

Full Length Research Paper

Insect pests infesting black pepper (*Piper nigrum* L.) in southwestern part of Ethiopia

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Received 8 September, 2016; Accepted 20 October, 2016

Survey was carried out to study the distribution, infestation and damaging level of insect pests of black pepper during 2013/2014 cropping season in Southwestern Ethiopia. Insect pests were observed and identified at their sites in the surveyed areas. In addition, samples of insect pests and infected plant parts were collected and insect images were taken. The samples were diagnosed in Tepi National Spice Research Center laboratory. A total of twenty two species of insect pests were recorded as black pepper insect pest with different rate of infestation and damage level. Biting black ants (*Tetramorium* species), black pepper flea beetle (*Longitarsus* species), leaf gal trips (*Liothrips* species), and stink bugs (Pentatomidae) were recorded with relatively high infestation and damage level from all surveyed area, while others were considered as intermediate and minor pest due to low infestation and damage level. Therefore, it is important to design control options for these major insect pests to ensure plant health and pest action under economic threshold level.

Key words: Survey, black pepper, insect pests, infestation, damage level, spices.

INTRODUCTION

Ethiopia is a homeland for many spices, such as korarima (*Aframomum corrarima*), long pepper (*Piper capense*), black cumin (*Nigella sativa*), bishops weed (*Trachy spermumammii*) ('Nechazmud') and coriander (*Coriandrum sativum*) (Jansen, 1981; Edossa, 1998; Girma et al., 2008a). Black pepper known as king of spices is one of the oldest spice crops that originated from India and distributed to other countries (Purseglove et al., 1981; Girma et al., 2008a). Black pepper ('Kundo-

berbere' in Amharic) was introduced to Ethiopia between 1979 and 1980 from potential producing countries (Girma et al., 2008a, b; TNSRC, unpublished data).

It is considered a high value spice crop, since it earns significant foreign exchange for a country (CSA, 2016). For instance, in 2012 around 45,000 kg of dry black pepper was exported from Ethiopia (Bebeka Coffee Plantation, currently Horizon Plantation PLC., 2012). The demand for black pepper and its product is increasing

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year by year in the world market, but production is limited to few countries. Recently, black pepper has performed well in the south west of Ethiopia, particularly, at Tepi, Gemadro and Bebeke large scale farms (Girma et al., 2008a, b). Due to its promising performance in these areas, various business plans on black pepper production, value addition and black pepper oil production are being planned. After long evaluation for adaptation, yield and quality performance, two cultivars of black pepper were selected and released for large-scale production in Ethiopia. The varieties are "Tato" and "Gacheb" and they give dry yield of 2170 and 3050 kg/ha, and 10 and 9.1% (w/w) oleoresin and 2.29 and 3.2% (v/w) essential oil contents, respectively. This performance is below their genetic potential due to several factors (Girma et al., 2008a). Black pepper cultivation has been under threat due to various diseases and insects attacking it, starting from nursery to field plantation at any growing stage (Habetewold, unpublished data). Also reports from India suggest that insects and diseases can cause considerable yield loss on black pepper. For instance, Pollu beetle is the most destructive pest causing 30 to 40% yield loss in humid, tropical evergreen forests of India (Devasahayam et al., 1988) which is similar to south western Ethiopia where black pepper is adapted (Table 1).

Hence, black pepper cultivation is at its infant stage in Ethiopia and little has been done on crop protection. Therefore, the current study aims to survey insect pest damaging black pepper in south western Ethiopia to initiate control options.

METHODOLOGY

A survey was conducted in three zones: Bench-Maji, Mezhenger (known as Majang) and Sheka during the 2013/2014 cropping season. From Bench-Maji zone, two districts (Guraferda, and Sheko), Majang one district (Godere), from Sheka zone two districts (Yeki and Andracha (Gemadro)) were surveyed at flowering and maturity growth stages of black pepper (Figure 1). Eighteen sites (three state farms, one on stations (Black pepper maintenance field) and fourteen farmers' field) were surveyed. Field size covered by black pepper was obtained from zonal agricultural office to determine representative samples. From each site, 10 to 15 plants were taken at random to assess pest prevalence from each of the upper (8 leaves), middle (8 leaves) and lower (8 leaves) layers of the black pepper sampled plant. Moreover, insect pests were collected from selected sites for further identification. A pocket lens (10X), insect collecting nets, camel brush, glass vials and polythene bags were used for collection of insect pests for their proper identification. Some pests were identified in the field using identification keys and some of them were brought to Tepi National Spice Research Center for detail study, using pertinent literature and internet search. Some specimens have been maintained to be identified at a later date.

The insect damage scale was assigned according to Seif and Hillocks (1999) that states very low ($\leq 5\%$), low (6 to 10%), medium (11 to 20%), high (21 to 50%) and very high ($>50\%$) levels. Infestation and damage level from attacked plant leaf/parts were calculated by using the following formula. Infestation per cent = Number of affected sampled leaves/Total number of sampled

leaves \times Hundred (100); Damage level = Area of plant tissue affected/Total area of plant (tissue) \times Hundred (100).

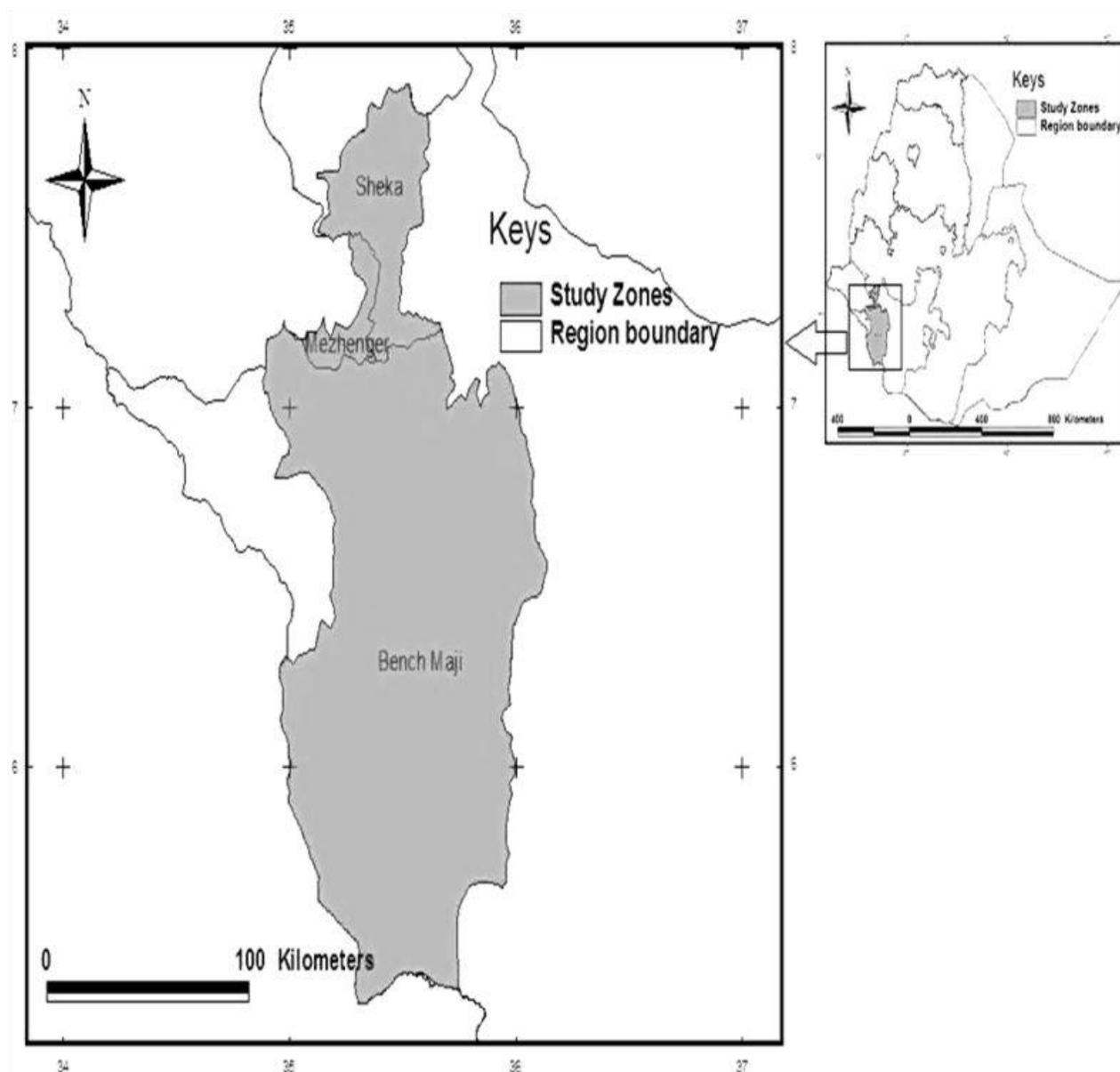
RESULTS AND DISCUSSION

The present survey revealed distribution, infestation, and damage level of insect pests in southwestern part of Ethiopia (Table 2). Twenty two species of insect pest from six orders and one mite pest were recorded causing different infestation and damage levels. Among insect pests recorded were biting black ants (*Tetramorium* species), black pepper flea beetle (*Longitarsus* species), leaf gall thrips (*Liothrips* species), and stink bugs (Pentatomidae) were recorded relatively with high infestation and damage level from all surveyed areas (Figure 2). Insect pests of pepper have been reviewed recently by Devasahayam (2000) as pepper is infested by 56 general species of insects damaging various parts of vines such as root, stem, shoot, leaves, spikes and berries. However, depending on the severity and extent of damage, pollu beetle, top shoot borer, leaf gall thrips and scale insects could be considered as major pests.

Infestation rate of biting black ants was (Guraferda (42.8%), Sheko (35.5%), Goderre (39.2%), and Andracha (Gemadro) (26.2%) and the ant's damage level were high in Guraferda (28.3%), Goderre (23.7%) and Andracha (21.8%). Biting black ants (*Tetramorium* spp.) found with constructed nest mostly between two leaves. Leaves with ants showed wounded and deformed symptoms. Fisseha (2014) also reported that biting black ants cause indirect attack by interfering with normal agronomic practices particularly during harvesting time. Similar to this result, Hill (1983) reported that the ants spread rapidly when disturbed, bite severely and inject formic acid to the wound which cause irritation. Roger and Alain (1993) stated that urticating ant *Tetramorium aculeatum* (Mayr), the biting ant, is an African ant feared by plantation laborers. Similarly, black pepper flea beetle (*Longitarsus* spp.), were recorded with high infestation rate 36.6 and 23.8% damage level in Guraferda, while it caused 20.1% infestation rate in Sheko district. The adults were found damaging fruit and chewing leaves which cause considerable leaf and tender leaf defoliation. Similar to this finding, pollu beetles belonging to Chrysomelidae families are the most destructive pest of black pepper in India (Devasahayam et al., 1988). Verma (1988) also reported that leaf beetles or Chrysomelidae are one of the largest families with diverse species that adapt in a range of ecology. Among insect pests recorded, leaf gall thrips (*Liothrips* spp.) were also found seriously infesting black pepper plants (Guraferda (23.2%) and Godere (28.4%)) (Table 2). Apart from leaf gall, the pest infestation resulted in reduction in size and malformation of infested leaf. Banerjee et al. (1981) also recorded that the leaf thrips were the most pest of black pepper in south Wynad area in Kerala. In addition to the above pests, brown sting bugs were recorded with a high

Table 1. Geographical description of the study areas (CSA, 2007).

Regions	Zones	Geographic location		Altitude (masl)	Temperature (°C)	Rainfall (mm)
		Longitude (N)	Latitude (E)			
SNNPR	Bench-Maji	34.88 to 36.14	5.33-7.21	500 to 2500	15.1-27	400-2000
Gambella	Majang	7.20	35.10	2400-522	15 and 25	1400 and 2200
SNNPR	Sheka	35.24 to 37.90	7.12-7.89	1001-3000	15.1-27.5	1201-1800

**Figure 1.** Map showing the location of zones surveyed for black pepper insect pests.

infestation rate in Yeki (27.1%). However, its damaging and infestation rate are low to medium in other districts. This bug damaged plant parts by sucking plant contents. The infestation and damage level of this insect varied

from district to district (Table 2). McPherson and McPherson (2000) reported that stink bugs (Pentatomidae) and leaf-footed bugs (Coreidae) are important direct pests of many crops which agree with

Table 2. Distribution and infestation level of insect pests of black pepper in Southwestern parts of Ethiopia between 2013 and 2014 cropping season.

Zone	District	Insect pests				Infestation (%)	Damage level (%)
		Order	Family	Species	Common name		
Bench-Mmaji	Guraferda	Coleoptera	Chrysomelidae	<i>Longitarsus</i> spp.	Black pepper flea beetle ****	34.6	23.8
		Homoptera	Cicadellidae	<i>Poecilocardia</i> spp.	Leaf hopper*	3.1	0.4
		Thysanoptera	Phlaeotripidae	<i>Liothrips</i> spp.	Leaf gal trips****	23.2	9.7
		Coleoptera	Chrysomelidae	-	Blue leaf flea beetle*	1.2	0.06
		Hymenoptera	Formicidae	<i>Tetramorium</i> spp.	Biting black ants****	42.8	28.3
		Coleoptera	-	<i>Lophobaris</i> spp.	Black pepper stem borer	-	-
		Orthoptera	Acrididae	<i>Cyrtacanthacris</i> spp.	Brownspotted grasshopper***	18.0	7.8
		Hemiptera	Pentatomidae	<i>Euschistus</i> spp.	Brown sting bug***	15.5	11.6
	Sheko	Orthoptera	Acrididae	<i>Acanthacris</i> spp.	Grasshopper*	2.7	3.6
		Homoptera	Cicadellidae	<i>Poecilocardia</i> spp.	Leaf hopper*	0.6	0.01
		Homoptera	Pseudococcidae	<i>Ferrisia</i> spp.	Mealy bug*	2.1	0.4
		Hemiptera	Pentatomidae	<i>Euschistus</i> spp.	Brown sting bug***	19.3	16.7
		Coleoptera	Chrysomelidae	<i>Longitarsus</i> spp.	pepper flea beetle ***	20.1	13.4
		Hymenoptera	Formicidae	<i>Tetramorium</i> spp.	Biting black ants****	34.5	19.1
Hemiptera		Pyrrhocoroidea	<i>Dysdercus</i> spp.	Brown long bug*	1.2	0.11	
Thysanoptera		Phlaeotripidae	<i>Liothrips</i> spp.	Leaf gal trips**	9.1	4.3	
Majang	Godere	Hemiptera	Miridae	<i>Neurocolpus</i> spp.	Plant bug*	0.4	0.07
		Hemiptera	Pentatomidae	<i>Euschistus</i> spp.	Brown sting bug***	11.1	4.1
		Lepidoptera	Geometridae	<i>Ascotis</i> spp.	Caterpillar) *	0.3	0.67
		Coleoptera	Chrysomelidae	<i>Longitarsus</i> spp.	Black pepper flea beetle **	8.8	5.3
		Homoptera	Cicadellidae	<i>Poecilocardia</i> spp.	Leaf hopper*	0.1	0.01
		Heteroptera	Coreidae	<i>Leptoglossus</i> spp.	Leaf-footed plant bug*	4.1	2.3
		Thysanoptera	Phlaeotripidae	<i>Liothrips</i> spp.	Leaf gal trips****	28.45	16.2
		Orthoptera	Acrididae	<i>Cyrtacanthacris</i> spp.	Brownspotted grasshopper***	17.4	12.4
		Hymenoptera	Formicidae	<i>Tetramorium</i> spp.	Biting black ants****	39.2	23.7
		Sheka	Yeki	Coleoptera	Chrysomelidae	-	Small spotted leaf beetle***
Hymenoptera	Formicidae			<i>Tetramorium</i> spp.	Biting black ants**	18.5	8.7
Orthoptera	Acrididae			<i>Cyrtacanthacris</i> spp.	Brownspotted grasshopper****	17.8	12.2
Homoptera	Cicadellidae			<i>Poecilocardia</i> spp.	Leaf hopper*	0.3	1.1
Coleoptera	Chrysomelidae			<i>Longitarsus</i> spp.	Black pepper flea beetle ****	24.1	6.5
Homoptera	-			<i>Toxoptera</i> spp.	Black pepper aphids	6.7	3.2
Acarina	Eriophyidae			<i>Oligionychus</i> spp.	Red mite*	0.1	0.01

Table 2. Contd.

	Hemiptera	Pentatomidae	<i>Euschistus</i> spp.	Brown sting bug****	27.1	13.5
	Isoptera	Termitidae	<i>Macrotermes</i> spp.	Termite*	-	-
	Heteroptera	Coreidae	<i>Leptoglossus</i> spp.	Leaf-footed plant bug*	0.4	3.2
	Homoptera	Coccidae	<i>Lepidosaphes</i> spp.	Soft brown scale*	0.9	0.02
	Thysanoptera	Phlaeotripidae	<i>Liothrips</i> spp.	Leaf gal trips***	19.7	13.6
	Homoptera	Coccidae	<i>Lepidosaphes</i> spp.	Soft brown scale*	1.8	0.73
	Hymenoptera	Formicidae	<i>Tetramorium</i> spp.	Biting black ants****	26.2	21.8
	Homoptera	Cicadellidae	<i>Poecilocarda</i> spp.	Leaf hopper*	0.05	0.02
Andracha	Orthoptera	Acrididae	<i>Catantops</i> Spp.	Green grasshopper**	9.2	2.4
	Coleoptera	Chrysomelidae	<i>Longitarsus</i> spp.	Black pepper flea beetle ***	14.8	9.3
	Orthoptera	Acrididae	<i>Cyrtacanthacris</i> spp.	Brown grasshopper***	19.1	15.75
	Hemiptera	Pentatomidae	<i>Euschistus</i> spp.	Brown sting bug***	16.9	12.2
	Isoptera	Termitidae	<i>Macrotermes</i> spp.	Termite*	-	-
	Thysanoptera	Phlaeotripidae	<i>Liothrips</i> Spp.	Leaf gal trips***	18.6	6.2
	Coleoptera	Chrysomelidae	-	Small spotted leaf beetle*	0.3	0.04

The infestation and damage of biting ants (black ants) were recorded in terms of nest constructed and leaf wounded due to ants. Key: - Very low ($\leq 5\%$) =*, low (6-10%) = **, medium (11-20%) =***, high (21-50%) =****level.

current finding. Adults and nymphs suck the plant sap particularly younger plant resulting in discoloration and causing the vine to die. Aldrich et al. (1991) recorded both sexes of stink bugs and the nymphs cause damage by their feeding. Black pepper stem bores (*Lophobaris* species) were also found seriously injuring black pepper plant at Gurafereda (Bebeka). However, this pest was not observed in other areas during survey time. Girma (2015), field observations also confirm that this pest is becoming a serious issue at Bebeke State farm.

Similarly, brown spotted grasshopper (*Cyrtacanthacris* species), leaf hopper (*Poecilocarda* species), termite (*Macrotermes* species) and small spotted leaf beetle were widely distributed in all surveyed areas infestation and damage level were low to medium (Table 2).

These pests occurred with low infestation and damage level included: brown grasshopper (*Acrida* species), mealy bug (*Ferrisia* species), scale insects, leaf-footed plant bug, plant bug (*Neurocolpus* species), and black pepper aphids. These pests, which are found to be very low to medium infestation and damage level, may become serious pests in future due to environmental fluctuation and pest dynamism behaviors.

In addition to insect pests, different natural enemies were observed on black pepper which included different flies (Diptera: Syrphidae species), bugs (Hemiptera: Reduviidae species), lady beetles (Coccinellidae species), green lacewings (Chrysopidae species), spiders (Salticidae and Thomisidae species), wasps (Vespidae and Braconidae species) and praying

mantids during survey period.

Conclusions

The survey provided some clues to understand distribution, infestation and importance of insect pests on black pepper in southwestern Ethiopia. From this survey, it can be concluded that the insects which were the most distributed and recorded with high infestation rate and damaging level could be categorized as major insect pests. These pests are biting black ants (*Tetramorium* spp.), black pepper flea beetles (*Longitarsus* spp.), leaf gall thrips (*Liothrips* spp.), and stink bugs (Pentatomidae spp.). The brown spotted grasshoppers (*Cyrtacanthacris* spp.) and leaf hoppers (*Poecilocarda* spp.) could be categorized



Figures 2. Throughout the survey, the major insect pests observed on black pepper.

Note: A = Black pepper flea beetles (*Longitarsus* spp), B = Leaf gal trips (*Liothrips* spp), C = Brown sting bug (*Euschistus* spp), D = Biting black ants (*Tetramorium* spp), E = Black pepper stem borer (*Lophobaris* spp)

as intermediate pests because they were the second most important insect pests in the surveyed areas. Termites (*Macrotermes* spp.) and small spotted leaf beetles, brown grasshoppers (*Acrida* spp.), mealy bugs (*Ferrisia* spp.), scale insects, leaf-footed plant bugs, plant bugs (*Neurocolpus* spp.), and black pepper aphids are considered as minor pests. Even though some of them were widely distributed over all surveyed areas, the very low infestation rate caused less damage. Black pepper stem borers (*Lophobaris* spp.) were recorded causing high damage level at Bebeke State farm only during survey time; therefore, other locations need to be surveyed in detail. Currently, insect pests recorded as major insect pests needed emphasis for development of suitable monitoring and management technique, while regular survey is important to access potential insect pest, because there is the probability for the current minor pest become major insect pest in the future. Farmers need awareness about these pests and follow appropriate cultural practice.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

ACKNOWLEDGEMENTS

The author expresses sincere thanks to Gamadiro State farm, Bebeke State farms and Teppi State farm for their permission during insect record. They acknowledge Ato Fikire Dubele (technical assistant) for his support during data collection. The study was financially supported by the Ethiopian Institute of Agricultural Research (EIAR).

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