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Survey on relative abundance of stored grain pests in maize samples of different storage duration in Telangana

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Abstract

To identify the species composition and relative abundance of stored grain pests in maize samples of different storage duration a survey was conducted at Karimnagar, Nizamabad and Rangareddy districts of Telangana during 2015-2016 in godowns of MARKFED, private seed companies and poultry feed factories. Insect pests detected during the survey in the samples of six months and one year old stocks were rice weevil, *Sitophilus oryzae*; lesser grain borer, *Rhyzopertha dominica*; angoumois grain moth, *Sitotroga cerealella*; rust red flour beetle, *Tribolium castaneum*; rice moth, *Corcyra cephalonica*. Similar insect pests were recorded in two years old stocks except rice moth. *Sitophilus oryzae* found to be more predominant (14.73, 22.86 and 92.93 per 500g sample) in six months, one year and two years old stocks, respectively. While *Corcyra cephalonica* was least predominant among the stored grain pests (3.27 and 0.07 per 500g sample) in six months and one year old stocks, respectively. However, its relative abundance varied with storage duration, type of storage container used, type of seed and the source of a primary and secondary infestation.

Keywords: Maize samples, stored grain pests, survey, Telangana

1. Introduction

The three major cereals viz., rice, wheat and maize constitute about 85 per cent of total global cereal production. Maize or Corn (*Zea mays* L.), a cereal crop originated in Central Mexico is a versatile crop grown over a range of agro-climatic zones. Maize seeds in storage are infested by more than 37 species of arthropod pests (Abraham, 1991) [1]. Among these insect pests, *Sitophilus oryzae* L., (Coleoptera: Curculionidae) (Lucas & Riudavets, 2000) [2] and *Sitotroga cerealella* (Oliv.) (Lepidoptera: Gelechiidae) are the major primary insect pests causing quantitative and qualitative losses (Lakshmi Soujanya *et al.*, 2013) [3] starts infestation in the field itself and continues in stored corn. They destroy the seed completely from inside and make them chaffy and finally seed viability is lost (Hill, 2002) [4]. In Telangana, maize seeds stored in godowns are usually infested by rice weevil, lesser grain borer, angoumois grain moth, rust red flour beetle and rice moth. *Sitophilus oryzae* is a major pest causing losses upto 100 per cent in stored maize in India and other countries (Irabagon, 1959 and Singh *et al.*, 1974) [5 & 6]. This evidently indicates the importance of *S. oryzae* in the storage of maize seed. Infested seed reduces seed viability and subsequent planting. It also fetches lower market price due to poor seed quality (Tefera, 2012) [7]. A survey was conducted in three major maize growing districts of Telangana state viz., Nizamabad, Karimnagar and Ranga reddy to know the problems associated during the period of maize seed storage, the major pests affecting stored grain and to estimate the extent of relative damage caused by major insect pests, so that it will be useful in developing a new approach to control storage pests in Telangana.

2. Materials and Methods

Maize is damaged by several insect pests during storage whose incidence varies with locality, climate and storage practices, besides its competitive ability with other pests. Hence, a survey was conducted to identify the species composition of stored grain pests of maize and to assess their relative abundance during 2015-2016 in godowns of MARKFED, private seed companies and poultry feed factories in Nizamabad, Karimnagar and Rangareddy districts of Telangana where maize is being predominantly cultivated and stored.

Two kilogram (kg) samples of maize were drawn from six months, one year and two years old stocks in the godowns by using spear sampler (20 cm length) by following sampling protocol described by Hangstrum and Subramaniam, 2000^[8]. The sample of 100 g was drawn from the middle, top and bottom portion of each bag and in similar way samples from twenty bags were collected from the same lot. After collecting the sample it was thoroughly mixed, divided into four parts, from which 500 grams maize seed was randomly selected from each location. These samples were replicated thrice by random selection of 500 grams. Each sample was put in a paper bag and labelled with necessary information and placed in a cloth bag for further inspection in laboratory as per the methods used by Firdissa (1999)^[9].

2.1 Determination of species composition:

To determine the species composition of stored pests in maize, approximately 500 maize seeds from each sample were transferred into a cylindrical glass jar (500 ml), sufficient amount of water was added and then insects and infested seeds which float on the water were collected separately. The infested seeds and insects were dried in shade on tissue paper and counted. Further examination was done under microscope to identify different insect species. Doubtful seeds were moistened, cut opened and examined under microscope for hidden infestation.

2.2 Identification of insect pests of stored maize:

The insect pests found in stored maize were collected, examined under stereoscopic binocular microscope and identified based on the marks of identification. After identification of species composition, the data were analyzed statistically as per Panse and Sukhatame, 1985^[10].

3. Results and Discussion

Insect species composition of storage pests of maize in six months, one year and two year old stocks of maize was assessed through a survey from different godowns and the data on their relative abundance are presented in Table 1 to 3.

3.1 Species composition of storage pests in six months old stocks of maize collected from three districts of Telangana (Rangareddy, Karimnagar and Nizamabad)

Six months old samples of maize collected from eleven locations of three districts of Telangana (Rangareddy, Karimnagar and Nizamabad) showed significant interactions between the two factors *viz.*, location and pests. Significant variability on species composition of storage pests at various godowns was observed (Table 1 and Figure 1).

The five insect species recorded were rice weevil, *Sitophilus oryzae*; lesser grain borer, *Rhyzopertha dominica*; rust red flour beetle, *Tribolium castaneum*; rice moth, *Corcyra cephalonica* and angoumois grain moth, *Sitotroga cerealella*.

The significant difference in pest composition was observed in all the samples of maize seed collected from eleven locations. The pest composition was highest in Sanjeev Reddy Poultry Feed, Nizamabad (18.00 sample⁻¹) followed by Sri Rama Poultry Feed, Rangareddy (10.61 sample⁻¹) and lowest pest composition was observed in the samples drawn from Shri Ram Bioseed, Jeedimetla (1.67 sample⁻¹). The pest composition in the remaining locations ranged from 2.00 to 10.33 sample⁻¹.

Among the pests, *S. oryzae* was predominant (14.73 sample⁻¹) in the maize samples of six months old stocks followed by

Sitotroga cerealella (5.97 sample⁻¹) and *Rhyzopertha dominica* (5.94 sample⁻¹) and they were on par with each other, while the *Corcyra cephalonica* was least predominant pest.

There was a significant variation in the pest incidence among the locations including their interactions. Significantly highest population of *Sitophilus oryzae* (32.33 sample⁻¹) was observed from the samples collected from Venkatesh Poultry Feed, Karimnagar and Sanjeev Reddy Poultry Feed, Nizamabad. *Rhyzopertha dominica* (22.00), *Tribolium castaneum* (13.00), *Corcyra cephalonica* (5.33) and *Sitotroga cerealella* (17.33) were significantly higher in the samples of Sanjeev Reddy Poultry Feed.

Tribolium castaneum was not observed in the samples collected from Shri Ram Bioseed, Jeedimetla. Similarly, *C. cephalonica* was not observed in Ganga Kaveri Ltd., Godvally and Shri Ram Bioseed, Jeedimetla. Highest number of angoumois grain moth, *Sitotroga cerealella* were observed in samples of Sanjeev Reddy Poultry Feed (17.33 sample⁻¹), while, only 1.33 sample⁻¹ was found in the samples of Ganga Kaveri Ltd., Godvally.

3.2 Species composition of storage pests in one year old stocks

Significantly higher range of variability was observed is the species composition of storage pests at various godowns. Samples of one year old stocks of maize were collected from seven locations. The insect species recorded were *Sitophilus oryzae*, *Rhyzopertha dominica*, *Tribolium castaneum*, *Corcyra cephalonica* and *Sitotroga cerealella* (Table 2 and Figure 2).

The pest abundance was high in the maize samples of Sharanya Poultry Feed (17.00 sample⁻¹), Karimnagar, followed by MARKFED, Karimnagar (11.00 sample⁻¹), while it was least in Ganga Kaveri, Ltd., Godavally. (4.60 sample⁻¹). Among the pests, *Sitophilus oryzae* was predominant in the maize samples of one year old stocks (22.86 sample⁻¹) followed by *Rhyzopertha dominica* (6.38 sample⁻¹) and *Sitotroga cerealella* (6.33 sample⁻¹) and they were on par with each other. While *Corcyra cephalonica* was least predominant.

There was significant interaction between locations and pests. Significantly, the highest population of *Sitophilus oryzae* was observed from the samples of Sharanya Poultry Feed, Karimnagar (36.00 sample⁻¹) followed by MARKFED, Nizamabad district (29.00 sample⁻¹). *Rhyzopertha dominica* was significantly higher in the samples of Sharanya Poultry Feed (23.67 sample⁻¹) and the lowest population was observed in the samples collected from Nuziveedu Seeds, Kompally (0.33 sample⁻¹).

Population of *Tribolium castaneum* was significantly higher (13.67 samples⁻¹) in the samples of Sharanya Poultry Feed, Karimnagar. *Corcyra cephalonica* was not observed in the samples collected from Ganga Kaveri, Ltd., Godavally; Kiranmai Agrogenetics, Nizamabad; MARKFED, Rangareddy and Nuziveedu Seeds, Kompally godown.

3.3 Species composition of storage pests in two years old stocks

Two years old maize grain or seed stocks were collected from godowns located at five locations. Significant variability was observed in the species composition.

The insect species recorded were *Sitophilus oryzae*, *Rhyzopertha dominica*, *Tribolium castaneum* and *Sitotroga*

cereallela, similar to six and one year old stocks except *Corcyra cephalonica* (Table 3 and Figure 3).

The pest composition was significantly high in MARKFED, Rangareddy (66.20 sample⁻¹) followed by MARKFED, Nizamabad (64.20 sample⁻¹). While lowest pest composition was found in Ganga Kaveri Ltd., Godavally (3.90 sample⁻¹).

Among the four species recorded, *Sitophilus oryzae* (92.93 sample⁻¹) population was found highest compared to other pests viz., (*Sitotroga cereallela* (33.07 sample⁻¹), *Rhyzopertha dominica* (10.73 sample⁻¹) and *Tribolium castaneum* (10.20 sample⁻¹).

The significant interaction between locations and pests was also observed. Significantly highest population of *Sitophilus oryzae* (181.67 sample⁻¹) was observed in the samples of MARKFED, Rangareddy, followed by MARKFED, Nizamabad (165.33 sample⁻¹). While, relatively less number (5.33 sample⁻¹) was noticed from Ganga Kaveri, Ltd., Godavally. *Rhyzopertha dominica* and *Tribolium castaneum* were significantly higher in the samples of MARKFED, Karimnagar (44.33 and 17.33), respectively. While *Rhyzopertha dominica* was not observed in the samples of Ganga Kaveri, Ltd., Godavally. *Tribolium castaneum* abundance was less in the samples collected from MARKFED, Nizamabad district (4.67 sample⁻¹).

Significantly highest population of *Sitotroga cereallela* (82.00 sample⁻¹) had been observed in the samples of MARKFED, Nizamabad, whereas relatively less number (2.00 sample⁻¹) was observed in Nuziveedu Seeds, Kompally.

Significantly higher variation was observed among six months, one year and two years old stocks in all the locations and there was significant variation in location and pest interaction among six months, one year and two year old stocks. In India, rice weevil, *Sitophilus oryzae*; lesser grain borer, *Rhyzopertha dominica*; red rust beetle, *Tribolium castaneum*; rice moth *Corcyra cephalonica* and angoumois grain moth, *Sitotroga cereallela* are the predominant species attacking maize seed. The prevalence and distribution of these insect species vary with regions.

The species composition of storage pests in six months and one year old stocks at different maize seed or grain godowns were rice weevil, *Sitophilus oryzae*; lesser grain borer, *Rhyzopertha dominica*; red rust beetle, *Tribolium castaneum*; rice moth, *Corcyra cephalonica* and angoumois grain moth, *Sitotroga cereallela*. The predominance of *S. oryzae* and *Sitotroga cereallela* observed may be due to tropical conditions favourable for their multiplication (Srivastava, 1985) [11]. It is evident from the data that the predominance of *S. oryzae* in one year and two years old maize stocks might be

due to their multiplication and population build up in older stocks. Predominance of *Sitophilus oryzae* was in accordance with results reported by earlier workers (Mohan Rao *et al.*, 1973 [12]; Borikar *et al.*, 1977 [13]; Ivbijaro 1978 [14]; Bharadwaj *et al.*, 1979 [15]; Pandey and Das, 1984 [16]; Ayetey and Ibitoye, 1987 [17]; Arbogast and Mullen, 1988 [18]; Lavigne, 1991 [19]; Nyambo, 1993 [20]; Buchelos and Katopodis, 1995 [21]).

The mean population of all pests irrespective of the species was more in six month old stocks of Sanjeev Reddy Poultry Feed, (18.00 sample⁻¹), Govindapet, Nizamabad where as in one year old stocks, MARKFED, Karimnagar (11.00 sample⁻¹) and two years old stocks in MARKFED, Ranga reddy (66.20 sample⁻¹). Probably because of higher initial infestation carried over from the field to godowns.

Rhyzopertha dominica and *Tribolium castaneum*, in two years old stocks was more than six months old stock but not as much as *Sitophilus oryzae* probably because of favourable conditions prevailing for multiplication of *Sitophilus oryzae* which require high moisture content and moderately high temperature, while *Rhyzopertha dominica* and *Tribolium* require hot and dry conditions but can also survive in variable conditions (Chaudhary *et al.*, 1993) [22]. Chestnut and Douglas, 1971 [23] reported that *Sitophilus zeamias* mechanically damage the developing moth as a result of feeding activity of the weevil. Similar findings were observed in two years old stocks. Absence of *Corcyra* moth eggs, larvae and pupae may be also due to mechanical damage caused by adult weevil. However, predominance of species is not always fixed but is determined by several interrelated factors such as adoptability to different abiotic factors (Park, 1954) [24], high reproductive potential (Birch, 1953) [25] and age of seed stock (Birch, 1954) [26].

Diverse variation observed in the pest dominance depends on the source of primary field infestation at seed production centres and the source of secondary cross infestation at godowns. Dominance of pest species among the locations indicated their adaptability to different environmental factors, type of the storage container used, the age of seed stock as well as the maize cultivars from which the samples were drawn. The rejected seed without treatment appears to be the major source of cross infestation at godowns. The prevalence of insect pests is largely due to the inadequate sanitary measures, which are essential to keep godowns clean and tidy. Cross infestation will invariably occur if contaminated seed is not disposed in a proper way. Hence, regular prophylactic measures would help to protect seed or grain from the storage insect pests.

Table 1: Species composition of stored grain pests in six months old stocks of maize.

S. No.	Location	Species of stored grain pests/500 g of maize seed					Mean
		<i>Sitophilus oryzae</i>	<i>Rhyzopertha dominica</i>	<i>Tribolium castaneum</i>	<i>Corcyra cephalonica</i>	<i>Sitotroga cereallela</i>	
1	Ganga Kaveri Ltd., Godavally	4.67 (2.26)	3.00 (1.86)	1.00 (1.22)	0.00 (0.79)	1.33 (1.34)	2.00 (1.48)
2	Shri Ram Bio seed, Jeedimetla	4.33 (2.20)	2.33 (1.64)	0.00 (0.71)	0.00 (0.71)	1.67 (1.44)	1.67 (1.34)
3	Zuari Seeds, Medchal	6.33 (2.60)	3.67 (2.06)	2.00 (1.58)	1.00 (1.22)	5.00 (2.34)	3.60 (1.95)
4	Sonam Seeds, Karimnagar	9.00 (3.08)	2.53 (1.66)	5.00 (2.35)	1.00 (1.22)	3.67 (2.04)	4.20 (2.07)
5	Varun Seeds, Karimnagar	6.33 (2.69)	2.00 (1.58)	3.00 (1.86)	0.67 (1.05)	4.00 (2.12)	3.20 (1.84)
6	Kiranmai Agro Genetics, Nizamabad	9.00 (3.08)	4.00 (2.11)	7.33 (2.80)	0.33 (0.88)	2.33 (1.64)	4.60 (2.10)
7	Sharanya Poultry Feed, Karimnagar	25.00 (5.04)	11.67 (3.48)	4.00 (2.09)	3.00 (1.87)	8.00 (2.91)	10.33 (3.08)
8	Venkatesh Poultry Feed, Karimnagar	32.33 (5.73)	2.00 (1.58)	1.33 (1.34)	3.67 (2.03)	6.00 (2.54)	9.06 (2.65)
9	Srinivasa Poultry Feed, Nizamabad	9.00 (3.08)	5.00 (2.34)	8.00 (2.91)	5.00 (2.34)	12.33 (3.57)	7.87 (2.85)
10	Sanjeev Reddy Poultry Feed, Nizamabad	32.33 (5.73)	22.00 (4.74)	13.00 (3.67)	5.33 (2.41)	17.33 (4.21)	18.00 (4.15)
11	Sri Rama Poultry Feed, Rangareddy	23.62 (4.92)	7.33 (2.79)	2.33 (1.67)	16.00 (4.06)	4.00 (2.11)	10.61 (3.11)
	Mean	14.73 (3.67)	5.94 (2.35)	4.27 (2.02)	3.27 (1.68)	5.97 (2.39)	

		SEm±	CD (P=0.05)
	Locations (A)	0.06	0.16
	Pests (B)	0.04	0.11
	Locations X Pests	0.13	0.37
	CV (%)	9.36	

Figures in the parentheses are square root transformed values

Table 2: Species composition of stored grain pests in one year old stocks of maize

S. No.	Location	Species of stored grain pests/500 g of maize seed					Mean
		<i>Sitophilus oryzae</i>	<i>Rhyzopertha dominica</i>	<i>Tribolium castaneum</i>	<i>Corcyra cephalonica</i>	<i>Sitotroga cerealella</i>	
1	Ganga Kaveri Ltd., Godavally	14.67 (3.89)	3.00 (1.86)	1.00 (1.22)	0.00 (0.71)	4.33 (2.19)	4.60 (1.98)
2	Kiranmai Agro Genetics, Nizamabad	22.00 (4.74)	2.33 (1.67)	3.00 (1.86)	0.0 (0.71)	4.33 (2.19)	6.33 (2.24)
3	MARKFED, Rangareddy	23.00 (4.85)	2.33 (1.67)	3.67 (2.03)	0.00 (0.71)	5.33 (2.40)	6.87 (2.33)
4	MARKFED, Nizamabad	29.00 (5.43)	5.00 (2.34)	2.00 (1.56)	0.11 (1.77)	4.33 (2.20)	8.80 (2.66)
5	MARKFED, Karimnagar	23.33 (4.88)	8.00 (2.91)	11.67 (3.48)	0.20 (1.76)	9.33 (3.12)	11.00 (3.23)
6	Nuziveedu Seeds, Kompally	12.00 (3.53)	0.33 (0.88)	3.33 (1.93)	0.00 (0.71)	9.00 (3.08)	4.93 (2.03)
7	Sharanya Poultry Feed, Karimnagar	36.00 (6.04)	23.67 (4.91)	13.67 (3.76)	0.18 (2.11)	7.67 (2.86)	17.00 (3.94)
	Mean	22.86 (4.76)	6.38 (2.32)	5.48 (2.26)	0.07 (1.21)	6.33 (2.58)	
		SEm±			CD (P=0.05)		
	Locations (A)	0.05			0.15		
	Pests (B)	0.05			0.13		
	Locations X Pests	0.12			0.34		
	CV (%)	7.90					

Figures in the parentheses are square root transformed values

Table 3: Species composition of stored grain pests in two years old stocks of maize

S. No.	Location	Species of stored grain pests/500 g of maize seed				Mean	
		<i>Sitophilus oryzae</i>	<i>Rhyzopertha dominica</i>	<i>Tribolium castaneum</i>	<i>Sitotroga cerealella</i>		
1	MARKFED, Rangareddy	181.67 (13.50)	3.67 (2.04)	15.00 (3.94)	64.33 (8.05)	66.20 (6.88)	
2	MARKFED, Nizamabad	165.33 (12.88)	4.61 (2.27)	4.67 (2.26)	82.00 (9.08)	64.20 (6.62)	
3	MARKFED, Karimnagar	76.33 (8.77)	44.33 (6.69)	17.33 (4.22)	14.67 (3.89)	38.20 (5.89)	
4	Nuziveedu Seeds, Kompally	36.00 (6.04)	1.00 (1.23)	6.00 (2.54)	2.00 (1.58)	11.30 (2.85)	
5	Ganga Kaveri Ltd., Godavally	5.33 (2.40)	0.00 (0.71)	8.00 (2.91)	2.33 (1.68)	3.90 (1.92)	
	Mean	92.93 (8.72)	10.73 (2.59)	10.20 (3.18)	33.07 (4.86)		
		SEm±			CD (P=0.05)		
	Locations (A)	0.05			0.14		
	Pests (B)	0.04			0.12		
	Locations X Pests	0.10			0.28		
	CV (%)	3.47					

Figures in the parentheses are square root transformed values

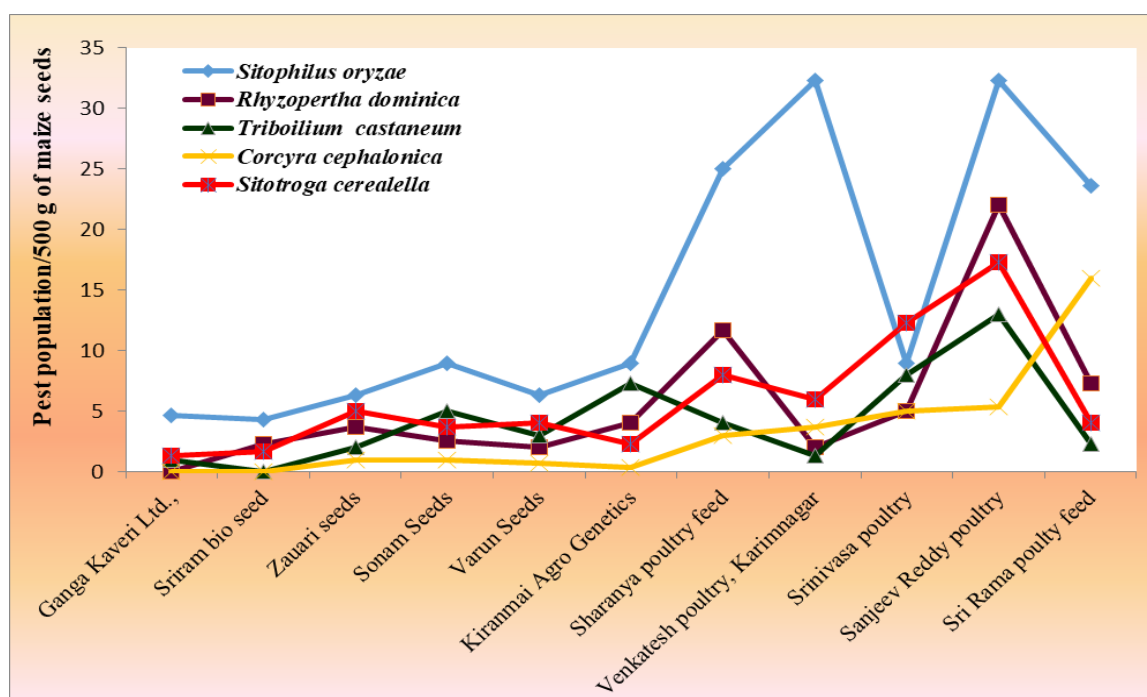


Fig 1: Species composition of stored grain pests in six months old stocks (maize).

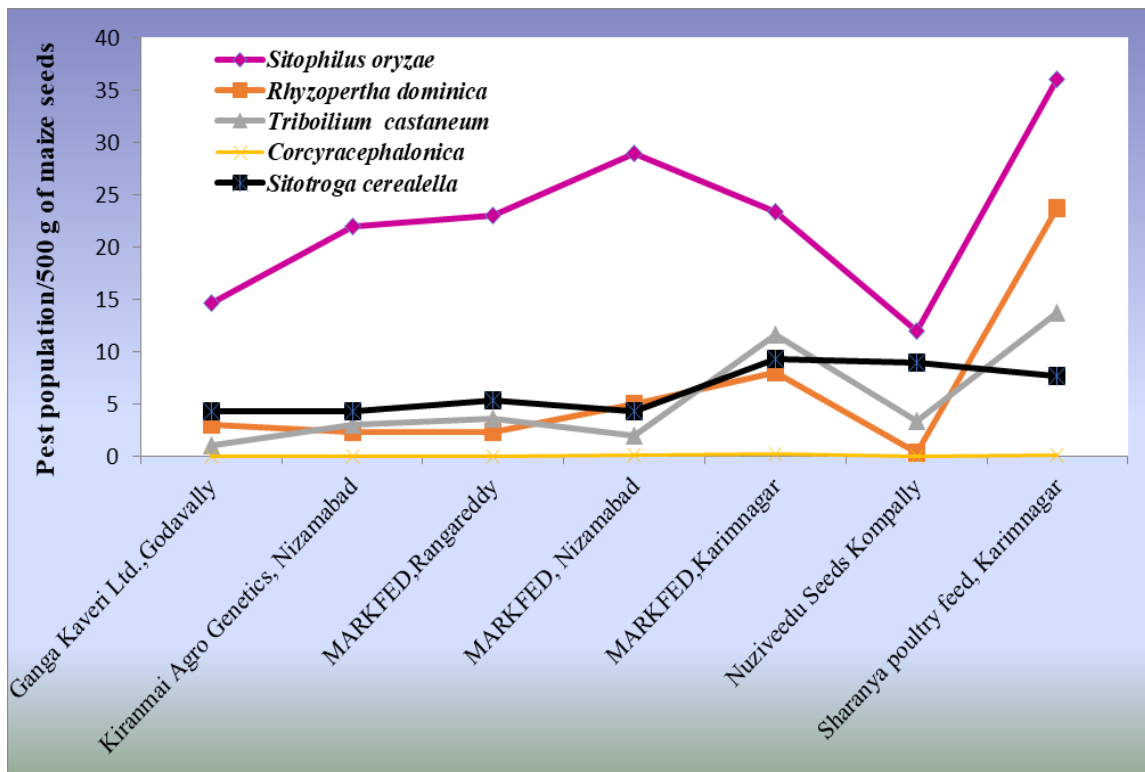


Fig 2: Species composition of stored grain pests in one year old stocks (maize).

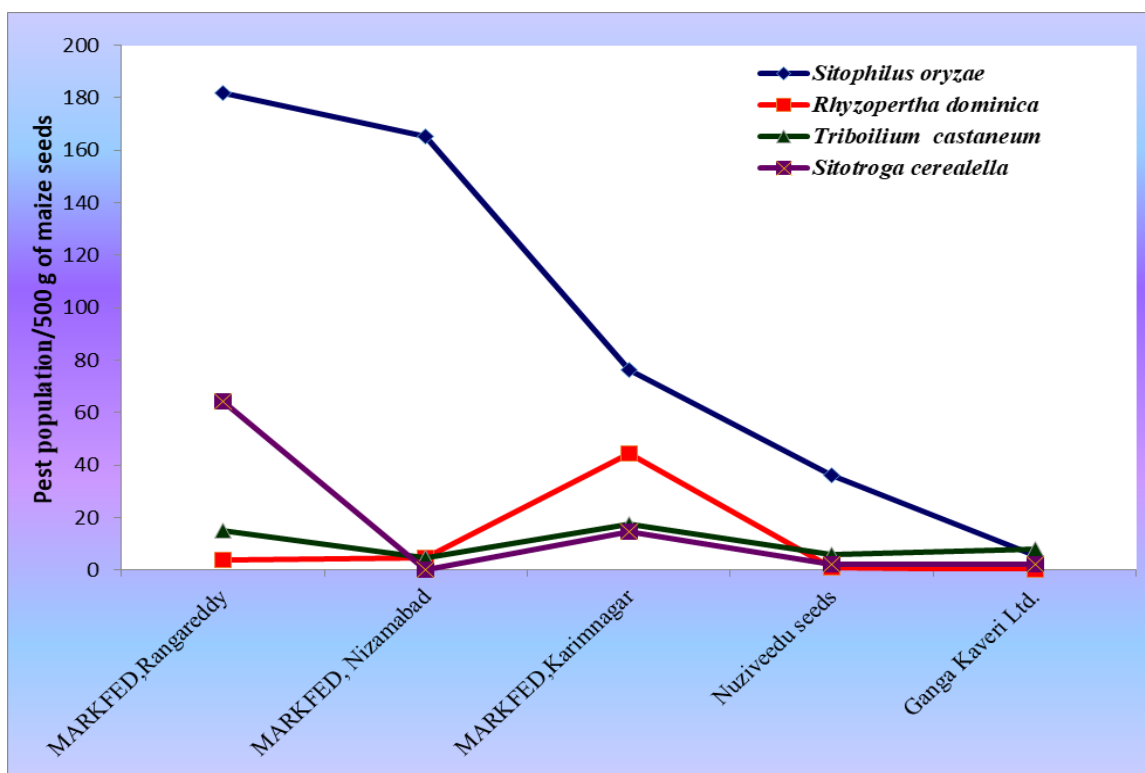


Fig 3: Species composition of stored grain pests in two years old stocks (maize).

4. Conclusion

Insect pests detected during the survey in the Telangana state were rice weevil, *Sitophilus oryzae*; lesser grain borer, *Rhyzopertha dominica*; rust red flour beetle, *Tribolium castaneum*; rice moth, *Corcyra cephalonica* and angoumois grain moth, *Sitotroga cerealella* in six months old stocks. Similar insect pests were recorded in two years old stocks except *Corcyra cephalonica*. *Sitophilus oryzae* was found to be more abundant in all godowns. However, its relative

abundance varied with storage duration, type of storage container used, type of seed and the source of primary and secondary infestation.

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