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RESEARCH ARTICLE

Characteristics of farmers and agro-ecological knowledge of termites and their devastation in semi-irrigated farming system of central India

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ABSTRACT

Investigations were carried out during four consecutive years (2007-08 to 2010-11) at farmers' fields of Satpura pleatue and Gird agro-climatic zones of Madhya Pradesh to evaluate the assessment of infestation, characteristics and farmers' agro-ecological knowledge about termites. Termites infestation and their abundance is an important problem of the farmers in sandy light soils. It needs to pay attention in the characterization of the dominant farming system to formulate the agro-ecologically acceptable sustainable termite management strategies. Focus group discussion and in depth individual interview schedule were conducted of 150 farmers to collect the information of termite in the region. About 83.3 per cent of the respondents were engaged in both of the farming and livestock production and 92.0 per cent belonged to male gender. Approximately, 86.7 per cent could not achieve above Higher Secondary education. Only 17.3 per cent respondent farmers were having above 10 ha land, majority came under marginal land holding and 80.66 per cent recognized termite problem before fifteen years. About 81.0 and 74.0 per cent respondents cultivated mustard and wheat crop with 22.0 and 21.0 per cent plant infestation caused by termites, respectively. 72.0 per cent respondents stated that the termite infestation and damage levels were higher during January to June in sandy light soils with 48.7 per cent. Termetaria was present in 88 per cent of the farmers' fields and 30.66 per cent respondents accepted that it was a major factor responsible for spreading and enhancement of termite damage in field crops.

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INTRODUCTION

In India, termites are widely distributed in red, sandy loam, lateritic, red loam and alluvial soils. Among various insect pests attacking different crops, termites are the major menace of semi-arid and sub-humid tropics, causing economic losses to the field crops, forests trees, rangelands and buildings (Anonymous, 2000). Termites are found in wide range of terrestrial environment and distributed throughout the tropical, subtropical and temperate region of the world and infesting various crops, *i.e.*, sugarcane, wheat, castor and cotton. Damage to wheat crop by termites has been also reported from Madhya Pradesh, U.P., Gujarat and Rajasthan (Kumar and Pardeshi, 2011). Infestation of termites was observed up to 20-25 per cent in rainfed and up to 10 per cent in irrigated crop, in general damage by termites is greater in rainfed than irrigated crops (Sharma *et al*., 2009).

Termite is a polyphagous pest and one of the most destructive creatures of all cultivated crop plants throughout the world. It feeds on all the things which contain cellulose. In loam or light soil and dry areas where proper facilities for irrigation are not usually available, the termite infestation is

more inimical. The infestation of termites is more on *Rabi* crop as compared to *Kharif* crops. It feeds on the roots of all the vegetable plants and a result of infestation, the leaves of infested plant start dry and such plant can easily be pulled out from the soil (Shukla, 2009). In the dryer part of India, infestations by termite have been reported in maize, pearl millet, pulses, sugarcane, cotton, paddy (20 %), groundnut (35 %), potato, citrus, vegetables, spices and fruit crops (Roonwal, 1979). Termite are the most important soil fauna in the semi-arid tropics (Lobry de Bruyns and Conacher, 1990) and found in wide range of terrestrial environments and are distributed throughout the tropical, subtropical and temperate regions of the world (Smeathman, 1781; Freise, 1949; Krishna and Weesner, 1970; Pearce, 1997).

A farming system is a population of individual farm system that has broadly similar resource base, enterprise patterns, house hold livelihood and constraints and for which similar developmental strategies and interventions would be appropriate (FAO, 2001). These individual farm systems are characterized with structurally complex parts but with existent interrelationship between various components. The integral part of these could be broadly grouped into prevailing biophysical and socio-economic components. Therefore, variations in the characteristics of individual farm systems arise from variation in resource development and family circumstances that constitute the socio-economic and human element of the system (Obi, *et al.*, 2008). Peculiarity of the study area in the severity of termite abundance and infestation, whose effect could be grouped into agronomic, economic, social, environmental and physiological/categories.

This seems to an enthusiastic endeavour to generate agro-ecologically sustainable and acceptable termite management strategies. However, development of such strategies requires an explicit understanding of the beginning of the termite problem in the area. No work has been done to find out the characteristics of farmers' and agro-ecological knowledge of termite problem and assessment of infestation in semi-irrigated farming system of Madhya Pradesh. This study was thus conceived to investigate farmers knowledge of the termite problem with the intent to build more coherent principals required in the development of appropriate termite management strategies and therefore present studies were carried out.

MATERIAL AND METHODS

Description of the study area :

Different villages were surveyed by scientists of Krishi Vigyan Kendras. While collecting preliminary information of cropping pattern and resource availability, it was found that the farmers of these villages despite of paucity of irrigation facilities were inclined to cultivate *Rabi* crops. Farmers were found to suffer from the severe termite infestation in their field crops and they were not using any management practice. They were also not aware about the technical knowledge of improved agricultural practices.

Period, location, climate, soil and crops :

The field experiment was laid down in four consecutive years during 2007 - 08 to 2010 - 11 at 150 farmers' fields in 10 villages of one district Chhindwara in Satpura plateau and three districts *viz.*, Gwalior, Bhind and Morena in Gird agro-climatic zone of Madhya Pradesh, which is the part of central India. Madhya Pradesh is bounded by the state of Uttar Pradesh and Rajasthan on the north, Uttar Pradesh and Chhattisgarh on the east, Maharasthra on the south and Gujarat on the west. It is located between latitudes 23^0 10' N and longitudes 77^0 12' E. The mean annual maximum and minimum temperature is ranged from 50^0 to 2^0 C. The average annual rainfall received from 750 mm to 1250 mm, out of which 90 per cent received during rainy session, 15th June to September. The soils of study area are deep black, medium black, sandy light and alluvial. All type of crops *viz.*, cereals, legumes, oilseeds, vegetables, fruit crops and trees are being cultivated.

Sample procedure, sample size, data collection and analysis:

The process was aimed to access the distribution, extend of problem and constraints imposed by termites infestation on the locality. Discussions were held with the extension personals of the state Department of Agriculture and 150 farmers of the ten villages of four districts in study area. The questionnaire was administrated on the farmers, which conveyed all personal, fields, crops, soils, sessions, termite damage and infestation details. Systemic random sampling procedure, qualitative and quantitative data were obtained using semi-structured pre-tested questionnaire administrated by way of one - by one direct interview. Focus group discussion was also conducted to corroborate the information collected in direct interview and perceptions of farmers are given here. XLSTATE (2007) was used to generate summary statistics (frequencies, percentages and means).

RESULTS AND DISCUSSION

The results obtained from the present investigation have been presented in the following sub heads :

The characteristics of farmers :

The experiment was laid down in four consecutive years and results are sown in Table 1. It was noticed that 92.0 per cent respondents were male and mijority of the farmers came under 35 to 54 years age group with 83.3 per cent engaged in farming and livestock both. About 48 per cent respondents could not get education above Middle level, only 5.33 per cent were post graduates. The distributions of family size were from 1 – 5 members (28.0 %), 6 – 10 members (42.0 %) and

Table 1: Socio-economic status of the farmers (respondents), damage levels and recognition of the termite problem in the study area (n=150)

Variables	Frequency	Percentage (%)
Sex of respondents		
Male	138	92
Female	12	08
Age group		
15-24	09	06
25-34	24	16.0
35-44	40	26.7
45-54	45	30.0
55-64	26	17.33
>65	06	04
Major occupation		
Farming	15	10.0
Livestock production	04	2.6
Farming and livestock both	125	83.3
Civil servant	06	04
Level of education		
None educated	03	02
Primary	18	12.0
Middle	49	32.7
Higher Secondry	60	40.0
Graduate	12	08
Post graduate	08	5.33
Family size		
1-5	42	28.0
6-10	63	42.0
11-15	39	26.0
>15	06	04
Size of land holding (hectare)		
? 1	07	4.66
1-3	51	34.0
4-10	66	44.0
>10	26	17.3
Year of recognition		
1-5 years ago	10	6.66
6-10 years ago	55	36.66
11-15 years ago	66	44.0
16-20 years ago	12	8.0
21-25 years ago	05	3.3
>25 years ago	02	1.3
Use of production		
Home consumption	09	6.0
Sale	08	5.3
Sale and consumption	133	88.7

11 – 15 members (26 %) and in terms of land holding maximum (78.0 per cent) respondents were having marginal land 1 – 10 hectares and only 17.3 per cent respondents have above 10 hectares of land. Most of the farmers (88.7 %) used their production for the purpose of consumption and sale, while the remaining 6 and 5.3 per cent of the respondents produced for the home consumption and sale alone, respectively. Majority of the farmers (80.66 %) indicated that the problem was first recognized as far as 6 to 15 years back. Obi *et al*. (2008) also reported similar characteristics of the respondents and their socio-economic status.

Termite's infestation in different soils :

Data regarding to the infestation of termites in different soils of study area are given in Table 2. The maximum termites infestation was in sandy light soil (48.7 % respondents) followed by alluvial soil (27.3 % respondents) and 8.0 per cent respondents, light black soil. These observations corroborate with the findings of Shukla, (2009) who reported that termite infestation was more serious in loam and light soil. It was also observed that about 88.0 per cent of the respondents had termetaria in their farm and rest of 12.0 per cent have not seen termateria in their fields. This study was confirmed by Obi *et al*. (2008), who noticed that about 75.0 per cent of the respondents had termite mound (termetaria) in their fields. Thakur (1991) published a series on the field ecology, eco-biogeography and economic importance of termites and recorded occurrence, abundance, distribution and economic significance of termites of Gujarat.

Table 2 : Termite infestation in different soils (n=150)

Soil types	Frequency	Percentage (%)
Sandy light soils	73	48.7
Deep black soils	09	6.0
Light black soils	12	8.0
Alluvial soil	41	27.3
Clay loam soil	15	10.0
Termitaria (mounds) present in their fields		
Present	132	88.0
Not present	18	12.0

Factors enhancing termite problem :

About 30.66 per cent of the respondents reported that the termetaria was present in their fields and it was a major factor responsible for spreading and enhancement of termite damage in crops than the other factors (Table 3). Obi, *et al*. (2008) also reported that about 75.0 per cent of the respondents had termite mound (termetaria) in their fields. Approximately 24.6 per cent of the respondents reported to present study in sandy light soils in the region but other factors like use of un-decomposed FYM, availability old crop retunes in the fields and minimum irrigation facilities seemed to be moderate factor

for spreading and enhancement of termite problem. Topography of the soil observed negligible and the least responsible for termite enhancement by 6.0 per cent of the respondents.

Table 3 : Farmers' rankings of factors enhancing termite damage

Causes	Frequency	Percentage (%)
Light soils	37.0	24.66
Use not decompose FYM	21.0	14.0
Mounds/Termitaria	46.0	30.66
Old crop retunes	18.0	12.0
Low irrigation	18.0	12.0
Topography	10.0	6.66

Farmers engaged with different crops and termite infestation in them :

The proportion of the farmers that produce different type of crops like cereals, legumes, oilseeds, cash crops, vegetables, fruit crops and trees in the study area are presented in Table 4. It is revealed that the cereals included wheat, pearl millet, paddy, sorghum and maize cultivated by about 74.0, 53.0, 11.0, 20.0 and 12.0 per cent of the farmers' respondents with termite infestation 21.0, 11.0, 12.0, 19.0 and 13.0 per cent, respectively. Approximately 36.0, 21.0 and 37.0 per cent farmers' respondents were growing chickpea, soybean and pigeon pea with infestation of termite 23.0, 7.0 and 14.0 per cent, respectively. Most of the farmers respondents cultivated oilseed crops *i.e.* mustard (81.0 %) and groundnut (9.0 %) and they noticed that termite infestation 22.0 and 21.0 per cent, respectively. In case of cash crops, farmers were cultivating potato 33.0, cotton 19.0 and sugarcane 9.0 per cent along with the infestation caused by termites were 9.0, 24.0, and 25.0 per cent, respectively. It was also reviewed that the 42.0 and 12.0 per cent of farmers respondents were engaged in the cultivation of different vegetables and fruit plants mainly guava, aonla, mandarin, mango etc. but higher 32.0 per cent termite infestation were observed in fruit plants than the negligable in vegetables (7.0 %). The study also showed that majority of respondents (73.0 %) were heaving different type of trees on their farm with highest 46.0 per cent termite infestation. Obi *et al*. (2008) also noticed that majority of respondents were engaged in different types of crop like cereals, pulses, oilseeds, vegetables, cash crops etc. by the respondents in the farming system and infestation caused by termites. Damage to wheat crop by termite has been also reported from Madhya Pradesh, U.P., Gujarat and Rajsthan (Kumar and Pardeshi, 2011). Termite infestation (20-25 %) was observed in rainfed and up to 10 per cent in irrigated crops, in general damage by termites was greater in rainfed than irrigated crops (Sharma *et al.,* 2009). A report (India, 1960) stated that a huge stock of 13, 000 tones of wheat in Madhya Pradesh was damaged by termites (Roonwal, 1979).

Table 4 : Percentage of farmers engaged in cultivation of crops and termite infestation

Crops	(%) Farmers engaged in crop production	(%) Per cent infestation
Wheat	74	21
Chickpea	36	23
Mustard	81	22
Soybean	21	07
Cotton	19	24
Pigeonpea	37	14
Sugarcane	09	25
Paddy	11	12
Pearl millet	53	11
Sorghum	20	19
Groundnut	09	21
Maize	12	13
Potato	33	09
Vegetables	42	07
Fruit orchard (guava, aonla, mendarin, mango etc.)	12	32
Trees	73	46

Level of termite damage during a year :

Generally, the farmers consider damage level of termite to be higher in the warmer months during January to June than in the humid months July to December. The farmers noticed very high 49.3 per cent damage level of termite during January to March in first quarter of the year and other rated as high (24.0 %), moderate (18.0 %) and low (8.0 %) in this quarter. Similar trends of respondents of the termite damage level were also observed during second quarter of the year April to June, very high (48.0 %), high (29.3 %), moderate (15.3 %) and low (7.3 %). The results indicated that 54.0 per cent of the respondents found low level of termite damage during rainy session (July to September) and 30.66 per cent respondents recorded moderate level. The farmers reported that the damage level of termite was as low as 10.66, moderate (20.6), high (32.0) and very high (36.6 %) in increasing trends of respondents. This is in line with Mugerwa *et al.* (2011), who observed termites damage in all pasture seedlings a few days post emergence in the wet session and peak termite attack was recorded during dry period by Logan *et al.,* 1990. Sharma *et al.,* 2009 also revealed that termite infestation was found higher in *Rabi* season as compared to *Kharif* and dry ereas. Probably this reason increases the possibility of access or attack to the crops at the time of foraging. However, termites remain active throughout the year (Imms, 1919) and cause extensive damage to agricultural crops at any time in suitable environmental conditions (Kumar and Pardeshi, 2011).

Conclusion :

From the above overall discussion, It can be deduced

Table 5 : Level of termite damage in different months

Months /Damage level	Frequency	Percentage
I. January- March		
Low	13.0	8.66
Moderate	27.0	18.00
High	36.0	24.00
Vary high	74.0	49.33
II. April- June		
Low	11.0	7.33
Moderate	23.0	15.33
High	44.0	29.33
Vary high	72.0	48.00
III. July- September		
Low	81.0	54.00
Moderate	46.0	30.66
High	14.0	9.33
Vary high	09	6.00
IV. October-December		
Low	16.0	10.66
Moderate	31.0	20.66
High	48.0	32.00
Vary high	55.0	36.66

that majority of the farmers respondents were low educated and engaged in crop production and live stock both, with marginal land holding. They noticed that intensity of termite infestation, dama ge level increased in sandy light soils during the dry session, first and second quarter of the year January to June and decreased during rainy and wet sessions. The entire respondents reported that termeteria was present in their fields and it is main pose of spreading of termites. It was also evident from the study that the respondents were aware of the termite problem and their damage was higher particularly in trees, fruit crops and rain fed crops. Sustainable termite management strategies in sandy light soil of semi- irrigated farming system should not only target termites but also focus on ensuring agro-ecological integrity. This study has also provided some basic information about farmers and their knowledge related to termite in different soils, recognition, factors enhancing damage and severity in different crops during round the year that could aid the development and promotion of sustainable and socially acceptable termite management measures in agro-ecosystem.

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