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Research Article

GEOGRAPHICAL DISTRIBUTION OF SOUTH AMERICAN TOMATO LEAF MINER *TUTA ABSOLUTA* (MEYRICK, 1917) (LEPIDOPTERA: GELECHIIDAE) IN NEPAL.

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ABSTRACT

South American tomato leaf miner, *Tuta absoluta* (Meyrick, 1917) (Lepidoptera: Gelechiidae) is an invasive insect pest of tomato (*Lycopersicon esculentum* Miller) both in field and controlled environment conditions. *T. absoluta* is native to South America, it was detected first time in Nepal from Kathmandu during May, 2016. Survey was conducted at 46 locations of 31 districts in terai and mid hills of Nepal during February to June 2018. *T. absoluta* was detected from 45 locations of 30 districts surveyed. *T. absoluta* which was detected from Kathmandu, Lalitpur, Bhaktapur, Kavre and Dhading districts in 2016 has now been spread into 33 districts across the Nepal. Apart from 33 districts *T. absoluta* might be present in other districts which were not surveyed during the study. Farmers generally manage *T. absoluta* through indiscriminate use of chemical pesticides. So, extensive research is needed in future to develop integrated pest management technique which is suitable and sustainable for its management in Nepalese context.

Key words: *Tuta absoluta*, survey, distribution, tomato leaf miner.

INTRODUCTION

South American tomato leaf miner, *Tuta absoluta* (Meyrick, 1917) (Lepidoptera: Gelechiidae) is a harmful insect pest of tomato (*Lycopersicon esculentum* Miller) both in field and controlled environment conditions. *T. absoluta* is typically an invasive insect pest due to its ability to develop very quickly into suitable agro-ecological conditions, spreading rapidly in newly invaded area causing sizeable damage and economic loss (Desneux *et al*., 2010). The insect is multivoltine species with a high reproductive potential which allows the pest population to increase very rapidly.

T. absoluta is native to South America was first described as *Phthorimaea absoluta* (Meyrick, 1917) from Peru, and considered one of the key pest of tomato since 1964 (Gracia and Espul, 1982). Following its first detection out of South America in eastern Spain in 2006 (Urbaneja *et al.*, 2007), the pest has spread into Europe, North Africa, and Middle East

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very rapidly (Grazia *et al*., 2012). In South Asia, this pest has been reported from India in 2014 (Shashank *et al.,* 2014) and Bangladesh in 2016 (Hossain *et al.*, 2016). *T. absoluta* was recorded for first time in Nepal from Kathmandu in May, 2016 and found spread into tomato growing areas of Kathmandu valley and surrounding areas (Bajracharya *et al*., 2016). Nepal is a country with diverse climatic conditions from tropical to alpine due to its altitudinal differences with elevations ranging from less than 100 meters to 8848 meters above sea level. Tomato is cultivated in 20,046 ha with production of 386,824.6 mt and productivity of 19.3 mt in different altitudes and climates in Nepal (MOAD, 2016). *T. absoluta* has a high capacity to adapt to wide range of temperatures with different average developmental periods at different temperatures: 76.3 days at 14^{o}C, 39.8 days at 19.7^{o}C and 23.8 days at 27.1^{o}C (Barrientons *et al.*, 1998). It is essential to know geographical distribution of *T. absoluta* within the country after introduction in Nepal. Considering this fact survey was conducted in major tomato growing areas of 31 districts in Nepal. This paper highlights on distribution pattern of *T. absoluta* within the country with its severity of infestations, which will be useful for researchers, policy makers, students and other concerned people for its various studies, management and program development in future.

MATERIALS AND METHODS

Survey was conducted at 46 locations of 31 districts in Terai and mid hills of Nepal to check the presence of *T. absoluta*. The survey was conducted from February to June 2018. Visual observation was made at each site for damage symptoms of *T. absoluta* in leaves, apical stems and fruits of tomato plants. When the damage symptoms were detected, larvae of the insect was collected and observed with hand lens in field. Once larvae were confirmed as *T. absoluta*, sample of larvae along with leaves and apical stems were collected. These samples were brought to Entomology Division laboratory for further confirmation under binocular microscope, BestScope BS-3040B and BS-3040T. These larvae were observed under stereo microscope for presence of prothoracic shield behind head for confirmation as *T. absoluta* larvae. Presence of a dark distinct prothoracic shield just behind the head of larvae of *T. absoluta*, which differentiates from larvae of *Keiferia lycopersicella* (tomato pin worm) externally (ChemTica International, 2018).The larvae were reared into adult moths in plastic rearing boxes with dimensions of 18.7 cm X 12.6 cm X 7.8 cm at laboratory condition. These adult moths were used for external morphology study to confirm as *T. absoluta* on the basis of CAPS identification aid (CAPS, 2010). These adult moths were preserved in butter paper envelops in Entomology Division for future study. GPS coordinates and altitudes were recorded with GARMIN (GPS map 62sc) from each site. The GPS coordinates were used to prepare *T. absoluta* distribution map in Google Earth Pro.

At each site, five random tomato plants were selected and observed for total number of leaves, apical stems and fruits were recorded. Similarly, number of infested leaves, apical stems and fruits were recorded and percent infested leaves, apical stems and fruits were calculated. Percent infested plants were calculated from 10 random tomato plants at each

site. Tomato growing season, date of appearance of *T. absoluta*, management practices followed and pesticides used by farmers were also recorded during the survey.

RESULTS AND DISCUSSION

T. absoluta was detected from 45 locations of 30 districts out of 46 locations of 31 districts on tomato plants from farmers' field surveyed. The insect and its damage symptoms were not observed from Lakadigarh region of Rupandehi district. Various stages of *T. absoluta* detected from 45 locations of 30 districts along with GPS coordinates and elevations are given in table 1. Larvae of *T. absoluta* were detected from 45 locations of 30 districts; however adult moths were observed only from 16 locations of 14 districts during survey. Larvae collected from all locations were reared in Entomology Division, NARC. Adult moths emerged from larvae of 45 locations of 30 districts confirmed as *T. absoluta* after studying external morphology on the basis of CAPS identification aid.

During interaction with farmers and pesticide traders of Lakadigarh region of Rupandehi district, it was known that farmers were spraying insecticide Allcora® (Chlorantraniliprole 18.5% SC) twice a week for controlling insect pests in tomato crop. On the basis of damage symptoms and live larvae on leaf, bud and fruits, Chlorantraniliprole 18.5% was very effective insecticide to manage *T. absoluta* in tomato (Bajracharya *et al.*, 2017; Sridhar *et al.*, 2016). This could be one of possible reasons behind absence of *T. abolsuta* and its damage at Lakadigarh region of Rupandehi district during the survey.

A detection survey conducted during May to June 2016 in Kathmandu, Lalitpur, Bhaktapur Kavre and Dhading, districts: *T. absoluta* was detected from all five districts (Bajracharya *et al.*, 2016). Thus in total *T. absoluta* has been confirmed from 33 districts of Nepal (30 districts from present survey and Kathamandu, Lalitpur, Bhaktapur from previous survey). A total of 17 locations were surveyed during 2016 and *T. absoluta* was found from 14 locations (Bajracharya *et al.*, 2016). The insect was absent at Benighat of Dhading district during 2016 but found in 2018 survey. *T. absoluta* which was confined to Kathmandu valley and its vicinity during 2016, have spread into nearly whole country from east to west in 2018. Apart from above mentioned 33 districts *T. absoluta* might be present in other districts which were not surveyed during the study. Distribution and detection of *T. absoluta* at various locations of different district in Nepal is depicted in Figure 1.

Percent plant, leaf, fruit and apical stem infestation by *T. absoluta* and tomato varieties cultivated at various locations of different district in Nepal is shown in Table 2. Srijana is most popular variety in mid hill districts and mostly cultivated under polyhouse. Local varieties like Purbe chiuri and Lapsi were popular in eastern terai region. These varieties were generally cultivated in open field condition in winter season without staking. Other varieties found cultivated in various loations across the country were; Kabita, Trishul, Surya, Himsona, Manisha, Vaishnavi 2082, Mintu F-1, Madhavi, CERES, Amita, Samjhana, Sirish, Abees, UN hybrid and some unknown local varieties. Percent plant

infestation in different locations ranged from five to 100 percent. Insect infestation was not observed in Lakadigarh region of Rupandehi district. Lowest percent infestation was found at Bhauratar of Parsa and Rampur of Chitwan where tomato plants were well organized under supervision of agriculture officer and scientist. However, in most of the locations, 100 percent plants were found infested with *T. absoluta*. Percent leaf and apical stem infestation was found ranged between zero to 100 percent. Percent fruit infestation ranged between zero to 96.67 percent in different locations.

Season of tomato cultivation, date of appearance of *T. absoluta* and management options applied at various locations of different districts are given in Table 3. In hills tomato was generally cultivated form March to September. Whereas, tomato was cultivated during winter season in terai from September to April. Farmers from Kaski district and Roshi area of Kavre districts were cultivating tomato throughout the year. According to farmers of Dhankuta, Nuwakot and Salyan *T. absoluta* infestation was observed from 2016 tomato season. However, farmers from 14 locations surveyed thought *T. absoluta* infestation initiated from 2017. Similarly, farmers from 15 locations surveyed found *T. absoluta* infestation only form 2018 tomato season. Fourteen farmers surveyed did not know about the *T. absoluta* infestation however, insect infestation was present in their field.

Most of the farmers applied various chemical insecticides to manage *T. absoluta* infestation. Commercial lures of male sex pheromone to attract and trap male moths was found practiced by farmers in Kavre, Sindhuli, Kaski and Dang districts. Kavre, Sindhuli and Kaski farmers were using WOTA-T trap with pheromone lure whereas, farmers from Dang used yellow sticky paper as trap along with pheromone lure. Farmers form Bardiya and Udaypur also applied various fermented plant extract in cow urine for management of *T. absoluta*. Emamectin benzoate and Cypermethrin were mostly used chemical insecticide against *T. absoluta*. Other insecticides used against *T. absoluta* were, Chloropyrifos, Dimethoate, Imidacloprid, Deltamethrin, Acetamiprid, Flonicamid, Flubendiamide, Malathion and Neem (Azadirachtin). Chlorantraniliprole and Spinosad were found used only at two locations which are recommended insecticide for *T. absoluta* management in Nepal.

Table 1. Occurence of *Tuta absoluta* at various locations in different districts during 2018.

SN	Districts	Locations	GPS Coordinates		Altitude (m asl)	Stages detected*
			Latitude	Longitude		
1	Jhapa	Kankai municipality-2	N 26°40.265'	E 87°53.270'	106	A, L
2	Morang	Biratnagar municipality - 8	N 26°26.354'	E 87°17.445'	54	L
3	Sunsari	Bokhraha, Dhok -1	N 26°38.848'	E 87°06.139'	74	A, L
4	Dhankuta	Guthitar	N 26°57.943'	E 87°19.284'	645	L
5	Saptari	Rajbiraj -9	N 26°33.869'	E 86°44.571'	76	L
6	Saptari	Amaha, Khadak - 4	N 26°39.492'	E 86°34.812'	102	L
7	Udayapur	Lalpatta, Khar-6	N 26°46.793'	E 86°34.186'	134	L
8	Udayapur	Bagaha, Triyoga-4	N 26°47.517'	E 86°39.997'	152	L
9	Siraha	Garjana - 11	N 26°51.725'	E 86°11.602'	103	L
10	Siraha	Dhangadimai municipality - 7	N 26°46.965'	E 86°21.568'	126	L
11	Dhanusa	Hardinath	N 26°48.185'	E 85°57.700'	77	L
12	Dhanusa	Naktajhijha Kushawaha chowk	N 26°52.425'	E 85°56.868'	104	L
13	Dhanusa	Majhitole - 10	N 26°58.677'	E 85°55.575'	199	L
14	Mahottari	Maisthan	N 27°00.811'	E 85°51.987'	216	L
15	Mahottari	Nayatole - 4	N 27°01.247'	E 85°52.179'	223	L
16	Sarlahi	Lalbandi	N 27°04.398'	E 85°35.114'	121	L
17	Sarlahi	Bagmati - 2	N 27°06.286'	E 85°30.972'	119	L
18	Bara	Tangiya Basti -16	N 27°08.802'	E 85°07.936'	119	L
19	Parsa	Bhauratar, Bahudharamai- 5	N 27°05.530'	E 84°49.729'	64	L
20	Sindhuli	Sunkoshi -3	N 27°24.899'	E 85°52.947'	512	L
21	Sindhuli	Kamalamai- 8	N 27°09.797'	E 85°54.187'	459	A, L
22	Makawanpur	Khaireni, Sanantar	N 27°27.728'	E 84°54.654'	344	L
23	Makawanpur	Manahari-6	N 27°28.003'	E 84°52.942'	333	A, L

SN	Districts	Locations	GPS Coordinates		Altitude (m asl)	Stages detected*
			Latitude	Longitude		
24	Kavre	Rosi-7	N 27°31.366'	E 85°41.501'	844	A, L
25	Chitwan	Bhandhara	N 27°35.445'	E 84°38.566'	201	A, L
26	Chitwan	Rampur	N 27°39.030'	E 84°21.123'	170	A,L
27	Nuwakot	Jurethum	N 27°49.786'	E 85°12.602'	1500	L
28	Ddhading	Simle	N 27°45.165'	E 85°02.902'	573	A, L
29	Ddhading	Benighat	N 27°48.180'	E 84°44.661'	307	L
30	Gorakha	Nibel, Bhimsen Gaonpalika - 1	N 28°02.906'	E 84°39.099'	481	A, L
31	Tanahu	Abukhaireni Gaonpalika-2	N 27°55592'	E 84°28.962'	351	L
32	Tanahu	Patan, Byas Nagarpalika	N 27°58.356'	E 84°15.554'	304	L
33	Lamjung	Pangrephat	N 28°06.713'	E 84°26.640'	604	A, L
34	Kaski	Buddhatole, Lekhanath - 27	N 28°10.244'	E 84°02.742'	741	A, L
35	Kaski	Hemja	N 28°16.644'	E 83°55.628'	1071	A, L
36	Syangja	Rakshe, Waling - 2	N 27°59.520'	E 83°48.280'	777	A, L
37	Parbat	Kusma	N 28°15.447'	E 83°43.194'	830	A, L
38	Nawalparasi	Hupsekot-3	N 27°40.857'	E 84°03.720'	216	L
39	Rupandehi	Lakadigarh,	N 27°31.002'	E 83°18.749'	82	N
40	Kapilbastu	Buddhabhumi Nagarpalika - 10	N 27°34.589'	E 83°00.522'	85	L
41	Kapilbastu	Gopalpur	N 27°33.713'	E 83°00.857'	83	L
42	Dang	Masine	N 28°03.003'	E 82°30.771'	681	A, L
43	Salyan	Kapurkot - 3	N 28°13.591'	E 82°21.597'	1584	L
44	Bardiya	Bansagadhi Nagarpalika	N 28°14.069'	E 81°32.159'	148	L, A
45	Bardiya	Bansagadhi Nagarpalika - 6	N 28°14.607'	E 81°30.601'	144	L
46	Kailali	Ghodaghodi - 8	N 28°43.484'	E 81°00.524'	190	L

*L : Larva, A : Adult N: Not observed

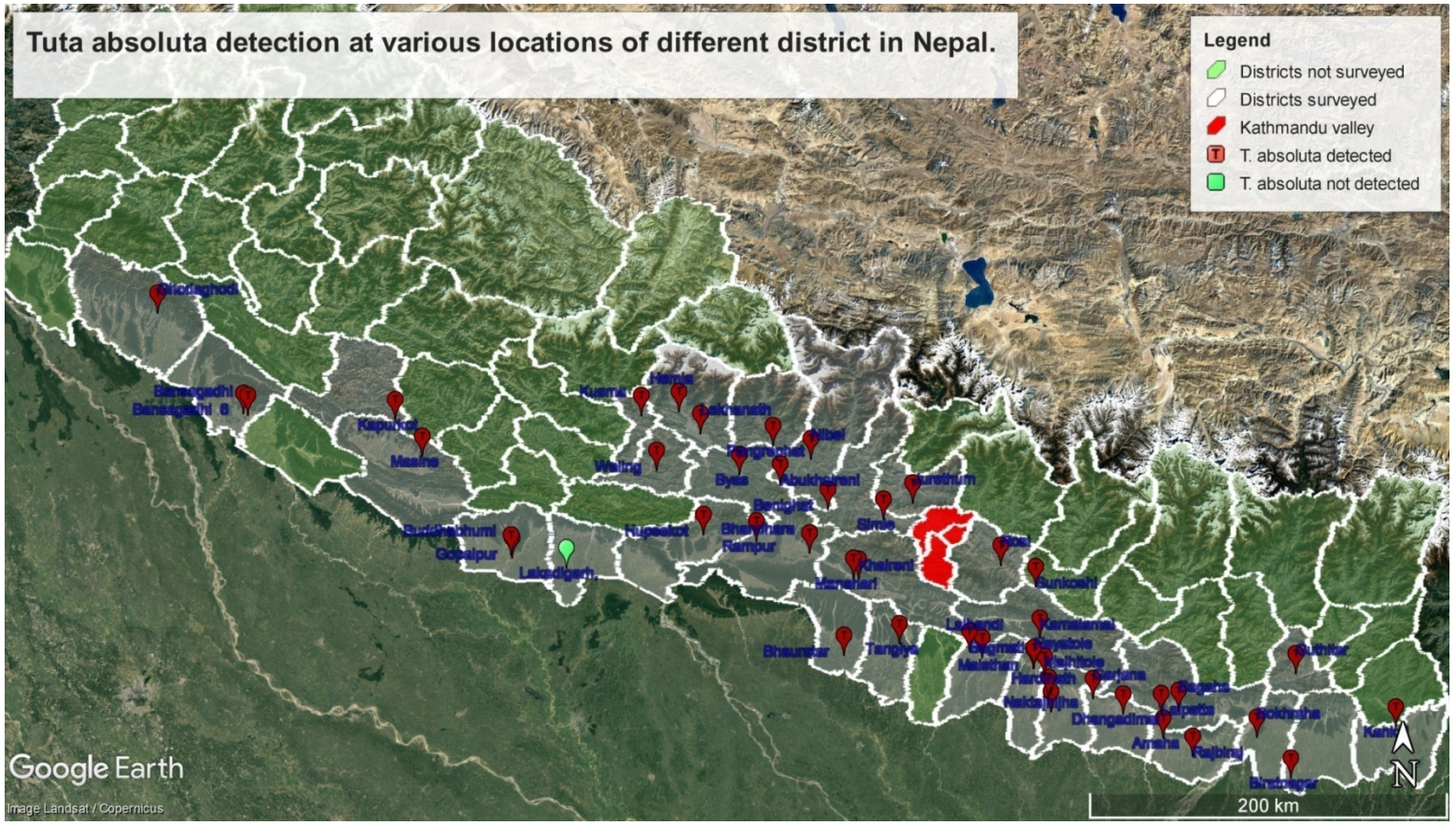

Fig. 1 : Distribution and detection of *Tuta absoluta* at various locations of different districts in Nepal.

Table 2. Percent plant, leaf, fruit and apical stem infestation by *Tuta absoluta* and tomato varieties cultivated.

SN	District	Location	Variety	Plant infestation (%)	Leaf infestation (%)	Fruit infestation (%)	Apical stem Infestation(%)
1	Jhapa	Kankai municipality-2	Trishul	100.00	50.89	9.51	78.50
2	Morang	Biratnagar municipality - 8	Purbe chiuri	100.00	52.62	11.22	57.39
3	Sunsari	Bokhraha, Dhok -1	Trishul	100.00	100.00	61.47	97.78
4	Dhankuta	Guthitar	Srijana	25.00	12.00	5.00	14.00
5	Saptari	Rajbiraj -9	UN hybrid	100.00	66.25	38.43	89.50
6	Saptari	Amaha, Khadak - 4	Pusa ruby	100.00	100.00	96.67	100.00
7	Udayapur	Lalpatta, Khar-6	Srijana	100.00	45.31	36.21	64.51
8	Udayapur	Bagaha, Triyoga-4	Mintu F-1	100.00	48.17	12.63	84.44
9	Siraha	Garjana - 11	Local variety	100.00	57.96	8.03	66.88
10	Siraha	Dhangadimai municipality - 7	Local variety	100.00	49.29	6.28	57.22
11	Dhanusa	Hardinath	NA	100.00	45	5.12	34.90
12	Dhanusa	Naktajhijha Kushawaha chowk	Vaishnavi 2082 F-1	100.00	60.25	14.83	78.71
13	Dhanusa	Majhitole - 10	Srijana	100.00	37.78	17.14	75.99
14	Mahottari	Maisthan	NA	25.00	4.23	0.00	10.12
15	Mahottari	Nayatole - 4	Purbe chiuri	25.00	1.92	0.00	13.79
16	Sarlahi	Lalbandi	Purbe chiuri	100.00	43.94	0.00	77.33
17	Sarlahi	Bagmati - 2	Lapsi, Purbe chiuri	15.00	10.54	0.00	5.33
18	Bara	Tangiya Basti -16	Purbe chiuri	50.00	23.62	0.00	37.12
19	Parsa	Bhauratar, Bahudharamai- 5	Himsona	5.00	0.00	0.00	0.00
20	Sindhuli	Sunkoshi -3	Srijana	80.00	26.28	0.00	25.36
21	Sindhuli	Kamalamai- 8	Kabita, Surya 111	100.00	67.20	40.33	58.12
22	Makawanpur	Khaireni, Sanantar	NA	12.00	18.23	0.00	30.28
23	Makawanpur	Manahari-6	Kabita, Surya 111	100.00	18.27	0.00	24.65

SN	District	Location	Variety	Plant infestation (%)	Leaf infestation (%)	Fruit infestation (%)	Apical stem Infestation(%)
24	Kavre	Rosi-7	Srijana, Doctor 3	100.00	75.22	0.00	65.00
25	Chitwan	Bhandhara	Surya 111	100.00	62.33	0.00	25.00
26	Chitwan	Rampur	Srijana	5.00	6.76	0.00	0.00
27	Nuwakot	Jurethum	Srijana	40.00	30.00	12.00	25.00
28	Ddhading	Simle	Lapsi	100.00	24.11	62.95	61.88
29	Ddhading	Benighat	LocalManakamana	30.00	16.21	5.00	10.32
30	Gorakha	Nibel, Bhimsen Gaonpalika - 1	Srijana	100.00	100.00	100.00	100.00
31	Tanahu	Abukhaireni Gaonpalika-2	Kabita	100.00	49.06	12.29	93.80
32	Tanahu	Patan, Byas Nagarpalika	CERES	10.00	3.67	24.44	12.38
33	Lamjung	Pangrephat	Madhavi	30.00	14.34	3.33	23.33
34	Kaski	Buddhatole, Lekhanath - 27	Amita	50.00	23.64	4.98	35.82
35	Kaski	Hemja	Srijana, Purna	20.00	17.71	0.00	0.00
36	Syangja	Rakshe, Waling - 2	Manisha	100.00	100.00	67.46	100.00
37	Parbat	Kusma	Samjhana, Surya	100.00	17.96	4.55	33.33
38	Nawalparasi	Hupsekot-3	Srijana	25.00	6.65	4.55	9.38
39	Rupandehi	Lakadigarh,	Himsona	0.00	0.00	0.00	0.00
40	Kapilbastu	Buddhabhumi Nagarpalika - 10	Local	25.00	8.38	33.33	21.31
41	Kapilbastu	Gopalpur	NA	30.00	7.87	20.00	12.32
42	Dang	Masine	Sirish	10.00	13.44	2.22	15.00
43	Salyan	Kapurkot - 3	Himsona	35.00	24.11	16.67	8.33
44	Bardiya	Bansagadhi Nagarpalika	Local	15.00	23.76	7.98	6.98
45	Bardiya	Bansagadhi Nagarpalika - 6	Abees	20.00	25.90	12.56	9.87
46	Kailali	Ghodaghodi - 8	Manisha	30.00	35.92	25.00	44.44

Table 3. Season of tomato cultivation, date of appearance of *T. absoluta* and management options applied.

SN	District	Location	Season of Tomato cultivation	Date of appearance of *Tuta*	Management options used	Chemicals used
1	Jhapa	Kankai municipality-2	November – May	2017	N	N
2	Morang	Biratnagar municipality - 8	January – June	NK	N	N
3	Sunsari	Bokhraha, Dhok -1	January – June	2018	N	N
4	Dhankuta	Guthitar	March - September	2016	C	Cypermethrin
5	Saptari	Rajbiraj -9	October –May	NK	N	N
6	Saptari	Amaha, Khadak - 4	October – May	2018	C	Imidacloprid, Cypermethrin
7	Udayapur	Lalpatta, Khar-6	September – April	NK	N	N
8	Udayapur	Bagaha, Triyoga-4	September – April	2018	C, B	Dimethoate, Malathion
9	Siraha	Garjana - 11	October – May	2018	C	N
10	Siraha	Dhangadimai municipality - 7	October – May	NK	N	N
11	Dhanusa	Hardinath	October – May	NK	N	N
12	Dhanusa	Naktajhijha Kushawaha chowk	October – May	2018	C	Dimethoate, Emamectin benzoate, Flonicamid
13	Dhanusa	Majhitole - 10	September – April	2018	N	N
14	Mahottari	Maisthan	September – April	NK	N	N
15	Mahottari	Nayatole - 4	September – April	NK	N	N
16	Sarlahi	Lalbandi	September – April	2018	C	Cypermethrin
17	Sarlahi	Bagmati - 2	September – April	NK	C	Cypermethrin + Chlorpyrifos
18	Bara	Tangiya Basti -16	September – April	2018	C	N
19	Parsa	Bhauratar, Bahudharamai- 5	January – June	2018	C	Cypermethrin
20	Sindhuli	Sunkoshi -3	March - September	2017	PT, C	Imidacloprid, Emamectin benzoate.
21	Sindhuli	Kamalamai- 8	March – September	2017	N	N

SN	District	Location	Season of Tomato cultivation	Date of appearance of *Tuta*	Management options used	Chemicals used
22	Makawanpur	Khaireni, Sanantar	September – April	2017	N	N
23	Makawanpur	Manahari-6	September – April	2017	C	Deltamethrin
24	Kavre	Rosi-7	October – May March – September	2017	PT	N
25	Chitwan	Bhandhara	October – May	2018	C	Various insecticides
26	Chitwan	Rampur	October – May	2017	C	Chlorantraniliprole, Spinosad
27	Nuwakot	Jurethum	March – September	2016	C	Cypermethrin +Chloropyrifos
28	Ddhading	Simle	March – September	2018	N	N
29	Ddhading	Benighat	March – September	NK	N	N
30	Gorakha	Nibel, Bhimsen Gaonpalika - 1	March – September	2018	N	N
31	Tanahu	Abukhaireni Gaonpalika-2	February – June	2018	C	Emamectin benzoate
32	Tanahu	Patan, Byas Nagarpalika	February – June	NK	C	Emamectin benzoate
33	Lamjung	Pangrephat	March – September	2017	C	Emamectin benzoate
34	Kaski	Buddhatole, Lekhanath - 27	October - May March – September	2018	PT, C	Lava plus
35	Kaski	Hemja	October – May March – September	2017	PT, C	Lava plus
36	Syangja	Rakshe, Waling - 2	February – June	2018	C	Acetamiprid
37	Parbat	Kusma	October – May	2017	C	Lava plus
38	Nawalparasi	Hupsekot-3	September – April	NK	N	N
39	Rupandehi	Lakadigarh,	January – June	NK	C	Chlorantrniliprole
40	Kapilbastu	Buddhabhumi Nagarpalika - 10	November – June	NK	N	N
41	Kapilbastu	Gopalpur	November – June	NK	N	N

SN	District	Location	Season of Tomato cultivation	Date of appearance of *Tuta*	Management options used	Chemicals used
42	Dang	Masine	September – April March – September	2017	PTY, C	DDVP, Emamectin benzoate, Neem
43	Salyan	Kapurkot - 3	March – September	2016	C	Chloropyrifos
44	Bardiya	Bansagadhi Nagarpalika	October – May	2017	N	N
45	Bardiya	Bansagadhi Nagarpalika - 6	October – May	2017	C, B	Flubendiamide
46	Kailali	Ghodaghodi - 8	October – May	2017	C	Neem

NK: Not known, N: not used, PT: Pheromone water trap, PTY: Pheromone yellow sticky, C: Chemicals, B: Botanical cocktails.

T. absoluta which was found infesting tomato cultivation from Kathmandu, Lalitpur, Bhaktapur, Kavre and Dhading districts during 2016 has been spread to 33 districts of hills and terai across the Nepal in 2018. Nearly whole country from east to west in mid hills and terai region has been covered by the insect. Such distribution is also reported from Mediterranean countries where *T. absoluta* spread into 4000 square kilometer area in 5 years of period (Desneux *et al*., 2011). Generally, long range distribution of the insect is possible due to trade of tomato; however, active flight and passive flight through wind are also probable for spreading of *T. absoluta* (Desneux *et al.,* 2011). Tropical and subtropical climatic conditions in mid hills and terai region are also favorable for development and spreading *T. absoluta* across the country.

Farmers are generally managing *T. absoluta* with various chemical pesticides which are not recommended for *T. absoluta* management in Nepal due to lack of awareness about the insect and its recommended management practices. Insect resistance against various insecticides including spinosad, abamectin, methamidophos, bifenthrin, cartap, deltamethrin, diflubenzuron, indoxacarb, permethrin, teflubenzuron and triflumuron had been recorded in South America and elsewhere (Real IPM, 2016). Even high resistance level by Italian population of *T. absoluta* was reported against diamide group of insecticides; chlorantraniliprole and flubendiamaide (Roditakis *et al.,* 2015). Routine, excessive and indiscriminate application of insecticides should be avoided to reduce risk of resistance and health hazard to consumer and farmers. Extensive research is needed in future to develop integrated pest management technique which is suitable and sustainable in Nepalese context for management of the insect.

CONCLUSION

South American tomato leaf miner, *Tuta absoluta* (Meyrick, 1917) native to South America was detected first time in Nepal from Kathmandu during May 2016, has now been spread into 33 districts across the Nepal. Indiscriminate chemical management practiced by farmers has negative impact on ecosystem and human health. Thus research on integrated pest management and creation of awareness among farmers are essential to cope with increasing problem of *T. absoluta* in Nepal.

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