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Study for assessment of infestation of rust red flour beetle, *T. castaneum* (Hrbst) in basmati rice under Western U.P conditions

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Abstract
A survey was conducted to find out the effect of grain moisture on infestation caused by rust red flour beetle *T. castaneum* (Hrbst) in basmati rice at Meerut district during Jan. 2018 to Dec. 2018. The samples were collected from ten retailers around the Meerut district. The average moisture content of basmati rice grain was 11.54 Per cent and average grain infestation caused by *T. castaneum* was 5.14 Per cent during the year from Jan. 2018 to Dec. 2018. The highest mean moisture content (13.10%) in grain was recorded with 6.41 Per cent infestation in second fortnight of September 2018 and lowest moisture content (10.06%) with 3.96 Per cent infestation in second fortnight of June 2018. The average moisture content (11.44%) and average infestation (5.21%) were recorded in the samples procured from different retailers. The minimum moisture content (10.45%) and minimum grain infestation of (4.95%) was found in samples procured from M/s Prashant provision store, near Daurala sugar factory, Daurala (Meerut) where as the highest moisture content (12.14%) and highest grain infestation (5.61%) was recorded from the grain procured from M/s Shiv provision store, Pawlikhas (Meerut). The positive correlation (r= 0.93) was calculated between moisture content and grain infestation caused by *T. castaneum.*

Keywords: Moisture, infestation, basmati rice**,** *Tribolium castaneum*

Introduction
Paddy is the most important and extensive food crop which has been grown in tropical, subtropical and temperate countries in the World and provide as staple food of more than 60 Per cent of the world population (Lu, 1998) [13]. Outer layer of rice shell is called husk. Rice is considered as high caloritic value food because the major part of rice consists of carbohydrate in the form of starch, which is about 72-75 Per cent of the total grain composition. Basmati rice is a variety of long, slender-grained aromatic rice which is traditionally confined to Indian subcontinent. India accounts for over 70% of the world's basmati rice production. In India the basmati rice is grown in 81 districts including 22 districts of Punjab, 21 districts of Haryana, 29 districts of Uttar Pradesh, 4 districts of Uttarakhand, 2 districts of Himachal Pradesh and 3 districts of Jammu & Kashmir. Overall, Basmati rice area has decreased by 2.46% in comparison to last year (Anonymous, 2018b) [2]. Nearly one thousand species of insects have been found associated with stored products in various parts of the word (Girish, 1983) [9]. Among these species, rust red flour beetle, *Tribolium castaneum* (Hbrst) is one of the major and most destructive insects pest of stored commodities (Prakash *et al.,* 1987) [19]. It is also a polyphagous and cosmopolitan in nature having Indo- Australian origin (Smith and Whitman, 1992) [21]. Although its pest status as stored grain pest is considered as a secondary pest, required prior infestation by primary pest *viz.,* Rice weevil, *S. oryzae,* Lesser grain borer and *R. dominica* an internal feeder or grain may be damaged at the time of harvesting operation. Damage is done by both larvae and adults especially feed on the broken or damaged grain. Therefore, the stored materials are infested with *T. castaneum* is become unfit for consumption purpose (Patil, 2014) [18].

Materials and Methods
A survey at fortnightly interval carried out from the ten retailers of different markets of Meerut district. For assessment of Per cent moisture content and Per cent infestation caused by *T. castaneum* the 200 g samples of basmati rice grain collected in polythene bags and the

open ends closed tightly with the help of rubber band to avoid the change of moisture content and escape of insect for further investigation. The Per cent moisture content of each sample was recorded fortnightly by using moisture meter method. The Per cent infestation of each sample was calculated fortnightly by counting the damaged and healthy grain from 300 grains randomly collected from samples by using methodology suggested by Pathak and Jha (2003) [17]. The average Per cent moisture content and Per cent infestation caused by *T. castaneum* of ten samples was calculated fortnightly.

$$\text{Per cent infestation} = \frac{\text{Number of infested grains}}{\text{Total number of grains observed}} x100$$

Results and Discussion

To assess the Per cent moisture content and Per cent grain infestation caused by *T. castaneum* in stored basmati rice a general survey was carried out at various retailers around the Meerut district. The results of present investigation are given below.

Moisture content (%)

The data of present investigation are given in Table 1&2 and graphically depicted in Fig.1&2. The data revealed that the mean Per cent moisture content in the grain during the study period *i.e.* Jan. 2018 to Dec. 2018 ranged from 10.06 to 13.10 with an average of 11.54 Per cent. The highest mean moisture content (13.10%) in grain was recorded in second fortnight of September, 2018 and lowest mean (10.06%) recorded in second fortnight of June, 2018 (Table 1& Fig. 1). However, the Per cent moisture content in the grain from different retailers ranged from 10.45 to 12.14 Per cent with an average of 11.44 Per cent. The highest mean Per cent moisture content (12.14%) in the grain was recorded from the grain procured from M/s Shiv provision Stores, Pawlikhas (Meerut) and lowest mean Per cent moisture content in the grain (10.45%) was recorded from the grain procured from M/s Prashant provision store, near Daurala sugar factory, Daurala (Meerut) (Table 2 & Fig.2).

Grain infestation (%)

The mean Per cent infestation in basmati rice grain caused by *T. castaneum* ranged from 3.96 to 6.41 Per cent with an average of 5.14 Per cent. The highest infestation (6.41%) was recorded in second fortnight of September 2018 and lowest (3.96%) second fortnight in June 2018 (Table 1 & Fig.1). However, the Per cent infestation from different retailers was ranged from 4.95 to 5.61 with an average of 5.21 Per cent. The highest mean infestation (5.61%) in the grain was recorded from the grain procured from M/s Shiv provision Stores, Pawlikhas (Meerut) and lowest mean infestation (4.95%) in the grain was recorded from the grain procured from M/s Prashant provision store, near Daurala sugar factory, Daurala (Meerut) (Table 2 & Fig.2). The correlation (r) between Per cent moisture content and grain infestation was also calculated. The data presented in Table.3 showed that the positive correlation (0.93) between Per cent moisture content and grain infestation during the year of investigation. The present findings are in accordance with Chaudhary and Mahla (2001) [4] who surveyed the insect pest complex and grain mite from 39 distantly located villages of different climatic zones of Haryana, and found that, among the different storage insect pests, *T. castaneum* was observed to infest wheat grain. Further, Chimoya and Abdullahi (2011) [5] conducted a survey work on insect pest with stored cereal *viz.*, maize, millet, sorghum and rice in some selected markets of Maiduguri district of Nigeria and reported that, the relative abundance of *T. castaneum* was found to be among different storage insects. The present finding closely agreement with (Patil, 2014) [18] who observed infested rice grain and recorded the highest moisture content (12.75%) in second fortnight of December while, it was minimum (10.35%) in second fortnight of May. He was also found the mean Per cent moisture content 11.59 Per cent and the infestations in samples with an average of 4.82 Per cent collected from different retailers. He also calculated that correlation (r) between per cent moisture content and infestation in the rice grain and found positively non-significant association during the first year of investigation.

Table 1: Fortnightly assessment of Per cent moisture content and Per cent infestation caused by *T. castaneum* in stored basmati rice samples during Jan. 2018 to Dec. 2018 of Meerut district

Month	Fortnight	Average Moisture content (%) of 10 samples	Average Grain infestation (%) of 10 samples
January	I	11.39	5.69
	II	11.11	4.50
February	I	11.29	4.67
	II	11.14	4.59
March	I	11.16	4.73
	II	10.91	4.30
April	I	10.86	4.24
	II	10.79	4.16
May	I	10.70	4.15
	II	10.54	4.01
June	I	10.10	3.99
	II	10.06	3.96
July	I	11.22	5.24
	II	11.03	5.31
August	I	12.52	6.16
	II	12.27	5.93
September	I	12.98	6.04
	II	13.10	6.41
October	I	12.04	5.96
	II	11.94	5.32
November	I	12.61	6.17
	II	12.14	6.02
December	I	12.28	5.82
	II	12.81	6.11
Average		11.54	5.14

Table 2: Assessment of Per cent moisture content and Per cent infestation caused by *T. castaneum* in stored basmati rice samples procured from different retailers of Meerut district.

Site of sampling	Retailers	Average Moisture content (%)	Average Grain infestation (%)
1.	M/s Prashant provision store, near Daurala sugar factory, Meerut	10.45	4.95
2.	M/s Bansal kirana store, Daurala, Meerut	11.42	5.12
3.	M/s Shri ganapati kirana store, Mawana road Meerut	11.46	5.19
4.	M/s Gupta kirana store, Kanker khera Meerut	11.54	5.04
5.	M/s Rastogi kirana store, begambagh, Meerut	11.63	5.20
6.	M/s Marwadi kirana store, Sadar dal mandi, Meerut	10.95	5.19
7.	M/s Titu kirana store, Kankerkhera, Meerut Cantt.	11.46	5.25
8.	M/s Shiv provision store, Pawlikhas, Meerut	12.14	5.61
9.	M/s Garg kirana store, Meerut	11.72	5.22
10.	M/s Ketan kirana store, Pallavpuram, Meerut	11.68	5.33
Average		11.44	5.21

Table 3: Correlation coefficient between moisture content and grain infestation caused by *T. castaneum* in basmati rice 2018

Parameter	Correlation coefficient (r)
	***Tribolium castaneum* infestation in basmati rice grain**
Moisture content (%)	0.93

* Significant at 0.05% level

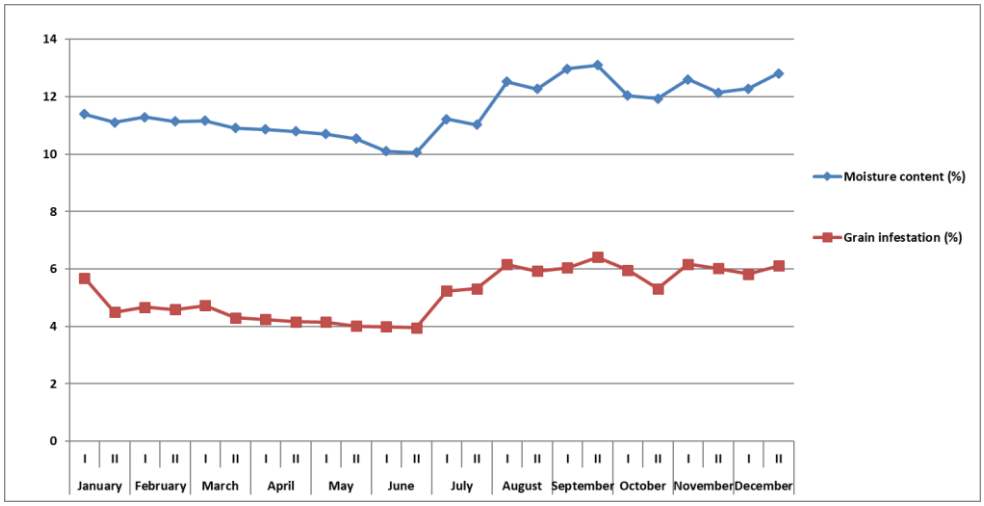

Fig 1: Fortnightly assessment of Per cent moisture content and Per cent infestation of *T. castaneum* in stored basmati rice samples during Jan. 2018 to Dec. 2018 collected from different retailers of district of Meerut

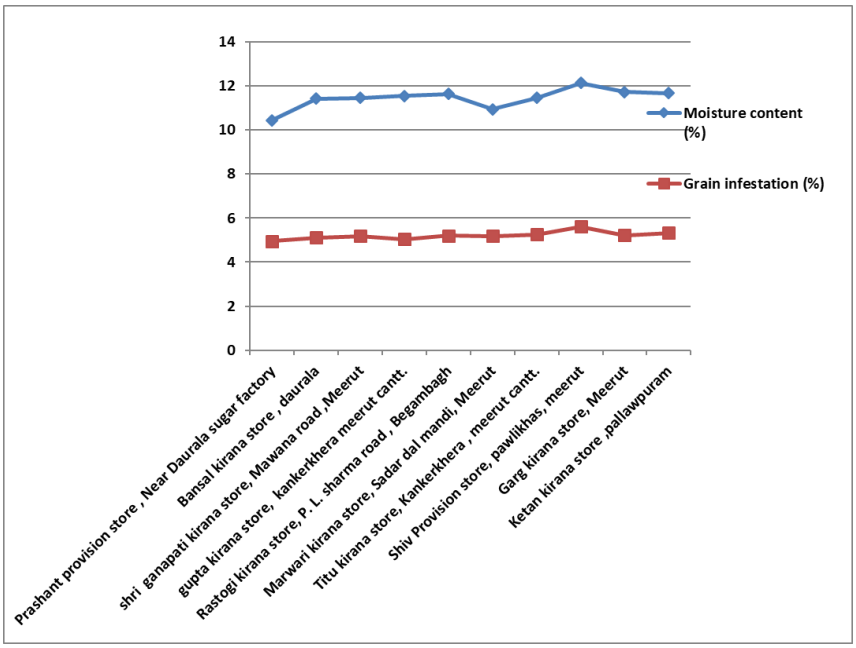

Fig 2: Assessment of moisture content Per cent and infestation level of *T. castaneum* in stored basmati rice samples procured from different retailers of district of Meerut

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