Bark occurrence in U.S. and Canadian wooden pallets

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Abstract

International Standards for Phytosanitary Measures Publication No. 15 (ISPM 15) describes phytosanitary measures to reduce the risk of introduction and/or spread of quarantine pests associated with wood packing materials, including pallets, containers, and dunnage. In 2002, the International Commission on Phytosanitary Measures (ICPM) published ISPM 15, and implementation of the standard began to go into force around the world. However, in October 2004, the European Commission issued Directive 2004/102/EC that, among other things, introduced the concept of requiring wood packaging materials to be "debarked." In order to establish an empirical baseline of potential impact of this requirement on North American pallet production, 10 pallet production facilities and three exporting customer facilities were visited in three geographic regions. Based on an inspection of 5,584 pallets in this study, about one in five exhibited at least one occurrence of bark or a bark-like defect, even though 88 percent of the pallets examined were produced from raw material that had been debarked prior to pallet manufacture. Additionally, the study suggests that an appropriate set of inspection criteria and procedures for bark-free wood pallets and crates will be extremely difficult to implement and verify over time in different cultural settings.

The International Plant Protection Convention (IPPC) is an international treaty relating to plant health, administered by the Food and Agriculture Organization (FAO). FAO established the Interim Commission on Phytosanitary Measures (ICPM) as an interim measure until the New Revised Text of the IPPC comes into force. ICPM published International Standards for Phytosanitary Measures Publication No. 15 (ISPM 15) *Guidelines for Regulating Wood Packaging Material in International Trade*[1] in March 2002. ISPM 15 describes phytosanitary measures to reduce the risk of introduction and/or spread of quarantine pests associated with wood packaging materials, including pallets, containers, and dunnage.

After its publication, implementation of ISPM 15 began to go into force, as approved in its 2002 form. However, in October 2004, the European Commission (EC) issued Directive 2004/102/EC,[2] which put additional restrictions on wood packaging materials related to the raw material composition, specifically, that wood packaging materials be debarked, bark-free, or free of sign of pests in other forms that might be indicated by the physical appearance of the wood itself. Specifically, wood packaging material was required to be "made from debarked round wood" in addition to the requirements of ISPM 15, and "the letters 'DB' shall be added" to the required IPPC mark. The terminology used to describe the concept of debarked wood is varied throughout Directive 2004/102/EC and its predecessor Directive 2000/29/EC, somewhat obscuring the true intent of the EC. After a postponement of the directive until January 2009, the latest overview docu-

[1] Interim Commission on Phytosanitary Measures (ICPM). 2002. International Standards for Phytosanitary Measures Publication No. 15: Guidelines for regulating wood for packaging material in international trade. Secretariat of the International Plant Protection Convention, Food and Agriculture Organization of the United Nations, Rome, IT. 15 pp.

[2] European Union (EU). 2004. Commission directive 2004/102/EC. Official Journal of the European Union. http://europa.eu.int/comm/food/plant/organisms/imports/special_en.htm.

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Table 1. — Data description of pallets included in the study.

	U.S. - East Coast	Canada - Ontario	U.S. - West Coast	Total	Entire sample (%)
Pallet producer locations	4	4	2	10	
Pallet customer locations	0	0	3	3	
Total pallets inspected	2055	1764	1765	5584	
Production pallets inspected	1748	460	671	2879	51.6
Stacked pallets inspected	307	1304	1094	2705	48.4
Hardwood pallets inspected	2055	849	145	3049	54.6
Softwood pallets inspected	0	915	1620	2535	45.4
Heat-treated pallets inspected	1045	1175	1530	3750	67.2
Non-HT pallets inspected	1010	589	235	1834	32.8
Pallets from non-debarked raw material	397	280	0	677	12.1
Pallets from debarked raw material	1658	1484	1765	4907	88.1

ment[3] provided by the EC states simply that "From January 2009, all wood packaging material imported into the EU will have to be debarked."

Of particular concern to the wood packaging industry is the lack of a clear definition of the bark requirement actually targeted by the EC directive. Also, various industries and governmental agencies around the world have interest in determining the impact this directive might have on the wood packaging industry, its customers, and consumers worldwide. In order to establish an empirical baseline of potential impact on North American pallet production, this study sought to establish how many wood pallets as currently manufactured might fall under the evolving definitions of the EC directive, and whether there are differential potential impacts according to geographic region, wood species, or size of pallet producer.

Methodology

Numerous interviews were conducted with people familiar with the workings of both the international phytosanitary standards and the global logistics community. In order to ascertain the potential impact of a bark-free standard, in terms of number of pallets that might be impacted by a "debarking" or "bark-free" requirement, numerous sawmills, pallet producers, and their customers were visited. During these visits, pallet production methods, storage procedures, and shipping standards were reviewed with operational personnel. Cost components of these processes were discussed, and the issue of bark-free production was explored. Customers were queried as to their knowledge of this issue, and their reactions to each of several possible outcomes were noted.

Production facilities were visited in three geographic regions to determine whether regional differences in pallet bark populations could be detected. At 10 of the pallet production facilities and three of the customer facilities, data were collected on the number of pallets with bark or barky-type defects relative to bark-free pallets. **Table 1** defines the data set collected.

Data collection

For each pallet inspected, a decision was made whether the pallet had at least one occurrence of bark or barky defect, was free of bark and barky defects, or had something too difficult to call. The intent was to simulate, as closely as possible, the decision process a typical port inspector would have. At issue, then, was the determination of what level or dimension of bark defect would be allowed to pass inspection.

Data collection, in terms of the inspection data from the pallets, was at first begun with an assumption, based on hearsay, that "credit card" size or smaller bark would be considered a bark-free wood pallet. At the first location, however, the lack of specificity was obvious; most bark, or barky defects on pallets, does not come in incremental blocks that can be compared in size to a credit card. Bark occurrences on the wane portion of lumber, for example, typically has a narrow, triangular shape that abruptly ends where a debarker was effective in removing the bark (**Fig. 1**). Bark pockets normally appear as long, narrow defects in pallet stringers (**Fig. 2**) or deckboards (**Fig. 3**). Other "barky defects" that could be identified as potential pest harbors are commonly found in pallet blocks (**Fig. 4**), deckboards (**Fig. 5**), and stringers (**Fig. 6**) and are the result of several types of unsound defects commonly found in pallet cants.[4]

Other grading issues also were revealed in the process of inspecting the study pallets for bark. Bark often occurs as long (4 to 24 inches), very slim (less than 1/4 inches wide) slivers clinging onto a wane surface, but these types of bark occurrences do not seem to pose credible phytosanitary risks, especially when exposed to necessary condition of heat or chemical treatment in production. Often, dark, suspicious looking areas are hidden on the underside of deckboards, or at the back side of a stringer component where the inspector cannot confirm whether it is bark, or not. To add to the potential visual confusion, debarked clear wane on most woody species begins to darken up shortly after manufacturing, causing the wane to appear to still have a bark covering.

Furthermore, the proximity of the inspector to the pallet and visual perspective of the surface being inspected induce a source of variability and potential inspection error to the problem. In port inspection situations, pallets are loaded, so deck board surfaces are hidden from the inspector; they are also stacked, so visual examination of pallets is often impaired by

[3] European Union (EU). 2006. An overview of EU rules on wood packaging material. http://europa.eu.int/comm/food/plant/organisms/imports/overview_eu_rules.pdf

[4] Araman, P.A., M.F. Winn, M.F. Kabir, X.Torcheux, and G. Loizeaud. 2003. Unsound defect volume in hardwood pallet cants. Forest Prod. J. 53(2):45-49.

Figure 1. — Wane on board with bark occurrence not removed by debarker.

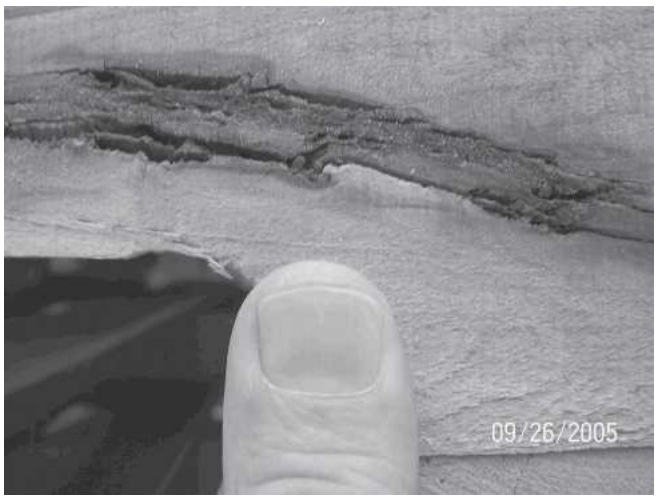

Figure 2. — Bark pocket in pallet stringer.

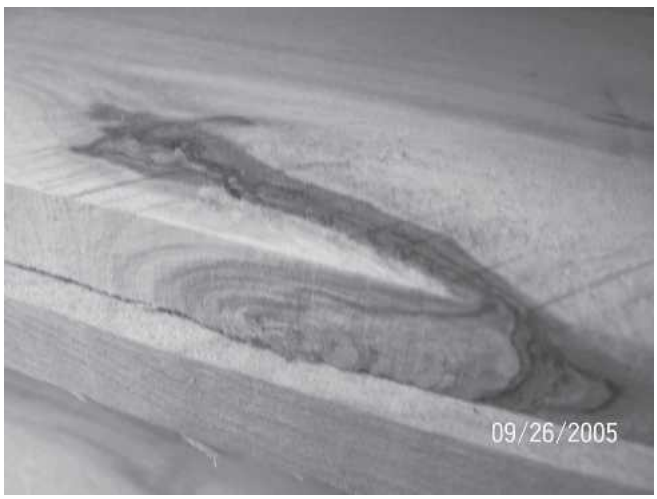

Figure 3. — Bark pocket in pallet deckboard.

Figure 4. — Barky hole in pallet block.

Figure 5. — Barky hole in pallet deckboard.

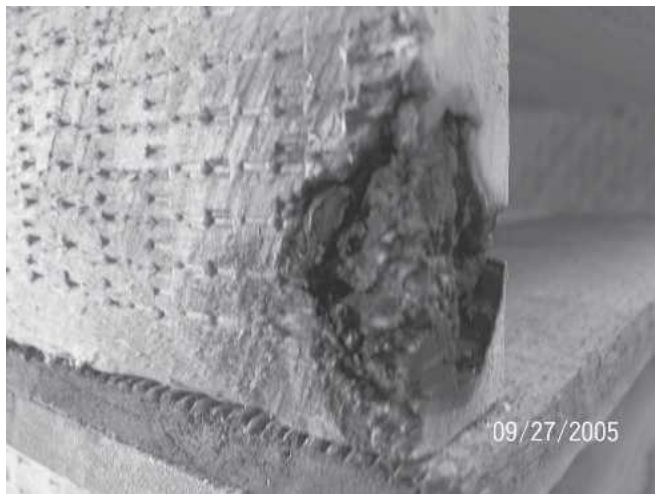

Figure 6. — Remnant loose knot on end of pallet stringer.

its height above (or at the feet of) the inspector, or its depth within a bay of pallets.

For these reasons, two distinct types of pallet bark counts were collected. The first type was visual tally of bark defects as the pallets were stacked in inventory, allowing the inspector to effectively see less of the pallet as its height in the stack increased. For the purposes of this exploratory study, this type of inspection simulated a port inspection process and results. The second type of pallet bark inspection was conducted on

pallets in production, where the inspector could usually see both sides of pallet components as they were being assembled. In automated pallet assembly operations, the average inspection time per pallet was 8 to 9 seconds. In hand assembly operations (all custom pallet operations in this study), the average inspection time was about 1 minute per pallet.

The following general decision rules were applied. If an observed barky defect was less than 1/4 inches at its narrowest dimension, it was not counted as a bark occurrence, regardless of its length. If the bark occurrence was between 1/4 inches and 1 inch at it narrowest, but its widest dimension was less than 3 inches, it was not counted as a bark occurrence. If its narrowest dimension was greater than 1 inch, it was counted as a bark occurrence regardless of the size of its widest dimension. These rules were developed to differentiate between insignificant bark remnants, and bark occurrences that realistically might provide a pathway for reinfestation of the wood, given conditions of exposure to the pest after treatment. See **Table 2** for a summary of these rules.

These criteria were applied through visual, non-measured estimation only, to allow for data collection in both production environments where the pallets were being automatically conveyed, and from stacks that, because of their location and height would not allow physical measurements. This methodology also roughly simulates the inspection conditions of a typical port inspection. The principal author of this paper served as inspector for all 5584 pallets in the study, to ensure consistency of the data collection under the stated inspection criteria. At each location, however, an operational supervisor or other representative of the company was asked to accompany the inspector for at least a portion of the data collection, in order to illustrate the process of the data collection and to affirm the process under the auspices of many different individuals.

Ultimately, each pallet was tallied as one of three conditions: bark, bark-free, or no-call. Pallets tallied as "bark" had at least one confirmable barky defect of the size described above. "Confirmed" defects were those that were, in the mind of the inspector through visual or physical confirmation, definitely an occurrence of bark or barky defect. That is, a bark occurrence could be confirmed in this study, even at 15 feet in the air, if the inspector could clearly see and identify it as such. Pallets tallied as "bark-free" have no apparent bark or barky defect on the pallet. A final category, "no-call" was necessitated by "possible bark sightings" that passed by the inspector too quickly in production for confirmation, or appeared out-of-reach for closer inspection, but could not in good conscience be counted as "bark-free".

Table 2. — Decision rules for determination of bark occurrence in this study.

Small dimension	Large dimension	Bark?
(in)		
< 1/4	Any	No
1/4 < by < 1	< 3	No
1/4 < by < 1	> 3	Yes
> 1	Any	Yes

Results and discussion

Table 3 summarizes the data by each of the three geographic regions included in the study. Overall, 19.4 percent of the pallets inspected in all three regions were found to have at least one occurrence of bark; the percentages for each of the three regions were consistent with the overall average (17.7, 18.4, and 22.3 percent, respectively). These figures show a perhaps surprising consistency in bark occurrence between these regions, considering the different pallet types, production systems, and raw material species contained within the study. In fact, almost every way the data are broken out, roughly 1 out of 5 pallets was found to have at least one bark occurrence.

Table 4 also bears out this consistency under further dis-

Table 3. — Summaries of bark occurrences by region.

	Bark		Bark-Free		No-call		Total
Region	(No.)	(%)	(No.)	(%)	(No.)	(%)	(No.)
U.S. - East Coast	364	17.7	1311	63.8	380	18.5	2055
Canada - Ontario	324	18.4	1263	71.6	177	10.0	1764
U.S. - West Coast	393	22.3	1203	68.2	169	9.6	1765
Total	1081	19.4	3777	67.6	726	13.0	5584

Table 4. — Summaries of bark occurrences by pallet category.

	Bark		Bark-Free		No-call		Total
Category	(No.)	(%)	(No.)	(%)	(No.)	(%)	(No.)
All pallets	1081	19.4	3777	67.6	726	13.0	5584
Stacked pallets	532	19.7	1961	72.5	212	7.8	2705
Production pallets	549	19.1	1816	63.1	514	17.9	2879
Hardwood pallets	490	16.1	2090	68.5	469	15.4	3049
Softwood pallets	591	23.3	1687	66.5	257	10.1	2535
Treated pallets	724	19.3	2551	68.0	475	12.7	3750
Non-treated pallets	357	19.5	1226	66.8	251	13.7	1834
Non-debarked raw material	233	34.4	309	45.6	135	19.9	677
Debarked raw material	848	17.3	3468	70.7	591	12.0	4907

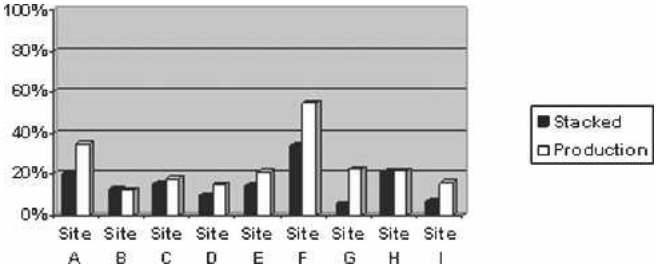

Figure 7. — Bark occurrence rates in like pallet samples, stacked vs. production.

section of the data. Comparing pallets that were inspected under stacked vs. production conditions resulted in 19.7 percent and 19.1 percent bark occurrence, respectively. Hardwood and softwood pallets compared at 16.1 percent and 23.3 percent, respectively, still relatively close to the 19.4 percent average. The difference between treated and nontreated pallets is virtually nonexistent at 19.3 percent and 19.5 percent, respectively. The largest difference in bark occurrence was found between pallets that were manufactured from raw material debarked either through debarking or sawing to cant or pallet stock (17.3%), vs. those manufactured from boards sawn from non-debarked logs (34.4%). The rate of bark occurrence of these "non-debarked" pallets is the only rate that appears truly higher than the grand average 19.4 percent bark occurrence rate. These pallets represent 12 percent of the total pallets inspected, a number apparently in proportion to actual non-debarked pallet lumber production. It was noted in the course of data collection that these pallets were not targeted at export product customers.

The only comparison that might be misinterpreted from the above percentages is the stacked vs. production data. The numbers above show no apparent difference in bark occurrence between the two groups, which could be interpreted that inspection under port conditions would be an accurate measure of actual bark occurrence. However, a more accurate assessment of this possibility is reflected in **Figure 7**. Here, only those data that represent "like" batches of pallets are compared. For example, at Site A, a group of stacked pallets contained about 20 percent bark occurrence on inspection, while the group of production pallets tallied (of the same type and from the same order) revealed that over 35 percent actually contained a bark occurrence. This trend of higher observable bark occurrence in production pallets held true in all cases except in the like pallet batches at Site B and Site H, where the differences appeared to be negligible. From the entire paired dataset represented in **Figure 7**, the percentage of stacked pallets confirmed as "bark-free" was 74.7 percent for stacked pallets, vs. only 61.8 percent for the production pallets. This difference reflects a higher rate of confirmed bark occurrences in production pallets (19.9%) vs. their stacked equivalents (16.3%), and a higher rate of no-calls, or potential bark occurrences in production pallets (18.3%) vs. their stacked equivalents (9.0%). These preliminary results imply a significant alpha error rate, or error of missing a bark occurrence, on those pallets inspected while stacked, as in common port conditions.

Conclusions

For the entire data set of pallets inspected in this study, about one in five exhibited at least one occurrence of bark or a bark-like defect. An additional 13 percent had a suspect blemish on the wood that could not be confirmed in the course of the inspection routine. These results are enlightening in that some phytosanitary experts have assumed that using debarked round wood as a raw material for pallet stock necessarily results in bark-free pallets, or at least an overwhelming percentage of bark-free pallets. Based on the results reported here, this is not the case. As would be expected, only about one-half (45.6%) of the pallets produced from non-debarked raw material were inspected as bark-free; however, even with debarked wood as the raw material, only seven in 10 (70.7%) of the pallets produced were inspected as bark-free. Industry estimates are that pallets produced from non-debarked wood total 10 to 15 percent or less of all pallets manufactured in Canada and the United States; they were found at a 12 percent proportion in the relatively small sampling represented by this study.

The widespread practice of using low-grade wood as a value-added component in wood pallet production, the naturally occurring defect volume in pallet cants, the degree of incomplete efficacy of debarking round wood, and the multiplying effect of sawing bark and bark-like defects into pallet components, all contribute to ensuring that the natural variability of solid wood (in this case, as represented by bark and bark-like occurrences) exhibits itself in a significant number of manufactured wood pallets, if not systematically constrained. This will best be performed through sorting of pallet cants, lumber, components, or the pallets themselves, to segregate bark-free products and components from those that have bark occurrence. As shown by the results of this study, specification and certification of debarked round wood as the pallet raw material will not reliably produce "debarked" pallets.

Additionally, the study suggests that an appropriate set of inspection criteria and procedures for bark-free wood packaging will be extremely difficult to implement and verify over time in different cultural settings. Additional studies focused on multiple inspector efficacy and variation under differing sets of specified criteria, for different types of wood packaging, are needed to ascertain the expected effectiveness of any phytosanitary measure targeted at eliminating a naturally occurring feature of wood.