the isolate studied was frequent alternation of thick and thin cells, or groups of cells, in a single filament. This was also found in a few isolates of *F. roseum*.

The similarities found in pigments, mycelial dimensions, branching and spores, as well as the well-known tendency of *Fusarium* to mutate in culture, suggest the following conclusion: isolate 1142, and probably also the type of *Rhizoctonia lilacina* which was not available, might be considered as unusual variants of a species of *Fusarium*, probably *F. roseum*. Such variants have reduced tendency to form conidia and an increased tendency to form chlamydospores. As this variant lacks some characteristics used for species identification within *Fusarium*, an exact determination is not possible.—**O. Vaartaja.**

PRAIRIE PROVINCES

Two Species of Gall-producing Saperda in Manitoba and Saskatchewan.—In an early monograph of the genus *Saperda* Felt and Joutel (Bull. New York Mus. 74. 1904) reported that *S. concolor* LeConte produces galls on poplars and willows, and that *S. moesta* LeConte, which they considered to be a subspecies of *S. populnea,* produces galls on balsam poplar. Craighead provided essentially the same information (U.S. Dept. Agric. Misc. Pub. 657. 1950). In more recent references Graham *et al.* (Aspens. Univ. of Mich. Press. 1963) report that both *S. concolor* and *S. moesta* produce galls on poplars, while MacAloney and Ewan (U.S. For. Service Res. Paper LS-11. 1964) report them on aspens and willows.

Identifications by the Entomology Research Institute, Ottawa, of *Saperda* spp. reared from galls of poplars and willows in Manitoba and Saskatchewan by the Forest Insect Survey reveal that *S. concolor* and *S. populnea moesta* are apparently host-specific in this region and that they form distinctive galls. The galls of *concolor* were collected mainly from various species of willow and only rarely from reproduction trembling aspen. With the exception of a single collection on trembling aspen the galls of *S. populnea moesta* were observed only on balsam poplar and never on willow. The female of the former species selects for oviposition, a stem that is 3 or more years old and makes one to nine U-shaped egg scars around it. The resulting gall is about 2½ inches long and 1¼ inches wide with a fluted appearance; longitudinal depressed areas between ridges of normal growth result from the death of cambium in the vicinity of the oviposition scars. *S. populnea moesta* restricts its attack to stems less than 3 years old and makes only a single U-shaped oviposition scar. The resulting gall is ovoid in shape, relatively smooth in appearance, about 1¼ inches long and ¾ inches wide, and is slightly flattened on the side where the scar has killed the cambium.

Both species apparently prefer small trees or shrubs growing in the open or along the fringe of forest stands, and their attacks usually cause the portion of the shoot above the gall to die and become susceptible to wind breakage.

These observations were made in the course of a current investigation of insect-produced galls on forest trees and shrubs in this Region.—H. R. Wong and B. B. McLeod.

ROCKY MOUNTAIN REGION

Photosynthetic Capacity of Mined Needles.—The larvae of the lodgepole needle miner, *Recurvaria starki* Free. feed upon the mesophyl of the needles of lodgepole pine, *Pinus contorta* var. *latifolia* Engelm. leaving the epidermal layers intact (Can. Entomol. 86: 1-19. 1954). In the early stages of the life cycle only the distal part of the needle is mined but the effect on the photosynthetic capacity of the non-attacked basal part of the needle was unknown. To test this effect the rate of oxygen evolved during photosynthesis from needles with different degrees of mining were compared with non-attacked whole and cut needles in an illuminated Warburg respirometer.

Twenty-five needles were selected at random from 1- and 2-year old sun foliage, and placed in 1 ml. of water in a reaction flask and illuminated with 2100 ft-c. of incandescent light. A constant CO_2 partial pressure of 0.03% was maintained by placing a carbonate-bicarbonate buffer solution in the centre well of a reaction flask with a filter paper wick. All tests were made at 25°C. Readings were begun after a 20 min. equilibration period and continued every 13 min. for 130 min. A thermobarometer containing the water but no needles was used to compensate for any change in temperature or pressure which took place during each test.

Photosynthetic rates were expressed as volume of oxygen evolved per millilitre of green tissue per hour. The volume of tissue in each flask was determined after the photosynthesis study by volume displacement following a technique similar to that of Clark 1961 (Tech. Publ. 85, State Univ. College of Forestry, Syracuse Univ.), except that ethyl alcohol was used instead of water to reduce the formation of air bubbles. The mined portion of the needle was cut off before the volume measurements so that only green tissue remained.

Three series of tests were made: in the first the twelve flasks were divided equally between whole green needles and 50% mined needles, in the second between whole green needles and 25% mined needles, and in the third between whole green needles and 50% mined needles and 50% cut needles. The results of each series and its replicate are given below.

	ul O_2/ml green tissue/hr.			
	Whole Green Needles	50% Mined Needles	50% Cut Needles	25% Mined Needles
June 11	38.33	42.38		
June 16	17.15	13.52		
June 17	31.90			32.17
July 9	14.57			19.28
July 10	18.33	21.95	21.35	
Aug. 5	28.97	22.32	28.42	

Large differences were found between runs but t-tests within run indicated no significant difference between O_2 evolved per volume of green tissue in mined, cut, or whole needles. Thus on the basis of this limited test it was concluded that differences in photosynthetic rates between mined and non-mined needles were in proportion to the tissue removed.—P. I. Van Eck and R. F. Shepherd.

BRITISH COLUMBIA

A Preliminary Study of Mycangia in the Bark Beetles, Dendroctonus ponderosae Hopk., Dendroctronus obesus Mann., and Dendroctonus pseudotsugae Hopk.—Recently it has been shown that many scolytid ambrosia beetles possess specialized structures or mycangia in which spores of their symbiotic fungi are transported from one host to another. For many years investigators have recognized a close association between blue-staining fungi and bark beetles and Francke-Grosmann (Z. ang. Entomol. 52: 355-361. 1963) has described mycangia in the bark beetle *Ips acuminatus* Gyll. containing spores of a blue-staining fungus associated with this insect.

Bark beetles of the genus *Dendroctonus* in logs or trees are often associated with blue-staining fungi and preliminary studies were carried out to determine whether three native species, *Dendroctonus ponderosae* Hopk. (the mountain pine beetle), *Dendroctonus obesus* Mann. (the spruce beetle), and *Dendroctonus pseudotsugae* Hopk. (the Douglas-fir beetle) possess mycangia or specialized structures in which blue-staining fungi are carried.

All beetles examined were excavated from their host and kill-fixed in alcoholic Bouin's solution, dehydrated in tertiary butyl alcohol, wax embedded, sectioned, and stained with a modified Gram-Weigert stain. This stain shows a clear differentiation between fungus material and insect tissue (Fernando, Ann. Mag. Nat. Hist. Ser. 13(2), 475-480. 1960; Farris, Can. Entomol. 95: 257-259. 1963).

In *D. ponderosae,* structures were found in the pregular region of the head which seemed to be associated with the oesophagus and contained material, assumed from its staining reaction to be fungus. Of 21 specimens examined, 12 females and four males had fungoid material in this location, but these structures in the other five females were empty.

Similar structures were not found in either sex of *D. obesus*. However, stained sections of this species showed fungoid material in the hollow interior of apodemes associated with coxal cavities of both sexes. Of 36 specimens examined (18 ♀ and 18 ♂) only one male had fungoid material, whereas eight females had deposits of the material in one or more of these structures. In addition, six specimens had similar fungoid material in the integumental folds associated with the scutellum. Most of the *D. obesus* specimens were teneral adults, which might not be expected to have as much fungus as older beetles; the mycangia in the late pupae and teneral adults of some ambrosia beetles are void of fungus.

All specimens of *D. pseudotsugae* examined were teneral adults and of 25 individuals studied, only one female had fungoid material in the apodemes associated with the forecoxal and metacoxal cavities. The same specimen also had similar material in the integumental folds of the scutellum. No other deposits or concentrations of fungoid material were found.

Further studies are being made of the occurrence of fungi in these species of *Dendroctonus,* and older beetles are

being used to avoid the uncertainties associated with teneral adults. If blue-staining fungi are related symbiotically with beetles of this genus, the constant occurrence of fungi in individuals ready to fly may be expected.—S. H. Farris.

Severe Mineral Deficiencies in Douglas-fir Seedlings in a Newly Developed Forest Nursery.—Phosphorus deficiency symptoms appeared during August 1964 in 1 - 0 Douglas-fir seedlings growing in a new forest nursery, formerly farmland, at Duncan, B.C. The symptom severity varied in different parts of the nursery from only slight needle discoloration, to severe discoloration with stunting, to complete necrosis. However, throughout the whole area there were isolated patches of up to 30 seedlings with no deficiency symptoms.

Soil and foliage analyses made in November on samples from each symptom class (by J. T. Gillingham, Department of Agriculture, Experimental Farm, Saanichton, B.C.) showed low P and K values in several instances (Table 1). Average soil pH was 5.7.

TABLE I

Nitrogen, phosphorus, and potassium contents of soil and foliage samples from Douglas-fir nursery beds in relation to mineral deficiency symptoms

Symptom Class	Nitrogen	Phosphorus		Potassium	
	Needles[a]	Needles[b]	Soil[c]	Needles[b]	Soil[c]
Thrifty, slight discoloration	2.03	0.09	6.2	0.83	44.2
Stunted without discoloration	2.80	0.08	4.2	0.55	48.5
Stunted with discoloration	2.41	0.03	5.7	0.50	44.2
Dead	1.65	0.03	5.0	0.30	34.0
Isolated patches of thrifty	2.20	0.10	7.0	0.75	34.0
Adjacent patches of stunted seedlings	2.52	0.05	6.5	0.44	45.0

[a]% expressed on moisture free basis.
[b]% moisture free basis. Phosphorus determined by method of Smith, G. R. et al. Can. J. Research 17, 178–191, 1939. Potassium determined with an oxy-hydrogen flame using a Beckman Model B flame photometer.
[c]parts per million.

The following April, 285 lbs/acre of ammonium phosphate were applied to the area, followed by a further 240 lbs. in June. Also, 120 lbs./acre of potassium sulphate were added in June and again in July. By the middle of August, the deficiency symptoms had disappeared and growth was comparable to that in the older nurseries.

P and K deficiencies have not occurred in the older part of the nursery at Duncan, therefore one would suspect that some factor or factors connected with the previous or present treatment of the area had a bearing on the situation. For instance, there was an almost complete lack of deficiency symptoms from an area formerly producing potatoes in contrast to the widespread symptoms in areas previously under grass or grain crops. Secondly, the size and distribution of small patches of thrifty seedlings, surrounded by large areas of stunted stock, strongly suggested "Juno" spots, caused by cattle droppings in pastures. Thirdly, the continuous removal of heavy weed growth (mainly clover and equisetum) during the first summer of nursery operations is suspected to have contributed to depletion. It is necessary to point out that the author has never seen such abundant weed growth in nursery beds, and that approximately 25 weeders, fully employed during the entire growing season were unable to keep pace with the growth. Whole plants of equisetum had, on analysis, 0.16% P and 1.72% K (moisture-free basis) thus greatly exceeding the content of Douglas-fir seedlings and presumably representing a substantial drain from the soil.

Vancouver Island soils are known to be low in phosphorus (Gillingham, J. T., Soil Sci. *In press*) so that a logical interpretation of the evidence would include a low initial P and K level in the soil of the area in question, aggravated by depletion to the point of causing deficiency. Variations in P and K content of soil and tissues apparently related to previous land management, tend to support rather than refute this.—W. J. Bloomberg.

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