A study of spatial distribution characteristics and chemical control on *Soritia leptalina* in southeast Tibet

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In recent years, *Soritia leptalina* has seriously harmed *Quercus aquifolioides* forest in southeast Tibet. Based on the field investigation and indoor control experiment, this paper analyzed the distribution characteristics of *S. leptalina*, the damage characteristics of *Q. aquifolioides*, and the control effect on the larvae of *S. leptalina* in southeast Tibet. The results showed that the frequency of appearance of *S. leptalina* was 0.85 in the survey plots. There were significant differences in the insect density of different plots, directions, and tree part of *Q. aquifolioides*. In general, the proportions order of leaves in different damage levels of *Q. aquifolioides* was: grade III > grade IV > grade II > grade I = grade 0, and the order of tree leaf damage rates in different directions was: south > east > west > north. The order of leaf damage rate in different tree part was: upper part > lower part > middle part. On the whole, the severely-stressed strain rate of *Q. aquifolioides* forest was 28.69%. Unlike the severely affected strain rate in 8 plots, the rate of severely injured plants in JL was as high as 77.79%. The control effects of the six test agents were different. After 96 hours of application, all the larvae of the test were killed. In short, the *Q. aquifolioides* was seriously damaged, and the pesticide effect was good. Environment-friendly agents could be sprayed, or biological control measures could be taken to control the damage of the *S. leptalina* and achieve sustainable development.

Keywords: *Soritia leptalina*; spatial distribution; chemical control; southeast Tibet.

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Introduction

Soritia leptalina belongs to the Zygaenidae of Lepidoptera and was named in 1844. It was first discovered in India and recorded to distribute in China since 1980s, but only in Motuo and Bomi Counties of Tibet [1-4]. This insect was a new record species discovered in Tibet in 1988. At that time, the morphological characteristics of adults were first described [5-6]. In recent years, we also studied the morphological and biological characteristics of the insects in different stages [7]. It developed one generation per year in Nyingchi region of Tibet. It overwintered as 3rd or 4th instar larvae stage from late October in leaves and branches. In the early March of the next year, the overwintering larvae began to move and feed. The mature larvae made cocoons and pupated from late June to early July. Its adult emergence began in early August with an emergence peak in mid-August. Subsequently, it mated and laid eggs that will hatch in six or seven days after emergence. The adult's emergence and activity were at daytime. It was found that egg-laying usually occurred between 14:00 and 17:00 after the 1st or 2nd day of mating. Its phototaxis was weak and the diet was monophagous (only harming *Q. aquifolioides*). In recent years, the larvae had occurred in large areas in Nyingchi County and Milin County, mainly feeding on the leaves of *Q. aquifolioides*, which seriously affects the photosynthesis of the leaves of *Q. aquifolioides*. At the same time, due to the recession of the growth potential of *Q. aquifolioides*, the secondary pests such as sooty blotch, tumor virus, decay and leaf spot virus were infected, which intensified the death of trees.

Q. aquifolioides is an important species in the evergreen broad-leaved forest in southeast Tibet. It is mainly located in the basins of the Niyang River and the Yarlung Zangbo River, highly germinated and often forms large-area shrubs, which is of great significance to conserving water, maintaining water and soil, increasing forest coverage and establishing a national ecological security barrier system in the eastern Tibetan plateau [8-9]. It is also a popular wood product that facilitates people's production and life [10].

At present, there is no report on the ecological characteristics, damage, and prevention of this pest. Based on field monitoring and indoor tests, this paper specifically studied the spatial distribution, the damage to *Q. aquifolioides*, and the chemical control of *S. leptalina*. The aim of this study is to lay a foundation for the effective control of the pest and to provide a theoretical basis for the renewal, recovery, and management of *Q. aquifolioides*.

Materials and methods

Material sampling area

The study area was the Linzhi county and Milin county of southeast Tibet. The area belongs to typical semi-humid monsoon climate region of plateau temperature zone with wet and dry season being clearly demarcated. The annual rainfall is 600-800 mm. The rainfall from June to September is over 80%. The relative humidity is 50-75%. The mean annual temperature is higher than 7°C with the maximum and minimum daily mean temperatures of 29.2°C and 15.5°C respectively. The frostless period is more than 150 days. The soil type is mainly brown soil or dark brown soil. There are 1,106 wild vascular plants including 1,024 species of angiosperm, 73 species of ferns, and 9 species of gymnosperms. The number of endemic species accounts for a higher percent in the total number of species. The species of plants are mainly *Quercus aquifolioides*, *Lonicera lanceolata*, *Salix oritrepha*, *Spiraea myrtilloedes*, *Cotoneaster obscurus*, *Beris uymbtlliflora*, *Arundinella yunnanensis*, *Lris decora*, *Polygonatum cirrhifolium*, and *Anemone rivularis*.

In the study area, according to the typicality, comprehensiveness, and representativeness of the sample selection, *Q. aquifolioides* and *S. leptalina* were selected as the research objects on the basis of comprehensive investigation. Eight typical sampling plots were determined in study area (Figure 1).

Investigation on the affected *Q. aquifolioides*

Q. aquifolioides was the main species in survey plots and of important ecological and economic value, while *S. leptalina* only fed on *Q. aquifolioides* and brought great harm to it. The geographical features of sampling plots were differed (Table 1).

At each location, the overall damage situation of *Q. aquifolioides* forest was first investigated. The overall distribution of pests in *Q. aquifolioides* was divided into four types of damage: the distribution of individual strain (1-5 strains occurred), block distribution (5 strains in 0.25 ha), flake distribution (0.25-0.5 ha), and large flake distribution (greater than 0.5 ha).

Three quadrats for each location were chosen with the size of a quadrat as 30 × 30 m^2. The damage status of each quadrat was investigated, and the damage level of each quadrat was determined. "No damage" refers to "no damage is found in the leaf of the strain"; "Slight

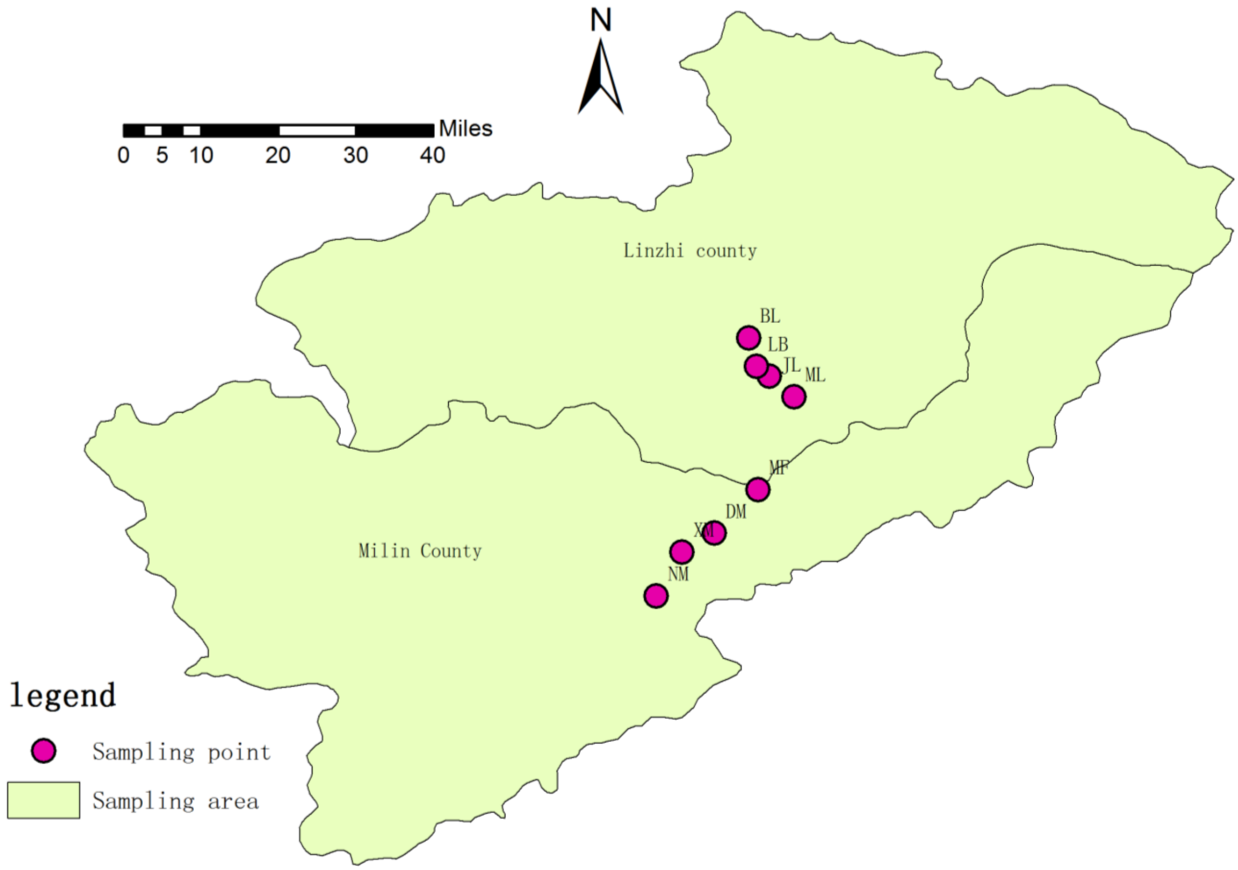

Figure 1. The schematic diagram of study area and sampling plots. (XM= Xueka village of Milin county, MF= Milin farm, NM= Nanyi town of Milin county, DM= Duoka village of Milin county, ML= Mirui town of Linzhi county, JL= Jiemai village of Linzhi county, LB= Linzhi no.2 bridge, BL= Biri mountain of Linzhi county.)

Table 1. The geographical features of sampling plots on *S. leptalina*

Location	Latitude and longitude	Altitude (m)	Slope position	Aspect (°)	Slope (°)	Community canopy
XM	29°14.47′N, 94°15.14′E	2941	under	267	8	0.6
MF	29°21.46′N, 94°23.69′E	2968	under	35	<5	0.6
NM	29°09.54′N, 94°12.28′E	2992	under	86	15	0.7
DM	29°16.57′N, 94°18.78′E	2943	under	177	8	0.5
ML	29°31.86′N, 94°27.75′E	2960	middle and lower	155	23	0.7
JL	29°34.17′N, 94°24.98′E	2990	under	358	<5	0.8
LB	29°35.26′N, 94°23.51′E	2986	under	23	<5	0.8
BL	29°38.45′N, 94°22.67′E	3038	medium	75	37	0.5

Table 2. Toxicity, dosage, and concentration of each agent used in the experiment.

Agent name	Toxicity	Formulation	Recommended concentration/times	Spray concentration/times
25% deltamethrin	Low toxicity	Emulsifiable concentrate	2,000-5,000	3,700
3% acetamiprid	Low toxicity	Emulsifiable concentrate	500-1,500	1,000
25% buprofezin	Low toxicity	Wettable powder	1,000-2,000	1,500
40% toxic silk	Moderate toxicity	Emulsifiable concentrate	800-1,000	900
90% methomyl	High toxicity	Soluble powder	1,000-2,000	1,500
2% thiacloprid	Low toxicity	Microcapsule suspension concentrate	1,000-2,000	1,500

damage" refers to "the leaf damage rate per strain is 1/3 or less"; "Moderate damage" refers to "the leaf damage rate is 1/3-2/3"; and "Serious damage" refers to "the leaf damage rate is 2/3 or larger".

Survey of pest distribution

In order to further investigate the spatial distribution of pests, standard strains (with an average height and average crown strain of the whole quadrat) were selected in each sample plot, which were divided to four directions: east, south, west, and north. Each direction was additionally divided into three parts (upper, middle, and lower). In each direction, 3 twigs with each about 10 cm long were selected randomly in each part for investigation. The number of pests and the damage degree of single leaf and strain were recorded. The degree of damage was divided into five grades with grade 0 referring to the undamaged leaves or not being fed, grade I referring to the leaves with damaged area less than 1/4, grade II referring to the leaves with damaged area greater than 1/4 and less than 1/3, grade III referring to the leaves with damaged area greater than 1/3 and less than 1/2, and grade IV referring to the leaves with damaged area greater than 1/2.

Control experiment

A variety of agents were applied on the leaf-eating pests in *Q. aquifolioides* for control experiment. The comprehensive analysis results of the experiments can provide technical support for large-scale control of the pests. The following agents were used in the experiment: 2% thiacloprid microcapsule suspension concentrate (Jiangxi Tianren Ecological Co., Ji'an, Jiangxi, China), 90% methomyl soluble powder (Zhongxun Chemical Co., Huizhou, Guangdong, China), 25% buprofezin wettable powder (Xiannong Biotechnology Co., Xi'an, Shaanxi, China), 3% acetamiprid emulsifiable concentrate (Runjing Pesticide Factory, Zhaoqing, Guangdong, China), 25% deltamethrin emulsifiable concentrate (Nanjing Red Sun Co., Nanjing, Jiangsu, China), and 40% toxic silk emulsifiable concentrate (Huiguang Chemical Company, Shanghai, China). The above agents were all applied at an intermediate concentration of manufacturers' recommended concentration. The concentrations of all agents are shown in Table 2.

The larvae of *S. leptalina* and the fresh branches of *Q. aquifolioides* from the field were brought back to the laboratory. In the laboratory, the fresh branches of *Q. aquifolioides* were inserted into a beaker or a plastic bottle containing tap water. The larvae of *S. leptalina* collected from the field were moved to fresh branches with the number of insects on each group of branches to be 40. After larvae adapted for one day, the above-mentioned agents were tested. Three groups of branches were applied to various agents with the water as the control. The number of live insects was checked at 1h, 2h, 3h, 7h, 24h, 48h, and 72h after treatment, respectively. The population reduction rate and the correction population decrease rate were calculated [11]. The insect population reduction rate (%) = (Number of insects before application - Number of insects after application) / Number of insects before application × 100%. The corrected rate of decline (%) = (Reduction rate of insects in the treatment area - Reduction rate of insects in the control area) / (1 - Reduction rate of insects in the control area) × 100%.

Results

Distribution characteristics of *S. leptalina*

The spatial distribution pattern and quantitative dynamics of pests are the result of the biological characteristics of the pests themselves and the comprehensive effects of the environment. Finding out its distribution pattern and identifying its quantity dynamics are the basis for its comprehensive management. The distribution pattern of insect population is the positional state or layout of the individual population in their living space, also called the internal distribution type. The spatial distribution pattern of the population can be divided into three types: uniform type, random type, and aggregate type. The aggregate distribution is the most common type in nature. It is mainly the result of insects responding to habitat differences as well as daily and seasonal changes in climate and environment, reproductive patterns, social behavior, nutrients, and other factors. By the analysis of the spatial distribution pattern of *S. leptalina* on *Q. aquifolioides* and the spatial characteristics of the damaged leaves of *Q. aquifolioides*, it is discovered that *S. leptalina* specially hazards *Q. aquifolioides* in southeast Tibet with the aggregate distribution. In the survey sample, the appearance frequency of *S. leptalina* was 0.85.

The density of the larvae of *S. leptalina* in the eight samples of *Q. aquifolioides* was: JL > XM > BL > ML > LB > NM > MF> DM. The average density of the insect population was 1.50 head/twig, 1.34 head/twig, 0.99 head/twig, 0.50 head/twig, 0.25 head/twig, 0.19 head/twig, 0.166 head/twig, and 0.165 head/twig, respectively (Figure 2).

The spatial distribution of *S. leptalina* on *Q. aquifolioides* in southeast Tibet was shown in Figure 3. Generally speaking, the insect density in the west of *Q. aquifolioides* was the highest (0.85 head/twig) followed by the north (0.83 head/twig), the east (0.8 head/twig), and the south (0.5 head/twig). The density of insects in the four directions are quite different mainly due to the influence of sun light and temperature. From the angle of different tree parts, *S. leptalina* was mainly distributed in the upper part and the lower part of *Q. aquifolioides*, and less distributed in the middle part. The density of the larvae at the upper, middle, and lower parts was 1.22 head/twig, 1.18 head/twig, and 0.63 head/twig, respectively.

Spatial characteristics of the affected leaves of *Q. aquifolioides*

The spatial characteristics of the damaged leaves also reflected the spatiotemporal characteristics of *S. leptalina* to a certain extent, and the ratio of leaves at different damage levels in different directions and tree parts of *Q. aquifolioides* also differed much (Figure 4).

Because of habitat difference of *Q. aquifolioides* in 8 sampling plots and the activity difference of *S. leptalina* on the leaves, the degree of damage in different direction was diversified (Figure 4). On the whole, the damage of *Q. aquifolioides* leaves in southeast Tibet was more serious. The leaf damage rate was 85.29% with 14.71% of the leaves was not damaged. The proportions of leaves in different damage levels were 27.81%,

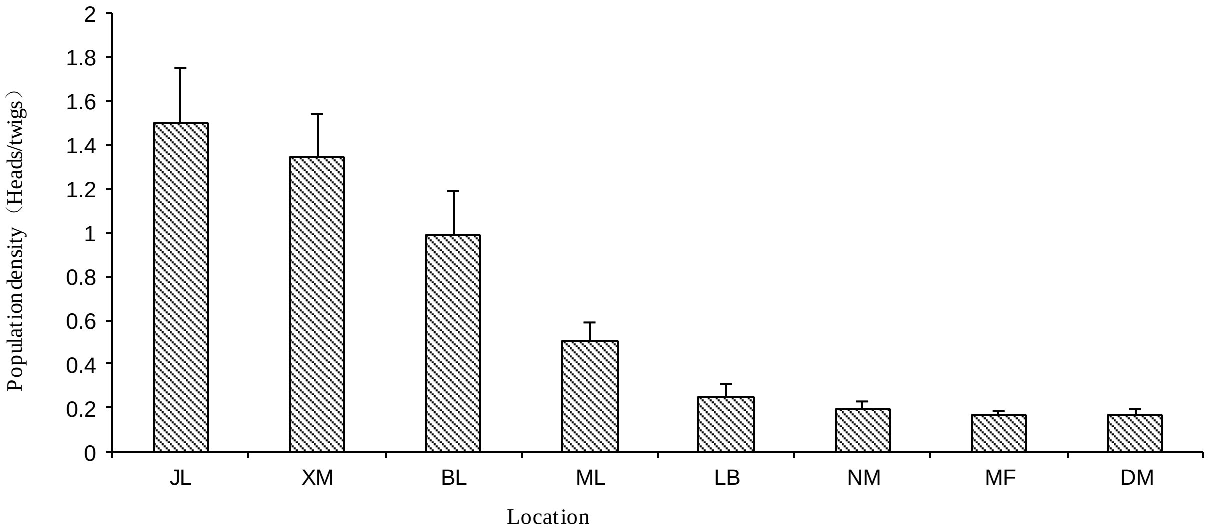

Figure 2. Distribution of *S. leptalina* in southeast Tibet.

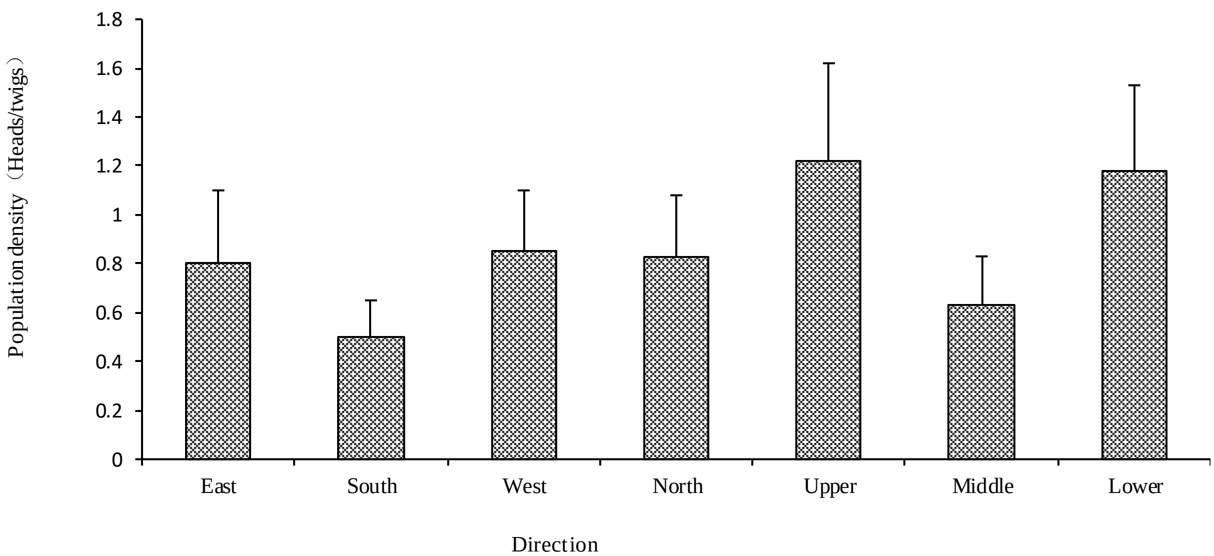

Figure 3. Spatial distribution of *S. leptalina* on *Q. aquifolioides* in southeast Tibet.

24.27%, 18.37%, 14.71%, and 14.71%, respectively with the damage levels of grade III > grade IV > grade II > grade I = grade 0. In the east side of the tree, the leaves of each damage level accounted for a certain proportion with 15.7% of the leaves unaffected. The grade II, IV, and III affected leaves were of 22.95%, 22.46%, and 21.74% respectively while the grade I affected leaves accounted for 17.15%. In the south side of the tree, the most affected leaves were at grade IV (29.37%) followed by grade III (26.11%), and then, grade I (14.69%) and grade II (13.75%). The unaffected leaves accounted for 16.08%. In the west side of the tree, the proportion of undamaged leaves was 15.04% while the grade III and IV damaged leaves were 28.32% and 27.57% respectively comparing to the grade II (16.04%) and grade I (13.03%). In the north side of the tree, 11.65% of the leaves were found undamaged. The grade III damaged leaves were

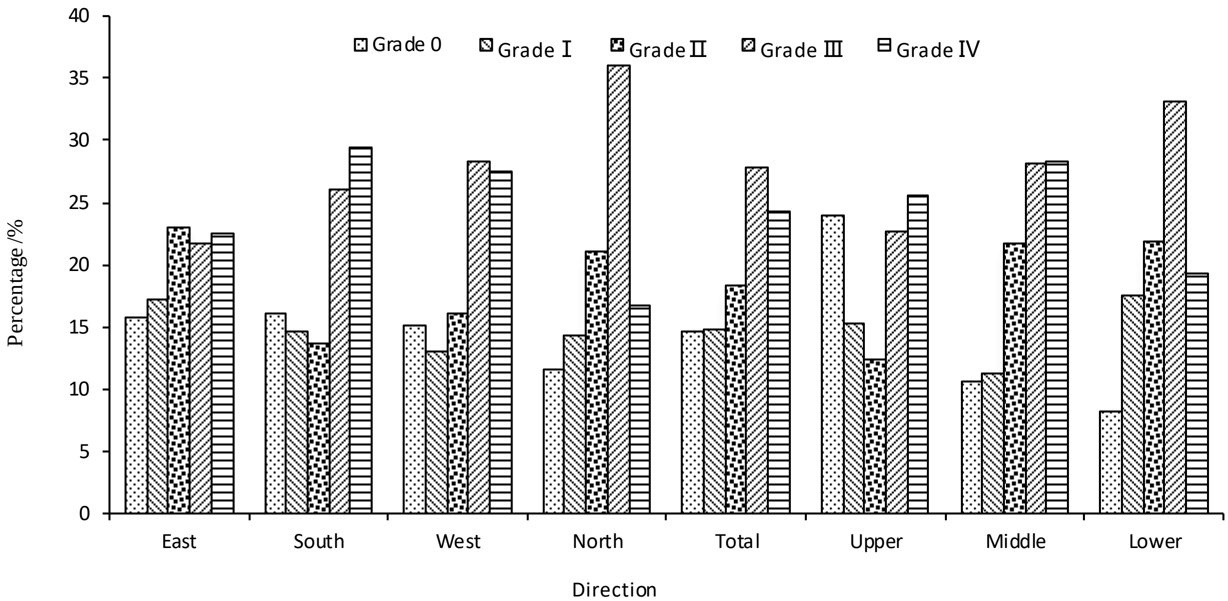

Figure 4. Damaged leaves in different directions *Q. aquifolioides* in southeast Tibet.

the highest accounting for 36.04%, followed by the grade II (21.14%), IV (16.8%), and I (14.36%) damaged leaves. In the upper part of the tree, the affected leaves were mainly grade IV (25.55%) and grade III (22.66%). The fewer affected leaves were grade I (15.33%) and grade II (12.44%). About 24.02% of the leaves were unaffected. In the middle part of the tree, both grade IV and III damaged leaves were the majority parts accounting for 28.33% and 28.13% respectively followed by grade II and I damaged leaves accounting for 21.67% and 11.25% respectively. About 10.63% of leaves were undamaged. In the lower part of the tree, 8.27% of the leaves were unaffected while grade III, II, IV, and I damaged leaves accounted for 33.09%, 21.88%, 19.3%, and 17.46% respectively.

The distribution of damaged leaves of *Q. aquifolioides* in southeast Tibet showed certain differences in four different directions (Figure 5). These differences mainly originated from the differences of eight locations. Due to the diversity of habitats such as topography and climate, the difference in southeast Tibet was smaller than that among eight locations. It also showed that the differences were big in small scale and small in large scale. In general, the unaffected leaves (grade 0) were mainly distributed in the south, east, and west of the tree accounting for 29.11%, 27.43%, and 25.32% respectively, and fewer damaged leaves were in the north side of the tree (18.14%). Considering the direction, the unaffected leaves in the upper part of the tree accounted for 59.49% of total damaged leaves, and the damaged leaves in the middle and lower parts of the tree accounted for 21.52% and 18.99%, respectively. The grade I damaged leaves were mainly in the east side of the tree (29.71%) followed by the south, north, and west side of the tree for 26.36%, 22.18%, and 21.76%, respectively. The lower and upper parts of the tree were more affected areas accounting for 39.75% and 37.66% than the middle part accounting for 22.59%. The grade II damaged leaves were also mainly in the east side of the tree accounting for 32.09% followed by the north side of the tree (26.35%). The least affected leaves in the west and south side of the tree accounted for 21.62% and 19.93% respectively. The most affected leaves in the lower part of the tree accounted for 40.2%, and fewer damaged leaves were in the middle and upper parts of the tree accounting for 35.14% and 24.66%, respectively. The grade III damaged

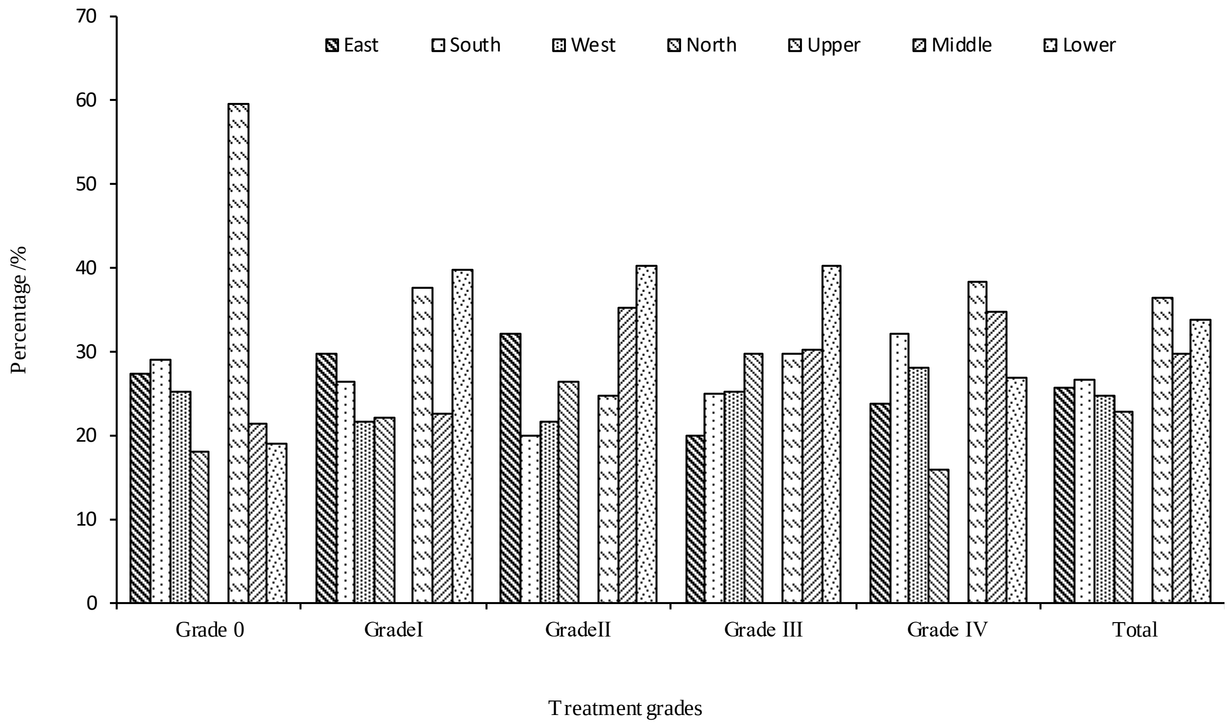

Figure 5. Spatial distribution of different grade damaged leaves of *Q. aquifolioides* in southeast Tibet.

leaves were mainly in the north side of the tree accounting for 29.63% followed by the west and south side of the tree accounting for 25.22% and 25%. The least damaged leaves were in the east side of the tree accounting for 20.09%. The most affected part was the lower part of the tree accounting for 40.18% followed by the middle of the tree (30.13%) and the upper part of the tree (29.69%). The grade IV damaged leaves in the north side of the tree accounted for 15.86%, which is the least. More damaged leaves were in the west and east side of the tree accounting for 28.13% and 23.79% respectively. The most damaged leaves were in the south side of the tree accounting for 32.23%. The affected leaves in the upper part of the tree accounted for 38.36%, which was relatively more than that in the middle (34.78%) and lower (26.85%) parts of the tree. In general, the distribution of the damaged leaves was not significantly different in the four directions and the three tree parts. The order of damaged leaf rates in different directions was tree south > tree east > tree west > tree north. The order of damaged leaf rates in different tree parts was upper part of the tree > lower part of the tree > middle part of the tree (Figure 5).

Analysis of the damage degree of *Q. aquifolioides* forest

In the eight sampling plots in southeast Tibet, the damages of *Q. aquifolioides* forests were different. The five locations of XM, ML, JL, LB, and BL were large flake distribution that the damage area of *Q. aquifolioides* forest was more than 0.53 ha. The distribution of *Q. aquifolioides* in the three locations of MF, NM, and DM showed flake distribution (Table 3).

From the perspective of different damaged strains rate, except one third of *Q. aquifolioides* found undamaged in NM, no undamaged *Q. aquifolioides* was found in the quadrat of the other seven locations. The rate of severely affected strains was high in JL (77.79%) followed by BL (52.44%) and XM (45.18%). The low rates

Table 3. The situation of *S. leptalina* harming *Q. aquifolioides* forests.

Location	Overall victimization	The ratio of different grades victim strain (%)			
		No victimization	Slight victimization	Moderate victimization	Serious victimization
XM	Large flake distribution	0	27.41	27.41	45.18
MF	Flake distribution	0	80	15.56	4.44
NM	Flake distribution	33.33	47.41	16.29	2.96
DM	Flake distribution	0	64.44	26.67	8.89
ML	Large flake distribution	0	24.44	57.78	17.78
JL	Large flake distribution	0	1.48	20.74	77.79
LB	Large flake distribution	0	26.67	53.33	20
BL	Large flake distribution	0	12.4	35.11	52.44

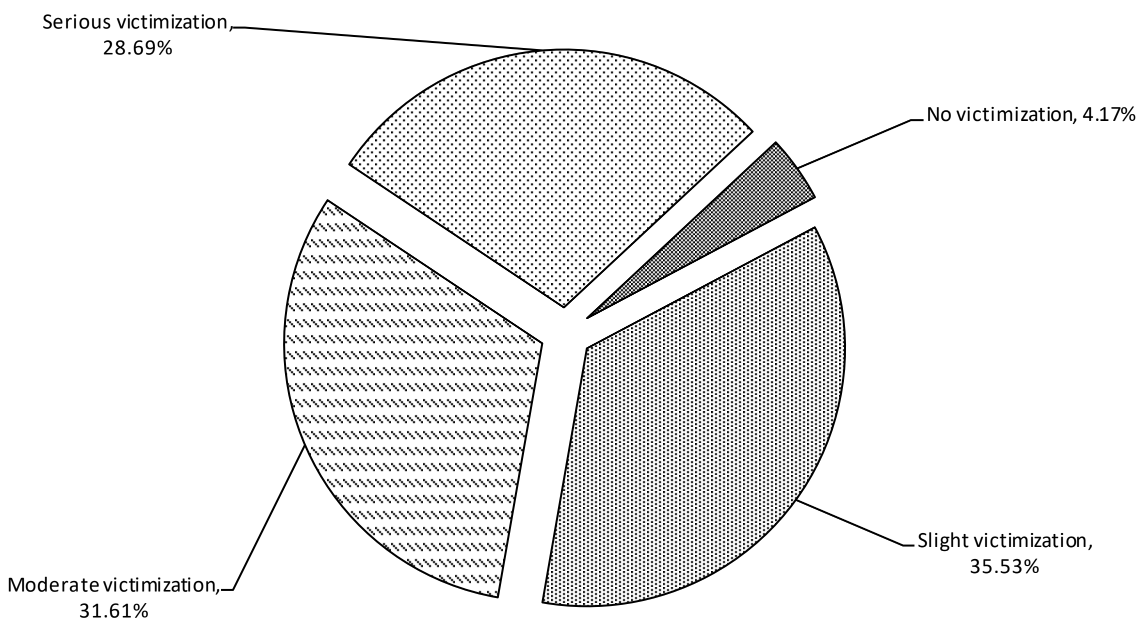

Figure 6. The situation of *S. leptalina* harming *Q. aquifolioides* in southeast Tibet.

Table 4. Statistics of indoor control experiment results.

Pharmacy	Remaining number after processing							Insect population reduction rate (%) (Corrected rate)						
	1h	2h	3h	7h	24h	48h	72h	1h	2h	3h	7h	24h	48h	72h
25% deltamethrin	30.3	24	20.7	12.7	4	2.3	1	24.25 (24.25)	40 (40)	48.25 (48.25)	68.25 (68.25)	90 (89.92)	94.25 (93.99)	97.5 (97.25)
3% acetamiprid	24	20.7	14.3	6.3	0	0	0	40 (40)	48.25 (48.25)	64.25 (64.25)	84.25 (84.25)	100 (100)	100 (100)	100 (100)
25% buprofezin	34.7	32.3	32	24	10	5.3	2	13.25 (13.25)	19.25 (19.25)	20 (20)	40 (40)	75 (75.81)	86.75 (86.16)	95 (94.49)
40% dursban	26	18	14.7	4.7	0	0	0	35 (35)	55 (55)	63.25 (63.25)	88.25 (88.25)	100 (100)	100 (100)	100 (100)
90% methomyl	22.7	16.3	12.3	4	2.7	0	0	43.25 (43.25)	59.25 (59.25)	69.25 (69.25)	90 (90)	93.25 (93.2)	100 (100)	100 (100)
2% thiacloprid	38	34	30.3	26	22	19.3	1	5 (5)	15 (15)	24.25 (24.25)	35 (35)	45 (44.58)	51.75 (49.61)	97.5 (97,25)
Clear water control	40	40	40	40	39.7	38.3	36.3	0	0	0	0	0.75	4.25	9.25

Notes: The data in () was the corrected population reduction rate (%)

were in MF (4.44%) and NM (2.96%). The order of severely affected strains in different locations was JL > BL > XM > LB > ML > DM > MF > NM. The high rates of moderately affected strains were in ML (57.78%) and LB (53.33%). The low rates were MF (15.56%) and NM (16.29%). The ranking of moderately affected strains in different locations was: ML > LB > BL > XM > DM > JL > NM > MF. The slightly affected strains were mostly distributed in MF (80%) followed by DM (64.44%). The least distributed location was JL (1.48%). The order of slightly affected strains in different locations was MF > DM > NM > XM > LB > ML > BL > JL.

The situation of *S. leptalina* harmed *Q. aquifolioides* in southeast Tibet was shown in Figure 6. It can be seen that the severely damaged *Q. aquifolioides* accounted for 28.69% that was more than 2/3 of these *Q. aquifolioides* leaves damaged by *S. leptalina*, which caused the leaves failing to perform photosynthesis normally and even die to further affect photosynthesis. However, *S. leptalina* did not feed on dead leaves. They moved to other strains or branches to eat green leaves. Thus, a vicious circle formed to weak the trees. Taking this opportunity, other harmful organisms such as scale insects, coal pollution, etc. occurred. Coupled with more droughts in March to June period, the upper part of *Q. aquifolioides* eventually died. If the ground part was not removed for a long time, the underground part would also die. However, if the ground part was removed in time during April to May, the underground part would sprout, and new leaves would emerge. The rate of moderately damaged *Q. aquifolioides* was 31.61% and that of slightly damaged was 35.53% with both totaling to 67.14%. It's better to control moderately- and slightly-damaged *Q. aquifolioides* by biological agents during the time from March to May. No victimization accounted for 4.17%, mainly distributed in NM.

Control experiment results

The six tested commonly used pesticides were classified into low toxicity, medium toxicity, and high toxicity three categories. The test results were shown in Table 4. It can be seen that, after 1 hour of application, the highest rate of population reduction (43.25%) was achieved by applying 90% methomyl followed by 3% acetamiprid with the population reduction rate of 40%. The lowest population reduction rate (5%) was obtained by using 2% thiacloprid. After 24 hours of application, all *S. leptalina* was killed by treating with 3% acetamiprid and 40%

dursban. After 48 hours, all *S. leptalina* was killed by applying 90% methomyl. After 72 hours, the corrected population reduction rates for 25% deltamethrin, 3% acetamiprid, 25% buprofezin, 40% dursban, 90% methomyl, and 2% thiacloprid were 97.25%, 100%, 94.49 %, 100%, 100%, and 97.25%, respectively. After 96 hours (4 days) of application, all the applied *S. leptalina* died.

Discussion

Through the investigation of the damaged *Q. aquifolioides* in southeast Tibet, it was found that *S. leptalina* seriously affected their growth and even survival. The probability of occurrence of *S. leptalina* in each sampling plot was 0.85. The damaged area was more than 1.33 × 105 ha with the seriously damaged area reached 1.00 × 105 ha and the dead area reached 0.67 × 105 ha. Among the 8 sampling plots, the order of seriously damaged strains rate of *Q. aquifolioides* was JL > BL > XM > LB > ML > DM > MF > NM. More than half of *Q. aquifolioides* in the top 4 sampling plots was affected with the highest rate of the affected strains in JL (77.79 %).

The characteristics of *S. leptalina* in southeast Tibet were high density of larvae, long larval stage, large damaged area, rapid diffusion rate, strong specificity, and large social impact. The particularity of topographical conditions brought more difficulty to prevention and control work.

Therefore, it was recommended to protect the resources of *Q. aquifolioides*. Most of *Q. aquifolioides* forests were located on the sunny slopes of the Qinghai-Tibet Plateau alpine forest, or the dry valleys, and even the steep slopes of the rocky review. They were often in the worst conditions of the site such as shallow, dry, and barren soil. Other alpine trees were hard to adapt to such harsh environmental conditions [12]. Therefore, *Q. aquifolioides* forests in these areas should be classified as shelter forests which ensure and strengthen the capacity of water conservation and soil protection. For this reason, it was strictly prohibited to cut down. On the other hand, the basic research on current pests with large damaged area and serious damage, the background investigation, and regularly or irregularly survey the forestry pests in southeast Tibet to determine the key prevention research object according to the census data should also be strengthened. Additionally, during our research on *Q. aquifolioides* leaf-fed pests, it was founded that the pests had specificity to the host. The specific mechanism should be further studied. Besides, *Senecio Scandens* had a strong attraction to pests. This phenomenon should be used to control the pest.

There were big differences in the different directions and different tree parts of *Q. aquifolioides* in southeast Tibet. The differences in the leaf damage rate were also significant.The incidence rate of *S. leptalina* was different in different sampling plots. The effects of the six test agents on *S. leptalina* were different too. Based on the occurrence characteristics, occurrence environment, and control test results of *S. leptalina*, the recommended control measures were as follows: firstly, scientifically spray environmentally friendly agents on the edge of the seriously damaged area and the occurrence area of *Q. aquifolioides* to quickly reduce the density of the insects in *Q. aquifolioides* forest. In the adult stage, insecticidal lamps could be used to trap some worms. Secondly, appropriate tending management measures can be adopted such as branch cutting and scientifically destroying the ground part, which use the strong germination ability of *Q. aquifolioides* carp for self-repairing.

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