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in

Mutke S. (ed.), Piqué M. (ed.), Calama R. (ed.).
Mediterranean stone pine for agroforestry

Zaragoza : CIHEAM / FAO / INIA / IRTA / CESEFOR / CTFC
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 105

2013
pages 29-33

Effects of pests and diseases on stone pine (*Pinus pinea* L.) conelet losses in Kozak catchment area

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Abstract. Kozak catchment area is in Bergama District in İzmir, a bowl shaped area with 16,000 hectare stone pine forest which forms one-third of the total stone pine area in Turkey. Almost all the forest area is private. In recent years, conelet losses of stone pine have been increased. To investigate the relation between the losses and pest-disease effects, 8 different sample areas were examined during 2005–2008. The results showed that almost all cone losses occurred in new conelets. In the cone losses, significant differences were found between years and sample areas. But neither a pest nor a disease was found as the effect of the high losses. The most abundant insect species on two and three aged cones was *Dioryctria pineae* Staudinger (Lep., Pyralidae). Damage rate of this pest was 3% in some areas. Other pests were identified as *Ernobius pini* (Col., Anobiidae), *Camptomyia pinicola* (Dipt. Cecidomyiidae), *Cicada* sp. (Hom., Cicadidae), *Apterygothrips priesneri* zur Strassen (Thys., Phlaeothripidae) and *Neohydatothrips gracilicornis* (Williams) (Thys., Thripidae). And some pests and diseases which caused indirect conelet losses –making some damages on shoots– were identified as *Tomicus* sp. (Col., Curculionidae), *Sordaria* sp. and *Pestalotiopsis* sp..

Keywords. Stone pine – Cone losses – Pest – Disease.

Effet des maladies et ravageurs sur les pertes en jeunes cônes de pin pignon (*Pinus pinea *L.) dans le bassin hydrographique de Kozak

Résumé. *Le bassin hydrographique de Kozak se trouve dans la zone de Bergama, Izmir, une superficie en forme de cuvette de 16 000 hectares de forêts de pins pignons qui constitue un tiers de la surface totale de pins pignons de la Turquie. Presque toute la surface forestière est de propriété privée. Dernièrement, les pertes de jeunes cônes de pins pignons se sont accrues. Pour étudier le rapport entre ces pertes et les effets des ravageurs et maladies, 8 différentes parcelles d'échantillonnage ont été examinées sur les années 2005–2008. Les résultats ont montré que presque toutes ces pertes avaient lieu sur les jeunes cônes. Des différences significatives quant aux pertes de cônes ont été trouvées entre années et parcelles d'échantillonnage. Mais aucune maladie ni ravageur ne s'est avéré être la cause de ces fortes pertes. L'espèce la plus abondante d'insectes sur les cônes de deux ou trois ans d'âge était Dioryctria pineae Staudinger (Lep., Pyralidae). Le taux de dommages de ce ravageur était de 3 % dans certaines zones. D'autres ravageurs ont été identifiés comme étant* Ernobius pini *(Col., Anobiidae),* Camptomyia pinicola *(Dipt. Cecidomyiidae),* Cicada *sp. (Hom., Cicadidae),* Apterygothrips priesneri *zur Strassen (Thys., Phlaeothripidae) et* Neohydatothrips gracilicornis *(Williams) (Thys., Thripidae). Et certains ravageurs et maladies qui causaient des pertes indirectes de jeunes cônes – provoquant quelques dégâts sur les bourgeons – furent identifiés comme* Tomicus *sp. (Col., Curculionidae)*, Sordaria *sp. et* Pestalotiopsis *sp.*

Mots-clés. *Pin pignon – Perte de cônes – Ravageur – Maladie*.

I – Introduction

Kozak basin is in Bergama District near İzmir, a bowl shaped area with 16,000 hectare stone pine forest which forms one-third of the total stone pine area in Turkey. Almost all the forest area is private. In recent years, conelet losses of stone pine have been increased.

Previous studies about pest and disease effects on *Pinus pinea* L. cones exist. Roques (1983) investigated some cone pests according to the development stages of 7 pine species (*Pinus sylvestris, P. uncinata, P.nigra, P. halepensis, P. pinaster, P. pinea* and *P. cembra*) cones. Also,

Kanat (2001) in Kahramanmaraş-Önsen; Can and Özçankaya (2004) in Aegean Region and Mutke *et al.* (2007) in Spain investigated some stone pine cone pests. But in recent years, conelet losses of stone pine have increased in Kozak. In this study, the relationship between conelet losses and pest-disease effects was investigated.

II – Materials and methods

The materials of the study were consisted of one, two and three aged cones (one aged cones: 0-12 months; two aged cones: 12-24 months; three aged cones: older than 24 months) collected from the sample areas and biotic agents (insects and diseases) which were obtained from the damaged cones.

In Kozak catchment area, 8 different sample areas were chosen according to: 2 different altitudes (higher and lower than 500 m), two wind conditions (open the sea wind and not) and the abundance of conelets (high or low) (Table 1). There were no regular data about the amount of conelets so the declarations of the land owners were considered as a basis for classifying.

Table 1. Some properties of the sample areas

Sample area no.	Altitude (m)	Exposed to sea wind	Abundance of cones	Texture	pH
1	710	-	High	SL (sandy loam)	6.12
2	590	-	Low	SL (sandy loam)	6.11
3	720	+	High	LS (loamy sand)	6.07
4	380	+	Low	LS (loamy sand)	6.43
5	230	+	Low	LS (loamy sand)	6.54
6	270	-	High	LS (loamy sand)	6.69
7	550	+	Low	LS (loamy sand)	6.41
8	480	-	High	S (sand)	6.19

In each sample area, to control and count one, two and three aged cones, five trees were chosen, from which two branches - preferably located at the middle of the crown- were marked. From 2005 to 2008, cone observations were made twice a month during the vegetation season and once a month in the rest of the year. Damaged or dried cones were taken to the laboratory for the detailed examinations. Cones were counted by the same two experienced persons.

Brought insect samples at the immature stages were observed and their biological data were recorded at the laboratory conditions. Obtained adults were identified by the specialists.

After bringing the diseased plant samples into the laboratory, the infected tissues along with adjacent small unaffected tissue were cut into small pieces (2-5 mm squares). They were transferred to sterile glass-beaker containing 0.5 % sodium hypochlorite solution used for surface sterilization of plant tissues for a period of 30-60 s. The tissue pieces were washed twice by transferring briefly to sterile distilled water. The pieces then were dried on sterile filter paper. The sterilized pieces were aseptically transferred to petridishes containing potato dextrose agar (PDA) supplemented with streptomycin sulfate, at the rate of three to five pieces of tissues per petri plate and incubated at room temperatures (24-25°C) that may favor the pathogen development.

III – Results

The results showed that almost all cone losses occurred in new conelets. Therefore, evaluations were based on this period. In the cone losses, statistically significant differences were found between years and sample areas (0.1 %).

There were statistically significant differences (0.1 %) between the sample areas according to the living percentages of cones during two periods that recorded from the first occurrence of cones to the reaping time (the first period: 2005-2007; the second period: 2006-2008). 1st, 3rd, 7th and 8th sample areas had a higher living percentages of cones than the other areas (Fig. 1). Determinated insect pests and diseases are mentioned according to the rate of damage (Table 2):

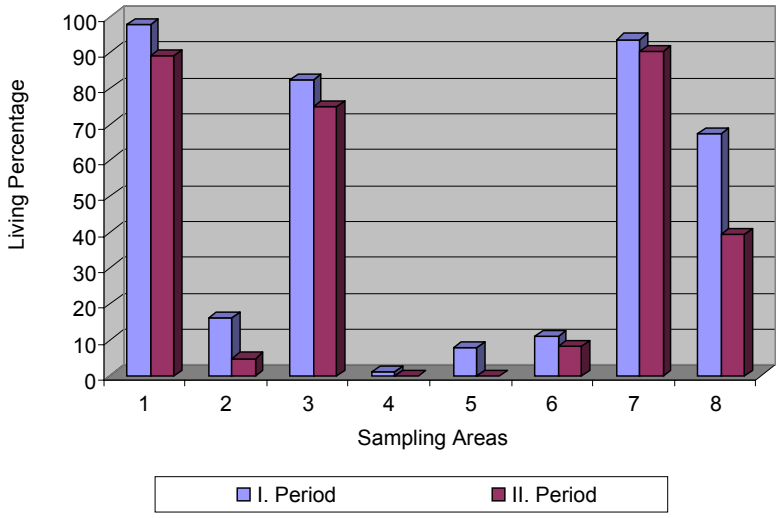

Fig. 1. Evaluated living percentages of cones in the first and the second periods in the sampling areas.

Table 2. Percentage of cones (one, two, three aged) affected by insects

Year	Cone age	Evaluated cone number	Percentage of cones (one, two, three aged) affected by				
			Dioryctria pinea	*Ernobius pini*	*Tomicus* sp.	*Camptomyia pinicola*	Thrips species
2005	1	749		0.4		0.26	0.26
	2	453					
	3	65	1.5				
2006	1	1401		0.07			0.14
	2	378		0.52			
	3	520	0.76			0.38	
2007	1	697		0.14			0.14
	2	586		1.19			
	3	393	2.79			0.76	
2008	1	537		0,18	0.74		0.55
	2	141		9.92			
	3	616	3.57			0.64	

Dioryctria pineae Staudinger (Lepidoptera, Pyralidae). *D. pineae* individuals were obtained from two and three aged cones in the 3rd, 5th and 8th sample areas. Especially in the third sample area 3% of

three aged cones were infested by this pest. Adults emerged from the beginning of September till the end of October.

Ernobius pini Sturm (Coleoptera, Anobiidae). This pest was found in dried one aged conelets from the previous year, drying two aged cones and also in drying or in *D. pineae* damaged three aged cones. Adults emerged during June and July. It was observed that beside matures, larvae also kept on feeding at dried material along the year.

Tomicus sp. (Coleoptera, Curculionidae). In this study, *Tomicus* sp. was found in the 1st, 2nd and 8th sampling areas with a very low population rate. Adults emerged from the beginning of March to the middle of April.

Camptomyia pinicola Mamaev (Diptera, Cecidomyiidae). This species was observed in three aged cones damaged by *D. pineae* in the 3rd and 8th sampling areas. It is accepted as a secondary pest since it was found together with other pests. Adults emerged from mid-April to mid-November.

Cicada sp. (Homopreta, Cicadidae). This pest was observed in all sampling areas with a high population rate. Adults emerged from the end of June to the end of August.

Apterygothrips priesneri zur Strassen (Thysanoptera, Phlaeothripidae) and *Neohydatothrips gracilicornis* (Williams) (Thysanoptera, Thripidae). These species were found in the 3rd and 5th sample areas. The number of insects observed was very low, specially for *N. gracilicornis*.

Sordaria sp., *Pestalotiopsis* sp. and *Dothistroma* sp. were recorded as the fungal diseases especially in the 8th sampling area.

IV – Discussion and conclusions

To investigate the relation between the cone losses and pest-disease effects, 8 different sample areas in Kozak catchment area were examined during 2005-2008.

As the result, some needle and cone pests and diseases were identified. But neither a pest nor a disease was found as the effect of the high losses.

The 2nd, 4th, 5th and 6th sample areas had lower living percentages of cones than the other areas (Fig. 1). The needle lengths in those sampling areas were shorter and sparse. This was probably related with the lack of water in the summer months and the microclimatic conditions. And there was no evidence between one aged cone losses and insect pests. This situation in one-year aged cones, was explained by Roques (1977) with progeny incontinence (=conelet abortion) because of different abiotic factors. Katowich *et al*. (1989) indicated that 0-4 month interval was the major period of losses in the seed orchard, and conelet abortion as the major mortality factor. The results of the present work show the same.

By the way, in the 1st, 2nd and 8th sampling areas *Tomicus* sp. was responsible for conelet losses indirectly but in lower population level. This pest should be kept under observations in the 8th sampling area, since it tends to be more active together with the stress factors such as drought.

On the other hand, the pests and damage rates obtained from two- and three-year aged cones are parallel with the former studies.

The most abundant insect species on two and three aged cones was *Dioryctria pineae* Staudinger (Lep., Pyralidae). This pest was found in the 3rd, 5th and 8th sample areas and it's damage rate reached to 3% of three-year aged cones in the 3rd sample area. The results of former studies on the cone pests in stone pine and other pine species (Roques, 1983; Dormont and Roques, 1999; Kanat, 2001; Can ve Özçankaya, 2006; Mutke *et al*., 2007) determine *Dioryctria* species as the key pests. According to Mutke *et al*. (2007) damaged cones by *D. mendacella* can be easily sorted out by their changed colour, burned and brownish. But, some natural enemies of this pest like *Carpelimus* sp. (Col., Staphylinidae) and some parasitic hymentopter species were observed

abundantly during this study. This datum indicates that the natural balance between the pest and the natural enemy populations is conserved. The damage of *D. pineae* remains at acceptable rates when the natural enemy population is considered.

Tomicus sp. (Col., Curculionidae) caused indirect conelet losses –making some damages on shoots– with low population level. However, it should be kept under observation, because it tends to be more active together with some stress factors such as drought.

Other pests were identified, as *Ernobius pini* (Col., Anobiidae) and *Camptomyia pinicola* (Dipt., Cecidomyiidae) at the different aged cones in all sampling areas. These pests were defined as secondary pests since they were found in damaged cones by *D. pinea* or abiotic factors.

Cicada sp. (Hom., Cicadidae) was found aboundtly in all sampling areas. But the relationship between cone losses and this pest should be examined with more details because stone pine trees are bigger than the other host plants of *Cicada* species, consequently showing a higher tolerance to pests.

In addition, *Sordaria* sp., *Pestalotiopsis* sp. and *Dothistroma* sp. were recorded as the fungal diseases. *Dothistroma* needle blight of pine was determined in some areas in some years. Sinclair *et al*. (1989) reported that the disease had made a severe damage in seedlings and young plantations of *Pinus radiata, P. nigra* and *P. ponderosa* in New Zealand and North America. Besides, *Sordaria* sp. and *Pestalotiopsis* sp. which are common fungal diseases were identified in the 8th sample area. Even, the symptoms of *Pestalotiopsis* sp. have been observed in needles and shoots weakened or injured by other factors such as freezing, sun burn or insects, and as the result, they wilt and turn brown (Sinclair *et al.,* 1989).

When summarized, some pests and diseases of needle and cones have been determined in the whole sampling areas. But none of them could cause significant cone loss. However, it should be taken into consideration that pests and diseases could become more effective in adverse climatic conditions such as drought and increase in the number of stone quarries in the province.

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