DECAY IN THE ZIARAT JUNIPER FORESTS OF BALUCHISTAN

by

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Abstract. *A study of* 137 *juniper trees indicated that the incidence of decay was* 83% *and the extent of volume loss* 32% *among the sample trees. The amount of decay increased with the diamaeter of the tree, rising markedly above* 23 *cm dbh. Pyrofomes demidoffii, the heart rot fungus, accounted for over* 96% *of the total decay volume. Dead branch stubs and root-connections were the important means of entry for decay fungi.*

Introduction. Decay is a natural process involving destruction and disintegration of timber, mostly by wood-rotting fungi in association with bacteria and other non-decay fungi (Shigo, 1967). The organisms enter trees through wounds caused by fire, weather, insects, birds, animals, or man.

Juniper (*Juniperus excelsa*) covers about 31418 hectares in the Ziarat forests of Baluchistan, forming Dry juniper forests included in the Dry Temperate Forest type (Champion, Seth and Khattak, 1965). The forests are mature and over-mature. Management of these is a major problem for the foresters. Therefore, a study was carried out in the Ziarat forests to provide reliable information on the extent of decay in juniper and its major causes.

Review of literature. *P. demidoffii* (= *Fomes demidoffii*), a decay fungus, has been reported by various workers (Hussain, 1951; Khattak, 1963; Quraishi and Mehmood, 1971; Ahmad, 1972; Beg and Jamal. 1974) as occurring on junipers of Baluchistan.

Material and method. The Ziarat juniper forest area was divided into 15 localities. 8 localities were selected at random and in each locality 2 concentric plots were laid out, one on northern and one on southern aspect in relatively stocked areas. The study areas ranged in elevation from 2000 to 2700 metres.

Each plot consisted of concentric circles .02, .04, and .08 ha in size. All living trees 9.1 cm larger in diameter at breast height were cut on .02 ha plots; and trees 14.2 cm and larger were cut on .04 ha plots; and trees 29.5 cm and larger on .08 ha plots. Data collected from all the sample trees were combined after blowing up the data of smaller plots to .08 ha size.

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General information about location, topography, aspect, age and stand history were recorded in respect of each plot. The trees meeting specifications for the plot were tallied and numbered. The d.b.h., crown class and tree conditions were noted. Dead trees were recorded but not included in the study.

The marked trees were felled at an average height of .30 m from the ground level. The main stem and merchantable branches were cut into 4.9 m logs. Total height was recorded. The nature, extent and location of all surface defects were noted. Each log was further cut into 1.2 m bolts upto .10 m top diameter (inside bark). Defects previously noted were examined and if decay was associated with them, this was recorded on the tally sheet. Where decay appeared, its extent and dimensions were determined by splitting the bolts longitudinally.

The diameter inside bark at 4.9 m intervals from stump height to .10 m merchantable top was recorded. Top and bottom diameters and lengths of merchantable limbs were noted. Lengths of decay columns were measured in both directions from the maximum diameter and were recorded to the nearest .15 m. Cubic metre volume of logs and decay columns was computed by Smalian's formula.

Cultures were prepared from decay samples as soon as possible to determine the fungi responsible for decay. The samples were split, and from the freshly exposed faces of the infected wood six small bits of wood were extracted with a sterilized scalpel and placed in test tubes containing 2% malt extract agar. If the decay organism was not isolated on the first attempt, additional re-isolations were made from the decay samples. The isolates were grown into pure cultures. The cultures were determined by comparing them with the standard cultures maintained in the laboratory.

Results. Out of 16 plots studied, trees in all the plots had decay in them (100%). Of the 137 study trees 114 (83.2%) were found attacked by decay-causing fungi. The total volumes of the study trees and the decay volumes were determined. Relationship of decay losses to infection courts, aspect and diameter of the tree were studied.

The decay fungi. 3 species of fungi: *P. demidoffii* and a species each of *Poria* and *Stereum* were found in association with decay in the juniper trees. *P. demidoffii* alone was responsible for more than 96% of the total decay volume as follows:

Fungus species	Volume of decay	
	m^3	%
Pyrofomes demidoffii (Lev.) Kotl. and Pous.	13.77	96.3
Poria sp.	0.18	1.2
Stereum sp.	0.11	0.8
Unknown and undetermined	0.24	1.7
Total:	14.30	100.0

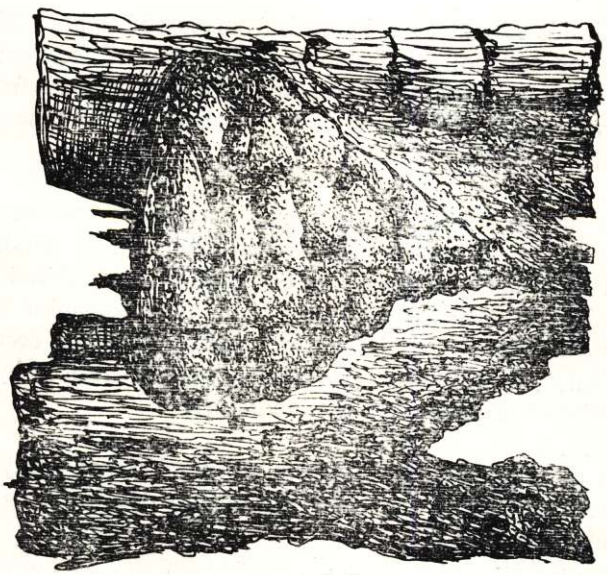

Fig. 1 Sporophore of *Pyrofomes demidoffli* on *Juniperus excelsa.*

Fig. 2 Radial view of Juniper stem showing decay due to *Pyrofomes demidoffi i*

Many of the decay columns yielded bacteria and non-decay fungi while others remained sterile. The close association of bacteria and non-hymenomycetous fungi suggests that all these organisms are important in the decay process (Shigo, 1967).

Indicators of decay. The fungi associated with decay in juniper rarely produce sporophores on living trees (Fig. 1), making it often impossible to determine the causal fungi from the type of decay alone. Therefore, to identify the decay fungi, it was necessary to obtain their pure isolates and compare the unidentified ones with sporophore cultures.

Type of rot. *P. demidoffii*, the juniper Fomes, causes pocket rot of the heart wood of living junipers (Fig. 2). The incipient decay is first visible as a light yellowish discolouration which later on becomes more pronounced. The affected wood becomes whitish and soft. The advance stage is characterized by large hollow vertical pockets lined with yellowish-white fibres. The pockets are commonly placed one above the other, and, when they join, long tubes result (Boyce, 1961).

The species of *Poria* and *Stereum* were literally of no importance as decaying agents of juniper trees casuing white spongy butt and root rot and dark brown discolouration of heart wood, respectively.

Entry courts and decay. Fungi that caused decay in the standing juniper trees penetrated the host mostly through branch stubs (84%) and roots (10.5%). The relationship between decay and infection courts is presented below:

Infection courts	Infections		Volume of decay	
	No.	%	m^3	%
Dead branch stubs	140	52.2	9.11	63.7
Open branch stub scars	85	31.7	3.14	22.0
Roots	28	10.5	1.03	7.2
Unknown	15	5.6	1.02	7.1

Diameter and decay. Generally the decay volume increased with increasing diameter from not measureable in the smallest diameter class (18-23 cm) to over 51% in trees 63 to 68 cm in diameter as follows:

Diameter class	Number of trees	Number of trees with decay		Gross volume	Gross decay volume	Decay
cm		No.	%	m^3	m^3	%
18—23	6	3	50.0	0.40	N.M.*	—
23—28	9	6	66.7	1.09	0.22	20.2
28—33	32	24	75.0	4.92	1.13	22.9
33—38	28	24	85.7	6.29	1.60	25.4
38—43	20	18	90.0	6.35	1.82	28.6
43—48	10	9	90.0	4.00	1.34	33.5
48—53	17	16	94.1	7.96	2.50	31.4
53—58	6	6	100.0	4.44	1.42	34.2
58—63	6	5	83.3	5.15	2.07	40.1
63—68	3	3	100.0	4.29	2.20	51.2

*Not measureable (where decay measures less than .15 m from maximum column to any direction).

Aspect and decay. Incidence of decay and decay volume were higher in trees growing on southern aspects (35.9%) than in trees on the northern (28.3%) as follows:

Aspect	Number of trees	Number of trees with decay		Gross volume	Gross decay volume	Decay
		No.	%	m^3	m^3	%
Northern	69	54	78.3	23.75	6.72	28.3
Southern	68	60	88.2	21.14	7.58	35.9
Total:	137	114	..	44.89	14.30	..
Average:	..	..	83.2	..	..	31.9

Discussion and conclusions. The study shows 83.2 percent incidence of decay among all the study trees. The extent of decay volume as 31.9 percent of the total volume of the sample trees indicates that the decay is serious in the junipers of Baluchistan.

The decay volume generally increases with the diameter of the tree, losses becoming significantly higher in trees with more than 23 cm d.b.h., corresponding to the age of about 200 years (Khattak, 1963).

Among the decay fungi, *P. demidoffii* was found to be the most common and destructive causing as much as over 96 percent of the total volume loss in the juniper forests.

Southern aspects appeared to favour the incidence of decay.

Branch stubs and roots were the major infection courts for the decay pathogens.

Reducing losses from decay. No direct control of heart rots is known. However, the losses can be reduced to a great extent by keeping the following points in mind based on the study:

(1) Injuries on the surface of the host such as branch stubs should be kept at the minimum possible level since they serve as entry points for a large number of decay fungi.

(2) Generally, decay volume increased progressively with increasing diameter. The decay losses in trees with less than 18-23 cm d.b.h. (170 to 200 years) were relatively minor. Therefore, a rotation of not more than 200 years is suggested for the juniper forests of Baluchistan.

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