}	7.90 (16.28)^{a}	5.04 (12.18)^{a}
Ratan	0.00 (1.00)^{e}	1.77 (1.62)^{g}	7.33 (1.81)^{f}	3.00 (1.47)^{g}	0.1 (1.81)^{d}	0.1 (1.81)^{e}	0.1 (1.81)^{f}	0.1 (1.81)^{f}
S.E. m (±)	0.073	0.087	0.126	0.095	0.054	0.109	0.126	0.096
C.D. (5%)	0.21	0.26	0.38	0.28	0.162	0.32	0.38	0.287
C.V. (%)	6.48	3.14	2.84	4.15	3.36	3.11	2.84	3.10

*Figures in parantheses are square root transformed values
** Figures in parantheses are angular transformed values
DAI-days after infestation

Table 3: Adult emergence and percent weight loss caused by rice weevil on different wheat varieties under no choice test

Wheat varieties	Adult emergence				Percent weight loss			
	35 DAI	50 DAI	65 DAI	MEAN	35 DAI	50 DAI	65 DAI	MEAN
CG03	2.33 (1.82)^{d}*	75.00 (8.71)^{c}	87.33 (9.39)^{d}	54.89 (6.64)^{d}	0.70 (4.67)^{d}**	3.33 (10.51)^{d}	5.20 (13.13)^{d}	3.10 (9.44)^{c}
CG1029	0.33 (1.13)^{f}	17.00 (4.23)^{e}	57.33 (7.63)^{e}	24.89 (4.33)^{e}	0.50 (4.18)^{e}	2.40 (8.83)^{e}	4.30 (11.96)^{ef}	2.40 (8.32)^{d}
CG1018	13.77 (3.82)^{b}	100.33 (10.06)^{a}	203.00 (14.28)^{b}	105.67 (9.39)^{b}	1.90 (7.84)^{a}	5.40 (13.38)^{b}	8.70 (17.18)^{b}	5.30 (12.80)^{a}
CG1023	8.77 (3.10)^{c}	63.77 (8.04)^{d}	115.33 (10.73)^{c}	62.56 (7.29)^{c}	0.66 (4.31)^{de}	2.77 (9.45)^{e}	4.66 (12.39)^{e}	2.60 (8.69)^{d}
CG04	1.00 (1.41)^{e}	74.0 (8.65)^{c}	178.33 (13.39)^{b}	84.44 (7.82)^{c}	1.00 (5.83)^{c}	4.20 (11.82)^{c}	6.10 (14.25)^{c}	3.80 (10.63)^{b}
CG1040	0.00 (1.00)^{f}	19.33 (4.50)^{e}	31.67 (5.70)^{f}	17.00 (3.73)^{e}	0.1 (2.06)^{f}	1.11 (5.91)^{f}	3.33 (10.45)^{g}	1.50 (6.14)^{f}
CG1036	28.33 (5.41)^{a}	88.33 (9.44)^{b}	367.33 (19.19)^{a}	161.33 (11.35)^{a}	1.22 (6.28)^{b}	7.33 (15.70)^{a}	9.40 (17.87)^{a}	6.00 (13.29)^{a}
Ratan	0.00 (1.00)^{f}	15.00 (3.97)^{e}	34.67 (5.96)^{f}	16.56 (3.64)^{e}	0.50 (4.18)^{e}	1.33 (6.44)^{f}	4.00 (11.57)^{f}	1.90 (7.40)^{e}
S.E. m (±)	0.064	0.183	0.307	0.184	0.133	0.214	0.17	0.172
C.D. (5%)	0.194	0.552	0.928	0.558	0.401	0.648	0.514	0.521
C.V. (%)	4.74	4.39	4.92	4.68	4.66	3.61	2.16	3.48

*Figures in parantheses are square root transformed values
** Figures in parantheses are angular transformed values
DAI-days after infestation

Percent Grain damage

A. No choice test:

The analysis of grain damage percent revealed that damage of grain on number basis varied from (11.00 to 51.33%) after 120 DAI. The lowest grain damage was recorded in Ratan (11.00%) which was statistically superior over all varieties. The next best variety with minimum grain damage was CG 1040 (14.77%) followed by CG 1029 (24.77%), CG 1023 (31.00%), CG 03 (39.77%), CG 1018 (44.77%) and CG 04 (45.00%), respectively. The highest grain damage percent was observed in CG 1036 (51.33%) which was least performed variety among all other.

Table 4: Percent grain damage caused by rice weevil on different wheat varieties under no choice test.

Wheat Varities	Grain damage (%)
	120 DAI
CG03	39.7 (39.019)[c]*
CG1029	24.7 (29.766)[e]
CG1018	44.7 (41.913)[b]
CG1023	31.0 (33.818)[d]
CG04	45.0 (42.111)[b]
CG1040	14.7 (22.491)[f]
CG1036	51.3 (45.746)[a]
Ratan	11.0 (19.35)[g]
S.E. m (±)	0.743
C.D (5%)	2.24
C.V (%)	3.75

* Figures in parantheses are angular transformed values

Conclusion

The screening of newly released wheat varieties against *S. oryzae* was studied. In case of screening of different wheat varieties, the results revealed that Ratan and CG 1040 variety performed best under storage conditions with minimal attack of rice weevil considered as resistant variety. Whereas, maximum no. of adult emergence, per weight loss and percent grain damage was recorded in variety CG 1036 and it was designated as the most susceptible variety.

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