

31.3.80

BEHAVIOUR OF IPS GRANDICOLLIS (EICHHOFF) (COLEOPTERA:SCOLYTIDAE)

by

Jayanthi P. Witanachchi B.Sc. (Hons.) (Ceylon)

A thesis submitted for the degree of
Doctor of Philosophy in the Faculty of Agricultural Science
at the University of Adelaide

Department of Entomology
Waite Agricultural Research Institute
University of Adelaide

84907

February 1980

SUMMARY

Ips grandicollis (Eichhoff) is an inhabitant of the subcortical tissues of coniferous trees, mainly Pinus species. It has been classed as a pest of secondary importance, with the potential to become a primary pest under outbreak situations, both in its native habitat in North America and in South and Western Australia (where it became established in about 1943).

Investigations carried out during this study have been restricted to its major host species in Australia; Pinus radiata D. Don. Factors which contribute to resistance of individual trees to attack by I. grandicollis were investigated. The defense mechanism usually involves the flow of resin from reservoirs and ducts damaged by beetles during initial boring. Failure to encounter any of these resin barriers, cessation of boring and retreat was associated with secondary resin produced by the damaged phloem cells. The absence of such defence mechanisms in declining trees, resulted in continued boring.

During Dispersal, I. grandicollis was found to land randomly on trees within a pine stand, the actual selection being made after boring into the bark of the tree.

Dispersing adult I. grandicollis, either caught on pheromone-baited traps in the field or collected in the laboratory during emergence from field infested logs, included a high percentage of mated females. Mating occurred only within galleries in the bark. Some of the progeny adults, including siblings, mated before emergence and later produced offspring. The number of females

thus mated depended upon the time spent within the bark by mature adults before emergence from the host in which they developed. Virgin and mated females initiate galleries even in the presence of male-initiated galleries. Moreover, males join both virgin and mated females which have produced galleries. Similarly, both virgin and mated females were accepted into nuptial chambers by males.

A technique using GC/MS was developed to determine the concentration of ipsenol in extracts of whole beetles. Production of ipsenol in males began about 9 to 12 hr after boring into suitable host material and this tended to coincide with the appearance of faecal pellets in the frass. Adult males which rejected bore-sites in 'resistant' trees had not produced ipsenol. These data indicate that males do not feed and hence do not produce any ipsenol until the decision to continue boring has been made. This evidence supports the generally accepted concepts of ipsenol production and its dependence on feeding by the male, but it provides a more critical basis for the development of secondary attraction of I. grandicollis than has so far been presented.

TABLE OF CONTENTS

SUMMARY	(v)
DECLARATION	(vii)
ACKNOWLEDGEMENTS	(viii)
SECTION 1 INTRODUCTION	1
1.1 <u>Ips</u> species as worldwide pests of conifers	1
1.2 Status of <u>Ips grandicollis</u> as a pest	4
1.3 Biology and behaviour of <u>I. grandicollis</u>	8
1.3.1 Classification	8
1.3.2 Past work	9
1.3.3 Behaviour	11
1.3.4 Life cycle	14
1.3.5 Biology	16
1.3.6 Factors contributing to mortality	17
1.3.7 Associates of <u>I. grandicollis</u>	18
1.4 Scope of study	20
SECTION 2 PROCESS OF HOST SELECTION IN <u>IPS GRANDICOLLIS</u>	21
2.1 Introduction	21
2.2 Theories	22
2.3 Methods and materials	24
2.4 Results	25
2.5 Discussion and conclusion	27

4.3 Discussion and conclusion	55
SECTION 5 RESPONSE OF <u>I. GRANDICOLLIS</u> MALES TO GALLERIES INITIATED BY FEMALES	59
5.1 Introduction	59
5.2 Methods and materials	61
5.3 Results	63
5.4 Conclusions and discussion	66
SECTION 6 STUDIES ON THE AGGREGATION PHEROMONE, IPSENOL OF <u>I. GRANDICOLLIS</u>	68
6.1 Determination of the amount of ipsenol present in extracts of unmated and mated male beetles fed for 48 hr	68
6.1.1 Introduction	68
6.1.2 Materials and methods	69
6.1.3 Instrumentation	70
6.1.4 Results	71
6.1.5 Discussion and conclusion	71
6.2 Determination of the minimum period required by boring adult <u>I. grandicollis</u> males to produce ipsenol	73
6.2.1 Introduction	73
6.2.2 Methods and materials	74
6.2.3 Results	74
6.2.4 Discussion and conclusion	75
6.3 Analysis of gut extracts of male <u>I. grandicollis</u> (a) that rejected 'resistant' trees, and (b) obtained from the dispersing natural population	78
6.3.1 Introduction	78
6.3.2 Materials and methods	78

6.3.3 Results	79
6.3.4 Discussion and conclusion	79
SECTION 7 GENERAL DISCUSSION	81
APPENDICES	87
BIBLIOGRAPHY	95