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Categorization of rice genotypes against paddy black beetle, *Heteronychus liodere*s Redtenbacher (Scarabaeidae: Coleoptera)

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Abstract
Screening of sixty-three rice genotypes against paddy black beetle was done at Tikkri (Kangra), Himachal Pradesh. Categorization of genotypes was carried out in terms of percent tiller infestation caused by the beetle by converting the values to a 0-9 scale. None of the genotypes recorded damage score of 0 to 1. The entries namely T-23 and Vallabh Basmati-24 recorded damage score of 3 (low infestation) and were designated as moderately resistant while all other genotypes were categorized under moderately susceptible, susceptible and highly susceptible.

Keywords: Rice, black beetle, genotypes, screening, tiller infestation, categorization

Introduction

Rice (*Oryza sativa* L.) is the world's most important staple food grown in over 100 countries, consumed regularly by over two billion people and the primary source of protein for millions. India is the leading rice producing country in terms of area and is the second largest producer next to China. Rice is grown in an area of 76.55 thousand hectare with production of nearly 146.59 thousand tonnes and productivity of 19.14 q/ha in Himachal Pradesh [1].

The paddy black beetle, *Heteronychus liodere*s Redtenbacher (Scarabaeidae: Coleoptera) is shiny black beetle and burrows in the soil to feed on rice plants, cutting tillers at soil level. This pest has been reported as serious pest of rice from some rice growing districts of Himachal Pradesh. The extent of damage caused by white grubs range from 40-80 percent in different agricultural crops [2]. They are distributed from high altitude of Himalayas to low altitude of Kerala, from arid and semi-arid tracts to high rainfall, humid regions of north east hill region and west coastal peninsula [3].

In Uttarakhand district of India, severe outbreaks of white grubs including *H. liodere*s occurs over large areas in paddy causing more than 50 percent damage [4] while, Shah [5] has reported that *H. loideres* infests low-lying irrigated as well as unirrigated rice fields in western Himalayas. There are certain reports on management of this beetle by synthetic insecticides, however, their indiscriminate use has led to several environmental and health hazards. An alternative to this is the use of varietal resistance as management tactic, which is an eco-friendly approach. Therefore, the present study was carried out to know the differences in damage and preference of paddy black beetle to different rice genotypes, which in turn will be helpful for the farmers to go for a particular cultivar and avoiding the more susceptible one.

Materials and Methods

The study was conducted at Tikkri (Kangra) during *kharif* season. The experiment farm was situated at an elevation of 961 m above mean sea level with latitude 32°07.180 N and longitude 76°25.065 E. The area falls in the mid hill sub humid zone of Himachal Pradesh and is characterized and acidic soils and humid temperate climate with average annual rainfall of about 2500 mm. Sixty rice genotypes including aromatic, red rice and basmati for their reaction against black beetle under natural conditions were cultivated. The experiment was conducted in randomized block design with three replications. The nursery was raised on June 13, 2018 and the transplanting of seedling was done on July 13, 2018. Various intercultural operations, such as nutrient application, irrigation and weeding were carried out in accordance with the recommended package of practices. Observation on percent tiller infestation was recorded at 60 days after treatment.

Ten hills in each genotype were selected and data on percent tiller infestation were recorded and graded and was transformed to 0-9 scale of standard evaluation system for paddy black beetle [6].

$$\text{Percent tiller infestation (\%)} = \frac{\text{Number of infested tillers}}{\text{Total number of tillers}} \times 100$$

Table 1: Grading scale for different genotypes

Scale	Rating	Damage (%)
0	Immune	No damage
1	Resistant	1-10%
3	Moderately resistant	11- 20%
5	Moderately susceptible	21- 30%
7	Susceptible	31- 60%
9	Highly susceptible	61% and above

Results and Discussion

The damage caused by black beetle was assess in terms of tiller infestation and was converted to 0-9 scale. The percent tiller infestation due to black beetle in different genotypes was recorded and it varied from 12.50 to 100 percent. The entries namely T-23 and Vallabh Basmati-24 recorded percent infestation of 12.50 and 16.66 respectively with the damage score of 3 (0-9 scale). Chohartu, Jatoo Dhan, Pusa Basmati-6, Pusa Basmati 24, HPR 2860, HPR 2858, HPR 2695, LakhamaI, HPR 2747, Vasumati, HPR 2746 recorded a damage score of 5, suffering 22.2-26.66 percent tiller damage. The other 35 entries namely IC3131180, Naggar Dhan, ACC 19186, Matali, Narkanda, Chohartu, Karad, HPR 2800, Bhathi Dhan, Varun Dhan, Desi Dhan, ACC 19164, HPR 2795, Kalhaina, Tarori Basmati, Pant Basmati-2,Vallabh Basmati-22, Malviya Basmati 10-9, Pusa Basmati 1121,Ranbir Basmati,Pant Basmati-1, Basmati370, Super Basmati, Vallabh Basmati-23, Vallabh Basmati-21, Basmati 564, HPR 2668, HPR 2761, HPR 2693, PBI 509, Hassan, HPR 2757, Sharbti, HPR 2612, Basmati-3 recorded damage score of 7, suffering 30.76-60.00 percent tiller damage. The remaining entries namely Saila Chaina, Acchoo, Bongal Dhan, Roda Dhan, Totu, Sukara Dahan, Improved Pusa Basmati, Haryana Basmati-2, Punjab Basmati, Kasturi, HPR 2667 and HPR 2661 recorded Score of 9, with 61.3-100 percent tiller damage.

Every insect-plant interaction involves antixenosis, antibiosis and tolerance which further leads to resistance of a particular cultivar over others. This study gives a basic idea of comparative damage caused by black beetle in different genotypes of rice. This work cannot be compared with any earlier research as no study based on screening of rice genotypes against black beetle has been carried out and majority of genotypes used are of local origin, however few studies have been conducted on other pests of rice including different species of white grubs. An experiment was conducted at Salija (2050 meters above sea level), Parbat (Nepal) by Bhikash *et al.* [7] to identify economic pests of potato-based agroecosystem to assess the damage level of white grubs and to screen the pipeline potato genotypes against the pest. PRP 35861.18 incurred the lowest infestation (0.126±0.063%) and PRP 25861.11 was affected to a great extent (9.973±10.556%). A similar trend was found on the basis of weight loss. Seventy-three genotypes of rice were screened under field condition during *Kharif* 2016 and 2017, to evaluate their performance against hopper complex by Rishikesh *et al*. [8]. The population of *Nilaparvata lugens*, *Sogatella furcifera* and *Nephotettix virescens* were recorded throughout the crop period at 10 days intervals. Lowest pooled mean population of *Nilaparvata lugens* were recorded to be 0.84, 1.03 and 1.31 hoppers/plant on genotype R 1750-937-1-530-1, PTB-33 and R 2090-818-1-275-1, respectively. *Sogatella furcifera* population was lowest on genotypes/varieties R 1700-2240-4-2295-1, PTB 33 and MTU 1060 (1.12, 1.69 and 1.98 hoppers/plant, respectively), while lowest mean population of *Nephotettix virescens* was recorded on genotype R 1747-4941-1-15-1, followed by variety IR 64 and genotype R 1700-2240-4-2295-1, (1.08, 1.28, 1.40 hoppers/plant). This clearly indicated the more preference towards one cultivar and comparatively less for others. Similarly, Singh and Shukla [9] and Kumar and Tiwari [10] also evaluated rice cultivars against this hopper and found similar results.

Table 2: Categorization of different rice genotypes against paddy black beetle

Score	Rating	Damage tiller (%)	Genotype
0	Immune	No damage	Nil
1	Resistant	1 – 10%	Nil
3	Moderately resistant	11- 20%	T-23, Vallabh Basmati-24
5	Moderately susceptible	21-30%	Chohartu, Jatoo Dhan, Pusa Basmati-6, Pusa Basmati24, HPR 2860, HPR 2858, HPR 2695, Lakhamai, HPR 2747, Vasumati, HPR 2746
7	Susceptible	31 – 60%	IC 3131180, Naggar Dhan, ACC 19186, Matalilal, Lal Narkanda, Karad, HPR 2800, Bhathi Dhan, Varun Dhan, Desi Dhan, Acc19164, HPR 2795, Kalhaina, Tarori Basmati, Pant Basmati-2,Vallabh Basmati-22,Malviya Basmati 109,Pusa Basmati 1121, Ranbir Basmati, Pant Basmati-1, Basmati 370, Super Basmati, Vallabh Basmati-23, Vallabh Basmati-21, Basmati 564, HPR 2668, HPR 2761, HPR 2693, PBI 509, Hassan, HPR 2757, Sharbti, HPR 2612, Basmati-3, Basmati csr 30
9	Highly Susecptible	61% and above	Saila Chaina, Acchoo, Bongal Dhan, Roda Dhan, Totu, Sukara Dahan, Improved Pusa Basmati, Haryana Basmati-2, Punjab Basmati, Kasturi, HPR 2667, HPR 2661

Similarly, seven rice cultivars were evaluated for resistance by Anandhi and Pillai [11] to rice black bug, *Scotinophara coarctata*, under greenhouse conditions. They clearly classified the genotypes as: CO-37 was moderately resistant, while ASD 16, IR 36, IR 20 and White Ponni were susceptible. IR64, IR50 and ADT36 were highly susceptible to black bug. In another study, seventy-three genotypes of rice were screened by Rishikesh *et al*. [12] to evaluate their performance against *Scirpophaga incertulas*. Lowest white ears (pooled mean) were recorded to be 0.00, 0.17, 0.17 & 0.17 /plant on genotypes IR 36, R 1700- 302-1-156-1, Shymla and IR 64 respectively, thus making the less susceptible. Similar findings have been reported by Preetha [13] and Prasad *et al*. [14] against *S. incertulas*, but unfortunately there are no such reports on screening of genotypes of any crop against paddy black beetle and hence, all the comparisons made here are of pests other than black beetle and a detailed investigation regarding response of this pest to different genotypes need to be studied by integrating ecological and biochemical factors.

Fig 1: Adult of paddy black beetle in rice roots

Fig 2: Damage caused by black beetle in rice field

Conclusion

No genotypes were found completely resistant to the black beetle. The entries namely T-23 and Vallabh Basmati-24 recorded lowest damage score and were designated as moderately resistant. Thus, these two genotypes can be recommended or preferred by the farmers over other cultivars for avoiding losses caused by this particular beetle. However, a detailed study on these interactions is required to know about actual reason of such differences among the genotypes.

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