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Investigations

Forest Pathology Pattern of Forest Stands of the Green Belt of Astana

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Abstract: The article presents the results of researches on an estimation of a forest pathology pattern of the Astana green belt stands. For the first time, a complex of insect pests and entomophages is being specified in the Astana green belt stands. The biological effectiveness of biopreparations and insecticides against harmful insects in the system of protective measures and the forest pathology pattern of stands have been estimated. There has been determined the percentage of dominance of the main insect pests, such as birch leaf miner (*Fenusa pumila Kl.*), spruce bud scale (*Physokermes hemicryphus* (Dalm.), red spider (*Paratetranychus ununguis* Jac.), as well as pine web-spinning sawfly (*Acantholyda posticalis* Mats.) that periodically create a chronic focus and the entomophages: spider (*Araneus diadematus* Cl.), common *lacewing* (*Chrysoperla carnea)*, labirynth agelena (*Ageiena labyrinthica* (Cl.). Bitoxibacillinum biopreparation showed high biological efficiency against birch leaf miner and the akkabelek biopreparation-against butterfly caterpillars. The tested systemic insecticide Aktara 250 v.d.g. against birch leaf miners showed good biological efficiency.

Keywords: Green Belt, Forest Pathology Monitoring, Pests, Diseases

Introduction

Forests are the most important natural resource in the vast areas of the Republic of Kazakhstan, therefore timely recording, condition monitoring and implementation of forest protection measures aimed at preserving the forest cover of the country are among the most important state tasks.

Since 1996, on the initiative of the President of the Republic of Kazakhstan, N.A. Nazarbayev, the cultivation of the forest of the "green belt" has been started around the city of Astana, its areas have been increasing annually and today they occupy more than 75 thousand hectares. Until 2020, it is planned to expand green area up to 100,000 hectares (Toyshibekova, 2016).

Now it is quite real that the forest, in the long run, will be recognized as a permanent and most significant means of supporting the health of the earth and its inhabitants. Federenko G.P states as follows: "Not everyone understands this yet, but in the near future, forests will be regarded as the most important regulatory resource, primarily as a purifier of the Earth's atmosphere, an oxygen supplier and a consumer of excessive carbon dioxide" (Bayzakov, 2007).

When growing trees and shrubs in landscaping plantings and green areas, the issues of protection from pests and diseases become topical. Pests and diseases worsen the vital state of the plantations; reduce their stability in as little as few days. The scope of the study was to clarify the dominance of pests and their entomophages, harmfulness and to assess the forest pathology pattern of the green belt of Astana.

Materials and Methods

The data obtained in 2015-2016 during the reconnaissance and detailed surveys served as the materials of the study. The investigations were carried

out in the stands of the Astana green belt and at the laboratory of the Kazakh Research Institute for Plant Protection and Quarantine named after Zh. Zhiembaev using the generally accepted methods in forest entomology, phytopathology and plant protection (Talman and Katayev, 1964; Ilinskiy, 1965).

The degree of damage to the leaves had been established by counting the number of mines thereon and the pest damage area. For this purpose, 25 leaves (100 leaves in total) had been examined from four sides of the recorded trees. After that, the degree of damage and spread of the miners had been assessed: Weak-damaged - up to 25% of leaves, very few insects and mines were encountered; moderate-damaged - up to 50% of leaves; strong - more than 50% of leaves were damaged, the mines were abundant (Tuzov, 2004; RPPG, 2008).

Results

Within a period of 10 years a number of changes have taken place in the biogeocenosis in the plantations of the Astana green belt of the Zhasyl Aimak RSE and the Astana Ormany LLP with the growth and development of plantations. The fauna of insect pests and their annual harmfulness in the foci of dominant species have increased. The group desiccation of individual stand species is also encountered.

From 2006 to 2016, foci of pests were recorded in four forestries: Astaninskoye, Shortandinskoye, Vyacheslavskoye, Kyzylzharskoye and in the Ak kaıyn nursery. The greatest area of the pest with an area of 1,496.9 hectares was observed in the Astaninskoye forestry.

The focus of the outbreak of the hazel sawfly on an area of 318.6 hectares has been identified, as well as damage to the leaves of a large hazel sawfly has been observed. A large hazel miner sawfly is one of the dangerous pests in Kazakhstan. This pest can adapt in new conditions which requires a detailed study of its biological and ecological features. On average, the harmfulness of the large hazel miner sawfly on the model leaves of the birch ranged from 25 to 75% and harmfulness of the small miner sawfly, respectively, ranged from 25 to 57%. Due to the secretive lifestyle of the larval phase of the large hazel miner and other sawflies, a study is required in order to establish the optimal terms and to perform the protective measures.

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In 2016, the dominated pests in the stands of the Astana green belt were a large hazel miner sawfly (*Scolioneura betulae* Zadd) - 14.9% in total crops at record sites; small hazel miner sawfly (*Fenusa pumila* Kl.) - 12.7%, the red spidder - (*Paratetranychus ununguis* Jac.) - 7.0%. The subdominant ones included: Nematus millaris (*Pontania proxima* Lepel.) - 4.7%; spruce bud scale - (*Physokermes hemicryphus* (Dalm.)) - 4.4%, Rhodococcus latipes *(Physokermes piceae* Schr.) - 3.5%, thorn butterfly (*Aporia crataegi* L.) - 2.0% and pine web-spinning sawfly (*Acantholyda posticalis* Mats.) - 2.6%.

The dominant species of entomophages were the cross spider (*Araneus diadematus* Cl.) - 11.6%, common *lacewing* (*Chrysopa carnea Steph.)* - 9.6%, labirynth agelena (*Agelena labyrinthica* Cl.) - 9.0%. The subdominant ones included: *Syrphys corollae* F. - 3.5%, *Trichogramma embryophagum* Htg. - 2.8%. The occurrence of insect pests and entomophages and their abundance in the forestries differed in the number of species to a certain extent.

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We selected several forestries to assess the forest pathology pattern of the green stands of Zhasyl Aimak RSE and the Astana Ormany LLP. Monitoring sites were laid in homogeneous birch stands (Table 1).

In general, the pathology pattern in these institutions was satisfactory one. However, the forest pathology pattern of the green stands of the Zhasyl Aymak RSE was preferable to that of the Astana Ormany LLP.

To control the phytosanitary conditions of the green belt stands, permanent forest pathology monitoring (no less than 3 to 7 times during the vegetation period) is required, which will allow to timely detect a foci of pests and diseases and to take adequate protective measures.

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The Aktara 250 v.d.g preparation with a systemic action was also tested (13.05.2016) in the Astana green belt stand in five options against secretively living pests (large hazel miner sawfly and Nematus millaris).

Against a large hazel miner sawfly, the biological efficacy of the tested Aktara 250 v.d.g preparation in the pilot versions averaged from 89.5 to 94.7%. In the version against the Nematus millaris it was 60.3% on average. In the case of timely processing and spillage, the state of the stands was significantly different in terms of conservation compared to the control.

Table 1: Assessment of the forest pathology pattern of trees on the trial plots of RSE "Zhasyl Aimak" and LLP "Astana Ormany"

Zhasyl Aimak RSE							
	Tree condition category, %						
Monitoring sites' location	I	II	III	IV	Trees preserved, %	Total number of trees, pcs.	Fallen away trees, %
Kyzylzharskoye forestry, sq. 102 GPS: H-394; N-51°09.780; E-071°41.438	-	16.6	83.4	-	100.0	36	-
Astaninskoye Forestry, Kosshy District, Maybalyk working project sq. 7 H-367,2; N-51°00. 814; E-071°24. 149;	-	6.3	61.5	29.0	97.031	3.2	
sq.45 H-345; N-51°12.791; E-071°19/036 Astana ormany LLP	-	-	53.7	46.3	100.0	54	-
sq. 46 H-340; N-51°12. 360; E-071°18.57 Ilyinka settlement	-	-	78.0	17.0	100.0	41	5.0
sq. 7 H-374; N-51°06.441; E-071°15.129	-	15.2	68.0	12.7	100.0	88	4.1

In the version against the Nematus millaris it averaged to 60.3%. In case of timely processing and spillage, the state of the stands was significantly different in terms of safety compared to the control.

To date, the concept of combating harmful insects includes various measures aimed at preventing mass reproduction and spread of pests, forecasting changes in population and their direct destruction by dangerous chemical products, without knowing the exact concentrations and lead time.

Unfortunately, during the assessment and comparison of various combat methods, they often proceed from the position of providing a direct, momentary effect, while it is economically more important to prevent outbreaks of reproduction, to anticipate the place of their occurrence and the course of the change in the pests' population. Biological factors, such as the stability of woody plants and entomophages (Krushev, 1973) are crucial.

However, its proper application has not yet been found in the forestry of the country. Its further development will be possible only if there is good knowledge of the most effective methods of use by specialists - forest pathologists (Vorontsov, 1982).

In accordance with the Regulations on Specially Protected Areas, the use of highly toxic chemicals will be prohibited in such forests in the future; at the same time, the possibilities of using biological protection methods against pests have not been developed; it is necessary to solve the problems of searching for active entomophages, activating their useful activities and saturating forest biocoenoses with them through the development of a biological laboratory for entomophages' breeding.

The use of biological methods in forest protection will ensure the maximum preservation of forest stands, not allowing the harmful effect of insecticides on the beneficial fauna of forest biocoenosis.

The biological method of struggle is part of a unified system of forest protection measures. It should be closely related to integrated and forestry methods of forest protection of entomophages. The use of biological methods in forest protection will ensure maximum conservation of forest stands, while preventing the harmful effect of insecticides on the useful fauna of forest biocenosis. The biological method of control is part of a unified system of forest protection measures. It should be closely related to integrated and forestry methods of forest protection (Vorontsov, 1982; Mukhamadiyev *et al*., 2016).

Therefore, a complex-foci method, including a series of mutually complementary techniques (attraction of insectivorous birds, the expansion of ants to build up the efficiency of entomophages, building nest-houses, the use of biological preparations and if necessary, the use of pesticides from the chitin synthesis inhibitors' group, etc.) will allow to effectively suppress the development of pests and at the same time to avoid contamination of forest biocenoses and the environment with hazardous pesticides. The scientific support, training and further training, exchange of experience of research staff in the field of forest entomology and forest protection in developed foreign countries are the most important things.

Conclusion

The forest pathological condition of the stands of the green belt of Astana city was established. The expected leaf damage by the hazel miner sawfly in 2017 was estimated, which was 60-79.1% on average. The biological effectiveness of biologicals and insecticides against harmful insects was established. In the future, it is necessary to strengthen the monitoring and use of bioinsecticides for the conservation of forest biodiversity.

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Authors Contributions

All authors equally contributed in this work.

Ethics

Authors declare no conflicts of interests.

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